CURRENTS OF CHANGE

PAPERS PRESENTED AT THE FIRST LITHICS CONFERENCE

Saturday July 30, 2005
Riverside, the Farnsley-Moremen Landing
Louisville, Kentucky

Fall 2005
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Journal of the Falls of the Ohio Archaeological Society

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Cover: Example of Crab Orchard chert.
See article, this issue.

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Currents of Change is published biannually in the spring and fall by the Falls of the Ohio Archaeological Society (FOAS). The FOAS is dedicated to legally and ethically promoting the exchange of information on the prehistoric and historic heritage of the Falls region among professional archaeologists, students, avocational archaeologists, Native Americans, collectors, professionals in other disciplines (historians, teachers, etc.), and other members of the interested public.

The FOAS publishes articles and news briefs primarily, but not exclusively, about the archaeology of the Falls of the Ohio River region. The Falls Region is centered at Louisville, Kentucky and includes the area within a hundred-mile radius, encompassing north-central Kentucky and southern Indiana (see map on back cover). The subject matter of articles and news briefs may address either prehistoric or historic period subjects related to archaeology and the early history of this region. Articles or newsworthy items focusing on areas elsewhere in the Ohio River Valley may also be included.

Contributions by professionals, avocational archaeologists, students, and the interested public are welcomed. Authors wishing to submit papers for publication should contact the Editors at the FOAS website, www.falls-society.org, for details about the acceptable file submission and photo formats. Papers in proper file format on disc or CD may be mailed to Anne T. Bader at 12705 Razor Branch Court, Louisville, Kentucky 40299. All submissions should be accompanied by a brief biographical note (150 words or less) about the author(s).

Subscription is by membership to the FOAS. Dues for Full membership are $15.00 annually; dues for Family membership are $20.00 annually. Lifetime membership is $100.00. Student membership dues are $10.00. Membership includes a quarterly newsletter and any miscellaneous papers published. To join the FOAS, register on-line at www.falls-society.org or use the form on the back inside cover of this publication.

Back issues of *Currents of Change* may be purchased and downloaded from the FOAS website for $12.00 each.

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Anne T. Bader, RPA, is a professional archaeologist with 30 years of experience in the Falls area. Formerly an archaeologist with the Louisville District Corps of Engineers, Ms. Bader currently owns and manages a small cultural resources consulting firm, Corn Island Archaeology LLC.

Kathryn J. McGrath, RPA, has been involved with North American archaeology since 1990. This experience has included analysis in the Midwestern, Middle Atlantic, Caribbean, and Southeastern cultural areas. The Falls of the Ohio River area has been the focus of interest since her move to the area in 1999.

I have a good friend in the East, who comes to my shows and says, you sing a lot about the past, you can't live in the past, you know. I say to him, I can go outside and pick up a rock that's older than the oldest song you know, and bring it back in here and drop it on your foot. Now the past didn't go anywhere, did it? It's right here, right now.

-Utah Phillips

A rock pile ceases to be a rock pile the moment a single man contemplates it, bearing within him the image of a cathedral.

-Antoine de Saint-Exupery

...sometimes there just aren't enough rocks.

-Forrest Gump

On Saturday, July 30, 2005, the Falls of the Ohio Archaeological Society (FOAS) sponsored a conference that focused on the lithic resources of the greater Falls of the Ohio River area. The conference was held at the Farnsley-Moremen House (Riverside Landing) located in southwest Jefferson County, Kentucky. The day-long event was attended by nearly 80 professionals and avocationals from Kentucky, Indiana, Illinois, Ohio, New York, and West Virginia.

A series of technical research papers were presented on the subject of lithic raw materials available to prehistoric occupants of the region as well as implications to the manufacture and use of the artifacts made from them. Following the presentations, discussants Jack Holland of Holland Lithic Laboratory, Cheryl Munson of Indiana University, and Noel Justice of Glenn Black Laboratory provided commentary.

In addition to the papers, participants were invited to bring provenienced samples of chert types from the area for exchange to enhance personal and professional raw material type collections. Other activities included atlatl throwing and flintknapping. A tour of the historic house was available. Breakfast and lunch were provided.

While this was planned to be an annual event, the conference has not been repeated five years later. Feedback from the participants was encouraging, however, and a second conference is planned for the near future.

This volume presents the technical papers delivered at the conference, along with two contributed papers. Several presentations were not submitted for publication; abstracts are provided for those papers.

FIRST ANNUAL
FALLS OF THE OHIO LITHICS CONFERENCE

Sponsored by
The Falls of the Ohio Archaeological Society

Saturday July 30, 2005
Riverside, the Farnsley-Moremen Landing
Louisville, Kentucky

Presented Papers

Lithic Resources of the Falls of the Ohio Area. Mark Cantin, Steve Mocas, James Conklin, and Perry Harrell

Exotic Flakes by the Millions: Results from a Hopewell-age Knapping Locale in Southwest, Ohio. Robert Genheimer, Frank Cowan, and Ted Sunderhaus

Differential Patterns of Chert Utilization during the late Middle-Late Archaic and Woodland Periods at the Falls….What Does it Mean Anyway? Anne Bader

The Gas Well Hollow Chert Complex in Meade County, Kentucky. Rick Brown

Stalking Stromatoporoids: Geological Aspects of "Crab Orchard Chert". James Murphy

A Survey of Paleoindian Points…Their Distribution in Clark County, Indiana. Perry Harrell

Back From the Hills: Lithic Utilization at Site 15WN73, Wayne County, Kentucky. Richard Stallings and Mindi King

Further Clarification of Matanzas and McWhinney Projectile Points in the Falls of the Ohio Area. Kathy McGrath, Anne Bader, and Donald Janzen

Preliminary Lithic Analysis of the Meyer Site Assemblage….Tool Use, Maintenance, and Discard at the Meyer Site, a late Middle Archaic Mortuary Site in Spencer County, Indiana. Sundea Murphy

Lithic Analysis at the Hedden Site: A Diachronic View of Site Function and Spatial Organization during the Middle Archaic. Richard Stallings and Nancy Ross- Stallings

Discussants

Noel Justice, Glenn Black Laboratory of Archaeology, Indiana University
Cheryl Munson, Indiana University
Jack Holland, Holland Lithic Laboratory, Buffalo Museum of Science

Demonstrations and Displays

Chert Samples-Display and Exchange
Flintknapping-Demonstrations and Participation
Atlatl Throwing

Optional Tour
the Farnsley-Moreman House

ABSTRACTS FOR PAPERS PRESENTED BUT NOT SUBMITTED FOR PUBLICATION

Exotic Flakes by the Millions: Results from a Hopewell-age Knapping Locale in Southwest, Ohio

Robert A. Genheimer, Curator of Archaeology, Cincinnati Museum Center
Frank L. Cowan, Adjunct Curator, Cincinnati Museum Center
Ted S. Sunderhaus, Adjunct Curator, Cincinnati Museum Center

The Barnyard Site, an outlier of the Hopewell-age Stubbs Earthwork in southwest Ohio, has proven to be one of the densest Hopewell lithic sites in America. Estimates from controlled surface collections and soil samples taken from a 0.1 hectare cultivated segment of the site suggest that between 8 and 12 million lithic reduction flakes are present. Nearly all flakes are exotic to the area, and more than a dozen flint and material sources have been tentatively identified. These include Flint Ridge and Upper Mercer from Ohio; Newman, Boyle, Sonora, and Ste. Genevieve from Kentucky; Harrison County from Indiana; several varieties of Knox from Tennessee; Burlington from Illinois or Missouri; Kaolin from Illinois; Hixton from Wisconsin; obsidian from Wyoming; and, rock crystal quartz, most likely from the southern Appalachians. Substantial numbers of high-quality flint remain unidentified. Data from both the Stubbs Earthwork and the Barnyard Site suggest that in many cases groups in geographic proximity to the flint sources may have brought these materials to this southwest Ohio earthwork complex.

Back From the Hills: Lithic Utilization at Site 15WN73, Wayne County, Kentucky

Richard Stallings, AMEC Earth & Environmental
Melinda King, AMEC Earth & Environmental

Archaeologists from AMEC Earth & Environmental, Inc. recently conducted Phase II and III investigations at site 15WN73 with funds provided by the Kentucky Transportation Cabinet. While the diagnostic artifacts indicate the site was occupied throughout the Archaic period, the most intensive use appears to have been during the Middle and Late Archaic. Located in an area with locally abundant chert, the lithic analysis suggests a series of short term occupations geared toward late stage reduction and tool maintenance. This analysis along with the results of microwear analysis and site function will be discussed.

Lithic Analysis at the Hedden Site: A Diachronic View of Site Function and Spatial Organization during the Middle Archaic

Richard Stallings, AMEC Earth & Environmental
Nancy Ross-Stallings, Cultural Horizons, Inc.

Analysis of the lithic assemblage from the Hedden Site (15McC81), located in western Kentucky, has afforded us the opportunity to examine site function and spatial organization during the Middle Archaic Period in the lower Ohio River Valley. Analysis revealed that the features at this site were derived from two distinct occupation events that were separated by both time and function. The results of the lithic analysis are supported by the ethnobotanical data. Despite their differences, the two occupations are amazingly similar in their spatial organization.

CONTENTS

LITHIC RESOURCES OF THE FALLS OF THE OHIO REGION

By Mark Cantin[1], James E. Conkin[2], Stephen T. Mocas[1], and Perry Harrell[3]
Error! Bookmark not defined.

1. Indiana State University Anthropology Laboratory, Terre Haute
2. Prof. Emeritus, Dept. of Geology, University of Louisville
3. Falls of the Ohio Archaeological Society

Abstract

This paper addresses a number of chert lithotypes of archaeological interest with geographic and geologic provenance in the Falls of the Ohio region of Indiana and Kentucky. While the chert types discussed here have been long-documented in the geological literature, their identification as to type and provenance had been unknown to archaeologists. Types analyzed in this paper are largely of Silurian and Devonian age and include Louisville, Jeffersonville, and New Chapel cherts, as well as better-known Mississippian Muldraugh variants and St. Louis chert. Geologic provenance has been established for each of these types from various roadcuts, quarries, and other exposures by professional geologists, with recognition of cultural utilization demonstrated in excavations conducted at the Caesars Archaeological Project conducted near Louisville.

Introduction

The Indiana State University Anthropology Laboratory completed archaeological excavations of several sites at the Caesar's riverboat casino complex near Louisville, Kentucky. This tract is located in eastern Harrison County, Indiana, near the Floyd County border, along the Ohio River. The mitigations resulted in the recovery of a voluminous lithic assemblage from three major sites. While analysis is yet in progress, over 30,000 chert tools were recovered, and a lithic debitage count is likely to be in the millions, weighing several tons. Over twenty distinct chert types were recorded. While many of these were of known geological provenance, many were not. Their identification is the focus of this investigation.

Sites mitigated included: the Farnsley site (12HR520), with a buried/stratified sequence from Late Paleoindian through Early Archaic Thebes and Kirk traditions; the Knob Creek site (12HR484), with a buried/stratified sequence from early Middle Archaic Knob Creek to Early and Middle Woodland cultures; and the Townsend site (12HR481), with a stratified Kirk and Late Archaic sequence.

Perhaps a determining factor in the location of these sites was the local occurrence of Muldraugh chert which outcrops in the bluffs that bound this part of the Ohio River valley. Each of the sites was characterized by high densities of lithic debitage, and lithic reduction/retooling seemed to be a major function of each, and the primary function in the Kirk component of the Farnsley site. While Muldraugh chert was usually the dominant type represented in the lithic assemblages of each site (including its fossiliferous variant, Allens Creek), other chert types occurred in significant quantities as well. Wyandotte chert was second in recorded frequency, especially in the Woodland components of the Knob Creek site and the Kirk component(s) from Farnsley. It outcrops nearest on the opposite side of Harrison County, about 35 km away; it also outcrops in eastern Crawford County, Indiana, and Meade and Hardin counties of Kentucky. Varieties of St. Louis chert that outcrop closer than Wyandotte, and a few other cherts from greater distances also seem to occur in significant quantities, such as Ste. Genevieve and St. Louis materials from south-central Kentucky, Newman/Paoli/Carter Cave from northeastern Kentucky, and Laurel and the "Coffee Creek" variant of Jeffersonville from the Jefferson-Jennings county area of southeastern Indiana.

However, a number of cherts represented in the Caesars assemblages were unidentifiable by analysts Cantin and Mocas. These “mystery cherts” occurred in great enough frequencies as to suggest they had fairly local provenance, as a general correlation between outcrop distances and incidence of archaeological utilization is not unusual. In certain instances, an archaeological sample would only *approximate* a known geological type, so the analysts were hesitant to assign it as a known type without a comfortable level of certainty. A review of archaeological literature failed to completely resolve the chert identification issues, which was unexpected given the intensive focus of archaeological investigations in this area over the last 35 years (Guernsey 1937; Janzen 1971; Mocas 1976; Mocas and Brown 1976; Dobbs and Dragoo 1976; Baltz 1985, 1986; Sieber and Otteson 1986).

Archaeologists often inadvertently overlook the geological literature which may contain references to chert, documents which amount to “gray literature” in a relative sense. Such publications are often difficult to access given their intended audience, and are of course written with the geologist, not the archaeologist, in mind. Given that chert has little modern economic value, many geologic reports only cite chert as being present within a stratigraphic column (perhaps as a marker bed) with no further descriptive discussion that would be useful to the archaeologist. As a result, some of the geologic literature, even when it is known and available, is of little practical utility to the archaeologist. Without proper geological guidance or training, the archaeologist can misidentify geological provenances trying to source artifacts to outcrops. This is where cooperation between the archaeologist and geologist becomes imperative. Recognizing these problems, Mocas and Cantin enlisted the aid of Dr. James Conkin, a geologist from the University of Louisville who has published profusely on the stratigraphy of the Falls of the Ohio area.

Louisville Area Geology

The Louisville area is located on the western flank of a large anticlinal structure, the Cincinnati Arch. Older geologic units will be in the center of such a feature, with progressively younger units found concentrically to the outside of the structure. The units of concern in this study are of Silurian, Devonian, and Mississippian age, from the interior outward (Conkin 2003).

Thick carbonate deposits (often reefs) dominate the Silurian and Devonian lithologies (Conkin et al. 1992a and 1992b), and chert is a common constituent in each. Cherts found within Silurian units include Brassfield, Laurel (more common to the northeast in Indiana), and Louisville cherts. Chert is abundant in deposits of Middle Devonian age, namely Jeffersonville chert (Jeffersonville limestone) and New Chapel chert (Silver Creek limestone) (Conkin et al. 2004). The Falls of the Ohio, developed in the Devonian Jeffersonville limestone (Conkin et al. 1998), is an exposure of a shallow-sea bioherm famous for its fossils, notably corals, bryzoans, crinoids, brachiopods, stromatoporoids, sponges, and trilobites. Many of the roadcuts on the expressways of Louisville are cut through Silurian limestones such as the Louisville limestone. Many of the local quarries which specialize in cement matrix production are accessing Silurian and Middle Devonian limestones (e.g., Conkin et al. 2004).

Thick sequences of chert-less deltaic shales characterize much of the lower Mississippian age deposits, such as New Albany shale which is readily evident around that city (Conkin and Conkin 1979; Conkin et al. 1980), but above them are chert-bearing carbonate and clastic units of the Borden and Sanders Groups. These are the units that form the Knobstone Escarpment that looms to the west of Louisville. The Muldraugh Formation of the latter group contains Muldraugh and Allens Creek cherts. The Sanders Group also contains Harrodsburg and Salem chert (in Kentucky only) from same-named limestones. Above this and to the west is the thick carbonate sequence of the Blue River Group, which contains cherts not only in abundance but of high quality as well (Bassett and Powell 1983). Cherts from the Blue River include the famed Wyandotte type, as well as other high-quality cherts from the St. Louis and Ste. Genevieve series.

Falls of the Ohio Chert Typology

The first systematic assessment of Falls of the Ohio area chert resources in the *archaeological* literature was prepared by Donald Janzen (1971). Janzen (1971:374-376) recognized six separate chert types, designated as Types I-VI. As interpreted by the authors, Janzen described Muldraugh (his Type I, "Knob chert"), Allens Creek (Type II, "Silicified Oolithic Limestone"), Wyandotte (Type III, "Galconda chert"), likely Jeffersonville (Type IV, "Falls chert"), alluvial pebble chert (Type V), and an indeterminable type (Type VI). He correctly associated Muldraugh with Allens Creek in geologic provenance, and pinned down Jeffersonville to Devonian or Silurian units, and recognized the diagnostic utility of the fossils contained therein. These were remarkably prescient conclusions for an archaeologist practicing within the realm of geology which was quite advanced for that time. The authors acknowledge a debt of gratitude to him.

Beyond Janzen (1971), only one other systematic assessment of lithic resources of the Falls area has been done on the Indiana side, that being by Sieber and Otteson (1988) for the Clark Maritime Project. As such, Janzen's typology has well-stood as the model for the entire region since that time. With these typologies in hand, several chert types were still not identifiable through the course of the Caesars analysis. These would later be identified as two different varieties of Jeffersonville, a hueless form of fossiliferous chert (Salem), a distinctly fossiliferous form of St. Louis, and New Chapel chert, a geologically long-known type with great variability—including one phase that resembles a bryzoan-rich Wyandotte chert. Also geologically identified was Louisville chert, though this appears to be of very limited archaeological use. While Cantin and Mocas had reasonable presumptions what some of the types were, most had to be geologically verified by Conkin. Each will be described below. It should be noted that specific outcrops are discussed; this is not to imply that these are the *only* areas at which the specified cherts occur, but rather represent good exposures for geologic reference (**Figure 1**).

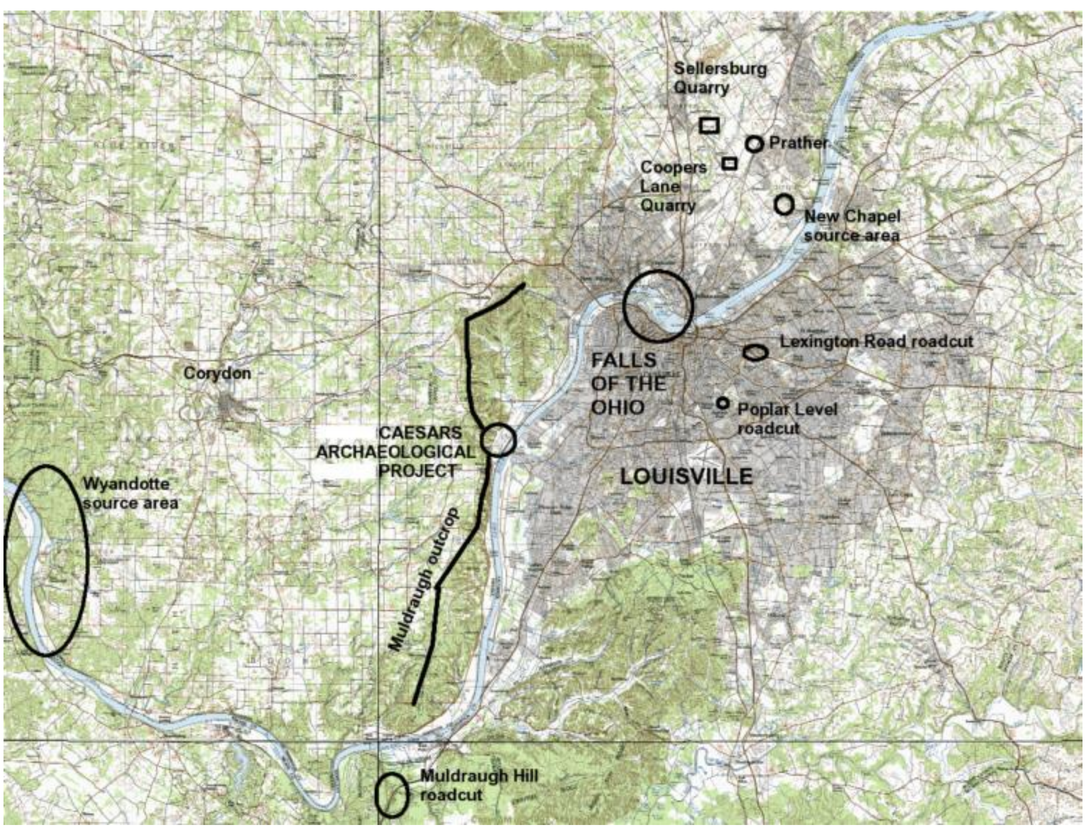

Figure 1. Collection locations.

Jeffersonville Chert. The presence of chert in the Jeffersonville limestone has been long-documented in the geological literature (Butts 1915; Perkins 1963; Shaver 1974; Conkin et al. 1998). Conkin (e.g., Conkin et al. 1998) places the Jeffersonville chert in the Bryzoan-Brachiopod Zone, above the *Brevispirifer gregarious* Zone, both of which are subordinate divisions of the *Paraspirifer acuminatus* Zone.

Jeffersonville chert has been recognized as a cultural resource by archaeologists for some time, referred to as Coffee Creek, Falls, and Scipio chert (Janzen 1971; Meadows 1977; Gatus 1979; Boisvert et al. 1979; Vento 1982; Tomak 1987; Tankersley 1989; Sieber and Otteson 1988:69). It was officially defined in the Indiana archaeological literature by Cantin and Anslinger (1985; also Cantin 2005), after geological provenance was established for a type colloquially known as "Coffee Creek" chert, which was known to occur in tributary drainages such as Coffee Creek, Big Creek, and Graham Creek in the Muscatatuck basin of the Jennings/Jefferson/Scott county area in Indiana.

In this study, Jeffersonville chert was sampled from three locales: just below the Prather site (12CL4) near the community of Prather in Clark County, Indiana (Munson and McCullough 2004); the Liter's Coopers Lane Quarry near Watson in Clark County, Indiana (Conkin et al 2004); and from the Poplar Level Roadcut in Louisville. All were bedrock exposures (**Figure 2**).

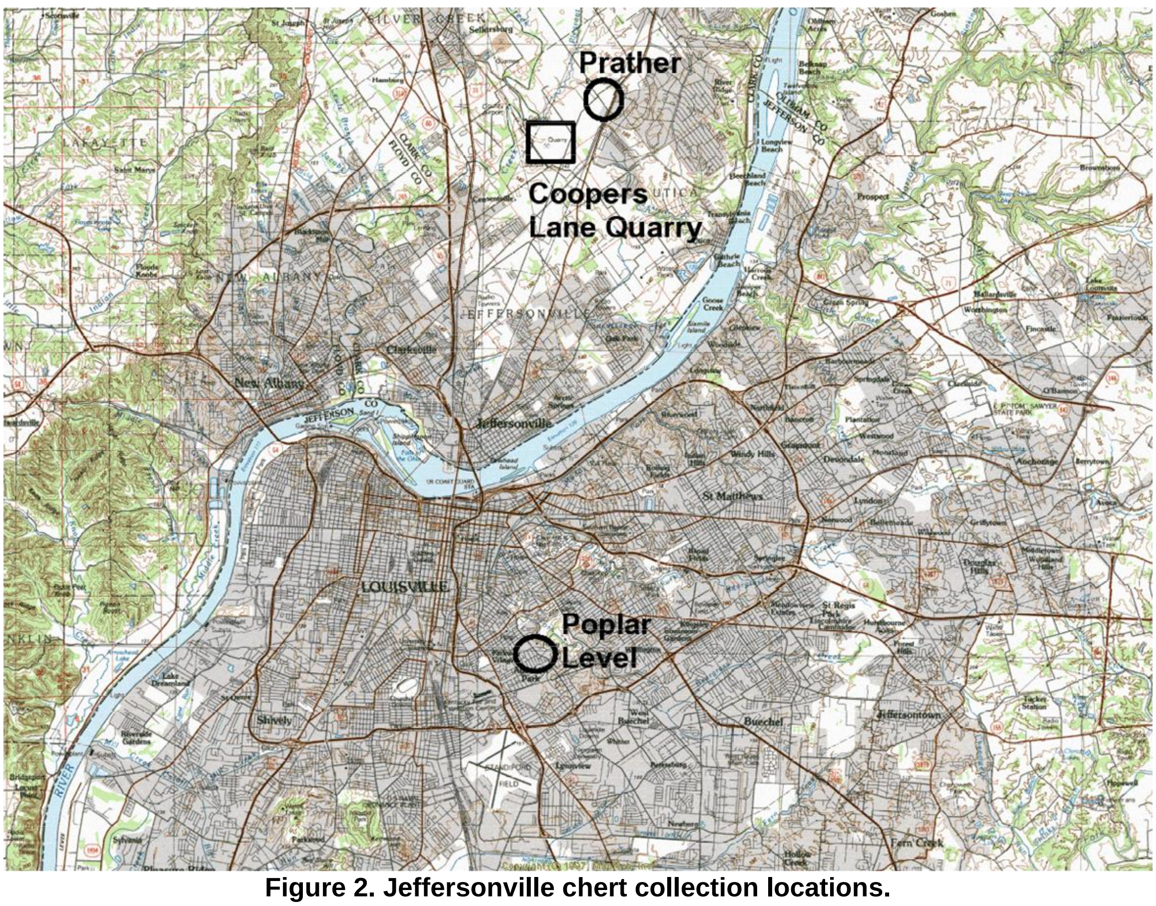

Figure 2. Jeffersonville chert collection locations.

Prather Locality. The presence of Jeffersonville outcrops was brought to the attention of co-author Steve Mocas by co-author Perry Harrell, who was involved in investigations of the Prather mound group (Munson and McCullough 2004). The Jeffersonville chert exposed here is, in general, of better quality than that material present in the "Coffee Creek" outcrops of the Muscatatuck basin of southeastern Indiana--the "archaeological type site" for this chert as recommended by Cantin and Anslinger

(1985), as originally described in Shaver (1974).

The material from Prather was strikingly different than the "Coffee Creek" variant referred to above. It is a lustrous, somewhat translucent, bright white/light gray, lightly variegated, fine-textured material. It has a milky, creamy appearance. Munsell colors for the general matrix are light gray (N7) to very light gray (N8), and to pale brown (10YR 8/2) to pinkish white (7.5YR 8/2), although chalky white opaque variegations are white (N9). The white variegations have medium-coarse to coarse-medium texture (Rick 1978:15), while the darker colored variegations tend to be finer grained and more translucent. Commonly found in unsorted distribution are crinoidal fragments that are distinguished as crystalline quartz replacement structures of light yellowish brown (2.5Y 6/3) to light olive brown color (2.5Y 5/3) (**Figure 3**). Echinoderm plates (crinoidal calyx?) or possibly coral polyps have been observed. Bryzoan fronds and tendrils are abundant, and tend to be white and opaque with coarser texture. Fenestrate bryzoans are more common, though a distinct "feathered" form has been noted as well. Foraminifera are rare. Spicular material (sponge?) is evident as whiter spines which are more visible in the darker translucent spots. Some pyrite derived from decomposed, incompletely replaced organic matter has also been noted. Fracture property was good-conchoidal (Ray 1982:8). That the Prather material significantly differs from other Jeffersonville chert variants may reflect formation of the former directly within the reef facies.

The identification of this chert in the Caesars assemblage may not be the first archaeological encounter with this type in Indiana. This material was seemingly described by Sieber and Otteson (1986: 69) at the Clark Maritime project, where they equated it to Janzen's "Falls" chert, correctly suggesting a Middle Devonian Jeffersonville provenance for it.

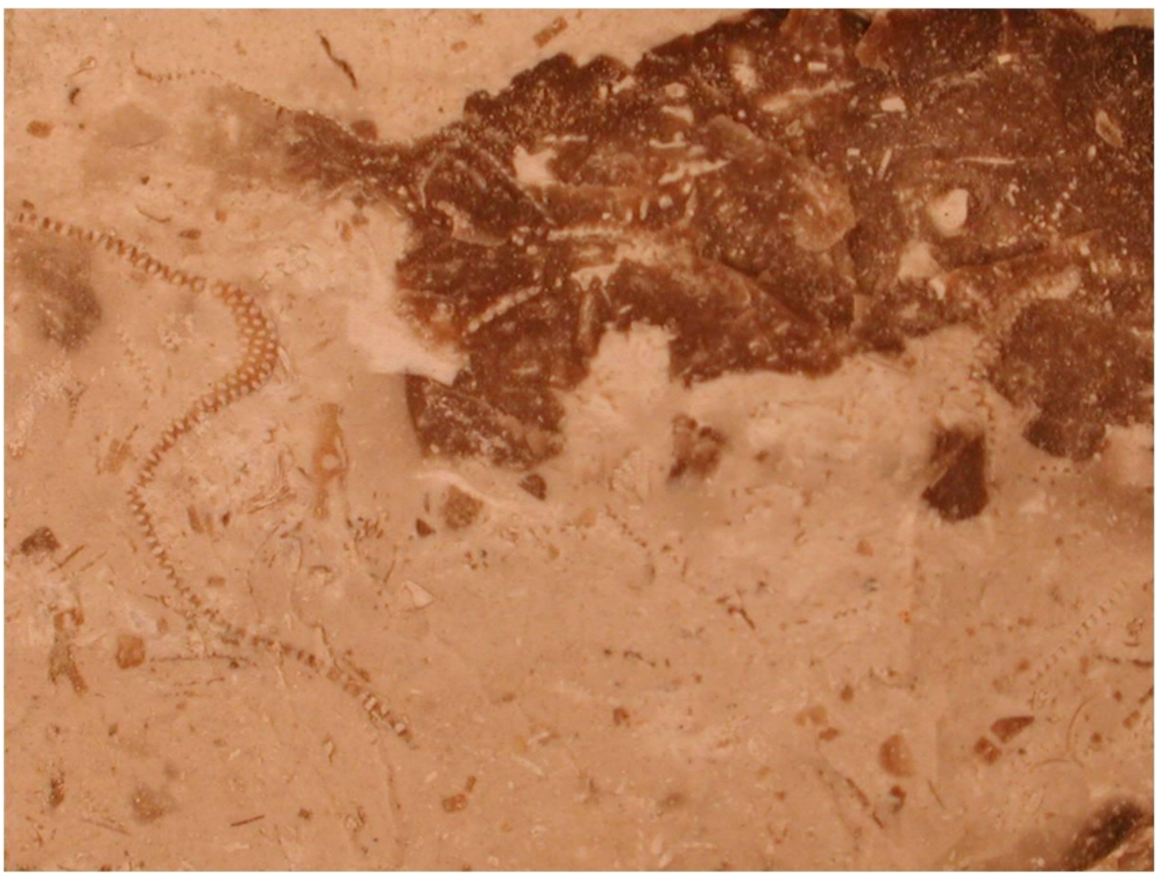

Figure 3. Bioclast inclusions in Jeffersonville chert.

Poplar Level Roadcut. Jeffersonville chert was found in at least three and potentially four thin beds. Descriptions will address individual beds given some tangible variation noted.

Zone 1 (lowest): Very similar to the “Coffee Creek” variety described by Cantin and Anslinger (1985). The chert matrix Munsell color is light gray (N7), and variegated medium light gray (N6). Pinpoint-sized brown spots are common; the color ranges between light yellowish brown (2.5Y6/3) to light olive brown (2.5Y5/3). They are round to subangular, and appear to be translucent crystalline quartz. It cannot be determined conclusively if they are fossil fragments, but they are suspected to be, and if so, are likely well-sorted crinoidal debris. The fabric is opaque, luster is dull, and texture is medium (Rick 1978:15). It is generally a poor quality material.

Zone 2: Similar to Zone 1 described above, and Zone 3 described below.

Zone 3 (potentially highest): The matrix is the basic light gray to very light gray (N7-N8), and has a dull luster, medium coarse to medium texture (Rick 1978:15), with larger and more distinct olive brown siliceous mottles (2.5Y4/3-4/4), similar to Jennings County samples. As it gets finer textured, the matrix gets darker, and more fossils (crinoidal and spicular debris) become visible. Some dendritic structures were noted, but were determined to be manganese blooms. This bed is fairly similar to Zone 1 described above.

Zone 3/above: Material represented here may be from Zone 3, or may occur in a bed above it which is covered; the material collected was residual. This material more closely resembles that recovered from the Prather locale; it had a generally finer texture, was more translucent, and had greater luster. It also displayed a greater profusion of bioclasts, including the feathery bryzoan fronds, translucent crystalline olive brown crinoidal debris, and corals in the cortex/limestone contact surfaces. Foraminifera or possibly ostracods were noted, as well as rare brachiopod valve impressions (possibly *Brevispirifer lucasensis)*.

Liter’s Cooper Lane Quarry. Jeffersonville chert recovered from this quarry was more comparable to the “Coffee Creek” variety than to that observed at the Prather locale, which is rather “refined” for Jeffersonville. The Coopers Lane Quarry material was typically medium textured and non-lustrous. The general coloration was darker than the Prather material and more like “Coffee Creek”, with a typical matrix color being light gray (N7). The mottling and variegation structures were more pronounced than the Prather material. The mottles were “more siliceous”, being finer textured and more translucent, and were dark gray (2.5Y4/1) to gray (2.5Y5/1) with a brownish cast, and strongly contrasted with the matrix. The mottles ranged in shape from 4 cm-diameter amorphous blobs to distinct bands several centimeters long and a centimeter thick. The bioclast assemblage contained abundant fenestrate bryzoa, few small fragments of the “feathery” bryzoa, profuse spicular material, and the olive brown crystalline crinoidal debris. An unidentified bivalve was even observed in one sample. General fracture properties ranged from good-conchoidal to hackly (Ray 1982:8), especially nearer to cortical/contact surfaces.

New Chapel Chert. New Chapel chert is another Devonian chert that has been long-known to geologists though only recently recognized as a cultural resource by archaeologists. New Chapel chert is ascribed bed status, and was first referred to by Whitlatch and Huddle (1932:3671) for a cherty interval in the upper part of the Silver Creek limestone, which overlies the Jeffersonville. The Indiana Geological Survey places the New Chapel in the Silver Creek Limestone Member of the North Vernon Limestone of the Muscatatuck Group. The taxonomy utilized by Conkin et al. (2004:7, also see plates 2, 3, 4 and 5) place it as a member within the Silver Creek Formation, below the Swanville (Bone Bed 12) and above the Lower Silver Creek members, which are collectively overlain by the Beechwood Limestone. Excellent bedrock exposures are present in Liter's Coopers Lane Quarry. This quarry, located in Land Grant 50, Silver Creek Township, Clark County, should be considered as the Indiana archaeological type site for this chert. Another excellent exposure of New Chapel chert exists in the extreme southern corner of Land Grant 24, Utica Township, USGS 7.5' Jeffersonville Quad, above Lentzier's Creek at an elevation of 520' AMSL. At this locale, the very top of the New Chapel, as geologically corroborated by Conkin, is found to be eroding with much chert lag at the surface. This source, too, was brought to the attention of Mocas by Harrell.

New Chapel chert was first identified as a potential archaeological resource by INDOT archaeologist Curt Tomak in 1985, who termed it "Clark" chert. Tomak recorded exposures in Grant 25, Utica Township. and Grant 35, Jeffersonville Township, Clark County, Indiana. It also may have been identified in investigations of areas to be developed for new Ohio River bridges at Louisville by Archaeological Services Consultants (Striker et al. 2000). Chert was traced to eight different residual exposures thought to be of Middle Devonian age (or less possibly, Silurian). Their Residual Beds 5 and 7 especially seem to describe New Chapel chert. While they noted macroscopic similarities to Wyandotte, they likened this chert more to the Muldraugh type.

New Chapel chert is a nodular type with a 0.5-1.0-cm-thick, well-developed but rough, ruddy reddish yellow/yellowish red (5YR 6/6-5/6) cortex. The color often turns a chalky white/light gray just below the surface, forming a well developed, porous rind. Nodules can often be highly irregular and lobate in shape.

As understood, New Chapel chert has two macroscopic variations. The first and apparently more common form is dull and variegated light gray/pale brown. This is the form collected by Tomak and later by Harrell. The second variety is finer textured, waxy, homogeneous bluish gray; and strongly resembles Wyandotte chert. They hold in common a distinctive bryzoan assemblage.

The more common form, as stated, is dull and variegated. Macroscopically, the general matrix color is light gray (N7), medium light gray (N6), and/or gray (10YR 6/1). Under low power microscopy, this macroscopic color is derived from gentle mottling of light brownish gray (10YR 6/2), pale brown (10YR 6/3), and light gray (10YR 7/1). Some artifactual samples were light yellowish brown (2.5Y 6/3) to pale brown (10YR 6/3). The texture is medium to medium fine, and luster (Rick 1978:15), as noted, is dull. Darker mottles tend to be a more crystalline form of quartz, and are more lustrous and translucent on a microscopic scale. Muscovite and pyrite have been observed, though occur in very small crystals, really only detectable at magnifications of 50X, and tend to be associated with the darker crystalline mottles. Fracture is generally conchoidal (Ray 1982:8), though hackly fractures are not unusual. Distinct, well-defined and well-preserved bryzoan tendrils are common, though crinoidal debris and foraminifera only occasionally occur.

The physical properties of the Wyandotte-like variety can show a great deal of range which is dependent on its state of weathering and dehydration. What is suspected to be the more weathered form is a finely mottled light gray to very light gray (N7-N8) to a slightly browner light brownish gray to light gray (10YR 6/2-7/2) color. It has a chalky medium texture, although it still has fine conchoidal fracture and is opaque. In this state, it very closely resembles Jeffersonville chert. Some weathered samples develop a vitreous siliceous light yellowish-gray patina. Subsequent removal of this patina often reveals chert in either a more highly weathered state as described above, or a fresher, more hydrated state as discussed below.

Unweathered New Chapel chert is virtually identical to Wyandotte chert (or certain forms of Kentucky Ste. Genevieve and St. Louis series cherts). The color is a homogeneous dark bluish gray with no banding or mottling. The texture is fine grained/ cryptocrystalline (Rick 1978:15), and it has a waxy luster. This form of New Chapel chert possesses excellent conchoidal fracture and shows flaking ripples, bulbs, and cones well, and flakes terminate in thin feathered edges. Edges are translucent and brownish, perhaps due to pyrite. Under low power microscopy, though, the texture is somewhat more sacchritic (less fine) than Wyandotte.

While the finer grade of New Chapel is virtually identical to Wyandotte, the two cherts can be readily distinguished on the basis of readily obvious bioclasts in the former which contrasts with the nonfossiliferous latter. The most common and diagnostic fossil is an opaline, milky white, barbed bryzoan tendril/frond. White spicular objects (some of which are almost certainly sponge spines), football-shaped foraminifera, and possible ostracods are abundant. Crinoid casts also have been noted but are rare. Agatized structures with opaline and crystalline quartz are not uncommon, but these, too, can occur in Wyandotte.

Samples of New Chapel chert were also recovered from the Sellersburg Quarry near Sellersburg, Land Grant 90, Silver Creek Township., Clark County, Indiana (**Figure 4**). The chert observed here was of extremely low quality, was limy, occurred in small irregular lenses, and was not of cultural utility. It was very light gray (N8), with a coarse texture and dull luster. Fenestrate bryzoa were abundant. Fracture mechanics were poor.

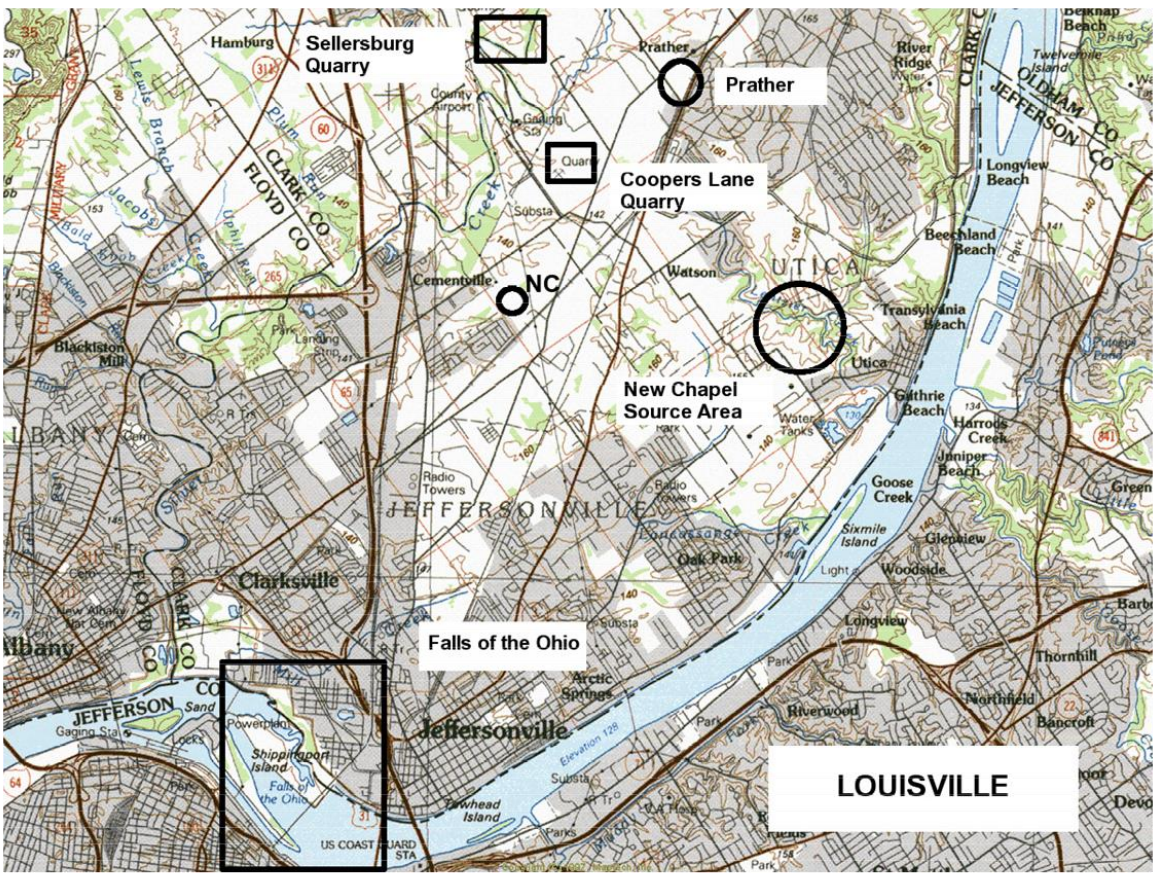

Figure 4. New Chapel collection locations.

Louisville Chert. Louisville chert was sampled from exposures along Lexington Road, near its junction with Grinstead Road in Louisville (Conkin et al. 1992), and at Liter's Coopers Lane Quarry near Watson, Clark County, Indiana (Conkin et al. 2004) (**Figure 5**). More specifically, the chert was sampled from two beds Conkin et al. (2004) term Ledges 22 and 23 (Gray and Top Blue Ledges, respectively) of the Silurian Louisville Limestone, which holds formation rank in southern Indiana (Shaver et al 1986). What they term the Flint Flagging Ledge exists just below these units, but was not available for sampling. The Louisville Limestone and its lenticular chert beds are obvious in roadcuts along the interstate system of east-central Louisville.

The matrix is generally light gray (N7), but mottled anywhere between medium light gray to very light gray (N6-N8). Mottles of opaque, very light gray (N8) appear to be poorly preserved or replaced fossils (bryzoan masses?). Crinoid fragments are common, apparent as dark grayish brown (2.5Y 4/2) "spots" of crystalline quartz. Other fossil types appear to be represented in this preservation/ replacement state as well, including unidentified spicular debris and possible foraminifera (uncommon). Scalar calcite "frosting" was evident on some faces, probably those of incipient fracture planes. The chert matrix is medium-textured (Rick 1978:15), though under magnification looks finer grained. It is opaque, with a dull to slightly waxy luster. The material sampled, directly from irregular lenses in the bedrock, was small and blocky in structure, and shattered into angular pieces due to the ame fracture planes. The material sampled from Coopers Lane Quarry and the Lexington Road exposure were likely not adequate for prehistoric utilization, nor was any identified with certainty in any of the Caesars sites' lithic assemblages. This would have been a minor resource used for exigent purposes only. We only note its existence and resource potential should better sources be identified.

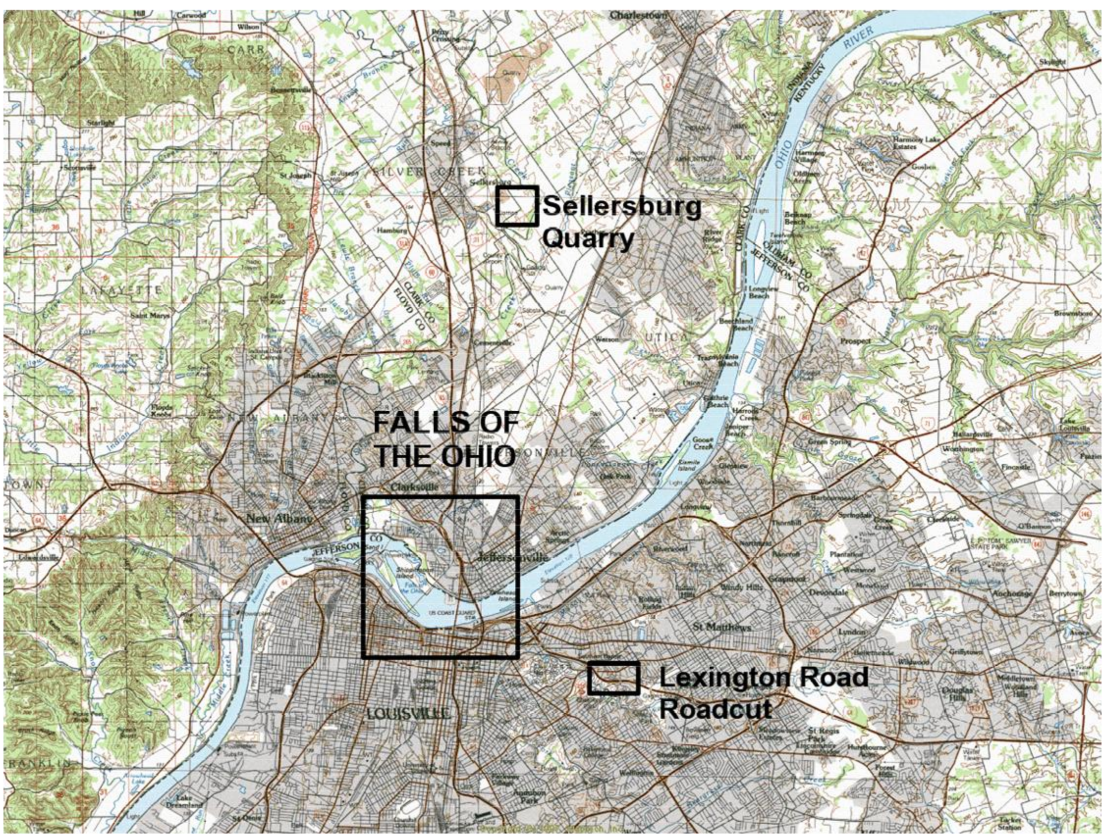

Figure 5. Louisville chert collection locations.

St. Louis Fossiliferous Chert. This chert technically outcrops outside of the Falls of the Ohio area, but it frequently appears in archaeological assemblages from that area. To the authors' knowledge, it has not been described in the archaeological literature, and hence its inclusion in this discussion. St. Louis chert is highly variable across space, in part due to the thickness of the limestone which represents considerable passage of time in its formation. High quality, bluish gray and bluish green forms are recognized in south-central Kentucky and even into southern Illinois (Spielbauer 1976; Koldehoff 1985). St. Louis material in Indiana tends to be a nodular bluish gray banded type, generally of lower grade and small nodule size (Cantin 2005). Discussion of St. Louis in this paper will be limited to a distinctive dark steely brownish gray, conspicuously white-flecked variant.

St. Louis Fossiliferous chert was found in residuum at a variety of locales at the Fort Knox Military Reservation. Spherical to ellipsoidal nodules from 5 to 20 cm in diameter were abundant in residuum on the surface of the Mississippian Plateau upland of Meade and Hardin counties, Kentucky. Samples were gathered, and the surfaces correlated with USGS geologic quadrangles at locations above the Doe Run Valley, west of Otter Creek, west of Mill Creek, and on the ridge between Mill Creek and Cedar Creek. These surfaces were all in the St. Louis Limestone 25 to 35 m above the top of the Salem Limestone. Nodules also were found in residuum at the base of the St. Louis Limestone at the Muldraugh Hill/Round Hill road cut. The origin of these nodules was not ascertained during the chert surveys at Fort Knox.

The USGS quadrangles for the area report nodular chert in the upper St. Louis Limestone (e.g., Withington and Sable 1969), but although the basal and middle St. Louis Limestone is exposed throughout almost all of the Mississippian Plateau, there are few upper St. Louis outcrops exposed.

Coloration of this St. Louis variant is distinctive. It generally courses through the medium gray (N5)/medium light gray (N6)/light gray (N7) range. Very typically the material has an olive brown "hazing" (2.5Y 4/3), which can range to dark gray (10YR 4/1) to brown (10YR 4/3). Some have very circumscribed mottles of very pale brown (10YR 7/3).

Texture is fine (Rick 1978:15), much like other Mississippian types (Wyandotte, Ste. Genevieve, other St. Louis). Luster is waxy to greasy. Fracture is highly conchoidal with little hackling (Ray 1982:8). The microfossil assemblage discussed below does not seem to impede fracture, and bulbs of percussion and rippling structures are well defined. It is slightly translucent on thin edges. It is a very high quality material for cultural exploitation.

Dr. Robert Howe, former Indiana State University micropaleontologist (personal communication 1999) examined the fossil assemblage and identified endothyroid foraminifera (many planispiral forms noted), fusulinids, and ostracods. These are very abundant, and appear as the prominent white flecking which is diagnostic of this type. Bryzoan and crinoid fragments are rare

Muldraugh Chert. Muldraugh chert is one of the better-documented lithic resources of the Falls area. It is a constituent of the Muldraugh Formation of the Sanders Group, Mississippian System (Shaver et al. 1986:97-98). A reference section has been established in the north half of the southeast quarter of Section 26, Township 4 South, Range 5 East on Indiana State Road 211 between SR 111 and SR 11, in that county (Munson et al. 1983:192). At this exposure, four discontinuous tabular beds of Muldraugh chert are exposed, ranging from 15 cm to 45 cm in thickness, throughout 10 stratigraphic meters. The chert horizon laterally grades into a limestone facies to the north.

Muldraugh chert is omnipresent as the capstone of the Knobstone Escarpment that fronts the Ohio River that forms the eastern border of Harrison County, Indiana. Beds of more than 30 cm thickness can extend for hundreds of meters, and large unweathered blocks can be easily procured. Secondary deposits are ubiquitous in the talus and high-order drainages leading from the scarp. Quality varies from poor to high with a waxy luster and fine texture in the same exposures within a few tens of meters from one another.

The Muldraugh Formation/chert undergoes a facies change to the northwest, and even within a single outcrop. In the Knobstone Escarpment caprock of Harrison County, Muldraugh chert locally grades into the highly fossiliferous Allens Creek chert. Allens Creek chert becomes the sole chert type in this lithologic unit farther to the northwest in Monroe, Washington, and Floyd counties. Muldraugh is also equivalent to the formation that bears the pastel green Attica chert in the Warren-Fountain county area of northwest Indiana. However, all three cherts are distinct from one another, at least in color or other superficial physical properties. The Muldraugh formation and its geologic equivalents continue from south-central Indiana through Kentucky and into Tennessee, where it is known as the Fort Payne Formation/chert.

"Typical" Muldraugh chert, as mentioned, is generally pastel brown in color or occurs in shades of gray. Munsell color evaluations include medium to light grays (N5-N7), to pale brown (10YR6/3), light olive brown (5Y5/6) to dusky yellow (5Y6/4). While uniform colors can rarely occur, the chert is usually variegated or mottled with lighter shades of gray, light brown, or olive. Irregular chalky-white patches and vugs (macrocrystalline quartz) have also been observed, and may represent unsilicified (or de-silicified) fossils and/or geode-like pockets. Muldraugh shows an incredibly wide range of texture, from a gritty medium-coarse to a waxy-lustered fine texture, though it is usually medium (Rick 1978:15). This range is visible even within the same outcrop and bed, with samples of each derived within a few meters from one another. Most Muldraugh chert samples are macroscopically nonfossiliferous (Munson et al. 1983:192), though spicular bioclasts are not uncommon at the microscopic level. Rare samples display clusters of bryzoans. Suspected algal and burrow structures are occasionally present. Mica, pyrite, and clay minerals are evident, especially in coarser grades. Fracture is fair- to good-conchoidal (Ray 1982:8), with sharp but relatively “soft” edges. Silt within the fabric sometimes makes for hackly fracture mechanics, and step fractures are common in artifactual samples.

Archaeologically, Muldraugh chert was used to various degrees throughout prehistory. Tankersley (1987) reports fluted points of Muldraugh chert from the Middle Ohio Valley. Muldraugh chert was used extensively at the Early Archaic Kirk sites such as the James Farnsley site (12HR520) in Harrison County, Indiana (Stafford and Cantin, in preparation) and Longworth-Gick site in Kentucky (Collins 1979), and in lesser though significant amounts at Swan's Landing Site, also in Harrison County (Smith 1986). Coarser grades were often selected for adze manufacture at the former site. Indeed, Muldraugh was the overwhelming selection recorded at all Archaic components excavated at the Caesars Archaeological Project. Munson et al. (1983:192-193) report that it is recovered in significant percentages from floodplain and rock shelter sites in Harrison County, especially from those dating to the Late Archaic period.

Allens Creek Chert. Allens Creek chert is one of several fossiliferous Indiana cherts that at times are nearly indistinguishable from one another. Allens Creek chert occurs in the Floyds Knob limestone member of the Edwardsville Formation, Borden Group, Mississippian System (Shaver, et al. 1986:46-47), and has been referred to as "Knobs chert" by Janzen (1971:376). It may be correlative, in part, to Attica chert, though dissimilar in appearance (Munson and Munson 1984:153). It is a variety of Muldraugh chert. Both are found in alternating beds and even laterally grade together in the same beds as seen in a roadcut on SR211 in Harrison County, and elsewhere along the Knobstone Escarpment of Harrison and Floyd counties. On a microscopic level, the “fabric” of Muldraugh and Allens Creek is remarkably similar, fossils notwithstanding.

The type site exists along Allens Creek in sections 18 and 19, T7N, R1E, Monroe County, Indiana (Munson and Munson 1984:153). It is found in bedded and semi-nodular masses up to 15 cm thick. It is present in outcrop from Bedford (Lawrence County, Indiana), to Salem (Washington County), and New Albany (Floyd County, Indiana), through extreme south-central Harrison County (Indiana) into Kentucky.

The appearance of Allens Creek chert is varied due to the fossil content, density, and size of fragments, though these tend to be well-sorted. The fossil assemblage is predominantly crinoidal, though sponge spicules and fenestrate bryzoa are common. A diagnostic bryzoan type tentatively identified is of the *Archimedes* genus, with a corkscrew-like “stalk” and fan-shaped colony head (Dr. Tony Rathburn, Indiana State University paleontologist, personal communication, 2004). The background silica matrix is often N8, "light gray", in color. The chert has an even, speckled appearance (due to replaced fossil fragments), with the replaced fossils consisting of shades of gray, tan, brown, and blue or may be transparent as well. Fossil size varies due to turbidity at the time of deposition; greater turbidity results in finer fragments. A great percentage of Allens Creek chert has particles of sand-to-granule size. However, some samples have large fossils (up to 1 cm diameter) and may best be described as "fossil hash" (Munson et al. 1983:191).

Other fossiliferous Indiana cherts approximate Allens Creek chert in appearance, and they are often virtually impossible to distinguish on a macroscopic basis. Microscopy is often required, and sorting must be done on fossil and/or mineral assemblages. Fine-grained Haney chert is similar to Allens Creek in certain properties. Coarser-grained, poorer grades of Allens Creek chert closely resemble Harrodsburg/Ramp Creek cherts. Allens Creek chert is crinoid-rich, while Harrodsburg/Ramp Creek cherts lack the transparent silica fossil fillings in general (Munson et al. 1983:192-193). A suite of highly fossiliferous cherts is found in a Muldraugh Hill roadcut near Louisville, Kentucky, and includes Allens Creek, Harrodsburg, and Salem types (discussed below). These tend to be devoid of color, and are predominantly salt-and-pepper gray-black-white. These, too, are virtually indistinguishable even under a microscope.

Allens Creek chert samples *appear* to have a "coarse" to "coarse-medium" texture (Rick 1978:15). However, Allens Creek is often remarkably well silicified and homogeneous, and approaches “fine” texture, visible fossils notwithstanding. Luster is usually dull, but more silicified (and less calcareous) specimens have a slightly glossy appearance. It is most often opaque.

Although Allens Creek chert is highly fossiliferous, it has good conchoidal fracture--unusual for many other highly fossiliferous cherts. Finer grades are found in blocks free of internal stress fractures, tending to be rather well consolidated and homogenous. This allows for a fair degree of conchoidal fracture, with regular, sharp (though easily dulled) flakes. It is well-represented in Archaic assemblages from the Caesars Archaeological Project.

Wyandotte Chert. Current stra-tigraphic assignment by Bassett and Powell (1984) places Wyandotte chert in the Fredonia Member of the Ste. Genevieve Limestone, Blue River Group, Valmeyeran Series, Mississippian System, not in the St. Louis Limestone as formerly believed. As such, it occurs in nodules and tabular form in a chert-bearing horizon 2 to 4 meters thick (Bassett and Powell 1984:243). It was formerly called "Indiana Hornstone" or more commonly "Harrison County Flint/Chert", but as Tankersley stated (1985:251): "(it is an) inadequate term because it is not the only chert in Harrison County, Indiana, and it outcrops in areas outside Harrison County". Its geologic distribution is limited, however, to Harrison and Crawford counties, Indiana, and Meade, Breckinridge, and Hardin counties, Kentucky (Tankersley 1985:252). Large, high-quality nodules of Wyandotte chert can be found by the thousands in stream beds and residual exposures in these counties (especially near Valley City in Harrison County, Indiana). The type area, after which this chert type was renamed, is in Wyandotte Cave, Harrison County, Indiana (Bassett and Powell 1984).

Wyandotte chert does not occur in a wide range of colors--generally only grays and bluish grays--but does occur in a wide assortment of shades of these colors, ranging from very light to very dark gray. The "typical" colors of Wyandotte chert have a Munsell value of medium bluish gray (5B 5/1) and medium light gray (N6) to grayish black (N2.5). Other hues of gray noted are 2.5YN7 to 2.5Y/N3, 2.5Y 6/2 to 2.5Y 4/2, 2.5YR/N6 to 2.5YR/N3, 7.5YR/N7 to 7.5YR/N3, and 10YR 6/1 to 10YR 4/1 (Tankersley 1984:253). It will, however, patinate in shades of brown and tan. The chert is frequently concentrically banded with various shades of gray, and commonly a light gray zone of varying width (1-2 cm average) exists just below the cortex.

The cortex is usually well-developed on Wyandotte nodules. Thickness varies, and

some nodules are entirely corticated. On a "typical" high-quality nodule, cortex thickness is about 1 to 2 cm. The cortex is chalky and porous, and usually a ruddy buff-brown color.
“Classic” Wyandotte chert nodules are ordinarily free of internal stress fractures and are very homogenous (Munson et al. 1983:194). However, occasional samples will display geode-like attributes, possessing an internal cavity filled with various crystallites such as quartz, calcite, fluorite, and pyrite (Tankersley 1985:253,255). Macroscopic fossils are rare in Wyandotte chert. Oolites and, less often, brachiopods may be encountered (Tankersley 1985:253). Sponge spicules are not uncommon on a microscopic level, though other microfossils are rare. To properly separate Wyandotte chert from myriad "look-alikes", Tankersley (1985) undertook a series of petrographic tests, using scanning electron microscopy, to obtain the "fingerprint" of Wyandotte chert and found dolomite, calcite, pyrite, anthraxolite, fluorite, and a distinct suite of trace elements disseminated throughout Wyandotte chert. Luster ranges from slight to very waxy. It is extremely cryptocrystalline, and texture is ordinarily fine (Rick 1978:15). Wyandotte chert is slightly translucent, appearing brown on thin edges due to pyrite content.

Knapping characteristics of Wyandotte chert are excellent. This is due to the lack of flaws, and a high degree of cryptocrystallinity and homogeneity (Ray 1982:8). It possesses an unsurpassed degree of conchoidal fracture that is slightly rippled at times. Flake edges are strong, "clean", and sharp. Given its highly predictable flaking qualities, it is conducive to the production of thin, technically superior, aesthetically pleasing projectile points found in cultures utilizing curated technologies such as those in the Paleoindian, Early Archaic, and Middle Woodland periods. At the Caesars Archaeological Project, Wyandotte chert, which outcrops 35 km to the west, was more frequently utilized than Muldraugh in Early and Middle Woodland projectile point assemblages, although Muldraugh outcrops within a few hundred meters.

Muldraugh Hill Roadcut

This Louisville roadcut along US 31 West (Dixie Highway) (Conkin and Conkin 1960) well reflects the stratigraphic relationships between a number of cherts. From bottom to top of this 66-m-thick deposit:

Bed 1: Allens Creek Chert. This chert, found in a 20-cm-thick bed, is basically a silicified and agatized bryzoan mass (including *Archimedes*[?] and fenestrates). Milky white chalcedonic or opaline “halos” have developed around the myriad bryzoan fragments, giving it a unique paisley appearance under magnification. The bryzoans are a pale yellow (2.5Y 8/2, also 8/1, 7/1, 7/2), though the milky opaque chalcedony is white (N9), giving the chert an overall macroscopic Munsell color of light gray (N7) to very light gray (N8). Also very characteristic is the presence of a moderate density of black spots, which gives the chert a very salt-and-pepper look. Under magnification, these spots are actually light yellowish brown (2.5Y 6/3) to light olive brown (2.5Y 5/3) to dark gray (N3) color. They are translucent quartz replacements of some type of bioclast, not apparently crinoidal as in the case of Jeffersonville. They *might* be foraminfera. Crinoidal debris is rare, virtually absent. Macrocrystalline quartz veins are common in interstices, though they do not seem to occur in geode-like vugs. Texture is medium to medium-fine (Rick 1978:15), luster is dull, and the chert is opaque. It is well-consolidated and of moderate knapping quality, displaying good conchoidal fracture. In many ways, it resembles Allens Creek chert, though Allens Creek usually contains a much higher ratio of crinoid-to-bryzoan detritus.

Bed 2: Harrodsburg chert. Harrodsburg chert is also highly fossiliferous, being more a crinoidal coquina as opposed to a bryzoan hash. It was in an 8-cm-thick bed, approximately 2.5 m above Bed 1 described previously. The general color is a medium gray (N5), but under magnification the matrix is medium dark gray (N4), while the fossils are very light gray (N8) to white (N9). Few bryzoans were observed, but when present were more often the fenestrate type. The bioclasts are well-sorted in size and distribution though weak evidence of laminating of fossil debris is not unusual. Perhaps a diagnostic is calcite “frosting” on the joint planes which effervesces when weak hydrochloric acid is applied. The material is opaque, of medium texture and dull luster. Conchoidal fracture seems adequate for reduction purposes.

Bed 3a: **Harrodsburg chert**. This bed is part of a 10-bed horizon that is at least 5 m above Bed 2. This particular bed is 12 cm to 2 cm thick. This is a hueless form of Harrodsburg chert, being black-gray-white only, with none of the redder or bluer hues present that are usually so common in the otherwise similar Allens Creek chert. It is a crinoidal coquina with three forms of bryzoa present—the fenestrate, "feathered", and corkscrew *Archimedes* all documented. The overall color is medium light gray to light gray (N6-N7). Most of the bryzoan material is dark gray (N3) though some fronds are chalcedonic/opaline and very light gray (N8). Most crinoidal debris is medium light gray (N6) to light gray (N7). The chalky interstitial matrix is white (N9). Just about any shade of gray is present. The fossils are well sorted and well silicified; and the chert is medium-fine textured (Rick 1978:15), above-average flaking material. Other Bed 3 material is more weathered, coarser textured, limy, and of poor quality. It strongly resembles what we believe is Salem chert, though the presence of geodes in the same lithologic unit is more indicative of the Harrodsburg limestone and Ramp Creek formation (of Indiana).

Bed 4: **Salem chert**. This is yet another black-and-white fossiliferous silicified coquina, with bioclast frequency equally split between crinoidal debris and fenestrate bryzoan material. This chert appears to occur in the basal Salem limestone. It should be noted that the Salem limestone is not particularly cherty in Indiana, but apparently is so southward into Kentucky. The chert from Bed 4 is much like that found in Bed 3a. It is more distinctly banded, and most of the bryzoans are oriented perpendicular to bedding plane. Texture is medium to medium-fine (Rick 1978:15), with finer (which coincides with *darker*) samples possessing waxy luster. Flaking properties are excellent (Ray 1982:8), as seen from archaeological assemblages.

Bed 5a: **St. Louis chert.** Bed 5 contains three variants of one chert. One is virtually identical to the Indian Creek type of the Monroe/Greene/Lawrence county area of south-central Indiana; the second is identical to the finer-grained, multi-hued variant of Indian Creek, which also resembles St. Louis "Green" of Kentucky; and the third is a nondescript type. The Indian Creek look-alikes are both nodular and nonfossiliferous. The first type alluded to is pale yellow (2.5Y 7/3-7/4) with faint light gray banding. It has a medium to medium-fine texture (Rick 1978:15), dull luster, and is opaque. It is homogeneous and has good conchoidal fracture. The finer variety has a general matrix color of medium dark gray (N4) to medium gray (N5) and is concentrically banded grayish brown (2.5Y5/2) and dark yellowish brown (10YR4/6). It has a waxy luster, fine texture, is translucent, and has excellent conchoidal fracture (Ray 1982:8). Both have a well-defined rind-like cortex which is rough, porous, and buff-colored--identical to that of Indian Creek and Wyandotte. The third variant is a thinly bedded type. The matrix is light gray to white (N7-N9), medium-textured, and non-fossiliferous except for a low density of spicular material.

While this material very closely resembles Indian Creek chert of south-central Indiana, it should not be present here. Bassett and Powell (1983) traced Indian Creek chert to south-central Lawrence County at its most southern extent, which is some 80 to 90 km to the northwest of Louisville. Unconfirmed claims of Indian Creek outcroppings as far south as Harrison County have been made, however.

Bed 5b: St. Louis chert. Chert in Bed 5 is a bedded and banded type. Thin relict bedding is preserved near the limestone contacts. The color is a medium light gray (N6) to light gray (N7), and moves to a more olive-gray (2.5Y 7/3; actually "pale yellow"). The texture becomes finer toward the center, and is medium-fine at best (Rick 1978:15). The chert is nonfossiliferous. Yellowish red (5YR 5/6) iron staining is common along joint fractures.

Bed 6: St. Louis chert. Most of the samples are fine textured, translucent, and with a waxy luster. The material appears to be nonfossiliferous. The chert is seemingly a bedded or tabular type. The chert is finely banded, color ranges between medium gray (N5) to medium light gray (N6) on grayer pieces, though the material can display lighter browner hues: light gray (2.5Y 7/2)-light brownish gray (2.5Y 6/2). A third lesser-quality material has also been identified. It is a mottled light gray (N7) to very light gray (N8), has a medium to medium-coarse texture (Rick 1978:15), has a chalky luster, is not translucent, and contains an abundance of spicular bioclasts. This may represent weathered forms of the first two variants, but the spicular debris not present in the first two suggests otherwise.

Summary

Recognition of lithic sources is essential to understanding how prehistoric groups interacted with their environment. Much has been learned of those resources of the Falls of the Ohio region in the 30-plus years since Janzen's (1971) seminal definitions. No doubt, even more will be learned in the next 30 years. The intent of this paper is to build upon the previous works of others, not to replace it. In turn, it is expected that improvements or changes to this paper will be necessary in the future as more data are generated. Undoubtedly, other unique chert resources occur in the area and await definition by both geologists and archaeologists. Studies such as this should be viewed as a work in perpetual progress, much like adding a few pieces to a large jigsaw puzzle over time. We do feel more confident in our analysis given that a professional biostratigrapher/geologist, Dr. James Conkin, was involved, which we view as being absolutely essential in such a study. While many have contributed to the strengths of this paper, the primary author takes sole responsibility for its shortcomings.

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STALKING STROMATOPOROIDS: GEOLOGICAL ASPECTS OF "CRAB ORCHARD CHERT"

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Abstract

"Crab Orchard Chert" consists of silicified fossil Ordovician stromatoporoid bodies weathered from enclosed shales and limestones and locally utilized during prehistoric times. Although "Crab Orchard chert" is limited to the area of Paint Lick and Lancaster, in Garrard County, Kentucky, very similar materials occur in Ordovician and Devonian rocks of Tennessee, Ohio, and New York, and may be expected elsewhere. Distinguishing various stromatoporoidal "cherts" based upon stromatoporoid taxonomy may be feasible in some cases but is inhibited by the reluctance of paleontologists to study material in which silicification has destroyed much of the internal structure and which requires thin-section preparation. The distribution of silicified stromatoporoids has also been neglected by most field geologists and largely ignored by archaeologists.

Introduction

"Crab Orchard Chert" was originally described and named as a "provisional type" by DeRegnaucourt and Georgiady (1988) from the Silurian Crab Orchard Formation of Garrard Co., Kentucky; it was further described in Deregnaucourt (2001) but mistakenly considered Devonian in age. In any case Crab Orchard strata are nowhere known to include significant amounts of flint or chert, and recent study shows that the type locality on the Walker-Noe Farm near Paint Lick (**Figure 1**) actually consists of float fragments of silicified fossil stromatoporoid colonies weathered from the Reba Member of the Upper Ordovician Ashlock Formation (**Figure 2**). At the Walker-Noe farm, silicified stromatoporoid bodies occur mainly between elevations of 990-1010' A.M.S.L. along a small tributary of Walker Run and, along with utilized material, in cultivated fields immediately to the south, where the mottled, banded gray material is mixed with abundant brightly-colored flint derived from outcrops of Boyle Dolomite occurring about 80 feet higher. The intervening bedrock is of poorly exposed dolomitic shales of the upper Orodovician Drakes Formation and the Silurian Crab Orchard Formation,neither of which contain any flint or chert.

Stromatoporoids. Stromatoporoids are extinct invertebrate organisms of poriferan affinities with non-spiculate, calcareous basal skeletons of laminar, domical, bulbous, branching to columnar form; internally composed of regular, continuous network of growth parallel and normal to growth skeletal elements, either interconnected laminae, or cyst plates, and pillars (**Figure 3**). They are limited primarily to Ordovician through Devonian marine strata. "Stroms" are often poorly preserved due to replacement of the original high-magnesium calcite and aragonite by low-magnesium calcite and even silica. (Stearn et al. 1999).

Identification even at the generic level usually requires microscopic study of thin sections. Unfortunately, because silicification often destroys the finer structures of stromatoporoids, silicified examples have not received any study by paleontologists; for that matter, stratigraphers and general geologists often pay little attention to the occurrence of stromatoporoids unless they are abundant enough to form large, reef-like masses. Conversation with Kentucky geologists has not revealed any recollection of seeing silicified stromatoporoids in the field, and stromatoporoid specialists have been reluctant to study the available material, although much of it does preserve stromatoporoid microstructure.

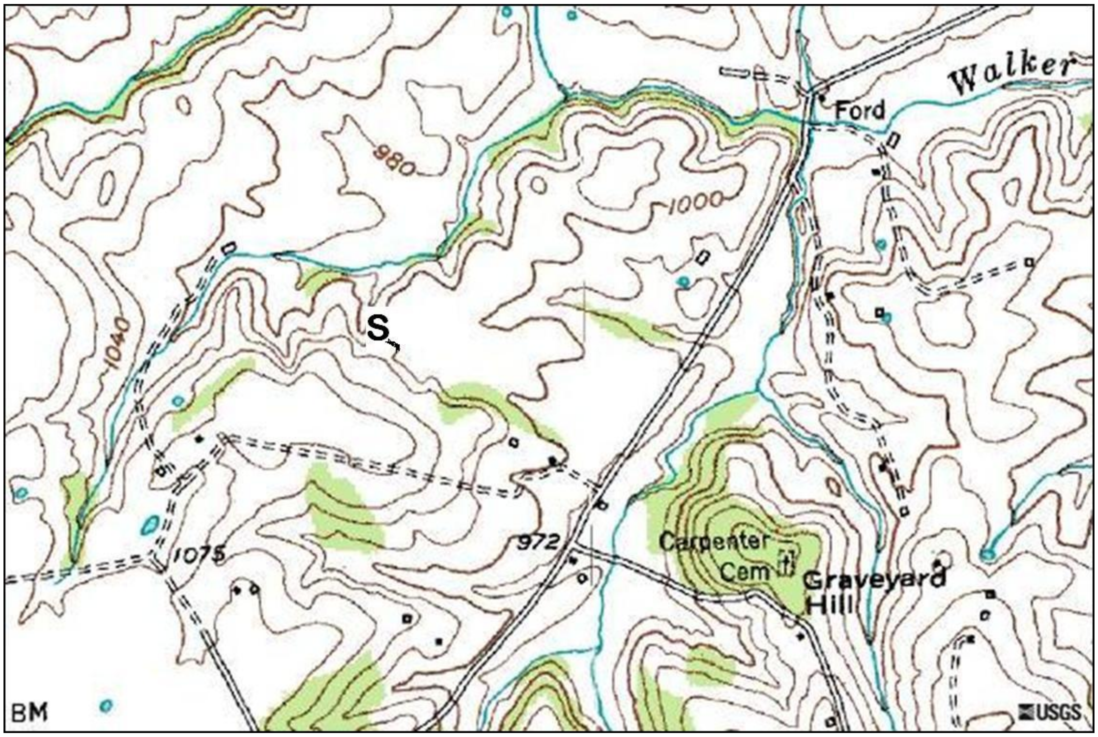

Figure 1. Location of Walker-Noe Farm near Paint Lick, Kentucky.

Figure 2. Silicified fossil stromatoporoid colonies weathered from the Reba Member of the Upper Ordovician Ashlock Formation.

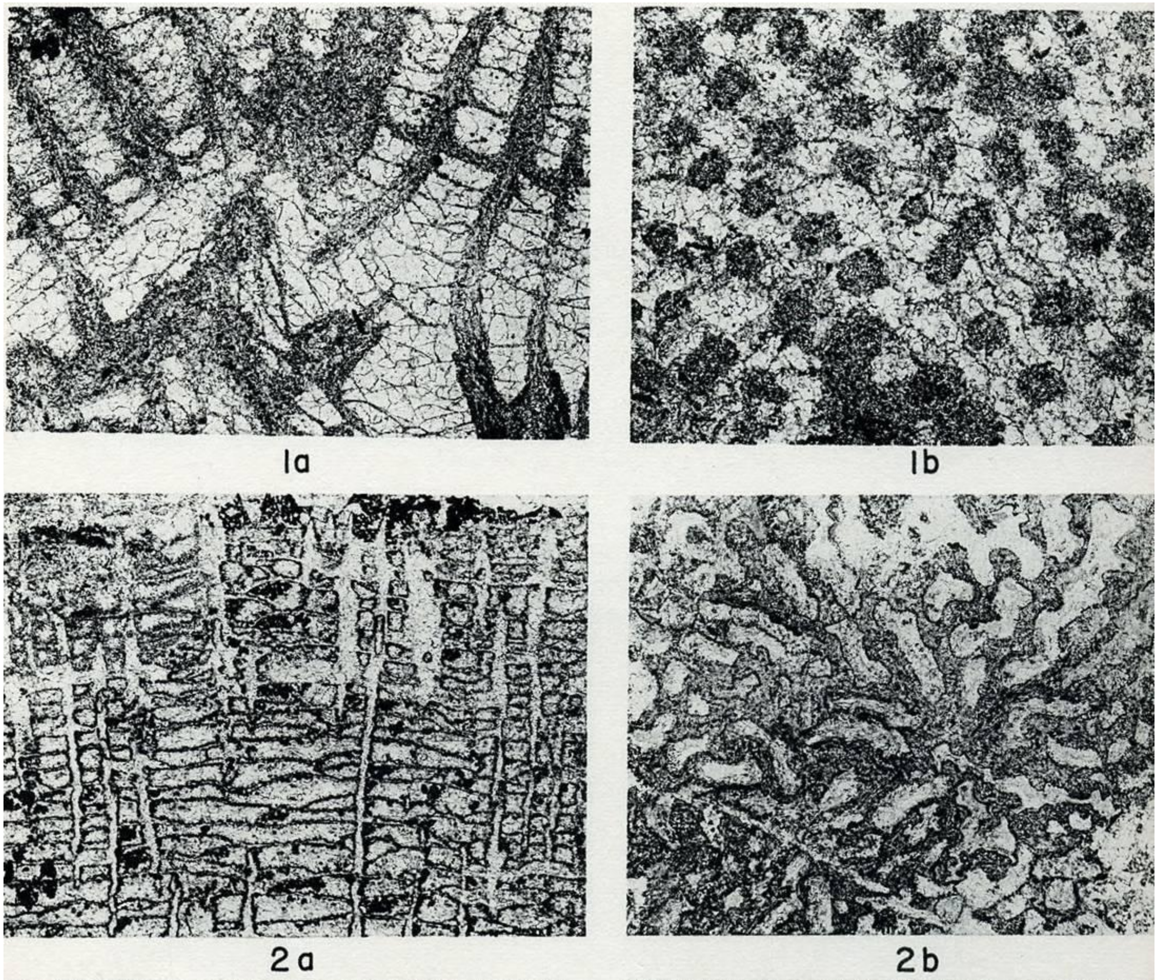

Figure 3. Stromatoporoids: extinct invertebrate organisms.

Silicified Stromatoporoids in Kentucky. The Reba limestone member of the upper Ashlock Formation ranges from 10 to 25 feet thick. It has been found from near Stanford to near Winchester and was previously referred to as the Arnheim Formation of Ohio, a stratigraphic term no longer used (Weir, Greene, and Simmons 1965).

Silicified stromatoporoids have been located *in situ* in the Reba Member as far west as Lancaster, Garrard Co. They have also been found in a new roadcut at Point Leavall, ca. 5 km northwest of the Walker-Noe outcrop. The Reba Member intergrades eastward into beds of the Bull Fork Formation and southward into the Cumberland Formation, and silicified stromatoporoids have not been found in outcrops of those rocks, although thin stringers of chert have been noted in the Cumberland Formation near Burkesville, Kentucky, and unsilicified stromatoporoids occur in the Sunset Member of the Bull Fork Formation well to the east of the Paint Lick study area.

Silicified stromatoporoids have also been found in the Middle Ordovician Tanglewood Member of the Lexington Formation near Danville, Boyle County., where the largest known silicified Kentucky examples occur. These have been tentatively identified as *Stromatocerium*, although unsilicified stromatoporoid bodies abundant in the Strodes Creek, Stamping Ground, and Tanglewood members of the Lexington Limestone, where they are sometimes very conspicuous (**Figure 4**), have generally been referred to as *Labechia*. The geographic extent of silicified material is currently very poorly known, but since it clearly occurs in more than one stratigraphic unit, this material should probably be referred to as “Kentucky stromatoporoid chert” or “Ordovician stromatoporoid chert” unless there is a clear reason to believe the material came from a particular stratigraphic unit. The term Crab Orchard Chert is definitely misleading and should not be used.

At present, none of the stromatoporoid material has been identified to genus or species, with any degree of certainty, although the microscopic internal structures required to identify genus and species is frequently preserved in the silicified specimens. For years such material has been assigned to the genus *Stromatocerium*, though currently Lexington Limestone examples are assigned to the genus *Labechia*. An early distributional map by August Foerste, an Ohio paleontologist who was intent on tracing the Arnheim fauna through Kentucky, remains a good indicator of the extent of stromatoporoid material in rocks of this age in south-central Kentucky, although Foerste did not indicate whether the material was silicified or not. On his map (**Figure 5**), only the Paint Lick locale indicated in southeastern Garrard County, has yielded silicified stromatoporoids thus far. None has yet been found at his Ophelia locality north of Richmond nor at the mouth of Red River in Clark County. Abundant stromatoporoids in the Sunset and Grant Lake formations in Fleming County appear not to be silicified.

Utilization of Kentucky Stromatoporoid Chert. Kentucky stromatoporoid chert clearly was collected from colluvial and alluvial material at and below outcrops of the Reba Formation (**Figure 6**). Based largely upon material collected by Randall Carrier, Garrard County stromatoporoid chert was utilized throughout prehistoric time--from the Paleo-Indian to the Late Prehistoric period (**Figure 7** and **Figure 8**).

Figure 4. Unsilicified stromatoporoid bodies in the Strodes Creek, Stamping Ground, and Tanglewood members of the Lexington Limestone.

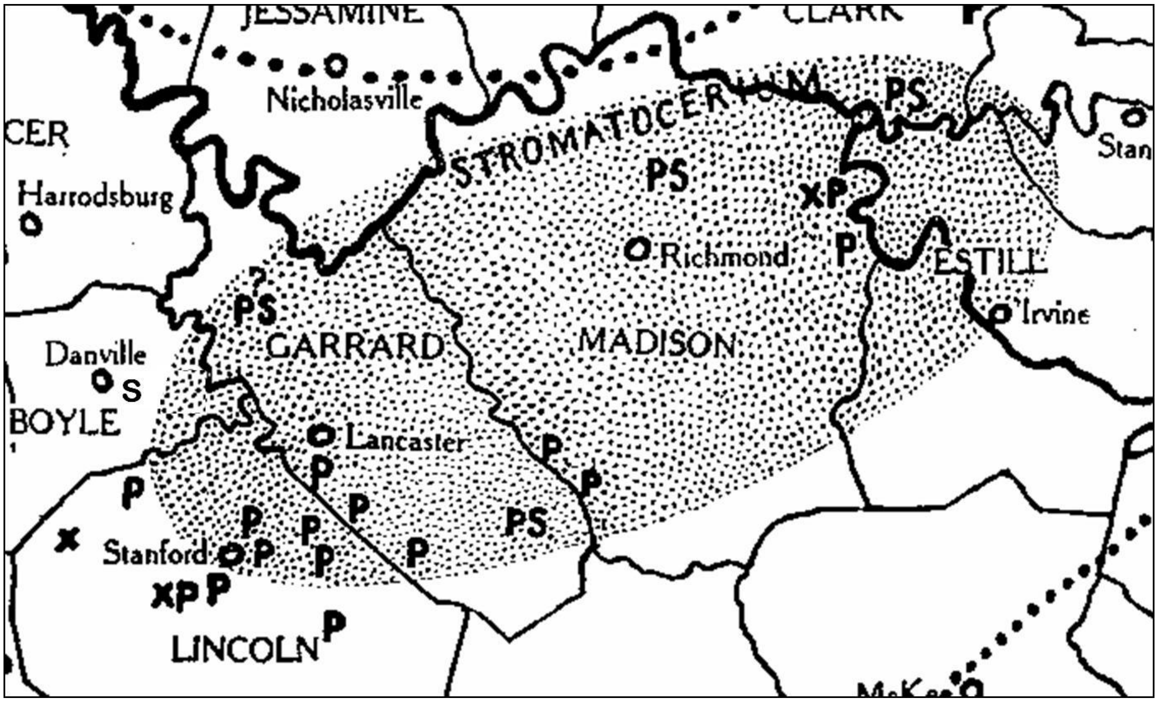

Figure 5. Location of Paint Lick locale in southeastern Garrard Co., that has yielded silicified stromatoporoids.

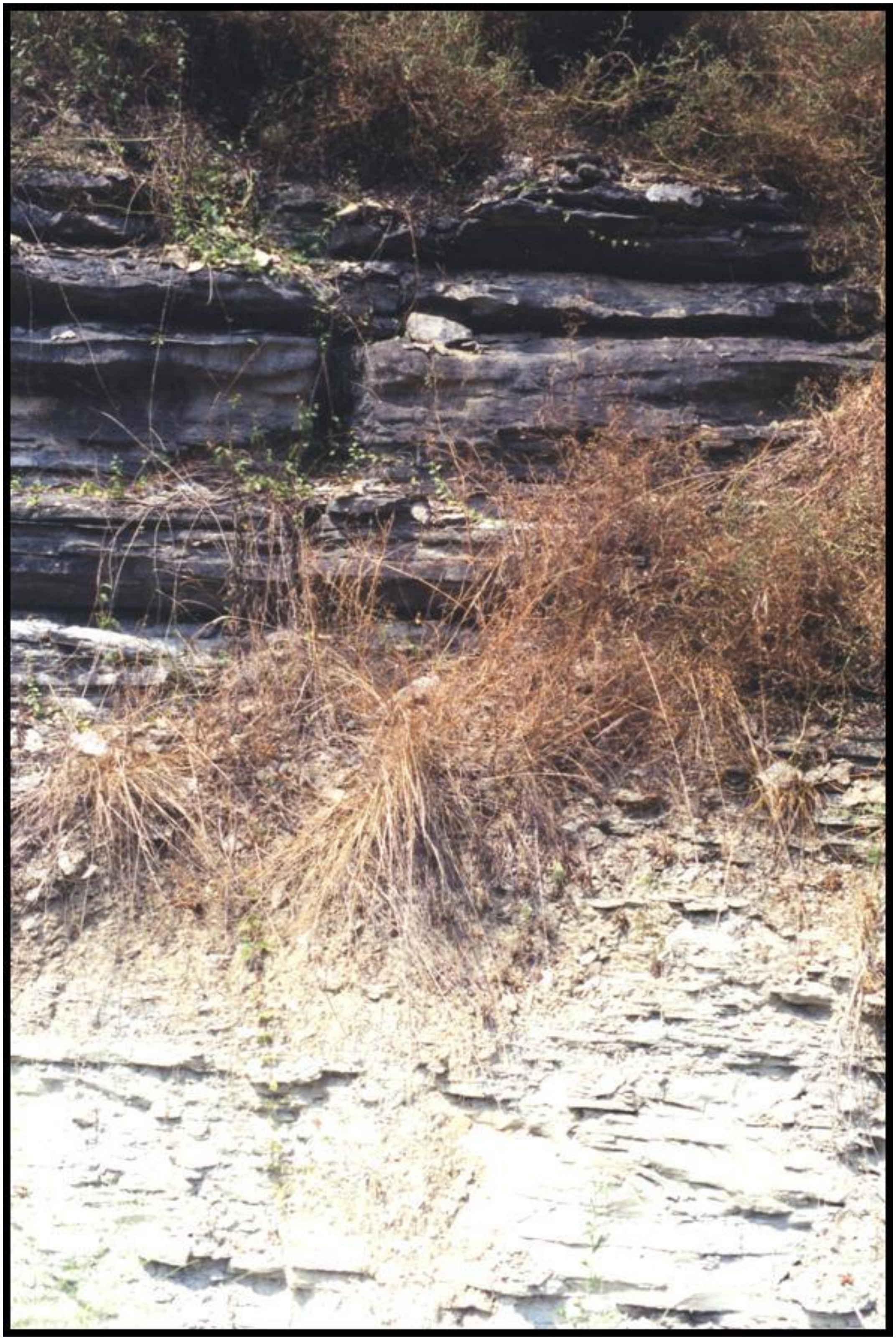

Figure 6. Outcrops of the Reba Formation.

Figure 7. Artifacts manufactured by Randall Carrier from Garrard County stromatoporoid chert.

Figure 8. Additional artifacts manufactured by Randall Carrier from Garrard County stromatoporoid chert.

Confusion with Tyrone and Other Kentucky Banded Cherts. It appears that the stromatoporoid chert of central Kentucky has been confused with banded chert from the older Ordovician Tyrone Limestone and with banded Mississippian cherts of the Meade Co. area. Thin bedded and nodular banded chert is common in the Ordovician Tyrone limestone, often associated with siliceous pyrolitic bentonite ash beds, and local collectors frequently refer to banded chert artifacts found in the area along the Kentucky River north of Garrard County as "Tyrone chert," even if it exhibits fossilized stromatoporoid structure. The Tyrone has been examined at the type locality in and near the quarry at Tyrone, Anderson County, about five miles west of Versailles, and in the High Bridge section near Boonesborough. At Tyrone, nodular and thin-bedded banded chert is abundant but generally too fractured to have been widely utilized for artifact material. Suitable material may occur elsewhere in the Tyrone and have been carried downstream along the Kentucky River, but this remains to be established. Finely banded nodular chert is also common in Mississippian limestones in Meade County, across the Ohio River from the better known "Harrison County" or Wyandot chert of Indiana. Lacking fossil evidence, these Ordovician and Mississippian cherts can easily be confused with one another; they lack the zig-zag pattern created by stromatoporoid mamelons as well as the finer cellular structure of stromatoporoid bodies.

Silicified Stromatoporoids in Tennessee. To complicate matters further, silicified stromatoporoids are also abundant in central Tennessee, particularly along the Cumberland and Duck Rivers, where the material was utilized in prehistoric times as well as the present. Bassler (1932) and Wilson (1948) provide data on numerous occurrences of silicified stromatoporoids in middle and upper Ordovician rocks of central Tennessee, and this material is familiar to Tennessee archaeologists as "sponge chert" (Kellberg 1963). Corbin (2002) illustrates a worked silicified stromatoporoid body found along Caney Fork River in Smith County, Tennessee. Preliminary field work along the Cumblerand River indicates that at some sites 25 percent of the lithic debitage consists of stromatoporoidal chert. In the Normandy Reservoir area, stromatoporoidal chert from the Ordovician Bigby-Cannon limestone has been described in some detail (Faulkner and McCullough 1973, Penny and McCollough 1976) as "gray banded chert" without recognition of its organic origin. It is not certain that all of the material described as gray banded chert from the Normandy Reservoir area is fossilized stromatoporoid material but initial field work documents that some and probably most of it is. Amick (1987) illustrates fossil stromatoporoid chert from the Bigby-Cannon but fails to recognize its organic nature and may also include non-stromatoporoidal material in his "gray banded chert." Material collected at the Shelton Quarry site (40-Bd-80), at Horseshoe Bend just below the Normandie dam, considered to be the "type site for gray banded chert" (Penny and McCullough 1976: 163) consists largely of very dark but unmistakable stromatoporoid chert (**Figure 9**)

Silicified Stromatoporoids in New York and Ohio. Silicified stromatoporoids and bedded black chert have been described from dolomite in the Martisco Reef Complex of Cobleskill age near Marcellus Falls, New York (Ciurca 2003). Stromatoporoids are common in Ordovician, Silurian and Devonian rocks of Ohio, but silicified examples have not been reported. Although Ordovician and Silurian examples are relatively small, massive stromatoporoids (*Anostylostroma*) up to 20 cm. in diameter are common in the Devonian limestones of central and northwestern Ohio and might be available in glacial drift (Keller 1963). One endscraper of this material has been noted in a collection from the Crawford County area. The finely spaced, broad, even laminae are quite distinctive and such material cannot be confused with known Ordovician stromatoporoids from Kentucky and Tennessee.

Conclusions

The term "Crab Orchard chert" is based upon a stratigraphic misidentification and should not be used. Lithic material derived from silicified stromatoporoids in the Reba limestone of Garrard Co. can be identified with certainty only within the general area of outcrop in central Kentucky. It can readily be distinguished from banded Ordovician Tyrone chert and banded Mississippian cherts by virtue of its fossilized cellular structure. Only further field work will reveal the extent of similar silicified stromatoporoid occurrences in Kentucky and Tennessee, while detailed paleontological study is necessary to determine whether distinct species characterize the different stratigraphic occurrences.

Figure 9. Dark stromatoporoid chert collected at the Shelton Quarry site (40BD80), at Horseshoe Bend just below the Normandy Dam in Tennessee

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ABORIGINAL UTILIZATION OF CHERT ASSOCIATED WITH HIGH-LEVEL FLUVIAL DEPOSITS IN BOONE COUNTY, ASSOCIATED WITH THE (OLD) KENTUCKY RIVER

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Abstract

Ten areas in western Boone County were studied where high-level fluvial chert was utilized or occurred as deposits. High-level fluvial chert resulted from the northern flow of the ancient (old) Kentucky River. If high-level fluvial deposits were within 1.5 kilometers of an archaeological site, this material appears to have been extensively used. This review needs to be expanded to sites farther away from the deposits to evaluate the full dimension of utilization. Also, continued mapping of elements of the ancient river meander may afford information on distribution patterns.

During the pre-glacial Pleistocene period, the ancient (Old) Kentucky River flowed north and connected with the Teays River in northern Ohio. Deposits of material consisting of chert and silicified limestone occurring as subangular and subrounded pebbles, cobbles, and blocks, geodes, quartz pebbles, quartzite, limonite and slabs of sandstone are common throughout the remnants of the ancient stream (Teller 1991).

The deposits contain material eroded from Mississippian, Silurian, Devonian, and Ordovician limestone. Wisconsin glacial till has not been identified in Kentucky (Andrews 2004, Kentucky Geological Survey 2006). However, it has been suggested that high-fluvial deposits are, for the most part, composed of material derived from Mississippian and Pennsylvanian rocks of south-central Kentucky, augmented in places by locally derived clasts from older strata (Silurian, Devonian, and Ordovician) (McDowell 2001).

The ancient river departed from the current Kentucky River about 4 miles from Carrollton and flowed north through a series of meanders that were generally in or south of the present Ohio valley. East of Warsaw the pre-glacial Eagle Creek joined with the ancient Kentucky River and flowed north to what is now the Miami River. The overall meandering course distance was 95 miles but it only traversed a distance of about 50 linear miles (Swadley 1971a).
This ancient stream merged with the Licking River near Springfield, Ohio and continued north until it merged with the Teays northeast of Columbus, Ohio. This drainage pattern was interrupted and then blocked by south advancing glaciers (Teller 1991).

The course of the river between Carroll County and Boone County may be tracked by the presence of what are referred to as “high-level fluvial” deposits. These are indicated on the three USGS geological topographic maps covering Boone County. The Verona and Union geological maps indicate these deposits by a yellow area identified as (Qf) (Swadley 1969). For the Rising Sun geological map the designation is (QTf). Also, the Rising Sun map has the suggested course of the river plotted with a green dotted line. The extensive meandering is quite apparent (Swadley 1971b).

Archaeological Sites and High-Fluvial Association

Big Bone Lick *(SR 338 at SR 1925).* In 1952, a trip with my father to Big Bone, Kentucky permitted me to visit with Mrs. Baker who owned what has become the central part of Big Bone Lick State Park. During the visit, she permitted me to walk around the farm and, while crossing the Big Bone Creek ford (where the current park bridge is located), three broken triangular bifaces were observed at the edge of the creek. Also, a triangular point was observed on a farm road that led to the original family home where the park campground is now located. At the top of the hill there was a barn across from the family cemetery, and at the barnyard gate there was a large pile of gravel containing a variety of chert. A few pieces were collected, and Mrs. Baker permitted these and the artifacts to be kept. [*These artifacts are on display in the museum in the nature center at Big Bone Lick State Park.*]

Maley Farm Site (15BE475; located on Cleek Lane, 0.2 km west of US 42). On November 26, 1995 while assisting at our son's newly purchased farm on the north side of Cleek Lane, an archaeological site was uncovered when soil was removed for fill around the new house. Chert flakes similar to the chert observed at Big Bone Lick in 1952 suggested a possible association between the Lick and the farm site (15BE475). Big Bone Lick is only 4 kilometers northwest from the farm. *Total flakes reviewed: 49**

Liberty Hill Site 1 (15BE476; located opposite and 0.2 kilometers southwest of 15BE475, on the south side of Cleek Lane). During the late morning of March 22, 1997 an individual who is a tenant at the Liberty Hill horse farm came to our son's farm and we began a discussion about the area. He was shown the flakes that had been found at 15BE475 and asked about his observing such material on the Liberty Hill farm. He immediately pointed to a small wooden box on the tractor, and it contained a number of large flakes and chert chunks plus some broken bifaces. He indicated that they came from a field that was being prepared for planting. We then visited the field, and it was immediately apparent that this had been a village site. Permission from the owner was obtained to conduct a surface review of the field. This yielded a large number of flakes that were similar to those found at 15BE475 and to stone observed at Big Bone Lick.

Two 1-m-wide areas were marked off in the north-south direction and in the east-west direction. A dark "U"-shaped midden was obvious with an opening to the west. The surface review focused on the midden. Chert flakes, burned and unburned bone, Late Woodland period pottery, broken and complete triangular points, a Fort Ancient knife, geodes, fossils, chert chunks, FCR, hammerstones, and charcoal were collected for review. A site report was completed, and it was assigned the name Combs-Beach Liberty Hill with the state designation 15BE476. *Total flakes reviewed: 180**

Webb Farm Site (15BE517; located at west end of Webb Lane). In October, the grandson of William Webb indicated that he had seen "rocks" similar to those associated with 15BE475 and 15BE476 on his grandfather's farm. Mr. Webb was contacted and permission was received to visit the farm. On October 30, 1999 a small garden plot was reviewed, and chert flakes and chunks were observed that were similar to all the others thus reviewed (**Figure 1**). However, in this case, it was found that the road that passed through the farm had scattered chunks of brownish-colored rock that turned out to be chert. The road led to a large barn where the area had been partly excavated. In this 10-ft-deep excavated area, there were chert pebbles, cobbles, and small boulders along with geodes up to three inches in diameter. Quartz pebbles, limonite, small nodules, and quartzite pebbles and cobbles were present. *Total flakes reviewed: 52**

Examination of the chert indicated immediately that this was the same material found at the three archaeological sites. A direct link between this deposit and the material from the archaeological sites was only speculative, but it seemed logical due to the proximity. Big Bone Lick, while only about 2 kilometers from the Webb farm, seemed less likely as a primary resource area for these sites.

Figure 1. High-level fluvial material at Webb Farm Site (15BE517).

Kevin Williamson Farm Site (15BE518; located north of SR 536 on Dale Williamson Road)*.* By this time, geological topographic maps had been obtained, and the locations of high-level fluvial deposits had been assessed. Thus, during a visit to the Williamson farm to obtain some wood, it was observed that the area around the bark had a number of the brownish stones commonly seen on the Webb farm. Mr. Williamson was questioned regarding the presence of these stones to determine if he had dumped them there or if they were natural. His comment was "*they have always been there*". Permission was granted and on May 5, 2005 the three fields that lie between Dale Williamson Road and Gunpowder Creek were examined. Again, flakes of the same type of high-level fluvial associated chert were observed; however, in this case, there were a number of stones related to glacial outwash. The interesting point, though, is that it seemed that very few, if any, flakes were of glacial chert. The only use for which the glacial material seemed to have been employed was for hammer or grinding stones.

Three gravel deposits, adjacent to the farm, in the Gunpowder Creek were examined, and the majority of the pebbles observed were of the high-level fluvial material. This would be expected since the ancient stream crossed what is now Gunpowder Creek about 1 kilometer upstream. The high ridge to the west of the farm has an indication of the presence of a considerable amount of the high-level fluvial material. *Total flakes reviewed: 33**

Flaig Site (15BE429; located immediately south of SR 536 with the Gunpowder Creek on the east edge)*.* This site had already been reported, but only a limited review had been completed. The site was large and was divided into three areas, but only two provided any indication of occupation. The lowest area had been flooded, and sediment covered the field. The highest field area (Field 1) produced the largest amount of material. Local collectors were there previously and during each of the times a survey was conducted. They presented items associated with Early and Late Archaic periods. Basically two-thirds of the flakes collected in Field 1 had a high-level fluvial association. The remaining flakes were glacial with the exception of one "Paoli" flake scraper. There were a number of glacial outwash small boulders and considerable fire-cracked rock (FCR). *Total flakes reviewed: 42**

Field 2 provided two broken triangular bifaces, suggesting a Late Woodland period association. All but one of the flakes found in this field was associated with high-level fluvial material. The number of glacial outwash stones was very high, especially on the western side of the field. It looked as though they had been collected and spread over a long narrow area. Most were non-igneous. *Total flakes reviewed: 20**

Flaig GP (located on a 30 degree slope on the west edge of Field 1, leading down to the flooded field). The material on this slope probably washed down from the eastern side of Field 1 and was similar to that found in Field 1. *Total flakes reviewed: 24**

Riddle Run 1 (15BE540; **located east of 15BE429, east of Riddle Run Road and south of SR 536)*.*** This was a very large field, but cultural material was focused in a rather narrow area along the northern edge of the field. There were two areas divided by a large space where little cultural material was observed. The northeast section of the field had a deposit of high-fluvial material made up of mostly small gravel. A few flakes were observed and all but one was of a high-level fluvial origin. *Total flakes reviewed: 28**

The more western area of the fielded yielded a large number of flakes with 83 percent being represented by high-level fluvial chert. Two drills, several bifaces, hammerstones, and fire cracked rock were observed. However, as in other sites along the Gunpowder Creek, the use of glacial material was somewhat limited to hammerstones or grinding tools. *Total flakes reviewed: 297**

Riddle Run 2 (15BE541; located south of 15BE540 and Riddle Run Creek, east of Riddle Run Road). The distribution of cultural material suggested occupation extended from Riddle Run Road to the top of the ridge, but the majority of cultural material was observed near the top of the ridge. Over 600 chert flakes were observed, and 100 percent were associated with high-level fluvial material. Also, there was a high proportion of black chert present. Some small pieces of grit-tempered pottery were found, and a Jack's Reef Pentagonal and Perkioman like points were found. Most of the glacial material was broken (FCR), and the hammerstones were of material associated with the high-level fluvial deposits. *Total flakes reviewed: 646**

Liberty Hill 2 *(located about 0.2 kilometers south of Cleek Lane and about 0.3 kilometers east of 15BE476.)*. A house was to be constructed, and the topsoil was removed and placed in three large mounds adjacent to the construction site. This exposed several fire pits, chert flakes, pottery fragments, FCR and chunks of chert and other quartz-containing material. The tenant on the farm reported finding two triangular points after the soil had been removed. This was not confirmed. The pottery, however, was Late Woodland. All of the flakes and chert chunks were associated with high-level fluvial deposits. *Total flakes reviewed: 53**

Brookhaven Farm (located adjacent to Gunpowder Creek, 0.1 kilometers downstream from the SR 237 bridge across creek - Camp Ernst Road)*.* This location was not formally recorded as a site since only two high-level fluvial chert flakes and one broken spear point (high-level fluvial) were found. However, it is significant in that there is a deposit of high-level fluvial material present that is not specifically identified on the Union geologic quadrangle map. Evidence of high-level fluvial material is present in several areas of this farm but the amounts are small. It is unknown how extensive the deposit is, but it is located 9 kilometers upstream from 15BE518 where the ancient river is shown to have gone toward the current Ohio River. There is, however, a branch extending toward the upstream section of the Gunpowder Creek indicated on the Rising Sun map, but there is no indication of this branch on the Union map. The literature cited indicated that the ancient river meandered up to 5 kilometers from the central course of the river; thus, other deposits may be present that have not been mapped.

It is possible that the source of the high-level fluvial chert flakes a local collector provided for review was at or near the Brookhaven Farm (see summary).

Landing Spring Farm and adjacent areas. To the northwest of Big Bone Lick, there is an area where the Ancient (Old) Kentucky River flowed leaving very extensive deposits of sand and gravel. A considerable amount of chert occurs in these deposits. Samples of chert flakes and artifacts collected by property owners indicated that of 105 flakes, 100 were associated with the high-level fluvial deposits. The other five flakes were from southern Indiana: four of Harrison County and one of Wyandotte. All but two of the dozen or so projectile points were made from chert associated with the "high-level fluvial" deposits. Also, there was one hammerstone and it "quartzite" from the deposits. There were at least ten celts and all of these were either composed of basalt or granite which is not common in the immediate area. There are four identified/reported sites on the farm. Three are open habitation, and one is a mound that had been excavated in the 1940s by William S. Webb. These sites were located at the northern edge of where the Old Kentucky River turned from a northwesterly direction to a south to southwesterly flow. A small stream cuts along the path of the Old Kentucky River and high-level fluvial deposits may be observed along most of this stream.

The stream originates as a very active spring (thus the name for the farm). This spring was producing a rather high flow volume when visited on September 28, 2007 even after little or no rain has fallen in the area for many weeks.

Discussion/Additional Information

Sections of Boone County are rapidly being converted from farmland to housing projects, shopping areas, schools, and places of business. Also, many of the farms that may have grown crops that required tilling of the soil have now converted their fields to pastures or hay crops. Thus, the opportunity to continue this survey to assess the aboriginal utilization of ancient Kentucky River high-level fluvial deposits is becoming limited. One objective at this point is to attempt to continue to determine the distribution of sites that contain evidence of high-level fluvial chert utilization. How far to the east of the known high-level fluvial chert deposits does utilization occur? Also, locating currently unmapped elements of the ancient river meander may afford information on distribution patterns.

This review has suggested that the high-level fluvial deposits associated with Big Bone Lick, the Webb Farm (15BE517), and the Landing Spring area afforded a rich supply of lithic material to the Native Americans who visited the area (**Figure 2**). Big Bone Lick has always been considered important due to the salt deposits and the animals that were attracted to the salt. The Native Americans used the salt and harvested the animals that sought the salt. However, they likewise used Big Bone Lick as a raw material resource area for chert and other stone.

A permit was granted by the Kentucky Park Cabinet to obtain a sample of chert from the Big Bone Lick Park. Three areas were reviewed and samples collected. Big Bone Creek contained a considerable amount of high-level fluvial associate material; however, most of the material was small and very weathered. Two streams that drain from the ridge on which the campground is located offer larger and less weather-damaged elements of the ancient deposits. The largest amount of high-level fluvial material, however, was located in the small stream that flows north from the campground and passes the newly constructed office/gift shop building. Large pieces of chert, geodes, quartz pebbles and other remnants of the high-level fluvial deposits were common.

As indicated in this report, much of the chert and other material is associated with Mississippian limestone. However, Devonian, Silurian, and Ordovician material is, likewise, present. A microscopic review of chert flakes, found at the sites listed in this report, could mislead someone to assume that Native Americans traveled many miles or traded with others to obtain the raw material that is represented if they were not aware of the ancient river-associated deposits.

Figure 2. Display of high-fluvial chert from Webb Farm (15BE517) and Big Bone Creek.

Discussions with some archaeologists have suggested that this may have occurred. In fact, I have done this in relation to two chert items that closely resemble chert obtained from outcrops in Carter County, Kentucky. A "Paoli" flake scraper found at the Flaig Site (15BE429) and an "Upper Newman – non-oolitic Haney" scraper found at Field 2, Webb Farm Site (15BE517), are easily matched with samples obtained at 15CR221 and 15CR102 respectively, which are quarry/workshop sites. Were these flakes associated with material gathered in Carter County, or are they related to the erosion of material from the Mississippian limestone that contained these chert types? Devonian and Silurian chert types are represented, and these can be identified as Boyle and Brassfield but they were not collected by Native Americans in Silurian or Devonian limestone outcrops.

Jeannine Kreinbrink, a local archaeologist, has offered the opportunity to review some of the Boone County-associated archaeological site collections housed at a Covington museum. Such a review may provide an opportunity to assess the distribution of high-level fluvial chert in areas of the county that extend beyond the study area indicated in this review.

It should be noted that the quality of some of the high-level fluvial associated chert is exceptional. This is specifically true for the black chert types. Frequently, these are found in deposits with a very white patina and in the shape of rectangles, however, more rounded forms are also observed. A local flint knapper was provided pieces of this material to assess the quality and has produced several exceptional point reproductions and drills for school and outdoor programs.

Disposition of Artifacts

The Kentucky Archaeological Survey has agreed to curate the artifacts (chert flakes, tools, and projectile points) that were obtained during the reviews of the Boone County sites listed in this document (designated with an asterisk). These will be made available for any future study by archaeologists interested in Boone County Native American prehistory.

The artifacts found at Big Bone Lick have been placed in a display case and returned to Big Bone Lick State Part for display in the Nature Center museum.

Summary

The review of western Boone County sites, including Big Bone Lick, has resulted in the determination that most of the chert utilized was associated with the naturally occurring ancient (Old) Kentucky River high-level fluvial deposits. (**Table 1**) The review suggested that, for upland sites away from the Gunpowder Creek (south of SR 338), glacial material was only used for making celts. One celt was observed at the Maley Farm Site (15BE475), the tenant collected four at Combs-Beach Liberty Hill Site (15BE476), and ten or more were collected by the owners of the Landing Spring Farm.

For sites along the Gunpowder Creek, the majority of chert flakes were associated with high-level fluvial deposits, but some glacial and exotic chert flakes were observed. Glacial material otherwise was used only as hammers and grinding tools. The review of the 1557 flakes collected during this study plus those collected by others has indicated that 96 percent were of high-level fluvial origin.

A review of the USGS geologic quadrangle maps covering the study area in Boone County has suggested that if high-level fluvial deposits were within 1.5 kilometers of an archaeological site, it would be expected that this material would be extensively used. This review needs to be expanded to sites farther away from the deposits to evaluate the full dimension of utilization.

A suggestion of the possible wider utilization of high-level fluvial chert has come from a sample of chert flakes provided by a local collector. It was indicated that the sites were north of SR 536, which was several kilometers from Big Bone Lick and it was further suggested that these sites were, likewise, several kilometers from the high-level fluvial deposits indicated on the three USGS maps utilized in the study (**Table 2**).

Native Americans had access to local lithic resources that provided chert and other silicon-based stone for the production of a variety of tools. These resources are widely distributed north of Carrollton, Kentucky to northwestern Boone County.

Table 1. Review of Chert from Sites in Boone County Kentucky

Location	High-Fluvial		Glacial Chert		Other	Comments
	Flakes	Chunks	Flakes	Chunk		
CBLH 1 (15BE476)	180	12				2 FA PT., 4 FA KN, 3 BF
CBLH 2 (15BE_)	53	1				2 triangle points
Flaig (15BE429) (1)	31	1	11	2	Paoli scraper	
Flaig (15BE429) (2)	19	4	1			HF:2 biface, 2 utilized flakes
Flaig (15BE429) GP	24		1			near Gunpowder Creek
Maley Farm 15BE475	49					1 preform, 1 Palmer point (broken)
Riddle Run 1 (15BE540) N-E	27	1				1 BF, 1 utilized flake
Riddle Run 1 (15BE540) west	253	20	44			4 BF, 3 Pt, 7 utilized flakes, 2 drills
Riddle Run 2 (15BE541)	646	20			Point (?)	HF: 1 PT, 24 utilized flakes, 5 cores
Thomas Site (15BE247) east	13	5				1 utilized flake
Thomas Site (15BE247) west	118	6				6 utilized flakes, 1 preform
Webb Farm (15BE517)	52					1 BF broken
Webb Farm (15BE517) (1)		1				
Webb Farm (15BE517) (2)	2	4			UN scraper	
Williamson 1 (15BE518)	9	1				HF biface
Williamson 2 (15BE518)	2					
Williamson 3 (15BE518)	21	4	1	2		2 utilized HF flakes
Landing Springs 15BE17,416,430,431	103	2			Harrison Co. Wyandotte	several biface points of HF material
Totals	**1602**	**82**	**58**	**4**	**5**	

Note1: HF= high-level fluvial, BF= biface (all broken), PT= point, FA= Fort Ancient, KN= knife, UN= Upper Newman (Carter Co.).
Note 2: 96% of the flakes listed here are associated with high-level fluvial deposits.
Note 3: Flaig (15BE429) and Thomas Site (15BE247) were requested revisits to survey the sites and report on results.

Table 2. Boone County, Kentucky Archaeological Sites: Chert Review

Chert Type	Not used	Used	Total	Scraper S	Knife K	Punch P	S/K	P/K	S/P	Biface
Harrison County	60	21	81	16	0	2	1	1	0	1
High-level Fluvial	187	21	208	13	5	1	0	1	1	3
Upper Newman?	1	1	2	1	0	0	0	0		
Unknown	1	0	1	0	0					
Total	**249**	**43**	**292**	**30**	**5**	**3**	**1**	**2**	**1**	**4**

Note 1: These flakes were provided by a collector who indicated that he had reviewed sites to the north of SR 536.

Note 2: The percentage of high-level fluvial chert in this review is 71.2%.

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PRELIMINARY GEOLOGICAL MODELING AND TESTING OF POTENTIAL CHERT EXTRACTION LOCATIONS AT FORT KNOX U.S. ARMY GARRISON, KENTUCKY

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Abstract

Gray & Pape, Inc. conducted archaeological surveys at Fort Knox U.S. Army Garrison in 2005 with the goal of not only providing cultural resource assessment, but also to develop a preliminary model for the identification of potential prehistoric chert quarries. First, underlying bedrock sources as documented on geologic quadrangles were reviewed. Second, factors that influence the development of a quarry and the type of extraction processes per criteria proposed by Philip LaPorta were examined. Third, the predictive power of these methods was evaluated through field reconnaissance in selected survey areas. Finally, a number of recommendations for future research were made.

In the summer of 2005, Gray & Pape, Inc. conducted an archaeological survey at several areas at Fort Knox U.S. Army Garrison (Fort Knox) (**Figure 1**). Dr. R. Criss Helmkamp, the Cultural Resources Program manager at the garrison, expressed an interest that the survey incorporate some investigation of chert resources on the base, and he provided Gray & Pape with some degree of flexibility in designing this research within certain limitations. The primary limitation was that the areas to be investigated needed to be contiguous areas that would fulfill the administrative requirements to survey a certain number of acres during the calendar year. In addition to a series of areas that required survey for imminent construction projects, we were permitted to select two areas that could serve to support our research. These areas could not have been previously subjected to archaeological survey, and they could not be located in areas of the base to which access was restricted.

The purpose of the research was to provide a preliminary model for the identification of potential prehistoric chert quarries at Fort Knox. It is important to note that this research was not intended to be an all-inclusive effort. Instead, it is meant to be a preliminary assessment towards documenting and evaluating the potential for the archaeological signatures of chert extraction loci. As a result, it has focused on the use of primary geologic references in determining potential locations for chert extraction and subsequent, although limited, field verification.

The identification of chert extraction loci is an important factor in reconstructing past human behavior, particularly in placing individual archaeological sites into larger regional contexts. In terms of chert, this is best accomplished by using the concept of the *chaîne opératoire*. This refers to

> [T]he different stages of tool production from the acquisition of raw material to the final abandonment of the desired and/or used objects. By reconstructing the operational sequence we reveal the choices made by…humans (Bar-Yosef et al. 1992:511).

Although it originated in the Old World, this concept has been applied successfully to archaeological analysis in Kentucky, notably by Wall et al. (1995) and Miller and Duerksen (1995). While the acquisition of raw materials is clearly the first physical step in this sequence, it cannot be viewed as a starting point. The selection of raw material for creating stone tools is part of an ongoing process of tool manufacture, use, maintenance, and discard that occurs across

Figure 1. Unnamed tributary to Mill Creek in the Canby Hill Area.

time and space. Although all steps within this process are the result of human agency constrained by physical and social limitations, raw material acquisition is unique within this process in that it is the one step that is fixed in space by the presence of raw material occurring in the natural world. This constraint and the potential uneven distribution of these materials provides a starting point for our research: that is, the identification of suitable materials and their potential locations on the landscape. Further, we cannot determine the potential social limitations placed upon the actors in this process, although the physical result of these behaviors can potentially be identified.

The Geological Setting

The investigation began with a review of the general archaeological and geological literature for the area, including The Geology of Kentucky – A Text to Accompany the Geologic Map of Kentucky (McDowell 2001), the appropriate USGS 7.5-minute-series geologic quadrangles. Although essential for understanding the general geology of the area, these resources are very generalized in nature and ultimately, as we will demonstrate, of limited value in detecting the presence of prehistoric chert extraction loci.

Generally, the bedrock geology of the Fort Knox region consists of Silurian and Devonian shales and carbonates that are capped by Mississippian limestones (Grabowski 2001; Pollack 1990; Whitaker and Waters 1986). The Knobstone Escarpment and the area of Fort Knox northeast of the Salt River are capped with St. Louis limestone, but are underlain by the erodible shales of the Borden Formation (Whitaker and Waters 1986). The narrow ridges and knobs of the area further east are capped with an acidic siltstone of the Borden Formation (Kepferle 1967). Floodplains of the Ohio and Salt Rivers are composed primarily of fine to coarse alluvial and lacustrine deposits, ranging from 3 meters to more than 25 meters in depth (Kepferle 1967). The landscape west of the escarpment is composed primarily of rolling uplands and karstic plains containing numerous sinkholes and depressions (Quarterman and Powell 1978). Of primary concern for this research are the Mississippian formations, including the Borden Formation, the Salem, Warsaw, and Harrodsburg Limestones, and the Ste. Genevieve and St. Louis limestones, as these are the chert-bearing deposits in the area.

The Borden Formation is the oldest of the Mississippian formations in the area. This formation developed in basinal and delataic deposition during the Early Mississippian time (Grabowski 2001:3). While the lower portions of this formation include shales, these are overlain by the Muldraugh Member. The Muldraugh Member is "considered to be a thinned lateral equivalent of the Fort Payne Formation… [i]t is a silty and cherty dolomite, but contains smaller bodies of crinoidal limestone and some silty shale" (Grabowski 2001:4).

Previous archaeological descriptions of the chert described as Muldraugh chert note that it originates in the "Knobs of Kentucky along Muldraugh escarpment – probably in Salem or Harrodsburg formations…It occurs as angular, blocky pieces in colluvia as well as poorly rounded cobbles in streams" (Boisvert et al. 1979:71).

The Salem, Warsaw, and Harrodsburg limestones formed in shallow sea conditions that followed the basin-filling episode in which the Borden Formation originated (Grabowski 2001:5), although each material was deposited under slightly different conditions. Salem Limestone is dark, "dolomitic siltstone and shale, with minor bodies of skeletal limestone in the lower part, overlain by argillaceous, cross-bedded limestone in the upper part" (Grabowski 2001:6). Salem Limestone originates in shallow marine or lagoonal contexts. The Warsaw Limestone "is a mixture of argillaceous, cross-bedded skeletal limestone and dark, dolomitic siltstone and shale (Grabowski 2001:6), which reflects formation in shallow marine waters more turbid than that in which the Harrodsburg limestone formed. The Harrodsburg Limestone resembles the limestone which occurs in the Borden formation, but "has more calcite cement and less argillaceous matrix" (Grabowski 2001:5).

Harrodsburg chert has been described as dark olive brown to tan, sometimes visibly grainy in appearance, with some fossil inclusions. It occurs in bedded contexts and as irregular nodules (Davis 1999:83). Davis (1999:83) indicates that this material may correspond to what Boisvert et al. (1979:71) identified as Coquina Muldraugh chert, which occurs in colluvium in stream valleys in the vicinity of Fort Knox (note that Davis [1999:83] erroneously references Collins [1979] as the source of this information).

The St. Louis and Ste. Genevieve limestones underlie the karstic plains in Kentucky west of the Falls of the Ohio. The St. Louis Limestone is "very fine-grained, somewhat cherty, argillaceous and dolomitic limestone with some beds of skeletal limestone" (Grabowski 2001:7) that formed in a shallow marine environment. It "is divided into two informal members separated by a zone of abundant chert" (Grabowski 2001:6-7). There is a 3.28-meter to 6.56-meter thick layer of extremely cherty limestone near the top of the St. Louis Limestone.

Chert derived from the St. Louis Limestone has been described as "very fine-grained chert composed primarily of cryptocrystalline quartz…Fossils, especially coelenterate remains commonly can be found (Vento 1983:713). Macroscopically, the chert can be blue and olive, grayish blue, tan mottled, or green (Davis 1999:94; Vento 1983:713).

The Ste. Genevieve Limestone, which overlies the St. Louis Limestone, formed as sandbars and shoals in a shallow marine environment and is divided into three members. The Fredonia Member, which is the lowermost and thickest, is "a very light gray, cross-bedded and massive, oolitic to skeletal limestone" (Grabowski 2001:7). This member is overlain by the Rosiclaire Sandstone Member, which is composed of calcareous limestone and shale. The Levias Limestone Member, which is the uppermost, "is an oolitic to skeletal limestone similar to Fredonia (Grabowski 2001:7).

Chert deriving from the Ste. Genevieve Limestone is composed primarily of microcrystalline quartz with inclusions and vugs of microfibrous authigenic quartz. (Vento 1983:713). The chert has been described as vitreous to semi-vitreous, light to medium blue, or olive gray to yellowish gray in concentric bands (Davis 1999:92), and reddish gray (Gatus 1980:587).

It is important to note that the chert commonly referred to as Indiana Hornstone, or Harrison County chert "can be best classified as belonging either to the Upper St. Louis or basal Ste. Genevieve chert-bearing limestones" (Vento 1983:719).

In addition to the primary contexts discussed above, chert is also present as gravel in the Pleistocene and Holocene alluvium that covers the lowland portions of the base (Kepferle 1967). These gravels are well exposed in stream bottoms.

The Development of Prehistoric Quarries

Philip LaPorta has identified several factors that influence the development of a quarry and the type of extraction processes employed. The following discussion of these factors is taken directly from LaPorta (2005:124-125).

1. Concentration of raw material-bearing units. The association of several closely-spaced material beds (e.g., chert beds) presents an attractive target for mining. The close spatial proximity of two or more raw material units increases the ore value (i.e., the tenor of the ore).

2. General inclination, or dip, of the raw material-bearing rocks in the subsurface (bedding attitude). Levers and wedges can be used to extract chert from beds dipping 10° or more. Raw material extraction from horizontal, or sub-horizontal beds, usually involves the removal of great quantities of overburden, unless the beds are exposed along the face of a cliff.

3. Thickness of the surrounding rocks.

4. Thickness of the ore within a bed. Criteria 3 and 4 go hand in hand, as they involve an assessment of the worthiness of the mining effort. The ore may be very high grade, but if the surrounding rocks are too thick the effort expended may be too great to make quarrying worthwhile. Alternately, the ore may not be the best grade of material, but if the surrounding rock is relatively easy to remove, or if a number of low-grade ore beds are closely spaced, the ore value is increased and the lower-grade ore may become the preferred target.

5. Presence of well-defined bedding planes. Where bedding plane surfaces exhibit a contrast in grain size, the weakness therein developed may be exploited to break rock. At many locations, where chert comprises a distinct unit between beds of dolomite, a force applied directly to the interface between the chert and dolomite is sufficient to dislodge the chert.

6. Presence and orientation of joint surfaces. This is particularly important with regard to conjugate joints (intersecting joint sets) and/or fracture cleavage; the domains of the cleavage and joints serve as the focal point for wedge and lever work. The volume of chert between the cleavage domains (microlithon) is the ore of varying grade to be mined.

7. Presence of a stable platform below the zone of extraction. The stable platform in front of or below the zone of extraction aids in providing access to strata from a position above, on the side, or below the quarry face.

8. Availability of glacial till which includes boulders of high-rank metamorphic rocks (preferably quartzites), or else another mineable formation of suitable material as a source of hammerstones. The full-scale development of a quarry relies upon the prevalence of hammerstones of varying degrees of elasticity (LaPorta 2005:124-125).

All of these factors refer specifically to the mining of chert from primary geological contexts, and are not necessarily relevant to the extraction of chert from alluvial settings. Nevertheless, this list provides a set of criteria against which we were able to compare the available mapping in search of promising areas. We would further add that the "knappability" of cherts is an important element in the selection of which potentially exploitable chert sources would actually be exploited. This adds a degree of human agency to the process that is not accounted for in LaPorta's model.

Selection of Survey Areas

Armed with the geologic background information and LaPorta's criteria, the investigators set about to select areas for survey. The information available suggested three potential situations in which quarries might be identified. The first was the mining in intact geological formations, including the Muldraugh Member of the Borden Formation; the Salem, Warsaw, and Harrodsburg Limestones; and the Ste. Genevieve and St. Louis Limestones. Mines located to exploit these deposits are likely to be subject to LaPorta's criteria. If they are not, then the model developed by LaPorta is not applicable to the current setting. In either event, locations favorable for the extraction of chert are likely to be exploited repeatedly.

The second potential situation in which a quarry might be identified is in alluvial and colluvial deposits in stream valleys in the western part of the base. These deposits date from the Pleistocene and Holocene and include gravels and cobbles derived from the bedrock of the surrounding hillsides. Chert sources in these deposits would be small, unpredictable, and would likely be gathered as they are encountered. It is likely that extraction sites in these settings would be represented by debitage and abandoned cores or preforms, perhaps accompanied by some unusable raw material.

The third potential situation occurs in or adjacent to karstic features such as sinkholes in St. Louis or Ste. Genevieve Limestone. Extraction locations in these settings might be long-term or short-term, depending upon the amount of chert present in the area. The exploitation of these features is well documented in karstic areas. Besides often holding seasonal water sources, sinks provide an opportunity to easily exploit eroded nodules of chert. In essence, sinks are often the natural equivalent of man-made divits such as those recorded at the famous quarries like Flint Ridge in Ohio and the jasper quarries of the Hardyston Formation in Eastern Pennsylvania. Exploitation of the chert in sinks often provides abundant resources with minimal efforts.

Kentucky geologic quadrangles for the Fort Knox study area were acquired from the Kentucky Division of Geographic Information website (http://gis.ky.gov). The informational collars from these images were cropped out and a mosaic was created using ArcGIS 9.1 (Environmental Systems Research Institute 2006). All contacts, strikes, and historic-era quarries were digitized so that these features could be overlaid on other data layers, e.g., aerial photos, USGS topographic quadrangles (also acquired from the Kentucky Division of Geographic Information website). The corresponding geologic members and/or deposits were attributed for each contact, strike, and quarry. Various maps were created using these digitized geologic quadrangle data for use in the selection of our survey areas.

The project required that the areas investigated be contiguous to qualify as acreage subjected to archaeological survey for the purposes of resource management on the garrison. Two sinkholes were located in areas previously selected for survey and part of the larger project under which these investigations were conducted, and so additional karstic areas were not included. The selection of additional areas was undertaken in order to explore other potential quarry locations. Two areas were selected based on slightly different criteria.

The Canby Hill Area was selected because the geologic quadrangle indicates that there are exposed joints at locations where Muldraugh, Harrodsburg, and St. Louis material appear to be exposed. The exposed joints should provide access to potentially chert-bearing material. Field investigations of this area were intended to observe and identify the individual

Figure 2. Stream gravels in the Canby Hill Area.

joints, examine them for the presence of chert and quarrying activities, and evaluate any chert in terms of suitability for knapping. The investigations also were intended to examine the remainder of the Canby Hill Area, including stream cuts and stream bottoms (**Figure 2**).

The Cedar Point Branch Area was selected based on the presence of a permanent watercourse that cuts through all potentially chert-bearing deposits, including both primary and alluvial deposits. Furthermore, there are no exposed joints documented on the geologic quadrangle. This begs the question of whether one should limit the selection areas to be examined to those for which exposed joints are depicted on the geologic quadrangles. Without a detailed description of the methodology used in creating these quadrangles, it cannot be known whether these areas were field-checked by a geologist and no joints were observed, or whether these areas were not examined at all.

These survey areas were digitized from the contours on the geologic quadrangles, and then uploaded to a Trimble GeoXT GPS unit along with the contact, strike, and quarry data so that our survey team could easily navigate to these areas and locate the known exposures. Both areas were examined for primary and secondary deposits of chert. In addition, these areas were evaluated in terms of LaPorta's (2005:124-125) criteria for the development of mines (quarries).

The Canby Hill Area

The Canby Hill Area is 57.5 hectares in size and located on the steep north- and east-facing slopes of Canby Hill overlooking Mill Creek in Hardin County. Geologically, the area is located atop the Muldraugh and Nancy Members of the Borden Formation, and the Salem Limestone. The St. Louis Limestone sits atop the Salem Limestone, but is located at elevations greater than the survey area.

Soils in the Canby Hill Area include Markland silty clay, 6 to 12 percent slopes, severely eroded; Caneyville-Rock outcrop complex, 20 to 30 percent slopes; McGary silt loam; Hagerstown silt loam, 12 to 20 percent slopes; and Nolin silt loam (Arms et al. 1979). The soil survey for Hardin County does not provide information on the derivation of the soils; however, the soils information indicates a combination of slopes, alluvium, and erosion. The Nolin silt loam, which represents the only alluvial deposit, is located along an unnamed tributary to Mill Creek.

Fieldwork in the Canby Hill Area focused on identification of exposed contacts, and survey for potential chert sources. The only joints that were identified during the fieldwork were those located along the road in the southwestern portion of the area (**Figure 3**). The remaining joints visible on the geologic quadrangle were not identified in the field.

The joints that were identified and examined are between the Harrodsburg Limestone and the Muldraugh Member of the Borden Formation, and Harrodsburg Limestone and the St. Louis Limestone. These joints were exposed on the surface, and the joint between the Harrodsburg Limestone and the Muldraugh Member contained a brecciated bedded chert containing abundant fossils largely consisting of crinoid fragments. The exposed chert, which appeared to originate in the Muldraugh Member, measured 54 millimeters in thickness. Due to the amount of fossil inclusions, the texture of this chert is saccharoidal and contains numerous sealed and unsealed fracture plains which, along with the relative thinness of the deposit, effectively limit the usefulness of this deposit for prehistoric knappers.

Chert, although not abundant, was recorded in an unnamed tributary to Mill Creek, below the aforementioned area. Numerous eroded pieces of chert were recorded in the stream gravels (**Figures 2**), although these comprised less than 10 percent of the gravel present. The chert was eroded and included small pieces of bedded cherts and boudin-shaped pods of brecciated saccharoidal-textured chert that contained abundant sealed and unsealed fractures. These pieces ranged in size from 69 millimeters to less than 25 millimeters, which are appropriate for fashioning only the very smallest prehistoric tools, such as retouched flakes.

Lacking cherts identified in primary geologic context in this area, we cannot evaluate LaPorta's model in any affirmative way. It is possible to state, however, that in many locations along the steep slopes, there are colluvial slopes and terraces that, had chert been present, would serve as suitable platforms for quarrying.

The Cedar Point Branch Area

The Cedar Point Branch Area included 67 hectares located on the steep slopes and valley bottom of Cedar Point Branch and one of its unnamed tributaries (**Figure 3**). The valley bottom is composed of Quaternary alluvium, while the valley walls include the Nancy and Muldraugh Members of the Borden Formation, the Harrodsburg Limestone, and the St. Louis Limestone.

Soils in the area include Caneyville-Rock outcrop complex, 20 to 40 percent slope; Crider silt loam, 6 to 12 percent, eroded; Crider silt loam, 12 to 20 percent, eroded; Garmon silt loam, 25 to 60 percent slopes; and Sensabaugh gravelly loam, occasionally flooded, which is located along the valley bottom (Whitaker and Waters 1986). The soils on the hilltops above the valley are described as severely eroded, a factor that is of great significance to the current research.

As there were no strikes located on the geologic quadrangles, the goals of the fieldwork in this area were to investigate the potential for chert sources at various locations in the stream valley. Rock outcrops were visible at several places, all of which were relatively high on the valley walls and consisted of outcrops of Harrodsburg Limestone (**Figure 4**). The exposures include interbeds of silty dolomitic limestone, which is characteristic of the lower part of the formation in this area (Kepferle 1977). No chert was noted in any portion of these outcrops. The Muldraugh Member of the Borden Formation underlies the Harrodsburg Limestone in the area and is entirely obscured by sediment within the valley. It is not clear, however, whether this sediment is ancient, or if it is related to the erosion of the hilltops during historic-period farming and deforestation.

Figure 3. Looking East along the Cedar Point Branch.

Figure 4. Rock outcrops in the Cedar Point Branch Area.

Throughout most of the valley, the stream bed in the valley bottom contains small, irregularly shaped tabs of limestone and gravels of varying sizes and origins (**Figure 5**). Near the western end of the study area, however, where the geologic quadrangle indicates that Quaternary alluvium is present, the gravel is generally smaller and more uniform in size but contains larger, blockier fragments of limestone (**Figure 6**). Chert was also documented in this area, including large blocky fragments of Muldraugh chert. These chert blocks, although containing some unsealed and sealed fractures, has a semi-vitreous texture and is easily flaked in a predictable manner once the fractures and fabric are identified and exploited. Further, prehistoric debitage was recorded in the stream gravels. Although it cannot be conclusively demonstrated that the chert was flaked at this location, it is clear that some exploitation activities were being conducted within the general vicinity.

The chert that occurs in the stream valley may be of two origins. It may be naturally occurring in the stream bottom as part of the alluvial deposits therein, that is, dating to the Pleistocene and earlier Holocene events that deposited the majority of this material. The other alternative is that it represents recent deposits of Muldraugh Member materials derived from intact geological deposits on the valley walls. As these deposits are now obscured by colluvium, it is not possible to compare the samples obtained from the valley bottom to deposits in primary contexts, nor is it possible to state that there are usable chert deposits in the Muldraugh Member within this stream valley. However, prehistoric people may have been able to obtain Muldraugh chert in the Cedar Point Branch Valley.

As was the case in the Canby Hill Area, we cannot evaluate LaPorta's model due to a lack of chert in primary geological context. It is possible to state, however, again as was the case in the Canby Hill Area, that there are colluvial slopes and terraces along the valley walls that, had chert been present, would serve as suitable platforms for quarrying.

Figure 5. Stream bed gravels in eastern portion of the Cedar Point Branch Area.

Figure 6. Stream bed gravels in western portion of the Cedar Point Branch Area.

Additional Observations

Two sinkholes were located within survey areas in the Cantonment Area at Fort Knox. Each of these had been the site of severe erosion, and one had been partially filled as a part of golf course construction or maintenance. The area around and within each was subjected to a thorough surface examination and some opportunistic shovel probing. No chert was identified within either sinkhole.

The karstic plain that is located adjacent to the western portions of the installation, in the area around Lickskillet, have been subjected to various unrelated archaeological investigations by the authors of the current paper. These investigations recovered abundant nodular chert that is vitreous and macroscopically identical to Wyandotte sources. Sites recorded as a result of those efforts indicated exploitation of sinkholes to acquire these raw materials.

Another observation can be made in relation to the recently conducted quarry research at Ft. Campbell. In comparison to Ft. Campbell, the physiography at Ft. Knox is more maturely dissected with steeper slopes and with exposures of cherts in these settings. Further, no felsemeer (boulder-seas) were identified within either of the survey areas included in the Ft. Knox research, while they are a prominent resource at Ft. Campbell, especially in the Fletchers Fork drainage. As such, it is unlikely that the streambeds were exploited at Ft. Knox in the same manner as those at Ft. Campbell. Further, it is also probable that the exposures along the slopes of the Salt River and other drainages contain quarries that are covered with recent colluvium. Although both posts contain karstic plains and numerous sinks, these have not been evaluated for evidence of quarrying to any great extent at Ft. Knox. LaPorta's recent research at Ft. Campbell (LaPorta et al. 2006) has demonstrated, however, that geologic models can provide significant results for identifying quarries and extraction zones for chert.

Evaluation

This preliminary evaluation of potential chert sources at Fort Knox provides important information for use in further modeling. First, it is important to note that geologic quadrangles are of limited utility in this exercise. The quadrangles do provide vital information concerning the locations of the geologic formations that are known to contain chert. However, information concerning exposed contacts is not necessarily useful for archaeological concerns. Mapped contacts may be artificial exposures, and the contacts may not be easily relocatable. Further, the geologic quadrangles indicate exposed contacts and joints only. Outcrops that do not include identifiable joints of contacts are not mapped. It also appears to be the case that contacts and joints are mapped as part of a general rather than systematic geologic examination of the area. It is suggested that the exposures mapped on geologic quadrangles be used to acquaint oneself with the geology of the area, but that they not be used in a predictive manner.

A second major limitation of the geologic quadrangles is that they are useful only in providing broad generalizations concerning geologic formations. The geologists responsible for producing these maps provide descriptions of chert because it is part of the petrographic descriptive data. There is little said in these descriptions concerning the thickness of chert beds, the uniformity of the material, etc. One should use these descriptions solely to learn whether chert is present or absent. Any further evaluation must be derived from field examination of chert by an archaeologist or geologist interested in the prehistoric use of chert.

Lacking chert deposits in primary geological context, it is not possible to evaluate LaPorta's model for chert quarry locations. It is important to bear in mind for future research, however, that his model is limited to settings with chert that is in primary geological context. The preliminary results at Fort Knox suggest that chert is available from alluvial deposits as well as possibly being extracted from primary geological contexts. LaPorta's model does not apply to such settings;, however, it should remain a tool to be used in looking at potential quarry locations.

The results of the current research make clear that we cannot rely on the geologic quadrangles for information concerning chert sources. The geologic quadrangles are vital in providing information concerning the geologic formations present and whether or not they contain chert. However, the geologic quadrangles do not provide any information concerning the suitability of chert for knapping, nor do they provide information concerning where chert outcrops. One can assume that the descriptions of the deposits are derived from mapped exposures, however, these may or may not be natural exposures, and may or may not be relocatable.

Recommendations for Future Research

The results of the current research illustrate the difficulties in conducting scientific research into raw material sourcing in a cultural resources management context. Due to the constraints of the project, it was necessary to develop a preliminary model based on available documentation and test the model against very limited areas. Nevertheless, this preliminary testing provides important information that can be used to provide guidance for future research. Recommendations for the design of future research are presented below.

Step 1. A re-examination of all of the collections from the installation. This task will provide a researcher with a baseline of macroscopic images of the cherts and artifacts and can be completed in a quick manner. Further, generalized trends in diagnostic tool assemblages verses debitage assemblages can be easily discerned in this manner. Finally, a consistent macroscopic template of cherts can be formulated. A lack of reliable macroscopic descriptions of chert from local sources was a major limitation of our research.

Step 2. Undertake a more thorough mapping project of exposed cherts. This task should include detailed mapping of exposed surfaces containing chert, indicating strike and dip across all portions of the post to derive a large cross-section of the resources along a larger scale. This will provide a useful tool in creating an elevational model for such exposures.

Step 3. Create a baseline of microscopic and chemical analyses of the cherts on the post from current exposures and prehistoric debitage. These analyses will be most important in generating a baseline from which to compare results by any researcher and cannot be stressed enough. At present, archaeological methods pertaining to chert identification are limited by undefined descriptive names. For example, what does the term Muldraugh mean? All Muldraugh is not the same and did not form in the exact same environmental conditions. Therefore, there is the potential for considerable chemical and microscopic variations of this and other cherts that are completely lost in the milieu of macroscopic observations of which we are all, albeit often forced, found to be guilty. Further, the macroscopic identifications of chert cannot be scientifically tested from researcher to researcher. If we all agree that the goal of archaeology is to identify and describe past human behaviors at any archaeological site, and link/compare/contrast those behaviors to other sites, then we must recognize and admit that the current methods of macroscopic observation will never allow us to achieve that goal, and that it effectively and completely undermines the resources by perpetuating inadequate and inaccurate methodologies by simplifying the complicated. We argue that our goal should be to get the cherts back to the quarries from whence they came and identify the activities there to realize the *chaîne opératoire*.

If chemical signatures can be established for specific chert-bearing exposures at specific loci and archaeological site locales, the opportunities for spatial analysis within a geographic information system (GIS) framework are virtually unlimited. For example, GIS could be utilized to establish potential travel routes to and from quarry sites and other sites where these specific cherts were utilized. A cost-surface analysis could help refine these potential routes into routes most likely traveled based on terrain attributes such as slope and distance. Furthermore, a network of pathways could be established that identifies key intersections across the Fort Knox landscape where the potential for human interaction would have been greater. These are just a few examples of prospective uses for these types of data sets. Clearly, these data could enrich archaeological research focused on land-use patterning and the construction of prehistoric anthropogenic landscapes, not to mention more traditional anthropological efforts interested in trade and human interaction.

Acknowledgments

The project discussed in this paper was conducted as part of an archaeological survey at Fort Knox U.S. Army Garrison, Kentucky. Projects of this scope generally do not permit archaeologists the opportunity to pursue "research", *per se*, but limit them to questions concerning presence or absence of archaeological sites in defined areas. We would not have been able to pursue the research presented here without the encouragement and support of Dr. R. Criss Helmkamp of Fort Knox U.S. Army Garrison, Rick Tibbits of ICI, LLC, and Dr. Cinder Miller and W. Kevin Pape of Gray & Pape, Inc. We would also like to thank the Falls of the Ohio Archaeological Society for allowing us an outlet for our research.

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DIFFERENTIAL PATTERNS OF CHERT UTILIZATION DURING THE MIDDLE/LATE ARCHAIC AND WOODLAND PERIODS AT THE FALLS …. WHAT DOES IT MEAN ANYWAY?

By Anne Tobbe Bader

Falls of the Ohio Archaeological Society

Abstract

It has long been noticed that late Middle-Late Archaic populations in the Falls area – as elsewhere regionally—used predominantly local cherts of comparatively poor quality such as Muldraugh, Jeffersonville, Allen's Creek, and cobble cherts, but relatively minor amounts of the higher grade materials such as Wyandotte found downriver in southern Harrison County, Indiana and neighboring counties in Indiana and Kentucky. At the Terminal Archaic/Early Woodland interface, a dramatic shift to the almost exclusive use of Wyandotte cherts occurred in this area. This phenomenon has not been satisfactorily explained, but it cannot be coincidence that it was simultaneous with other noteworthy innovations that occurred at this time, namely changes in settlement pattern and the introduction of ceramics. This paper explores some of the rationales behind this shift in raw material selection and proposes possible areas of future research.

Archaeological sites dating to the Late Archaic-Early Woodland transition are among the more poorly documented in the region of the Falls of the Ohio River. This time period has not been specifically targeted by researchers and existing data have not been adequately reported and synthesized, resulting in the lack of confident conclusions regarding the nature of the Archaic-Woodland transition at the Falls. Aside from data extracted during a few recent well-planned and intensive data recovery investigations, current databases relative to the Terminal Archaic and Early Woodland periods are incomplete and flawed.

The Kentucky State Historic Comprehensive Preservation Plan Report (Pollack 1990) states there is a generally smooth, continuous transition between Archaic and Woodland with little change in subsistence/settlement strategies or technology (aside from the introduction of ceramics) (Railey 1990:247-250).

In general, there is continuity in items of material culture from Archaic to Woodland times, and Woodland period technologies, for the most part, are the same as those of the preceding Late Archaic subdivision (Railey 1990:249).

However, in some ways this period at the Falls *seems* to have been witness to some fairly dramatic changes. The population evident in the Late Archaic at the Falls appears to have diminished during transition to the Early Woodland[1], with less than one-half the number of Woodland sites reported than the Archaic. A shift in settlement is suggested by some. In the more southern portions of the Falls area at Fort Knox, for instance, O'Malley et al. (1980:449) note that:

The transition from Late Archaic to Early Woodland times is at present a very poorly understood phenomenon. Very preliminary evidence is suggestive of a shift in the methods of subsistence with subsequent changes in settlement characteristics although the end result of these activities may not have varied from the Late Archaic Period. By the Woodland Period, the available evidence suggests that an adaptive strategy that concentrated on moving resources to consumers rather than the reverse may have been operating.

With a few notable exceptions, Woodland period settlement patterning at the Falls does

[1] Although see Collins 1979.

not reflect intensive long-term habitation; base camps are rare in comparison to the Late Archaic. Early and Middle Woodland components are commonly missing among the deeply stratified deposits of rockshelter and cave sites in the area as well as in shell bearing sites. In addition to ceramics, changes that occurred to material culture during the Late Archaic/Early Woodland transition include adoption of different projectile point styles and groundstone toolkits.

Undoubtedly, aspects of Early Woodland culture such as mound building, the innovation of ceramics, and an increasing focus on plant domestication did not develop overnight and must have had their roots in the preceding Archaic period, whether that antecedent was a local or remote population. But when it comes to the chipped stone tool industry, the differences between the Middle/Late Archaic and subsequent Woodland period technologies appear to be very distinct, and from the perspective of archaeological depth, even abrupt. In the Falls area, as elsewhere in the region, this distinction is highly visible in patterns of raw material utilization.

There existed, by all indications, a decided preference or - as Ed Smith calls it - a "tolerance" during the Middle and Late Archaic periods for manufacturing chipped stone tools from local and generally poor quality cherts, such as fossiliferous, oolitic, and stream-born cobbles of various sources. Raw materials (such as Muldraugh) derived from the Knobs that encircle the Falls area were especially targeted by Archaic populations. In contrast, beginning with the Terminal Archaic period and continuing throughout the Woodland period, high quality bluish gray chert, primarily Wyandotte, also known as Harrison County or Indiana hornstone, was almost exclusively utilized for chipped stone tool manufacture. Seeman (1975:55) has noted, in relation to Harrison County, Indiana, that:

> *In Harrison County itself this transition is particularly dramatic; virtually all of the Turkeytail, Adena, and Hopewell cache blades as well as Adena and Snyders points are made of Harrison County (Wyandotte) chert.*

This is by no means a new observation, nor is it restricted to the Falls area. It is one that has long captured the attention of scholars of the Falls of the Ohio River and elsewhere in the Midwest. Various studies since the 1970s - and indeed the 1930s - have commented on the correlation between temporal period and chert preference (Janzen 1971; Seeman 1975; Munson and Munson 1984; Myers 1981; Granger and Bader 1991). The Woodland groups at the Falls deliberately sought out Wyandotte chert for the manufacture and trade of artifacts and did not routinely rely on local cherts for even mundane tasks.

Seeman found that, on the average, 94 percent of all Woodland artifacts collected in Harrison County were made of Wyandotte chert, as opposed to 33 percent of the Archaic points from the same area. A more recent review by the author of CRM reports and current research shows that just shy of 99 percent of the Woodland projectile points were manufactured from Wyandotte chert. The percentage of Middle and Late Archaic projectile points made of Wyandotte chert was somewhat higher than Seeman reported in 1975 for Harrison County, at 43 percent.

Seeman also noted that:

> *… preliminary comparisons with material from other areas of southern Indiana indicate this trend [shift to Wyandotte in the Woodland] is even more striking further from the [Harrison County] quarry locations (Seeman 1975:52).*

This higher percentage of Wyandotte at the more remote Falls Woodland sites would seem to confirm what Seeman reported in 1975.

There is little in the way of quantifiable data regarding chert selection over time except as reflected in diagnostic bifaces. Although many sites have been excavated at the Falls, not many have contained stratified deposits, and even fewer of those have been adequately reported. One notable exception is a 1971 study by Donald Janzen that examined more than 10,000 debitage from the Hornung Site (15JF60), located at the mouth of the Salt River. As a result of this study, Janzen noted the same abrupt transition in chert preferences from the Archaic to Early Woodland (Janzen 1971; personal communication 2005) (**Figure 1**). In the upper three zones of the fourteen three-inch levels he excavated at Hornung, Wyandotte chert accounted for more than 75 percent of the total debitage. These levels were associated with Early and Middle Woodland occupations. In the lower levels, such as Level 10, Wyandotte accounted for less than 25 percent of the total, and Muldraugh chert accounted for more than 60 percent.

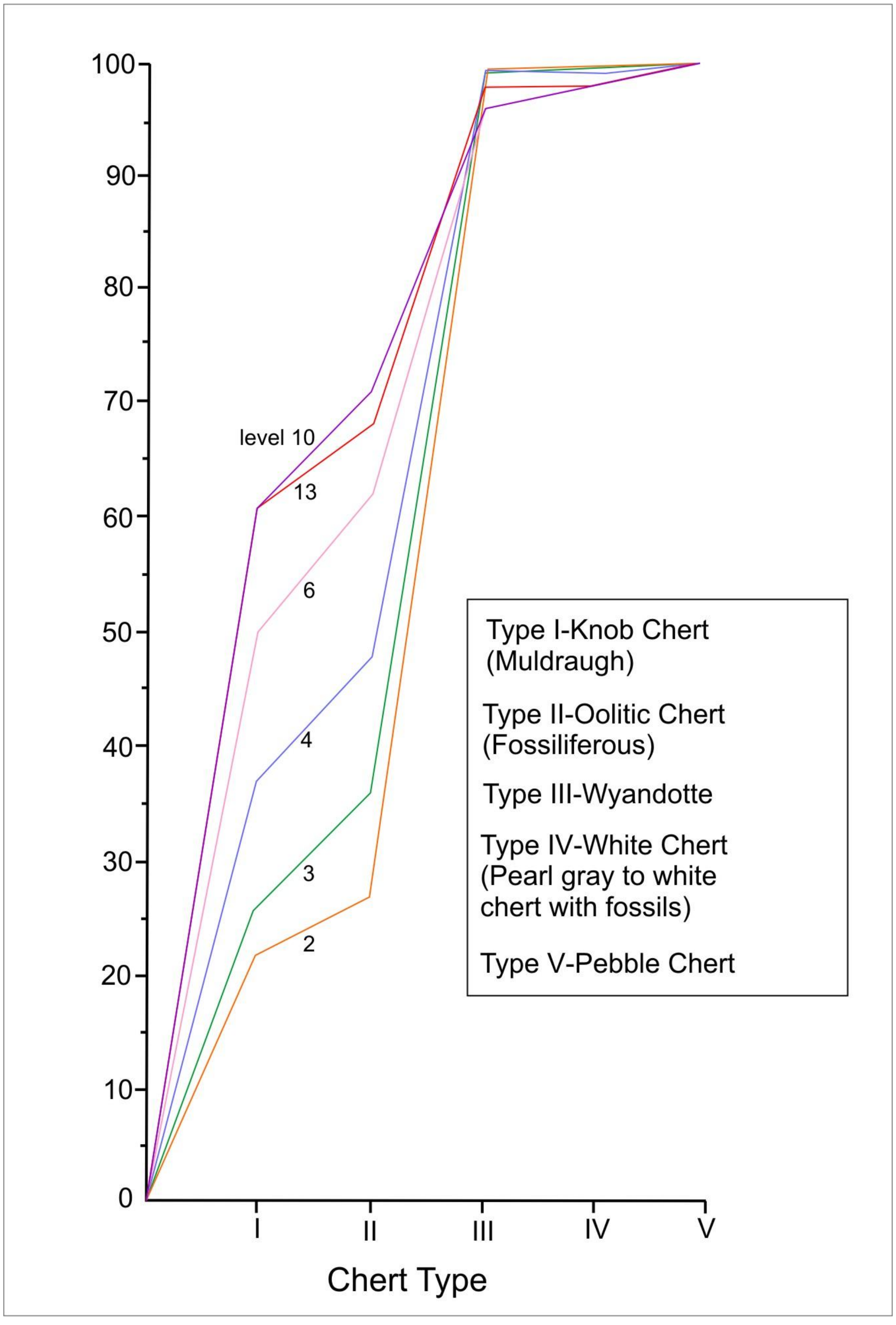

Figure 1. Distribution of chert types by level at the Hornung Site (15JF60) (with permission by Dr. Donald Janzen).

Researchers have sought an explanation for this over the years (e.g. Munson and Munson 1984), but definitive answers have been elusive. This paper is a brief review and summary of the varied explanations discussed in the literature. – offered in part for local avocationals who have also expressed an interest. The discussion demonstrates the complexity and inter-relatedness of environmental circumstances and cultural responses. As such, it offers no new insights. After summarizing recently proffered models of the Archaic-Woodland transition, however, the paper concludes with the suggestion that the apparent "abrupt" shift in chert selection signals an equally "abrupt" change in cultural adaptation.

Explanations offered in the literature regarding switch in raw material preferences between the Archaic and Woodland fall into one of the following categories:

- Tradition;
- Mobility;
- Economic Factors;
- Geographic Factors;
- Technological Factors;
- Social Factors; and
- Environmental Factors.

Tradition

It is a fact that Archaic populations targeted local resources, and in the immediate Falls area, poorer quality cherts such as Muldraugh, Jeffersonville, and other fossiliferous varieties are abundant and easy to obtain, while Wyandotte chert requires some traveling or trade to procure. It is easy to understand why Woodland peoples sought and utilized high quality Wyandotte chert to the near exclusion of the other raw materials of the area, but why did Middle and Late Archaic craftsmen opt for poorer grade materials, especially in those areas south of the Falls where the higher grade chert was located nearby?

A simple but not necessarily trivial response to the question of why Archaic peoples utilized local cherts can be simply laid to the feet of tradition. After all, if the poorer quality material had worked well for thousands of years, why change?

Mobility

Along this same line of thought, one of the more commonly expressed explanations for chert selection has to do with mobility. The occurrence of local versus nonlocal cherts in any given assemblage is assumed to reflect the geographic range in which the occupants of that site moved. Those sites containing higher frequencies of exotic cherts are presumed to have had a more fluid movement and a higher degree of residential and/or logistic mobility. Conversely, those sites exhibiting a dependence on local cherts are presumed to have been more sedentary overall or restricted to a less expansive territory.

Reduced mobility during Archaic times may be a reflection of the abundance of natural resources that permitted a population to simultaneously exploit a variety of local resources without the need to travel far afield. It may also reflect pressure imposed by an ever increasing population that forced groups into restricted "territories". In either case, chert types within site assemblages theoretically should reveal the raw materials that were available within the range of movement of a given population. As mentioned above, this notion works well to explain chert selection in the immediate Falls area where local cherts such as Muldraugh, oolitic cherts, and cobble cherts are easy to obtain.

Ingbar (1994) cautions against using the proportions of chert types to infer mobility. He conducted a series of simulations, and found that reliance by researchers on the proportions of chert types to predict mobility patterns for the occupants of any one site could result in inaccurate results, since the proportions are dependent upon which point in the cycle of procurement, use, and discard the site is situated. There are noted differences in percentages of chert types between sites where a raw material is procured, where the artifacts made from it are used, and where they are eventually discarded.

Interestingly, Seeman (1975) goes so far as to speculate whether or not the Woodland presence in the Harrison County area represented a few specialists working in the area to exploit the chert resources, or if the cultural units were subsisting in the area for a significant portion of the year in addition to quarrying.

Economic Factors

Related explanations suggest an economical basis for chert procurement and name distance from the source as a primary factor in its selection for use by any given group. The closer the source, the cheaper it is to obtain. Munson and Munson explain this as a "least cost" scenario in their study of differential chert utilization between the Early and Late Archaic periods in Monroe County of central Indiana (Munson and Munson 1984:164). While they found that the "least cost" scenario worked for both periods, they attributed observed differences in chert percentages for finished bifaces and debitage to the size of the geographic ranges occupied by the two populations.

Nearer the Falls, in Jefferson County, Kentucky, the study of chert usage at several Archaic period sites revealed the percentages of certain chert types is also directly related to distance from the source of the chert (Granger et al. 1992) (**Figure 2**). Cobble chert accounted for nearly 60 percent of the chert recovered at the Late Archaic Habich Site (15JF550), located on the Ohio River floodplain terrace in the northeastern part of Jefferson County above the Falls in an area generally devoid of chert outcrops. In contrast, Muldraugh chert accounted for 60 percent of the material recovered from the Longworth-Gick Site (15JF243) located south of the Falls, which is not surprising since it lies in easy distance of the outcrops in the Knobs that encircle the Falls area. The Hall-Standiford Site (15JF571) is located in the Scottsburg Lowland of central Jefferson County and is an extension of the KYANG Site (15JF267). The site lies geographically between the Habich Site and the Longworth Gick Site. The Hall-Standiford Site, which was closer to the Muldraugh source in the north Knobs of the Muldraugh Escarpment than the Habich Site, but farther from the source than the Longworth-Gick Site in southwestern Jefferson County, had a utilization percentage of Muldraugh chert that fell midway between the two. No cobble or pebble chert was in evidence at the Hall-Standiford Site, which was not surprising considering its inland position.

Janzen found the same occurrence at the Clarksville Site (12CL1) and the Hornung Site 15JF60), where higher frequencies of Muldraugh were found closest to the source in the Knobs (Janzen 1971). Virtually all of the chert from the Old Clarksville Site, however, was a white fossil-bearing Devonian chert available in the gravels below the site.

This would definitely seem to support that, although all of these chert types were in the range of any one Archaic group in the immediate Falls area, they opted to obtain those that were "cheaper" to obtain.

Jefferies, in his study of the Carrier Mills Project of southern Illinois (Jefferies and Butler 1982:1316) suggests, however, the procurement of non-local cherts was not particularly expensive and was likely picked up during the seasonal cycle when groups were in the source areas for other reasons. He argued that if non-local cherts were more expensive to procure, or if they possessed technological attributes that made them more efficient implements than those made from local cherts, then tools made from this material should have been more extensively recycled than that from local cherts. He found this was not the case.

The same appears to be true in the Falls area, judging from the conditions of a commonly found tool type, the hafted scraper. These forms were presumably derived from broken or worn projectile points. They are a distinctive Middle/Late Archaic tool type, and most often manufactured from local poorer quality cherts. These implements were utilized to exhaustion, sometimes found with the blade element reduced to the haft. Similar artifacts are found that were made from Wyandotte chert, but much less frequently.

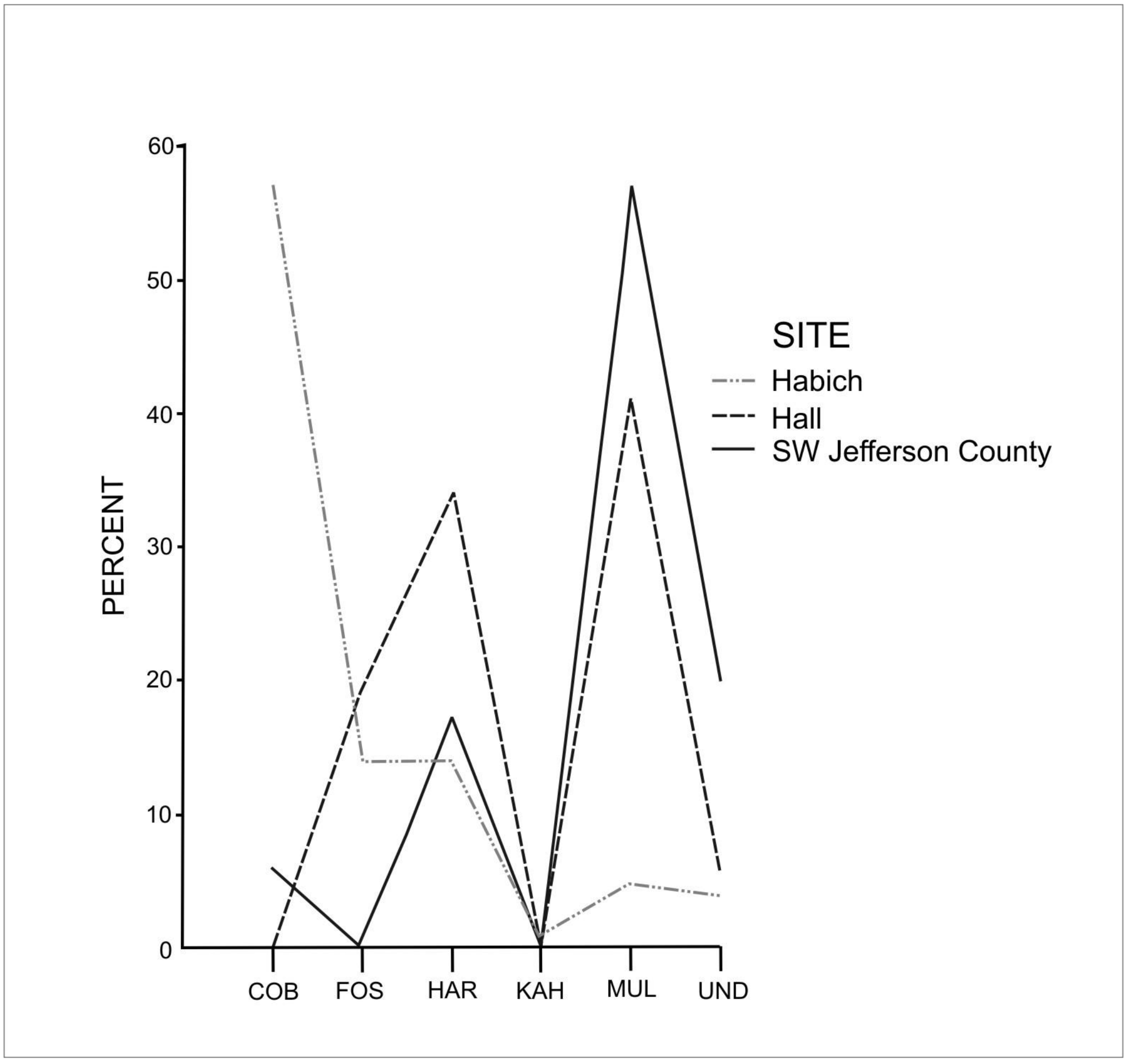

Figure 2. Comparison of chert utilization patterns for three sites in Jefferson County, Kentucky.

Geographic Factors

Availability undoubtedly plays an important role in the selection of raw material. Muldraugh and other local cherts are widely distributed across much of the uplands in the region. Wyandotte chert, on the other hand, is restricted to three to four counties in southern Indiana and several more across the Ohio River in Kentucky and is commonly found as nodules in streambeds or obtained through quarrying.

This fact prompted a local avocational to comment to the author that:

> *Procurement of this more durable [Muldraugh/Fort Payne] material is [possible] statewide, unlike the higher silica Wyandotte/ Hornstone and Ste. Genevieve [which is available in a much more restricted geographic area] (Jeff Shelton, personal communication 2005).*

Perhaps the apparent preference of local cherts by Archaic peoples can be explained as simple as that but probably not. More likely, variation in chert types between sites of the same period may reflect differential access to raw materials at a given stage of the cyclical settlement system.

Office of State Archaeology (OSA) data shows that, while Woodland sites are less frequent in the Falls area than Archaic sites, their distribution between upland and lowland appears relatively consistent with that of Archaic populations (**Figure 3**). As such, their access to chert-bearing deposits should have been similar as well.

In the immediate Falls area, Granger and Bader (1991) attempted to develop a unified pattern of resource exploitation that explains the distribution of Archaic and Woodland site types in northeastern Jefferson County along the Harrods Creek drainage. They concluded that Archaic groups intensively utilized the bottomland areas over a sustained period of time, resulting in longer term settlements with deep midden accumulation and evidence of storage features. They note that Archaic use appears to be lighter in the upland, while there are more sites in the floodplains. However, they provide a number of reasons why Archaic sites may be unrecognized and/or under-represented in professionally generated databases. In contrast, they point to such sites as Zorn Avenue (15JF250) in postulating that large Woodland villages occurred in the upland, while Woodland sites in the bottomland were transitory locations that were likely short-term camps for resources exploitation. This position has been criticized for its lack of supporting Woodland data; however, new data does appear to suggest that floodplain use during Woodland times in some locations of the Falls area may have been transient due to climatic conditions and flooding (see more below). In contrast, the Knob Creek Site (12HR484) that contains evidence of substantial Early Woodland occupation was located on a floodplain ridge below the Falls. Clearly, more – and more systematically acquired- data is needed.

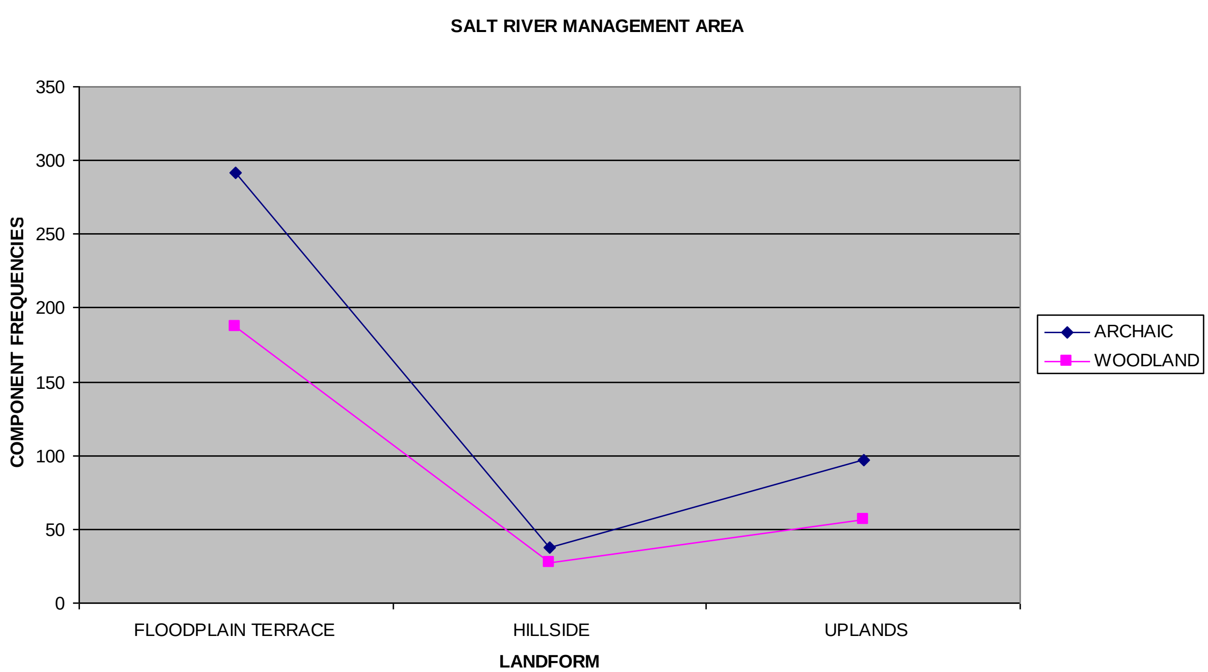

Figure 3. Frequencies of Archaic and Woodland sites in the Salt River Management Area of Kentucky by lowland and upland setting (2005 OSA data).

On many Middle/Late Archaic sites investigated in the region such as the KYANG Site (15JF267) at the Falls near Louisville and the Meyer Site (12SP1082) downriver near Rockport, Indiana, hafted bifaces were brought to the site in finished form. The low representation of debitage, bifaces, and cores at these sites suggests the peoples did not engage in the early stages of lithic reduction at these sites, but brought to the sites finished bifaces, as appropriate raw material was not immediately available in the area. Of either of these sites, raw material was procured and initially reduced during a separate aspect of the settlement system or possibly when the people were engaged in some specialized activity elsewhere. In addition, there was a high percentage of exhausted and discarded hafted bifaces in the assemblages from these sites, indicating a general lack of readily available raw material.

This is not the case at all Archaic sites in the greater Falls area, of course. At the predominantly Archaic period Lone Hill Site (15JF10) (**Figure 4**) in Jefferson County, for instance, nearly 24,000 of the 25,000+ artifacts recovered during 1995 excavations was debitage, and 74 percent of that was derived from the local Muldraugh chert sources (**Figure 5**) (Bader 2007). This reflects both the proximity of the site to an abundant local chert source in the nearby Knobs as well as the long-term sustained occupation of the site.

However, this does not provide a satisfactory explanation for chert selection during the Archaic to the south of the Falls downriver. Some Archaic sites, located in Harrison County, Indiana in proximity to the Wyandotte chert sources, did not elect to utilize the higher quality material even though it was clearly within their reach--in some cases, being located a matter of yards from the sites. For instance, at the Breeden Site (12HR11) in Harrison County, Indiana, Archaic and Early Woodland materials were present in intact stratified deposits.[2] From five distinct strata, Middle Archaic Side-notched, Matanzas, Late Archaic Stemmed, and Early Woodland Contracting Stemmed points were recovered. The Archaic points were made from local cherts and account for 56 percent of the total. Woodland points were manufactured from Wyandotte. However, it is interesting to note that:

The raw material represented by the debitage is almost exclusively of the classic Harrison County variety, a chert which is of excellent quality and which is readily available at several sources near the site (Bellis 1975:89; nd).

Despite the readily available presence of nearby Wyandotte chert, the Archaic occupants of the Breeden Site opted not to use it. Furthermore, debitage associated with the Archaic points was not present at the site. While Bellis attributes this to presumed mobility during the Archaic period in which the groups were not confined to the immediate environs of the site, another option is possible. As documented at other regional contemporaneous sites, this can also be seen as evidence that hafted bifaces were not being made on-site, but were being brought there from elsewhere in finished form.

[2] However, see Burdin 2008 for more recent data.

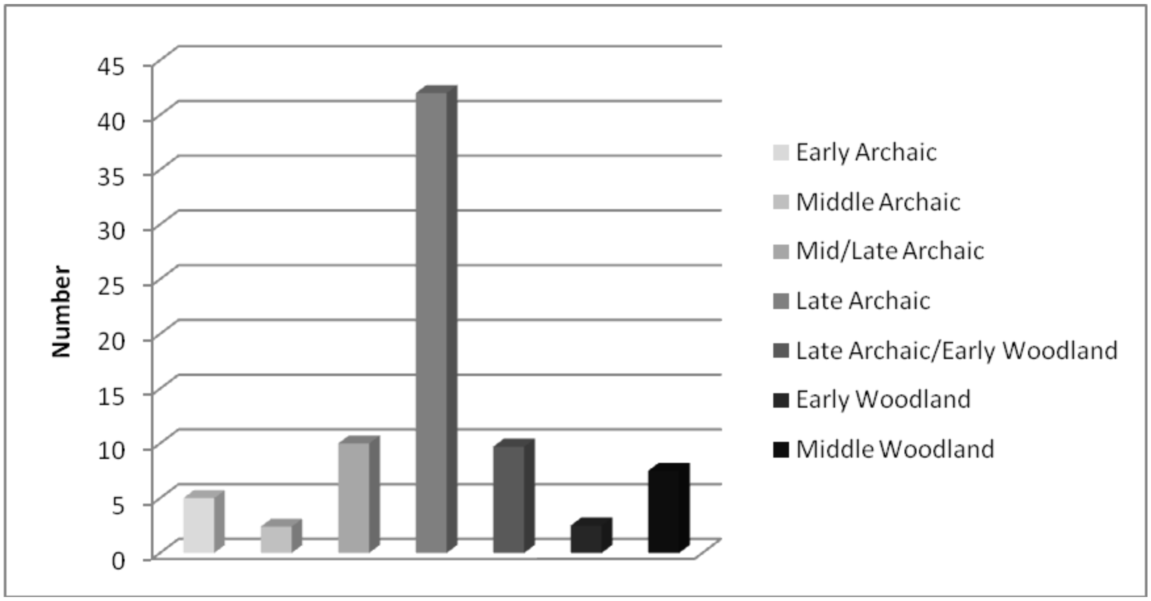

Figure 4. Frequency of diagnostics recovered from the Lone Hill Site (15JF10).

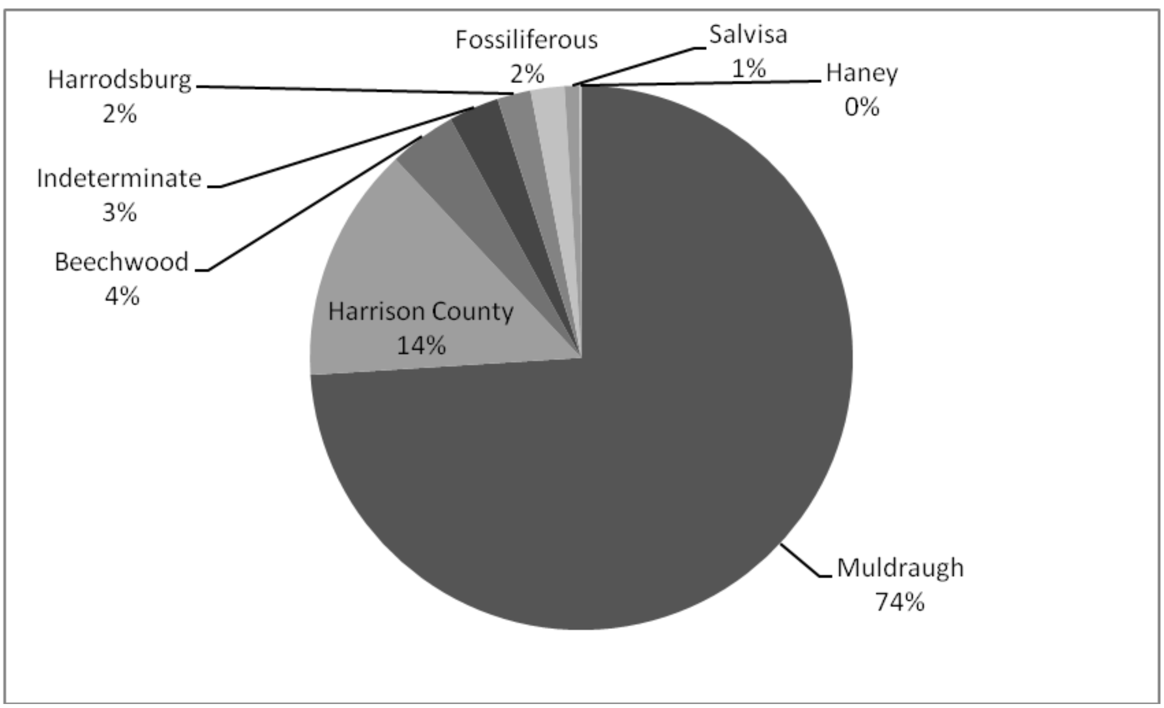

Figure 5. Frequency of diagnostics recovered from the Lone Hill Site (15JF10).

Technological Factors

During the Woodland period, chert quality appears to have been the primary factor guiding raw material selection (Myers 1981). The exploitation of Wyandotte chert was related to the specialized production of particular artifact classes destined for extra-regional distribution. Vast and broad-reaching long-distance exchange networks are evidenced by the procurement and reduction of this high quality chert and the manufacture of Turkey-tail and other lobate-based hafted bifaces. As the Woodland period progressed, the demand for Wyandotte chert increased.

Few studies have addressed the possibility that the poorer quality local cherts may also have been deliberately procured because of inherent qualities that rendered them suitable for specific tasks. These tasks might reflect differences in between the Archaic and Woodland adaptive strategies.

An article by Eric Ingbar states:

...the utility of a raw material source is not determined by the intrinsic properties of the source but by tool needs that the source may satisfy. Thus, if a group has no need of a particular raw material source, it may never be used no matter where it is in relation to other activities….The convenience of source identification is mitigated by the fact that raw material, like any resource, was acquired for a purpose. If no foreseeable need existed for its acquisition, a particular raw material source may go wholly unused (Ingbar 1994:540).

It has been noticed at some regional sites that chert selection varied by artifact function. From the McCain Site in DuBois County, Indiana, a local cherty limestone located 200 yards from the site was consistently used in the manufacture of rough, expediently made scrapers, whereas the projectile points were made of other--albeit poor grade--flint (Miller 1941:50). Perhaps the differences in chert utilization reflects the fact that different chert types possessed inherent qualities that made them more suitable for certain tasks, and perhaps the tasks varied through time.

There were changes in the proportion of functional tool types between the Archaic and Woodland periods. The use of gravers, for instance, increased through the Archaic, and diminished in the Woodland. Hafted scrapers were used primarily in the Archaic, and were replaced by unifacial endscrapers and bone gouges in the Woodland.

When asked, several amateur knappers claimed that Wyandotte performs better than Muldraugh because it is harder, and therefore has a longer use-life. After some thought, several professional knappers arrived at the same conclusion. The same question was posed to a local Kentucky amateur, Jeff Shelton, who not only makes chipped stone and hardstone tools but also uses them extensively in routine tasks, primarily to derive an understanding about wear patterns apparent in archaeological examples. He stated that while Wyandotte chert flakes were harder and sharper, Muldraugh was definitely more durable with the longer use-life.

He noted that certain types of chert were indeed better suited for specific tasks. For instance, in speaking of chipped stone adzes, Shelton reported:

"Most" of the [chert] adzes I have [found] are of Ft Payne/Muldraugh… inspection of these artifacts and replication and using them has shown to "me" that, though Wyandotte/hornstone is a much sharper stone (higher silica) than Ft Payne/Muldraugh, that [serves] to makes it more brittle for a chopping/shaving blade/bit. But if time is taken to totally polish the bit and sides, this material will work…so with a more durable material (but not as sharp) as you find with Ft/Payne/Muldraugh (lower silica content) less effort is spent in manufacturing and upkeep.

This would also be true, presumably, of scrapers.

For scraping twigs or smaller wood/bone items, a simple unmodified flake was best. One would simply snap the blade when it became dull to continue use.

…… the best flake for this is an over shot flake with the far edge still intact, and using the underside of this flake like a draw knife.

Regarding drills, however, he reported that:

Any high silica cherts work better for drills than the lesser types... knappability would be the number 1 cause in this area, and yes, I grind/ polish the sides where the knapped edge was to strengthen the whole body the same as in polishing the bit on axes/adzes. The tip is left as knapped in the working area, so slight (micro chipping, wear) on the tip keeps it working, and if it stalls out, very slight touch up work will give it a new surface to work with. Of course, the material being drilled will determine how much maintenance would be involved.

To determine if the quality of the raw material provided the rational for its procurement, a small experiment was attempted. A total of nineteen hafted scrapers were manufactured by two FOAS flintknappers: George Nall and Red Wynn. The scrapers were made from Wyandotte chert, Muldraugh, and heat-treated Muldraugh. Prior to experimental use, each replica was labeled, photographed, and the flaking pattern of the bit was drawn. A series of measurements were then taken, and the edge angle measured. To ensure replicability (since small increments were being recorded), a series of three measurements were taken for each attribute. These were then averaged to obtain a figure for comparative purposes.

Jefferies, in his 1990 article on the hafted endscrapers from the Black Earth Site, indicated that hafted scrapers were often used on dry hide, meat, and wood; and to a lesser extent on bone (Jefferies 1990b). The current experiment opted to experiment using wood, dried bone, and green bone. One set of scrapers was tested on wood. A second set was used on bone. The same number of strokes or scrapes was used on each. An effort was made to consistently use the same direction, angle, and force, but this could not be absolutely controlled. Measurements and observations were taken again, as before, and then compared. Overall, there was little measurable difference in overall length, which can probably be attributed to the limited period of use.

However, though it should be viewed with caution until more extended experiments are conducted, heat-treated Muldraugh appeared more durable when used on bone, with little difference in length reduction noticed between unheated Muldraugh and Wyandotte. When edge angle was examined, all exhibited a reduced angle; however, unheated Muldraugh showed the least reduction. However, under magnification, it could be seen that use of resistant materials such as wood or bone caused Wyandotte chert to flake in small thin flake removals. This did not seem to occur with the Muldraugh chert. Wyandotte chert then would require more maintenance and retooling, and therefore would be expended more quickly.

From a purely subjective basis, the tools manufactured from Wyandotte chert were sharper and performed better in that they removed more material from the wood and bone. However, if the Wyandotte edges were ground, as suggested by amateur Jeff Shelton, to reduce the step fracturing, then it would seem like this would mitigate the advantage of sharpness over Muldraugh chert.

Although this experiment was limited in scope, it suggests the quality of the stone and the function to which it was put during the Middle and Late Archaic periods may have been factors in its selection.

The use of local cherts for scraping and other mundane tasks can, however be explained in other ways. From data obtained at the Danville Tank Site in central Kentucky, it was concluded that there was a marked preference for specific cherts to be used for specific tools types during the Late Archaic and Early Woodland periods (Thomas Gatus in Boedy and Niquette 1987). Hunters, while hunting in the Knobs, apparently collected Boyle and Muldraugh chert to be made into projectile points and other hunting tools. Salvisa chert, on the other hand, was used mostly as scraping tools and was gathered from the Salt River Valley in the Low Area of the Peneplain, probably by those engaged in gathering--who also were more likely to use the finished product. Nearly 41 percent of the scraping tools recovered from the site were made from Salvisa chert. These procurement strategies may suggest, however, a division of labor along sex lines rather than the inherent suitability of a raw material for a particular task (Thomas Gatus in Boedy and Niquette 1987). Women, who did much of the scraping, may have been using the raw materials available close by the camp, namely, the poorer quality materials. Men, on the other hand, roamed farther afield in their hunts and trading excursions, and could more easily access the higher grade cherts. While the suggestion of an alignment with chert type by gender is intriguing, the pattern noted at Danville Tank Site is simply not duplicated in the other Falls site assemblages.

Social Factors

Some explanations have departed from practical and functional explanations to more esoteric explanations. Referring again to Seeman:

> *I feel that the best explanation of this shift lies in the relationship that exists between raw material and finished artifacts.*

In common with others, Seeman noted Wyandotte chert was used commonly during Paleoindian and Early Archaic periods. But a "devolution", as he called it, in projectile point manufacture occurred during the Middle and Late Archaic periods. The points were less technologically refined. Quoting Morse and Binford, Seeman suggests the size and quality of the points of the earlier Paleoindian and Early Archaic periods served more than technological considerations. He suggests they were embedded with social significance as well, serving a sociotechnic role (Seeman 1975:56). He argues that during the latter portions of the Archaic, this sociotechnic function was transferred to other larger and more exotic items such as groundstone tools and perhaps copper. And he suggests that it was the craftsman's conception of the artifact he wished to produce that governed his selection of raw material (Seeman 1975:55).

During the Early Woodland, the trend was dramatically reversed back in favor of Wyandotte chert. The exploitation of Wyandotte chert appeared to him to be a specialized production of particular artifact classes destined for extra-regional distribution. That is, the demand for Wyandotte chert dramatically increased. Seeman again attributes this to technological considerations, noting that some large chipped stone artifacts, such as hoes and gouges, could not be made from Wyandotte chert due to their large size, and were made from more exotic locations (Illinois and Tennessee) where the need fostered the extension of trade routes to obtain different raw materials, or the occupants utilized local limestone and shale (Seeman 1975:59).

Transitional Archaic-Woodland Models

In a recent article, Kidder provides a brief discussion of four models that have been advanced to characterize the Late Archaic-Early Woodland transition in the eastern U.S. (Kidder 2006:197-199).

Gradualism. In what he terms the gradualist model, steady *in situ* change is postulated. Virtually little change is seen between the two periods except for the addition of a few salient traits. As some have described it, Early Woodland is virtually the same as Archaic in many ways.

Punctated Equilibrium. In the American Bottoms area of southern Illinois, it has been argued that the transition of Archaic to Woodland was marked by the replacement of Late Archaic populations by immigrants (Kidder 2006:198). One line of evidence for this is that Early Woodland populations were organized in very different ways than the Archaic groups. This is evident by smaller settlements, more ephemeral occupations, and different artifacts. In fact, the differences are seemingly so dramatic that only immigration or intrusion appears to account for them. The immigrants may have brought ceramic and other technology onto the area with them, along with differing subsistence knowledge. The newcomers may have ousted the resident Archaic peoples due to better technology; however, the means of replacement is not specified (Kidder 2006:198). Because a gap of 100 to 300 years is noted between these populations, however, replacement is argued as more plausible that displacement (Kidder 2006:198).

Climatic Change. The role of climatic change as a factor in the Late Archaic-Terminal Woodland transition is becoming more widely considered. In many areas of the eastern U.S., decreases in population are noted at this time. This decline is associated with differences not only in settlement organization but in the distribution of populations (Kidder 2006:198). Cooler summer temperatures and increased winter precipitation is cited by Fiedel (2001) who observed that this appears to coincide with the Late Archaic-Early Woodland period. Increasing stress in responding and adapting to these changes may explain the cultural changes (Kidder 2006:198).

Kidder (2006), using as a null hypothesis the premise that there is temporal and cultural continuity from Late Archaic to Early Woodland, examined this notion further. To test this hypothesis, he used a series of radiometric dates from regional archaeological sites to explore regional chronologies for dated archaeological sequences (phase boundary probability distributions). The method can be queried to see if there is a gap or interval between the two periods. He concluded that during this period, massive flooding resulted in significant landscape changes and abandonment by people of portions of the basin, resulting in widespread cultural transformation. He noted, however, that populations undoubtedly had time to respond and make decisions on their futures. It was the human response rather than the climate change that caused the cultural change (Kidder 2006:221). He urged more research along these lines across the eastern U.S.

About this time, a decline in population apparently occurred at the Falls. As seen from these charts (**Figure 6**), based upon site frequencies, Woodland population dropped significantly at the Falls from the Late Archaic peak. As cautioned by Lewis, however, one must consider that the Woodland Period spanned a much smaller period than did the long centuries of the Archaic, and therefore, fewer sites of every type should be expected (Lewis 1986:596).

Yet, with several notable exceptions, early and Middle Woodland components are missing from the sequence in deeply stratified sites (shell middens and rockshelters) in the Falls area, or they are minimally represented by a thin veneer with few diagnostic artifacts. Based on admittedly limited data at the Falls, Woodland residential sites appear to be located primarily along the major rivers or upland hilltops overlooking the rivers. Where are the Woodland mound sites at the Falls? Where are the cemeteries so common at the Falls during the Middle and Late Archaic?

One cannot discount the possibility that dramatic changes in climate affected the landscape, resulting in changes to settlement in the area.

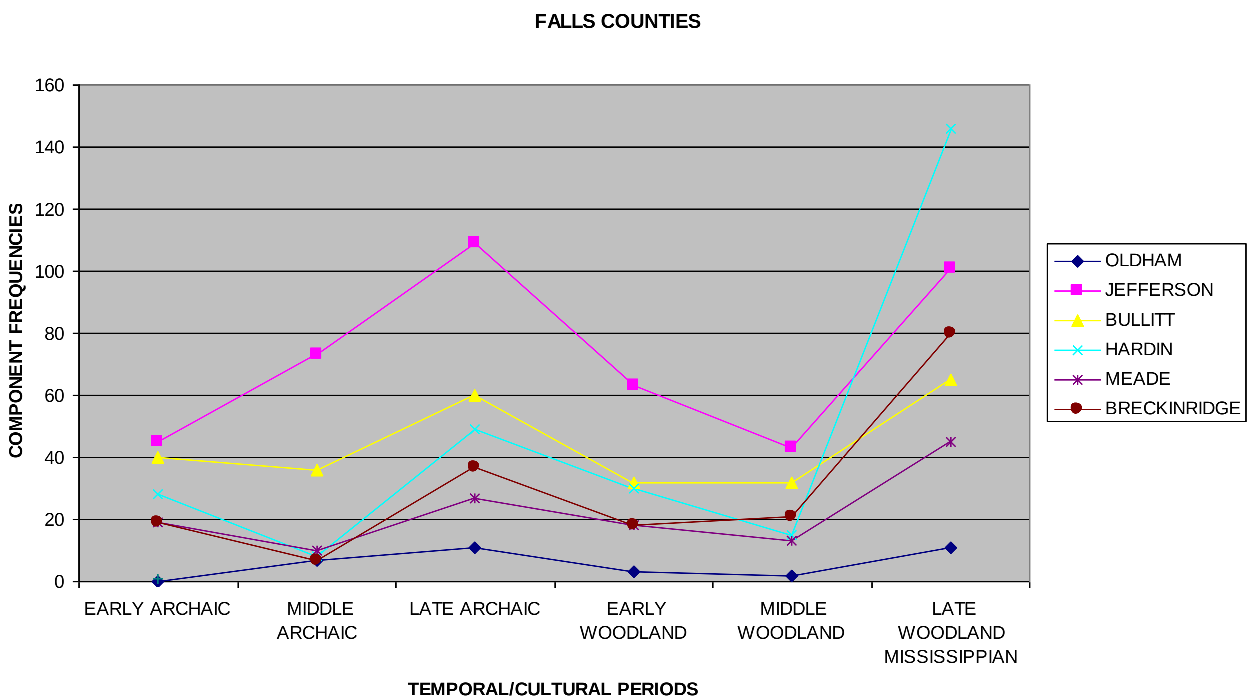

Figure 6. Frequencies of Temporal Components in Salt River Management Area, Kentucky. 2005 OSA data.

Cultural Pluralism. Clay suggests that in the middle Ohio Valley, one aspect of cultural pluralism in Early Woodland populations may lie in the differential adoption of and use of ceramics (Clay 2002:182). In his discussion of cultural pluralism in the Woodland "Heartland", Clay says:

The variability and uneven distribution of thick pottery in the Heartland indicate one of two scenarios or perhaps a combination of the two. The first is that the general dispersion of social in the region included both ceramic and aceramic groups. A second possibility is that population was concentrated in the Ohio Valley below the Scioto and scattered, or nonexistent, elsewhere.

I expect that a true explanation involves elements of both viewpoints. Thus, at this time (to ca. 350 B.C.) population may have been generally low level ***and*** *there may have been ceramic and aceramic groups existing side by side* (Clay 2002:170).

Kreisa and Stout, speaking of the Early Woodland period in the lower Ohio River valley in western Kentucky, offer the following comments:

Because Early Woodland ceramics seem to be rare, we cannot dismiss the possibility that the region may have been inhabited by 'ceramicless' Woodland peoples during this period (Kreisa and Stout 1991:99).

This notion may be related to Lewis's concept of "time-lagged" traits (Lewis 1986:596). Lewis notes that the spread and adoption of any innovation –such as pottery - is "time-lagged". That is, some groups living at the time may include pottery in their assemblages, while other groups in the region may not.

As noted by Railey (1996:81):

As measured by the presence of potsherds, the beginning of the Early Woodland period varies, therefore, by as much as 500 years from one end of Kentucky to the other.

Summary

The observed shift in chert selection between the Archaic and Woodland has long been noted and several studies have attempted to explain it. The matter is complex, as Munson (1980:642) concludes:

Selection of chert cannot be readily reduced to availability, to cultural period, or to ratios of tools to debitage. Instead, one must take into account natural availability, the cultural period under study, and whether the important information is in terms of where tools were made or where tools were discarded.

But it cannot be coincidental that a dramatic shift in chert selection – reversing thousands of years of tradition - occurred at the Archaic/Woodland interface simultaneously with the introduction of pottery, moundbuilding, and other distinguishing aspects of Woodland life. The shift in chert selection is yet another signal that broad sweeping changes occurred at the Falls and elsewhere that extend beyond the addition of ceramics and mortuary behavior. These changes are reflected in lithic material culture (and by extension behaviors), settlement patterning and landuse, and possibly even the arrival of a different population through emigration. Perhaps it is time to revisit this matter.

There is an unrelated series of "*What happened?"* articles in the professional literature. *What happened during the Middle Archaic? What happened during the Early Woodland?* (Fiedel 2001). The question is not the worse for having been used before. Just what happened anyway at the Late Archaic-Early Woodland interface at the Falls of the Ohio River? Whatever it was, it may not have been " *a generally smooth, continuous transition between Archaic and Woodland with little change in subsistence/settlement strategies or technology*".

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THE GAS WELL HOLLOW CHERT COMPLEX IN MEADE COUNTY, KENTUCKY

By Richard M. Brown

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Abstract

The paper is about the author's realization of the ancient lithic activities associated with the nodular Wyandotte chert occurrence in the French Creek watershed in Meade County, Kentucky. The paper is based on an amateur's ongoing survey for evidence of historic and prehistoric activities in the area. These observations prompted him to seek information about stone tool manufacture and usage, the people who created them, and why they were found in such abundance within that watershed. Observations and conclusions were supported by anecdotal material, published material, and Internet research.

This area has a nodular chert occurrence with widespread evidence of raw material procurement, lithic processing, stone tool manufacture, and tool usage by prehistoric people. The occurrence is a multi-component area in the watershed of French Creek, which flows into the Ohio River west of Brandenburg in Meade County, Kentucky.

Meade County

Meade County was formed in 1823 from portions of Hardin and Breckinridge counties. It is named for Capt. James Meade who died in the battle of River Raisin. (Ridenour 1977: 59)

An interesting feature of Meade County is its Ohio River boundary. The area is readily identifiable on a map of Kentucky by distinctive curves along the course of the Ohio River locally known as "Big Bend" and "Little Bend". Meade has one of the longest Ohio River boundaries in the commonwealth by virtue of the sharp "horseshoe" bend the river takes along its western border. Big Bend is reportedly the sharpest curve the Ohio River makes as it flows toward the Mississippi River. There is also a former "oxbow" in the area near Wolf Creek. There is a similar feature in Hoosier National Forest north of Derby, Indiana.

Big Bend and Little Bend in Meade County Oxbow near Wolf Creek I am not knowledgeable enough about geology to understand why the Ohio River takes such a sinuous route in the area and why it has changed its course over the ages. It may have to do with the Ste. Genevieve limestone outcrop that has an eastern boundary in Meade County.

I have recently learned something more about the local geology, especially in the French Creek watershed and specifically in an area known as Gas Well Hollow. My interest is motivated by my recent discovery or realization that there is extensive evidence of ancient and ongoing human activity there.

Of the most recent human activity in the area I am quite familiar. My mother's family name was Woolfolk and my great, great, great grandfather, James Barnett Woolfolk, built a house in the Gas Well Hollow area (ca. 1824) in the early days of the county. He paid taxes on 1500 acres of the land, including Gas Well Hollow and French Creek, according to the earliest Meade County tax records. James Barnett Woolfolk had a large family, and their lives and those of their descendents have figured intimately in the area's history for these many years.

The history of the Woolfolk family in Gas Well Hollow begins long after that of the area's previous long-term inhabitants, however. Until the summer of 2002, I had no real knowledge of the original people who lived on what I consider my ancestral lands. Only recently have I come to realize those people left an indelible mark and laid themselves on this land many millennia past.

In the days before the arrival of the white man, an area of Kentucky known as "the Barrens" found its northernmost reaches fading into the ancient forests of the Ohio River valley. Long before the American Bison found its niche in this territory and while the Wisconsin glaciers just north had yet to recede, humans came into the area around Harrison and Crawford counties in Indiana and Meade and Breckinridge counties in Kentucky. What brought them here may have been the pursuit of game such as prehistoric mammoths or giant sloths or other now long-extinct creatures. Many animals they hunted are also modern creatures such as the white-tailed deer, rabbits, and fowl. Quarries--or maybe something else that God only knows--brought the first humans to the area; one thing that kept them here and brought them back was a natural resource of great value.

Gas Well Hollow is a drainage gully and intermittent stream that is a major tributary to the watershed of French Creek (**Figure 1**). Gas Well Hollow does not appear on the county road maps or USGS quadrangles, but French Creek does. (see Mauckport and New Amsterdam, IN quadrangles for Kentucky). In 2003, Gas Well Hollow was added to the USGS Geographic Names Information System (GNIS) as the name for the crescent shaped valley that forms the western portion of the French Creek watershed.

French Creek flows into the Ohio River about 5 miles west of Brandenburg, Kentucky. In the early days of the white explorers, the stream was named Buck Run, but the name was changed after a party of Indians ambushed a surveyor named French along its course. The story is that French wandered from his party and was attacked. The Indians and French's party engaged in a battle in which the Indians were defeated. The fight took place on an old buffalo road that crossed the creek above the second bottoms there (Ridenour 1977: 16).

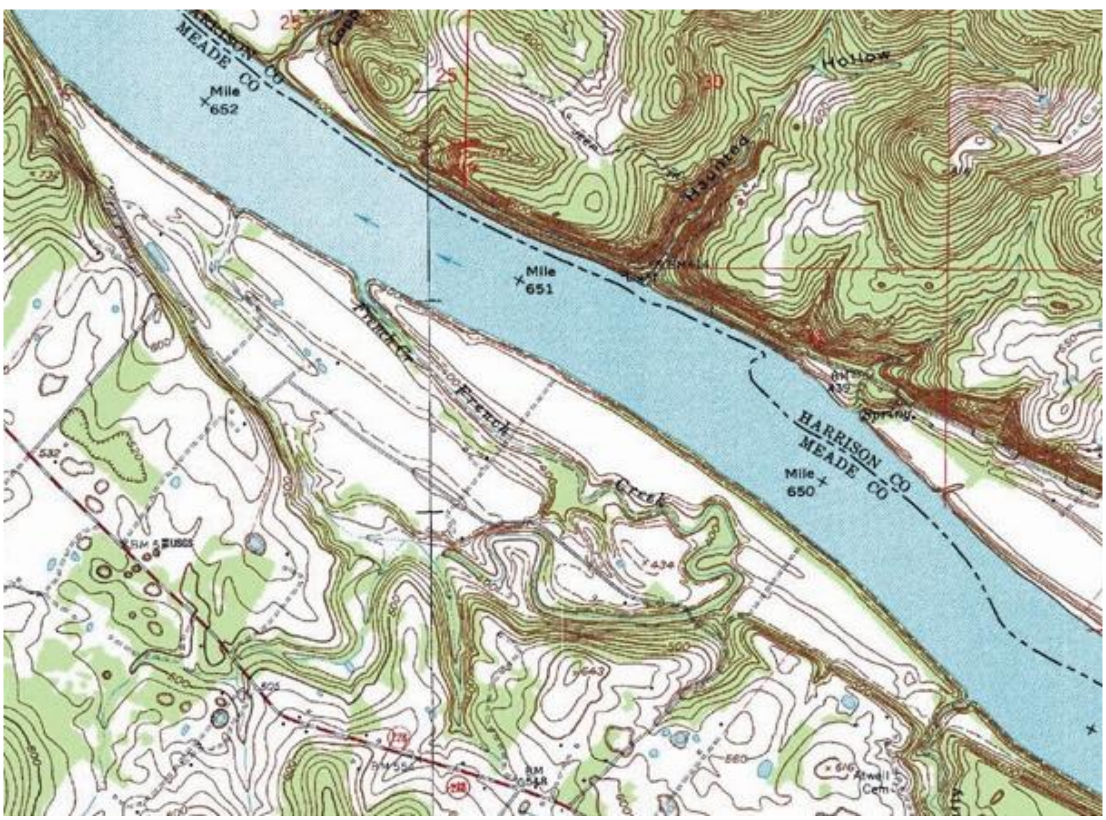


Figure 1. USGS topographic quadrangle showing French Creek and Gas Well Hollow in Meade County.

During the summer of 2003, I was able to traverse the eastern drainage of French Creek. In the easternmost drainage gully, evidence of chert was very sparse, although limestone shelves were exposed and nodular limestone formations were evident.

This ditch drains into the "Blue Hole". The Blue Hole is an artesian well that forms the head of French Creek. After periods of rain, I have watched the Blue Hole boil and surge with water. During dry periods, French Creek arises from springs farther downstream from the Blue Hole and actually drains upstream into it.

Upstream from the Blue Hole is a drainage gully that contains several limestone shelves. Chert is sparse along this portion of the ditch, but becomes much more plentiful as it nears KY SR 228. Many of the nodules along the approach to the road are intact, but some showed breakage. While I did not observe distinct lithic activity, I am sure it may be found upon further investigation—perhaps, further upstream.

Along the length of the gully known as Gas Well Hollow, the western portion of the French Creek drainage, there is ample occurrence of nodular chert. The nodules have eroded from the Fredonia member of Ste. Genevieve limestone that underlies the area and sometimes contacts the surface. The nodules are made of chert of the type called Wyandotte chert or Indiana hornstone. It is also locally commonly referred to as flint and was an ideal raw material for stone-age human tool making.

Figure 2 depicts typical Fredonia chert nodules and fragments from Gas Well Hollow, Kentucky. They were collected along KY SR 228 at a waterline construction site. These nodules were unearthed by modern-day construction equipment and were probably not used by early people, but they do show some conchoidal fracturing. Note the bluish gray chert exposed by breakage. The round nodule near the center of the photograph on the right shows a chalky appearance resulting from oxidation. The broken nodules show the thickness of their outside surface or cortex.

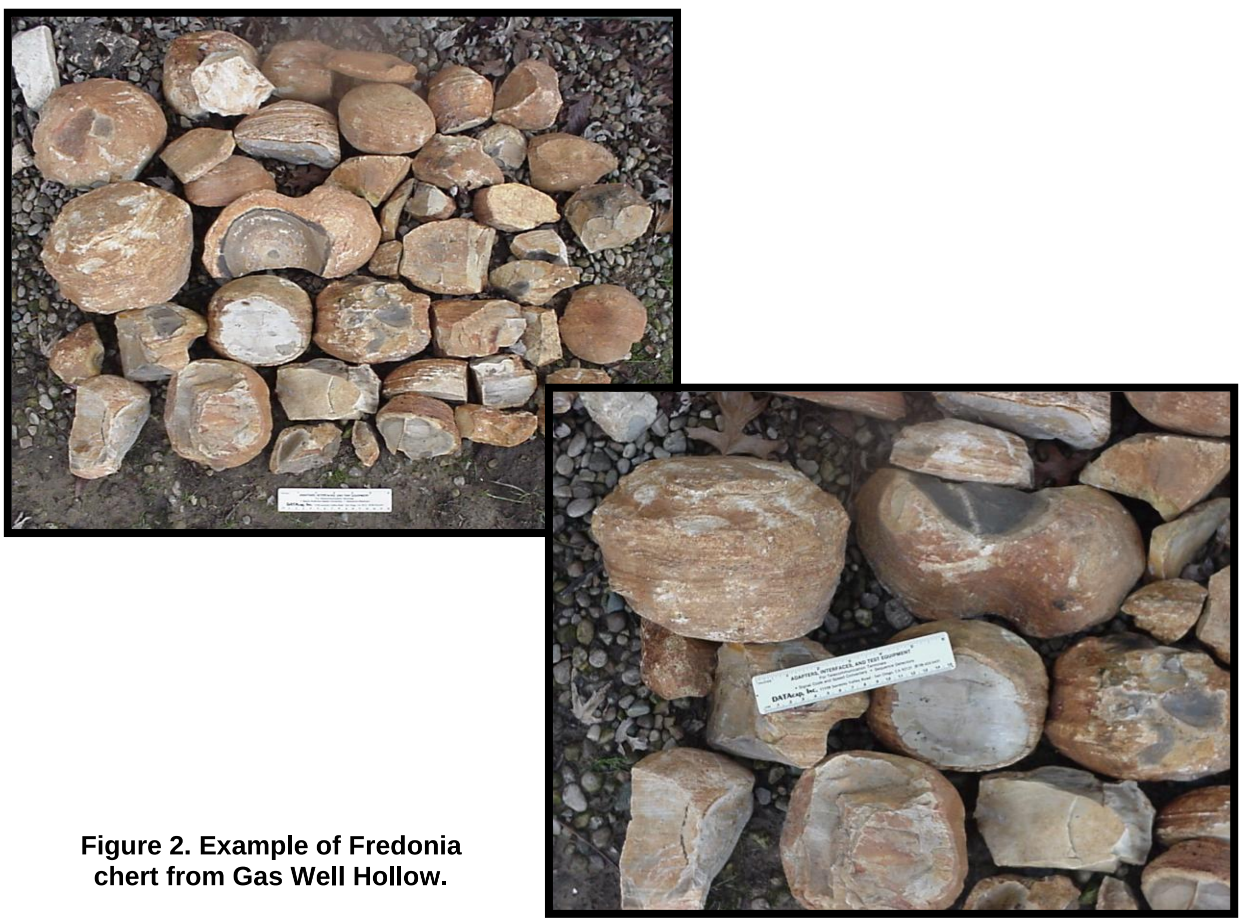


Figure 2. Example of Fredonia chert from Gas Well Hollow.

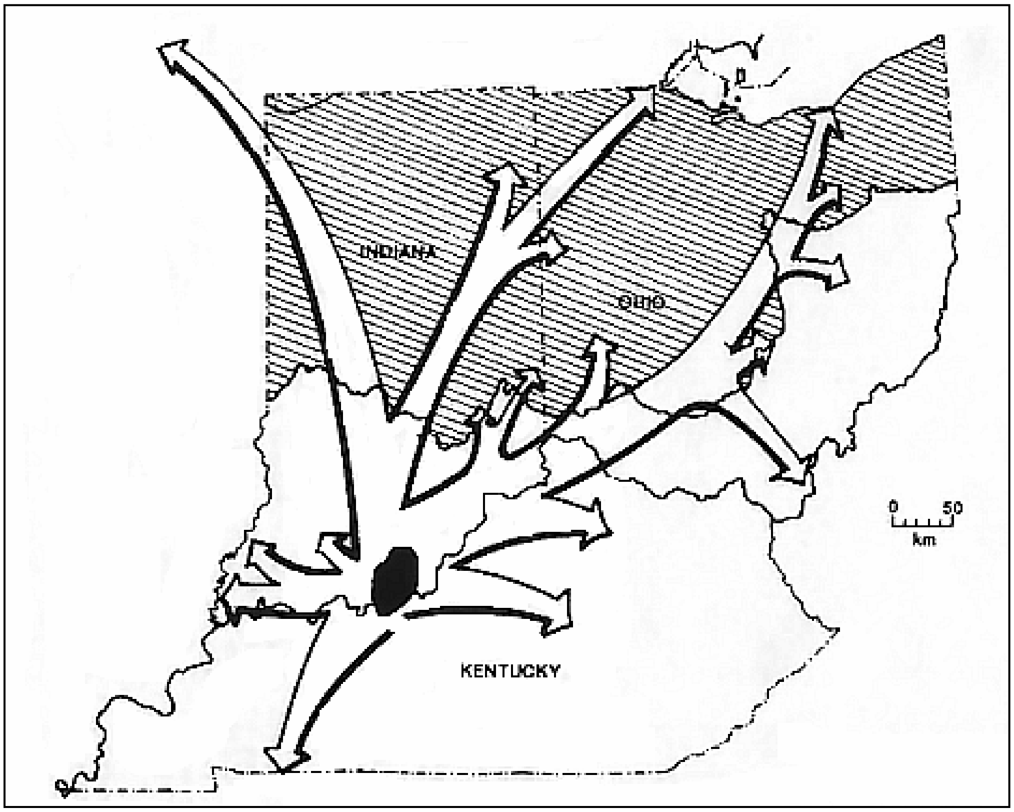


Figure 3. Wyandotte Chert Source. Courtesy of Glenn Black Laboratory of Archaeology and The Trustees of Indiana University
(http://www.gbl.indiana.edu/figures/87/87_5.gif)

Indiana University has conducted archaeological surveys of the counties north of the Ohio River from Meade County, Kentucky. According to their surveys most--if not all--of Meade County falls in a region they call the Wyandotte Chert Source.

> *The distribution of the Wyandotte chert source area (in black) compared with the distribution of fluted points manufactured from Wyandotte chert (broad arrows). Diagonal lines indicate the limits of glaciated terrain*.

The Wyandotte Chert Source was an area of ancient and ongoing lithic tool activity. The IU survey suggested human activity occurred at least as far back as 10,000 BC, the Paleoindian period, which is the oldest record of humans in North America. (Glenn Black Laboratory of Archaeology and the Trustees of Indiana University (see http://www.gbl.indiana.edu/abstracts/87/justice_87.html) (**Figure 3**).

Many who take an interest in our commonwealth's past are familiar with the archaeological surveys conducted by W. D. Funkhouser and W. S. Webb during the 1930s. In Volume II of their Archaeological Survey of Kentucky (1930:280, Item 4) they make the following comment:

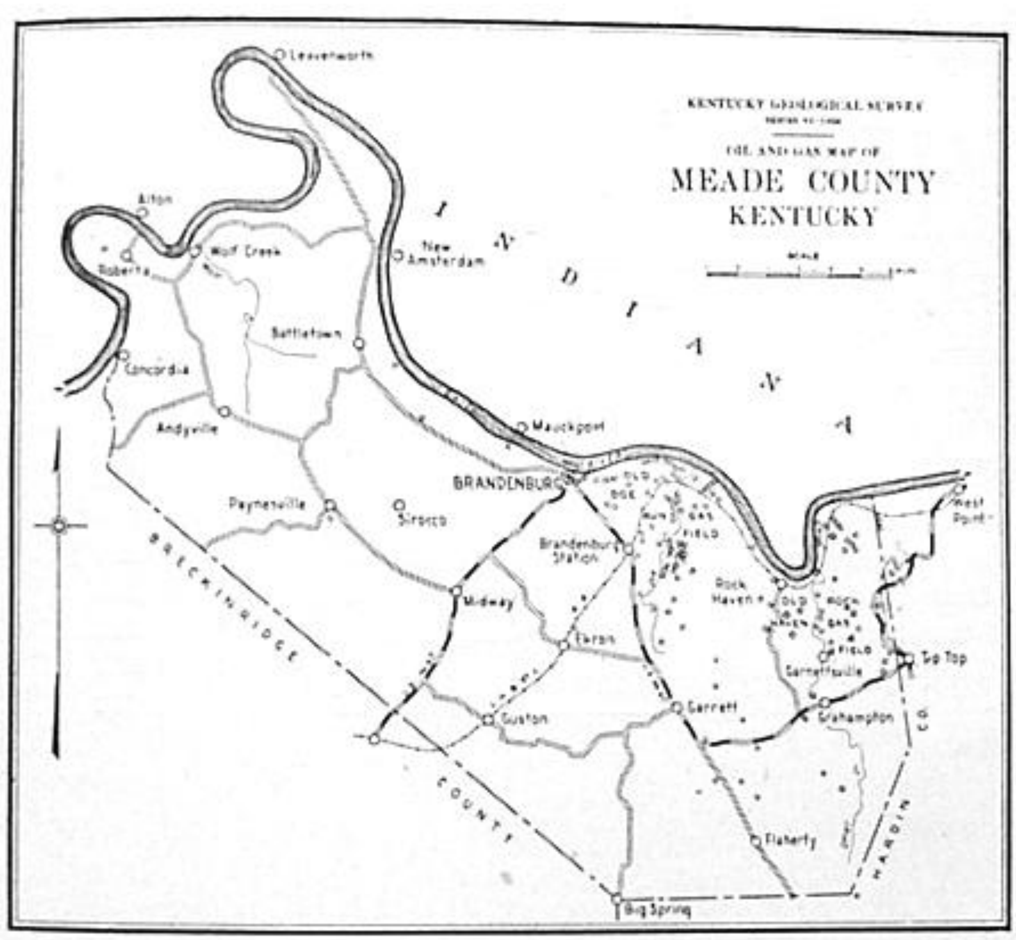
> *Mound on the farm of R. B. Shacklette about five and one-half miles west of Brandenburg. This mound has been in cultivation for nearly a hundred years and is now level with the surrounding field but it has yielded the largest number of artifacts of any site in the county. Reported by G. L. Ridenour.*

The description in the survey would place the mound in the vicinity of Gas Well Hollow. Further surface surveys might indicate the specific location. The Neben site referred to on the maps on Page 4 has a surface densely scattered with chert debitage and has been the site of many artifact finds.

I am currently looking for additional information about previous archaeological and geological surveys of the region and especially of the Meade County or Gas Well Hollow area. If anyone is familiar with any such information I would love to take a look at it.

According to my grandfather, Robert L. (Rob) Woolfolk, Gas Well Hollow is so named because a natural gas well was drilled in the area near where KY SR 228 crosses the gully. I remember as a child tripping numerous times over a pipe in the woods there. I cannot recall with certainty, however, whether my memory of that being a part of the gas well is accurate. My father and brothers recall the gas wellhead in the area, although they have not seen it in years. My oldest brother recalls his uncles lighting a flame of leaking gas on the plugged well. I do not know if the well economically produced natural gas, and I have not yet found the wellhead, but I do know the first natural gas wells in the commonwealth were in Meade County. (Nuttall Oil and Gas History Summary). There were some wells in the Rock Haven area in the eastern part of the county in the mid-nineteenth century--about 1858.

Sutton and Wagner's 1929 geologic map of Meade County shows a well known as the 'Wolfolk' (sic) well along the intermittent tributary to French Creek, just north of Highway 228.



OIL AND GAS SKETCH OF MEADE COUNTY, KY.

Figure 4. Gas wells in Meade County (Jillson 1930).

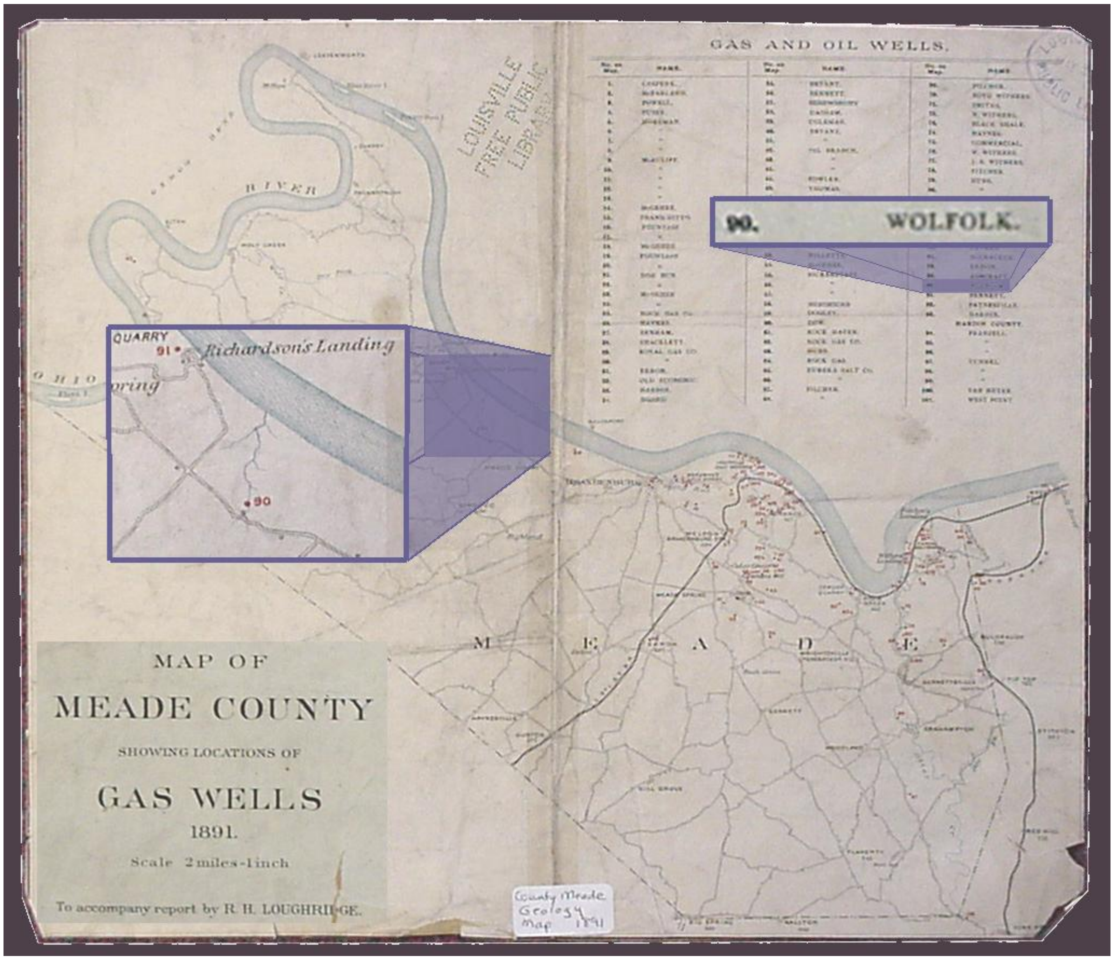


Figure 5. 1891 gas and oil wells in Meade County (Louisville Free Public Library Map Collection 2005).

The well is also shown on a Meade County sketch map in Jillson, 1930, *Oil and Gas in Western Kentucky*, Kentucky Geological Survey Series 6, volume 39, see page 249 (**Figure 4**). The Woolfolk well is not one of those included in the drilling records printed in the volume, however (Nuttall personal communication).

Figure 5 shows an 1891 map of Meade County gas and oil wells that was meant to accompany a report by an R. H. Loughridge. It shows a Wolfolk" well number 90 on the list of wells as the one in Gas Well Hollow (Louisville Free Public Library Map Collection 2005).

Throughout our childhood, my brothers and sisters and I frequently picked up obvious stone tools such as projectile points and side scrapers and occasional pestles while playing in the fields and woods near our home. My brother has an excellent collection of artifacts he has picked up along the Ohio River. One of my uncles had an extensive collection of "arrowheads" he picked up in the river bottoms during his many years of farming. Many local people, especially those who lived in the river bottoms, have similar collections. In my adulthood, I have often searched for surface artifacts in a particular area near my father's house. Over the years, I have found some nice pieces there. Although I have held this lifelong interest in stone artifacts, I have not pursued more than a tertiary knowledge of those who once lived in this land until recently.

A few years ago I began to perceive that most of the flint I find shows evidence of human workmanship. Scattered widely among the occasional fine projectile points are many utilitarian and expedient tools. At the very least, I think there are hundreds, if not thousands, of pounds of debitage from prehistoric tool making and associated activities in Gas Well Hollow.

I have found some very refined stone tools that show Stone Age people did indeed spend time in the area. But for every finer artifact there are dozens of rougher stones, chips, and flakes. When I began to realize I was finding stone relics that are not the "arrowheads" most of us know, I began to try to learn the characteristics of stone tools and the lithology behind them. The more I have learned, the more convinced I am that extensive lithic activity occurred there.

In July 2002 my daughter and I took a walk in the woods near my father's house. She wanted to try to catch a baby frog at a pond while I wanted to go look for relics in the field on a ridge above the pond, so we parted. I found no really good pieces in my usual hunting grounds and eventually went to the pond to get my daughter.

She, too, had poor luck and had not caught a frog. I suggested we look in the drainage ditch that runs by the pond. The ditch is an intermittent stream at best but usually has small pools of water within it throughout the year where frogs can be more easily caught.

We had been in the ditch a very short time when I found what might be a Paleolithic knife **Figure 1**.

At the time, I did not know exactly what I had found, but I knew it was well worked and complete. It was also of a type of chert that appears different from the common flint found nearby.

Figure 1. Flake displaying damage suggesting knife use.

Figure 7. Chert pieces showing typical Wyandotte chert characteristics. The cortex is visible on some pieces as is oxidation. The pieces pictured here show evidence of being produced as tools.

Having never found artifacts in the ditch before, I began looking about more intently. Quickly in the gravel beds of the ditch I found other stones that were possibly worked by humans. Soon I began to realize that a lot of the chert in the ditch, the flint that I took little.notice of as a child, showed signs of human workmanship (**Figure 8**). On the next trip to my father's home, I followed the ditch in the downstream direction and found more and more evidence of human stone usage. In one place, and—on later trips--in several places along the course of the ditch, I have gotten the sensation I am finding material *in situ*. That is probably my imagination running wild because the ditch often washes violently after rain has fallen. I suspect even larger stones get tumbled from their original resting places, but I think the evidence of human activity is extensive and irrefutable.

In the ensuing time, I have surveyed extensive portions of Gas Well Hollow and have found signs of nodular chert and lithic activity along its length.

Upon realizing what is there, I also began researching the area's geology and archaeology. It appears little archaeological research has been done there, and I fear much of the area's history is being lost as generations pass.

The photographs below are of examples of chert pieces found in Gas Well Hollow, most of which show signs of what can be interpreted as human usage.

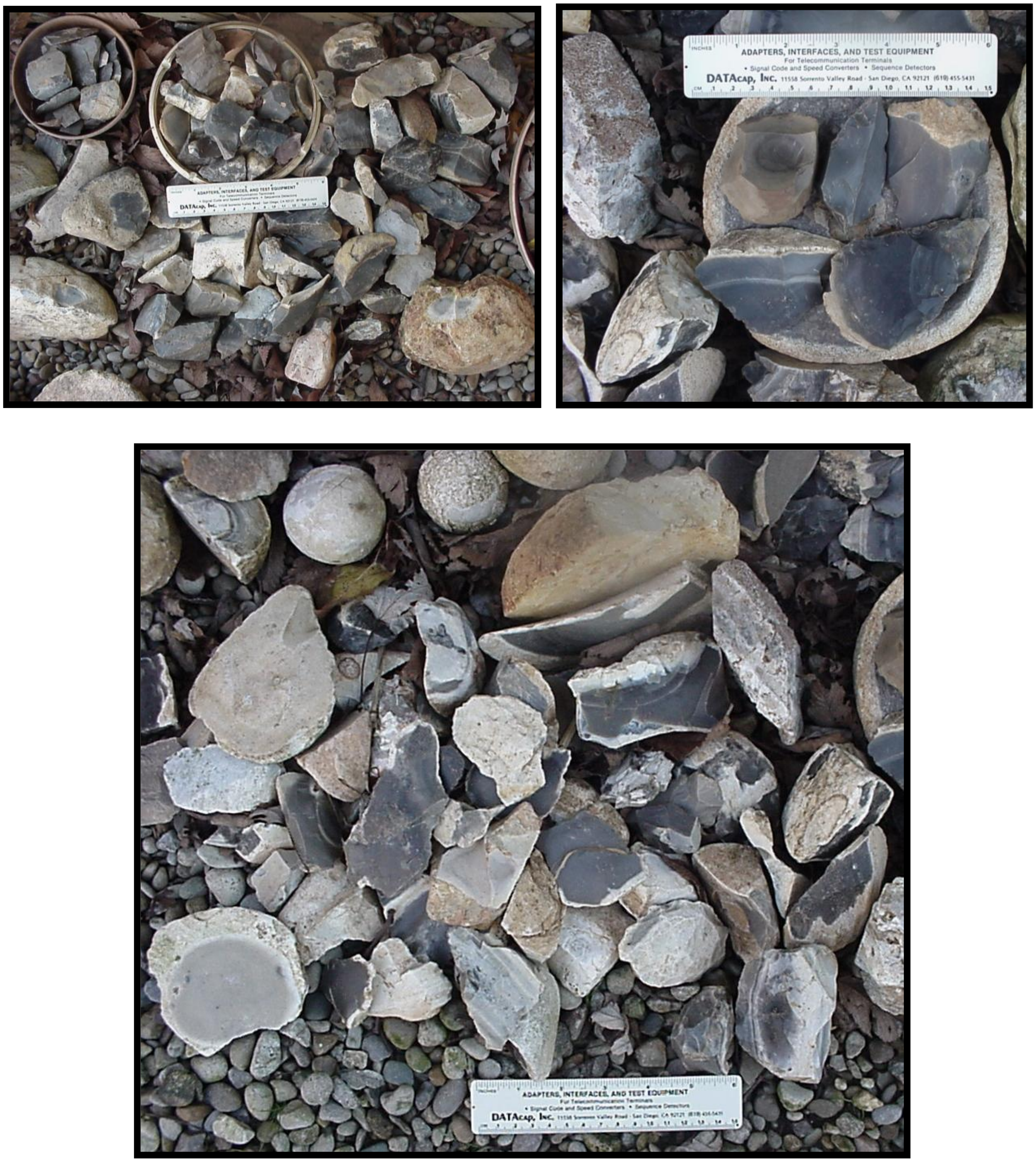


Figure 8. Chert pieces found in Gas Well Hollow that show signs of human usage.

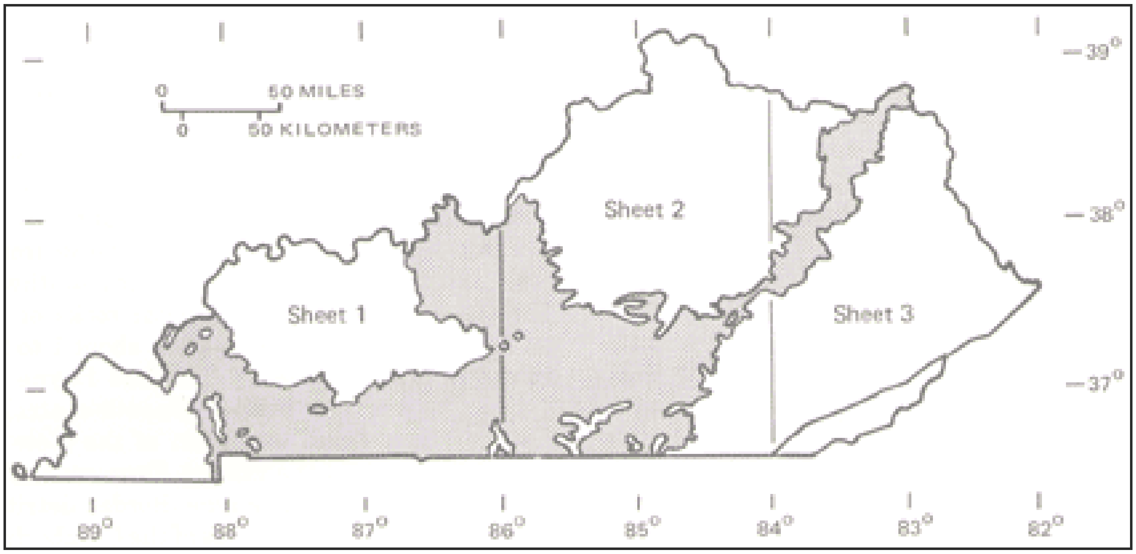


Figure 9. Area of outcrop of Mississippian strata in Kentucky (shaded) (Grabowski 2001).

Contacts with the Fredonia member of the Ste. Genevieve limestone occur in Gas Well Hollow. The general geology of the area is Mississippian karst, which dissolves in such a way as to form many sinkholes and caves (**Figure 9**). Many natural pools or ponds evidence a karst region, especially where cattle have been. This characteristic is widely evident on topographic maps.

Another distinct feature of portions of the Ste. Genevieve limestone is chert that formed within it and that erodes from it. Chert is found in the limestone in both nodular and sheet-like forms. There are several theories as to how chert was formed, but--regardless of that or its morphology--it proved a useful raw material for Stone Age people. Chert is harder than the surrounding limestone and is left behind as the limestone erodes. It ends up suspended in the soil that overlies the bedrock. Through erosion in the topsoil and alluvial deposition, the chert is exposed and can be gathered.

In the Gas Well Hollow area, there is a prevalence of nodular chert. The nodules are usually spheroidal but can occur in odder forms. Part of a survey of Meade County and the surrounding area should pay close attention to other places where there may be the occurrence of nodular chert. Chert in any form proved useful for lithic activity, but nodular chert can offer a high quality raw material.

Chert, when broken, provides razor sharp edges that were of considerable value to Stone Age Americans. A characteristic indicating chert that was broken by humans to make tools is conchoidal fracturing. The characteristics of conchoidal fracture are seen on much of the chert in the Gas Well Hollow area.

In a perfect conchoidal fracture, a cone is formed. These can be demonstrated by the conic structure formed in thick plate glass if it is hit, but not shattered, by something like a BB pellet.

In Stone Age tool manufacturing, the fracture characteristics are similar to sections of cones, hence conchoidal. Modern flintknappers are familiar with conchoidal fracturing and the breakage characteristics of chert and other glasslike stones (i.e. those with high SiO^2 content). Many chert nodules and, perhaps, all the chert pieces in Gas Well Hollow show conchoidal fracturing. This is evidence of primary steps in making stone tools.

Figure 10. A chert nodule showing conchoidal fracturing, probably caused by an early human. This might have been used for chopping or hewing (1-inch graph).

Another type of evidence of human stone tools is secondary work. Secondary work is shown by the small chips that have been removed along the edge of a piece of broken flint. In many cases, the chipping is to re-sharpen a dulled edge but is also seen in the extensive chipping that goes into making the more refined tools such as projectile points.

In stone tool making, raw material must be procured in its natural state and broken into usable pieces. Often after primary breakage, the resulting pieces are usable tools for work such as hewing wood or bone or for digging or drilling (**Figure 10**). Even for more complex jobs like butchery and making clothing or other useful items from hides, expedient chert flakes make useful tools. Chipping on broken pieces offered the chance to make more refined tools and to extend the life of others. This secondary working produces the tools that most people recognize as stone artifacts. For the archaeologist, secondary working offers tools that provide a context for determining cultural time periods.

Figure 11 depicts chert pieces gathered in the Gas Well Hollow area, some showing secondary work. Some of these tools such as the projectile points in the upper left of the left picture and several in the right picture offer a context that allows determination of the time period during which they were produced. The cultural points I have identified include what I think are Snyder, Wade, and Adena types. These would indicate activity as early as 1000 B.C.

In the situation of a chert procurement area, such as what is found in Gas Well Hollow, the large number of stone tools offers an interesting look into a past way of life, but little context into the timeline of human activity. Distinctive tools, such as projectile points, and other evidence, such as organic matter, allow measurements of time. In this area, a long-term study of what is there may lead to a better understanding of our past.

Figure 11. Examples collected in the Gas Well Hollow area, many with secondary work.

Gas Well Hollow Chert Complex

In the French Creek drainage, there are what I think are three distinct lithic areas showing different phases of Stone Age human activities. Two of the areas on the Dowden property I have taken to calling the ridgetop campsite and the procurement area. An area on the Neben property is what appears to be a reduction center. The area called the Hilltop site appears it may, too, have been a campsite.

On the Dowden property, there is a north/south-oriented ridge that lays between the two primary drainages into French Creek. I believe this area may have been a campsite. The quality and refinement of the tools I have found in there indicate a site where perhaps someone had the time (say in preparation for a hunt or after dinner) to make a better tool. I suspect such areas may be found throughout the highlands of the watershed as indicated by similar features at the Hilltop site. I once found some distinctive tools and points in the hills known as Turkey Heaven on the southern end of the watershed, but those points were lost years ago.

Gas Well Hollow is a drainage ditch that defines the western portion of the French Creek watershed. Along this ditch there are great numbers of chert nodules and what I take to be signs of lithic procurement, tool making, and tool usage.

On a third site near a pond on the Fred Neben property, broken chert pieces are of such size and in such quantity that I take it to be a stone-processing site. Here, I think the ancient people gathered the nodules to reduce them into great numbers of portable and tradable chert “blanks”. These blanks could have been used as flake cores and to make projectile points and other more refined tools.

As mentioned earlier, the eastern gully provided very few samples of chert until nodules begin to appear as it approaches the roadway.

I suspect a walkover survey of the entire watershed would yield ample evidence of additional Stone Age human activity. I am also curious as to what a wider survey of adjacent watersheds and undeveloped areas of Meade County might yield.

I know the ancient people, for thousands of years, gathered and utilized the stones that are found in the area where I grew up to allow them to perform the activities that allowed them to live. I know also I wish to continue to survey the area and to look wider for possible occurrences of the Ste. Genevieve chert nodules. I suspect that wherever the nodules are found there, too, will be evidence of stone-age human activity.

As I have continued my research, I have begun to suspect that any occurrence of lithic material that lends itself to tool manufacture was exploited by early humans. I suspect anywhere in the world where material with conchoidal fracture characteristics occurs, there is evidence of human activity. But in this little portion of the world, I am curious about what the ancient people were doing.

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FURTHER CLARIFICATION OF MATANZAS AND MCWHINNEY PROJECTILE POINTS IN THE FALLS OF THE OHIO AREA

By Kathryn J. McGrath[1], M.A., RPA, Anne T. Bader[1], M.A., RPA, and Donald Janzen[2], Ph.D.

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Abstract

Data will be presented from the Hornung Site (15JF60), which was excavated in 3-inch levels and supported by five radiocarbon dates, regarding the vertical distribution of Matanzas and McWhinney projectiles. This will be supplemented by data from other sites at the Falls, such as the Miles Rockshelter Site (15JF671), Habich Site (15JF550), and other late Middle and Late Archaic sites containing dated Matanzas and McWhinney points.

The Problem and Hypothesis

The temporal placement of small side-notched points such as Matanzas and the stemmed points such as McWhinney has evolved since their initial characterization. When originally defined in Fulton County, Illinois, Matanzas points were attributed to the Late Archaic period (Munson and Harn 1966:153). In the next few decades, Matanzas points continued to be classified in this region as diagnostic points of the Late Archaic period (Janzen 1977; Justice 1987). However, archaeological data has since suggested to a number of researchers that shallow side-notched points such as Matanzas became prominent much earlier than stemmed Late Archaic points such as McWhinney (Cantin and Anslinger 1987 cf. Stafford and Cantin 2005). In Tennessee, an earlier time frame for the Matanzas point was suggested by Des Jean and Benthall (1994:13) due to the presence of basal grinding on a high percentage of specimens. In Indiana, Stafford and Cantin (2005) defined the temporal range of Matanzas being primarily between 5300 and 4500 rcybp and the temporal range for stemmed types, in contrast, from 4500 to 3600 rcybp.

With regard to Kentucky, Jefferies (1990:153; 1996:46) considered Matanzas points as a diagnostic artifact of the late Middle Archaic period (6000-5000 BP). The question, then, was whether data from the Falls of the Ohio area also supported this temporal affiliation.

Our hypothesis asserts that, based on archaeological types, evidence from sites in the Falls of the Ohio area, Matanzas points appear earlier in the archaeological record than McWhinney points and are diagnostic of the late Middle Archaic period rather than the Late Archaic. In contrast, McWhinney points appear in the Late Archaic period and extend into a more recent time period than Matanzas points.

In order to evaluate this hypothesis, we will first define the cultural phases and point types, next look at radiocarbon dates from the Midwest region, and finally, look at the relative and absolute dates for these point types from sites in this area.

Definitions

Table 1 shows the time periods as used in this paper and the cultural affiliations common to these periods in the Falls of the Ohio area. The cultural phases were defined by Granger in the early 1980s. The early French Lick phase as it is being defined by Stafford and Cantin (2005) appears to correlate to the Old Clarksville phase here.

Table 1. Range of Dates and Cultural Affiliations for Middle and Late Archaic Periods

Period	Date Range	Falls of the Ohio Cultural Affiliation
Middle Archaic	8000-5000 BP (Jefferies 1990)	Old Clarksville: 6000-4400 BP (Granger1985)
Late Middle Archaic	6000-5000 BP (Jefferies 1990)	
Late Archaic	5000-3000 BP (Jefferies 1990)	Lone Hill: 4400-3200 BP (Granger 1985)

Next, we review Matanzas and McWhinney points.

Matanzas points were defined by Munson and Harn (1966:153) as a "shallow side notched, short stemmed point". In this first sample of Matanzas (n=27), 70 percent exhibited a straight base and only 7 percent exhibited basal grinding. In contrast, Justice (1987:119), basing his summary upon Cook's (1976) analysis of 262 Matanzas points from the Koster site in Illinois, mentions grinding of the base and notches as an important feature of Matanzas points. In fact, 84 percent of the Matanzas in the Koster sample showed grinding along the base, in the notches, or on both (Cook 1976:141-3). Although Cook defined five variants of Matanzas points, (modal, deep side-notched, flared stem, faint side-notched, and straight stemmed), variants considered for this paper would have fallen into the modal or faint side-notched variant (Cook 1976:140). The size of the Matanzas points is small; a sample examined by Justice (1987) exhibited a mean length of 41 mm, width of 20 mm, and thickness of 8 mm.

According to Justice (1987), the geographical distribution of Matanzas extended from mid-Ohio west to the Mississippi River Valley north to southern Wisconsin and south into Kentucky, but the distribution may extend south into Tennessee (Des Jean and Benthall 1994) and west of the Mississippi River (Perino 1968 cf Cook 1976). Points within this cluster considered for this paper include Stubby Shallow Side-notched (Duffield 1966:60-61) and Salt River Side-notched.

Cultural affiliations include the French Lick phase in Indiana (Munson and Cook 1980, cf Anslinger 1986) and the Old Clarksville phase in Kentucky. Stafford and Cantin (2005) suggest the early French Lick phase can be identified by a high percentage of Matanzas points in contrast to stemmed points. Meadows and Bair (2000) make the early versus late French Lick culture determination based on the presence of stemmed points such as Karnak as opposed to the Terminal Archaic barbed points.

McWhinney Heavy Stemmed points were originally defined by Heilman in Geistweit's 1970 Masters Thesis. Many attributes have since been confirmed or added by samples from the Maple Creek site (33CT52) (Vickery 1972). Justice (1987:138) summarizes the McWhinney Heavy Stemmed points as follows:

> *relatively thick-stemmed forms that often retain cortex…a medial ridge on one face, lack of basal grinding, and, usually, cortex at the base of the stem….[They] have short stems relative to blade length and width. The haft element is produced by a side notching technique . . . . The basal edge varies from straight or convex to slightly concave.*

Due to the significant variation in haft morphology, Vickery (1972) suggested if a review of a large sample of McWhinney points could be made, the type may be broken down into subtypes. White (2002:241) concurs, based on the sample recovered from 12CL158 (n=55).

Although always attributed to the Late Archaic period, the terminal date for McWhinney points is nebulous. Although absolute dates for McWhinney points from this region show that these artifacts extended later in time than Matanzas, dates based on associated artifacts suggest the McWhinney point extended into the Adena phase, a post-2500 BP, late Early Woodland to Middle Woodland culture (Railey 1996:98). This evidence comes from a burial feature at the Rosenberger Site (15JF18) (Driskell 1979:792) and is also discussed in White (2002:241). As noted by White (2002), this may be a consequence of the lumping of a variety of forms under the McWhinney label.

Other points within the McWhinney cluster considered in the data for this paper include Rowlett (**Figure 1**). Cultural affiliations represented by McWhinney Heavy Stemmed points include the Lone Hill phase in Kentucky, the Riverton culture downstream of the Falls, and the Maple Creek culture upstream of the Falls.

Chronology for Matanzas and McWhinney Points in the Region

In order to put the relative dates obtained from sites in the Falls of the Ohio area into perspective, a summary of the distribution of Matanzas and McWhinney points at one site—the Robert Dudgeon Site (15Ta6)—and a summary of absolute dates from sites in the Midwest region will aid the discussion.

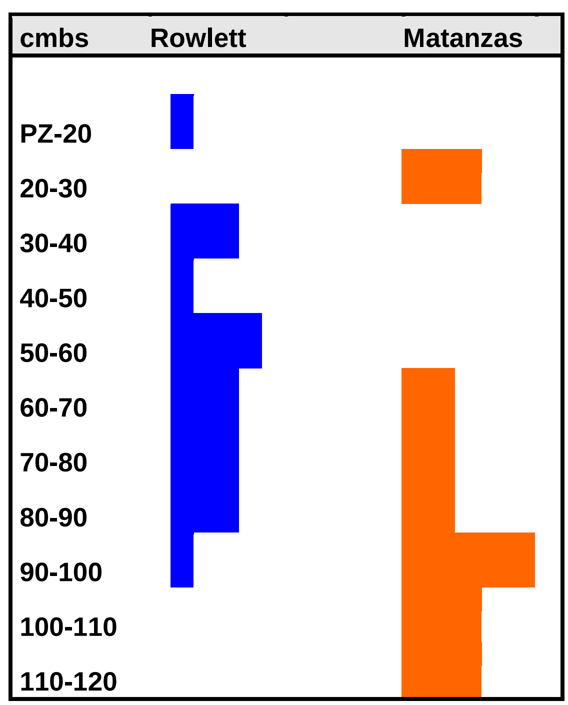
Robert Dudgeon Site (15TA6) (Duffield 1966). The Robert Dudgeon Site (15TA6) was excavated in 1965 and 1966 by Lathel Duffield and the University of Kentucky in cooperation with the National Park Service prior to the inundation of the Green River to form Green River Lake in Taylor and Adair counties of Kentucky. The site was known to have been occupied primarily by Archaic peoples. There were "trends" at the site suggesting a series of occupations. The data suggest the earliest occupation in the area was by a group who made short, stubby projectile points with shallow side notches (Matanzas) and possibly also deep side-notched projectile points. This group was followed by another who manufactured thick, long, narrow stemmed points that Duffield named Rowlett (McWhinney).

The site was located on a high erosional remnant on the right bank of Robinson Creek. The eastern edge of the site coincided with the upper edge of a low limestone bluff. On the western edge of the small knoll on which the site was situated, two springs were present. The site appeared to have been extensive.

The excavations at the site were conducted in 10-centimeter levels. Natural soil zones were noted, but the material was not collected by this means--only by arbitrary 10-centimeter levels. The soil profiles showed five different strata, which were labeled A through E. Zone A (8 to 18 cm thick) was the plowzone. Zone B was between 8 and 27 cm in thickness and was located below the plowzone. This zone included FCR but little debitage. Zone C, 14 to 40 cm thick, was a dark brown midden with FCR. Zone D was 85 cm in maximum thickness. This was comprised of yellowish brown soil with larger sandstone and FCR than Zone C. Zone E was yellow clay with many waterworn cobbles and flint debitage.

Table 2 shows the concentration of Matanzas between 60 and 120 cmbs with the highest frequency between 90 and 100 cmbs. The stemmed McWhinneys (Rowletts) were found between 30 and 100 cmbs, with the highest frequency between 50 and 60 cm.

Table 2: Comparison by Level of Rowlett and Matanzas Point Distributions from the Robert Dudgeon Site (15TA6)



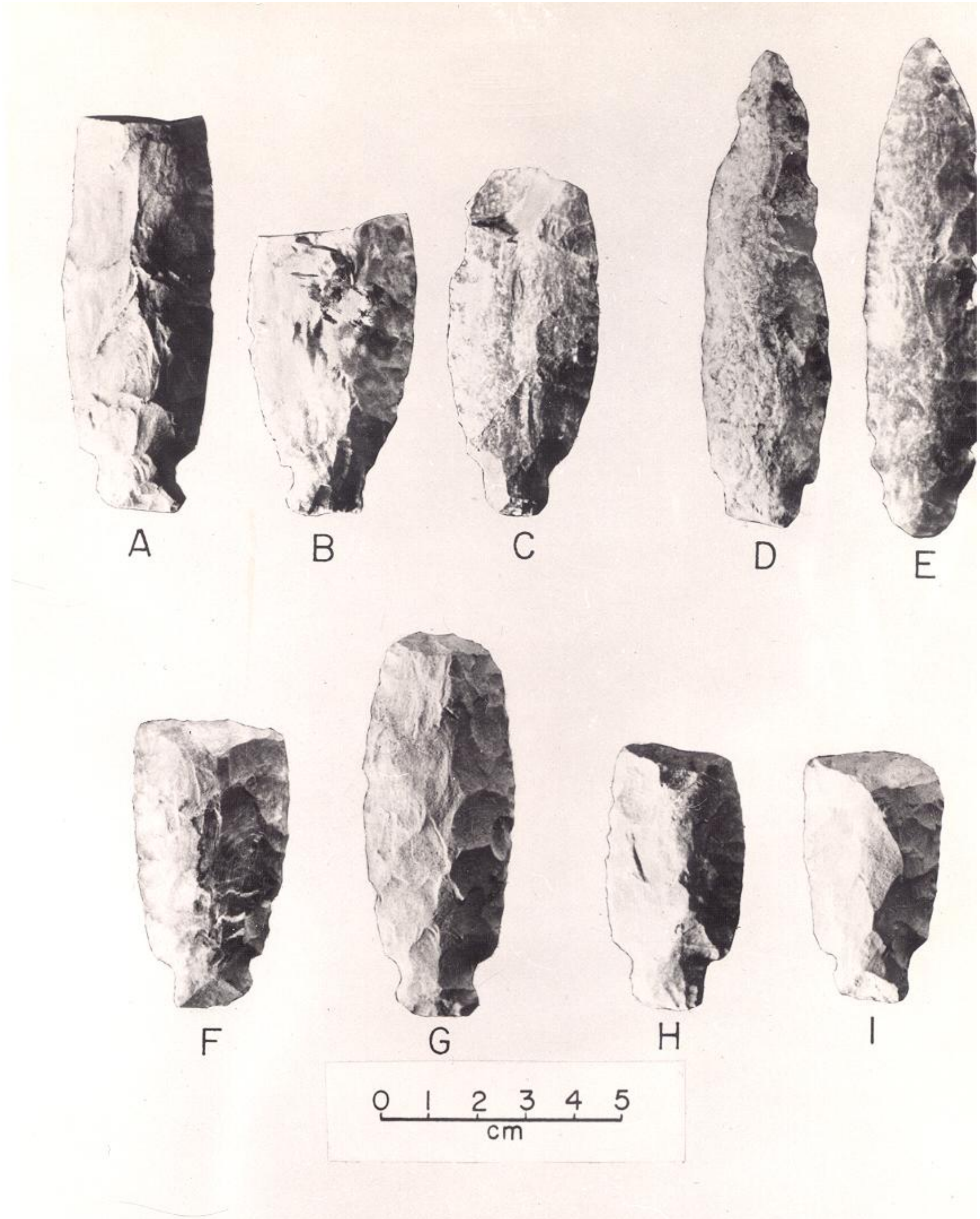


Figure 1. Rowlette points from the Robert Dudgeon Site (15TA6).

Radiocarbon Dates. A summary of radiocarbon dates from sites in the Midwest was compiled to put the data from the Falls of the Ohio into perspective (**Table 3**). Much of this data summarizes data from Stafford and Cantin (2005) and White (2002) as well as dates from the Meyer (12SP1082) and Hornung (15JF60) sites. From this data, it became clear that, although there is some overlap, dates for Matanzas points range from 4200 ± 200 (Breeden Site, 12HR11) to 5749 ± 50 (12PE929) rcybp. McWhinney points, on the other hand, range from 3260 ± 70 to 4590 ± 130 rcybp (12PE929). This indicated a small range of time in which both point types would overlap. This overlap appears to center around 4200 BP. A closer look at data from sites in the Falls of the Ohio region will show whether this holds true for this area as well.

Table 3. Radiocarbon Dates in Region: Latest Dates to Earliest

Site	McWhinney Date	Matanzas Date	Item Dated	Reference
12PE929	3260 ± 70 to 4590 ± 130 rcybp	No side-notched in midden	Midden with McWhinney	Stafford and Cantin 2005:30
Habich Site (15JF550)	3480 ± 100 rcybp		Charcoal from feature in which point was found	Granger, Hardesty, and Bader 1992:E-3
Mogan Site (12PE839)	3530 ± 90 BP	Matanzas present		Bader 1994, in Stafford and Cantin 2005
Skidmore Site	3550 ± 60 BP			Jefferies 1990:208
Mogan Site (12PE839)	3920 ± 80 BP	Matanzas present		Bader 1994, in Stafford and Cantin 2005
Oliver Vineyard Site (12MO141)	3940 ± 40 BP (mean of two dates)	Matanzas "common"	Feature material	Munson and Cook 1980, in Stafford and Cantin 2005:31
12PE929	4060 ± 30 rcybp (pooled average of four dates)			Stafford and Cantin 2005:30
Miles Farm Site (12CL158)	4060-4230 BP	One Matanzas present		White 2002
12SW99	4090 ± 40 rcybp (pooled mean for three dates			Stafford and Cantin 2005:30
Maple Creek Site (33CT52)	4115 ±150			Vickery 1972
Logan Site (33CT30)	4115 ± 455 BP			Vickery 1983, in White 2002
Millersburg Site (12W81)	4120 ± 80 rcybp		nutshell fragments	Stafford and Cantin 2005:24
Breeden Site (12HR11)		4200 ± 200	feature from lowest levels	Stafford and Cantin 2005:28
Hornung Site (15JF60)	McWhinneys present	4240 ± 95		
Hornung Site (15JF60)	McWhinneys present	4320 ± 60		
Habich Site (15JF550)	McWhinneys present	4480 ± 80 rcybp	Charcoal from feature in which point was found	Granger, Hardesty, and Bader 1992:E-5
15RO36	4425 ± 720 BP			Brooks et al. 1979, in White 2002
Patriot 2 Site (IN)	3400-4400 BP			GAI 1984, in White 2002
DuPont Site (33HA11)	4000-4600 BP			Vickery 1983, in White 2002
Black Earth Site (11SA87 Area A, Zone 3,)		4860 ± 85 near the top of the zone to 5905 ± 85 at the bottom (uncorrected dates)		Jefferies and Lynch 1983:307
Hornung Site (15JF60)	One McWhinney present	4900 ± 200		
KYANG (15JF267)		5010 ± 90 BP	Feature 14	Bader and Granger 1989
Bluegrass (12W162)		5030 ± 80 to 5290 ± 70 rcybp		Stafford and Cantin 20005:22
Hornung Site (15JF60)	One McWhinney Present	5220 ± 230 BP		
Meyers Site (12SP1082)		5280 ± 80 BP		
Millersburg Site (12W81)		5290 ± 50 rcybp	material from a pit	Stafford and Cantin 2005:24
Bullskin Creek (33CT29)	4300-5300 BP			Vickery 1983, in White 2002
Koster--Helton phase		5000 to 5700 BP		Cook 1976
12PE929		5749 ± 50 rcybp		Stafford and Cantin 2005:18

Closer Look at Stratigraphic Relationships

Within the Falls of the Ohio area, the chronologies of these point types at a number of sites were examined (**Figure 2**). Sites in a lowland setting include Miles Farm (12CL158), Meyer (12SP1082), KYANG (15JF267), Hornung (15JF60) and Habich (15JF550) sites; sites located in an upland setting include McNeely Lake (15JF200), Durrett (15JF201), and Miles Rockshelter (15JF671) sites.

Lowland Sites

Miles Farm Site (12CL158). 12CL158 is located along the Ohio River in Clark County, Indiana. Phase II excavations were completed between 1998 and 1999 by Indiana University at Fort Wayne Archaeological Survey (IPFW-AS) (White 2002). The main occupations of the site date to the Middle and Late Archaic periods. Of all the points recovered from the site, the majority were McWhinney points (n=55). Radiocarbon dates were obtained for two McWhinney points; material from the features containing the two McWhinney points provided a date range of 4230 to 4060 BP.

The dates from 12CL158 fit with dates obtained for the Old Clarksville Site (12FL1): 4000 to 4640 BP (uncorrected dates). One Matanzas point was recovered from the plowzone level of the site and appears to provide negative evidence for our hypothesis (White 2002:246).

Meyer Site (12SP1082). Near the end of May 2004, while excavating trenches to emplace foundation footers for a planned expansion to a residence, Mr. Russ Meyer of Hatfield, Indiana in Spencer County inadvertently disturbed human skeletal remains and uncovered numerous prehistoric artifacts dating to the late Middle Archaic and Late Archaic periods. The authorities were notified, and Mr. Jim Mohow of the Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology (IDNR/DHPA), among others, visited the site and confirmed that it contained disturbed burials as well as other feature types, including fire pits. The previous and current landowners of the Meyer Site have long collected prehistoric artifacts from the ground surface. Among the diagnostic projectile points that have been found are Brewerton and Matanzas types (**Figure 3**). Late Archaic stemmed points were less common in the collection. Several side-notched and corner-notched varieties, including Godar, were also present, suggesting an even earlier--but relatively minor--Archaic occupation. The radiocarbon date associated with the Matanzas points at Meyer was 5280 ± 80 BP.

KYANG (15JF267). KYANG (15JF267) was located on a knoll along a marsh environment in central Jefferson County. The site was excavated by the University of Louisville Archaeological Survey from 1972 to 1973 (Bader and Granger 1989). The site contained an extensive upper midden deposit that lacked significant shell debris and a lower midden deposit that contained extensive shell debris. People of the Old Clarksville occupation subsisted on deer and nuts as well as the shellfish; in contrast, the Lone Hill population exploited deer over alternatives. Although a radiocarbon date could not be obtained for the upper midden, a Lone Hill phase affiliation was obvious based on the assemblage. For the Lower Zone, one radiocarbon date (5010 ± 90 BP) was obtained for Feature 14, which also contained a Salt River side-notched point (**Table 4**) (Bader and Granger 1989:VIII-2). The data from KYANG (15JF267) support the placement of the Matanzas-like point earlier in time than the stemmed McWhinney/Rowlett points.

Figure 2. Discussed Archaic sites depicted on 2008 Google image.

Figure 3. Matanzas Projectile Points from the Meyer Site (12SP1082).

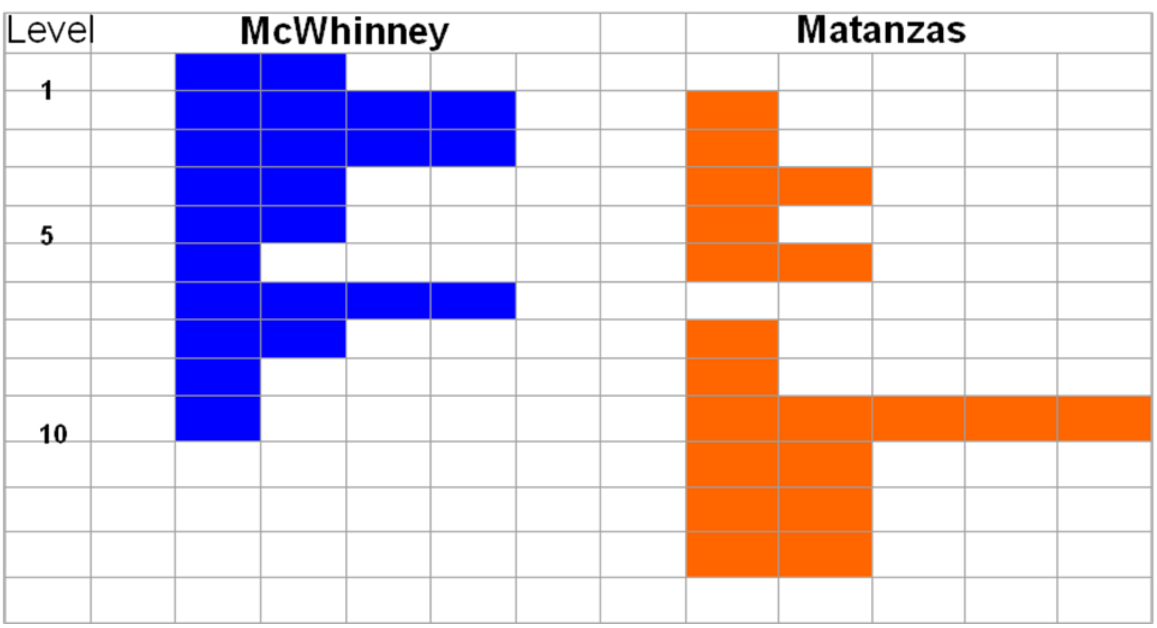
Table 4. KYANG Site (15JF267) Stratigraphy (Bader and Granger 1989)

Level	Cultural Affiliation	Point Type	C14 Date
KYANG II (Upper Midden Zone)	Lone Hill	Rowlett	No date
KYANG I (Lower Midden Zone)	Old Clarksville	Salt River Side-notched	5010+-90 BP Feature 14

Hornung Site (15JF60). The Hornung Site (15JF60) was excavated by Dr. Donald Janzen between 1970 and 1972, during which time he dug 28 5-x-5-ft square units. The site consisted of a mound that was 5 ft high and 110 ft long. Excavations at the height of the mound revealed a thin veneer of Early to Middle Woodland occupation, underlain by 42 in of Archaic midden. The mound appeared to have been a trash accumulation and was later used for burial. The features were hard to detect. Although a lot of bone was found, shell was sparse and found in isolated concentrations. On the mound, Janzen dug 14 three-inch (7.5-cm) levels. Excavations also were conducted off the mound.

Radiocarbon dates from Hornung range from 4520 BP for Level 4 to 6450 BP (recalibrated dates) for Level 13 with a majority of Matanzas coming from Level 10 (**Table 5**). As in this chart, a comparison of these points recovered from all levels supports the hypothesis that Matanzas began earlier and McWhinney points grew in prominence later in time.

Table 5. Comparison of McWhinney and Matanzas Point Distributions from Hornung (15JF60)



Habich Site (15JF550). The Habich Site (15JF550) was located along the Ohio River in northeastern Jefferson County. The Phase III data recovery of this site was implemented by Granger Consultants (later Archaeology Resources Consultant Services) in 1990 (Granger, Hardesty, and Bader 1992).

During these excavations, 10,776 artifacts were recovered, including 479 projectile point fragments, 223 hammerstones/utilized cobbles, 470 utilized flakes, and 134 pieces of fired clay. Twenty-four interments were also excavated.

Diagnostic projectile points recovered from the site ranged from Early Archaic through Late Woodland periods, but the periods most represented were Late Archaic (43 percent), Middle Archaic (31 percent), and Early Woodland (19 percent).

Of all the diagnostic projectile points recovered during the Phase II and Phase III projects, McWhinney points comprised the greatest number of all point types (n=20) (**Figure 4**). During the Phase III project, one of these McWhinney points was recovered from a radiocarbon-dated feature. The date of 3480 ± 100 was obtained from the heavy charcoal layer of Feature 81 within which the straight-stemmed McWhinney point was recovered. In contrast, a small side-notched point (probable Matanzas) was recovered from Feature 6. The radiocarbon date from this feature was 4480 ± 80 (Granger, Hardesty, and Bader 1992).

Figure 4. McWhinney projectile points from the Habich Site (15JF550).

In contrast to other Middle to Late Archaic settlements along the Ohio River, such as KYANG (15JF267) and Hornung (15JF60), the Habich Site (15JF550) did not contain large quantities of shell debris. Instead, a "heavy presence of nuts in the floral assemblage" suggested reliance on mast resources (Granger, Hardesty, and Bader 1992:231). As noted by Granger (1985), the lack of mussel shell and the presence of McWhinney projectile points suggest a Lone Hill affiliation (4400 to 3200 BP). Based on absolute dates provided by the radiocarbon assays, our original hypothesis is again supported.

Upland Sites

With regard to upland sites, McNeely Lake (15JF200), the Durrett Site (15JF201), and Miles Rockshelter (15JF671) provide additional information on the relative stratigraphy of Matanzas and McWhinney points and also provide comparison data on the subsistence strategies associated with these components. Rather than being associated with dense shell mounds or shell middens in these locations, Matanzas points were associated with other resources such as deer and nuts.

McNeely Lake (15JF200). McNeely Lake (15JF200) is a rockshelter site located along a tributary of Floyd's Fork in southern Jefferson County. Although subjected to vandalism throughout its history, some integrity remained, and the site was excavated by the Louisville Archaeological Society from 1963 to1965 and by the University of Louisville Archaeological Survey from 1967 to 1969 (Granger 1985:IV-5). The assemblage contributed information from the Archaic through Late Woodland periods, including the Middle Archaic Old Clarksville and Late Archaic Lone Hill phases (**Table 6**). The data recovered from McNeely Lake (15JF200) confirm our hypothesis: Salt River Side-notched points (Matanzas) were recovered from the Level III Old Clarksville occupation, while McWhinney and Rowlett points were recovered from the higher Level II Lone Hill component (Granger 1985:IV-9). Faunal and floral data from these two sites suggested a change in subsistence strategies: from shell, nuts, and deer during the Old Clarksville phase to a greater reliance on deer during the Lone Hill phase (Granger 1985:IV-22). Data from McNeely Lake (15JF200) also supports the placement of the Matanzas-like Salt River Side-notched point earlier in time than the stemmed McWhinney/Rowlett point.

Table 6. McNeely Lake (15JF200) Stratigraphy (Granger 1985:IV-9)

Excavation Level	Cultural Affiliation	Point Type
Level II	Lone Hill	Rowlett
Level III	Old Clarksville	Salt River Side-notched

Durrett Site (15JF201). The Durrett Site (15JF201) is a rockshelter also located in southern Jefferson County near McNeely Lake (15JF200). During excavations by the Louisville Archaeological Society from 1968 to 1971, 375 ft^2 were excavated, and artifacts indicative of Early Archaic through Woodland periods were recovered (**Table 7**). No radiocarbon dates were acquired; however, although natural stratigraphy was difficult to discern, three zones were identified and applicable cultural phases were assigned. Zone 1, located between 0 and 10 inches, contained Lone Hill artifacts such as Rowlett points. Zone 2, located between 10 and 17 inches below surface, contained Old Clarksville artifacts such as Salt River Side-notched points, and Zone 3 contained Early Archaic material (Louisville Archaeological Society 1972). Mussel shell was recovered throughout the profile, and a change in subsistence strategies between the two occupations was evident. Data from the Durrett Site (15JF201) support the placement of the Matanzas-like point earlier in time than the stemmed McWhinney/Rowlett point.

Table 7. Durrett Site (15JF201) Stratigraphy (Granger 1985:IV-15; Louisville Archaeological Society 1972)

Stratum	Excavation Level	Cultural Affiliation	Point Type
Zone 1 (0-10 cmbs)	Level II	Lone Hill	Rowlett
Zone 2 (10-17 cmbs)	Level III	Old Clarksville	Salt River Side-notched

Miles Rockshelter (15JF671). The Miles Rockshelter (15JF671) is located along Cedar

Creek in southern Jefferson County. A Phase II investigation was completed by Granger Consultants in 1998. In addition to other components identified at the Miles Rockshelter, the assemblage documented Middle and Late Archaic components. No radiocarbon dates have been obtained yet for this site.

Although vandalized repeatedly, some integrity remains. This integrity, however, is still compromised by the vandalism--the number and types of diagnostics has probably been altered. Granger (1985) found that, although Durrett (15JF201) and McNeely (15JF200) sites are very similar in setting and assemblage other than points, the proportion of diagnostic points were very different. At McNeely Lake (15JF200), the site that had been vandalized, points comprised only 25 percent of the assemblage whereas at Durrett (15JF201) points composed 47 percent of the assemblage (Granger 1985:IV-15).

The excavations at Miles Rockshelter were designed to determine the extent of the damage due to prior disturbance and to delineate the boundaries of the site. This was to be accomplished by opening three units. The first unit would be a 1-x-7-m unit located between the disturbed pits, and extending basically from the rear wall to the outer edge of the shelter beyond the drip line. This unit would give a full profile of the site and indicate the extent of any past disturbances. The second unit would be a 1-x-2-m unit located downslope to determine the maximum limits of the site. The third unit would be a 2-x-2-m unit placed in the vicinity of one of the disturbed pits. This unit would determine the depth and extent of the disturbances in the pits.

A total of six separate zones were identified, ranging from the root and debris of the topsoil layer, to intricate layers of soil and rock rubble of various size and density. Matanzas and McWhinney points were recovered from Zones 3 and 4.

Zone 3 was described as a silty clay loam with a Munsel reading of 10YR 3/3. This area extended from the south wall (N997/E1010) to the general area of the dripline (N1002/E1010)--a total distance of five meters. The general thickness of the zone was approximately 15 cm, but south of the dripline--in both east and west profiles--the depth increased to 60 cm. The zone was characterized by small rocks and rubble throughout the zone. Two McWhinney points and two Matanzas points were recovered from this zone (**Figure 5** and **Figure 6**).

Zone 4 was a rock rubble area extending from the south wall (N997/E1010) to the rear of the rockshelter wall. Rubble consisted of limestone and sandstone rocks in all sizes. This was the most extensive area of rock encountered in the trench. The zone was approximately 60 to 90 cm below surface, depending on the slope, and was generally 50 cm thick. The southern extension of this zone, approximately two meters, lies on the bedrock floor. One McWhinney point and two Matanzas were recovered from this zone.

The data from the Miles Rockshelter (15JF671), in contrast to McNeely Lake, KYANG, and Durrett, appears to represent a time period when Matanzas and McWhinney point were coeval. Additional analysis has yet to be completed, however.

Conclusions

Based on absolute dates from the region, such as the Bluegrass site, Matanzas points appear to be coeval with McWhinney points for a time. Based on data from the Falls of the Ohio, Matanzas points have repeatedly been recovered from lower stratigraphic positions than McWhinney points (as at KYANG (15JF267), McNeely Lake (15JF200), and Durrett (15JF201)). In addition to these relative dates, the range of radiocarbon dates also documents a transition between these two point types.

The date range for Matanzas in the Falls of the Ohio area appears to be 5360 to 4145 BP. In comparison, the date range for McWhinney points appears to be 4230 to 3380 BP. The transition between these point types at the Falls of the Ohio appears to be about 4200 BP. The temporal periods surrounding this fulcrum will be the most interesting to study further--particularly with regard to the process of cultural change as manifested by the significant subsistence change that occurred at this time and additional artifact types associated with each cultural group.

Figure 5. Matanzas points from Miles Rockshelter (15JF671).

Figure 6. McWhinney points from Miles Rockshelter (15JF671).

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A SURVEY OF PALEOINDIAN POINTS IN CLARK COUNTY, INDIANA AT THE FALLS OF THE OHIO RIVER

By Glenn Perry Harrell

Falls of the Ohio Archaeological Society

Abstract

Clark County, Indiana has long been recognized for its abundance of Paleoindian projectile points. E. Y. Guernsey's work in the 1930s (Guernsey 1939), along with John Dorwin's 1966 report on Paleoindian point distribution in Indiana, suggests that this area was a "hot spot" of activity for early inhabitants of the region. Sixteen Paleoindian points recovered within the county are examined with regard to Paleoindian point type, location, and environmental setting.

This paper concentrates on the distribution of Paleoindian projectile points from one collection assembled after seventy years by one individual. All artifacts are surface finds and all are precisely provenienced. The collection represents thirteen separate sites or locations. The collection provides a representative overview of Paleoindian point types at the Falls of the Ohio area (**Figure 1**), as well as insights regarding site location and environmental settings explored and exploited by Paleoindian groups (**Figure 2**).

The goals of this study were to inventory Paleoindian projectile points in the Falls area. This paper focuses on sixteen Paleoindian points recovered from Clark County, Indiana from known proveniences. However, more than seventy additional Paleoindian points recovered from Clark County have been identified to date. It should be noted that this work is preliminary. It is my intention to document as many of these points as possible and record location information.

Figure 1. Varieties of Paleoindian projectile points found within Clark County.

Point Types

Fluted Points. Six examples were identified, five of which were made from Wyandotte chert, and one of which was made from Fort Payne chert (**Table 1**). These are from Field Sites 12CL-FS8, 9, 3, 13, and two from 12CL-FS14 (**Figure 3**).

Agate Basin. Seven examples were identified, six of which were manufactured from Wyandotte chert, and one of which was made from New Chapel chert. Two were found at field site 12CL-FS5, and one was recovered from each of the following: 4, 15, 7, 10, and 14 (**Figure 4**).

Beaver Lake. Two examples were identified. One was struck from Muldraugh chert and the second from Wyandotte chert. One was found at field site 12CL-FS9 and the other at field site 12CL-FS7 (**Figure 5**).

Hardaway-Dalton. One example was made from Muldraugh chert; this was found at field site 12CL-FS7 (**Figure 6**).

Agate Basin? The last example was a re-sharpened projectile, most likely an Agate Basin. It was made from Muldraugh chert. It was recovered from field site 12CL-FS7.

Table 1. Comparison of Chert Types Represented by the Paleoindian Points.

Paleoindian Point Type	Wyandotte Chert	Muldraugh Chert	Fort Payne Chert	New Chapel Chert	Totals
Fluted	5		1		**6**
Agate Basin	6			1	**7**
Beaver Lake	1	1			**2**
Hardaway Dalton		1			**1**
Totals	**12**	**2**	**1**	**1**	**17**

The Sites

At this point in the study, no detailed descriptions of the sites will be presented. General site locations will be provided.

Field Site 14 is located at the Falls of the Ohio River. It is also known as the Old Clarksville Site (12CL1). It is situated at a natural river crossing. This area has an abundance of natural springs, a remnant of a Pleistocene lake bed, and is in proximity to a mineral spring at the headwaters of Mill Creek. It is also reported to be the crossing of the historic Buffalo Trace or Old Vincennes Trace.

Field Sites 7 and 10 are located on two upland projections across from each other on Sinking Fork, a tributary of Silver Creek. This area is somewhat karst, has abundant springs, and overlooks a wetland, possibly a former shallow lake or pond to the northeast and the confluence of Silver Creek and a broad floodplain to the southwest.

The remainder of the field sites is located near high volume springs and on tributaries of the Ohio River. In almost all cases, these sites are situated on high ground overlooking the springs and the surrounding bottoms.

Field Site 13 is located on Pleasant Run, a tributary of Silver Creek. **Field Site 12** is located less than one kilometer from Lick Creek, a tributary of Fourteen Mile Creek. At this site, there is a known mineral/salt lick.

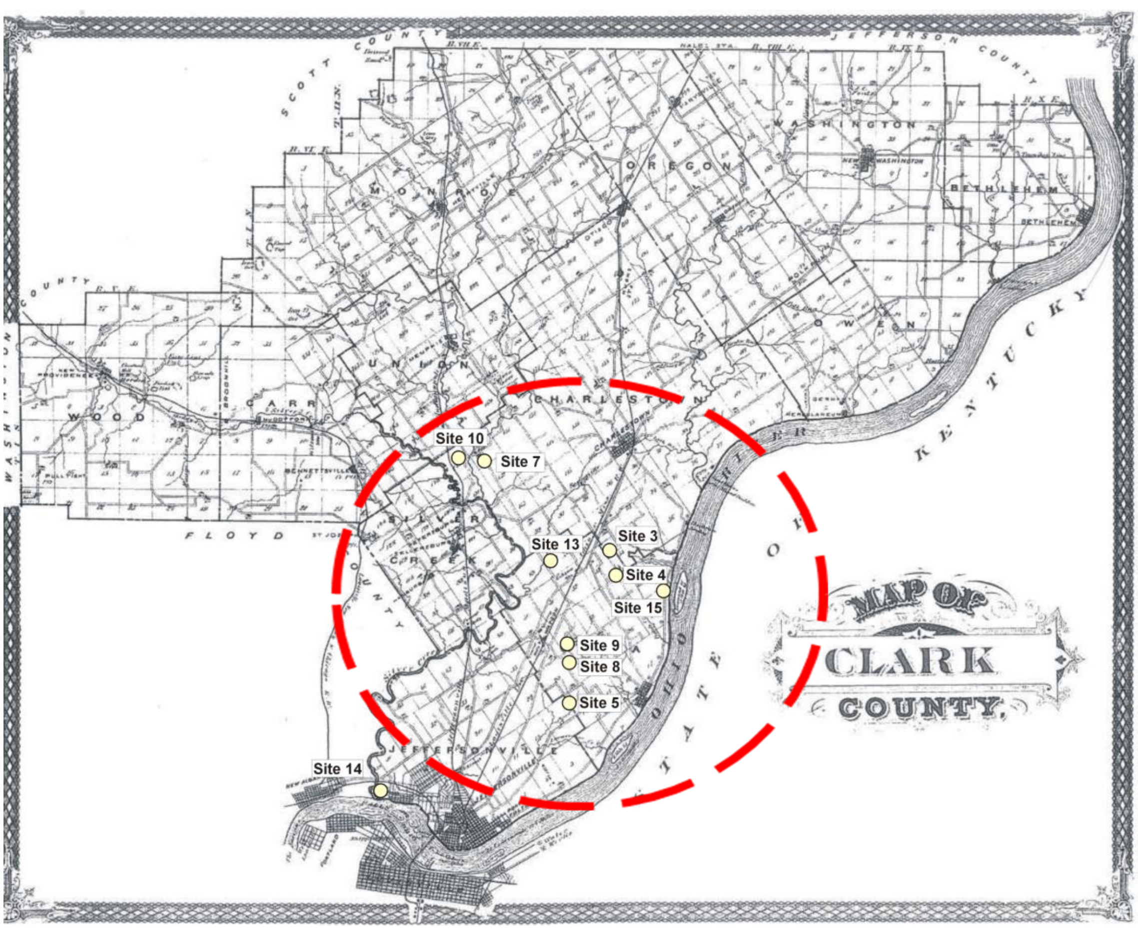

Figure 2. General location of sites discussed.

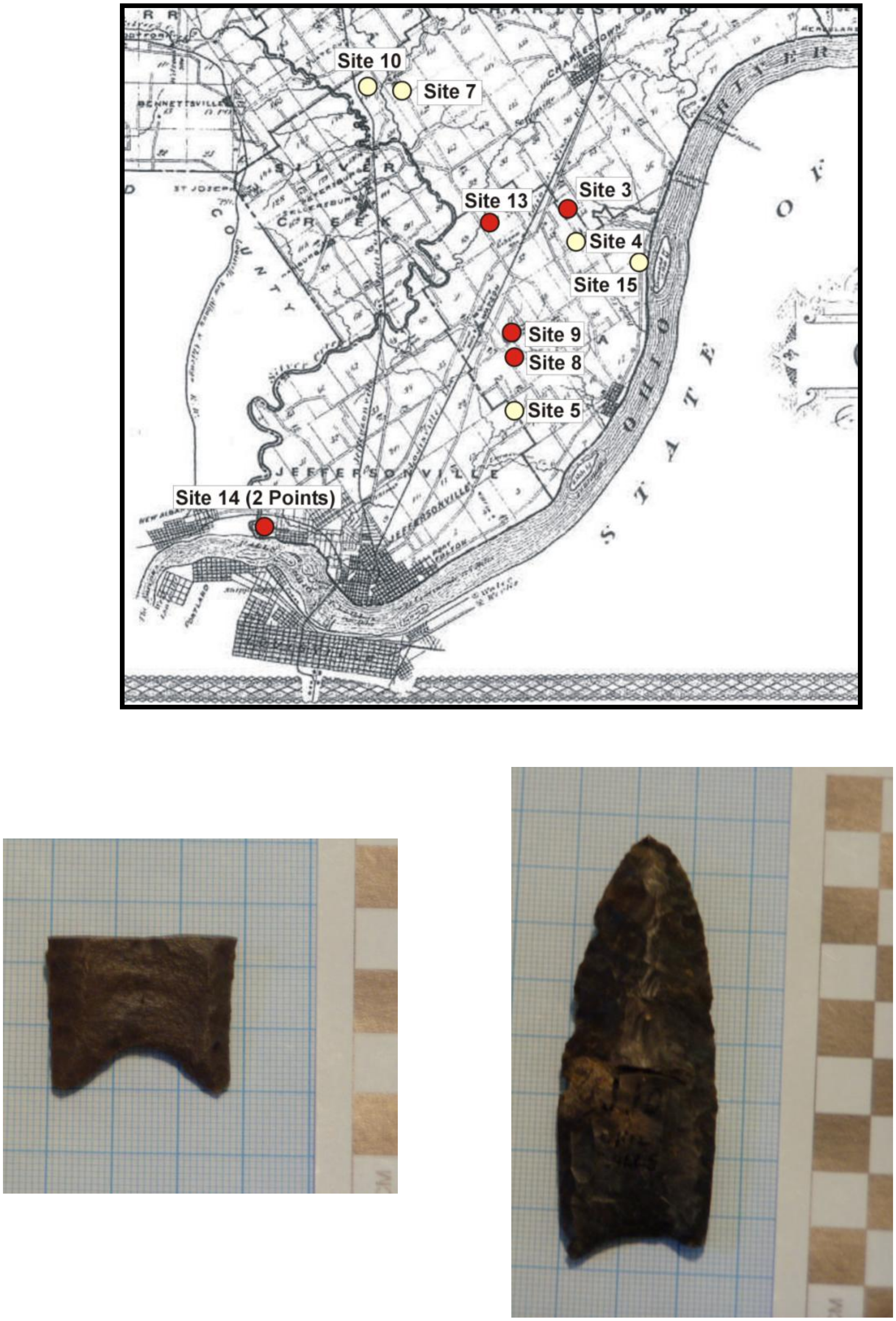

Figure 3. Fluted point distribution (marked with red) and points. Site 12CL-FS9 on left and 12CL-FS14 on right. Both made from Wyandotte chert.

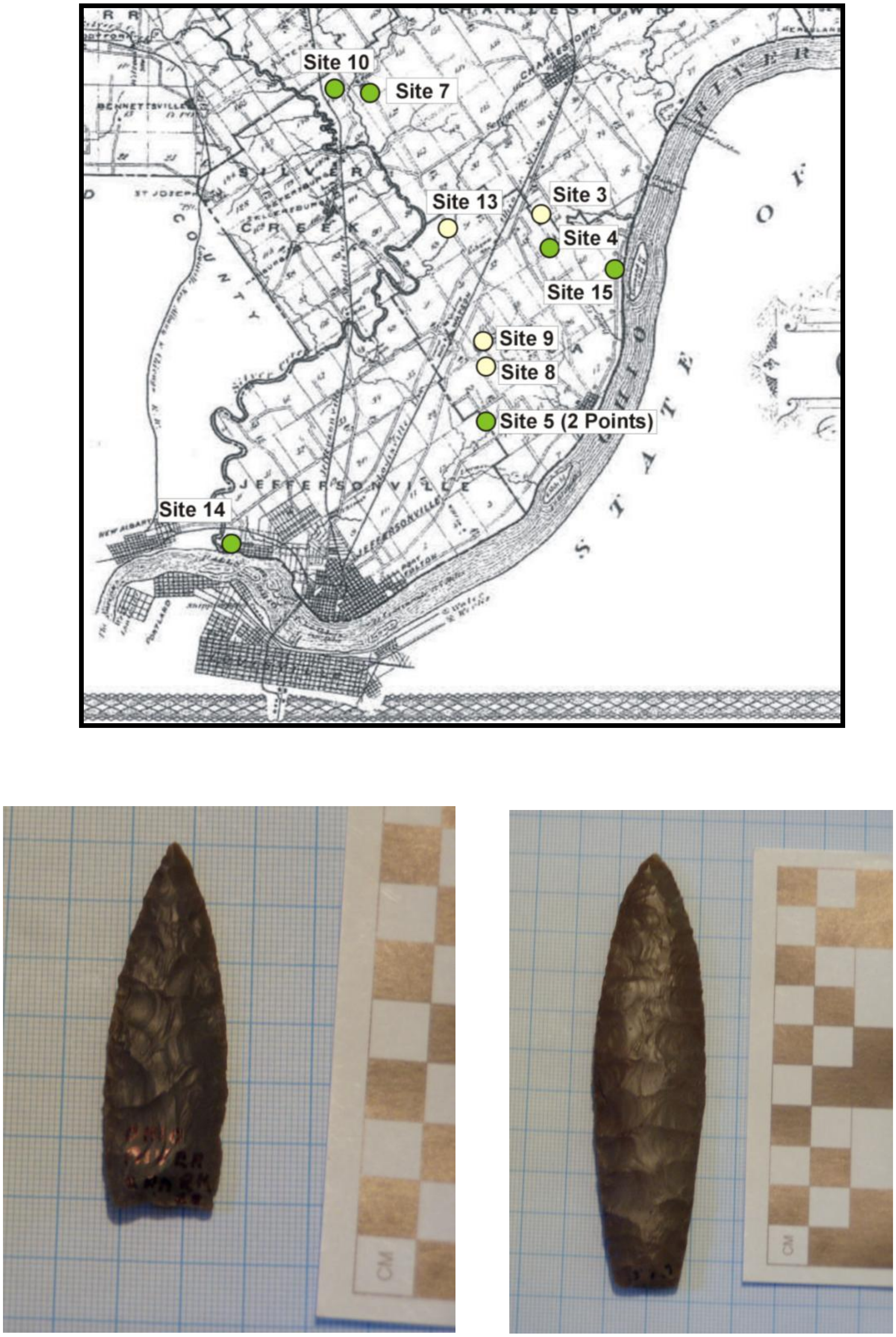

Figure 4. Agate Basin point distribution (marked with green) and points. Site 12CL-FS15 on left and 12CL-FS14 on right. Both made from Wyandotte chert.

Figure 5. Beaver Lake point distribution (marked with blue) and points. Site 12CL-FS9, made from Muldraugh on left and 12CL-FS7, made from Wyandotte chert, on right.

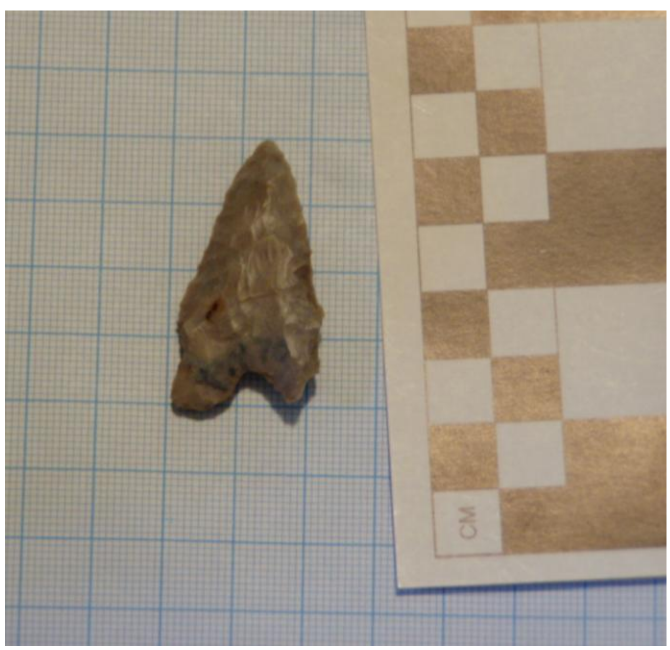

Figure 5. Hardaway Dalton point distribution (marked with orange) and point. Site 12CL-FS7, made from Muldraugh chert.

Preliminary Conclusions

I have represented in this collection a variety of Paleoindian projectiles dating from the earliest forms to the latest. All were manufactured from regionally available cherts. These points were found in situations that appear to best exploit the local resources, such as river crossings, karst, prominent overlooks near springs, wetlands, ponds, lakes, and areas adjacent or mineral and/or salt licks.

In itself, this data offers no new insights. These observations have been made previously by Dr. Edward Smith, Dr. Donald Cochran, and Dr. Ken Tankersley (1990). What is interesting, however, is the abundance of such natural settings in the Falls of the Ohio River vicinity.

Clark County, Indiana is a case in point. The Silver Creek drainage cuts through a lowland that was once a series of shallow lakes and ponds. Silver Creek enters the Ohio River just south of the Falls at a location that was a major river crossing. Ponds and wetlands extend up the river from the Falls to just above Six Mile Island near the town of Utica.

The eastern third of Clark County has a somewhat karstic landscape with abundant high volume springs and many mineral and salt licks. These include Lick Creek, a tributary of Fourteen Mile Creek that flows through Charlestown State Park, and the many mineral springs along Lentzier Creek at Utica.

In the western portion of the county is Blue Lick, another tributary stream of Silver Creek. This stream is also known for its mineral springs and salt licks. Blue Lick drains what was once an area of shallow ponds and wetlands.

At Henryville, Indiana, along the Middle Fork of Silver Creek, is another resource-rich area. Here the stream cuts through an old lake bed and expansive lowland. To the east is a prominent ridge overlooking the lowland. It is here that the Schaeffer Site (12CL391) is found. This site was reported by E.Y. Guernsey in the 1930s. It produced a number of fluted Paleoindian projectile point, 13 of which are curated at the Glenn Black Laboratory of Archaeology at Indiana University of Bloomington.

What I have presented at this early stage of the study is only a fraction of the Paleoindian points reported from Clark County, Indiana. An additional 70 examples in private collections have been examined by the author that are said to have been recovered from Clark County. Unfortunately, no site-specific information accompanies these artifacts. The Falls of the Ohio State Park Interpretive Center houses another four examples that are reportedly from the Old Clarksville Site (12CL1), Field Site 4. Yet three more points are known from Pleasant Run Creek near Field Site 13, and four are reported from the Arctic Springs area south of the Clark Maritime Center. There are also three sizeable collections each containing Paleoindian points with good proveniences.

In conclusion, it can be confidently stated that Clark County, situated as it is at the Falls of the Ohio River, was an exceptional location containing many desirable settings that were exploited by early peoples. The private and public collections bear this out. Unfortunately, too little professional research has been done on the topic in this area.

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PRELIMINARY LITHIC ANALYSIS OF THE MEYER SITE ASSEMBLAGE - TOOL USE AT A LATE MIDDLE ARCHAIC MORTUARY SITE IN SPENCER COUNTY, INDIANA

By Sundea Murphy and Anne T. Bader

Falls of the Ohio Archaeological Society

Abstract

The Meyer Site is primarily a mortuary site with numerous burials and little other evidence of day-to-day residential activities. A large number of finished bifaces were recovered from the Meyer Site, yet very little debitage was recovered. The bifaces found at this site, as at other late Middle Archaic sites, were manufactured elsewhere and brought to the location in finished form. A small assemblage of primarily late stage flakes indicated tool maintenance and resharpening. The majority of the hafted bifaces was of the Matanzas type. They were extensively worn and represented exhausted and discarded items. Some evidence for expedient core manufacture is also present. This paper explores the activities conducted at the site through use-wear analysis and discusses the relevance of exhausted projectiles in this predominantly mortuary site.

Introduction

In May 2004, the Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology (IDNR/DHPA) contacted the Falls of the Ohio Archaeological Society (FOAS) to ask if the Society would assist a landowner in removing cultural resources from his property (designated 12SP1082). The Indiana resident had uncovered artifacts while digging footer trenches intended for his house expansion and could not afford the cost of a professional excavation.

FOAS agreed to furnish the volunteer labor required to remove the archaeological materials from areas of the expansion. FOAS members and other professionals (87 in all) volunteered over 1500 man-hours to complete the task.

Meyer Site Details

The site was west of Rockport in southern Spencer County, Indiana (**Figure 1**), and was situated on a relatively flat section of land (**Figure 2**). Just past the site, the ground sloped to the south and southwest (about a 7.6 meter drop) towards Bakers Creek (**Figure 3)**.

It was noted that any Woodland component to this area was probably removed, either during the construction of the original house or during the removal of earth for the expansion. However, two layers of Archaic occupations remained.

Significant features found included several midden areas (**Figure 4**), some shallow, almost conical-shaped pits filled with carbonized material (possibly post holes), charcoal concentrations that resemble smudge pits (see **Figure 5**), a unique burial cache (**Figure 6**), and human interments. Artifacts found included drills, scrapers, cut antler and bone, ground stone tools, bone pins, bone awls, a partial slate bannerstone, and projectile points. In addition, small mammal, drumfish, deer, turtle, and large bird bones were found. Mussel shells and hickory nut hulls were recovered, also.

The vast majority of the lithics were late Middle-Late Archaic cluster types (**Figure 7**). Close to half of the identifiable points and hafted scrapers were of the Matanzas cluster (**Figure 8**). Most of these were nearly exhausted, broken, or heat damaged.

Figure 1. Location of Spencer County, Indiana

Figure 2. Level topography surrounding the Meyer house.

Figure 3. Bakers Creek.

Figure 4. Midden area visible as darkened soil.

Figure 5. Charcoal concentration.

Figure 6. Burial cache.

Figure 2. Late Middle Archaic to Late Archaic cluster point types.

Figure 3. Matanzas cluster points.

Meyer Site Function

Interestingly, the midden areas did not contain the normal assemblage of artifacts usually found at Archaic sites. Nor was much debitage found. The lack of debitage was explained following the flake analysis.

Rich Stallings used the Johnson-Morrow flint flake analysis model to compare various debitage distributions with that obtained at the 12SP1082 site. He compared the site debitage distribution with the model distributions for secondary core reduction and middle stage biface/mixed assemblages. The distribution curve for the site more closely matched the model curve for secondary core reduction (**Figure 9**). Stallings concluded:

> *The flakes indicated that the major lithic industry at 12SP1082 involved the production of useable flakes from secondary amorphous cores (ones where most or all of the cortex had already been removed). A lesser activity was the reduction and/or maintenance of late stage bifaces* (Stallings personal communication June 23, 2005).

Given the lack of midden materials, the fact that lithic activities were minimal, and the tools recovered extra-burial were either exhausted or in poor condition, the immediate site probably did not contain a residential area. Therefore, the interpretation of the 12SP1082 site could be that it was primarily a mortuary site. It seems the flint tools were brought there already prepared, with some occasional maintenance touch-ups done. Food was likely hunted or gathered in the immediate area only until such time burial preparation and/or ceremony could be completed.

Overall View of the Meyer Site Lithics

From the provenienced cultural materials recovered from the site, 44 bifaces were pulled for a preliminary lithics analysis. Of those, 34 bifaces could be identified, at least as to the cluster type. Fourteen of the bifaces appeared to be broken projectiles or knives (PPKs) that had been converted to scrapers. Fourteen were made from Wyandotte chert. It was interesting that the seven points displaying heat damage ("pot lidding"), were made from Wyandotte chert. At least 18 of these bifaces were found in burial context.

Sixteen of the 34 cluster-identifiable bifaces were of the Matanzas cluster and represented 36.4 percent of the recovered total. Five of the heat-damaged bifaces were Matanzas manufactured from Wyandotte chert. Though the sample size was not large enough to be considered statistically accurate, there did seem to be an overall size difference between the Matanzas bifaces made of Wyandotte chert and the bifaces made of other raw materials (**Table 1**).

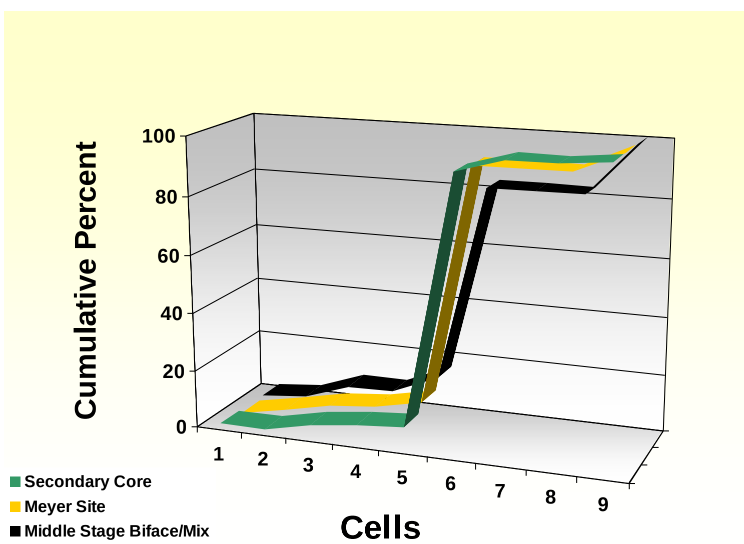

Figure 4. Comparison of Meyer Site debitage to secondary core reduction and middle stage biface/mixed assemblages.

Table 1. Matanzas Cluster Metrics

Measurement	PPK (Non-Wyandotte)	Scraper (Non-Wyandotte)	Scraper (Wyandotte)
Length (mm)	28.0 (n = 6)	19.9 (n = 4)	24.3 (n = 3)
Width (mm)	18.6 (n = 5)	20.6 (n = 2)	22.4 (n = 4)
Notch Width (mm)	14.9 (n = 5)	16.8 (n = 4)	16.7 (n = 4)

This cursory look at the collected Meyer site bifaces has shown that the Matanzas cluster points and hafted scrapers were an important and most frequently used tool. In addition, tools of this cluster were found in burial context more than any other. A lithics analysis of these particular tools might shed light on what activities were being performed at the site. To this goal, a lithics study outline was developed.

Usewear Study

The lithics study for the Matanzas cluster will include the measurements of working edge angles, low-power (40x) and high-power (200x) magnification views of usewear areas, and a lithics distribution site plot. The rest of this paper will report on the progress achieved to date, which includes the measurements of the biface working edge angle and the identification and mapping of wear use employing the low-power magnification technique.

Working Edge Angle Measurements

Of the nine bifaces that could be satisfactorily measured, the working edge angle averaged 68 degrees. However, one of the biface measurements was found to be drastically deviant from the median value. Upon magnification, it could be seen that the surface morphology (wear traces and patterns) of this particular biface was unique (**Figure 9**). This single radical data point was disregarded, yielding an average edge angle of 72 degrees.

One study of biface edge angles by Wilmsen (1968) concluded:

- angles between 26 and 35 degrees were suitable for cutting
- angles between 46 and 55 degrees were suitable for hide scraping
- angles between 66 and 75 degrees were suitable for wood and bone work

According to this study, the average of the measured Meyer Site biface angles was within the range Wilmsen determined for wood and bone working tools (66 to 75 degrees).

Another study by Broadbent (1979) and his colleague, Knuttson concluded:

- angles between 50 and 60 degrees were ideal for hide scraping, but past 70 degrees, the scrapers would be ineffective for this activity
- angles between 55 and 65 degrees were suitable for soft to medium hardness materials
- angles between 70 and 85 degrees were suitable for wood and bone work
- angles stabilized to between 70 and 80 degrees on bifaces used for woodworking

Based on these two studies, we can tentatively surmise that the edge angles on the Meyer Site bifaces show that: 1) edge angles for working soft to medium materials had become ineffective and possibly the tools were tossed at this point, or 2) the scrapers were used mainly for wood and bone working, and the angles had stabilized.

Use of Magnification Techniques for Lithic Analysis

Over the years, there has been much debate about what was the best method for microscopically viewing lithic wear areas and the analytical validity resulting from using the various techniques was questioned. Odell's (1981) low-power microscopic approach was limited to identifying the hardness of materials used on the lithic artifact. With this approach, there were more reproducible results between observers, but the information gained was not as detailed as that which was gained from the high-power microscopic examination. Keeley (1974, 1980) recognized that specific material produced distinctive polish (hide vs. wood vs. bone). He developed a high-power microscopic technique to distinguish patterning differences in the polish. Theoretically, these polish attributes relate to the type of material that produced the polish on the artifact being examined. However, this technique achieved results that were highly subjective and not very reproducible between observers.

More recently, researchers have curtailed the quarreling over which microscopic examination method yielded the best information. It has been recognized that both the low-power and high-power techniques have advantages and should complement one another for maximum results. For the purposes of this preliminary report, the low-power magnification was used specifically for mapping wear areas that require more comprehensive study at higher magnification.

Mapping Wear Patterns

Upon viewing the Matanzas tools under magnification, several observations immediately stood out. The converted scrapers had the greatest wear on the front edge and ears (**Figures 10, 11, and 12**). The PPKs showed the most wear on a small area on the ventral side of the tip and the ears (**Figure 13** and **Figure 14**)**.** Some wear was also noted on ridges near the notching areas (**Figure 15**). Interestingly, the highest degree of wear always appeared on the ears of the samples (**Figure 16**, **Figure 17**, and **Figure 18**).

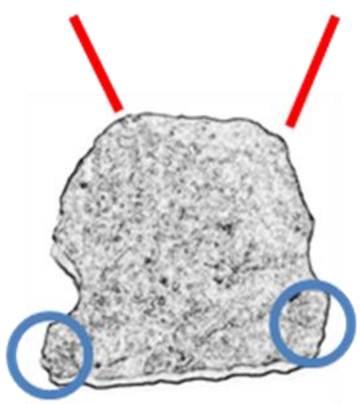

Figure 10. Usewear areas on scrapers.

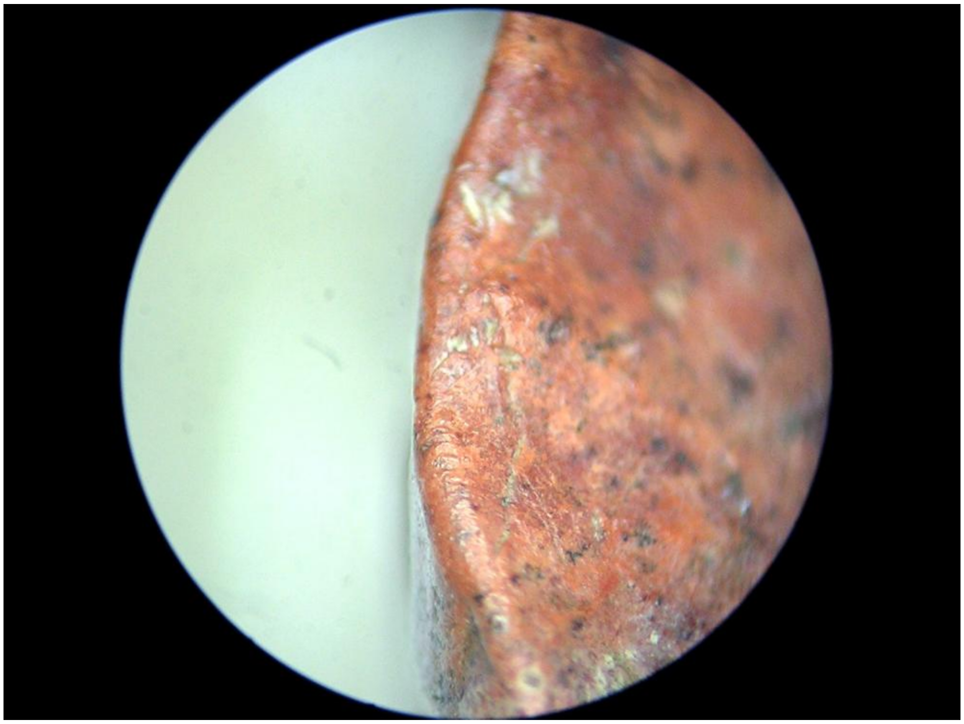

Figure 11. With severely smoothed edges, this tool has a deep u-shaped channel worn along the ventral side. Notice the deep abrasions and gouges on the edges. This was surely used to scrape, smooth, or shape a hard material such as bone or wood.

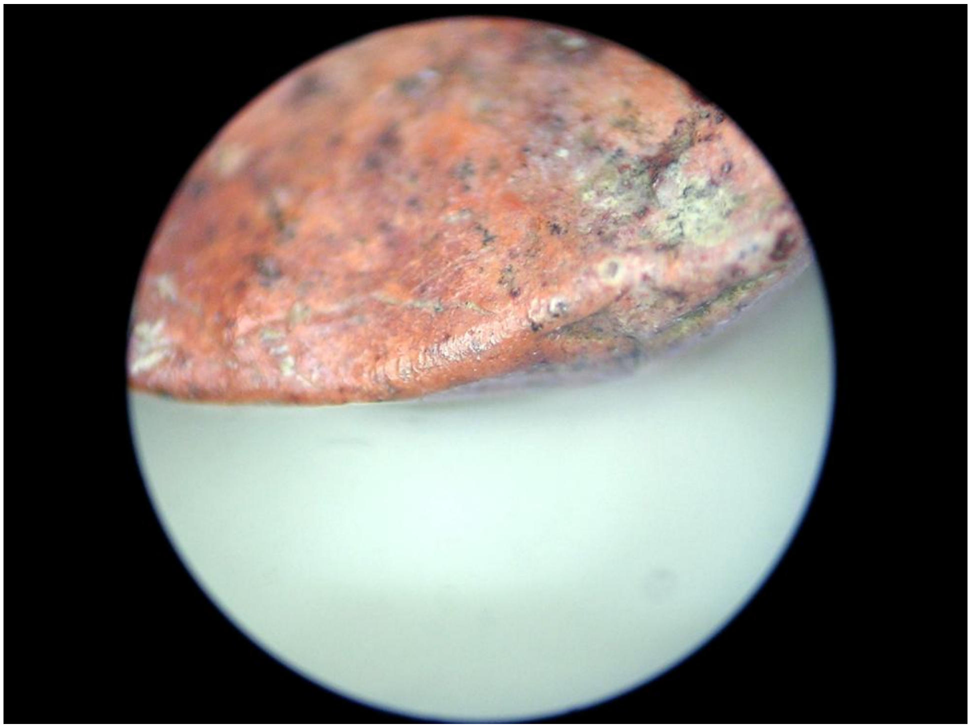

Figure 12. Scraper edge scarring.

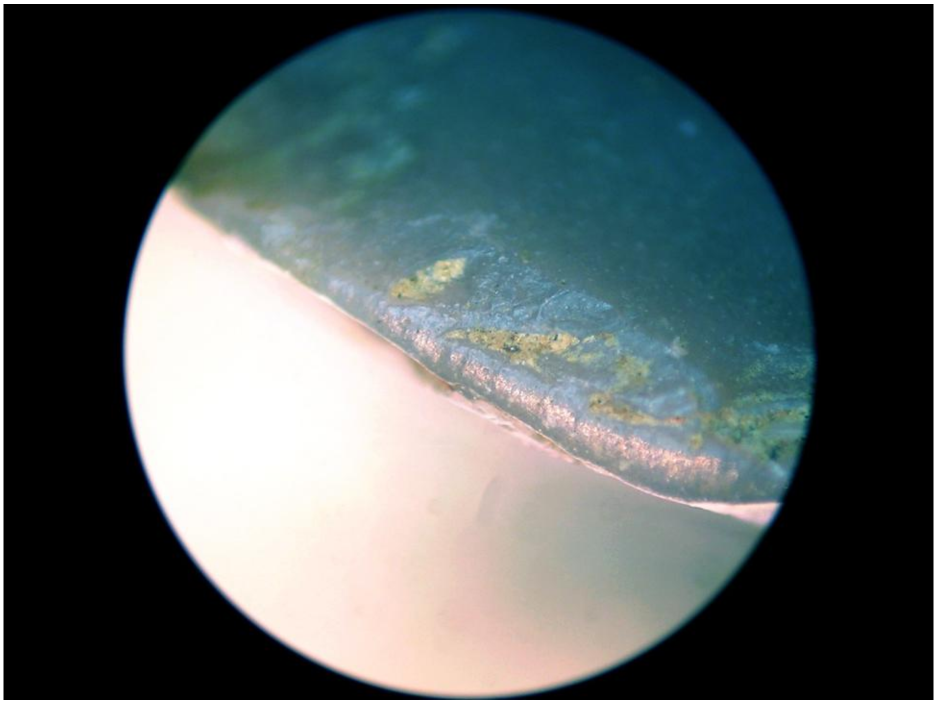

Figure 13. Note the flattened edge and the small scratching/etching toward the ventral side.

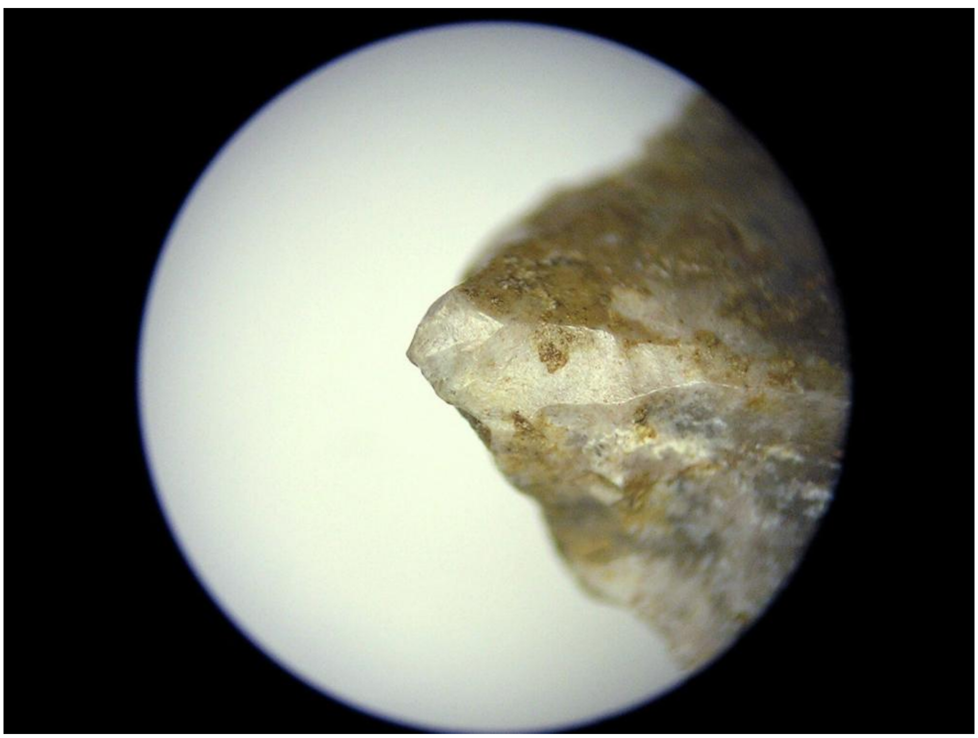

Figure 14. Usewear on tip (ventral side).

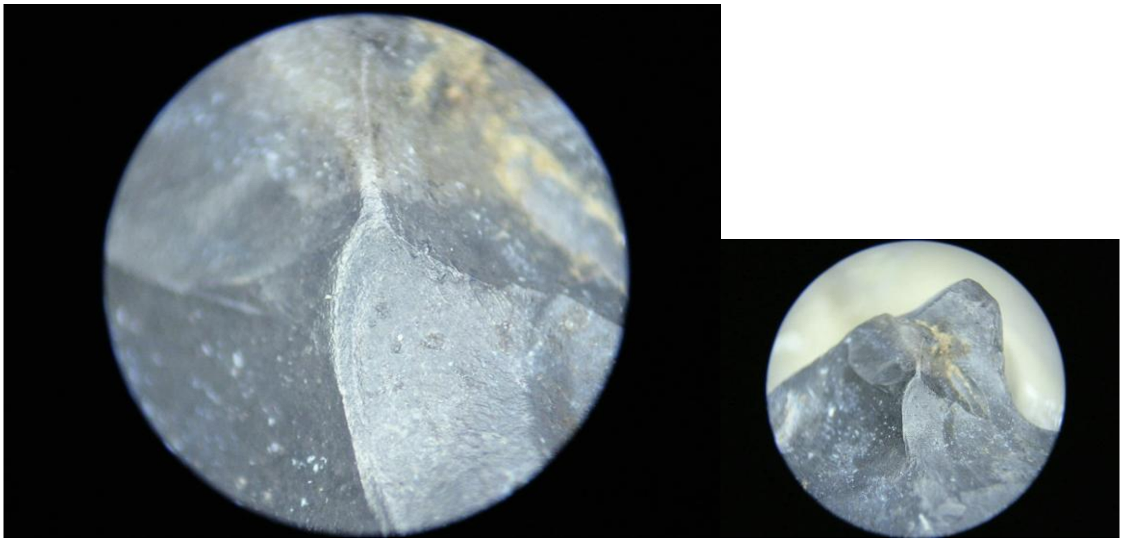

Figure 15. Wear along ridge near notch.

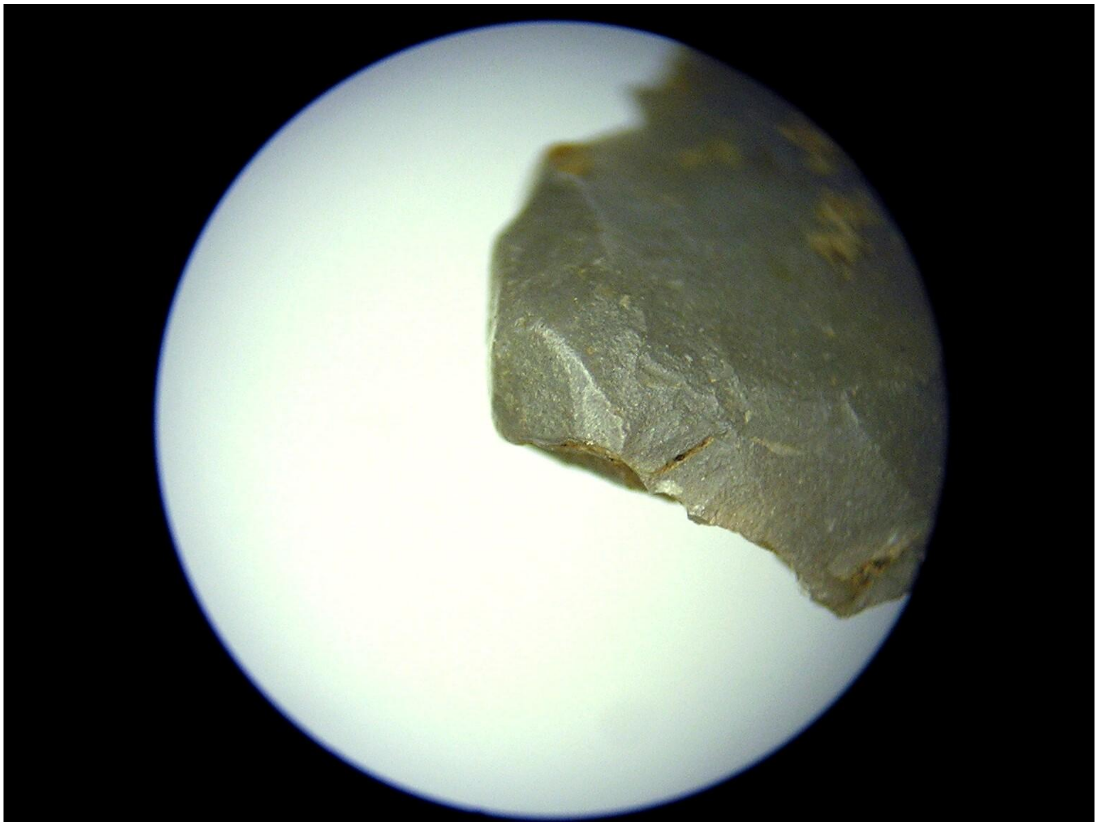

Figure 16. Wear along ear.

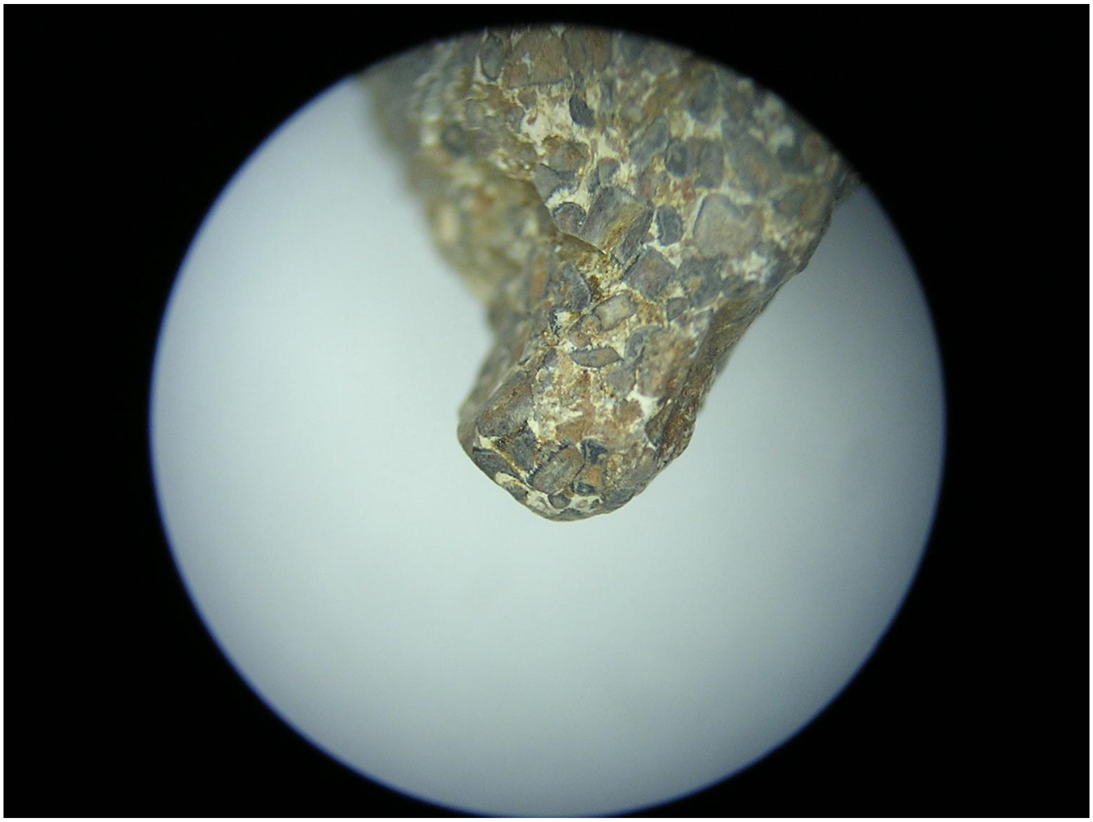

Figure 17. Extensive rounding at ear.

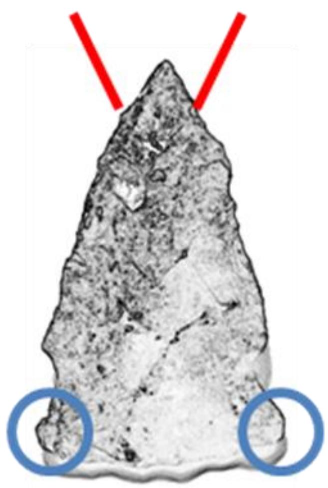

Figure 18. Usewear areas on ppks.

At first, it would seem logical to assume that the heavy wear polish in the hafting locations (around the notches and ears, see **Figure 15**, **Figure 16**, and **Figure 17**) would have occurred as a result of the lashing/hafting components abrading and smoothing the contacted lithic area. In addition, it could be supposed that the tool edges were resharpened many times, while leaving the hafting areas untouched. It would be expected that the hafting area naturally would be smoother (have more "polish") than other parts of the blade, simply because that area was exposed to hafting component friction over a longer time period. However, experimental conditions have revealed alternative conclusions as to why there were such intensely worn hafting areas on the Matanzas tools.

Grace (1989: Chapter 3; also Keeley 1982) conducted experiments to determine to what extent hafting contributed to the polish noted in the usual hafting positions on ppks. What he found was that hafting components did not produce polish attributable to the wood haft using either sinew- or resin-bound chert. One of his conclusions was that the polish on many tools probably occurred as a result of intentional smoothing. Such may be the case with the wear observed in the hafting areas of the Meyer Site Matanzas tools.

Observations Noted

Based on the ventral tip wear, the tool in **Figure 12** was probably a groover (see Grace 1989: Figure 65).

Literature reports that the intentional retouch on scrapers is most commonly seen on the dorsal side, being initiated from the ventral side (Grace 1989). The opposite is true of the retouch on the two intact, non-Wyandotte Matanzas. This unexpected retouch technique will be further investigated.

Future Work

High-magnification studies will be conducted in order to identify the specific materials worked by the Matanzas tools. In addition, a lithics distribution of the Meyer Site will be created. It is expected that identifying the worked materials and determining the loci of the tool concentration at the site will lead to the determination of the Matanzas tool's prime function.

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