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Archaeological Data Recovery At The Mary Ann Cole Site

U.S. Army Corps of Engineers,
Louisville District

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ARCHAEOLOGICAL DATA RECOVERY AT THE MARY ANN COLE SITE (12Cr1)

Crawford County, Indiana

A Prehistoric Lithic Workshop at the Confluence of the Blue and Ohio Rivers

PREPARED UNDER CONTRACT DACW 27-80-C-0043
And Funded by the United States Army Corps of Engineers
Louisville District

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FOREWORD

The archaeological data recovery program at the Mary Ann Cole Site (12Cr1) provided two significant contributions to Ohio Valley prehistory. Both relate to the often referenced but little understood chert resources of the Harrison-Crawford Counties area.

The first is the extensive and detailed definition of the geologic context and occurrence of the chert known by many names in the archaeological literature. It has been called Harrison County chert, Harrison County Flint, Indiana Hornstone, Wyandotte flint, Indiana Blue-Gray flint and other designations as well. The term having historical precedence is Wyandotte chert and it is recommended that hereafter all reference to the chert use the Wyandotte label.

The second contribution is in the area of lithic technology. A detailed examination of biface fragments and debitage revealed a manufacturing trajectory from raw material acquisition to dispersement of finished chert products throughout the midwest during late Archaic to middle Woodland times. It has been characterized as the hinge flaking technique of biface manufacturing. In some cases the step beyond biface manufacturing appears to have been modification into the well known Turkey tail point.

The limited data recovery effort was enhanced by the cooperation and smooth working relationship with the Louisville District Corps of Engineers personnel. In particular we would like to thank Don Ball and Charles Parrish for their assistance. In addition, the special efforts of Noel Justice on the lithic analysis and the extraordinary work of Jeff Myers in supervising the fieldwork and putting the whole report together are sincerely appreciated.

June 18, 1981

Littleton file ✓ *John T Dorwin*
John T Dorwin
Principal Investigator

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ABSTRACT

Archaeological data recovery at site 12CR1 in Crawford County, Indiana, consisted of excavations and a geologic survey of lithic resources in nearby uplands. Excavation of a 30x24ft contiguous block penetrated two separate cultural zones and achieved a total depth of approximately 14ft below the modern floodplain surface. Excavations examined deposits consisting primarily of lithic refuse reflecting the manufacture of a variety of chert objects relating to Late Archaic/Early Woodland transitional and Middle Woodland Periods. Materials indicated a lithic manufacturing locus composed entirely of waste products and broken or aborted biface fragments at various stages of incompleteness. Analysis characterized cultural behavior surrounding reduction strategies and reasons for unintentional artifact truncations. Focus was on raw material quality and technical application problems. In the absence of viable completed stone tools, analysis relied upon waste by-products to identify lithic technologies in the excavated deposits. A specialized manufacturing trajectory herein called "the hinge flaking technique" was identified. Hinge flakes exhibiting essential characteristics are diagnostic of cache blade manufacture. Additionally, a survey identified five geologically distinct chert lithotypes in Harrison and Crawford counties. "Harrison county chert" has been formally renamed Wyandotte chert and a detailed study of quality selection factors of prehistoric usage of this material was conducted.

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CHAPTER 1. INTRODUCTION

This report documents the methods and results of archaeological excavations conducted at the Mary Ann Cole Site (12Cr1) near Leavenworth, Indiana. The purpose of the study investigations was to recover archaeological data from a portion of the site proposed for construction.

The data recovery effort at the Mary Ann Cole Site, Ohio River, Cannelton Pool, Crawford County, Indiana was accomplished by Resource Analysts, Inc. (RAI) under the terms of Contract Number DAC27-80-C-0043, dated February 12, 1980, with the U.S. Army Corps of Engineers District, Louisville. The contract was originally awarded to the Bloomington, Indiana office of Soil Systems, Inc. The assets of that office were purchased by Resource Analysts, Inc. effective June 2, 1980. The contract responsibilities were subsequently transferred to RAI.

An early spring thaw allowed fieldwork to begin on March 6, 1980. Excavation of the main unit of investigation was initiated on March 17. Fieldwork was completed on May 23, 1980.

The contract was accomplished in order to meet requirements of P.L. 91-190 (N.E.P.A.), P.L. 93-191 (Reservoir Salvage Act of 1960, as amended), P.L. 89-665 (Historic Preservation Act of 1966), Presidential Executive Order 11593, and Corps of Engineers Regulation 1105-2-460.

The deeply buried and stratified Mary Ann Cole Site is located on the north bank of the Ohio River and the west bank of the Blue River at their confluence. The site is a large, multicomponent site, which stretches from the Blue River downstream along the Ohio for a distance of at least a quarter of a mile. Only that portion of the site to be impacted by the construction of public access facilities (including a boat ramp, parking, and picnic areas) was involved in the data recovery project. This data recovery, therefore, did not constitute mitigation of the entire site. Rather, it provided mitigation only of the portions proposed for direct impact.

Requirements of the scope of work stipulated that data recovery was to be accomplished by excavation of a single large block measuring 30x24 ft and supplemental deep trenching. The contract scope of work is included as Appendix A at the end of this document to allow reference to specific requirements of the study.

Field methodology consisted of a combination of hand and machine assisted excavation of three test trenches and the main block excavation. Backhoe excavation was limited to the trenching and removal of culturally sterile deposits in the block excavation. All cultural zones in the block were removed by hand in 3.9 inch (10 cm) levels gridded into 4x4 ft units. Recovered materials were analyzed and results are presented herein. The complete methodological statement is presented in Chapters 5 and 6. A glossary of terms is included as Appendix B.

Numerous individuals contributed to the project. The field crew consisted of Jim Adams, Sally Bush-Allen, Dave Barton, Jane Bouchard, Al Brine, Cris Gober, Dave Lynch, Bob McCullough, Jim Parker, Margaret Rothman, Richard Vanden Heuvel, and Karen Walker. Jeff Myers and Kevin Crouch supervised the fieldwork. Lab work was supervised by Jane Bouchard. Mechanical assistance was provided by a backhoe skillfully operated by R.J. Smith. Special thanks are extended to the Indiana Department of Natural Resources for providing a maintenance building for a field laboratory, and for loaning fencing materials to protect the site. The DNR personnel also provided security by watching the site during non-working hours. The information generously provided by the site's namesake, Mary Ann Cole, was also very helpful. Mrs. Cole graciously allowed us to examine her collections and hospitably offered a warm, dry refuge from frigid spring rains for several raucous, muddy archaeologists.

Geological studies of the cherts were conducted by John Bassett, who also authored the section on cherts in the Harrison/Crawford County region (Chapter 3.2). Chert qualities of the Wyandotte chert zone were sampled and tested by lithic experiments by Noel Justice from Indiana University. The chert quality section (Chapter 3.3) was authored by Noel Justice. Detailed technological analysis of the lithic remains from the data recovery was also accomplished by Noel Justice, who prepared major portions of the technical analysis (Chapter 7.3) with editorial assistance from Jeff Myers and Kevin Crouch. Background geological research was conducted by Linda Nichols. Advice from Henry Gray of the Indiana Geological Survey was valuable in interpreting the geomorphology of the alluvial deposits at the site. The cultural history of the area was compiled and written by Kevin Crouch with aid from Dave Barton on the brief historical section. The remainder of the report was prepared by Jeff Myers and Kevin Crouch under the supervision and direction of John Dorwin.

The report was produced by RAI's report production staff. Graphics were prepared by Jim Parker. Typing and tolerating innumerable tedious changes were the onerous tasks accomplished by Sally Bush-Allen and Margaret Rothman. Photography in the field and for the report plates was conducted by Kevin Crouch. Revision and editing was contributed by Jeff Myers and John Dorwin.

The efforts of all the above persons have resulted in a significant research contribution to archaeology of the central Ohio Valley. The value of the project has been an increased understanding and a new perspective on the lithic industries of the Early/Middle Woodland period and the importance of the Harrison County Chert sources during these times. Although only a fractional portion of the Cole Site was examined, the data recovered has indicated that this site was an important lithic workshop area producing bifaces and cache blades for dissemination to far ranging areas throughout the midwest. The investigated segment of the Cole Site appears to be a small unit of an elaborate industry distributing the high quality local cherts in a broad network. The underlying factors stimulating the development of the network are not addressed. Additional study of the site may eventually elucidate our understanding of the lithic industry and economic dynamics of the Early and Middle Woodland cultures often characterized by their apparent interaction spheres.

CHAPTER 2. BACKGROUND

2.1 THE PROJECT SETTING

In order to adequately evaluate the prehistoric cultural utilization of Site 12Cr1, it is necessary to understand the environmental setting of the project region. This section presents a general environmental background and outlines an overall land use profile of the project area.

2.1.1 Project Area Location

The Cole Site (12Cr1) is located in southeastern Crawford County in extreme south central Indiana. It is approximately one-half mile southeast of the village of Leavenworth and is situated on Public Use Sites 8A and 9, adjacent to the confluence of the Blue River and the Ohio River. Figure 2.1 illustrates the project area boundaries, the proposed impacts, previous test trenching, and general physiographic features of the area.

Situated in the floodplain of the Ohio River, it extends westward from the Blue River approximately one fifth of a mile. The site is bounded on the northeast by a depression which parallels the Ohio River. The floodplain setting of the site has been subjected to intermittent flooding, scouring, and sediment deposition. Major portions of the archaeological site are continually affected by bank erosion.

2.1.2 Current Land Use

The project area was developed during the 1920s in conjunction with the construction of Lock and Dam #44. The lockhouse and maintenance outbuildings were abandoned when the dam was removed in the early 1960s. The project area is currently maintained by the Indiana Department of Natural Resources and is accessible for public use during daylight hours. Only the northern half of the project area has been developed. The portion proposed for construction of the boat ramp is currently used as pasture. Figure 2.1 shows the developed and undeveloped portions of the property. The archaeological site, 12Cr1, extends the length of the property (Guendling et al. 1977:44). On the developed portion of the property, it is partially protected from erosion by rip-rap along the river bank. The southeastern end of the tract is unprotected from the river and is subject to severe erosion.

2.1.3 General Topography and Environment

The general topographic setting of the project area is characterized by three major features: the Ohio and Blue River; the narrow, gently sloping floodplain; and the steep rugged uplands. The natural environment contained numerous resources attractive to prehistoric cultural groups. Riverine resources, floodplain and upland terrestrial fauna, raw materials for tools and shelter, and the rivers for transportation were all present in the immediate area of Site 12Cr1.

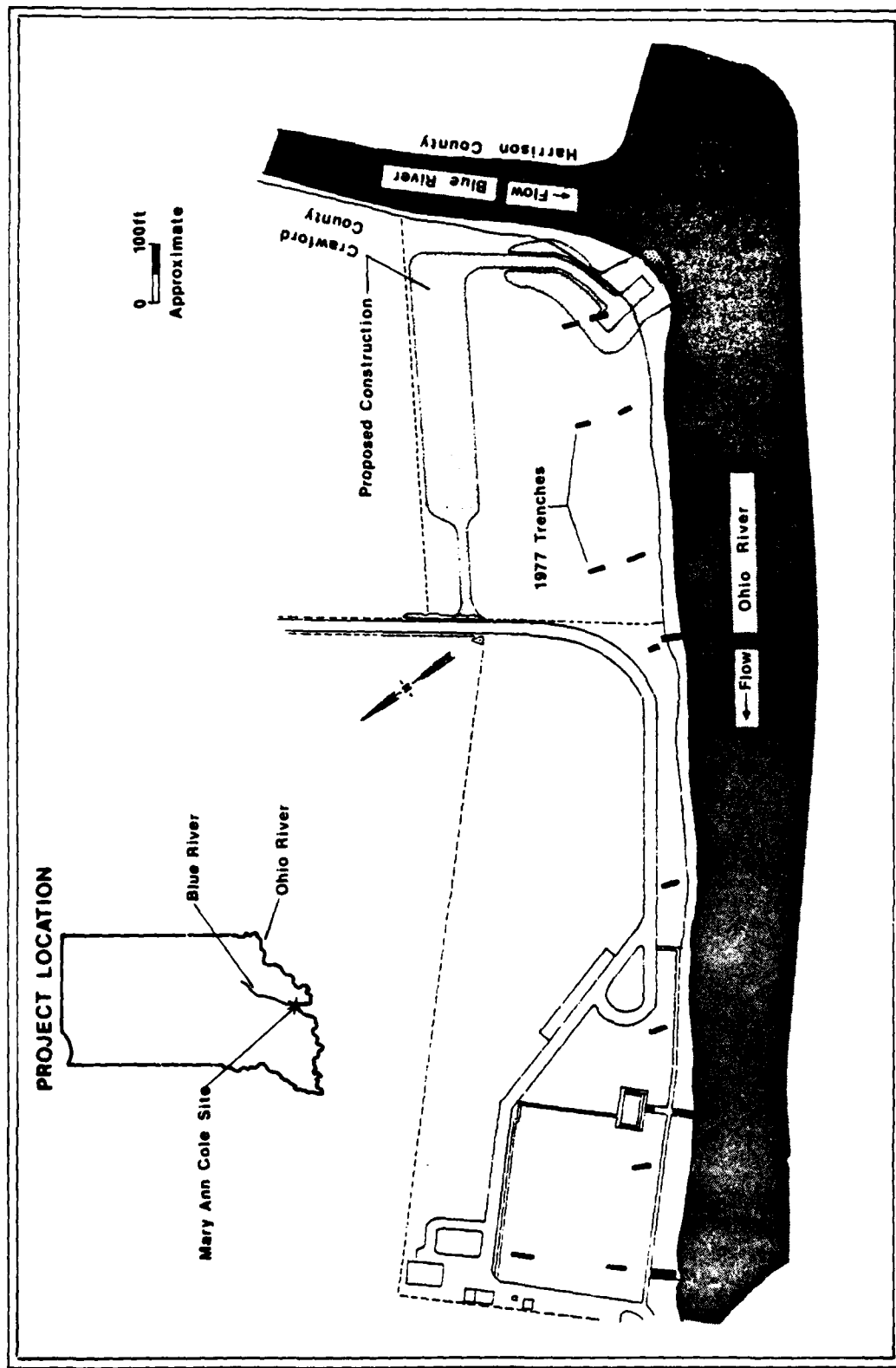


Figure 2.1 Project Area Map

Environmental and ecological variables affected and influenced activities and technologies of human groups which occupied a specific region. An understanding of the environment and availability of natural resources is necessary to interpret prehistoric lifeways and understand archaeological sites.

The natural environment must also be considered from the perspective of its effects on the preservation of archaeological sites. Flooding and erosion may alter or displace archaeological remains resulting in inaccurate site interpretations unless such processes are identified and understood. The following environmental background is intended to serve as a framework for understanding the aboriginal occupations.

2.2 THE NATURAL ENVIRONMENT

Site 12Cr1 lies near the southeastern limits of the physiographic province known as the Crawford Upland in Indiana (Malott 1922). East of the site is the boundary between the Crawford Upland and the Mitchell Plain physiographic provinces. Near the Ohio River this boundary is dramatically defined by the Chester Escarpment, a sharp cuesta scarp formed by resistant bedrock sandstones. The Crawford Upland is a maturely dissected westward sloping plateau characterized by numerous streams and rugged topography. Surface topography and subsurface physiographic features of the region result from the erosion of the underlying bedrock formations.

2.2.1 Bedrock Geology

The geologic history of the bedrock of southern Indiana began with open marine sedimentation during the Cambrian Period. Beginning with the deposition of the New Albany Shale during the Lower Devonian, 400 million years before present (mybp), the mode of sedimentation changed from primarily chemical to clastic, and this trend persisted through Pennsylvanian times. A temporary return to open sea environments is evidenced by the thick limestone sequence seen in the Mississippian Period strata, including those of the Blue River Group. The change was apparently in response to tectonic activity in the eastern United States. The sequence of sedimentation during the Upper Mississippian Period suggests the presence of a sea which fluctuated greatly in size over the area. Open marine limestones, restricted basin gypsum formation, thin bedded sandstone (indicative of a beach deposit), mudstones, and other argillaceous sediments formed probably as a result of fluvial or floodplain deposition.

At the close of the Mississippian Period, the entire area was uplifted and tilted slightly to the southwest. The erosion following this uplift truncated the previously flat-lying formations. Deep valleys were cut into the bedrock by the area's streams during this time, but this activity was halted in response to a subsidence of the land early in the Pennsylvanian Period. This lowering of elevation caused a resumption of deposition of clastic sediments.

Throughout the Pennsylvanian Period, there appears to have been a continuation of the cyclic pattern of depositional environments which was first seen in the Upper Mississippian Period, as evidenced by the

lithologies present in the formations. For example, the sandstones at the base of the Pennsylvanian could represent a beach or near shore environment, followed by a sequence of younger rocks consisting of "dirty" sandstones, shales, and coal beds, indicating a drop in the inland sea level with delta and swamp environments near shore.

Deposition of the bedrock sediments of the project area was complete by Late Paleozoic time. Following the close of the Pennsylvanian Period there was another period of uplift and tilting followed by more surface erosion and deposition; however, further geologic records of events are unclear until the late Tertiary Period.

2.2.2 Drainage History

During the Late Tertiary Period (3 mybp), the land surface was shaped by stream erosion. The Ohio River occupied only a portion of its present drainage basin. The Blue River had attained its approximate present limits, originating in the Norman Upland and flowing through the Mitchell Plain to the pre-Pleistocene Ohio River. The Norman Upland is upheld by resistant shale and siltstone formations of Early Mississippian age which form an eastern facing cuesta known as the Knobstone Escarpment (Powell 1964). These rocks dip southwest 30 feet per mile and pass beneath the Mitchell Plain. The Mitchell Plain was formed by the subterranean erosion and solution of the Middle Mississippian limestone series, which resulted in a karst plain--irregular topography characterized by sinkholes, caverns and underground drainage channels. The middle Mississippian limestones of the Mitchell Plain dip westward beneath the Crawford Upland. The Crawford Upland is a hilly area developed by Late Mississippian Age sandstones, shales and limestones. By the end of the Tertiary Period, the physiographic provinces of Indiana had undergone erosional processes and attained an essentially modern topographic configuration (Schneider 1966). Elevations in the area now range from 363 feet to 953 feet above sea level (Wingard 1975).

The pre-Pleistocene drainage systems differed substantially from the modern drainage pattern. The Blue River was possibly a master stream which carried a major amount of drainage from the Norman Upland (Gray 1965). As the sequences of continental glaciation advances began in the early Pleistocene the ice mass disrupted the existing drainage system and integrated many pre-glacial and glacial streams. The present Ohio River became the major drainage system when numerous small rivers were rerouted and combined. The effect of glacial ice masses and their sluiceways and outwash reversed the direction of rivers, eroded massive land divides and formed the modern drainage.

During the Pleistocene Epoch, sea levels dropped as much as 425 feet (Press and Sieve 1974) as water became "locked up" as glacial ice. As the sea level fell, the base levels of the streams and rivers were lowered and the Ohio River Valley was entrenched well below its present level (Gray and Powell 1965). Many of the streams which originate in the uplands went, at least in part, underground during periods of entrenchment and flowed downdip from the Norman and Crawford Upland under the Mitchell Plain. This

underground water activity intensified the formation of karst features. The Blue River Valley bedrock lies well above that of the Ohio River Valley as a result of the diversion to subsurface of the Blue River during formation stages of the Ohio River deep bedrock channel (Straw 1968). Repeated cycles of valley deepening followed by partial valley filling persisted throughout glaciation during the Pleistocene. Filling in of the major valleys resulted from the valleys acting as sluiceways for glacial meltwater during the Illinoian and Wisconsin glacial stages, and extensive valley trains developed down their courses (Thornbury 1950).

During the Sangamon inter-glacial event following the Illinoian glaciation, the streams cut down into the valley fill deposits of outwash material. Along the Blue River the valley train is preserved today as a karsted strath terrace at elevations of 70 - 130 feet above the present stream level. The strath remnants are characteristically small karst plains covered with varying thicknesses of terra rosa (from the weathering of limestones) and loess. Stream-borne iron stained pebbles, angular chert fragments, and subrounded geode fragments are found in small patches or as scattered pieces on the strath (Powell 1964).

During the Wisconsin glaciation, the drainage patterns changed, as the Wisconsin glacial ice sheet did not reach as far southward and the outwash was channeled through streams which headed farther to the north. The Blue River was not a sluiceway for the Wisconsin.

The Ohio River was a major sluiceway during both glacial events; however, there is little evidence of Illinoian glaciation remaining in the Valley. Gravel terraces of Illinoian age can be seen well above the present floodplain, but during the Sangamon age, most of the Illinoian fill was removed. The present valley fill in the Ohio River Valley is mostly of Wisconsin age. This fill exceeds 100 feet, with maximum thickness ranging from 150 - 170 feet. Sand, silt and clay are the components of the fill in the upper 40 or 50 feet, with gravel common in the lower part.

As valley trains were built down the major sluiceways, the tributary streams were ponded and lakes were formed. While the Blue River was a major sluiceway during the Illinoian, as noted, this was not the case for the Wisconsin glaciation. The Blue River ponded, and lacustrine deposits were laid down during this time. The materials deposited consisted mainly of calcareous clays and silts which were somewhat stratified, resembling varved, or seasonal deposits. During the winter months, when the sluiceways carried little outwash material, the glacial lakes dried up, and silt deposits were exposed to strong westerly winds.

The period of outwash deposition was followed by a period of near equilibrium. The Ohio River was probably a braided stream which degraded the valley fill relatively little but extensively regraded the deposits, keeping the surface barren and exposed to wind erosion. Aeolian loess deposits ranging from 3 to 35 feet thick evidence this equilibrium period.

Subsequent to 15,000 years before present, the Ohio River changed behavior. Glacial meltwater ceased and the reduction of discharge resulted in a new river regime. Total annual discharge was reduced and the flow pattern

changed from a strong summer peak to a weaker peak in late winter or spring. A significantly lowered base level resulted in downcutting of the Ohio River, followed by extensive deep reworking of outwash deposits to form the present floodplain. After the downcutting episode, the Ohio River began a regular but seasonal pattern of overbank flooding comparable to its present pattern. During occasional extreme floods, the river deeply excavated its channel.

2.2.2.1 Ohio River Floodplain Morphology

The Ohio River is presently aggrading, or slowly building its floodplain, by both overbank deposition and lateral accretion. Deposition is not evenly distributed due to building up of features in some areas and scouring in others. Floodplain buildup occurs by the deposition of suspended sediment from overbank floodwaters, and deposition on the inside of river curves as point bars. "Overbank deposits consist basically of material deposited from high water flowing, or standing, outside the channel. Point bars originate within the channel" (Wolman and Leopold 1957). Most geomorphological studies agree with this basic dichotomy of "vertical and lateral" accretion, and associate vertical deposits with suspended load and lateral or point bar deposits with bed load sediments. Point bar deposition is associated with the main channel and accounts for the majority of floodplain construction (Morisawa 1968:87; Wolman and Leopold 1950:178) with overbank deposition playing a minor role. The deep build-up of sediments in the Ohio River floodplain is commonly pictured as the result of vertical accretion in blanket form. However, recent geomorphological studies suggest that point bar deposition occurs on the floodplain above the bank and involves suspended sediment rather than bed load. Discovery that point bar deposition occurs on the floodplain was a result of studies on archaeological sites upriver from the Cole site near Louisville, Kentucky. Swells on the upper floodplain were classified as a series of point bar-like ridges that formed sequentially and that, in forming, prograded downstream (Gray 1978).

The channel of the Ohio River is not static and has extensively reworked the valley fill during Holocene times. Channel shifts occur through the development of a bar which helps concentrate erosion on the opposite bank. Once built, each bar forms a locus for further sedimentation, with deposition as a point bar on the downstream end and as overbank deposition after the bar has aggraded to the level of the annual flood. As each bar is built higher and is overflowed less, overbank deposits on it become more fine grained and accumulate more slowly. In addition to lateral accretion growth, there is also down-valley growth by progradation of each point bar ridge.

Older ridges have prograded farther down-valley than younger ridges. Ridges closer to the river are generally younger. Deposits at comparable depths will be progressively younger down-valley due to the prograding patterns of deposition (Henry H. Gray 1981, personal communication).

In the region of the project area the Ohio River Valley is narrow and deep, being constricted by the resistant bedrock of the surrounding uplands. The Ohio River course is rarely straight for more than a few miles. Meanderings

carry the river from one valley wall to the other so that extensive flood basins have not formed in this region. The narrow bottoms of the valley do, however, have many characteristics analogous to a flood basin.

Small flood basins occur on the downstream lowest part of most floodplain bottoms, and natural levees can be identified at the upstream end. Riverside ridges, such as the one on which our investigation was conducted, may represent poorly developed natural levees. Ridges occur on the floodplain and extend discontinuously down-valley subparallel to the river. Swales separate the ridges. (Gray 1981 personal communication).

During floodstage, waters first inundate the downstream end of a bottom, rising until the upstream end and natural levee is overflowed. The coarser suspended sediments are deposited on the levee. Mixed coarse and fine sediments are deposited in ridges that extend down-valley from the levee and the finest sediments are deposited in the deeper, quiet waters in the swales and at the floodbasin end of the bottom. "Overbank floodwater flowing across the ridged floodplain is partially constrained to channels formed by the swales, and thus tends to deposit a part of its load as point bars at the downstream ends of the ridges" (Gray 1981, personal communication).

Deposits at the Cole site have been developed by processes similar to those observed at the sites studied in the Southwest Jefferson County Floodwall Project (Gray 1981, personal communication). The homogeneity of the texture, color and particle size in the Cole site deposits suggests that they were formed from suspended sediments rather than bed load or traction material. A general tendency toward increased sandiness with depth was observed, suggesting an upward decrease (and therefore a decrease through time) in variability among depositing currents, mainly through a decrease in competence of more rapid currents that were responsible for bringing in the greater quantities of sand. If the sediments at the Cole site represent overbank deposition, the increase in sand with depth indicates that the floodplain was gradually being built above reach of common floods and waters that did cover them from time to time were shallower, quieter and less sediment laden.

2.2.2.2 Floodplain Archaeological Deposits

The Cole site sediments record a depositional history of several thousand years, and archaeological materials are buried within the vertical matrix. The occurrence of cultural deposits within the deep sediments lends the Cole site its particular archaeological significance. The site has the potential to demonstrate stratigraphic relationships of buried cultural remains and thereby construct a relative chronology of the cultural levels examined. The extent and the effectiveness of this attempt at chronology will be subject to the limits of the nature of material remains encountered. In addition to limitations imposed by the material sample, other factors related to fluvial processes will affect the interpretation of chronological relationships in the archaeological record. "Once it is suspected that floods or other flow phenomena may have impacted local archaeological resources to any extent, it becomes especially critical to acquire, analyze, and interpret archaeological data with the expectation that stream action may have introduced bias of various types into the record" (Turnbaugh 1978:605).

Sediment build-up is not a simple process of layering new sediments on top of old ground surfaces, burying any cultural materials that may have been laying on the surface. Although this certainly occurs, other considerations must be examined. Archaeological materials may be affected, altered, or removed by water on the floodplain surface. Major floods may have adequate velocity to scour away sediment beneath the heavy cultural remains, thereby lowering or mixing them with previously deposited and buried materials. Certainly most floating remains such as charcoal, wood, or other carbonized remains would be removed from the assemblage by floodwaters. Small materials such as flakes may be moved by the current or even sorted by size and weight. Although the deep alluvial deposits clearly show that build-up exceeds scouring and erosion, it is safe to assume that episodes of scouring and erosion have occurred during the long time period evidenced by the deposits.

Erosional processes between floods can also affect archaeological deposits near the floodplain surface. Lateral surface erosion can remove soils, and rills and gulleys can mix materials downward. Surface vegetation on a floodplain helps protect and enhance alluvial deposits. Vegetation slows currents during floods, allowing sediments to settle out and get trapped in the vegetation. Barren surfaces are more easily eroded and when drying may crack and allow materials to fall downward mixing into buried deposits. "Pothole" erosion can produce large, deep, steep-sided pits immediately downstream from a large object, such as a tree or stump. Potholes result from turbulence around a large object obstructing the smooth flow of overbank floodwaters. Cultural materials can become displaced into such a pit, creating a false feature.

Although these processes are not always easily identified, the possibility of their previous occurrence affecting archaeological remains must be considered on any floodplain site. Assumptions that buried sites are "undisturbed" may not necessarily be the case. Buried deposits may reflect cultural distribution patterns or patterns redistributed by flood processes.

2.2.3 Modern Soils

Modern soils at the Cole site are relatively immature because the parent material is young and new material is deposited periodically. An immature soil is one that has little or no soil horizon differentiation. Soils in the study tract have been classified as Huntington silt loam and Wheeling loam. The Huntington series consists of deep, well-drained nearly level soils formed in neutral silty alluvium. The underlying material is alluvial silt loam and post-Cary lateral accretion deposits (Straw 1968). The Wheeling series consists of deep well-drained, nearly level to steep soils on alluvial terraces. Both the Huntington and Wheeling soil series are subject to frequent seasonal flooding, a factor which probably limited aboriginal utilization to brief seasonal occupations. Native vegetation of both soil types was mixed hardwoods (Wingard 1975).

2.2.4 Climate

The climate of southcentral Indiana is characterized by four variable, but well defined seasons. Indiana has a humid mesothermal continental climate. There is a broad fluctuation from cold winters to hot summers and there is

no definite dry period or season. Tropical and polar air overlap in the region and changes in temperature and humidity are frequent. The growing season is 155-175 days per year and the average annual rainfall is 44 inches. Rainfall occurs year round with flooding probable during the period from December to April (U.S. Army Engineer Division 1966). Overbank flooding occurs in an annual or biennial pattern. Average daily maximum and minimum temperatures are 43 and 22 degrees F in January and 90 and 60 degrees F in July. Prevailing winds are from the southwest during most of the year, shifting to the west and northwest in mid-winter. Thunderstorms provide the most severe winds and most of the rainfall.

2.2.5 Flora

When European settlers arrived in the Blue and Ohio River area, the plant cover was largely hardwood trees. In the uplands, the stands consisted mainly of white, black, red, scarlet, and chinquapin oaks, but hickory, ash, sugar maple, and tulip poplar were also present. In bottomlands, pin oak and sweetgum dominated, with red maple, swamp white oak, river birch, ash, hickory and sycamore present as major species. Forests in the vicinity of the project area are of the Western Mesophytic Association and Oak-Hickory Association. Dominant species in the stand vary locally in the Western Mesophytic Association. In floodplains a large number of species share dominance. Beech and tulip poplar were important floodplain species in prehistoric times. Soon after historic settlement, land began to be extensively cleared for agriculture and timbering, allowing severe erosion to occur. All of the trees in the vicinity of the project area are secondary growth.

Based on a presettlement reconstruction of the Western Mesophytic Forest, Reidhead (1972) has illustrated the potential for an abundant seasonal supply of floral subsistence resources that would have been available prehistorically. Among these, acorns and nuts from the oaks, walnuts and hickory would have been harvested along with other edible plants within the forest understory and along its margins. Plants available for subsistence harvesting are too numerous to list in view of the negative results of our investigation in the attempt to recover floral remains (Floral data from Wingard 1975; Petty and Jackson 1966).

Any attempt to recover small floral remains in floodplain alluvial contexts must consider the factors affecting their preservation. Organic remains will generally not be preserved unless they have been carbonized. Floodwaters which carry alluvial sediments may float away any carbonized plant remains on the ground surface. The same process may introduce carbonized plant remains from other areas which subsequently become buried in the deposit matrix. The presense of carbon flecks in deposits bearing no other forms of cultural material exemplify this problem. Carbon within deposits bearing cultural materials may be associated with the materials or may have been imported by floodwaters.

2.2.6 Fauna

Potential faunal resources that would have been available prehistorically include most species present today. White tailed deer, eastern cottontail rabbit, opossum, red and grey squirrels, muskrat and woodchuck are native

mammals suitable as food sources. The Ohio and Blue Rivers would have provided aquatic resources. Current species include longnose gar, herrings, carp, catfish, suckers, temperate bass, sunfish, perch and freshwater drum as well as several species of mussels and amphibians. In the past the rivers would have contained clear water species no longer present in the modern Ohio. Seasonal birds and migratory waterfowl species also occur in the immediate area.

2.2.7 Lithic Raw Materials

One of the most important natural resources available in the region of the Cole site is the high grade chert, which occurs in the nearby uplands. Results of this study indicates heavy exploitation of this chert by the Cole site inhabitants. A detailed discussion of this prehistorically important resource is found in chapter 3.

2.2.8 Site Suitability

The topographic and environmental setting of site 12Cr1 is demonstrably suitable for aboriginal occupation. The diversity and accessibility of exploitable natural resources attracted Indians to the region throughout prehistory. The upper floodplain setting of the site would have been subjected to seasonal flooding. Occupation of the site would therefore be limited to dryer seasons. Flooding would have discouraged long term "village" settlement at site 12Cr1 in favor of nearby terraces at higher, more suitable elevations.

Seasonal camps and short term special function activities would have been ideal uses of the Cole site. The confluence of the Blue River and the Ohio River would have attracted numerous activities. The Blue River was available to serve as easy access into the upland interior and to sources of natural resources, particularly chert. The Cole site would be a logical locus for reduction processing of quarried cherts before the materials were taken from the region. These activities may have ranged from a single individual producing a replacement spear point at one sitting to a large-scale organized processing station with a base camp supporting an industry producing chert artifacts for exportation to other regions. The chert flakes and artifacts at the Cole site represent thousands of years and as many or more individuals making their stone tools at the same location, probably unaware of the buried evidence of previous knappers beneath their feet.

CHAPTER 3. CHERT RESOURCES

3.1 WYANDOTTE CHERT: A HISTORICAL NOTE

Corresponding to the Pittsburgh of the latter day, with its roaring blast furnaces, flaming converters and crashing forges fabricating the tools and weapons of 'civilization,' are flint quarries of Harrison County, where our red predecessors secured and procured the material for their tools and weapons (Lilly 1937:101).

The blue gray nodular chert that outcrops in the Harrison County area was undoubtedly the most important chert resource of southern Indiana. Labeled "Harrison County Flint," "Hornstone," and "Indiana blue gray," its presence in preform and finished tool form over the whole of the midwestern United States attests to its importance on a wider scale. The outcrops, quarries, and workshops were first reported by Edward T. Cox in the Indiana Geological Survey (1879:292-423). Subsequently, Gerard Fowke investigated and reported on the "aboriginal flint quarries" of the Harrison County area (1928:522-530). Fowke's study was the first extensive study of Wyandotte chert. As an archaeologist having training in geology, his observations included both archaeological and geological considerations of the chert resources. He noted that the nodular chert was derived from "the Chester and St. Louis groups of the Subcarboniferous limestone" (Fowke 1928:522). Also reported were a number of "quarry" sites and a number of "arrowhead factories" or workshop sites. Many of these workshop sites were located in the Ohio River floodplain. Although no specific mention of the Cole Site is made, reference to the general area is:

There is another workshop on the right bank of the Blue River, about 300 yards above its mouth: flakes show abundantly when the ground is plowed. In all the river bottoms, and especially on the shores where the banks have caved in and the earth is washed away, for several miles up and down the river from Leavenworth, flint chippings are very plentiful (Fowke 1928:528).

It is suggested herein that from the historical standpoint, the name "Wyandotte chert" be used as the standard nomenclature for what has in the past been called "Harrison County," "Hornstone," and "Indiana blue gray" (Lilly 1937:106). It is important to stress that while the nodular chert does occur in Wyandotte Cave, the cave was not a primary or even very important source of chert, as Fowke (1928:529) and Patty Jo Watson (1974:228) have suggested in the past. Recent investigations in the cave have produced evidence of prehistoric utilization of calcite, chert, and several other materials from the cave (Patric Munson and Cheryl Munson, personal communication). The recent investigations have confirmed Fowke's early observations that the aboriginal population visiting the cave did not utilize the tabular blocks that eroded out of the cave, but did use the exposed nodules that at one time littered the floors of various rooms in the cave.

During the summer of 1973, Mark Seeman and W.F. Limp conducted an archaeological survey of the Ohio River bottoms in Harrison County (Seeman 1975a:47-61). Seeman revisited quarries and workshops reported by Fowke and determined, that while most quarry sites were probably only sinkholes, some sites did produce evidence of limited digging in soils bearing nodules loosened from nearby parent bedrock. In addition to relocation of the quarry sites, Seeman investigated a number of workshop and habitation sites. It was suggested that the most intensive pattern of utilization of the chert resources of the area occurred during the Woodland Period. One example of this was located on a bluff above Haunted Hollow, where at a site recorded by Fowke (1928:526), Seeman found evidence of several quarry pits. Along with large amounts of debitage, he found hammerstones, blanks and preforms, and broken Turkey-Tail and Adena points. Nodules of Wyandotte chert were also recovered from the creekbed below the site. Reference to the importance of Wyandotte chert in trade networks and interaction spheres was also made, citing the fact that sites across the river in Meade County, Kentucky, and quarry sites in southern Illinois and northern Tennessee produce nodular chert that is almost identical to Wyandotte varieties.

Fowke noted that "There can be little or no question that from the flint beds of the county came the disks [cache blades] found in the Hopewell mounds near Chillicothe, Ohio" (1928:529). Adding to this, he believed that it was "extremely improbable that any particular quarry or spot exists where a special effort was made to shape the disks and nothing else" (1928:530). The question of identification of a manufacturing sequence, where cache blades were manufactured will be one of the objectives of the lithic analysis in this report.

Additional research questions, relevant to the Cole Site and Wyandotte chert were posed by Seeman (1975a:59-60):

A stylistic comparison of the artifacts together with a physical analysis of the deposits would seem to be logical possibilities for future research.

The particular formation that produces Harrison County chert has not at this time been adequately determined. The early writers such as Fowke refer to it as the St. Louis. Janzen (1971) associates it with the Golconda Formation, while Watson (1974) would place it in the Ste. Genevieve. Obviously, competent geological investigation is needed to settle the issue.

One of our goals in the present project is to answer some of the questions related to Wyandotte chert. The following investigations (chapter 3.2, 3.3) were undertaken to determine the geologic placement of the Wyandotte cherts and to determine quality selection factors that may have influenced prehistoric utilization of the cherts.

3.2 CHERT DEPOSITS IN BLUE RIVER GROUP LIMESTONES AS LITHIC RAW MATERIAL SOURCES

3.2.1 Introduction

3.2.1.1 Purpose of Study

Harrison County, Indiana has long been known as a major source of high quality flint used in the manufacture of lithic artifacts in prehistoric time. Although many localities are known in the county where quality "Harrison County" flint occurs, the geological source of these materials has not been defined. Geologic maps of the area (Amos 1972) indicate that cherts occur at definite intervals within limestones assigned to the Blue River Group of Mississippian, and they thus may constitute mappable geologic units. The purpose of this study was to identify, describe, and make collections of the chert deposits of the Blue River Group Limestones in Harrison County, specifically within the vicinity of the Cole site. Deposits were defined stratigraphically relative to each other and to other mappable horizons within the limestone sequence.

3.2.1.2 Scope of Study

The study was primarily oriented toward field mapping and collection of chert deposits in southwestern Harrison County and southeastern Crawford County, Indiana study area. Although many details of stratigraphy were noted, a complete reference was made to published and unpublished stratigraphic data compiled by the Indiana Geological Survey and provided by Donald D. Carr, Head, Coal and Industrial Minerals Section. Published core and outcrop descriptions were of considerable help in stratigraphic interpretation.

3.2.1.3 Previous Work

Reference has been made to numerous geologic reports on Harrison County and Blue River Group Limestones. Notable are a thesis by McGrain (1942) and a study of the Meramec-Chester boundary by Perry and Smith (1958). Geologic maps of a small part of the area have been prepared at a scale of 1:24,000 by Amos (1972). Numerous references to "Harrison County" chert occur in archaeological literature, although an exhaustive search of this literature was not made. Guernsey (1936:48) mentions that the quality "Harrison County flint" (chert) is generally known as "Wyandotte Flint" from exposures in Wyandotte Cave, Crawford County, Indiana. However, geologic correlation of these deposits to other parts of the county was not substantiated.

3.2.1.4 Field Work

Seventeen stratigraphic sections containing one or more chert zones were examined and sampled in Harrison County and immediately adjacent parts of Crawford County (Figure 3.1). Brief rock descriptions were made, and in many cases elevations of chert zones were determined. This permitted correlation of chert zones from outcrop to outcrop. Representative chert samples were numbered according to the outcrop designation shown in Figure 3.1, and are catalogued in Table 3.3.



Figure 3.1 Map of Harrison Co., Indiana showing locations of key outcrops and cores. ○ = Cole site. M_3 = Blue River Group Limestone. ▲ = chert sampling site. ▲ = other key outcrop. ○ = core. Site locations keyed to Table 3.2.

Table 3.1

Notes on Key Geological Sections

Locations of numbered sections shown in Figure 1.

1. Louisville Cement Company Quarry at Milltown, (abandoned), SE 1/4, SW 1/4, Sec. 10, T2S, R2E. 150.3 feet of section measured from base of Bethel Formation to top of Lost River Chert Bed. Small nodules of chert occur in St. Louis Limestone 26 feet below the top of the Lost River Chert. A single bed of bedded cream colored chert occurs 56 feet below the Bethel Formation. Top Lost River Chert Bed, 583 feet a.s.l. SAMPLES: LR-1, USC-1.
2. Outcrop of large nodular oolitic chert (Wyandotte) in creek bed. NW 1/4, SE 1/4, Sec. 28, T2S, R2E. Elevation 555 feet a.s.l.
3. Wyandotte Cave, SW 1/4, NW 1/4, Sec. 27, T3S, R2E. Nodular chert is exposed at several locations in the cave and was apparently utilized in prehistoric time. The Wyandotte chert is named from this locality. The top of the chert is at 476 foot elevation at the Animal Pit. Sample WY-3-1 is from near the top of a 5.5 foot thick nodular chert zone exposed at "Rugged Mountain". WY-3-2 is thick bedded chert from the top of the zone at Coon's Council Chamber. SAMPLES: WY-3-1, WY-3-2.
4. Everton Cave, SW 1/4, NE 1/4, Sec. 22, T3S, R2E. The Lost River Chert Bed is exposed in the cave 144 feet below the base of the Bethel Formation. SAMPLE: LR-4.
5. Roadcut along I-64 at Scout Mtn., SW 1/4, SW 1/4, Sec. 19, T3S, R3E. 159 feet of section measured. Large nodules of oolitic chert occur near the base of the cut 119 feet below base at Bethel Formation and 102 feet below the Popcorn Sandstone Bed. Nodular Wyandotte chert occurs 8 feet above (WY-5-4). Nodular Wyandotte chert is also seen in shaley limestone east "of the waterfall". At a waterfall along a tributary to Blue River 0.7 miles to the northwest, the Lost River Chert is exposed 27 feet below the oolitic chert (WYO-5-3). Oolitic chert is associated with high quality Wyandotte. Very discontinuous zones of chert are also present 1 foot and 25 feet (USG-5) beneath the base of Popcorn Sandstone Chert Bed (WY-5-1, WY-5-2). SAMPLES: WY-5-1, WY-5-2, WYO-5-3 (at waterfall), WY-5-4, WYO-5-3, USG-5.
6. Stream valley in NW 1/4, SW 1/4, Sec. 33, T3S, R3E, Lost River Chert exposed at about 590 feet a.s.l. Wyandotte chert was not observed. A thin nodular chert zone was observed 5 feet above the Lost River. SAMPLE: LSG-6.
7. Roadcut along new State Highway 135, SE 1/4, NE 1/4, Sec. 35, T3S, R3E, 6.5 feet of Lost River Chert is exposed. No Wyandotte chert is exposed in this section.
8. Stream cut along Potato Run, NW 1/4, NE 1/4, Sec. 16, T4S, R1E, Lost River Chert exposed at about 390 feet a.s.l. SAMPLES: LR-8.
9. Stream cut in Cold Friday Hollow, and in tributary entering Cold Friday Hollow from the north in NE 1/4, NW 1/4, Sec. 23, T4S, R2E, Lost River Chert is exposed in main stream at 460 feet a.s.l. Large nodules of oolitic chert (Wyandotte) were observed in tributary 50 feet above the Lost River.
10. Outcrop in bed of Potato Run, NW 1/4, SE 1/4, Sec. 10, T4S, R2E. Large nodules of Oolitic Chert in situ at 472 feet a.s.l., blue-black nodules of chert exposed 300 yards upstream from sewage plant. SAMPLE: WY-10.
11. Mauchport Section. Roadcut along new State Highway 135, 1.5 miles north of the Ohio River Bridge in NW 1/4, NW 1/4, Sec. 34, T5S, R3E, St. Louis, Wyandotte, and Lost River Chert are all exposed in this section. The Wyandotte chert is 56 feet above the Lost River and oolitic chert occurs 20 feet below the top of Wyandotte. St. Louis chert occurs 33 feet below the top of Lost River. SAMPLES: SL-11, LR-11, WYO-11.
12. Outcrop in Lopp Hollow along tributary in SW 1/4, SW 1/4, Sec. 19, T5S, R3E. Lost River Chert exposed at 490 feet a.s.l. Gray nodular chert float in stream, (presumably Wyandotte). SAMPLE: F-12.
13. Abandoned quarry, NW 1/4, SE 1/4, Sec. 6, T4S, R2E. Scattered nodules of chert were observed immediately beneath the Popcorn Sandstone Bed. SAMPLE: USC-13.
14. Roadcut along I-64, 0.7 miles east of Blue River Bridge in NW 1/4, SW 1/4, Sec. 20, T3S, R3E, Lost River Chert Bed exposed.
15. Abandoned quarry, SE 1/4, NW 1/4, Sec. 26, T3S, R2E, Lost River Chert Bed exposed in quarry face. Bed is 7.0 feet thick and is 41 feet beneath the Wyandotte chert zone. Nodular and oolitic chert occur interlayered in a zone a few feet thick. SAMPLE: WY-15.
16. Outcrop along Ohio River bluff, NW 1/4, NW 1/4, Sec. 16, T4S, R2E, 3.3 feet of Wyandotte Chert Zone exposed at 420 feet a.s.l. SAMPLE: WY-16.
17. Creek flowing east into Indian Creek across center Sec. 24, T4S, R2E. Chert in creek gravel derived from Wyandotte Chert Zone. SAMPLE: F-17.

Table 3.2

Cores

- A. Louisville Cement Company #1 Sutherland, SW 1/4, Sec. 24, T5S, R2E, Base Bethel Formation, 703 feet a.s.l., Lost River Chert 506 feet a.s.l.
- B. Marblehead Limestone Company #1-A, Ruby, NE 1/4, SE 1/4, Sec. 10, T5S, R3E, Base Bethel Formation, 750 feet a.s.l., Lost River 574 feet a.s.l.
- C. M & C Hole A, NW 1/4, Sec. 19, T5S, R3E, Wyandotte chert 607 feet a.s.l., Lost River Chert 543 feet a.s.l.
- D. M & C Hole B, SW 1/4, Sec. 30, T5S, R3E, Wyandotte chert 605 feet a.s.l., Lost River Chert 543 feet a.s.l.
- E. M & C Hole C, 1,300 feet NW, 3,200 feet EL, Sec. 30, T5S, R3E, Base Bethel Formation, 757 feet a.s.l., Lost River Chert, 553 feet a.s.l.
- F. Indiana Geological Survey, Drill Hole, 152, SW 1/4, Sec. 14, T4S, R2E, Wyandotte Chert 506 feet a.s.l.

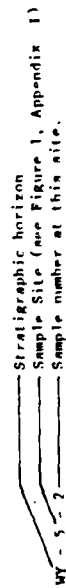
Data on Core Logs provided by Don Carr, Coal and Industrial Minerals Sections, Indiana Geological Survey. Locations of cores shown on Figure 1.

Table 3.3

Catalogue of Samples by Stratigraphic Horizon

Upper Ste. Genevieve	Wyandotte chert zone nodular & tabular (high quality)	Wyandotte chert zone nodular oolitic (poor quality)	Lower Ste. Genevieve	Lost River Chert Bed	St. Louis LS.	"Float" (not in situ)
UGS - 1	WY - 3 - 1	WYO - 5 - 3	LSG - 6	LR - 1	SL - 11	P - 12
UGS - 5	WY - 3 - 2	WYO - 11		LR - 4		P - 17
UGS - 13	WY - 5 - 1	WYO - 15		LR - 8		
	WY - 10			LR - 11		
	WY - 15					
	WY - 16					

Key -



3.2.2 Occurrence of Chert in Blue River Group Limestone

3.2.2.1 Stratigraphy and Structure

Chert bearing limestones of Harrison County are assigned to the Blue River Group (Gray et al. 1960:48) and consist in ascending order of the St. Louis, Ste. Genevieve, and Paoli Limestones. These formations have an aggregate thickness of 485 ft in southern Harrison County (McGrain 1942: Fig.2) but apparently thin in the northern portion of the county. The rocks dip to the west and southwest at about 40 ft per mile.

The St. Louis Limestone underlies much of the sinkhole plain area of central Harrison County. The Ste. Genevieve and Paoli Limestones underlie the western portion of the sinkhole plain and adjacent parts of Crawford Upland hill country to the west. The general outcrop pattern of Blue River Group Limestones in Harrison County is shown in Figure 3.2. A detailed stratigraphic column of the Blue River Group modified from Amos 1972, for the New Amsterdam and Mauckport Quadrangle, is shown in Appendix C.

Chert in the Blue River Group occurs for the most part in definite zones that may be identified and mapped. The chert zones are separated by barren zones which contain very little or insignificant amounts of chert. Chert occurs throughout much of the upper part of the St. Louis Limestone. Near or at the St. Louis-Ste. Genevieve Limestone contact the Lost River Chert Bed forms a readily identifiable marker in the Blue River Group (Figure 3.3). The Lost River Chert Bed has extensive distribution and is mappable in Orange, Washington, Crawford, and Harrison Counties, Indiana, and has been traced through central Kentucky (McGrain 1969:1).

The base of the Bethel Formation marks the top of the Blue River Group in Harrison County, and along with the Lost River Chert Bed forms a key pair of stratigraphic marker horizons to which other stratigraphic data may be related.

The Lost River Bed occurs 144 to 206 ft below the Bethel Formation in the area studied. The interval is thickest in the southern part of the county as determined from core and outcrop data.

A zone of high quality chert occurs 27 to 54 ft above the Lost River horizon. (Following common stratigraphic practice, all stratigraphic intervals given here refer to distances between the tops of each stratum.) This zone was correlated with chert exposed in Wyandotte Cave, and will here be called the "Wyandotte Chert Zone". Chert was also found at three or more horizons in the upper Ste. Genevieve Limestone. These cherts are more local in occurrence than either the Lost River or Wyandotte, and consist of single, thin beds or zones of nodular chert. The stratigraphic relations between the aforementioned cherts are illustrated by the stratigraphic section exposed at the I-64 roadcut at Scout Mountain (SE 1/4, Sec. 24, T3S, R2E, and SW 1/4, Sec. 19, T3S, R3E) and at a waterfall immediately to the northwest (NW 1/4, SW 1/4, NE 1/4, Sec. 24, T3S, R2E) (Figure 3.3).

At the Scout Mountain Section (Figure 3.1-#5), 147 ft of Ste. Genevieve and Paoli Limestones are exposed between the base of the Bethel Formation and the Lost River Chert Bed. Nodular St. Louis chert is exposed 25 ft below

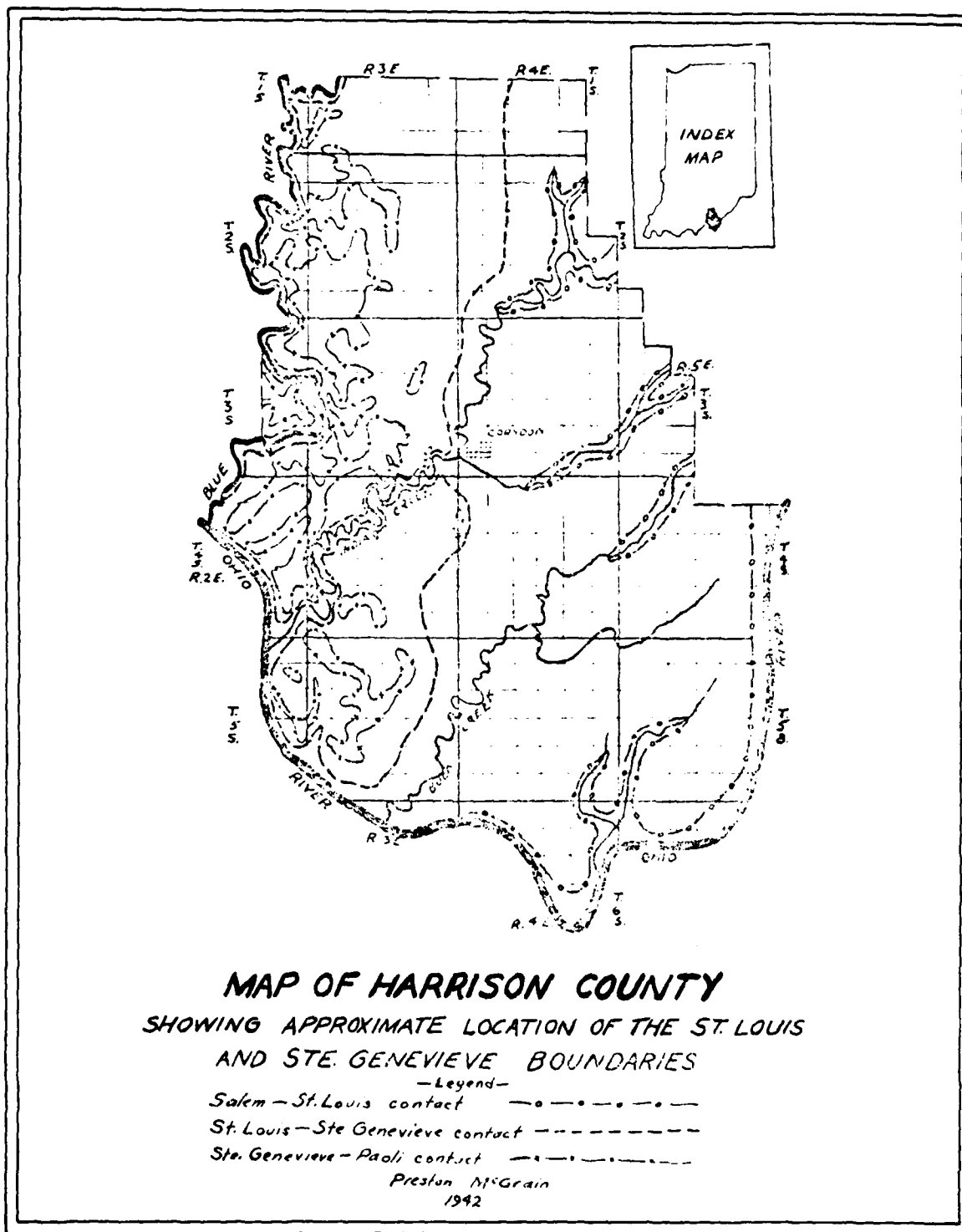


Figure 3.2 Blue River Group Limestone Contact Boundries in Harrison County.

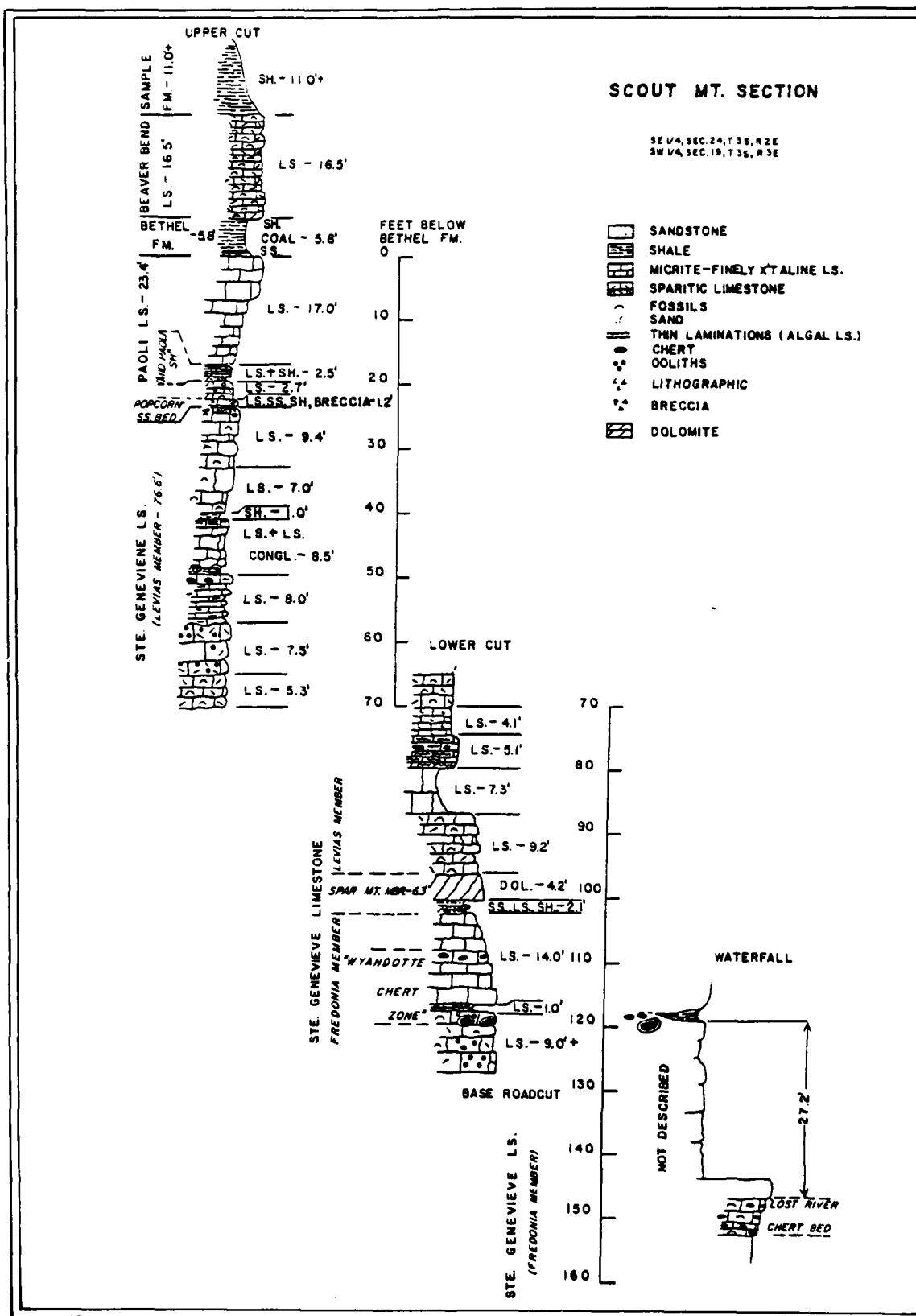


Figure 3.3 Composite Geological Section

the Lost River. A high quality nodular chert correlated with the Wyandotte chert zone occurs at the waterfall exposure, 27 ft above the Lost River. This chert zone is about 11 ft thick and lies 6 ft beneath a sandy interval known as the Spar Mountain Member of the Ste. Genevieve Limestone as defined by Carr and others (1978). The Spar Mountain Member is one of the three named members of the Ste. Genevieve Limestone in Indiana and separates the Fredonia Member from the Levias Member which forms the upper part of the Ste. Genevieve. Thus, in terms of accepted Ste. Genevieve stratigraphy, the Wyandotte chert zone lies in the upper part of the Fredonia Member, only a few feet beneath the Spar Mountain. A chert zone at this position was previously described from southern Harrison County by Carr and others (1978:17) and McGrain (1942:14).

Three minor chert zones occur in the upper Ste. Genevieve (Levias Member) at Scout Mountain. The uppermost is a zone 1 to 2 ft beneath the top of the Ste. Genevieve (24-25 ft below Bethel) and consists of widely scattered nodular chert. A second zone of widely scattered nodular chert occurs 51 ft below the Bethel. Scattered chert also occurs 74.5 ft beneath the Bethel.

3.2.2.2 St. Louis Chert

Nodular and thin tabular chert is extremely common in the upper St. Louis Limestone, and cherty debris weathered from limestone occurs in terra rosa soils covering the eastern part of the sinkhole plain. Nodular St. Louis chert occurs within 25 ft of the base of the Lost River chert.

St. Louis chert is white to medium gray in color and has a characteristic chalky white rind. It is often fossiliferous, bryozoans and brachiopods being common constituents. Some St. Louis chert will give conchoidal fracture, but on outcrop the chert is often seen to be highly fractured and virtually unusable as a lithic raw material source. Nodules are rarely more than 0.1 ft thick, and much of this thickness consists of chalky white rind. Excellent outcrops are located along State Highway 64 in NW 1/4, Sec. 25, T3S, R2E, beneath the Blue River bridge on I-64 in NW 1/4, SW 1/4, SE 1/4, Sec. 19, T3S, R3E, and on State Highway 135, 1.5 miles north of the Ohio River bridge (Figure 3.1. #11; sample SL-11).

3.2.2.3 Lost River Chert Bed

The Lost River Chert Bed is a formal stratigraphic unit and is a useful stratigraphic marker in the Blue River Group. The unit was named by Elrod (1899) for outcrops of such material along the banks of Lost River, Orange County, Indiana. Excellent exposures of Lost River chert occur at Milltown Quarry (Figure 3.1, # 1), and at Mauckport Section (Figure 3.1. # 11) in Harrison County. In the study area the Lost River Chert Bed ranges from 5.5 ft thick at Milltown to 11 ft thick at Mauckport. It is more truly a silicified or silica replaced limestone interlayered with non-silicious skeletal limestone. The layers stand in relief on weathered surfaces and have a very rough, irregular form. Individual layers may be up to 0.5 ft thick. The chert is highly fossiliferous, containing abundant bryozoans and brachiopods. Large blocks of Lost River chert weather from the limestone and commonly litter fields and ditches along its outcrop.

Lost River chert is lithologically similar to fossiliferous St. Louis chert, but individual layers of chert are commonly much thicker. It is separated from the St. Louis by a thick barren zone. The Lost River is white or light gray, breaks with hackly, irregular fracture and is of extremely poor quality for lithic materials. During this study, the Lost River was used primarily as a marker bed to correlate the stratigraphic position of the overlying Wyandotte chert. The Lost River was sampled at Sites 1, 4, 8, and 11 (Figure 3.1).

3.2.2.4 Wyandotte Chert Zone

The name Wyandotte chert zone is here applied to tabular and nodular chert lying near the top of the Fredonia Member of the Ste. Genevieve Limestone. The unit is not now recognized as a formal stratigraphic unit. The unit is well exposed and was sampled at a number of localities in Wyandotte Cave. It is by far the most important source of lithic raw material in Harrison County.

Wyandotte chert is not as widely distributed as Lost River Chert, and is not as lithologically uniform. The unit occurs at a fairly predictable stratigraphic horizon, but undergoes rapid lateral changes and often cannot be traced laterally more than a few hundred feet. The Wyandotte chert zone ranges from 27 to 64 ft above the Lost River Chert Bed in Harrison County, the interval generally being greatest in the southern part of the county. The zone was not identified at Milltown Quarry (Site 1) or at Sites 6 or 7 west of Corydon although its stratigraphic horizon is present. Wyandotte chert appears to have its thickest development in southern and western parts of the county.

As defined for this report, the Wyandotte chert zone consists of different types of chert which are often stratigraphically distinct, but also intergrade. At Mauckport Section, the Wyandotte chert zone consists of two distinct chert beds. The lowest bed, 34 ft above the Lost River, is a thin zone of very large chert nodules (often greater than 1 ft in diameter) that have replaced oolitic limestone. Ooliths are common in the chert (WYO-11), and the nodules often show concentric banding. This type of chert occurrence is here called "nodular oolitic", and is common in the Wyandotte chert zone. At Site 9, a single stratum of nodular oolitic chert 50 ft above the Lost River marks the position of the Wyandotte chert zone.

At Mauckport (Section 11), above the nodular oolitic chert is a 7 ft thick barren zone overlain by a 12 ft thick zone of nodular and tabular high quality bluish-black chert in micritic limestone matrix. Although two distinct cherty horizons are seen in the Wyandotte chert zone at this site, the intergradation of these two types of chert observed at other sites leads to the conclusion that the two chert types should be considered part of a single chert zone.

The stratigraphic complexities of the Wyandotte chert zone are illustrated in the Scout Mountain I-64 Section (Section 5). In the lower cut, (Figure 3.3) a nodular blue-gray chert horizon overlies a 1.0 ft thick shaley limestone layer and large oolitic nodules in oolitic limestone. This entire interval is correlated with the Wyandotte chert zone.

At the waterfall exposure 0.7 miles to the northwest (Figure 3.3), the oolitic chert zone is exposed 27 ft above the Lost River Chert Bed. Immediately above is a 1.5 ft to 2.0 ft thick shaley limestone bed which presumably correlates with the shaley limestone in the same stratigraphic position in the lower cut. However, at the waterfall the shaley limestone contains abundant chert. Nodules of high quality dark gray (N/4 color equivalents designated by Standard Munsell soil color charts) chert are contained in the unit (WY 3-1). The shaley limestone unit grades laterally into fine-grained limestone containing high quality nodular chert that is slightly lighter in color (WY 3-2). Numerous exposures of high quality chert are found in shaley limestone lithology in the Wyandotte chert zone in extreme western Harrison County and adjacent Crawford County.

The Wyandotte chert zone in Wyandotte Cave (Site 3) attains a thickness of about 10 ft, and consists of high quality nodular and tabular chert in shaley limestone 5 to 7 ft below the shaley limestone. Neither type of chert is observed at places in the cave illustrating the rapid lateral variations seen in the Wyandotte chert zone.

Wyandotte chert commonly shows faint color banding which is parallel to bedding in the tabular forms and concentric in the nodular forms. Common colors range from gray (N/6) to dark blue gray (5B 4/1). Weathered surfaces are commonly bleached a slightly lighter shade of gray than the interior of a chert mass.

Chert from the Wyandotte chert zone is by far the highest quality chert found in Harrison County near the Cole Site. At Site 16, 3.3 ft of nodular chert in shaley limestone outcrops in the Ohio River bluff, 1.1 miles upstream from the Cole Site (WY-16).

3.2.2.5. Upper Ste. Genevieve Cherts

At least three minor chert zones occur in the upper Ste. Genevieve (Levias Member) at Scout Mountain (Figure 3.3). The highest of these is a zone 1 to 2 ft below the Popcorn Sandstone Bed. The chert occurs in lithographic or micritic limestone which seems to be a general mode of occurrence of cherts in the upper Ste. Genevieve. A nodular chert in this same stratigraphic horizon was sampled from Site 13 (USG-13), 1.1 miles northwest of the Cole Site. This chert is mottled white to medium gray, highly fractured and sometimes brecciated. It is of poor lithic quality.

Another chert in the upper Ste. Genevieve occurs at Scout Mountain 51 ft below the Bethel Formation, and presumably correlates with a similar chert 56 ft below the Bethel at Milltown Quarry (Site 1). This chert is commonly white to light brownish-gray, fossiliferous, and possesses characteristic wavy parallel laminations (Samples USG-1, and USG-5).

Another chert was observed at Scout Mountain 77 ft below the Bethel. Only a few scattered nodules were seen along three hundred feet of outcrop, and this chert was not sampled.

3.2.2.6. Lower Ste. Genevieve Cherts

At Site 6, a bluish-gray high quality chert was found, in place, 5 ft above the Lost River Chert Bed. The chert was in a single thin stratum and resembles the Wyandotte chert. Because of its stratigraphic position relative to the Lost River, however, it is here listed as a minor chert in the lower Ste. Genevieve and is not correlated with any other chert bed in the study.

3.2.3. Lithic Resources Of Harrison County

By far the highest quality chert in Harrison County is found in what has been called the Wyandotte chert zone in this report. There is little doubt that most, if not virtually all, of the chert known to archaeologists as "Harrison County" was derived from the Wyandotte chert zone. In general, Wyandotte chert outcrops in Harrison and Crawford Counties about as far west as the mouth of the Blue River at the Cole site. West of this point, the rocks dip and the chert subcrops beneath alluvium in the Ohio River Valley. The zone may be absent in the northern and eastern parts of the county.

Creeks that drain areas underlain by the Wyandotte chert zone are commonly littered with chert for some distance downstream from the outcrop. Many of the creeks in southwestern Harrison County which drain into the Ohio River or Indian Creek would have been excellent sources of this high quality chert. Exceptional among these is an unnamed creek draining through the middle of Sec. 24, T4S, R2E, into Indian Creek (Site 17). This creek was found to be littered with Wyandotte chert debris, much of which had apparently been chipped or worked by man. A collection was made of this material (Sample F-17).

Other creeks in the area which would have been excellent sources of Wyandotte flint include Cold Friday Hollow in the Harrison-Crawford State Forest, Haunted Hollow, and Lopp Hollow. Several of the creeks in the vicinity of Valley City were reported to contain quantities of very high quality flint (presumably Wyandotte).

With such large quantities of Wyandotte flint available in creeks in southwestern Harrison County, and evidence that such a source was indeed being utilized (Site 17), this would appear to have been a principal resource available to Cole Site inhabitants.

At least one Indian flint quarry reported in early writing (Collett 1879) is associated with material weathered from the Wyandotte chert zone. Pits presumed to be part of this quarry area were examined in SW 1/4, NE 1/4, Sec. 23, T4S, R2E and appeared to be natural sinkholes developed above limestone bedrock.

3.2.4. Summary

Chert deposits of the Blue River Group Limestones in the vicinity of the Cole Site were examined and sampled to determine possible sources of lithic raw material in the Harrison County area. Chert occurs in definite, mappable zones which can be related to accepted rock stratigraphy of the

area. The most extensive chert zone in the area is the Lost River Chert Bed, a prominent stratigraphic marker in the Blue River Group Limestones, to which other chert zones may be related.

Chert in the St. Louis Limestone occurs in the upper part of the formation within 25 ft of the base of the Lost River. This chert is of poor quality.

Chert occurs in the Ste. Genevieve Limestone at several horizons which may or may not be correlative. A major chert, here called the Wyandotte Chert Zone for exposures in Wyandotte Cave, was correlated across much of western Harrison County, and is the source of chert known to archaeologists as "Harrison County Flint".

The Wyandotte chert zone occurs 27 to 64 ft above the Lost River Chert Bed in the upper part of the Fredonia Member of the Ste. Genevieve Limestone. The zone is lithologically variable, and contains chert of variable quality. High quality Wyandotte chert occurs in shaley limestone lithology at several locations in western Harrison County and adjacent Crawford County. Large nodules of oolitic chert of poor quality are found immediately below or laterally equivalent to this horizon, and may be the only indication of the Wyandotte Chert Zone. The Wyandotte Chert Zone is not as extensive as the Lost River Chert Bed, and was not found in outcrops in the central and northwestern parts of the county.

Surface streams that dissect the Wyandotte chert zone are commonly littered with chert debris which could have served as the major chert resource available to inhabitants of the Cole site.

3.3 QUALITY SELECTION FACTORS IN THE WYANDOTTE CHERT LITHOFACIES

In addition to the geological study of the regional chert deposits, a concurrent study was undertaken to specifically examine the suitability of the Wyandotte chert for lithic reduction processes. This study intended to examine the variable material quality and identify characteristics in the raw materials which may have influenced cultural selection patterns. Differential use of the Wyandotte chert reflects natural variables of the materials, as well as cultural selection factors. Identification of the natural material limitations may allow cultural selection factors to be isolated and observed.

Wyandotte chert is a common lithotype recognized in artifacts dating from at least the Early Archaic throughout later cultural periods in southern Indiana and a much broader area. Intense utilization of this material during prehistory has somewhat skewed the natural expression of the extent of this resource in the region. Even after thousands of years of exploitation the abundance of Wyandotte cherts is awesome. Natural weathering and erosion has provided this area with a consistent availability of this material.

Given the continuous and abundant availability, differential use of the chert through time will reflect cultural factors. Seeman's survey of

Harrison County clearly indicates higher frequency utilization of the local chert resources during Early and Middle Woodland cultural periods (1975a:55). Thus, it may be possible to study raw material selection factors as they reflect demands for particular aspects of the resource. All forms of the cherts derived from the Wyandotte chert zone may not be suitable raw materials for manufacturing portions of specific prehistoric tool kits.

The purpose of this study was to identify quality characteristics of the varied Wyandotte chert lithofacies. Material qualities were determined by macroscopic observation and limited testing by experimental knapping. During field collection of chert samples a secondary consideration of this study was the identification of prehistoric chert procurement areas.

3.3.1 The Reconnaissance

Uplands in proximity to the Cole site were selected as a sample area for information on raw materials derived from the Wyandotte chert formations. The sample area was roughly the center of the study area defined in 3.2.1.2. Collections were stratigraphically restricted to outcrops above the Lost River Chert Bed and below the Popcorn Sandstone Bed (Figure 3.3). Samples were obtained near the Cole site so that possible correlations with the outcrops might be identified. The chert survey focused on two small upland runoff channels which flow through Harrison-Crawford State Forest and join the Ohio River upstream from the Cole site. Potato Run is about 2.5 miles east of the Cole site. Cold Friday Hollow, the second sample area, is about 4 miles east of the site.

The collection strategy was designed to identify and record the full range of material present in both sample areas. The reconnaissance examined an approximate 1 mile stretch of each creek bottom. Stream beds were deemed the most fruitful avenues for collection and chert bed observations due to heavy forest vegetation. Stream exposures provide a horizontal long-section and a gradual vertical cross-section of bedrock strata. In the past, these routes would also have served as one of the best means of obtaining quick information on rock formations and chert bearing strata under forested conditions. Stream beds can be followed from an area of substantially weathered material upstream through progressively less weathered materials. When residual cherts are identified they can be followed upstream to bedrock exposures.

Chert materials were abundant and obvious in both reconnaissance areas. Residual cherts, bedrock outcrops, and evidence of both prehistoric and recent exploitation of the cherts was observed in both creeks. In Potato Run, chert was collected from 12 sample sites. In Cold Friday Hollow, chert was collected from 9 sample sites. Most of the collection sites consisted of residual chert in the creek beds. Five collection sites were outcrops. One sample area was a known prehistoric site, recorded as site 12Hr82 in Indiana University site files. Residual cherts and artifacts associated with this site were collected at three separate stream gravel deposits. In total, 21 sample areas of cherts relating to the Wyandotte chert zone were collected. Table 3.4 describes the samples. It is believed that the samples obtained during the reconnaissance represent a reasonable summary of available cherts and their qualities in this upland watershed area.

Table 3.4 Summary of Samples Collected at
Potato Run (PR) and Cold Friday Hollow (CF).

Sample #	Oolitic outcrop	Residual	Non-Oolitic outcrop	Residual	Prehistoric debris
Potato Run					
PR # 1				x	x
PR # 2				x	
PR # 3				x	
PR # 4	x			x	
PR # 5					
PR # 6					
PR # 7		x		x	
PR # 8					
PR # 9				x	x
PR #10	x				
PR #11	x				
PR #12		x			
Cole Friday Hollow					
CF #1				x	12 Hr 82
CF #2				x	12 Hr 82
CF #3				x	12 Hr 82
CF #4		x		x	x
CF #5	x	x			
CF #6	x				
CF #7	Buried	x	x	x	x
CF #8		x		x	x
CF #9	?	x		x	

All samples are Wyandotte chert derivatives unless otherwise indicated. [PR #9 and PR #10 correlate with Bassett's WY 10.]

3.3.2 Observed Characteristics of the Wyandotte Chert Zone

There are two basic chert lithofacies in the Wyandotte chert zone. The lower chert in the sequence consists of nodules bearing macroscopic oolites. This zone is formed as a single bed. The upper chert level is composed of several feet of alternating beds of tabular and nodular non-oolitic cherts.

Observed outcrops of the oolitic chert occurred as a tight unit with breakdown situated in the immediate area of bedrock exposures. Breakdown of oolitic chert is quite massive and compact. Oolitic chert outcrops were characterized by malformed nodules joined by thin bands. Alternate chert bands of varying "purity" (% of pure hydrated silica) and coarse oolitic cherty limestones within the nodules decrease in size and constrict as they pass between and join nodules to form a horizontally continuous unit of varying thickness. Nodules range from small to quite large. Numerous nodules ranging from 18 to 65 cm in diameter were observed.

Observed outcrops of upper Wyandotte cherts occurred as several feet of vertical deposits bearing multiple lenses of tabular, flattened, and spherical nodules of fine-grained blue-gray and blue-black cherts embedded in a shaley-limestone matrix. Breakdown occurred on a large scale with fine-grained non-oolitic chert often spread over considerable distances. Rapid weathering frees these materials from parent members and spherical forms are easily transported down creek runs or hillsides. Major portions of the upper Wyandotte chert level are composed of lense and thin-bedded cherts ranging from 1 to 15 cm thick. Most areas of non-oolitic chert were traversed without ever seeing parent bedrock due to the large amounts of breakdown.

Most of the observed sample areas were residual or secondary sources already freed from bedrock. A broad spectrum of weathering stages was observed on materials at most sample sites.

3.3.2.1 Weathering

Erosion and chemical decomposition are important considerations in attempting to understand the condition and occurrence of cherts in any topographic regime. Weathering processes expose chert materials and can alter their shape, size, color, and consistency. Weathering can remove matrix rock, obscuring evidence of parent materials which may have adhered to chert blocks or nodules. Chemical weathering results in large scale decomposition of shaley-limestone parent materials. Two of the primary effects are undercutting and exfoliation of the soft matrix surrounding chert beds and nodules. Factors of slope allow masses of detritus to accumulate immediately below parent members. This process continues until parent materials are completely buried by detritus, thereby obscuring their identification.

Several collection sites in the sample area illustrate weathering processes in various stages. One of these (sample site CF# 7) was a natural outcrop exposed by stream erosion. Nearly the complete Wyandotte section was exposed, illustrating initial and intermediate stages of weathering. Initial weathering in the form of chemical etching was observed around the

peripheries of nodules embedded in the top layer of a small bench in the uppermost Wyandotte deposits. Weathering had produced a "lumpy" surface of shaley limestone fracturing along discontinuities between the matrix and the more resistant cortex enclosing the nodules. Resultant exfoliation has created a rockfall accumulation spanning the creek and extending over 100 meters below the bench. This intermediate stage of weathering development has nearly hidden oolitic parent materials beneath detritus of the upper end of the rockfall.

Sample sites CF#1, CF#2, and CF#3 represent more advanced weathering. Although the gradient at these sites is low, outcrop disintegration and residual detritus formation have completely obscured the parent members.

The most advanced stage of weathering of cherts in the region is represented by materials in riverine gravel bars. By the time cherts arrive at the gravel bars, they have undergone substantial chemical decomposition and mechanical weathering. Fragments have been reduced to the smallest constituent parts of the bedrock cherts. Fracturing and chemical erosion have eliminated planes of weakness and non-silicate minerals in the cherts, reducing them to fragments. Gravel cherts are small but relatively pure and free from flaws.

Weathering processes also affect cherts by dissolving impurities from the chert mass. This can result in separation of fragments of chert bonded by non-silicious minerals in cracks or fissures. Weathering also changes the colors of the Wyandotte cherts. Fresh unweathered specimens generally range from blue/black to translucent chalcedony-like blues. Oxidation and bleaching occur in highly weathered states resulting in multiple shades of opaque white. Cherts partially exposed may reflect an opaque white patination with buried surfaces relatively unaffected by chemical weathering. Much of the upland stream weathering is due to carbonic acids in solution.

3.3.3 Quality Characteristics of the Wyandotte Lithofacies

Controlled reduction in chert knapping processes is governed by the quality of raw materials. Several criteria must be met by raw material, including a high silica content, elasticity, homogeneity, and freedom from structural and other flaws. Cherts of the Wyandotte zone satisfy these criteria to varying degrees. Although Wyandotte cherts are of relatively high quality, not all varieties of the chert are suitable for certain types of prehistoric tools. Size requirements in manufacturing tools could pose constraints on raw material acquisition potential and material availability. Mass limitations affected small tool kit technologies to a lesser degree than technologies demanding a large mass potential to create large artifacts.

3.3.3.1 Oolitic Wyandotte Facies

The chert reconnaissance noted that readily identifiable oolites were common across the spectrum of natural and weathered materials from the lower Wyandotte bed. Observations also indicated that large pieces of this material often contain amorphous bands of pure hydrated silica bearing little or no signs of oolites. These pure silica bands occur between more coarse-grained oolitic cherty limestone and oolitic limestone within the nodules. The oolitic cherts are characterized by alternating lenses or

bands possessing varying amounts of pure hydrated silica of small cryptocrystalline grain size and more coarse grain sizes in cherty limestones with less silica. This uneven distribution of identifiable macroscopic oolitic bodies is an important characteristic of the oolitic chert. This is also a potential source of error in identification of artifacts made from this material because the fine-grained siliceous derivatives from this oolitic chert bed often do not bear oolitic bodies. When oolites can be identified they are often congregated along lines of juncture between limestone matrix and relatively pure silica.

In general, oolitic Wyandotte chert is suitable for reduction processes, within limitations. Discontinuous textures within oolitic cherts do not present a homogeneous mass without special preparation. Experimental testing by hard hammer direct percussion indicated that junctures between cherts of markedly different grain size presented loci for splitting or sectioning these materials. This entails separating a sheet or lense of higher quality material situated between two coarse-grained areas within a nucleus. This resembles removing cortex from fine-grained homogeneous nodules. However, extraction of the fine-grained material in oolitic chert can be accomplished by only a few applications of force along lines of juncture. Coarse-grained materials can be split away in a mass several centimeters thick. This can free a fairly large-sized plate of high quality material that possesses length and width dimensions greater than thickness. These plates are well suited for bifacial reduction. This method of extraction seldom exhibits true conchoidal flake development. The majority of the fracture exhibits the morphology of the juncture between textures, rather than flake scars.

After extracting "purer" plates of oolitic cherts, additional tests were conducted for fracture quality and potential for bifacial tool production. Samples from site CF#5 were used. In general, results indicated very high overall quality comparable to the pure silica cherts of the non-oolitic upper Wyandotte cherts. Some blocky masses of oolitic chert were composed of homogeneous hydrated silica with differential colorations. These had vacant silica seams obscuring the matrix but no obvious textural changes across the mass. Percussion testing of these materials produced flakes suitable for further reduction and free from planes of weakness. Some masses of oolitic chert exhibited surfaces of previous plane scars. This indicates that fairly large homogeneous masses of oolitic cherts occur free from structural flaws.

3.3.3.2 Upper Wyandotte Facies

The upper Wyandotte facies is comprised of non-oolitic fine-grained cherts. Two distinct chert lithofacies characterize the upper Wyandotte zone. The major portion of the zone is composed of lense and thin bedded cherts. The other facies occurs in nodular forms.

The thin and lenticular chert beds observed during the reconnaissance were consistently fragmented into small blocks. Fissures, planes and structural weaknesses characterize this material. These weaknesses are inherent in the beds due to processes during their geologic formation. During chert

formation, silicious ooze precipitates from sea water and conglomerates as a colloidal gel (Tarr 1922). Subsequent sedimentation buries the gel mass and solidification processes occur as a result of the pressure and weight of the deposits. During the solidification processes, changes (diagenesis) can occur in the structure of forming materials. Cracks, fissures, planes and other structural flaws are the result of diagenetic processes (Lancelot 1973:393-8). The flaws in the tabular Wyandotte cherts are the result of early stress and strain and other factors long before the more recent erosion of bedrock on the modern surface.

A sample of the tabular bedded cherts was tested with a weak HCL acid solution along diagenetic planes. Calcite crystals were found to be common. Secondary calcite recrystallization in microfossil molds and calcite precipitation in voids of second generation fractures also apparently occurred during diagenesis. Lime encrustation was also fairly common along fractured plane surfaces. Tests indicated calcite and lime were more common than quartz in the flaws. This implies the differential hardness of chert, as opposed to the soft calcite and lime, presents no recompensation for the structural weaknesses.

This Wyandotte chert facies is highly subject to fracture at impact loads much below the force needed to produce conchoidal flakes. Striking this chert results in planes of weakness fractures rather than flake removal. Figure 3.4 illustrates a stylized fragmentation pattern of the Wyandotte tabular chert. After cube and plate structures are freed by percussion force or dissolution of bonding agents, the resulting fragments are relatively pure silica. These pieces were found to be suitable for reduction processes. Further evidence of the suitability of the "refined" pieces of this chert bed is the presence of original diagenetic plane surfaces on prehistoric artifacts found throughout the Ohio Valley.

Diagenetic plane surfaces were prolific on unmodified chert blocks in the sample areas, and prehistoric debitage also bore these signs. Use of these materials appears to be higher than would be expected, given the presence of the larger-sized pure silica nodules available for use.

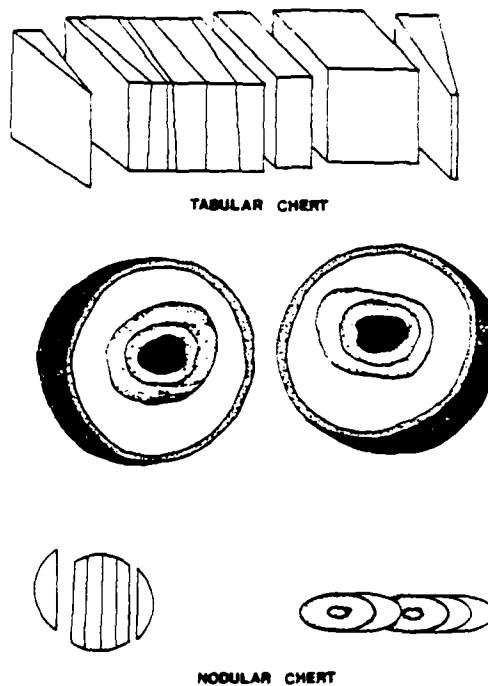


Figure 3.4

A minor aspect of the tabular chert was the occasional presence of thin bands of oolites within lenses of pure silica. Percussion testing resulted in slight deformation of shock waves directed transversely across these oolite lenses. Diagenetic planes also bore textural differences between oolitic bands and pure silica. These samples were not well represented in the study area and do not appear to be commonly associated with this bed.

Non-oolitic nodular cherts are the second form of chert present in the upper Wyandotte zone. Most of these nodules are basically spherical. Field observations indicated abundant availability of relatively pure silica nodules of various sizes and states of weathering. Prehistoric debitage observed during the reconnaissance reflects substantial use of this nodular material. Evidence of quality testing of nodules and bifacial reduction was abundant at collection sites.

Non-oolitic nodular Wyandotte cherts are the highest quality chert in the Wyandotte zones. They are the classic "Harrison County" cherts. These nodules contain pure silica, present in a large mass and relatively free from flaws. However, there are some discontinuities in the quality of this material which would have affected selection factors. Textural variations occur within nodules according to constituent amounts of silica formed during diagenesis. Malformed nodules containing primarily cherty limestone were not uncommon in the study area. Nodules with a concentric formation of silica just inside the cortex and a vacant or cherty limestone center were also found. Nodules without solid chert interiors could generally be recognized by comparing weight relative to mass. Pure silica nodules were consistently very heavy. Two large nodules measuring 30x30x12 cm and 40x40x15 cm were collected outside the study area at the Mauckport Section (Figure 3.1: site 11). Although these nodules were quite heavy, they contained 15-30 cm of poorly formed cherty limestone and a translucent black silica center. All variations of a textural spectrum exist in the nodules with limestone, dolomite, chalcedony, quartz, calcite, and vacant cavities as possible constituents.

Structural weaknesses also occur to a minor degree in the nodular cherts. Spherical forms appear to have resisted weakening processes during diagenesis resulting in a larger homogeneous mass. Structural weaknesses due to diagenesis are associated with more elliptical or flattened nodular forms. Due to dimensions and horizontal orientation within the beds, these forms were subject to more inherent structural flaws. When they occur, weaknesses in elliptical and spherical nodules are nearly flat cross-sections. Figure 3.4 illustrates the "plate-like" character of these weakness fractures. These plates can be edge trimmed to produce platforms from which thinning flakes can be detached for bifacial reduction.

3.3.3.4 Overall Suitability Review

Experimental chert knapping has indicated that all of the Wyandotte cherts are highly suitable for lithic manufacturing reduction processes. The study has indicated that each form of the Wyandotte cherts possesses some material quality limitations.

Non-oolitic nodular chert is the most suitable for maximizing utility in terms of overall mass, basic lack of textural differences throughout the mass, and relative freedom from inherent diagenetic structural weaknesses. Selection criteria for this material would necessitate identification of only those nodules of pure silica. Fracture planes in this material actually serve as an asset to freeing large homogeneous plates of chert. Large nodules of this material served the raw material demands of manufacturing large and small artifacts for tool kits. Non-oolitic nodular cherts of pure silica have a frequency of occurrence lower than the tabular and oolitic cherts.

Non-oolitic tabular cherts rank highest in frequency of occurrence throughout the Wyandotte Chert Zone. The tabular chert has the lowest mass potential. Structural weaknesses due to diagenetic fracture planes result in major discontinuities across the beds. However, once reduced to its smallest constituent fragments free from these structural flaws, this chert is relatively pure silica and is highly suitable for controlled reduction. Use of this material would be restricted to tool kits producing relatively small artifacts due to mass limitations. Selection criteria for this material would require that structural flaws be naturally separated by chemical or mechanical weathering or that flaws be removed by percussion. Collection from a secondary source such as a gravel bar on the Ohio River would provide pieces of this material in small, homogeneous fragments.

Oolitic nodular chert appears to be the least variable of the three forms, but it ranks consistently below the non-oolitic nodular and lense cherts based on frequency of occurrence and amount of hydrated silica relative to mass. Considering mass alone, oolitic cherts rank equal to non-oolitic nodular. However, due to the variable texture of the nodule interiors, the useable portion of the oolitic cherts is significantly lower. Textural variations in this material would require that selection factors consider the expenditure of energy necessary to extract the purer cherts from coarser textures within the nodules and interconnecting beds. Once extracted by natural processes or percussion, the pure pieces of this chert are of comparable quality to the fine grained non-oolitic nodules. This chert is limited in terms of available useable mass.

Hypothetical capability graphs comparing the three Wyandotte cherts are shown in Figure 3.5. These graphs illustrate the overall quality of the cherts considering occurrence and purity relative to mass. The graphs were compiled from the study data and knowledge of "Harrison County" chert gained through experimental projects by a number of individuals over the years.

3.3.4 Prehistoric Quarries and Mines

Undeniable evidence of prehistoric mining activity was not observed during the reconnaissance. However, ample evidence of the full range of classic reduction debris was present in areas where residual cherts were present. Although portions of this debris could represent mining activity systems, they are inseparably mixed with debris from residual collection/reduction systems.

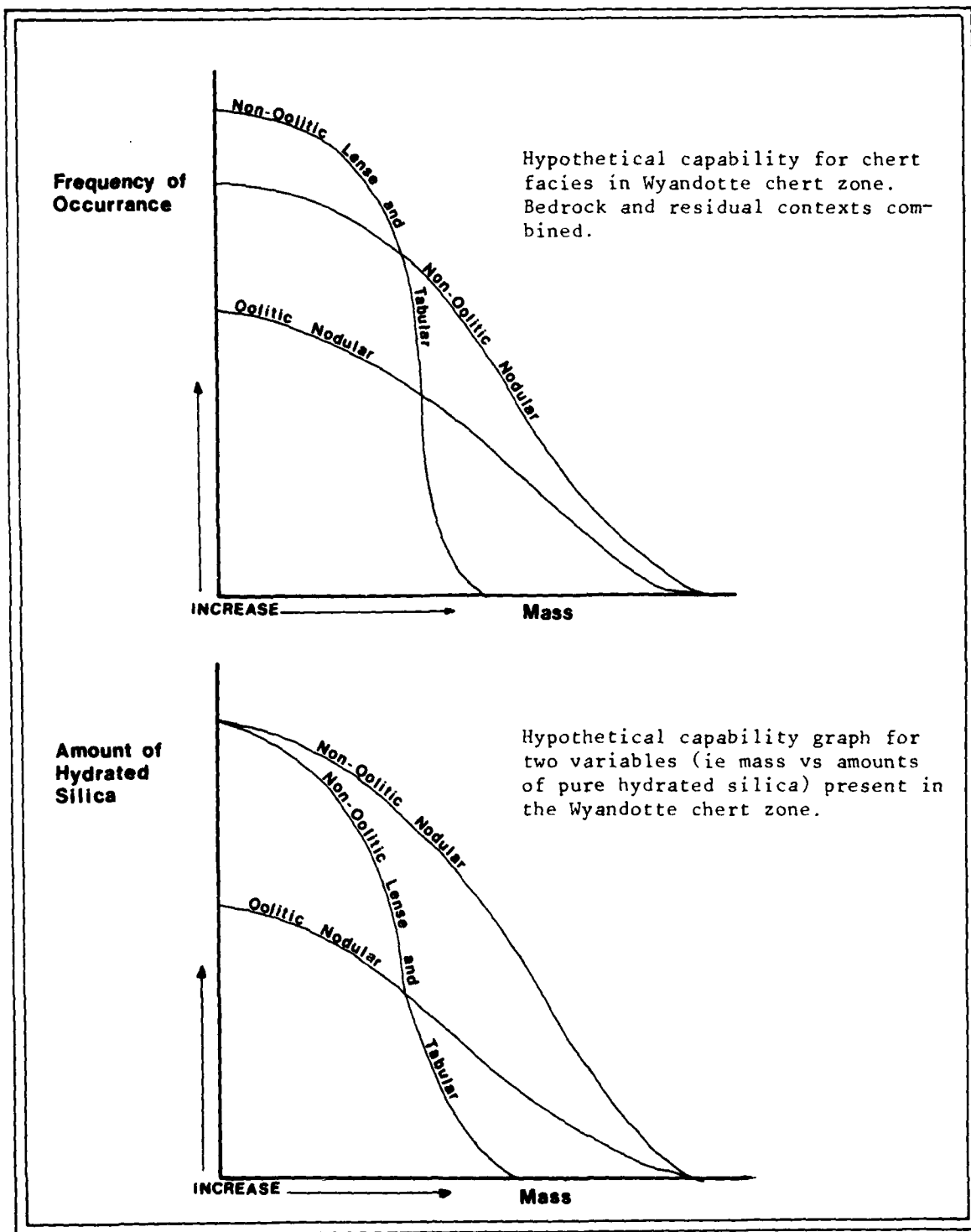


Figure 3.5 Hypothetical Capability Graphs

The identification of prehistoric primary chert extraction loci is complicated by several factors. The main hindrance to acquiring this information results from the effect of weathering on the chert outcrops. Chemical and mechanical erosion cause large scale decomposition of chert and the parent members. Accumulation of masses of detritus often bury outcrops and possible evidence of primary procurement sources. Weathering also frees great amounts of residual cherts which would mask identification of cultural manipulation in the cherts. Initial prehistoric cultural reduction would consist of separating diagenetic planes and quality testing and would resemble blocks separated by natural chemical and mechanical weathering. Weathering subsequent to possible quarrying of materials would remove limestone parent materials adhering to quarried pieces, thus eliminating evidence of initial stages of extraction.

Remains of intense mining over a sizeable area would look much the same as natural bedrock decomposition. Localized extraction debris would be morphologically similar to remains of reduction of collected raw material already mechanically weathered from the matrix. The problem is that prehistorically modified limestones and shales with little or no hydrated silica erode away, leaving no positive evidence of quarrying chert from bedrock. It is possible specific conditions may result in better preservation of quarries if chemical erosion is retarded. A filled quarry shaft or a dry cave may provide preservation of quarry evidence.

Perpetual weathering and erosion processes may have consistently provided natural exposures of the Wyandotte cherts at the outcrop, in stream beds, and in river gravel bars in sufficient quantity that increased cultural activities for procurement were not necessary. Seeman's view of this phenomenon claims "you can literally wait for chert to come out of the ground. Large, labor-intensive quarrying was not necessary" (1975a:49). Only a greatly increased demand for the raw material in a short time span would possibly deplete the natural availability of this material. Increased utilization and demand for nodular non-oolitic cherts during the Early-Middle Woodland Period (Seeman 1975a:55) may have required special extraction procedures.

No quarries or mines were identified during this study. Prehistoric site 12 Hr 82 was reported to have associated quarry pits (Fowke 1928). Our investigations concur with the interpretation of these pits as natural sinkholes, as suggested by Seeman (1975a:49) and chapter 3.2 of this report. Sinkholes are regular features of the limestones which bear the cherts and are common throughout the study area.

3.3.5 Summary and Conclusions

Three distinct chert lithofacies from the Wyandotte chert zone were identified and sampled to determine their suitability for lithic reduction processes. Although there is a multiplicity of raw material qualities associated with the Wyandotte chert zone, three basic and consistent chert facies are apparent from this study. The oolitic nodular, non-oolitic tabular, and non-oolitic nodular cherts should not be considered mutually exclusive chert types. They do, however, present basic differences in overall quality related to the differential and complex processes of diagenesis specific to the origin of the Wyandotte chert lithofacies.

Each of the Wyandotte facies is characterized by structural variability. Knowledge of the structural discontinuities of each of the cherts is essential to the successful lithic reduction of these materials. Oolitic nodular cherts contain textural differences which can affect fracturing. Tabular non-oolitic cherts contain varying amounts of silica. Each of these factors can affect utilization potential of the materials. These factors were also considerations in selective processes in aboriginal raw material collection systems.

Materials present in the Cole site collections reflect the entire range of material morphologies which have been analyzed from the sample areas. Substantial amounts of the Cole assemblage reflect collection of the Wyandotte materials from a secondary river gravel bar source area. This type of material acquisition reflects sound economic logic. Gravel bar sources are convenient, and deposits of this nature offer raw material already freed from undesirable characteristics by natural mechanical and chemical processes. Considering the entire morphological range, gravel cherts are of the most consistent quality relative to their reduced size.

Gravel bars would provide materials adequately suited for small tool production, and it is doubtful that small tool kit raw material requirements would ever have been subjected to stresses resulting from decreasing availability of preferred raw materials. Demand for large homogeneous masses of raw materials during the Early and Middle Woodland Periods would require more labor intensive efforts for maintaining supply levels otherwise subject to depletion.

An understanding of the natural quality variations of the raw material identifies requisite conditions upon which natural lithic morphologies will occur. By isolating natural variables, it is possible to approach the prehistoric culture processes and formulate culturally specific data sets to observe the interaction of cultural and natural variables in raw material acquisition systems.

As groundwork for the Cole site analysis, this study has outlined raw material qualities and characteristics. It has also been suggested large material masses, such as those provided only by the non-oolitic nodules, were a selection factor requirement during the Early and Middle Woodland Periods for portions of the tool kit at this time. The relative age of the major deposits encountered by the recent investigations at the Cole site fits well within these cultural periods, which direct our attention to increased chert acquisition to provide a stable flow of chert products for inter-regional distribution. Cole site inhabitants at the investigated levels disposed of relatively greater amounts of non-oolitic nodular materials suggesting this raw material preference orientation. Additional acquisition information on preferred prehistoric chert qualities within the Wyandotte Chert Zone could allow supply/demand and input/output models to be established for Early-Middle Woodland populations.

CHAPTER 4. CULTURAL HISTORY

4.2 THE PREHISTORIC PERSPECTIVE

Investigations of prehistoric archaeological sites in the middle Ohio River Valley have produced a cultural sequence spanning some 12,000 years. Ongoing work continues to supplement and elaborate upon the existing data base. The following overview of prehistoric culture development has been constructed from two main sources: Kellar's (1973) conspectus of Indiana Archaeology, An Introduction to the Prehistory of Indiana, and data collected by Mark F. Seeman of Indiana University during his 1973 survey for archaeological sites in Harrison County. His investigations into the prehistoric chert quarries and workshops of the area have been incorporated into this discussion. These sources have been included in the definition and interpretation of the various cultural components represented in the extensive and well documented private collection of Mrs. Mary Ann Cole. This assemblage of artifacts has been collected from the eroding deposits at 12Cr1 over the last four decades, and is well provenienced as to general intra-site location. Virtually every cultural component defined in the Ohio River Valley is represented in this collection of several thousand diagnostic artifacts.

While the exact stratigraphic relationship of these artifacts within their depositional context at the site is unknown, a relative chronology can be constructed based on comparisons with dated diagnostic assemblages from other areas within the eastern United States.

Details concerning settlement and subsistence patterns relative to the cultural manifestations represented in Mrs. Cole's collection, as well as those identified during Phase II investigations (Guendling et al 1977), and the present study have also been generalized and elaborated upon using contextual data and evidence from these other regional sources. These interpretations are made based on widespread similarities to other cultural groups. Similar environments are central to making these assumptions and comparisons. Most of these culture behavioral reconstructions are based on a comparison relationship with the overall defined cultural sequence for the midwestern United States. These will be discussed in the spatial context of the Ohio River Valley, and specifically the Crawford Upland and Mitchell Plain physiographic provinces.

4.2.1 Paleo-Indian Tradition (10,500--8500 B.C.+)

To date the earliest documented evidence of native American presence in the Ohio Valley corresponds closely with the closing stages of the Wisconsin Glaciation during the Pleistocene Epoch (as early as 12,000 years ago). Existing evidence characterizes these populations as small, tightly nucleated family groups, living a nomadic lifestyle. Specific details related to better defined dates and understanding of environmental, subsistence, and material culture interrelationships are still very poorly

interpreted due to the lack of reported undisturbed habitation sites from this period. Existing data are generally restricted to comparisons with sites in other areas of the East, including the Bull Brook Site in eastern Massachusetts (Byers 1954), the Debert Site in Nova Scotia (MacDonald 1968), the Williamson Site in Virginia (McCary 1951), and the Shoop Site in Pennsylvania (Witthoft 1952). These sites represent evidence of a big game hunting (megafauna) subsistence. While these sites evidence a megafauna diet, Paleo-Indian populations undoubtedly depended on a broader spectrum of hunting and gathering of wild floral resources and smaller game. Our present interpretation of a "Big Game Hunting" tradition only testifies to our poor understanding of their subsistence and lifeways.

The material culture of this period is characterized by the distinctive fluted projectile point (Dorwin 1966). These projectile points are characterized by a groove or channel on one or both faces of a bifacial lanceolate shaped blade, having a concave base with grinding/blunting of basal and lower lateral edges. This diagnostic trait of fluting is representative of a technological sophistication within the lithics industry of the Paleo-Indian Tradition that has its probable origin within the Paleolithic Stage of eastern Europe and Asia. Many of the fluted points reported in the midwestern United States have been made from Wyandotte chert. The exceptional quality of this chert was essential in the execution of the specialized lithic technology required to produce these points. Four of the five Clovis Points reported by Seeman from Harrison County were of the Wyandotte chert variety (1975a:50-52).

Most recent evidence suggests that Paleo-Indian sites were restricted to the bluffs and uplands along the valleys of major water courses. Two possible exceptions to this pattern exist in the Ohio Valley in Indiana. The first is in Spencer County, downriver from the Cole site. Here, Dorwin (1966:172) reported that three Clovis type points were recovered by local collectors from the base of the Crib Mound shell midden (12Spl, Indiana Archaeological Survey). These were suspected, though not proven, to be indicative of an earlier occupation at the site. The other example of a possible buried Paleo-Indian site in the floodplain comes from 12Crl. There are in the collection of Mrs. Cole three Clovis type points and a Cumberland type fluted point, as well as a number of endscrapers characteristic of the same lithic technology, and two of these are manufactured from Wyandotte chert. These are reported to have eroded out of the bank at a depth of about 19 ft below the surface (Mary Ann Cole, personal communication), at the present location of our main excavation unit. While the possibility of buried Paleo-Indian deposits in the floodplain in both cases is a plausible one, it has yet to be proven.

During the later stages of the Paleo-Indian Tradition (9000--8500 B.C.), a characteristic shortening of the blade and absence of the flute become typical in the contemporary tool kit. Projectile point types representative of this time period are present in the Cole collections, including examples of Plainview (Bell 1958:74), Agate Basin (Wormington 1957:141), Meserve (Bell and Hall 1953), and Greenbrier (Lewis and Kneberg 1958), as well as Beaver Lake (DeJarnette et al 1962) points. It has been hypothesized that this variety of tools and weapons corresponded to more diversified

exploitation of economic resources. The use of Wyandotte chert in the manufacture of these various point types at 12Cr1 is evidence of the early and continued importance of the local chert resources.

4.1.2 Archaic Tradition (8500--1000 B.C.)

With the changing post-Pleistocene environment, there was a corresponding change in prehistoric man's adaptation to the forest around him. During this time period material culture became expanded and elaborated upon as a result of shifting subsistence patterns. Regional cultures began to display increased efficiency in their utilization of the available natural resources.

Following the end of the Wisconsin Glaciation in North America and the extinction of the megafauna, in which prehistoric man probably played some role, Early Archaic (8500--6000 B.C.) groups began to exploit the northward expanding deciduous forests. Increased population levels with seasonal collecting and hunting activities are reflected in the archaeological record (Broyles 1971). Seaman (1975a:52) has noted that in general there was a greater frequency of Early Archaic than Paleo-Indian materials along the low terraces and floodplain areas of the Ohio River, suggesting both increases in population and a more intensive emphasis on the exploitation of riverine resources.

Changes in various tool forms are also indicative of changes in the overall lithic technology and resultant tool assemblages of the various regional groups. The lanceolate point forms of the Paleo-Indian groups, which functioned as the tip of hand-held lances, were replaced initially by medium to large, corner-notched and stemmed points of the Kirk corner-notched and serrated varieties (Coe 1964:69-70; Broyles 1971:67). The personal collection of Mrs. Cole contains a variety of points from this cluster, including the Kirk corner-notched, serrated, and stemmed forms, as well as examples of Palmer side-notched (Coe 1964), Barbee corner-notched (Winters 1967:19), Pine Tree (Cambron 1957), Stillwell (Perino 1970:120-121), and Amos corner-notched (Broyles 1971:55) point types, all representative of this beginning stage of the Early Archaic. Other Early Archaic projectile points represented in the Cole site collection are Thebes (Perino 1971:96), Lost Lake (DeJarnette et al 1962), and St. Charles (Luchterhand 1970).

Later during the Early Archaic Period the projectile point styles changed, becoming smaller in size and having diagnostic, bilobed or bifurcated stems. This latter portion of the Early Archaic Period is represented in the Cole collections with examples of Broyles (1971) entire St. Albans sequence, including MacCorckle Stemmed (Broyles 1966:23), LeCroy (Lewis and Kneberg 1955:79-81), and Kanawa points. Radiocarbon dates for these point types range from 6310 B.C. to 7900 B.C. (Broyles 1971:1). Most or all of the Early Archaic projectile points represented in the Cole collection were manufactured from Wyandotte cherts, suggesting the increased importance of the lithic raw material resources in the area during this time.

Several sites in the eastern United States have produced time sequences for the Early Archaic. Some of the more important of these include the St. Albans Site in West Virginia, the Jefferson Floodwall Sites near Louisville,

Kentucky (Dragoo and Dobbs 1976; Collins 1979) which produced evidence of a Kirk assemblage, the Icehouse Bottom and Rose Island Sites in Tennessee (Chapman 1975, 1977), and investigations at the Deep Shelter (Dorwin and Warholic 1971) which produced cultural deposits attributed to the Early Archaic.

Subsistence patterns recognized to date suggest that Early Archaic populations existed in small, mobile bands or groups, harvested plant resources, hunted migratory waterfowl, and supplemented these seasonal activities with year-round hunting and fishing. This probably resulted in the scheduled seasonal movement of these groups between small base camps in the various biotic zones. Floodplain sites are represented by small fires for heat and cooking, which probably included stone boiling in skin bags. Shallow storage and refuse pits were probably also present. Other tool forms, in addition to the aforementioned projectile point and knife forms, were scrapers, flake knives, burins, hardstone anvils, and hammerstones, as well as nutting stones (Dragoo and Dobbs 1977). Smaller sites present in the uplands often represent incidents of short-term activities, like overnight camps or tool resharpening stations.

The Middle Archaic Period (6000--3500 B.C.) is marked by more specialized regional developments in the material culture and settlement/subsistence modes. This period witnessed the appearance of a wider regional variety of projectile points and flaked chert tools, as well as the introduction of the atl-atl or spear thrower, and the initial appearance of several classes of ground, pecked, and polished stone tools. Among the best represented classes of these tools are the atl-atl weights (better known as "bannerstones"), netsinkers (plummetts), along with ground and polished, grooved axes and celts for woodworking. The most plentiful class of ground stone tools are those for plant food processing including manos, metates, nutting stones, and pestles.

Diagnostic Middle Archaic projectile point forms represented in the bank collections of Mary Ann Cole include Faulkner side-notched (Winters 1967:19), Big Sandy side-notched (Wittry 1959:33), Cypress Creek (Lewis and Lewis 1961:37-40), and Table Rock stemmed (Bray 1956:127). While the majority of the points related to this period from the site were made of Wyandotte chert, an estimated 25-30% were of foreign or non-local cherts, indicating that, at this time, the prehistoric groups visiting the Cole site and vicinity were covering or coming from a generally wider geographic area than in preceeding time periods. The chert resources, however, remained an important resource in the region.

The concept of "Primary Forest Efficiency" was introduced by Joseph Caldwell (1958) as a theory to explain the gradual adjustment by Archaic groups to the environment of the Eastern Woodlands. This adaptation or adjustment included the aforementioned seasonal harvesting of plant resources, as well as hunting of migratory waterfowl. Various hunting and fishing activities supplemented the seasonal resources year-round. Recent evidence from Middle Archaic horizons at the Koster Site in the Illinois River Valley point to an early and relatively "total" adjustment to the Eastern Woodland forest environment, and that by about 3000 B.C. the overall exploitation of the environment had become very narrow and specific in the varieties of food

stuffs exploited (Asch, Ford, and Asch 1972). Thus, it seems that prehistoric groups, at least those along major river valleys like the Illinois and Ohio, adapted to the environment over a shorter time span and in a more specialized manner than previously believed.

The Middle Archaic gradually evolved into the Late Archaic Period (3500-1000 B.C.); it is impossible to define a line between the individual Middle Archaic groups or "cultures" that preceded the Late Archaic. Thus, the whole Archaic Period was a continuum of developing cultures, with evolving settlement and subsistence patterns, that proceeded right through into the Woodland Period.

In southwestern Indiana and adjacent areas of Kentucky, along the Ohio and its tributaries, accumulations of freshwater mussel shells in "heaps," "middens," and "mounds" point to an increased dependence on shellfish and general riverine resources at this time. These shell middens have been linked to the Green River Archaic manifestation of the Late Archaic, as described by Webb in his work on Indian Knoll and other Green River sites (Webb 1946, 1950a, 1950b). One example of these shell middens is the Breeden site (12Hr11) located upriver from the Cole site in Harrison County, Indiana, some 3,500 ft. below the mouth of Indian Creek. First reported in 1964 by John T. Dorwin, under contract to the National Park Service, the Breeden site is one of the most easterly located shell middens in the Ohio River Valley. Excavation of the site by Bellis and Dorwin (Bellis 1967) revealed five distinct stratigraphic levels. The upper levels produced little shell, but they contained large quantities of fire cracked rock and a small amount of ceramic material (probably of the Crab Orchard Series). The third or central level contained the "midden proper" and was characterized by a very thick and heavy deposit of freshwater mussel shell and dark brown to black midden fill. While the upper ceramic bearing level was assigned to the "post-Archaic," or Early Woodland Stage based on the presence of stemmed points, pottery, and lack of worked bone, the main or primary midden deposit produced mostly side-notched points, worked bone, and antler, as well as a variety of ground stone tools.

Late Archaic side-notched points of the Salt River (Janzen n.d.), Brewerton (Ritchie 1961:16), and Matanza (Munson 1966:153-154) clusters, as well as several varieties of Late Archaic stemmed points, including Karnak/Harrodsburg stemmed and unstemmed (Winters 1967:19, Munson 1976:30) are represented in the Cole collection. Only about 65% are manufactured from local Wyandotte chert. Thus, along with the Late Woodland/ Mississippian occupation, the Late Archaic component at 12Cr1 was relatively small compared to the others present and made the least utilization of the local cherts. Two possible reasons or explanations can be made in reference to these phenomena. The lack of gravel bar development in the vicinity of the Cole site would have made the immediate area undesirable to populations who regularly exploited the shellfish resources of the river, while other areas, such as the location of the Breeden site, would have been more desirable. The second reason for the slight representation of the Green River Archaic at the site could lie in the probability that the lithic technology of these later groups did not require the high quality cherts needed by the earlier cultures for manufacture of the larger, more stylized point forms (Seaman 1975a:55).

Another riverine based Late Archaic development was the Riverton Culture (Winters 1969), which was first defined in the lower Wabash Valley and was present in southern Indiana up the Ohio, at least as far as Madison (Crouch 1979a:12). The Riverton culture has been described as having a harvesting economy with seasonal hunting activities. It too is represented in the Cole collection, though only as a minor component. All points corresponding to this period were manufactured from Wyandotte chert. Two Merom expanding stem points (Winters 1969:151-152) were recovered during the Phase II investigations from the site (Guendling et al 1977:12), and both Merom and Trimble side-notched points (Winters 1969:151-152) were noted in the Cole collection.

During the later stages of the Archaic, incipient trade networks developed (Winters 1969:175-221). These involved the transportation of copper from the Great Lakes, marine shells from the coast, and cherts. One of the most popular and available cherts exchanged was the fine blue/gray nodular Wyandotte chert from Harrison County, Indiana.

4.1.3 Woodland Tradition (1,000 B.C.-A.D. 1,000)

The initial differences that characterize the transition from the Archaic to the Woodland Traditions are not well defined. Settlement and subsistence patterns remain basically unchanged. The beginning of the Early Woodland Period (1000-500 B.C.) is marked by the initial appearance of fired clay containers. This early pottery was thick walled, crudely made, tempered with coarse grit, and was cord-marked on both interior and exterior surfaces. Vessel form was similar to modern day flower pots. There is substantial evidence for some early horticulture during this period, including gourd, squash, and sunflower (Yarnell 1964), while shellfish became less important in the diet. For the most part it appears that settlement patterns remained basically unchanged from the later stages of the Archaic Period. The local Early Woodland ceramic development that has been identified at the Cole site is that of the Crab Orchard Tradition (Maxwell 1951:274-278; Crouch 1979b).

During the Woodland Tradition of the Ohio Valley culture sequence, we see a reemphasis on the selection of high quality and exotic cherts. Wyandotte chert, which became less important after the Early Archaic Period, regained its importance in both the lithic technology and trade systems at this time and as Seeman has noted:

In Harrison County itself this transition is particularly dramatic; virtually all of the Turkeytail, Adena, and Hopewell cache blades as well as Adena and Synders points are made of Harrison County [Wyandotte] Chert. Further, these diagnostic Woodland artifacts together with massive quantities of flintworking debitage and fire-cracked rock are found on virtually every rise in the floodplain. Clearly, these multi-component sites reflect workshop activity. Apparently once the chert has been gathered in the uplands, it was brought down to the Ohio Bottoms and worked into both blanks and finished artifacts. This same pattern has been noticed elsewhere in the Eastern United States (Parker 1924; Prufer 1963:10-11). The concentration and density of cultural material in these workshops is greatest in those bottoms closest to the outcrops (1975a:55)

Previous archaeological investigations (McMichael 1976; Guendling et al 1977), and the present data recovery effort have confirmed Seeman's observations.

Diagnostic Early Woodland projectile point forms present in both beach/bank collections and subsurface investigations make up roughly half of the artifacts collected or recovered by Mary Ann Cole from the site. Projectile point types represented include: Turkey Tail (Didier 1967:73; Scully 1951:11), Buck Creek Barbed (Seeman 1975b:106-108), Adena Stemmed (Dragoo 1963), and various stemmed points of the Gary Cluster (Newell and Krieger 1949:164-165), as well as numerous unclassified stemmed points. It is estimated that 98 to 100% of these diagnostics were manufactured from Wyandotte chert.

Ceramics recovered from the site, mostly from slumping bank deposits and now in the Cole collection, represent all three of the "Phases" defined for the Crab Orchard Phase by Winters (1967). The first or "Early Phase" is typified by grit tempered ceramics such as Sugar Hill Cordmarked and Crab Orchard Fabric Impressed. The earliest radiocarbon date for this "Early Phase" is 650 B.C. $\pm$ 120 from Cedar Creek Reservoir in Jackson County, Illinois (McNerney 1976:160). The Yankeetown Site, located downstream near Evansville, Indiana has produced a radiocarbon date of 300 B.C. $\pm$ 140 (Kellar 1973:46).

The transition from grit to grog temper marks the transition from the "Early Phase" to the "Early Middle Phase" of Crab Orchard. Winters (1967) notes that this second phase is marked by the introduction of nodding along rims, the addition of grog as a tempering medium, and thinning of vessel walls. While there has been no nodding observed in any of the Cole site ceramics, there is a relatively high representation of grog and grog combined with other tempering materials. The absence of nodding in the Cole collection represents the absence of Havana (Illinois) influence in the middle Ohio River region in Indiana, suggesting either some later "independent" in-situ development or, more likely, influences from the Scioto/Miami Valley area of Ohio.

The third phase Winters has identified is the "Middle Middle" (A.D. 1 to A.D. 500) and represents the period of early "Hopewell" influence. No evidence of participation in the "Hopewell Interaction Sphere" has been noted at the Cole site; however, Snyders projectile points (Scully 1951:12; Winters 1967:44) diagnostic of this period are present in collections from the site, all of which are of Wyandotte chert.

The distribution of the Crab Orchard Tradition is centered in the hill country of southwestern Illinois and southern Indiana, as well as adjacent portions of Kentucky, Missouri, and Tennessee. In southern Indiana, the Crab Orchard ceramics are represented in collections from Gibson (Dragoo 1955), Posey (Adams 1949), Warrick (Blasingham 1953; Curry 1954), Spencer (Kellar 1956; Crouch 1979b), Perry (Kellar 1958), Crawford (Guendling et al 1977), and Harrison (Seeman 1975a) Counties in Indiana.

Settlement and subsistence patterns of Crab Orchard groups suggest that they exploited both upland and riverine resources. They appear to have utilized upland resources (i.e. nut harvesting) much more than other contemporary

culture developments, and it seems that the northern boundary of Crab Orchard was coincident with the northern limits of the oak-hickory forest (Struever 1964:92-96). These same peoples also utilized some early cultigens and "pseudo-cultigens" to a limited extent, including bottle gourd, sunflower, pumpkin, canary grass, and marsh elder.

Conical burial mounds attributed to this Early Woodland manifestation are found along the bluffs bordering on the Ohio River. Interment of the dead within these mounds represents an elaboration on Late Archaic mortuary practices. Trade networks also became more extensive with an increase in the flow of raw materials and possibly some finished artifacts occurring at this time. Wyandotte chert was one of the more notable items in these early trade networks. Most of the Turkey Tail preforms, Turkey Tail, and Adena cache blades involved in these trade spheres were manufactured from Wyandotte cherts. It is evident from both finished artifact forms as well as discarded, unfinished artifacts and debitage recovered at the Cole site, that 12Cr1 was a manufacturing and distribution point for these items during the Early Woodland Period.

The importance of the Cole site and other similar bottomland sites in the area as chert knapping stations continued during the Middle Woodland Period (500 B.C.-A.D. 500). During this time, mound interments and mortuary ritualism became more elaborate and sophisticated and, correspondingly, so did the trade networks. At this time, Wyandotte chert was heavily utilized in the manufacture of Hopewell cache blades and large ceremonial spear points and knives. In addition to the cache blades recovered from burial mounds, other artifacts include: copper from the Great Lakes, marine shells from the Gulf of Mexico, obsidian from the Rocky Mountains, and mica from the Appalachians (Kellar 1979). These "exotic" materials are representative of the breadth and diversity of the trade networks that originated during the Late Archaic. This apex of the exchange system and the resultant far-reaching distribution of exotic materials and artifacts, as well as some form of related ritualism, has been called the "Hopewell Interaction Sphere" (Caldwell 1958; Seaman 1977). This phenomenon crosscuts several regional developments which differed in many details of material culture, settlement, and subsistence; however, they all included the use of the exotic raw materials in the manufacture and trade of "ceremonial" objects to some degree.

At the Cole site the Crab Orchard complex appears to be ancestral to the "Allison-LaMotte/Mann" occupation. This later development is marked by the appearance of grog and grog with limestone tempering, relatively thin-walled cordmarked sherds from globular vessels. This ceramic type is represented in the Cole collection; however, it is scant relative to the earlier Crab Orchard assemblage. These later ceramics, representing the abandonment of Crab Orchard type wares, mark the transition from Early to Late Middle Woodland. The question of the relationship between Allison-LaMotte/Mann Complex ceramic and the Crab Orchard occupation in the middle Ohio Valley is, at present, still unknown. These later ceramics may be either an intrusive element or an evolution of the Crab Orchard Tradition into its Middle Woodland expression. Several other regional sequences illustrate an in-situ development/evolution of grog tempered ceramics similar to the Crab Orchard into Allison-LaMotte/Mann Complex, such as Scioto into Newtown, and Havana into Jersey Bluff.

In addition to the Late Middle Woodland ceramics in the 12Cr1 collections, there are the diagnostic projectile points identified as the Lowe Flared Base type (Pace and Apfelstad 1978:21-21, 71). These points, along with lamellar blades and cores found in the lower Wabash and middle Ohio Valleys are manufactured from Wyandotte chert. These material culture traits are representative of the Allison-LaMotte Complex (Winters 1967:47-60; Pace and Apfelstad 1978) and the Mann Complex (Kellar 1979), both recognized in southwestern Indiana.

The Mann Complex is defined as a more or less "classic" participant in the Middle Woodland "Hopewell Interaction Sphere." Kellar (1979) has recently presented the data and their relevance as revealed from the type site in Posey County, Indiana. The Mann site was a large earthwork complex. It is the only known example of a mound complex with earthwork enclosure in southwestern Indiana.

The Allison-LaMotte Complex in the Wabash Valley has produced carbon dates in the range of A.D. 200 to A.D. 600 for this Middle Woodland development. There is evidence that Allison-LaMotte people lived in circular houses and subsisted on a hunting and gathering economy, supplemented by some cultivation of squash and gourd.

The general archaeological record for the Middle Woodland Period suggests that populations were nucleated in villages. They seasonally exploited a riverine/forest environment. The subsistence base also included cultivated gourd, squash, sunflower, and some maize. Evidence to date, however, suggests that maize was not a significant part of the Middle Woodland diet.

These groups probably visited the Cole site and surrounding area on occasion only to obtain raw material, work it into preforms, and possibly take advantage of some of the aquatic resources at the confluence of the Blue and Ohio Rivers.

The Late Woodland Period (A.D. 600--A.D. 900) is marked by the breakdown or abandonment, for some unknown reason, of the Hopewell Interaction Sphere with its mortuary ritualism and trade networks. The widespread similarities promoted by trade interactions were replaced by relatively isolated regional cultural developments. The importance of Wyandotte chert also became significantly less, probably being exploited by only a few regional groups. The subsistence of these groups appears to have been based on relatively intensive maize agriculture, supplemented by hunting and gathering activities. While virtually nothing is known of the Late Woodland Period along the Ohio in southwestern Indiana, it is believed that the Albee Culture (MacLean 1931), found on the lower Wabash and White Rivers, may also have extended up the Ohio River. Well made utilitarian, undecorated, grit-tempered, cordmarked pottery, along with small thin, projectile points made on flakes are typical of this period. While maize and the technological innovation of the bow and arrow were introduced at this time, the Late Woodland Period, on the whole, has been called the "Dark Ages" of North American prehistory.

4.1.4 Late Woodland/Early Mississippian Transition (A.D. 900--A.D. 1050)

The Yankeetown Phase (Blasingham 1953; Dorwin and Kellar 1968; Vickery 1970) and the related Duffy Complex of Illinois appear to have been a transitional phase between the Late Woodland Period and the introduction of the Mississippian Tradition in the Wabash Lowlands. Subsistence centered around maize agriculture, supplemented by hunting and some gathering of wild plant foods. Mississippian attributes such as triangular projectile points, pottery trowels, and discs, as well as stone hoes and discoids are present. Ceramic vessel shapes, however, are both Woodland and Mississippian, with a distinctive decorative style that is not typical of Mississippian. Like Late Woodland groups, populations do not appear to have been nucleated, and no large population centers are known. This cultural development was restricted to the Wabash Lowlands and immediately adjacent areas of Indiana and Kentucky.

4.1.5 Mississippian Tradition (A.D. 1000--A.D. 1700)

The origins of the Mississippian Tradition are found in the central Mississippi River Valley. Influences originating there are reflected in the Middle Mississippian phases of the southwestern area of Indiana. Subsistence was centered around intensive maize agriculture, supplemented by various hunting and gathering activities. This subsistence base permitted populations to live as large nucleated groups in villages. In addition to the large stockade-enclosed towns and villages with pyramidal temple mounds, found in the floodplains along major rivers, there were less spectacular villages, hamlets, farmsteads, and camps. Many of the cultural features of this tradition indicate an elaborate socio-political organization that hints of distant Meso-American influences. There are two Middle Mississippian Phases defined for southwestern Indiana that appear to have been restricted to the Wabash Lowlands: The Angel Phase (Black 1967), and the Caborn-Welborn Phase (Munson and Green 1973). While each differed in ceramic decoration and settlement patterns, they did overlap temporally. The Angel Phase appears to have been slightly earlier. The Mississippian occupation of Indiana occurred relatively late in comparison to its occurrence in other areas of the eastern United States, and it appears that the Caborn-Welborn Phase existed into the Proto-Historic Period.

While several triangular projectile points have been recovered from the bank and beach at the Cole site, there have been no characteristic shell tempered ceramics found. It is probable that local Mississippian groups may have made occasional ventures to the site and area to acquire chert. Their occupation at the site was probably limited to no more than an overnight stop.

Wyandotte chert was utilized by the Mississippian groups at both Angel and Caborn-Welborn Phase sites in southwestern Indiana, in the manufacture of triangular points, knives, drills, and scrapers. The average nodule size precluded its use in the flaking of larger chert implements, such as hoes. Thus, while other chert sources such as Mill Creek and Dover (both widely used as raw material for hoe manufacture) became important in the Mississippian trade networks, Wyandotte chert appears to have been of only local utility. A possible exception to this is found in the surface

collections from the Upper (Late) Mississippian/Proto-Historic Wea Villages (Grandview Focus) on the Wabash River near Lafayette, Indiana (Crouch n.d.). There have been relatively numerous large flake-blanks, exhibiting slightly weathered cortex, struck from nodular cores, along with quantities of chert debris, hundreds of endscrapers, and triangular points, all of Wyandotte chert. It can be assumed that these Upper Mississippian peoples were either travelling south to the Ohio River to exploit the chert resources or were obtaining the high quality raw material in trade from contemporary groups closer to the source. The presence of large numbers of identical endscrapers at Caborn-Welborn sites, which may be contemporary to the Grandview sites, is one possible trade connection.

4.1.6 Summary

This overview has attempted to emphasize the importance of the Wyandotte chert resources throughout the Prehistoric Period. Initially, it was used by Paleo-Indian groups in the sophisticated technology involved in the shaping of fluted projectile points. This was followed by the increased exploitation of the outcrops during the Early Archaic for the manufacture of the large stylized knives and points. Its popularity seems to have fallen off during the Middle and Late Archaic times, probably due to the fact that these lithic technologies did not require the high grade cherts to execute the more simplified tool forms. The Early and Middle Woodland Periods undoubtedly exhibited the highest demand for and most intensive utilization of the Wyandotte cherts. The extensive trade networks and related socio-political/aesthetic developments were important factors in its demand, as were the lithic technologies of the various traditions and complexes. Intensive exploitation of the outcrops seems to have abated along with the decline of the trade spheres and relatively mundane cultural developments in Late Woodland times. Though on a local basis, Wyandotte chert continued to be utilized through the Proto-Historic Period, until it was replaced by raw materials such as brass, iron, and glass during the Historic Period.

Even today the quality chert outcrops of Harrison County, Indiana are exploited by students of lithic technology for the replication of various techniques and their resulting artifact forms. Most notable among these is Francis Bordes, Professor of Prehistory at Bordeaux, and the leading exponent of the French approach to the Paleolithic technology of Europe. Also, his American equivalent, Donald Crabtree of Idaho State University has made extensive use of the Wyandotte chert from Harrison County, Indiana in his experimental studies of various lithic technologies.

4.2 THE HISTORIC PERSPECTIVE

Euro-american settlers migrated into Crawford County as early as 1806 from Kentucky and Virginia. The first family to live along the Big Blue River was the Frakes, who settled in the northeastern portion of present day Crawford County (Weathers 1889:14). The Blue River provided not only a source of power for grist mills, such as the Leavenworth Mill at Milton (1818), but also was a means of transporting agricultural produce to the Ohio River to be shipped upriver to Louisville.

Ownership of the land adjacent to the mouth of the Big Blue River remained in the hands of the Zebulon Leavenworth family until 1910, when much of the property was purchased by the Cole family. Zebulon Leavenworth, who platted the town of Leavenworth in 1818, owned nearly three miles of river frontage both up and downriver from the town, including the study tract. When he purchased the property, a small cabin was included. Tradition maintains that an existing horizontal log structure located between the present Baywood Cole residence and the Indiana Department of Natural Resources property along the Old Leavenworth Road is that cabin. It was reportedly built in 1790 (Baywood Cole:personal communication).

Cultural activities, which have occurred at the proposed boat ramp facility, have been primarily agriculturally oriented since the 1820s. The tract was used as an agricultural field with rotating crops of corn, alfalfa, clover, and timothy in recent years. Wheat was never raised because the soil was typically too wet in the spring. Corn was the predominant crop, grown perhaps half of the time. In 1980, the lands adjacent to the mouth of the Big Blue River were used as pasture for cattle (Baywood Cole:personal communication).

Through the 19th century, the tract remained in cultivated fields. The Leavenworth family undoubtedly transported their corn by flatboat or wagon to the town of Leavenworth, a mile west, to be sold. Corn was ground either at Rothrock (11 miles) or White Cloud (7 miles). By 1875, Leavenworth had grown into a thriving town of 1500. Prominent industries included the Leavenworth Pearl Button Works, the D. Lyon Skiff Factory, and several commercial fisheries.

In 1919, the U.S. Army Corps of Engineers began construction on Lock and Dam No. 44, located a few hundred yards downriver from the proposed boat ramp site. Completed in 1924, the dam structure was built principally by Black day laborers from Louisville and a few local wage hands. Unable to secure housing in the area, as many as 300 Black laborers lived in flimsy frame barracks somewhere between the present project area and the lock house. During the construction period, a short narrow gauge rail line was built from the mouth of the Blue River to the dam site, to haul concrete and other supplies brought by boat (Cole 1966:4). The barracks were dismantled shortly after completion of the dam.

Material culture remains from the historical period in the project area are varied. Mary Ann Cole, in addition to collecting thousands of prehistoric artifacts from her property, has noticed numerous rail spikes, concrete fragments, and metal tubing from the dam construction period and domestic debris, such as nails and glass, from the barracks in the vicinity of the proposed boat ramp. Thousands of mussel shell blanks originally came from the Harry Bunch Button Factory in New Leavenworth, the town rebuilt on the bluff after the 1937 flood. Operating five machines in the late 1940s, Bunch donated several tons of cast-off shells to the Corps of Engineers to help solidify and consolidate the mud upon which the Lock and Dam maneuver boat was grounded. Other than a few button shell blanks and wire cut nails, no significant historic period cultural resources were located during this investigation.

4.3 PREVIOUS ARCHAEOLOGICAL RESEARCH IN THE AREA

The Crawford/Harrison County, Indiana area has long been recognized as being rich in prehistoric cultural resources. Wyandotte chert was the main focus of attention during the early periods of investigation. The chert quarries and workshops of this area were first reported by the Indiana Geological Survey (Cox 1879:292-423). Gerard Fowke subsequently commented on the "quarry pits" in an archaeological context in reference to the source of blue gray cherts (1928:522-530). During 1966, James Bellis and John Dorwin of Indiana University investigated the Breeden site (12Hr11) in Harrison County. This site was a Late Archaic shell heap with some evidence of a later Early Woodland occupation in the upper levels. During the summer of 1973, Mark Seeman of Indiana University surveyed the Ohio River bottoms in Harrison County to collect site location data to complement previous survey data along the Ohio River in Indiana, and in anticipation of future industrial development in the bottomlands. In addition to the floodplain survey, Seeman investigated the chert quarries previously recorded by Fowke, as well as several upland workshop sites (Seeman 1975a). Donald Janzen, of Centre College in Danville, Kentucky, also undertook a survey of the New Boston bottoms with his field school in 1973. Most recently, Philip Di Blasi and Michelle Darnley (1980) completed deep testing procedures at 12Hr103, a Late Archaic site at Lock and Dam 43 in Harrison County, Indiana.

The Mary Ann Cole site (12Cr1) has been known to local collectors for over half a century. Mrs. Cole, for whom the site is named, has conscientiously collected the site for nearly four decades, and has kept records and possession of all artifacts she has recovered. The site itself was first recorded by John T Dorwin, a graduate student at Indiana University, in July, 1964, as part of a National Park Service contract.

The first subsurface investigation at the site was in the form of limited test excavations in May, 1976, by the U.S. Army Corps of Engineers archaeologist (McMichael 1976). These were undertaken in recognition of the large collection from the site and the planned construction of a boat ramp and associated facilities. These test excavations determined the existence of subsurface cultural deposits at a depth of approximately 2 to 2.5 feet below the existing ground surface, and the presence of cultural material as deep as 8.0 feet below surface. The uppermost cultural deposit encountered contained large quantities of Wyandotte chert flakes, fire cracked rocks, and an incomplete, relatively thick-walled, grit and grog tempered pottery vessel. The ceramic vessel was believed to be diagnostic of the Early Woodland period (Guendling et al 1977:7), and is probably representative of the Early Middle Phase of the Crab Orchard Tradition.

In addition to this, various finds of subsurface cultural materials have been reported from the area of the existing lock house on the developed lower end of the property. A cache of Wyandotte chert preforms was unearthed during the installation of waterlines originating on Cole property.

From June 1 through 11, 1977, the Glenn A. Black Laboratory of Archaeology conducted Phase II test excavations at the site. These were executed at the request of the U.S. Army Corps of Engineers, Louisville District, in order to make determinations that could not be adequately answered in 1976. The four principal goals of the 1977 investigation were:

- 1) to determine the depth and areal extent of the prehistoric occupation(s) on government property, 2) determine the significance of those occupations in terms of the criteria for inclusion on the National Register of Historic Places, 3) determine the impact of planned construction on the prehistoric cultural resources, and 4) identify any culturally sterile areas within government property boundaries which could be used as alternative locations for the planned construction (Guendling et al. 1977:2).

The 1977 test excavations determined the existence of sealed subsurface prehistoric archaeological deposits, representative of multiple occupations dating to at least 1500 B.C. and earlier. One of these occupations was believed to be a Middle Woodland lithic workshop, as well as an earlier workshop occupation of undetermined cultural affinity. Additionally, the site was determined to be of National Register significance.

The present archaeological investigations were conducted to mitigate the direct impacts to the cultural deposits at the location of the proposed boat ramp and other public access facilities.

CHAPTER 5. THE TESTING

5.1 TEST TRENCHING

The first stage of the investigations at Site 12Cr1 consisted of excavation of deep linear trenches. Three trenches were mechanically excavated with a backhoe. Results obtained were comparable to deep trenching investigations previously conducted at the site.

The purpose of the trenching was to determine the nature and extent of buried cultural deposits in the vicinity of the proposed boat ramp access road. Similar trenching efforts in the 1977 Test Excavation Phase investigations conducted by Indiana University (Guendling et al 1977) did not extend into the area to be impacted by the access road. Backhoe trenching conducted during the 1980 fieldwork was intended to recover additional data to supplement the 1977 investigations and provide data specific to areas proposed for direct impact. Trenching provided preliminary information pertinent to the vertical depths and horizontal extent of cultural strata present in the impact area. The trenches also provided a small sample of material culture to compliment the results of the formal block excavation. Although trenching efforts did not recover diagnostic artifacts to interpret the cultural affiliation of specific levels, it was determined that substantial undisturbed archaeological deposits exist in the area to be graded to river level in the construction of the boat ramp access road.

Test trenches were located in the extreme southeastern portion of the site adjacent to the Blue River at its confluence with the Ohio River. Trench placement was intended to examine the access road area. Figure 5.1 shows the location of the trenches, with an overlay to illustrate their relationship to the proposed impacts. An engineers transit was used to plot and map trench locations in relation to permanent datums and temporary control points. Figure 5.2 is a scale diagram showing exact location-engineering involved in plotting the trenches. The datums, control points, distances, turning angles, trenches, and cardinal orientations are included. Trenches 1 and 2 were oriented south to north beginning at the upper edge of the bank of the Blue River. Trench 3 was oriented east-west and was in the swale believed to be an old overflow channel of the Blue River which borders the site on its north-east margin.

5.1.1 Trench Excavation Procedures

Excavation of the trenches was executed using a backhoe operated by a local contractor. Stakes and a taut string line were set to allow the operator to align the trenches. Trench width was 2.2-2.5 ft corresponding to the backhoe bucket. Removed soils were deposited on the west edge of the trenches. Each load was sorted and carefully examined for cultural materials. Recent surface deposits were removed as one level until prehistoric materials were encountered. Below historic period soils the deposits were removed in .48 ft (15 cm) levels. Levels were checked by dropping the stadia rod to the trench

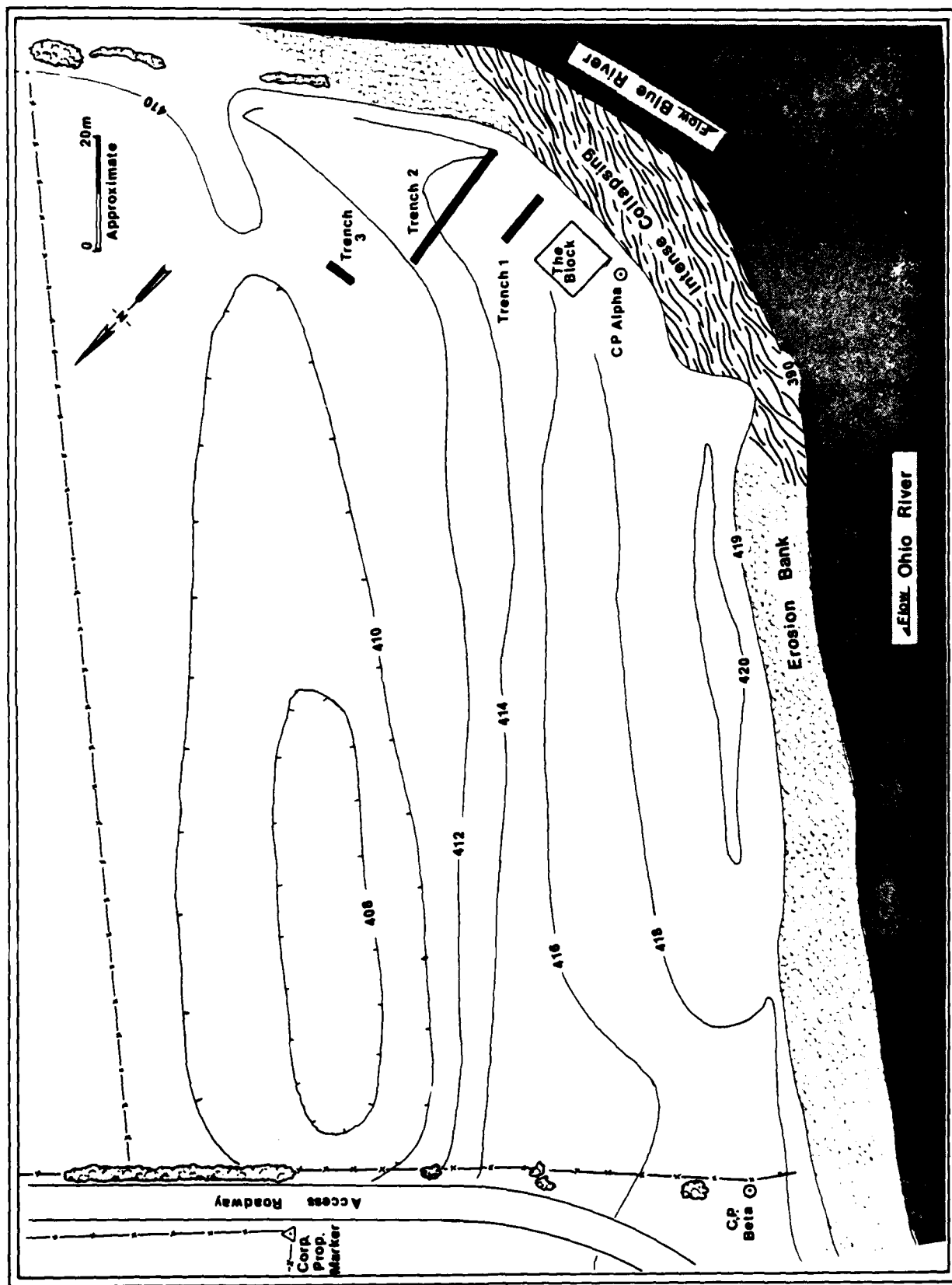


Figure 5.1 Location Map. 1980 Test Trenches and Block Excavation.

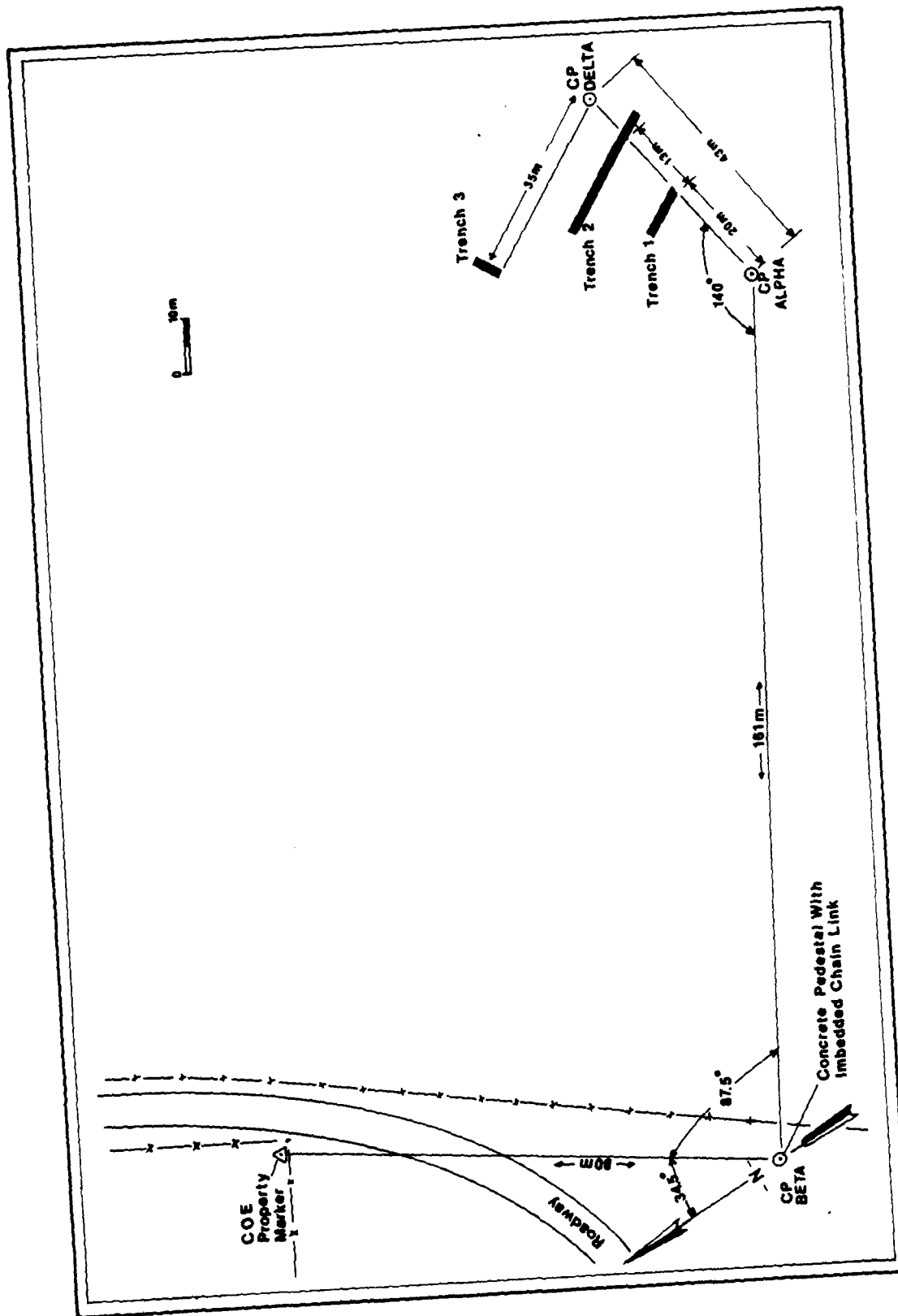


Figure 5.2 Diagram of Trench Location-Engineering.

floor and reading the measurement at ground surface. Level removal was accurate, but four non-removable teeth on the backhoe bucket disturbed soils approximately .2 ft (5 cm) below the bucket cutting edge. The rough floors caused by these teeth necessitated shovel removal of loose dirt at each level to allow better examination of the trench floor. When prehistoric cultural materials were encountered in the back dirt or in the trench floor it was noted and bagged at the appropriate level depths. A .2 cu ft (6 liters) soil sample was taken for flotation from each .48 ft (15 cm) level in the cultural zones. Trenches were extended to the maximum depth machine capabilities allowed. Maximum effective depth was about 11 ft (3.4m).

5.1.1.1 The Shoring System

As trench depths increased, the weight of the backdirt and the risk of trench cave-ins increased. Since it was necessary to physically enter the trenches to examine and map the profiles it was determined that a strong, safe "shoring system" was essential.

The effect of the weight load of the backhoe, the backdirt pile, and the weight and hydrostatic pressure of the deep deposits became apparent at a depth of about 6 ft (2 m) and could be observed in an obvious outward "bow" or swelling of the bottom of the trench walls. The shoring system, which was utilized, was safe and effective, and is recommended as a minimal safety measure when deep trenching must be conducted in unstable soils. Two sets of shoring were moved along the trench in a "leap-frog" technique to allow profiles to be mapped. Each set consisted of two 4 ft X 8 ft X 3/4 in thick plywood sheets, placed into the trench on opposing walls. Heavy guage steel basement floorjacks were used to brace the boards. One foot square pre-mounted plywood blocks were used to disperse the pressure at the ends of the jacks. Five jacks, one near each corner and one in the middle, were screw-tightened to restrain the wall pressure. The shoring system is illustrated in Figure 5.3. After a practice run the system could be set up by two people in about 10 minutes. Break-down time was rapid, braces could be dropped and thrown topside as they were loosened.

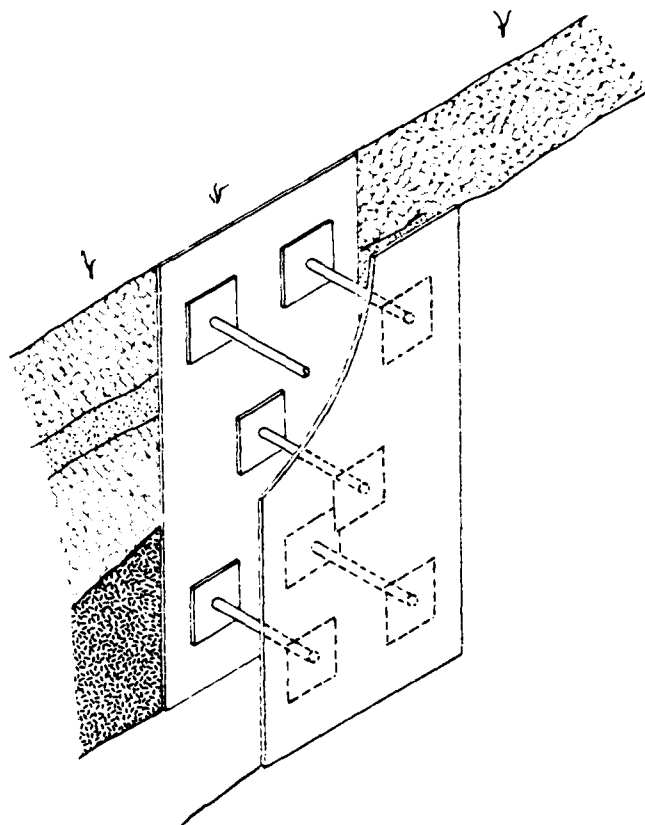


Figure 5.3 Shoring System

5.1.1.2 Profile Mapping

Profile mapping and examination was accomplished by establishing a level string line and using the stadia rod to measure above or below the line to cultural or soil zones or the trench floor or surface. Soil zones were very subtle and difficult to perceive in the trench shadow, but carbon flecks and cultural materials were plotted. A person in the trench called out measurements to a plotter on the surface and mapping proceeded quickly and kept time in the trench to a minimum. During profile mapping, dynamiting at a nearby quarry made the trench walls tremble ominously, further persuading rapid accomplishment of in-trench tasks.

5.2 TRENCHING RESULTS

Results of the trenching indicated that cultural materials exist at the location of Trench 1 and Trench 2. These deposits will be affected by the proposed improvements. Individual trench results are outlined below

5.2.1 Trench 1

Trench 1 was located approximately 66 ft east of Control Point Alpha (Figures 5.1 and 5.2) and extended 29.5 ft (9 m) north of CP Alpha-CP Delta baseline. Trench 1 achieved a maximum depth of 10.3 ft (3.15 m) but the effective depth was increased to 13.8 ft (4.23 m) by using a 4 inch bucket auger to examine the deposits an additional 3.6 ft (110) below the deepest floor of the trench.

Scattered drain tile, bricks, glass, and other recent historic debris was recovered to a depth of 2.5 ft (75 cm) below ground surface (BS). The underlying alluvium displayed no natural stratigraphy in the trench wall profile. Prehistoric cultural materials were encountered at a depth of 3.7 ft (115 cm)-7.6 ft (235cm) BS. No distinct material concentrations were discernable within the 3.4 feet. Cultural materials consisted of chert flakes, fire-cracked sandstone and hardstones, limestone, carbon flecks, and some quartzite. A thick grit-tempered ceramic sherd was recovered at the 3.7-4.2 ft (115-130cm) level indicating a probable Middle Woodland (200 B.C.-400 A.D.) affiliation at this depth. The pottery resembles Crab Orchard Tradition ceramics (Maxwell 1956). A utilized flake recovered from the 6.1-6.6 ft (190-205cm) BS level was the only modified chert from Trench 1. A battered hardstone hammer was found at 6.8 ft (210cm) BS. Analysis of the flotation samples from each level recovered sparse carbon fleck and small sandstone pebbles from Trench 1.

A thin sterile band occurred from the 7.6-7.9 ft (235-245cm). This level contained no carbon flecks and no cultural materials. Below this sterile zone a second cultural zone extended from 7.9 ft (245cm) to 9.7 ft (300cm) BS. This zone contained sparse chert, fire-cracked rock (FCR), and carbon and was underlain by a slightly lighter more sandy sterile soil that extended to the bottom of the trench (10.3 ft, or 3.14 m) and continued to at least 13.8 ft (420cm) in auger tests. Cultural materials recovered from Trench 1 are listed in Table 5.1. The profile map of the east wall of Trench 1 is shown on Figure 5.4A. It must be noted that soil zones graphically depicted on Figure 5.4A are much more dramatic than the actual

Table 5.1 Trench #1 Cultural Materials

Level m BS	Chert	FCR		Silicified Limestone	Other
		Hardstone	Sandstone		
0.00-0.70	1 wf (0.3)	-	-	4 (312.2)	4 hist. ceramic
0.70-0.85	-	-	-	-	-
0.85-1.00	-	-	-	-	-
1.00-1.15	1 Blk (20.2)	-	-	-	-
1.15-1.30	2 Sf (11.5) 1 Wf (2.2)	2 (306.1)	8 (135.8)	1 (1424.6)	1 Pottery sherd
1.30-1.45	1 Blk (2.7)	1 (.2)	3 (123.7)	-	-
1.45-1.60	1 Pf (.5) 2 Wf (1.9) 1 Blk (2.4)	1 (31.0)	3 (110.0)	1 (60.4)	-
1.60-1.75	1 Pf (1.4) 5 Wf (6.2)	3 (61.8)	16 (352.7)	-	-
1.75-1.90	6 Wf (2.9) 1 Blk (1.9)	1 (180.8)	15 (368.8)	4 (69.4)	6 charcoal 1 quartzite
1.90-2.05	3 Wf (2.6)	1 (39.9)	11 (366.6)	1 (0.6)	1 utilized flake
2.05-2.20	2 Sf (7.9)	-	12 (169.2)	-	1 hammerstone
2.20-2.35	2 Pf (10.1)	-	1 (23.1)	-	2 charcoal
2.35-2.45	-	-	-	-	-
2.45-2.60	2 Blk (21.4)	1 (33.6)	6 (96.4)	1 (30.7)	-
2.85-3.00	1 Pf (.6)	-	3 (57.2)	-	-
Feature #1 (Flotation materials)					
2.67	2 Sf (3.7) 21 Wf (13.1)	-	1 (256.6)	-	2 charred nut hulls x wood carbon

Wf= Waste flake
Sf= Secondary flake
Pf= Primary flake
Blk= Blocky chert

Weight is given in grams

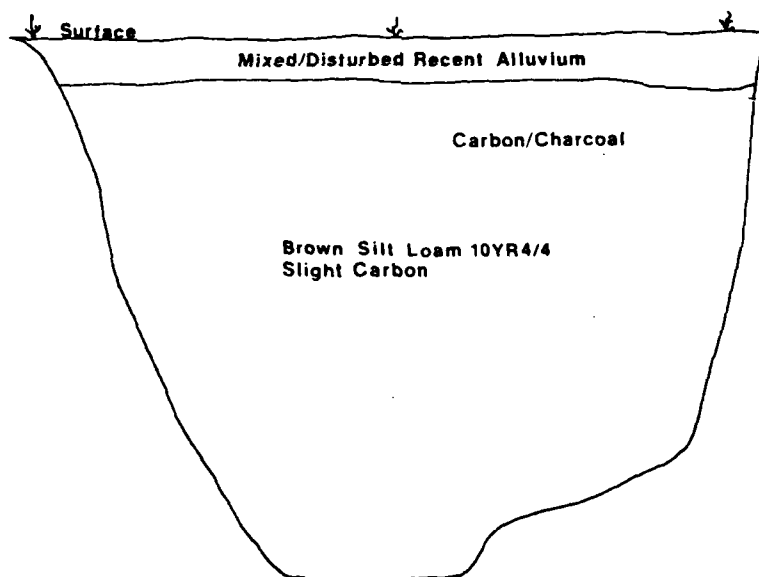
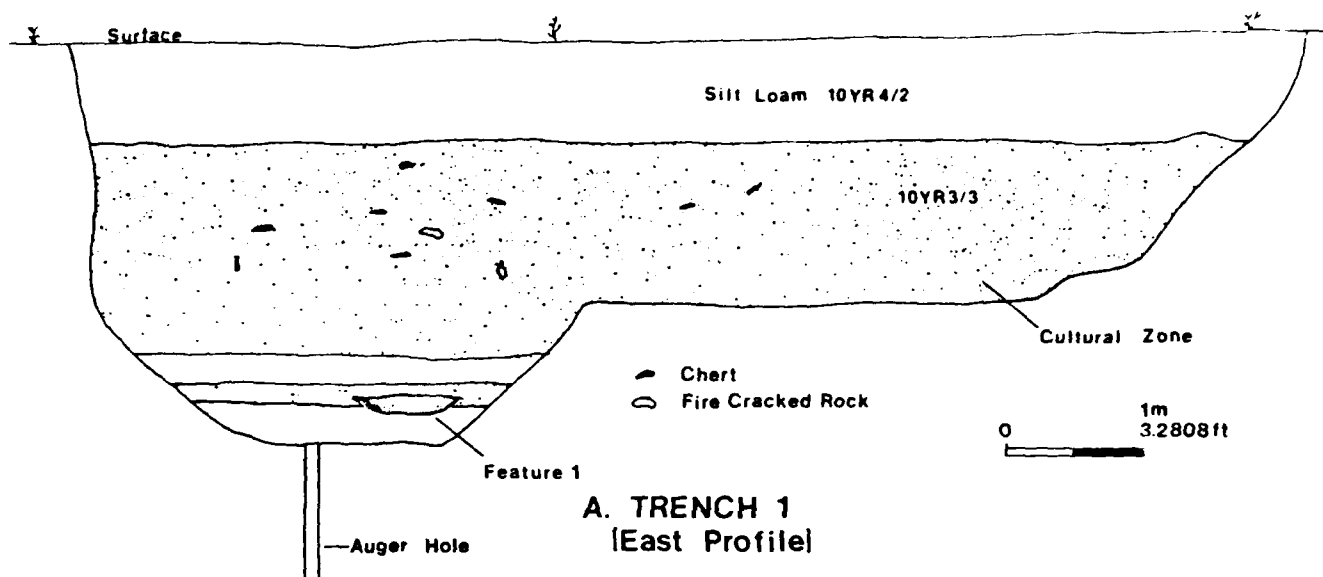


Figure 5.4 Trench Profiles

subtle variations in the deposits. After mapping of Trench 1, the shoring system was removed and the deep portion of the trench was destroyed by a massive cave-in during an overnight rain.

5.2.1.1 The Feature

One feature was encountered in Trench 1 at a depth of 8.7 ft (2.67 m) BS. This feature was a partially exposed, circular, basin-shaped pit, defined by dark carbon flecked soils against sandy, light matrix soils. The feature measured 2.5 ft (78 cm) north-south by 1.3 ft (41 cm) east-west with about one-half of the feature exposed on the east edge of the trench floor. The exposed portion was removed for flotation and the shallow feature was only .8 ft (25 cm) thick. Feature flotation results are listed at the end of Table 5.1. Carbon samples from this feature have been submitted for C-14 dating evaluation.

5.2.2 Trench 2

Trench 2 was located 42.25 ft (13 m) east of Trench 1. Trench 2 began approximately 15 ft (4.65 m) south of the CP Alpha-CP Delta baseline and extended northward away from the top of the Blue River bank for a total length of 81 ft (25 m). Trench 2 reached a maximum depth of 10.5 ft (3.2 m).

Recent historic debris such as coal, tile, and glass was recovered from the surface soil zone of Trench 2. Humus stained soils to a depth of 1-1.5 ft (30-45 cm) BS appeared to represent an old plow zone. Prehistoric cultural materials were encountered at a depth of 3.7 ft (115 cm) BS and continued to a depth of 7 ft (215 cm) BS. Deposits below 6.9 to 10.4 ft appeared to be sterile of cultural materials. Cultural materials consisted primarily of chert debris, limestone, sandstone, fire cracked hardstones, and carbon flecks. Cultural materials were relatively profuse in a zone from 5.2 ft (1.60 m) to 6.6 ft (2.05 m) BS in the south half of the trench. Small flakes and bits of burned bone were present throughout this zone. A crude biface and a biface fragment were recovered from the 5.2-5.6 ft level. Fire-fractured chert and bits of burned bone and deer teeth were recovered from the 5.6-6.1 ft level. Trench 2 material inventories are presented in Table 5.2. Flotation samples from Trench 2 indicated relatively profuse material from this zone. The profile is illustrated in Figure 5.5.

The concentrated cultural zone in Trench 2 did not appear in Trench 1 and may represent a restricted area of activity. The presence of these cultural materials indicates that substantial undisturbed archaeological deposits are present in some areas of the proposed ramp access road. No features were encountered in Trench 2.

5.2.3 Trench 3

Trench 3 was located 113.75 ft (35 m) north of CP Delta in the low overflow channel swale (Figure 5.1 and 5.2). Trench 3 was oriented east to west and achieved a maximum depth of 14.3 ft (4.4 m) and was 16.25 ft (5 m) long. The upper 1.6 ft (50 cm) of the trench profile appeared to be recently disturbed and contained profuse carbon and some bits of coal and cinders. From 1.6 ft to 14.3 ft, the soil profile was relatively homogeneous. No

Table 5.2 Trench #2 Cultural Materials

Level m BS	Chert	FCR		Silicified Limestone	Other
		Hardstone	Sandstone		
0.00-0.70	-	-	-	2 (332.5)	17 hist. glass, clear 1 iron bar 3 hist. cer., white 17 coal fragments
0.70-0.85	-	-	-	-	-
0.85-1.00	-	-	1 (44.1)	-	1 cinder
1.00-1.15	-	-	-	-	-
1.15-1.30	1 Wf (1.1)	1 (85.1)	4 (426.1)	-	5 hist. glass, clear coal
1.30-1.45	3 Wf (14.2)	-	2 (15.5)	-	-
1.45-1.60	1 Wf (0.3) 2 Sf (3.0)	-	7 (400.5)	-	-
1.60-1.75	45 Wf (34.2) 12 Sf (26.9) 7 Pf (22.5) 5 Blk (147.7)	6 (137.0)	49 (1063.0)	-	5 bone fragments 6 charcoal 1 quartzite, FCR 1 biface, crude 1 biface fragment
1.75-1.90	22 Wf (14.9) 8 Sf (10.9) 2 Pf (3.6)	-	3 (45.7)	1 (10.7)	5 teeth fragments* 1 quartzite 4 bone fragments* 1 w/w slate pebble 5 chert, FCR
1.90-2.05	19 Wf (13.5) 2 Sf (6.9) 1 Blk (3.7)	5 (521.5)	25 (1400.5)	4 (97.3)	1 shale fragment 1 flake scraper
2.05-2.15	2 Sf (4.1)	1 (81.2)	4 (534.1)		charcoal

* Teeth and bone fragments appear
to be deer (total weight 4.7)

Wf= Waste flake
Sf= Secondary flake
Pf= Primary flake
Blk= Blocky chert

Weight is given in grams

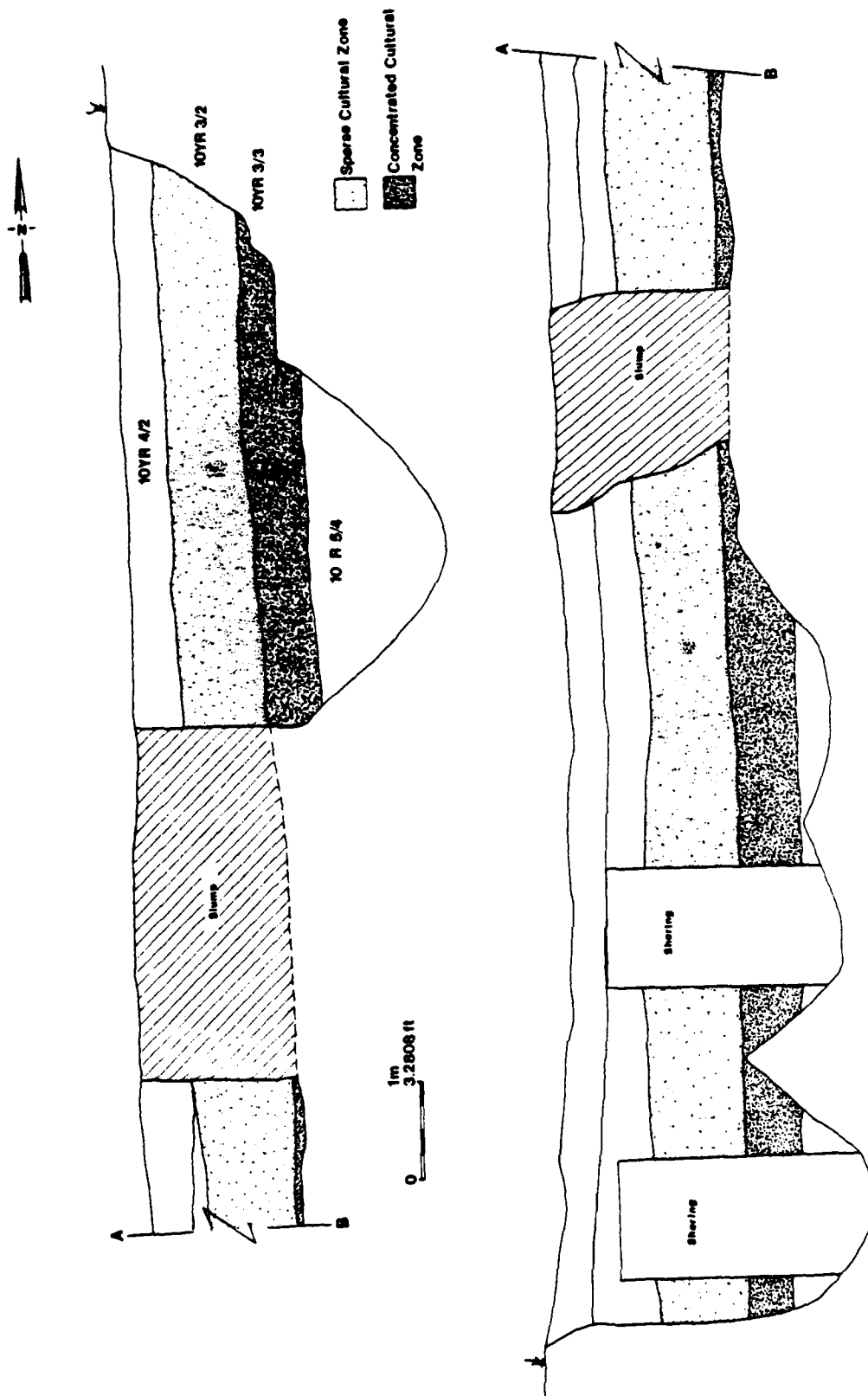


Figure 5.5 Trench 2 East Profiles

distinct natural strata were observed. Prehistoric cultural materials were absent in Trench 3. If prehistoric cultural remains are present in the vicinity they are buried beneath the maximum depth of Trench 3. The profile map of Trench 3 is illustrated on Figure 5.4B. The depth and steep access to Trench 3 necessitated the use of the backhoe bucket to lower the mapper into the trench to examine the profile. The alluvial silts of the swale were slightly darker and moister than those encountered in Trenches 1 and 2.

Soils were similar in texture and the sand content increased slightly with increasing depth in all trenches. All three trenches were backfilled after completion. Major wall slumping occurred in Trenches 1 and 2. Ground water was seeping into Trench 3 but backfilling was finished before slumping occurred.

5.2.4 Comparisons With Previous Trenching

Results of the test trenching indicated that the Cole site is an extremely complex prehistoric locus. Comparisons and attempts to interpret continuities were complicated by the distance between trenches, and the diffuse and discontinuous nature of the cultural deposits. The 1980 trenching results generally correspond with the trenches excavated in 1977.

The test excavations conducted by Indiana University identified buried cultural deposits throughout the entire federal property tract. In the southeastern portion of the property, five cultural occupations were identified. The 1977 trenches did not extend into the proposed area of impact. Locations of the 1977 trenches are shown on Figure 2.1. Trench 10 was closest to the impact zone. Trench 10 and an extension called Area 1 exposed four occupation zones. The youngest occupation was divided into Zone 1A and Zone 1B. Pottery from Zone 1A indicated a Middle Woodland cultural affiliation for this level. Large amounts of secondary and decortication flakes in the ceramic bearing deposits indicated a lithic workshop function for this occupation. Cultural and temporal identification was not possible for the lower Zones IB, II, and III, due to the lack of diagnostic artifacts. Large amounts of lithic debris from Zone 1B and Zone II imply a lithic workshop function for these levels. The 1977 report concluded that "given the distance between the test trenches, cultural zones existing at roughly the same depth below surface cannot be associated with any degree of certainty" (Guendling, et al 1977).

5.2.4.1 Correlation Between the 1977 and 1980 Testing

Identifying associations between the 1980 and 1977 trenches is complicated by several factors. The horizontally discontinuous nature of buried occupation zones makes it difficult to follow zones between trenches. The lack of natural stratigraphy and the vertically dispersed cultural deposits further hamper positive correlations. The best means of identifying corresponding deposits in different trenches is by the association of diagnostic artifact types. The paucity of diagnostics from the 1977 and 1980 trenching limits the applicability of this technique.

Trench 1 of our investigations encountered a zone of sparse cultural materials from 3.7-7.6 ft BS, which is believed to correspond with Zone I of the 1977 Trench 10 and Area 1. Pottery recovered at 4 ft BS in our Trench 1 is comparable to types recovered 1.5 ft-3.0 ft BS in Area 1. The cultural zone in our Trench 1 did not exhibit two distinct living floors as identified in Zone 1 of Trench 10 and Area 1 of the 1977 testing. Samples from the feature encountered in Trench 10 (4.7 ft BS) have been submitted for C-14 dating.

Both Trench 10 of the 1977 testing and our Trench 1 exhibit a sterile zone beneath cultural materials. In Trench 10, a second cultural zone occurs from 6.6-10.8 ft BS. In our Trench 1, a second zone occurs from 7.9-9.7 ft BS. No diagnostic artifacts were recovered to associate this zone in the trenches. Our Trench 1 exposed a feature at 8.7 ft BS, and carbon samples have been submitted for analysis to date this zone.

Our Trench 2 was about 40 ft east of Trench 1 and contained cultural materials at depths comparable to the first zone in Trench 1. Cultural materials occurred from 3.7 to 6.9 ft BS. Materials were relatively profuse in the southern end of Trench 2 at a depth of 5.2 to 6.6 ft BS. Material at this depth was concentrated and much denser than any zone in Trench 1. Trench 2 was sterile below 7.0 ft BS.

Our Trench 3 was devoid of cultural remains and does not correlate with trenches outside the swale.

5.2.4.2 Summary

A diffuse and varied zone of cultural materials appears to occur in Trench 10, and our Trenches 1 and 2 at a depth averaging about 3.0-7.0 ft BS. In addition to comparable depths in these trenches, the zone shares general similarities in material inclusions. Pottery sherds appear to confirm the association of the top of this zone in Trenches 1 and 10. Trench 1 and Trench 10 contain a second cultural zone, which apparently does not extend as far east as Trench 2.

Dates from carbon samples taken in Trench 10 at 4.7 ft BS and in Trench 1 at 8.7 ft BS will aid in interpreting the chronological relationship of the zones. The pottery indicates a date of ca 1000 B.C.-A.D.400 for the top of the first zone. Chert debris in Feature 1 in our Trench 1 may suggest a Late Archaic (3000-1000B.C.) affiliation. This would bracket the time span of the deposits exposed by the trenches from about 3000B.C.-A.D.400. This suggests that about 8 ft of alluvial deposits accumulated during a 3400 year period. During this speculative time span, it may safely be assumed that this location would have been occupied on numerous occasions.

The sparse, yet continuous occurrence of archaeological remains throughout several feet of deposits in Trenches 1 and 2 does not clearly imply any temporally concise major cultural occupations in the tested locations. The vertically dispersed nature of the cultural materials would seem to imply many repeated brief seasonal occupations represented by limited remains. The relatively dense occurrence of cultural materials in the 5.2-6.6 ft deep level of the southern end of Trench 2 implies an increased intensity of the

utilization of this area at the time these deposits were buried. Generally speaking, this portion of Site 12Cr1 does not demonstrate distinct stratigraphic zones of natural or cultural deposits. However, the undisturbed deep soil profile does preserve vertical relationships of cultural materials embedded in the alluvial matrix.

Despite the tentative nature of these correlations between the trenches discussed, the trenching has indicated the presence of buried cultural materials in the access road impact zone. Additional interpretation of the extent of "distinct" occupations will be presented at the end of the following chapter which describes the major excavation effort of the data recovery.

CHAPTER 6. THE DATA RECOVERY

6.1 THE BLOCK EXCAVATION

The second stage of the investigations at Site 12Cr1 was the controlled excavation of a large "excavation block." The block excavation measured 30x24 ft at ground surface and extended to a depth of 14.12 ft (4.3 m) into the floodplain alluvium. The block excavation was conducted primarily by hand excavation techniques with the mechanical assistance of a backhoe in culturally sterile deposits. The block excavation was stepped inward in a series of ledges as a precaution against caving. The completed excavation resembled an inverted pyramid.

6.1.1 Block Excavation Placement

Placement of the block excavation was determined by several factors. The contract Scope of Services stipulated the unit was to be situated in the southeastern corner of the recreation area in the vicinity of the bank and slopes to be graded preparatory to boat ramp construction. The irregular configuration of the river banks at the confluence of the Ohio and the Blue Rivers, and the danger of unstable sheer portions of the banks restricted free placement of the block. Avoidance of previous and concurrent deep trenches was also considered.

In order to locate the block and control provenience during excavation, a datum was established and staked 25.5 ft (7.8m) from Control Point Alpha on a line 78 degrees east of north. The excavation datum was staked one foot west of the southwest corner of the block excavation. The general location of the block excavation is shown on Figure 5.1. Figure 6.1 is a scale diagram showing the exact location-engineering involved in plotting the block in relation to datums and control points. The block was staked out with the short axis oriented north and the southern edge subparallel to the Blue River and abutted to the top of the bank. The block was placed between our Trench #1 and Trench #10 of the 1977 test excavations (Guendling 1977). Each of these trenches revealed cultural materials and aboriginal features.

6.1.2 Excavation Grid System

A grid system was designed to control the excavation to insure a systematic, consistent data recovery throughout the block. The Scope of Services stipulated the block excavation was to be 30x24 ft. Therefore, the English system was used for all horizontal measurements. However, vertical measurements were taken in the metric system because of equipment limitations. Measurements are presented as English conversions with exact metric depths in parenthesis. The grid system was designed to section the block into equal units measuring 4 ft on each side. The grid is best explained by diagrammatic illustration (Figure 6.2).

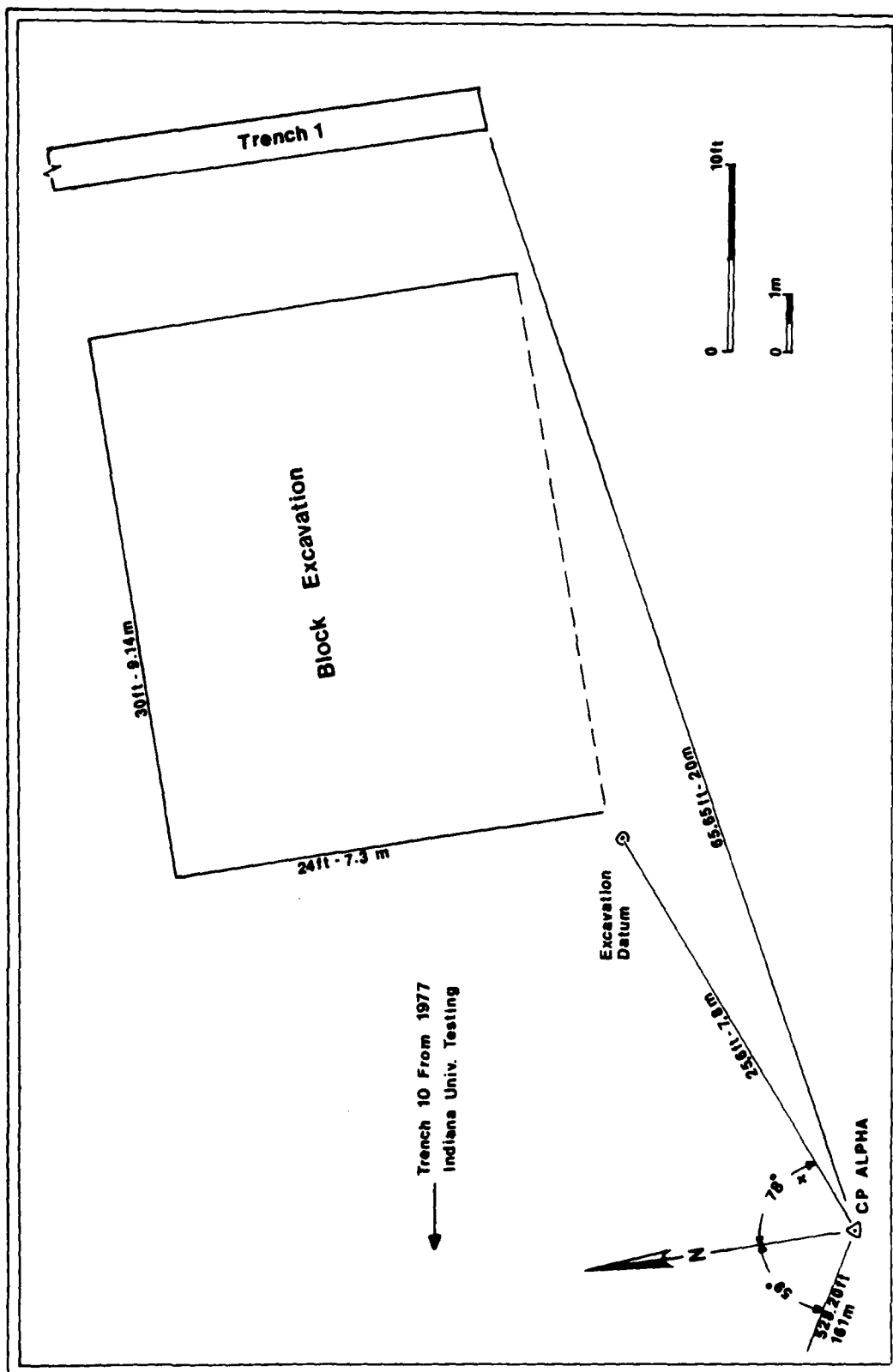


Figure 6.1 Block Excavation Location-Engineering.

The long axis of the block excavation area did not divide into an even number of 4 ft squares. This consideration, combined with the desire to maximize the size of the block at bottom level, determined the grid system.

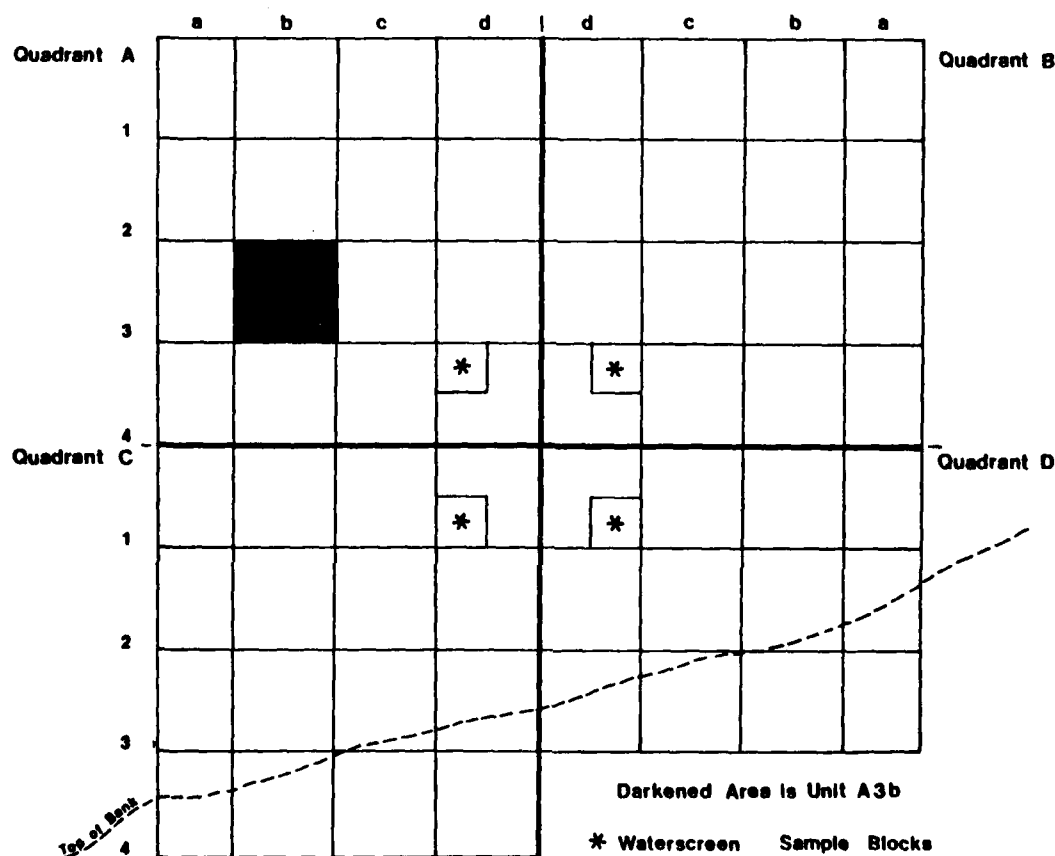


Figure 6.2 Diagram of Block Excavation Grid System

The grid system consisted of three basic components. A north-south and an east-west axis divided the block into quadrants designated A, B, C, D as shown. The block was then divided into north-south rows designated by lower case letters a, b, c, d, from west to east, then reversing east of the axis to d, c, b, a. A second series of rows running east-west divided the block into squares. These rows were designated numerically, 1, 2, 3, 4, from north to south with the sequence repeating at the east-west axis. Individual grid unit squares were designated by quadrant, east-west row number, and north-south row letter. The darkened square in the figure is Unit A3b.

The east-west grid axis deliberately was not centered in the 30x24 ft block to allow the bottom level of the excavation to be increased in size from four to six units. This shift moved the block midpoint 4 ft to the south and eliminated the need for a ledge at the third level on the south side of the block. This allowed the addition of two 4x4 ft units to the bottom level.

The a rows were left at 3x4 ft units. This apparent inconsistency of unit size was eliminated when the backhoe removed the sterile overburden deposits. After the initial backhoe excavation the entire block was leveled and stepped-in, constricting the next level to a 24x24 ft area. All of the irregular units were thus left in a tier 3 ft wide on the east and west edges and 4 ft wide along the north edge of the block.

At the bottom of the sterile overburden the block floor was cleaned and leveled and flagged spikes were placed at all unit corner points. Each grid unit was 4x4 ft to allow horizontal control on materials recovered from the excavation.

6.1.3 Vertical Control

Excavation units were removed in 3.9 inch (10 cm) arbitrary levels. Each level was controlled by sighting through a level transit scope to a stadia rod placed on the unit/level floor at any given depth. Unit/levels were determined within millimeters by subtracting the depth of the desired level and sighting the appropriate reading on the stadia. Instrument heights were correlated daily to the surface elevation at the excavation datum. Instrument sightings were made from CP Alpha.

All vertical measurements were below an imaginary horizontal plane intersecting the ground surface at the excavation datum. A total of 559 unit/levels were hand excavated during the data recovery. An additional 525 unit/levels were removed by machine in non-cultural deposits, not including the sterile overburden above the first cultural zone.

6.2 EXCAVATION METHODOLOGY

6.2.1 Sterile Overburden Removal

The upper portion of the deposits at the Cole site were known to be sterile of prehistoric materials based on trenching data. During the test excavation phase Trench #10 encountered prehistoric remains at a depth of 2.2 ft below surface (Guendling et al. 1977). In Trench #1 of our investigations prehistoric materials were first observed at a depth of 3.7 ft BS. The block excavation was located between these trenches.

A backhoe was used to remove the sterile deposits to reach the level of the cultural zone. Culturally sterile alluvium removed by the backhoe was disposed in spoil areas east and west of the block. Spoil piles were sufficiently distant to insure no additional stress on the block excavation

walls. Earth removed by the backhoe was carefully examined to detect possible prehistoric materials. Prehistoric material was first observed in the extreme southwest corner of the block at a depth of 2.9 ft (90cm) below the excavation datum. Backhoe excavation was terminated when the material was encountered. The block excavation floor was shovel scraped and cleaned at 2.9 ft (90cm) BD. Transit sightings were used to accurately level the entire 30x24 ft surface. Cultural materials were exposed only in Quadrant C. The northern and eastern halves of the block were sterile of materials at this depth.

6.2.2 Surface Slope

All vertical measurements were below a horizontal plane intersecting the ground surface at the excavation datum in the southwest corner of the block. The excavation datum was the highest point on the surface surrounding the block. The ground surface slopes gently downward to the north and east from the datum. The surface at the northwest corner was 3.5 inches (9cm) below datum and the northeast corner was 18.5 inches (47cm) below datum.

This surface slope accounts for the initial discovery of prehistoric materials in Quadrant C, the deepest area relative to ground surface. It was hypothesized that the prehistoric ground surface would roughly correspond to the conformation of the present surface. Further evidence of the cultural zone was thus expected to occur across the block at comparable depths below surface. This was confirmed as excavation proceeded by hand.

6.2.3 Unit/Level Excavations

Deposits containing cultural materials were removed using hand excavation techniques. Each excavation unit was 4x4 ft. Each unit/level was 3.9 inches (10cm) thick. The compact silty deposits were removed by shovel or trowel and carried by bucket or wheelbarrow to screens at designated spoil areas. All deposits in cultural zones were passed through 1/2 inch mesh hardware cloth screens to recover artifactual material.

Recovered materials were recorded and bagged by unit/level. Fieldnotes, unit/level records, bag tags and bags log entries were maintained for each hand excavated level. Level removal involved an excavator and a screen station assigned to each unit. Since the alluvium could generally be removed quicker than it could be screened, bucket retrieval and delivery was the responsibility of the excavator. As the block deepened and there was less room for several units to be simultaneously excavated, "bucket running" was specialized and the task was alternated among workers.

6.2.3.1 The Tier System

As the excavation of unit/levels proceeded downward, the size of the block was reduced on the three landward sides, in a series of constricting tiers. The unstable nature of deep vertical profiles in the alluvial silts necessitated the tier system to insure the safety of the workers. Tiers were stepped inward at a ratio of 1:1 (vertical to horizontal) resulting in

an overall 45 degree slope. No vertical profiles exceeded 4 ft in height. The completed block excavation had four different depth levels. Only six of the 36 excavated units extended from the surface to the deepest excavation floor.

The series of tiers was completely effective in stabilizing the vertical profiles and preventing cave-ins. No slumping, major or minor, occurred during the excavation. Tiers were quite solid when the deposits were dried and hardened by the sun and exposure. Even after frequent rains, tier ledges supported loaded wheelbarrows and ramps for removing earth from the block to the screen stations. Figure 6.3F illustrates a cross-section of the tier system at the block completion.

With the continued deepening of the block another safety precaution was necessary. A semi-circular fence, from banktop to banktop, was set around the excavation. The fence was erected to discourage accidental stumbling into the hole by unknowing victims. Although the large backdirt piles made the hole obvious, the fence was still an asset in restraining grazing cattle which occasionally strayed onto the project tract.

6.2.3.2 Unit Excavation Sequence (Figures 6.4 and 6.5)

After machine removal of sterile overburden, grid unit excavations were initiated. Figure 6.3 shows the sequence of excavation. Photos on Figure 6.4 and 6.5 show how the block appeared at various stages during the excavation. Unit/level removal began with the units above the second ledge. The units in the b rows and the number 2 row in quadrants A and B were excavated to the top of the second tier (6.9ft). The resulting U-shaped trench left the central portion of the block (Figure 6.3B) and exposed a long section of the profile on an interior and exterior face of the block. Chert debris and rough rock were recovered from most of the unit/levels in the U-shaped trench. Materials were encountered relatively deeper on the east side of the block. Deposits became culturally sterile at approximately 5.85 ft (180cm) BD in the west b row.

The central portion of the block was excavated by removing a 3.9 inch (10cm) level from each unit across the entire area. The entire central block was leveled before any individual unit was lowered another level. Flotation and waterscreen samples were taken from the four units adjacent to the grid axis intersection. Unit/level excavations were terminated when sterile deposits were encountered. The slope of the cultural deposits was reflected in the stepped slope formed by the unit/level floors (Figure 6.3C). Depths of the central block floors ranged from 5.85 ft (180cm) BD to 7.15 ft. (230cm) BD, west to east. These floors were at the top of the sterile deposits.

Exploratory core augerings were conducted along the west and north edge of the second tier to examine a sample of the deposits below. Results of the augering indicated that the sterile zone was approximately 40 inches (1m) thick. Burned soils and sandstone indicated a possible second cultural zone beginning at 8.7 ft (270cm) BD in unit C3c. Augering indicated the second cultural zone sloped downward to the north and east. The backhoe was used to remove sterile deposits between cultural zones. This stage in the excavation sequence is shown in Figure 6.3D. After backhoe excavation units

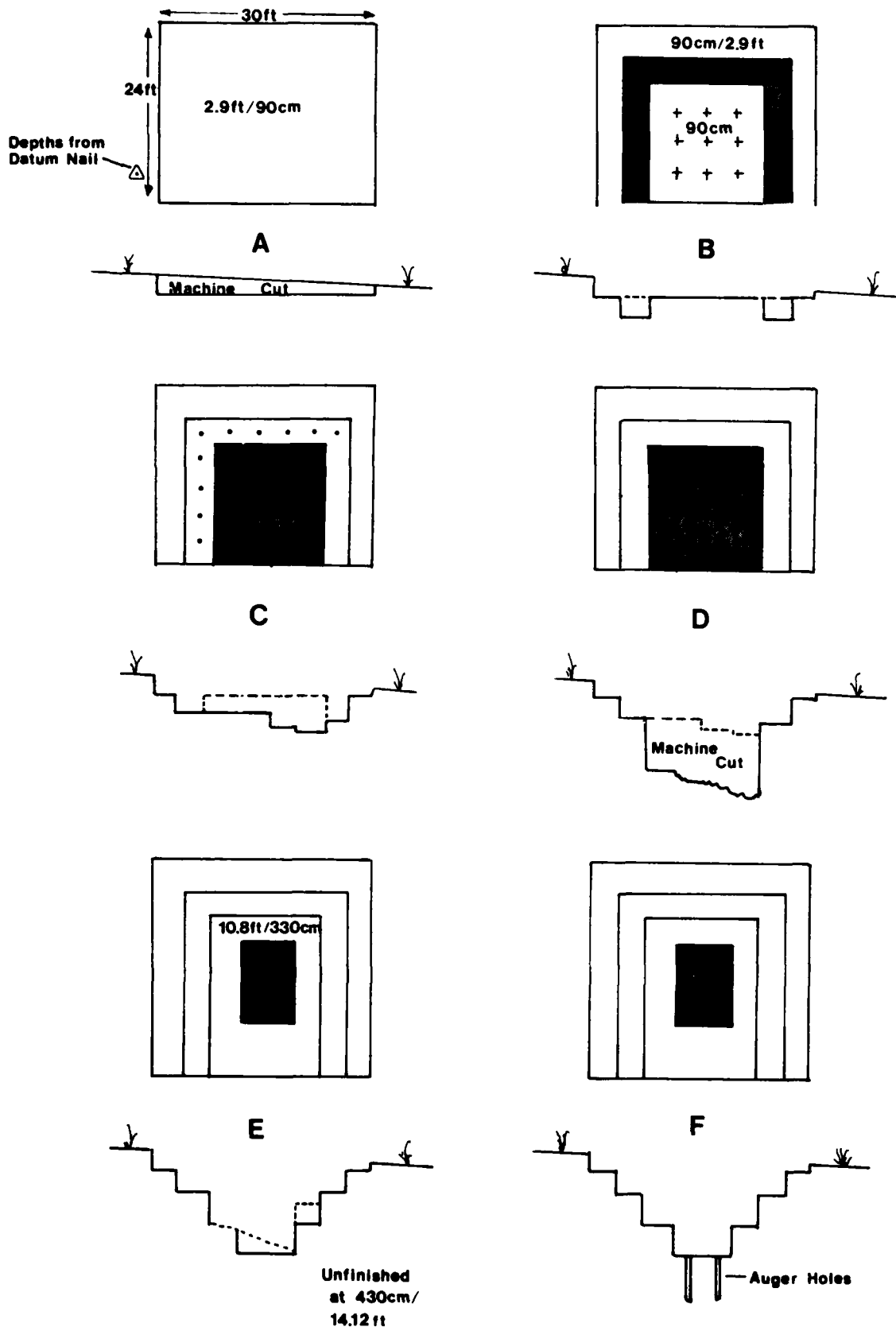
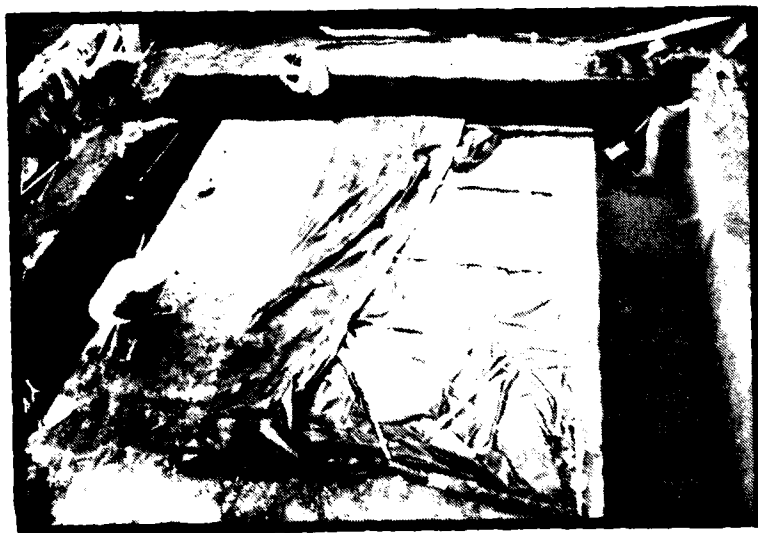


Figure 6.3 Sequence of Excavation.

A. Initiation of Unit/
Level Excavations



B. Excavation of Units
Above the level of the
Edge. This corresponds
to Fig. 6.30

C. Excavation of the
Central Block Units.
This corresponds to
Fig. 6.30

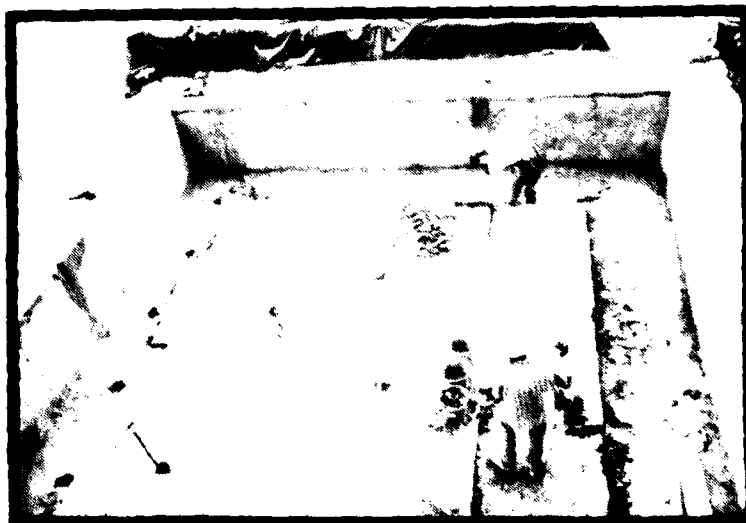


Figure 6.4 Block Excavation Sequence



A. Machine Removal of Sterile Soils Between Zone 1 and Zone 2.
This Corresponds to Fig. 6.3D.



B. Bottom of the Block Excavation Nearing Completion.
This Corresponds to Fig. 6.3E.

Figure 6.5 Block Excavation Sequence.

were reestablished and cleaned and leveled by hand. Units floors were just above the second cultural zone, and sloped in four steps from 8.7 ft (270cm) BD on the west to 10.8 ft (330cm) BD on the east.

Hand excavation of the unit/levels resumed in the second cultural zone. This zone was a thin lense of carbon and rough stone and contained scant material compared to the first cultural zone. The second cultural zone was approximately two excavation levels thick. Sterile deposits occurred at the base of the second cultural zone and augering indicated that no further cultural materials occurred for at least 40 inches (1m). When unit/level excavations were through the second cultural zone, deposits were no longer screened. Deposits at this depth were generally more compact and sandy than deposits closer to the ground surface. Due to the depth of the hole at this point use of the backhoe was no longer feasible. Therefore, hand excavation was continued in the sterile deposits. Deposits were removed by unit but the thickness of the levels was doubled to 7.8 inches (20cm). The third tier was established at 10.8 ft (330cm) BD and the excavation was constricted to a six unit block. These six units were extended to a total depth of 14.12 ft (430cm) when the excavation was terminated. Figure 6.3E illustrates the appearance of the unit at completion.

The final stage of the investigations consisted of three additional augerings through the bottom of the completed block excavation. Auger cores were extended to a total depth of 19.68 ft (ca. 6m) BD. No additional cultural deposits were observed in the auger cores (Figure 6.3F).

6.2.4 Special Samples

During the excavation of the central block (Figure 6.3C) special samples were taken for flotation and waterscreening. No feature fill samples were taken because no features were encountered. No carbon samples were of sufficient quantity to allow radiometric dating.

Samples for waterscreening were obtained from the outer corners of the four units adjacent to the axis intersection (Figure 6.2). One fourth (2 ft x 2 ft x 3.9 inches) of units A4d, B4d, C1d and D1d was sampled from each unit/level in the cultural zones. Samples were hosed through a series of graduated screens using a high pressure pump. Materials not passing through the 1/16 inch mesh of the final screen stage were retained for analysis. The purpose of waterscreen samples was to recover fragile botanical and biological subsistence remains such as bone or carbonized plant remains. No identifiable carbonized materials were recovered from the waterscreening. Chert flakes, bits of sandstone and limestone and small unidentifiable bits of carbonized wood were recovered. Waterscreen material inventories are listed in Appendix D.

Samples were also taken for flotation water separation. A .2 cubic ft (6 liter) sample was taken from the central axis from each level in the cultural zones. Failure of the flotation to recover identifiable botanical or biological materials confirmed the negative waterscreening results. This result appeared to indicate an absence of such remains in the excavated sterile deposits.

Flotation and waterscreen samples were processed in the field. A field laboratory station was operated concurrent to the excavation. Washing, sorting, fine reduction processing and preliminary levels of analysis were conducted at the field lab. Excavation time lost during rains was used in the lab. Slow permeability of the deposits in the block excavation caused ponding during heavy rains resulting in rain down time. Surface water was removed by bailing and sponging. Although rain did not penetrate and soak the deposits, the surface became muddy and tracked badly when wet. Drying time was necessary before excavations could resume.

The lack of permeability of the deposits also hampered waterscreening and flotation. Samples did not readily break down when soaked. It was necessary to completely air dry all samples prior to processing. Drying was time consuming but allowed samples to dissolve more readily in water processing.

6.2.5 The Alluvial Deposits

The salient characteristic of the vertical profile was the overall homogeneity of the deposits. Differences in texture, structure, and color were difficult to visually discern. Problems of interpreting the deposits at the Cole Site have been previously stated:

Although some textural differences could be discerned in the walls, no natural stratigraphy was apparent and the textural changes did not correlate with cultural horizons. The textural changes generally took place over many feet of vertical deposits and tended to overlap the cultural horizons rather than segregate them (Guendling et al. 1977: 10).

The overall homogeneity of the alluvium is the result of the depositional processes which built up the deep deposits. The profile exposed during the excavation appears to be the product of overbank deposition from suspended sediment load. A river the size of the Ohio River has a large capacity for suspended load but its competence is limited to relatively small particles. Competence refers to the maximum particle size a stream flow can carry at a given velocity. An abrupt cut-off level in particle size occurs according to stream velocity and height above the stream bed. During overflow stages, water which crests over the river bank carries only small suspended particles. Materials in the medium to coarse particle size range are notably absent in the profile. Sediments observed in the block excavation profiles are primarily sandy silt and silty sand. Clays represent a minor portion of the deposits, comprising approximately 25% of the silt and clay mixtures. Each single depositional event, such as an overbank annual or bi-annual flood, results in a vertically homogenous bed of deposition with little stratification. A series of similar or identical depositional episodes results in a cumulative sequence of beds characterized by a limited range of textures. Stratification is obscure or absent and contacts between beds are difficult to discern. Illuviation and sediment mixing processes at the confluence of the Blue River and Ohio River further obscure the individual bed deposits as a result of local flood scouring and redeposition.

The gradational nature of the deposits made mapping and describing the vertical profile difficult. Although demarcations of depositional zones were not apparent in the block profiles, general changes occurred across several feet of vertical deposits. Texture and compaction varied slightly.

Observations noted an increase in sand content with increased depth. This trend appears to correspond with floodplain deposits elsewhere in the Ohio River Valley (Gray 1979:894; DiBlasi 1980:13; Richardson 1977:26). The increasing sand content with depth indicates a gradual decrease in the competence of overbank floodwaters as the height of the floodplain was built-up through time.

6.2.5.1 The Vertical Profile

Due to the stepped configuration of the tier system the vertical profile of the block excavation was assembled in a series of segments. The stylized profile column in Figure 6.6 was taken beneath the excavation datum. Texture and consistency of the deposits changed gradually and did not correspond to the cultural zones. A total of 902 square feet of vertical profiles were exposed and examined.

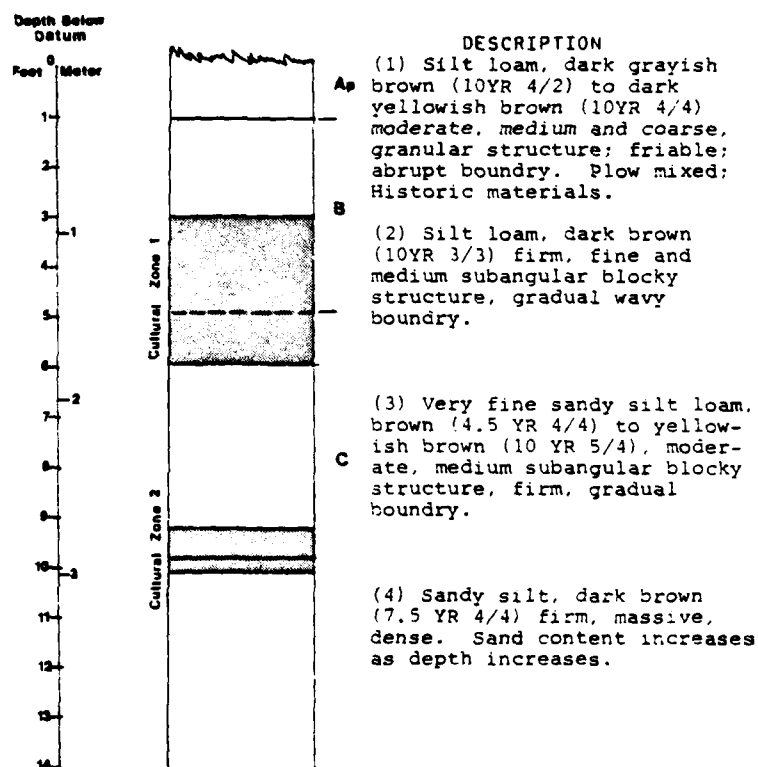


Figure 6.6 Stylized Vertical Profile

No buried soils, erosional scars, or other disconformities were observed in the deposits. Excepting the plow zone, no horizons in the deposits exhibited distinct contact boundaries. No distinct stratigraphy or depositional

episodes were identified. Variations in texture were minor, ranging from silt loam to sandy silt. Soil color was relatively homogenous and varied with moisture content. Horizons were poorly defined due to the immature soil development processes of the parent alluvial material. The bottom of the B horizon could not be distinguished from the parent material alluvial deposits.

6.3 THE DATA RECOVERY RESULTS

This section presents the results of the data recovery effort and evaluates the suitability of the data to address the research questions posed in the project proposal. Detailed analysis of the recovered materials will be presented in Chapter 7.

6.3.1 The General Nature of the Results

Results of the block excavation were relatively limited in terms of the diversity of types of archaeological remains which were recovered. Many categories of remains which were reasonably expected to occur were not encountered. No organic remains were recovered in sufficient quantity or quality of preservation to allow identification. Recovered materials were limited primarily to lithic remains. Chert debris, burned sandstone, and limestone constitute the vast majority of the artifacts from the block excavation. Diversity within the chert debris was also relatively limited, indicating specific types of activities at the examined locus. Identifiable chert tools consisted of fragmented bifaces aborted at various stages of manufacture, discarded projectile points, and utilized flakes. Pottery sherds and battered hardstones were also present in small quantities.

The results obtained from the block excavation do not appear to be representative of the Cole site as a whole. The small percentage of the site investigated by the block excavation does not adequately represent the potential of the site for significant data recovery. Bank profiles indicate profuse materials and concentrated cultural zones to the west of the block excavation outside the area proposed for boat ramp construction. Buried features are also commonly exposed by bank erosion. Features were discovered in the trenches immediately adjacent to the block to the east and west. The potential of the site is perhaps best evidenced by the multitude of artifacts collected from the beach by Mary Ann Cole. In view of these indications of abundant and diverse forms of prehistoric remains at the site, the results of the block excavation were initially disappointing. The absence of feature contexts was particularly unexpected. Although material recovery from excavation was not sparse, it does appear that the location of the block was peripheral to areas of most intense prehistoric activity buried at the Cole site.

6.3.2 The Cultural Zones

Excavation of the block penetrated two horizons in the alluvial deposits which contained cultural materials. These "zones" were defined only by the presence of cultural remains and did not correspond to specific depositional episodes in the alluvial matrix. Materials occur in the matrix of the

deposits and do not conform to a specific single buried surface. Deposits sterile of cultural materials occurred above and below each "cultural zone." Characteristics of the cultural material bearing zones were distinctly different and each is described below.

6.3.2.1 Cultural Zone I

Prehistoric cultural materials were first encountered at a depth of 2.9ft (90cm) below the excavation datum. Cultural materials occurred continuously to a depth of 5.85ft (180cm) BD. Cultural Zone I was slightly deeper on the east side of the block, beginning at about 3.7ft (120cm) BD and extending to 6.9ft (210cm) BD. The slope configuration of the cultural deposits roughly corresponded to the slope of the ground surface. Cultural Zone I was approximately 3ft (91cm) thick. The schema in Figure 6.7 depicts the excavation block, showing the cultural zones.

Cultural Zone I was defined by the occurrence of cultural materials within the otherwise undifferentiated matrix alluvium. Materials occurred in sparse amounts at the top of the zone and increased to a relatively concentrated central band and then tapered off toward the bottom of the zone. The greatest amounts of material occurred along a line 4.6ft (140cm) BD on the west to 5.6ft (170cm) BD on the east. Material density diffused away from this central concentration. The diffused nature of the materials did not clearly imply specific occupation layers within Zone I. Excepting relative density, materials varied little from bottom to top in Zone I.

Materials recovered from Zone I included 6318 chert flakes, 44 biface fragments, 10 cores, 228 retouched flakes, two denticulates, three spokeshaves, four graters, 78.9 kg. sandstone, 5.9 kg. limestone, three battered hardstones, one pitted stone, 20 pottery sherds, and a small amount of carbonized organic remains. Several small bits of burned bone were also recovered. No materials were recovered from feature contexts. No heavily concentrated material "clusters" were identified in the matrix, although densities did vary horizontally across the block. Figures 6.8, 6.9, and 6.10 illustrate the relative horizontal densities for chert, sandstone, and limestone.

Figure 6.11 shows the densities of flakes, cores, bifaces, and projectile points by level. Materials recovered at comparable depths below datum may not necessarily represent the same period of deposition. The slope of the deposits implies that associated materials will occur on a sloped surface-not on a horizontal plane. Figure 6.11 illustrates materials recovered from each arbitrary excavation level and does not mean that materials in the same level are culturally associated.

The occurrence of cultural remains throughout nearly 3ft (90cm) of vertical deposits suggests numerous occupations in Zone I. The few culturally diagnostic artifacts recovered also appear to indicate a substantial time span represented by Zone I. Cultural and chronological affiliations for this zone will be addressed in chapters 7 and 8.

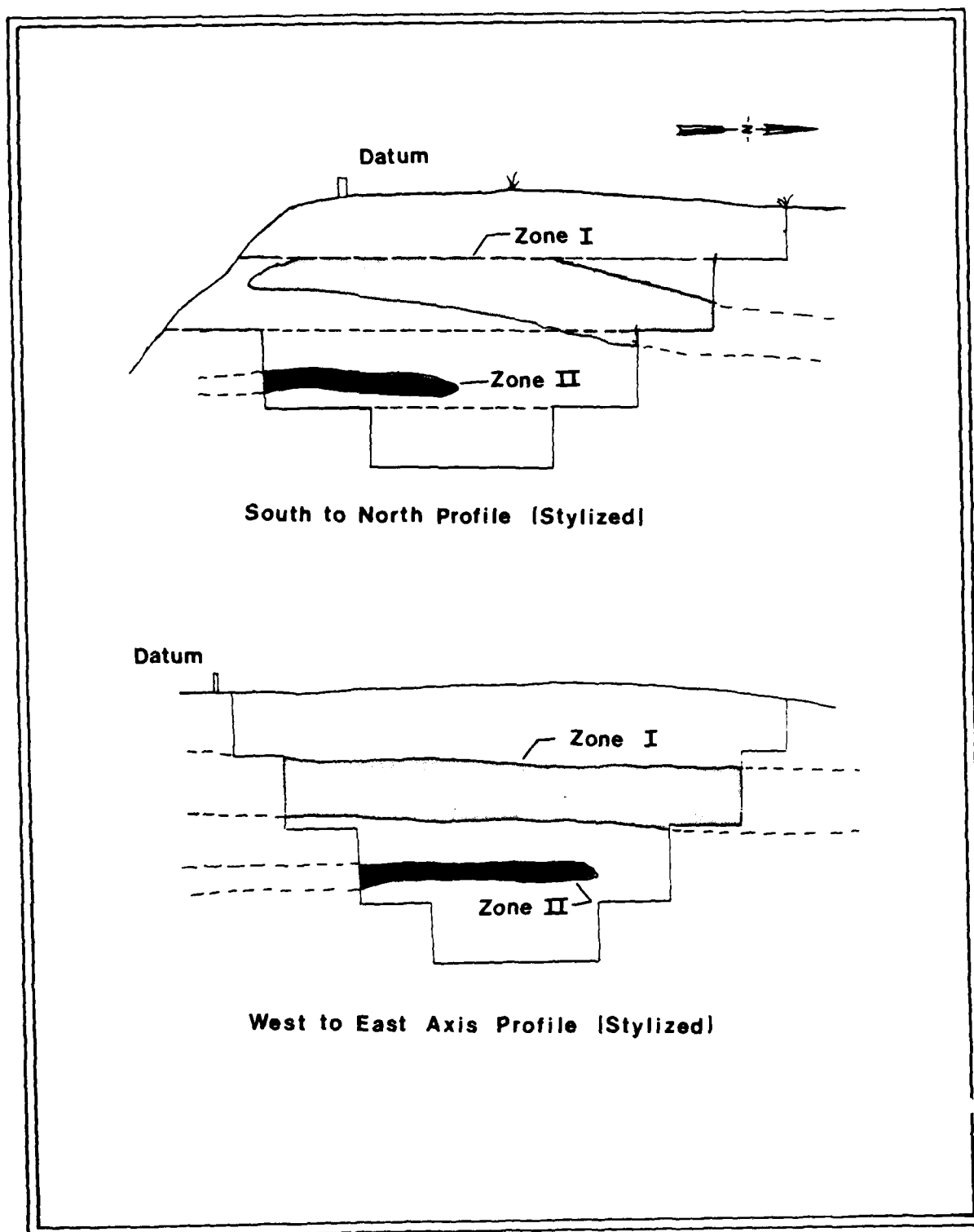


Figure 6.7 Sloped Configuration of the Cultural Zones.

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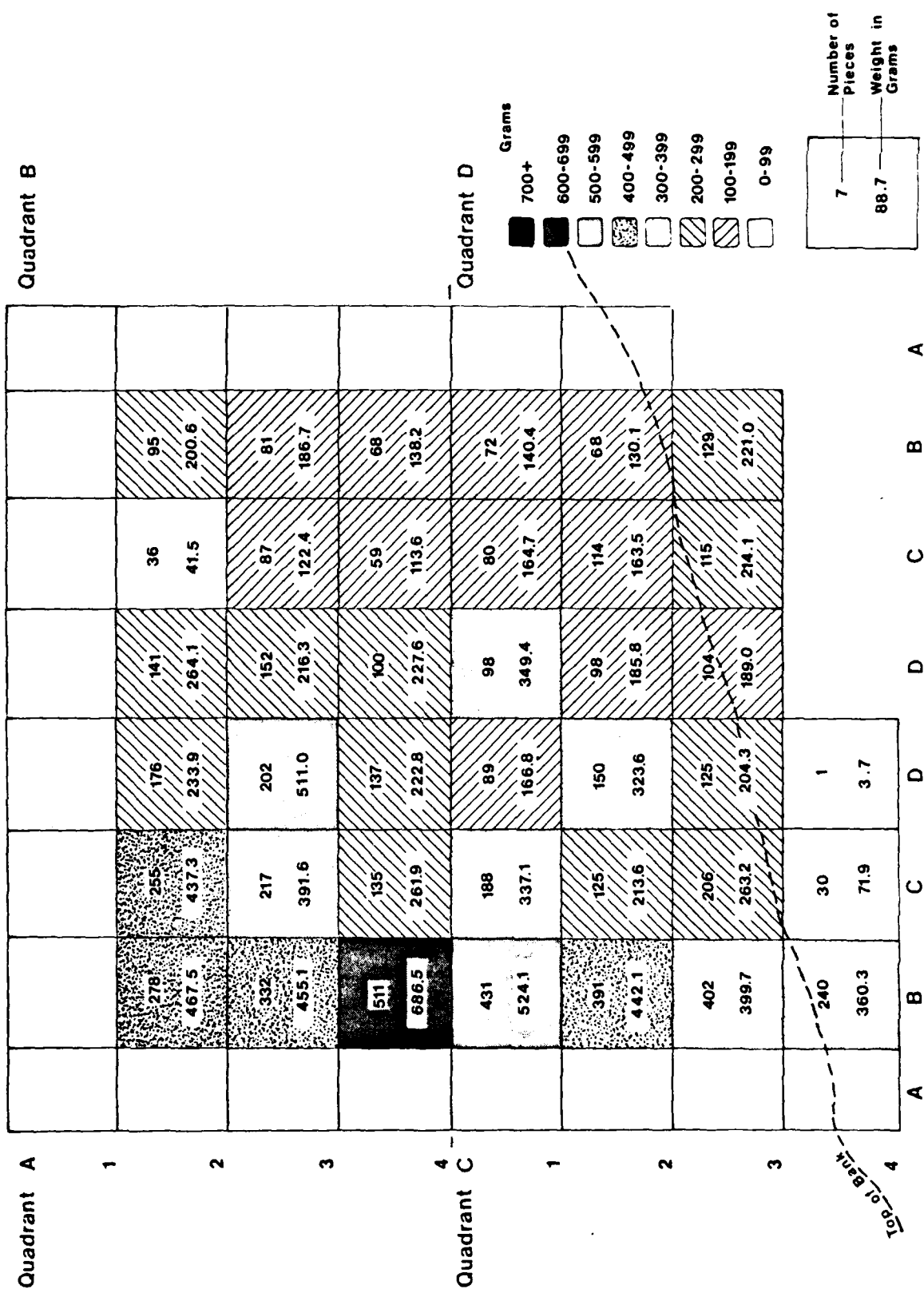


Figure 6.9 Sandstone Distribution in Zone I.

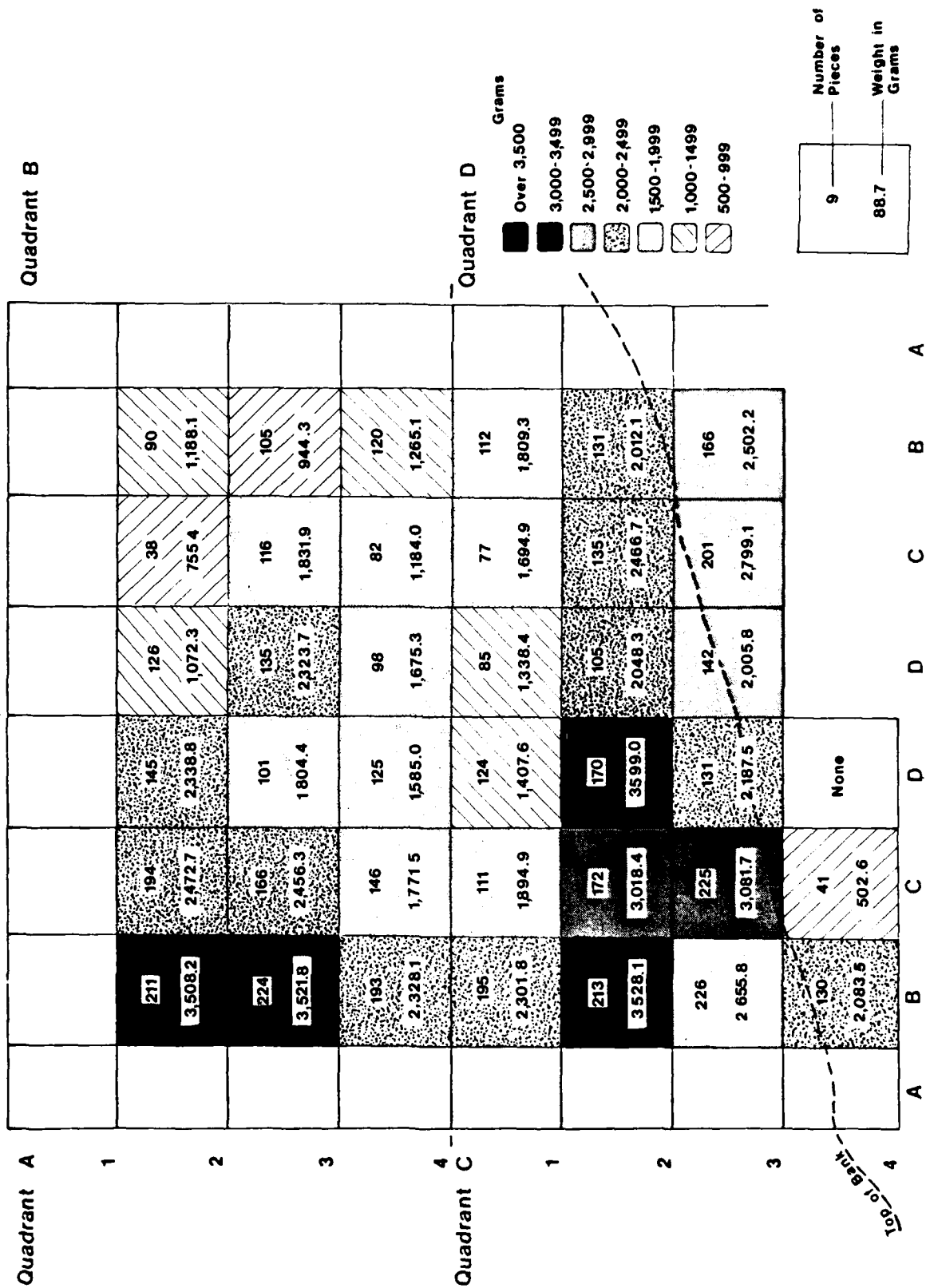
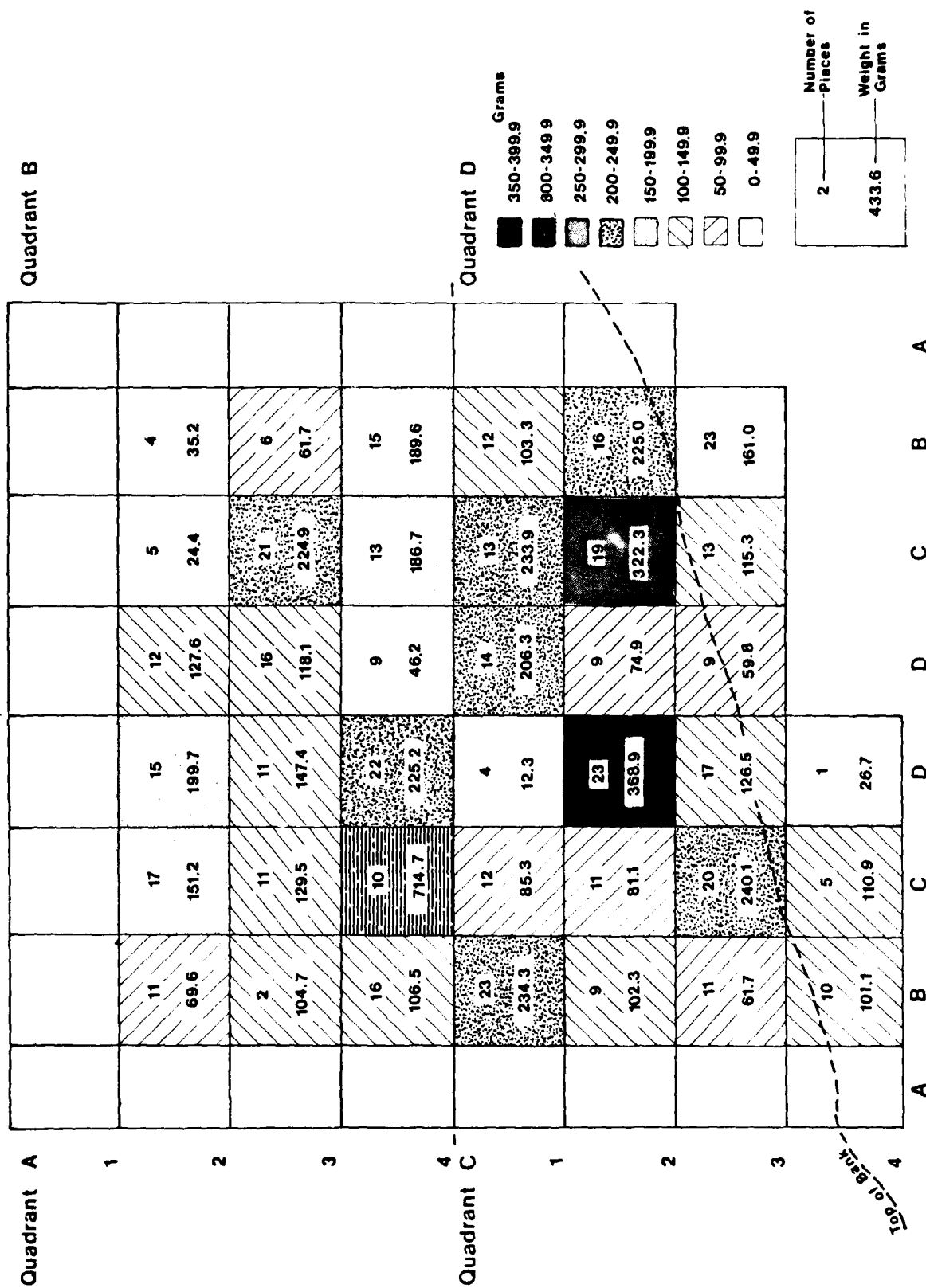


Figure 6.10 Silicified Limestone Distribution in Zone I.



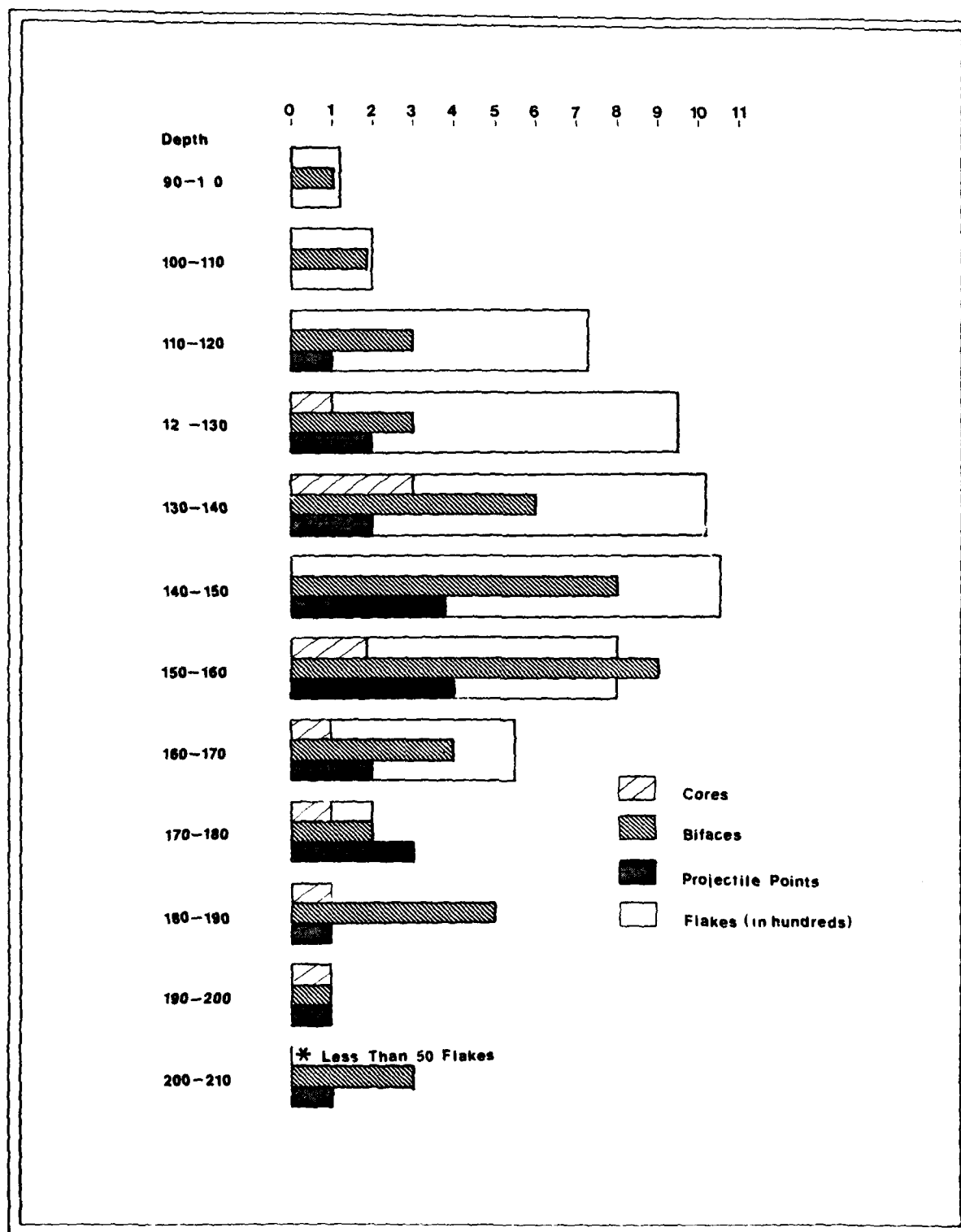


Figure 6.11 Artifact Density by Level.

6.3.2.2 Cultural Zone II

Beneath Zone I, sterile deposits extended for 40in (1m) before additional materials were encountered. Cultural Zone II occurred at 8.7ft (270cm) BD and was restricted in horizontal extent primarily to Quadrant C of the grid. Zone II was a thin lense of burned sandstone and scattered carbon flecks about 7.5in thick at the west edge of the block. The configuration and relative placement of Zone II is illustrated in Figure 6.7.

Cultural materials recovered from Zone II included only 8 flakes, 5 kg sandstone, 403 gms limestone, cannel coal, and scattered carbon flecks. Flotation recovered relatively more carbon from Zone II than Zone I but amounts were inadequate for radiometric dating in both zones. Figures 6.12, 6.13, and 6.14 illustrate the horizontal distribution of chert, sandstone, and limestone recovered in Zone II.

The paucity of materials from Zone II does not allow any substantial interpretations to be formulated. Little can be said of this level except that it clearly predates materials in Zone I and does not appear to represent intensive activity at this locus. This zone may possibly extend westward from the block, having only been exposed on its outer fringe.

6.3.2.3 Correlations with Bank Profiles

During the excavation process several vertical bank profiles were examined and mapped to allow comparisons with the block excavation results. Bank profiles mapped only the upper portions of the deposits due to slumps which obscured deeper observations. Figure 6.15 shows the stylized profile columns and their locations. The tops of the columns are aligned to their relative elevations. Profile locations were plotted using compass bearings and distances as sighted from CP Alpha. The series of bank profiles illustrates the density increase in buried cultural remains westward from the block excavation.

Cultural Zone I appears to correlate with the cultural zone in profile E and F (Figure 6.15). This cultural zone was also identified in Trench 10 of the testing phase (Guendling et al. 1977). Cultural Zone II may correlate with Zone II of Trench 10. Zone II is much more substantially represented in Trench 10 indicating that the intensity of the materials increases westward from the location of the block. The thinness and paucity of material in Zone II in the block supports the assumption that our investigations examined only the fringe of this cultural lens.

6.3.3 The Slope of Zone I

During hand excavation of Zone I it was noted that cultural materials occurred in a sloped configuration. In the 24x24 ft block Zone I sloped approximately 12.5in (ca 32cm) from west to east, corresponding roughly to the modern surface slope. However, Zone I dropped approximately 13.8in (ca 35cm) from south to north at a slope significantly greater than the modern surface slope of 3.5in (9cm) across the same distance.

Figure 6.12 Chert Distribution in Zone II.

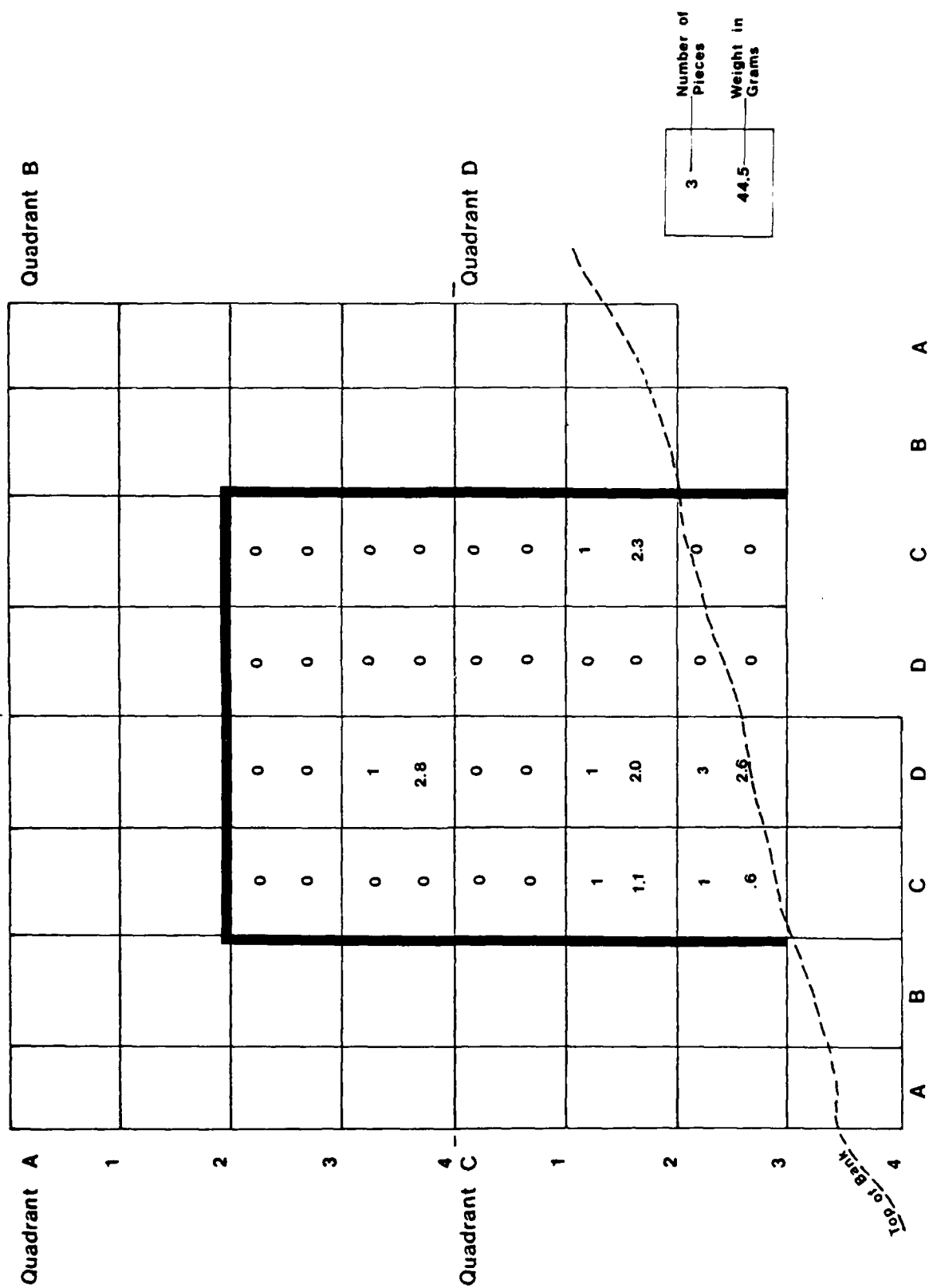
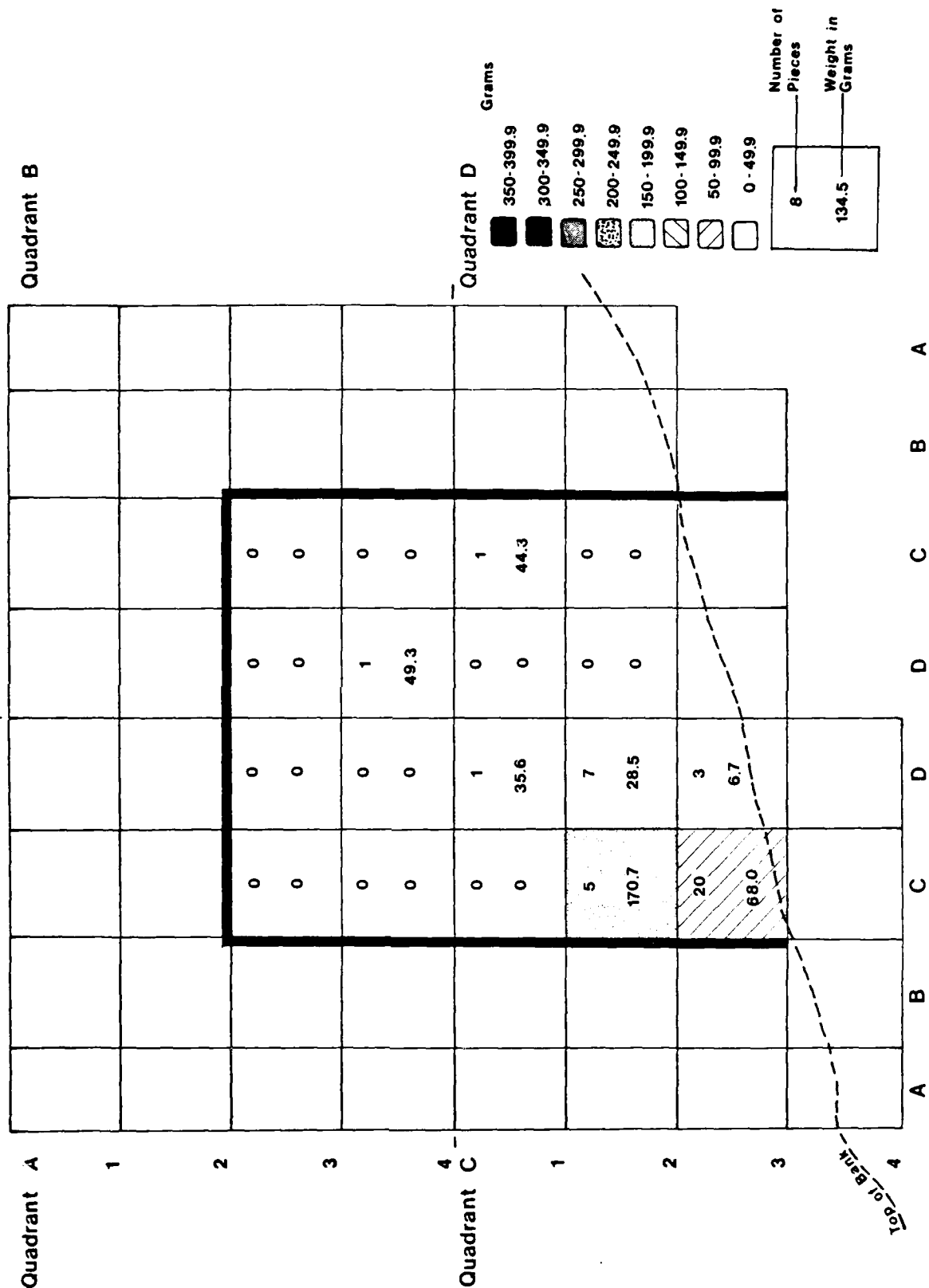


Figure 6.13 Sandstone Distribution in Zone II.



Figure 6.14 Limestone Distribution in Zone II.



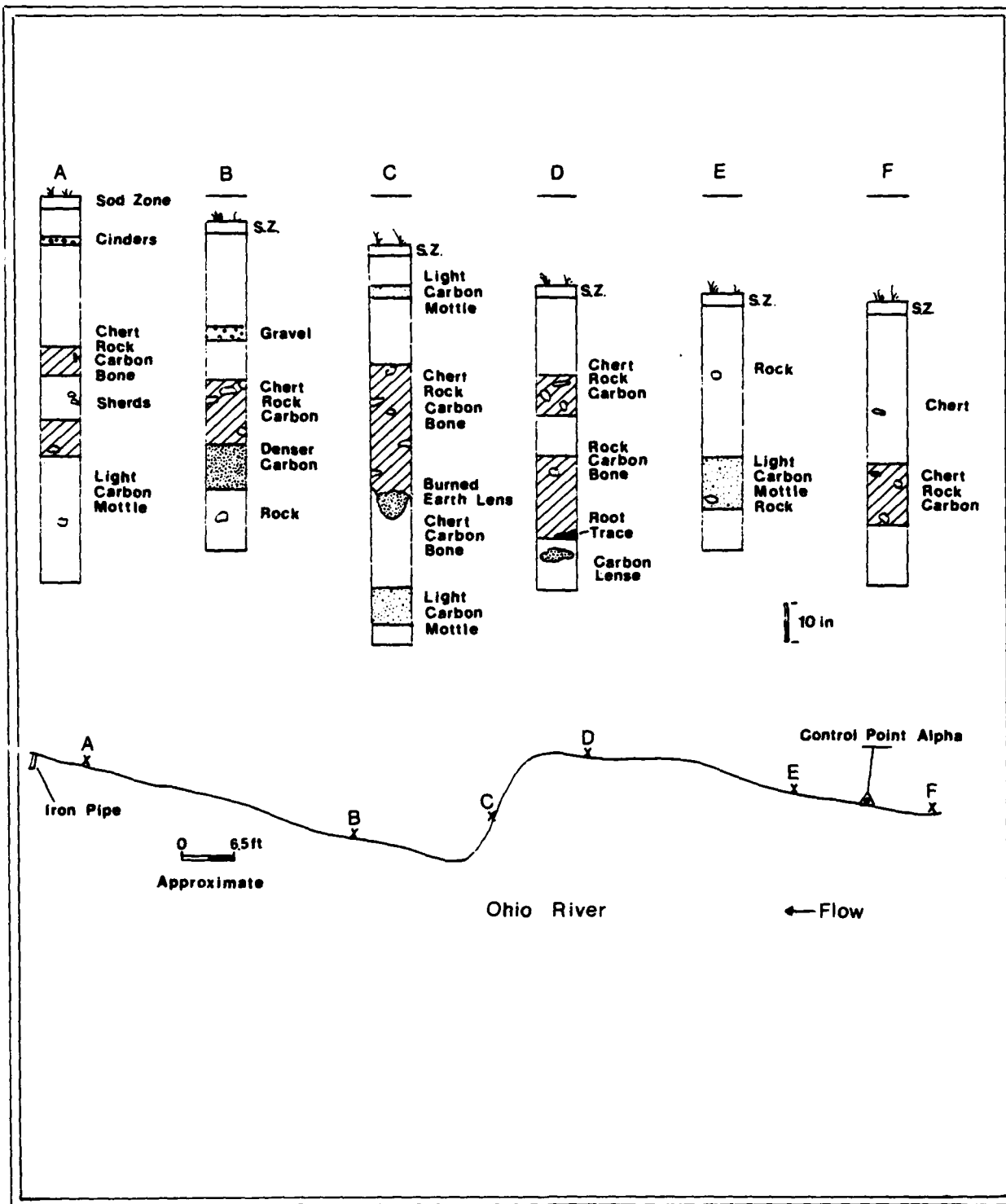


Figure 6.15 Vertical Bank Profiles West of the Block Excavation.

The zone sloped down north and east from the datum at the southwest corner of the block (see Figure 6.2, unit C2A). Although the slope is only approximately two and a half degrees in both directions, this drop is important when considering correlations between material remains within Zone I. Excavation unit/levels were removed on a horizontal plane and therefore obliquely cross-sectioned Zone I at a very acute angle. This meant that across one unit (4ft) of horizontal distance, materials deposited at the same time would be expected to occur about 2.2in (5.5cm) lower to the north or east. In other words, a slope factor of about .55in (1.4cm) vertical drop per foot horizontal, was used to correlate materials across the block depending on distance north and east of the datum.

Factors used to correct for slope were derived by averaging the slope in each of the six west to east grid rows and the six south to north grid rows. This average provided a correlation factor suitable for use within the 3.9in (10cm) thickness of the unit and was considered accurate within 10 centimeters. In order to obtain data to determine the depth of Zone I in each unit in each grid row, all of the flake debris counts were plotted on a series of 12 charts. Flake debris counts clearly indicate the slope configuration of the zone for south-north and west-east directions. Each chart is included in Appendix E to graphically depict the slopes. The charts also indicate the general observation made concerning decreasing density of cultural material from west to east across the block, implying that Zone I is "feathering out" or diminishing eastward. However, the charts show little change in material density from south to north. It may be hypothesized the location of the block examined the peripheral portion of a lithic processing area near its eastern margin.

The charts in Appendix E clearly show the central "core" or density concentration in the lower middle portion of Zone I. Not surprisingly, this portion of the zone also yielded the majority of the broken bifaces and projectile points, indicating an increase in lithic manufacturing occurring at this level. The charts also show Zone I dissipates or diffuses above this dense level. This is reflected in recovery of first a few flakes, then an increasing amount of flakes as each unit entered Zone I. Although the scattered pattern of a few dispersed flakes made it difficult to concretely define the top of the zone, the concentrated level clearly defines itself by gross quantity.

The importance of considering slope relates specifically to correlating materials associated in time. Material analysis (Chap 7.3) was conducted by unit/levels on a horizontal plane. Many of the tables in Chapter 7.3 are presented by unit/level and do not necessarily reflect the slope of the zone. When cultural affiliation or temporal associations are relevant, tables and charts are corrected or interpreted to account for the slope.

Cultural Zone II also demonstrated a sloped configuration similar to Zone I. However, the limited occurrence of this second zone, and the complete absence of diagnostic materials precludes the necessity to consider slope.

It may be hypothesized that the reason the zones are sloped relates to the possibility of a slopes aboriginal ground surface. It appears that materials in Zone I may have been discarded on the surface of a gentle

riverside knoll; the knoll being created by the depression paralleling the Ohio River on the northeast side of the occupation area. Considering this hypothesis and the variable depth of associated materials due to the slope of the buried zones, it is clear caution must be exercised in affiliating materials based on depth alone.

6.3.4 Results and the Research Objectives

Answers to various research questions hinge upon variables such as the amount of area opened and the quality and quantity of preservation. Since these variables are outside the control of the excavators, some research questions may remain unanswerable. Five questions were designed to structure the data recovery inquiry. They are evaluated below as they appeared in the project proposal. The results of the data recovery will be briefly examined to determine how they pertain to each question. Constraints and shortcomings will be identified. Answers and interpretations will follow in Chapter 7.

- 1.) How many vertically distinct occupation zones are located in the impact area? How old are they? What is their horizontal distribution within the impact area?

This set of questions deals with identifying occupation zones, determining their age and extent, and their relative chronological relationships. Excavation identified two "distinct" cultural zones. Segregation of individual occupations within these zones represents a problem. The diffused, yet continuous occurrence of materials throughout Zone I does not segregate distinct occupations. However, the thickness of the zone, the varying density of materials, and the limited presence of diagnostic artifacts suggests that Zone I represents a considerable time span, and numerous occupations. Dating the zones depends on three primary techniques; 1) relative positions, 2) culturally diagnostic artifact correlations, and 3) radiometric dating. The age of the occupations in the zones may be addressed to a limited extent based on relative positions of artifacts. Relative positions of materials in the alluvial matrix are reliable when sterile zones separate materials. Using positions of diagnostic artifacts to obtain relative dates relies on the assumption that comparable artifact types from different sites (or even different regions) are associated temporally. On this assumption, diagnostic artifacts are used to assign temporal affiliations by association with comparable artifacts from dated contexts. This technique is applicable to materials in Zone I. Two factors may inhibit the accuracy of this technique. Relative positions of materials in Zone I must consider the slope factor before artifacts can be correlated. Artifacts may also be disturbed from their original position. Bioturbation and cultural activities as well as geomorphological processes can affect deposits (see Chap 2.2.2.2). Associations must be viewed with caution. The paucity of culturally diagnostic artifacts is a constraint to concrete chronological interpretations. Pottery and finished projectile points allow a general age estimation for Zone I. Zone II is distinctly separated from Zone I and is relatively older. The total absence of diagnostic artifacts prohibits an associative age affiliation for Zone II. Failure of the excavation to identify and recover sufficient carbonized

remains for carbon dating precludes the use of radiometric dating for either cultural zone within the block. Carbonized remains in the matrix of the cultural zones might not reliably reflect the age of the zones due to possible contamination by "float" material introduced during depositional processes. No carbon was recovered from feature contexts in the block. Samples from features in our Trench 1 and Trench 10 of the test phase (Guendling et al. 1977) have been submitted for C14 dating. These samples will allow a "bracket" of dates for the cultural zones in the block.

The horizontal extent of the cultural zones can be speculated from the combined evaluation of the block excavation, the trenches, and the river bank profiles. However, the possible discontinuous nature of the cultural zones and the distance between the block and the trench profiles make extrapolations of horizontal distributions tentative.

- 2.) What were the subsistence strategies utilized by the inhabitants of the various occupation zones? How have they changed through time?

Data recovered from the excavation is not suited to research questions concerning subsistence. Remains of subsistence activities were not recovered. Organic remains were limited to sparse amounts of carbonized wood and a few bits of bone too small to identify. Artifacts from the block excavation reflect manufacturing activities only. One pitted stone may possibly indicate limited nut cracking. It appears that subsistence related activities did not occur at the investigated locus. Evidence pertaining to subsistence may be expected to occur at other locations on the site. No attempt can be made to interpret the subsistence strategies utilized by the Cole site inhabitants due to shortcomings of the data. Additional investigations could potentially yield subsistence data.

- 3.) What type of tool technology did the various inhabitants of the site possess? Has it change through time? Are these changes correlated with either change or stability in the subsistence strategy?

The bulk of the material recovered consisted of chert debitage in the form of flakes, cores, and broken bifaces and projectile points. Adequate amounts of lithic debris were recovered to address research questions pertaining to tool technologies. Manufacturing of stone tools is evidenced by abundant remains of manufacturing by-products. Finished products and tools exhibiting use-wear patterns are notably absent. Evidence of tool technology is limited to manufacturing related activities, and correlations between tool technologies and subsistence can not be made from the data. Specific manufacturing technologies and changes through time can be analyzed in the recovered materials. Changes in manufacturing technologies may correlate with specific cultural manifestations and socio-economic phenomena. Analysis will address manufacturing technologies considering raw material, reduction processes, material flaws and technical application problems, and intended final products. Zone II did not contain any stone tools, and chert debris was too limited to determine the nature of lithic technologies utilized at the time represented by this level. No further lithic analysis will thus be addressed for Zone II.

- 4.) What were the functions of the site during various periods in prehistory? Are houses, storage pits, processing areas, etc., present? Was the site occupied throughout the year or on a seasonal basis?

The restricted horizontal extent of the excavation does not allow extrapolations for the entire site to be made concerning function. The recovered data indicates function of the examined locus was restricted to stone tool manufacturing in Zone I. Negative evidence of other activities implies that subsistence and other domestic related activities did not occur at this location. Seasonal or circum-annual occupation cannot be determined from the recovered materials.

Materials in Zone II do not imply any specific function for this level. The sparse data from this zone is inadequate to address these questions.

- 5.) What was the character of the prehistoric environment at various periods in time and how did the occupants of 12CR1 interact with it? What data exist to augment more exact sources of paleoecological information, such as pollen cores?

No data were recovered which pertain to reconstruction of paleoenvironments. The information derived from the data recovery is not suitable to address the above questions. Environmental information may be present elsewhere on the site but must presently be extrapolated from data obtained from studies in other areas of the central Ohio Valley. Soil geomorphology indicates that the regime of the Ohio River has been relatively stable for at least several thousand years. No attempt will be made to answer the questions concerning environment in view of the inadequacy of the recovered data to address this subject.

Data from the recent investigations are suited only to research problems concerning tool technology and to a limited extent site function and chronology. Given the extremely small and (of necessity) biased sample, the analysis of materials from the southeastern portion of the site may not be typical of the site as a whole. The excavated portion of the site represents less than .25% of the estimated total site area of 285,000 sq ft (Guendling et al 1977:45). Less than one-quarter of one percent of such a large and diverse site should not be considered representative of the potential of the remainder of the site for additional data recovery. Analysis and interpretations in the following chapter pertain only to materials recovered in the block excavation. It is believed results of this data recovery are representative of the portion of the site which will be affected by the boat ramp construction impacts. The extent of the present data recovery investigation has adequately satisfied the memorandum of agreement and legislation protecting archaeological resources pursuant to Section 4 of Public Law 93-291.

CHAPTER 7. THE ANALYSIS

This chapter describes the results of analysis of the materials obtained during the data recovery program. Analysis has intended to outline and interpret the general nature of the materials and elucidate the function of the examined loci.

7.1 PROCEDURES

A field laboratory was established and operated concurrently with the excavation effort of the data recovery. The Indiana Department of Natural Resources provided one of the storage buildings on the developed portion of the Corps tract for use as a field laboratory. As artifactual material was brought out of the field, it was washed and sorted into gross categories. Flotation and waterscreening operations were run at the field laboratory. Bags and bag catalogues were recorded and checked on a regular basis, as materials arrived at the laboratory. Processed materials were sent to R.A.I.'s main laboratory facilities in Bloomington on a weekly basis.

All artifactual materials brought to the main laboratory were first cataloged in accordance with the system established at the Glenn A. Black Laboratory of Archaeology at Indiana University in order to allow for their ultimate curation at that institution. The materials were accessioned under number 3977. During cataloging, materials were sorted into finer categories for analysis. Catalog cards were filled out, with measurements, weights, and line drawings of tools being included. More specialized analysis was then made of a selected sample of the lithic materials, in an effort to better understand and interpret the lithic technology present in the main excavation unit at the Cole site.

Although the sample of lithic materials recovered from the excavation unit is relatively small, various aspects of the Early and Middle Woodland lithic technology were interpreted from them.

7.2 MATERIAL TYPOLOGIES

All of the cultural material classes recovered during our investigation are described in this section. Definitions are presented for each category of remains.

7.2.1 Flakes

Quantitatively, flakes represent the largest single category of "artifacts" recovered. Flakes generally represent the bulk of waste products resulting from a lithic reduction sequence. Flakes were divided into three categories based on the amount of cortex present on their dorsal surface. Divisions consisted of: Primary flakes exhibiting cortex on more than 50% of the dorsal surface; Secondary flakes with less than 50% dorsal surface cortex; and Waste flakes with no cortex. A total of 6318 unmodified or unretouched flakes were recovered between 90 and 210 cm BD. Levels between 120 and 150 cm BD had the densest relative concentration. There were 801 unmodified primary flakes, 1536 unmodified secondary flakes, and 3937 waste flakes. In a general sense, these three categories represent increased reduction or

refinement of raw chert with diminishing mass of cortex. Technological attributes of flakes are stressed in the analysis. When flakes are analyzed with regard to placement in a lithic reduction sequence, cortex becomes secondary in importance. More important factors will be former traces of bifacial or block edges, evidence of platform preparation for specialized flake detachments, and grinding facets superimposed onto flake scars from previous stages of reduction, among others.

7.2.1.1 Retouched Flakes

Retouched or utilized flakes are represented by three categories: Primary retouched, secondary retouched, and retouched waste flakes. Retouched flakes exhibit intentional modification of one or more edges. Modification of edges may also be the result of use (i.e. flake knives). Retouch was observed on a macroscopic level. Although general morphology differed, no segregation was attempted beyond the above three categories, excepting specialized categories of retouched flakes described below. There were 32 primary retouched flakes, 71 secondary retouched flakes, and 125 retouched waste flakes in the recovered materials. Most of the observed retouch represents preparation of edges for further flake removal.

Specialized Flake Tools

Spoke shaves (Figure 7.1 A and B) are notched flakes which exhibit relatively shallow retouched notches. There were 3 spoke shaves.

Denticulates (Figure 7.1 C and D) are flakes with multiple shallow retouched notches. Only 2 denticulate flakes were recovered.

Endscrapers are flakes with steep retouch along one narrow edge and were used as scraping tools. There were 2 endscrapers.

Sidescrapers (Figure 7.1 E). Only one sidescraper, made on a large, blocky, secondary flake was recovered. It exhibited a single, steeply flaked edge.

7.2.2 Cores (Figure 7.2 A and B)

Cores, as represented in the recovered assemblage, are amorphous fragments of Wyandotte chert from which flakes were removed. Flakes removed from cores were the product from which tools were produced. The recovered cores are generally of two forms: single platform (one striking platform) or amorphous (multiple, random striking platforms). Cores were separated from bifaces based on physical morphology. In this particular assemblage, the cores may actually be part of the lithic reduction sequence and were discarded before being bifacially flaked. Cores from flake manufacture and biface manufacture may share similar morphological characteristics at an early point in a lithic reduction sequence. Cores and core fragments were not separated in this analysis. A total of 10 cores and core fragments were recovered.

7.2.3 Bifaces (Figure 7.2 C, D and E)

Artifacts belonging to this stage of the reduction sequence represent "preforms." The main characteristic of this category is bifacially flaked edges. While bifaces may be placed into categories of ovate, triangular,

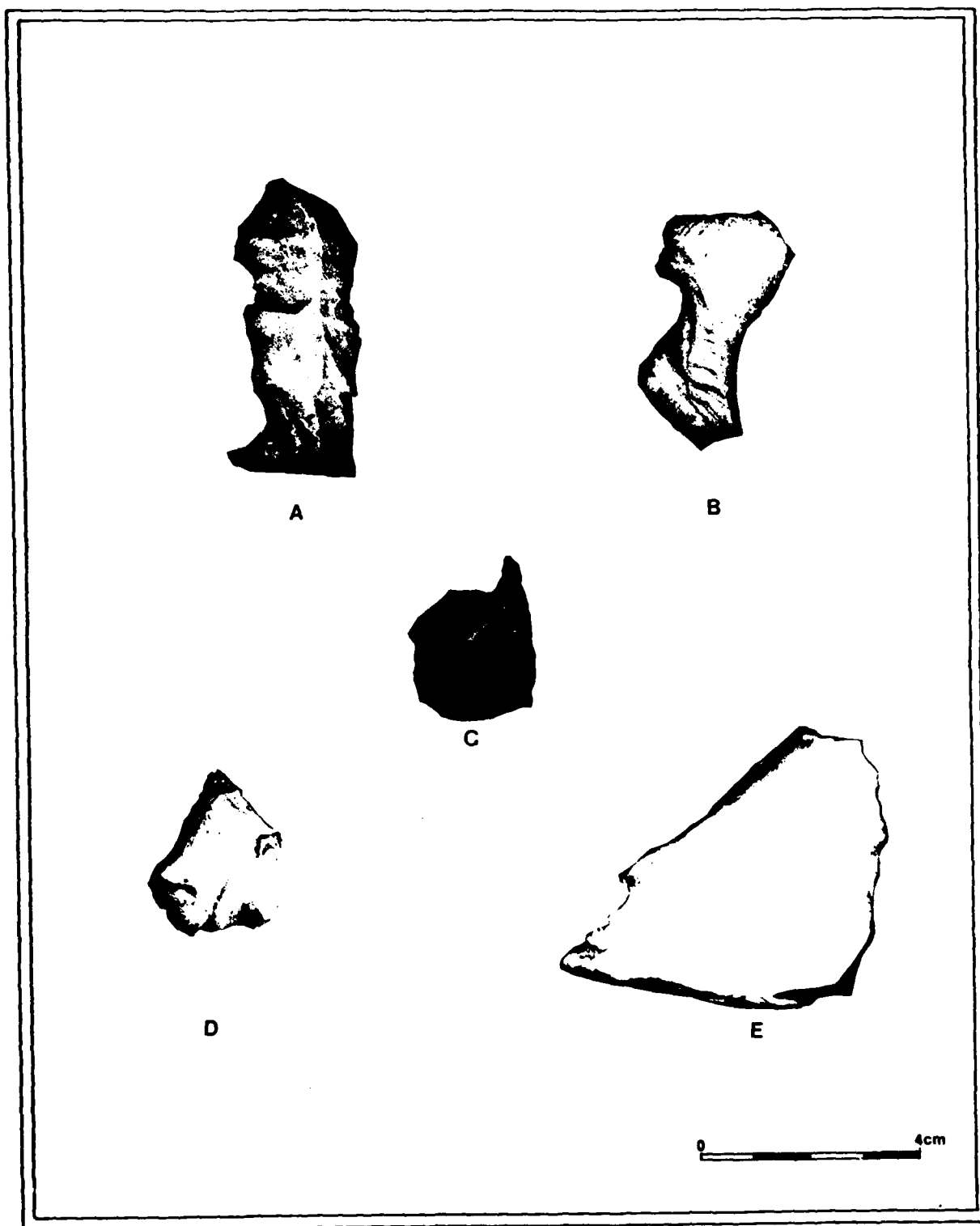


Figure 7.1 Specialized Flake Tools.

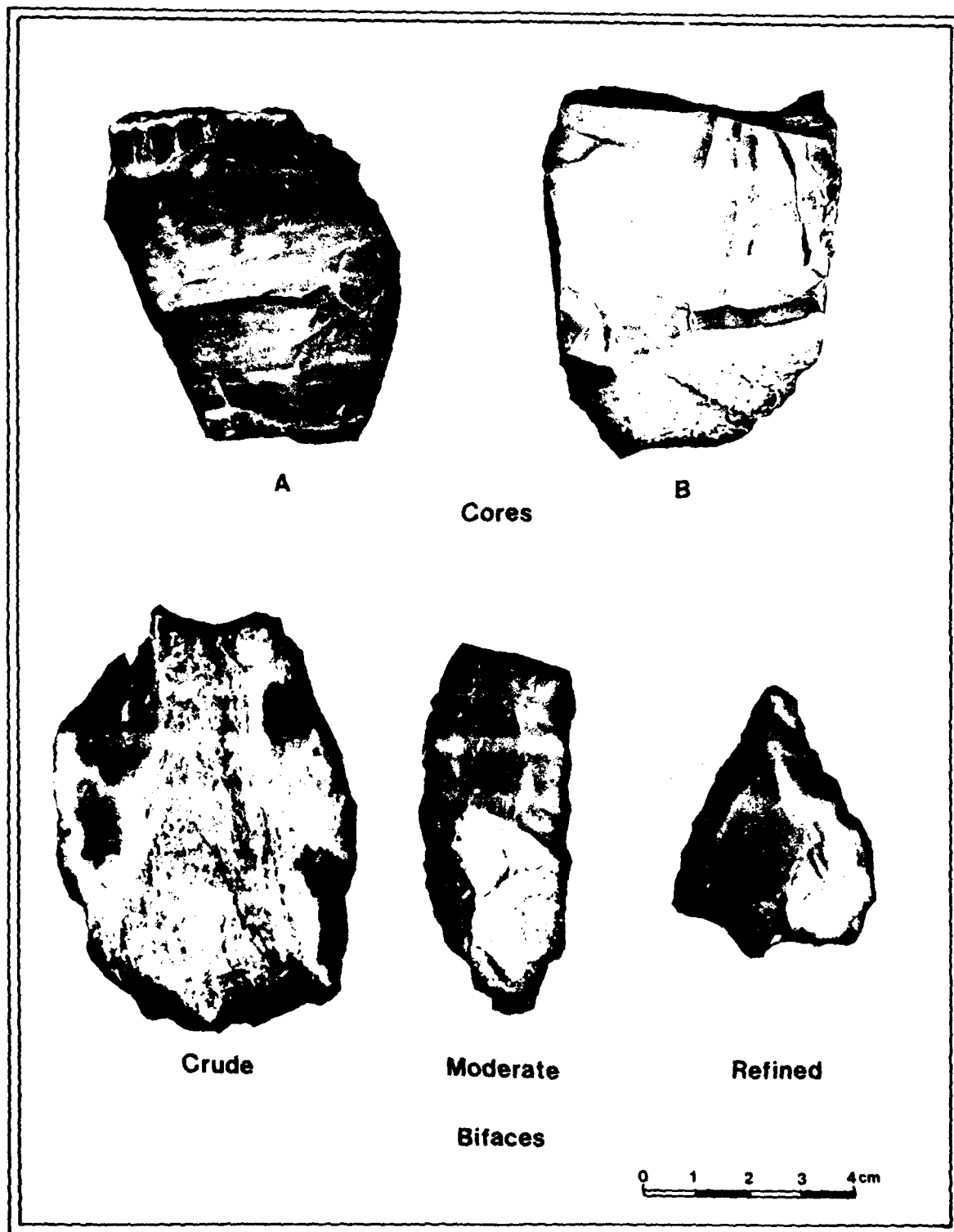


Figure 7.2 Cores and Biface Examples.

and lanceolate, those recovered were too fragmentary and amorphous to be segregated into these categories. Therefore, categories of refined, moderate and crude were utilized in this analysis. These are relative categories, based on amount of flaking and edge refinement on each specimen. Evidence suggests most recovered specimens were aborted at some point in the lithic reduction sequence before a finished product was obtained. A total of 13 refined, 25 moderate, and 15 crude bifaces were recovered.

7.2.4 Projectile Points

Hafted bifaces represent the category of projectile points. Artifacts in this category may have been intended to function as knives or projectile points. All projectile points, excepting one specimen, appear to have been aborted before a finished product was obtained.

7.2.4.1 Turkey Tail-like Projectile Points

Two specimens (incomplete)

Figure 7.3 A, B.

Morphology: Specimens are fragmentary basal portions. In their complete form, these are more or less bipoined, with small hafting notches that result in the base resembling the tail of a dressed turkey. Turkey Tail points are biconvex to flattened in cross-section with straight to tapered shoulders.

Distribution: (1) level 120-130, unit C2b, (1) level 150-160, unit A3c.

Metrics:

Specimen	Figure	Max. Length	Max. Width	Max. Thickness	Stem Length	Stem Width	Stem Thickness	Weight
1	7.3A	-	-	-	1.65	2.18	0.58	1.71 gm
2	7.3B	-	-	-	2.48	2.12	0.48	3.40 gm

Length, width, and thickness are given in centimeters.

Comments: This is the most diagnostic point type from the investigation. A Late Archaic through Early Woodland association is generally accepted for this point with a temporal range of 1500 B.C. to 500 B.C. It appears this point type is associated with both types of ceramics present in the deposits. A comparable point was recovered by Guendling in Trench 10 during the testing (1977:Figure 10d).

References: Bell 1960:90; Cambron and Hulse 1975:121; Didier 1967:3; Perino 1971:46; Ritzenthaler and Niehoff 1958:117; and Scully 1951:11.

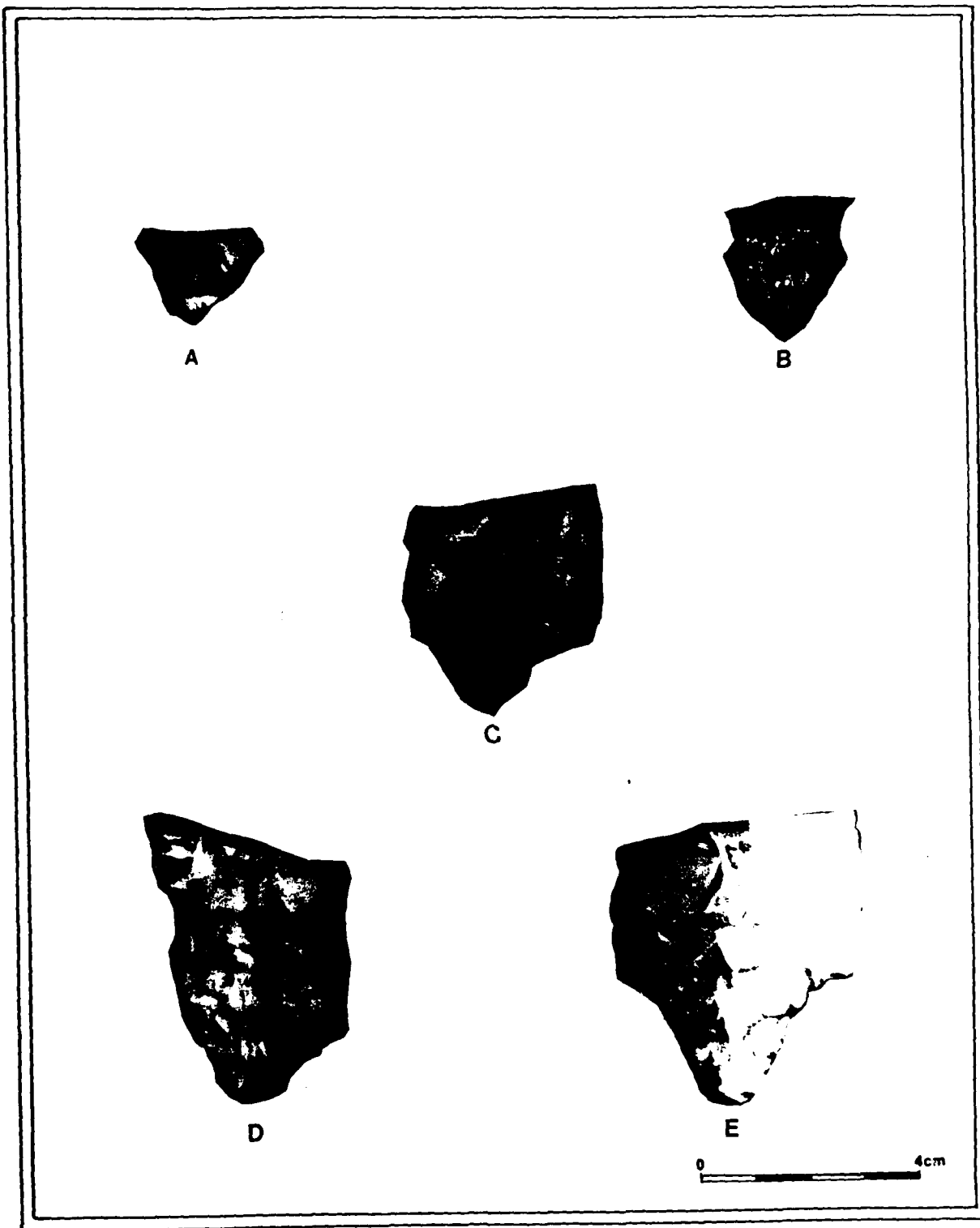


Figure 7.3 Turkey Tail and Contracting Stem Projectile Points.

7.2.4.2 Contracting stem

Eight specimens (six incomplete)

Figure 7.3 E, F, and G and 7.4 A, B, C, D, and E.

Morphology: Six of the specimens are fragmentary. Blade shape varies from symmetrical (Figure 7.4 A) to asymmetrical (Figure 7.4 B, C, and D), with a generally lanceolate form. Edges are irregular, with secondary flaking being generally crude. Shoulders are tapered and well defined; some are almost barbed (Figure 7.4 B, D). Stems are straight to slightly incurvate and tapering.

Distribution: (1) level 110-120, unit C2c; (1) level 120-130, unit C3b; (2) level 130-140, units C1b and C4b; (1) level 140-150, unit A4b; (1) level 150-160, unit A4c; (1) level 160-170, unit D1c; and (1) 190-200, unit B3c..

Metrics:

Spec.	Fig.	Max. Length	Max. Width	Max. Thickness	Stem Length	Stem Width	Stem Thickness	Weight
1	7.4A	-	3.28	1.40	1.55	1.85	0.65	20.30
2	7.4B	5.40	-	1.42	0.70	1.31	0.69	21.60
3	7.4C	-	3.65	1.10	1.35	2.20	0.85	19.60
4	7.4D	-	-	-	1.35	2.15	0.80	4.60
5	7.4E	5.19	3.23	0.79	0.92	1.66	0.51	15.00
6	7.3C	-	3.47	0.86	1.00	1.70	0.61	12.65
7	7.3D	-	3.37	1.44	1.15	1.45	0.62	20.20
8	7.3E-		4.17	1.10	1.80	2.17	0.98	21.40

Length, width, and thickness are given in centimeters.

Weight is given in grams.

Comments: These specimens are probably contemporary with the Turkey Tail Point. As represented here, these points should be considered Late Archaic or Early Woodland.

7.2.4.3 Straight stem

Five specimens (3 incomplete)

Figure 7.5 A, C, D, E and F

Morphology: These are generally thick, narrow, lanceolate points with slightly excurvate blade margins. They are relatively thick in cross-section and biconvex. Shoulders are well-defined (7.5 A) to very slight (7.5 D).

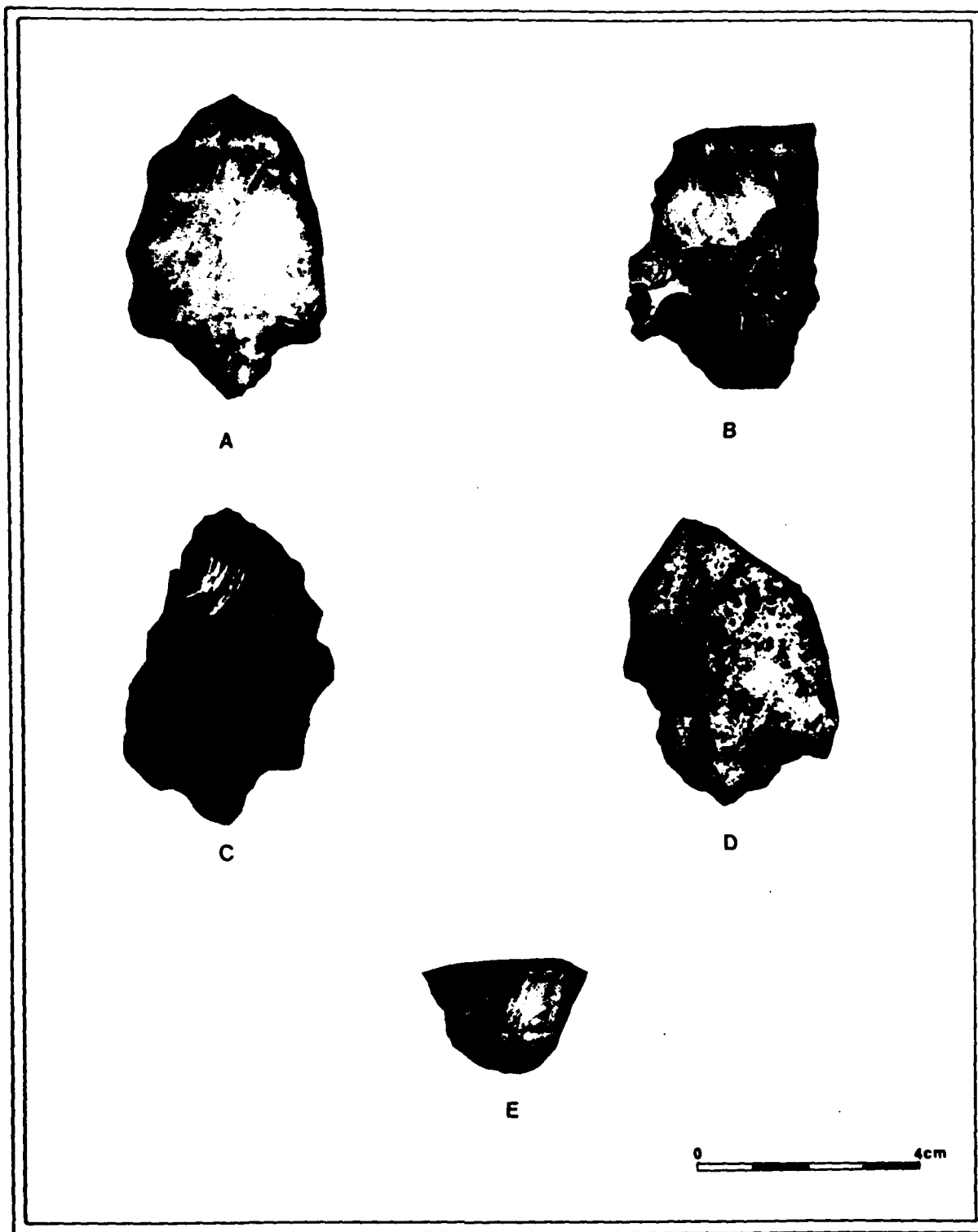


Figure 7.4 Contracting Stem Projectile Points.

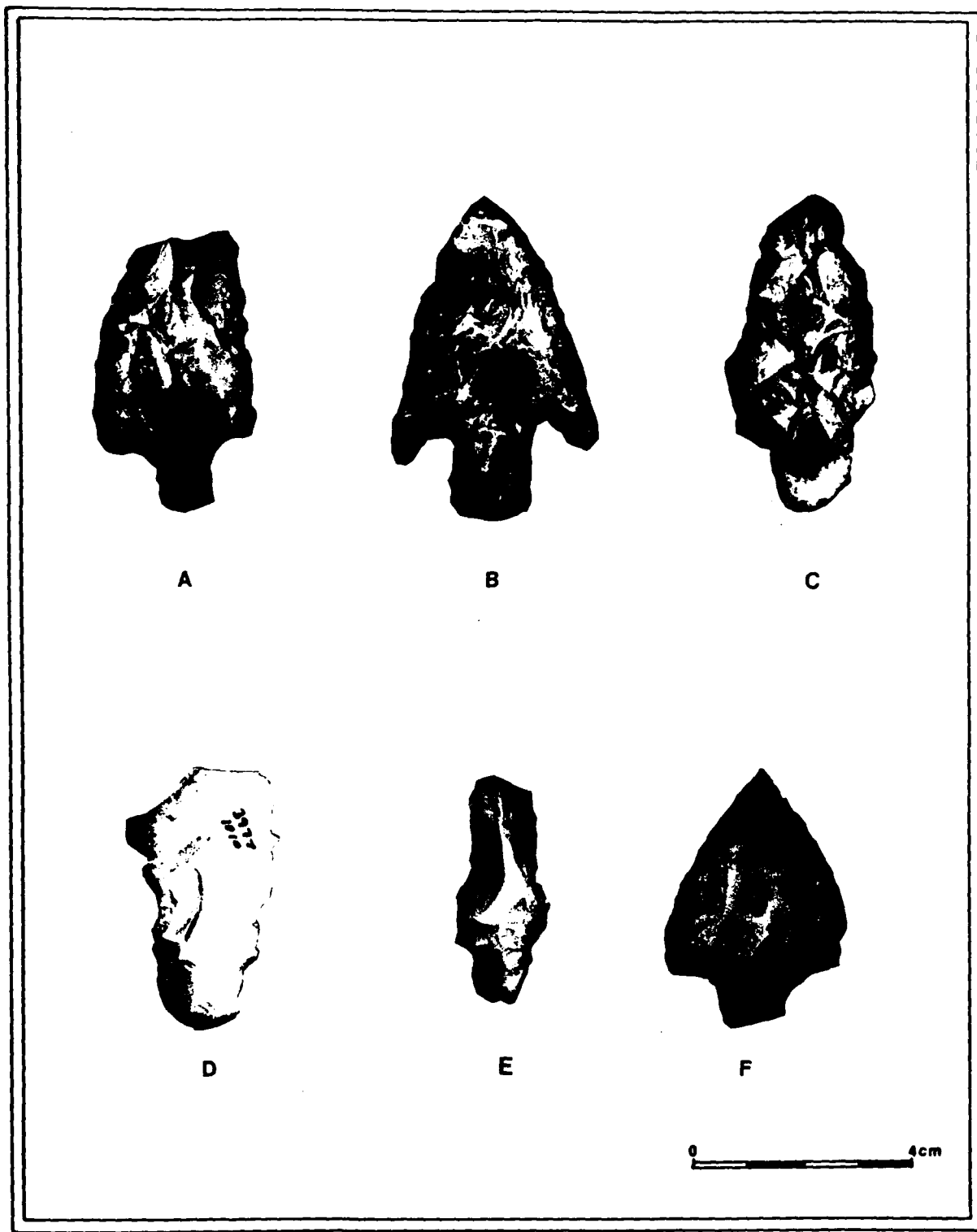


Figure 7.5 Straight Stem Projectile Points.

The stem is straight with an excurve base. These points are generally crude and seem unfinished in terms of the manufacturing trajectory.

Distribution: (1) level 120-130, unit C2b; (2) level 140-150, unit A3b and C2b; and (2) level 170-180, unit D2c and A3d

Metrics:

Spec.	Fig.	Max. Length	Max. Width	Max. Thickness	Stem Length	Stem Width	Stem Thickness	Shoulder Width	Weight
1	7.5A	-	2.73	1.21	1.09	1.00	0.61	-	18.40
2	7.5C	5.46	2.62	0.82	1.21	1.34	0.68	2.48	11.40
3	7.5D	-	2.75	1.40	1.60	1.45	0.75	-	12.80
4	7.5E	-	1.59	1.00	8.50	1.00	0.55	-	5.50
5	7.5F	4 45	3.20	0.84	0.75	1.21	0.52	2.97	10.10

Length, width, and thickness are given in centimeters.
Weight is given in grams.

Comments: These are relatively crude points and probably represent unfinished tools. They are likely to be Late Archaic or Early Woodland; however, morphological characteristics are too general to compare them to any defined point type.

7.2.4.4 Buck Creek Barbed

One specimen
Figure 7.5B

Morphology: The blade is triangular in outline with secondary retouch along the margins. It is biconvex in cross-section. Shoulders are barbed as a result of deep corner notching. The stem is straight and parallel with an excurve base. It exhibits very slight basal thinning.

Distribution: Level 150-160, unit D3c

Metrics:

Specimen	Figure	Max. Length	Max. Width	Max. Thickness	Stem Length	Stem Width	Stem Thickness	Weight
1	7.8B	5.61	3.52	0.92	1.60	1.42	0.72	13.90

Length, width, and thickness are given in centimeters.
Weight is given in grams.

Comments: This point is a member of the straight stem category on a broader level. This point type is found throughout southern Indiana. It is named for a type site located up river from the Cole site in Harrison County at the mouth of Buck Creek and the Ohio River.

Seeman (1975b:107) has noted that Buck Creek points were most likely used as hafted knives, while a few of the larger, thinner points may have been cache blades or projectile points. These points are similar to Wade points (Cambron and Hulse 1964:110) and Kampsville Barbed (Perino 1968). Guthe (1964:82) reported a Buck Creek Barbed point from excavations in a dry rockshelter in Logan County, Kentucky, where it was associated with Early Woodland diagnostics. Buck Creek Barbed points are almost always manufactured from Wyandotte chert (Seeman 1975b:107). These facts indicate the points are probably Terminal Archaic or Early Woodland in temporal affiliation.

References: Seeman 1975a:47-61; 1975b:106-108; Tomak 1980:5

7.2.4.5 Indeterminate

Six specimens (all incomplete)
Figure 7.6 A, B, C, D, and E

Comments: These points are fragmentary and are not temporally or culturally diagnostic. Two exhibit damage resulting from exposure to heat.

7.2.5 Ceramics

A total of 20 body sherds from ceramic vessels were recovered. Eighteen sherds originated within Zone I of the main block excavation. Table 7.1 presents level depths, unit number, temper, and thickness for the sherds. A sherd was recovered from slumped deposits at the front side of the block and another was recovered in Trench 1 from a depth of 115-130 cm below surface during the test trenching phase. Two ceramic types are recognized in the assemblage: a relatively thick, grog and crushed grit tempered variety representing an Early Woodland component, and a relatively thinner Middle Woodland ware with a limestone temper.

7.2.5.1 Grit, Chert, and Grog Temper (Plate 7.7 A, B, C, and D)

Temper: Particles are medium to coarse. Quartz, grog, chert, shale, and hematite were all used as tempering agents. Included in this category are three quartz tempered sherds; two grog sherds; one quartz, chert, and grog sherd; one hematite, quartz, and grog sherd; and one shale and grog tempered sherd.

Texture: Smooth, chalky surface, with coarse, grainy, poorly consolidated interior. Surfaces are sometimes eroded.

Thickness: Ranges from 6mm to 11.5mm, averaging 7.9mm in thickness.

Color: Surface or exterior colors range from brown (10 yr 5/4) and light yellowish brown (10 yr 6/4) to greyish brown (10 yr 5/2) with interiors ranging from dark grey (10 yr 4/1) to reddish yellow (7.5 yr 7/6).

Vessel form: While none of the sherds was large enough to determine vessel form, similar examples do exist in the collection of Mrs. Cole. These larger sherds and vessel fragments suggest long, relatively narrow conoidal jars with flat wide bases, constricted at the neck with slightly expanding shoulder.

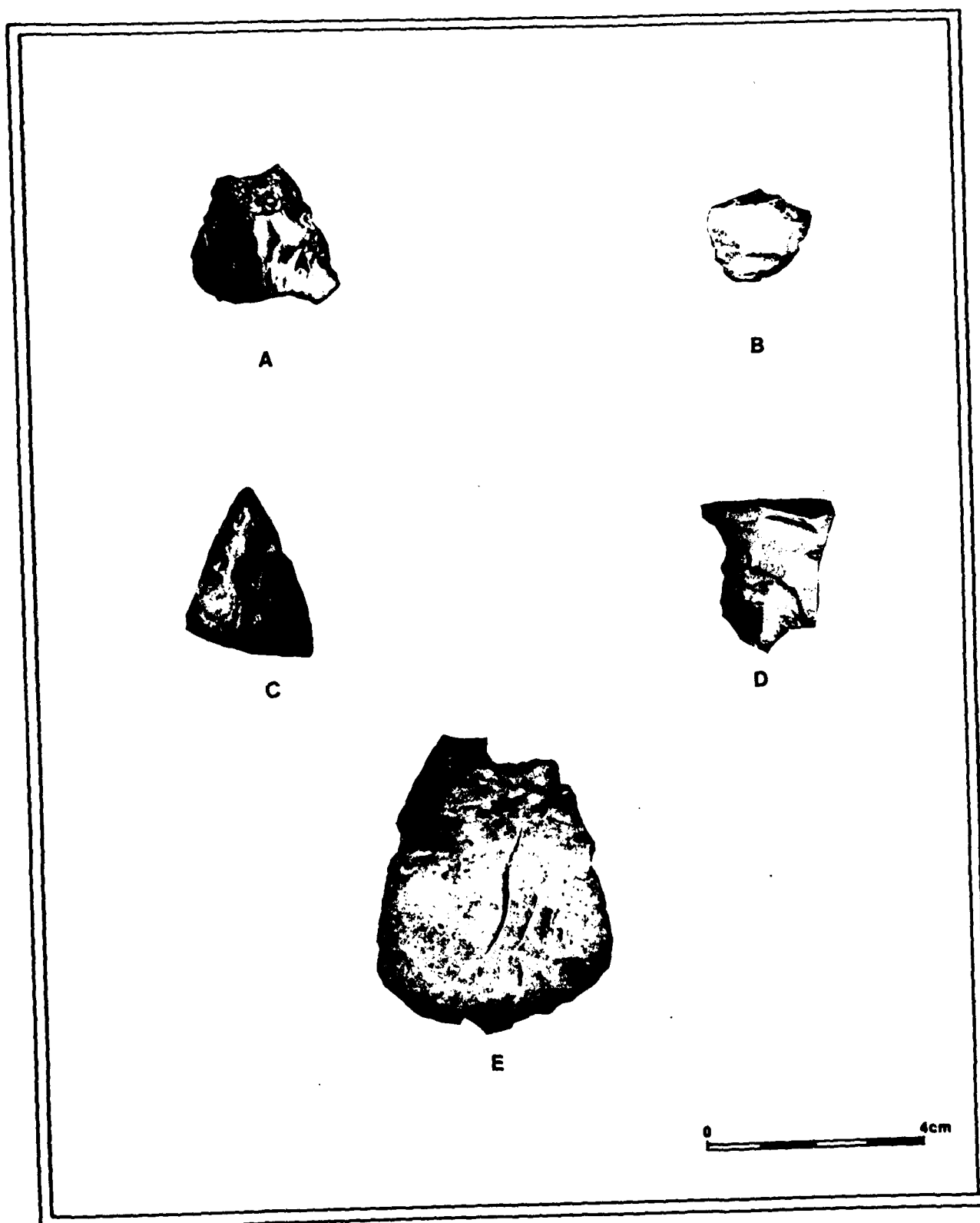


Figure 7.6 Indeterminate Point Fragments.

Comment: This ceramic type seems to correspond to the Early Crab Orchard development of the Middle Ohio Valley. They compare best to Sugar Hill Cordmarked and Crab Orchard Plain and Cordmarked (Maxwell 1951; Crouch 1979:45-47). A suggested temporal range is 300 B.C. to A.D. 1, with an Early Woodland cultural correlation. Both the sherd recovered from Test Trench One and the single sherd from the slumped deposits are included in this type. Chert temper is of the Wyandotte variety. Within Zone One, these sherds occur between 100-160 cm below datum.

Surface: Plain and cordmarked. Cordmarking generally is in single cords, spaced about 7mm apart.

Table 7.1 Occurrence of Ceramics by Level

Depth Bd. in cm	No.	Unit	Temper	Thickness in mm	Surface
90-100	1	A4b	Limestone	6.0	Plain
	1	C2c	Limestone	4.0	Plain
	1	C2b	Limestone	5.5	Plain
	3	C1c	Limestone	6.5	Plain
	1	A4b	Quartz	8.5	Smoothed over cordmarking
100-110	1	D2c	Limestone	9.0	Plain
	1	A4c	Grog	9.5	Plain
	1	C2b	Quartz	9.0	Plain
110-120	1	B4c	Limestone	6.0	Plain
	2	A4c	Quartz, chert, grog	11.5	Cordmarked
140-150	1	A3b	Grog	6.0	Eroded
	1	B3b	Quartz	-	Eroded
150-160	1	B2b	Limestone	6.5	Plain
	1	B2d	Quartz, hematite grog	11.0	Smoothed over cordmarking
	1	B2d	Shale, grog	8.0	Eroded

7.2.5.2 Limestone Temper (Plate 7.7 E, F, and G)

Temper: Particles are medium to coarse in size and in most cases are leached on the surface. Limestone is the only tempering agent.

Texture: These sherds are relatively thin and well made, being more compact than the sherds described above.

Thickness: These range from 4mm to 9mm in thickness with an average of 6.2mm.

Color: Interiors and exteriors generally range from pale brown (10 yr 6/3) to dark brown (10 yr 4/3).

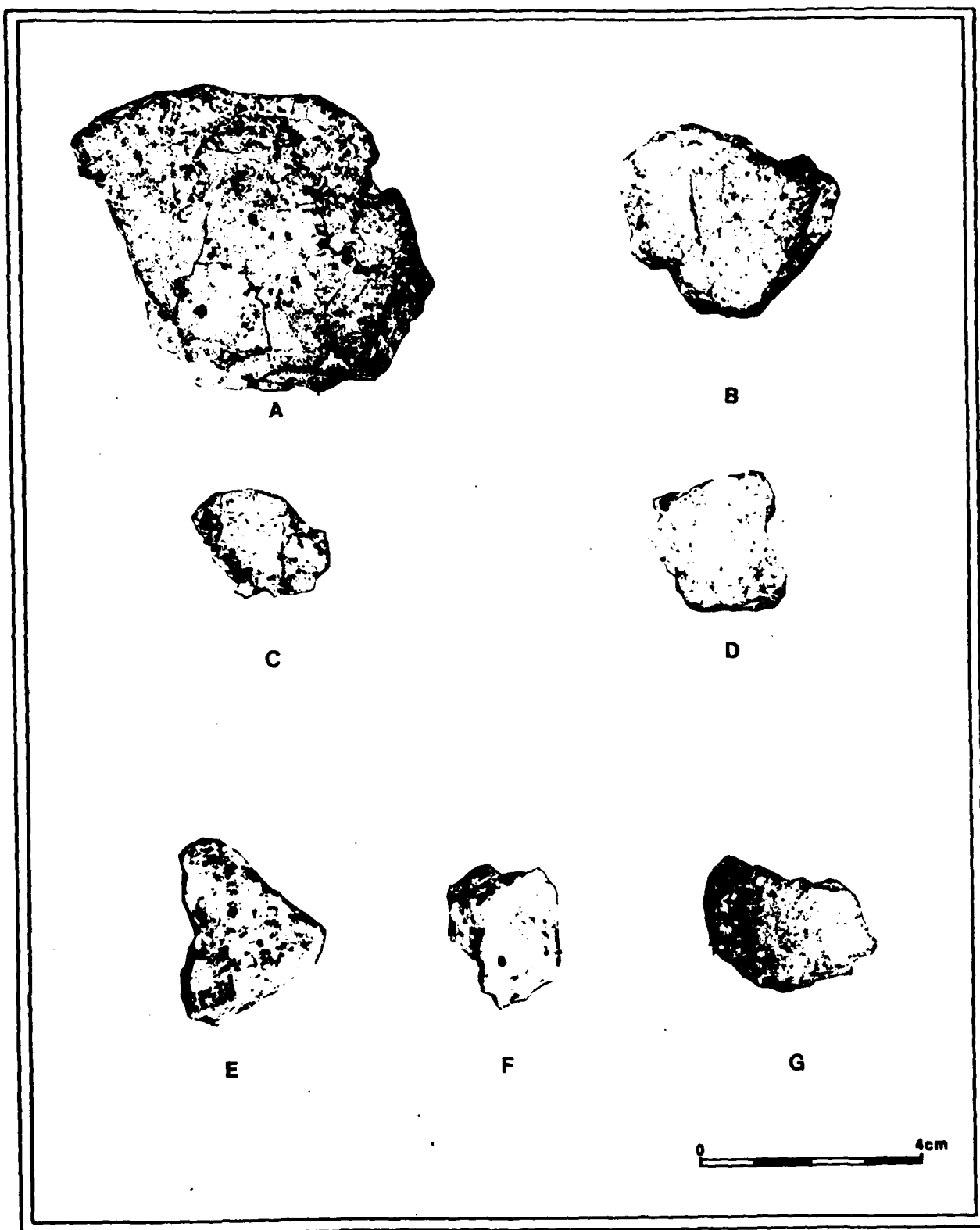


Figure 7.7 Ceramics

Surface: In all examples, surface is plain, or possibly eroded or smoothed over cordmarking, but this is not clear on any of the sherds.

Vessel form: Uncertain. The sherds possibly represent large globular, round based vessels.

Comments: This ceramic type is later than Early Crab Orchard ceramics. It may represent a Later Crab Orchard ware or is possibly related to the Allison-Lamotte limestone tempered wares (Pace and Aphelstadt 1978). Limestone tempering is regarded as a Middle to Late Woodland trait. In Zone I, these sherds occur in upper levels, between 90 and 110 cm BD. The single exception is a sherd from unit B2b at a depth of 150 cm BD. This appears to represent a misplaced sherd, intruded into lower levels of Zone I. Temporally, these ceramics probably date between A.D. 1 and 300.

7.2.6 Hammerstones

Hard stones and cobbles were used as implements for smashing chert cores to detach flakes. Hammerstones varied in size according to the amount of desired impact. A total of 3 hammerstones were recovered. These tools are an essential part of a manufacturing kit for working chert. Hammerstones show a characteristic pattern of wear from repeated battering. Examples are illustrated in figure 7.8.

7.2.7 Rough Rock

A large amount of unmodified sandstone and silicified limestone was recovered from Zone I. Oxidized sandstone was also recovered in large quantities. Difinative function of these abundant materials cannot be determined beyond speculation of their purposeful inclusion in fires. Fire cracked rock in this context may imply cooking or domestic activities in conjunction with lithic processing. Possible direct relationships between these materials and lithic manufacturing seems unlikely. These stones are generally too soft to serve as hammerstones and Wyandotte cherts are not conducive to quality improvement by heat treatment. These fire cracked rocks may indicate a winter occupation necessitating fires for warmth or light.

7.3 TECHNOLOGICAL ANALYSIS OF THE LITHIC MATERIALS

Cultural material obtained during the data recovery reflect Guendling's hypothesis that ceramic bearing deposits in the southeastern portion of the site represent a "specialized lithic workshop area" (1977:46). Abundant evidence of lithic reduction and a few diagnostic artifacts were recovered from Zone I. No recognizable features or demonstrable separate living floors were identified. Zone I provided the data from which the lithic analysis has been made. The second cultural horizon, Zone II, contained scant evidence of lithic reduction with the cultural debris composed largely of thermally cracked rock. Zone II is therefore excluded from the lithic analysis. Material discussed is from Zone I unless otherwise indicated.

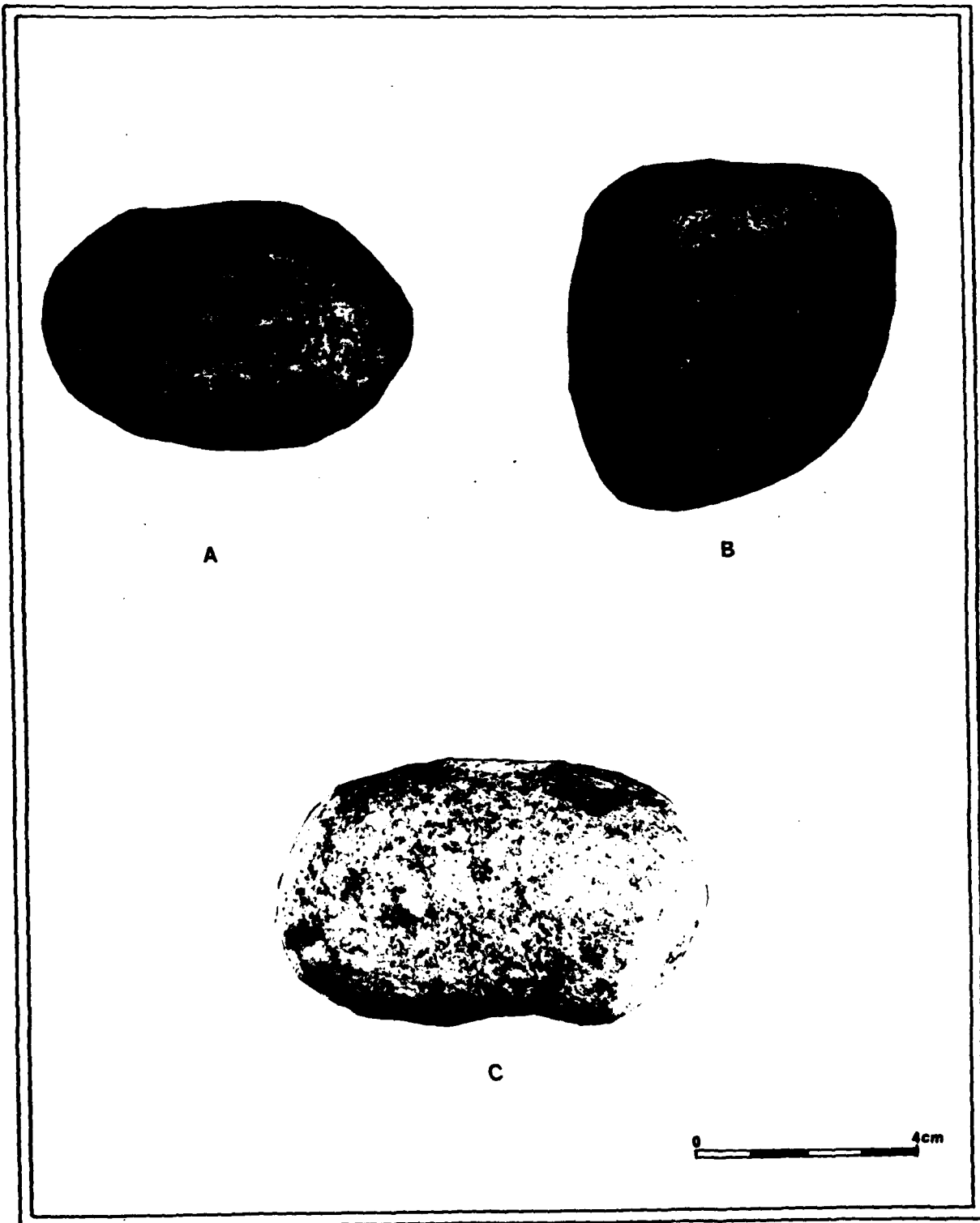


Figure 7.8 Hammerstones.

This analysis is not meant to be an all-inclusive, comprehensive expose of all the lithic material recovered. Interpretation and understanding the behavior of the lithic reduction systems, and identification of change throughout the deposits is a primary aim of the analysis. Identifying specific research potentialities of the Cole site, as pertains to lithic studies, was also a primary goal. To accomplish these ends, portions of each basic category of chipped stone (e.g. cores, bifaces, hafted bifaces, and flakes) were examined. Samples examined are believed to adequately and accurately reflect the nature of the total assemblage.

Materials from Zone I consist primarily of remains of lithic manufacturing activities. Any archaeological chipped stone assemblage is significant first, in that it was discarded. Finished complete artifacts and usable products would be expected to be under-represented in trash. Lithic material from Zone I is refuse consisting of fragments, rejects, partially modified pieces and debitage. These flaked materials make up an incomplete body of data regardless of the morphological categories recognized. From these discarded remnants the analyst must seek to reconstruct the useful and completed products which were removed from the manufacturing area. This "refuse hypothesis" is an underlying premise of the entire analysis, recognizing that only a limited amount of the original lithic activity still remains. Identifying manufacturing behavior at a specific site requires a range of materials, not simply flake debris. Bifacial forms, hammerstones, cores, etc., must compliment the flake debris. Observation of consistent reoccurrence of specific flake dimensions and overall morphologies allows reconstruction of stages utilized to reach a desired end product. Discovering the manufacturing system may allow recognition of the standard of the product. Product standards are culturally determined and chronologically significant. Product standards influenced the consistency of form in artifacts which has allowed archaeologists to classify artifacts into types. Products which have desirable features in accordance with standards will be expected to have been removed from the area of manufacture. However, by-products from manufacture will remain behind to testify to their former existence. It is the purpose of this lithic analysis to construct a model of prehistoric lithic reduction behavior. The analysis is based on the assumption that the lithic debris of the various stages of lithic reduction represented in the material culture of prehistoric groups is representative of past human behavior patterns.

7.3.1 Trajectory: the Lithic Reduction Sequence

The concept of "the manufacturing trajectory" is based in part on the work of Collins (1975a) and Cook (1980), along with additional identification of a range of lithic reduction sequences, as noted within Zone I. A manufacturing trajectory is a reconstruction of a sequence of steps or stages involved in the reduction of raw chert into a form that complies with an acceptable mental template. The ideal manufacturing trajectory as outlined here involves a five stage process: 1) collection of raw materials, 2) initial reduction, 3) primary and secondary reduction, 4) secondary shaping and trimming, and 5) final trimming. Figure 7.9 illustrates an idealized trajectory for the Cole Site.

Three basic variations of this trajectory have been observed in the Cole site materials. Each of these includes the initial stage. Stage I consists of the selective collection and possible limited quarrying of raw cherts. The availability of raw material in the immediate project area has already been discussed and need not be elaborated. Suffice it to say that chert resources were generally plentiful for the prehistoric groups at the Cole site and general geographic area. Additionally, two basic forms of Wyandotte Chert exist, tabular and nodular.

The second stage in the trajectory involves initial reduction of tabular pieces or nodules. Tabular pieces are reduced into blocks. Nodules are reduced into relatively large cores. Most of this initial reduction in the Harrison/Crawford County area appears to have taken place at the site of raw material acquisition, or in close proximity. Resultant debitage, in the form of large primary flakes and exhausted cores, is left at the site of initial reduction. Trimmed blocks and cores then leave the site. This stage is essentially absent in the study materials.

Stage three of the sequence results in manufacture of blanks and preforms from the blocks, and flake blanks from the cores. This stage of manufacture appears in evidence at the Cole site. The recovery of primary and secondary decortication flakes, as well as discarded cores and truncated or rejected blanks testifies to past execution of activities associated with this stage at the Cole site. Analytical discussion of cores is presented in the following section.

The manufacture of bifaces from tabular or flake blanks represents the fourth stage. It is in this stage that the larger bifaces and cache blades occur. These will be discussed in section 7.3.2.2. Some flake blanks are modified into hafted bifacial forms without a prior stage of unhafted biface production. This will be explained in section 7.3.2.3.1. In this fourth stage, "preforms" or blanks are secondarily reduced into the approximate shape, size, and mass of the intended finished artifact. Products of this stage can generally be recognized by their "unfinished" morphology and lack of use breakage and wear. Finished bifacial forms and possibly cache blades then leave the site. Debitage resulting from stage four is represented in the archaeological context of Zone I as secondary and waste flakes, as well as truncated and/or rejected bifaces.

Some of the other bifacial forms, that do not leave the site as cache blades or related forms, were further modified during the final stage. At this point in the trajectory, more specialized flaking techniques are applied to bifacial forms to execute hafting elements. These result in stems or notches and final edge trimming. The main form of debitage expected from this stage of reduction is waste flakes, truncated projectile points and knives, and "notch flakes" such as those examined in section 7.3.2.3.2. Hafted bifacial forms then leave the site.

Some writers have discussed a sixth stage in manufacturing trajectory: that of refurbishing tools. Because Zone I at the Cole site functioned primarily as a manufacturing station and most finished tool forms would be expected to leave the site, there appears to be little or no evidence of a sixth stage.

7.3.2 Analytical Description of Flaked Stone Tools

7.3.2.1 Cores

The core sample consists of seemingly disparate morphologies, rather than representing a single trajectory. By and large, the sample includes chert blocks bearing few flake scars. Some of these relate to initial biface reduction failures, while others relate to raw material fragments that were tested for quality but were not used extensively. Table 7.2 shows the extent of observations made on the materials in this category. The cores appear to represent very early phases in a biface trajectory. No controlled flake or blade reduction was observed. None are large, and a bifacial edge occurs only twice. Near equal numbers of unifacial single platform and multiple platform types exist. No prepared platforms were observed that correlate with "classic" prepared cores. Flake scars present may be preparation for later biface reduction that never took place. Eight specimens exhibited these unifacial flake scars. Crudity and lack of a well defined prepared striking platform are characteristic. In addition, 8 of the 10 specimens bear some form of weathered surface or plane.

Table 7.2 Characteristics of Cores From Zone I

Depths	Cortex	Bifacial Edge	Platform	Planes or Inclusions	Possible Biface Frag.	Blade Scars	Feathered Flake Terminations	Weathered or Plane Surface on Platform	Prepared Platform	Bed Orientation	Step Fractures
90-100											
100-110											
110-120											
120-130	-		-	-	-		*	-		#	-
130-140			-	heat	-	?	-			#	
	-		*	-			-				
	-		*	-			-				
140-150			*	Oolitic			-	-			
	-		-	-	?		-	-		#	
150-160			-	-			-	-		#	
	-	-	-	*				-			*
160-170		-	*	*	-			-			-
170-180	-		-	-	-		*	-		#	-
180-190											
190-200											

N = 10

KEY - Present * Multiple # Vertical Parallel

Presence of plane surfaces on cores does not allow positive identification of the procurement technique utilized to obtain the raw material. Recently Boksenbaum (1980) described characteristic traits associated with nodule smashing, and anomalies observed in specific flake detachment types of debris from nodule smashing were outlined. Using similar criteria, cores from Zone I were examined. These materials appear to lack evidence of such reduction techniques (i.e., simultaneous flake detachments and substantial amounts of blocky chert), and do not appear to result from nodule smashing. Previous discussion of plane structures (Chap 3.3) noted the variable conditions and characteristics of plane surfaces. The tendency of chert to break naturally along planes eliminates optimal conditions for identifying nodule smashing when planes are numerous. Unless water-wear covers the original plane surface, along with more recent flake detachments indicating the original material was already free of these weak areas prior to collection, it is not possible to suggest a cause for freed planes in an archaeological context. Chert fragments with relatively unworn plane scars occur naturally, mainly from chemical action, and cannot be reliably sorted from percussion induced freed planes.

Cores in the sample appear to have been selected from raw material blocks already exhibiting signs of freed planes. Most of the blocks are of rather poor quality material. Size of blocks selected is assumed to reflect the necessary mass limitations for the intended product. What appears to characterize the cores as a whole is the presence of additional interior weaknesses. It was observed that interior discontinuities occur on modified areas of the cores. Assuming that many of these do not run completely through the material, the notion of rejection at a point in the initial reduction sequence appears appropriate.

Many partially flaked pieces would be expected in a region where vast quantities of raw material are present. However, cores are not abundant in the recovered material. The cores relate principally to quality testing without any real association with a particular trajectory. The absence of a consistent application of technique or a patterned disposal within the reduction sequence does not allow the building of a model to account for observed morphological variability. Stage three in the manufacturing trajectory is present, but is poorly represented. Quality testing and initial biface reduction would best account for the bulk of the core sample.

The only consistent trait observed in the cores was flake detachment oriented parallel to natural bedding planes in the raw material. Bedding planes in the raw material did not necessarily occur during formation of the chert. Some planes observable today may be apparent only because of substantial weathering of the material. It cannot be determined whether or not bedding planes became visible before or after modification in the past. By chance, some amount of raw material would be collected and used, which exhibited macroscopic bedding planes. Weathered raw materials have the potential for textural change across their mass which can inhibit flake detachments. Nearly all cores, which bear visible bedding planes, exhibit flakes detached parallel to the beds. When cores bear visible bedding planes, flake scars are oriented parallel to beds, presumably in an effort to elicit some control over flake detachment. (Bedding plane orientation relative to overall pattern of modification will also be used to analyse bifaces, and projectile points).

The recovery of two prismatic blades (Figure 7.10 A and B) from Zone I indicates the possible presence of activities associated with specialized prepared blade cores. The failure to recover blade cores may be accounted for by the small portion of the site which was excavated. Blade core activities may be present at nearby locations associated with the limestone temper ceramic levels. Blades and limestone tempered pottery are tentative diagnostics of the Middle Woodland period. Blade cores that may have been manufactured within these deposits have been removed from this context. Although one of the recovered blades is fragmentary both bear platform preparation on their proximal ends. One blade fragment bears a dorsal surface indicative of initial block or core reduction, presumably from a nodule section. While both exhibit a dorsal ridge, the complete blade bears distally located scars from previous blade removals. Substantial dorsally applied platform preparation is evident, along with length and width which are unlike any bifacial reduction flakes recovered.

As the fragmentary specimen lacks a distal end, it is difficult to assign true blade status to it, although the standard "length is twice the width" would apply (Crabtree 1972: 42, Richardson 1977). Its position in the deposits (160-170 cm BD) places it deeper than expected. The second blade, however, possesses the requisite characteristics and its stratigraphic position (90-100 cm BD) is complimentary with the Crab Orchard component.

With the meager amount of blade core refuse extant in these deposits, it is obvious that specific manufacturing trajectories and resultant refuse frequencies are site specific phenomena. One cannot generalize about whole culturally specific technologies based on any single presumed manufacturing station. The appearance of cores and blades can vary depending on specific activities or the lack of them. It must be remembered the 1980 excavations do not reflect a total sample from an apparent manufacturing locus. Thus, transport out of the area under study need not be far to limit recognition here. Additionally, periodic use of blades would automatically present problems for identification, because of the conservative use of material in blade production. Specific dimensions are produced with minimal waste. The result is finished tools without the apparent necessity of further reduction, save the platform rejuvenation of cores. Evidence for this may be difficult to recover under standard excavation techniques, unless resulting refuse from this activity is massive.

7.3.2.2 Bifaces

Bifaces from Zone I are readily recognizable and exhibit regular multiple flaking. Each specimen has proceeded some distance from the initial edge preparation of flakes or blocks of chert. Table 7.3 presents observation sets used to record data during analysis of bifaces. All recognized bifaces and fragments are included with a total of 47 specimens. Additional observation criteria will be discussed when pertinent data are under scrutiny. The observation battery was designed to include biface fragments which compose over 90% of the biface sample.

Examination for presence or absence of remnant cortex on bifaces indicated an even distribution, with 50% exhibiting cortex and 50% with an absence of cortex. Attempts were made to suggest the stage at which discard occurred.

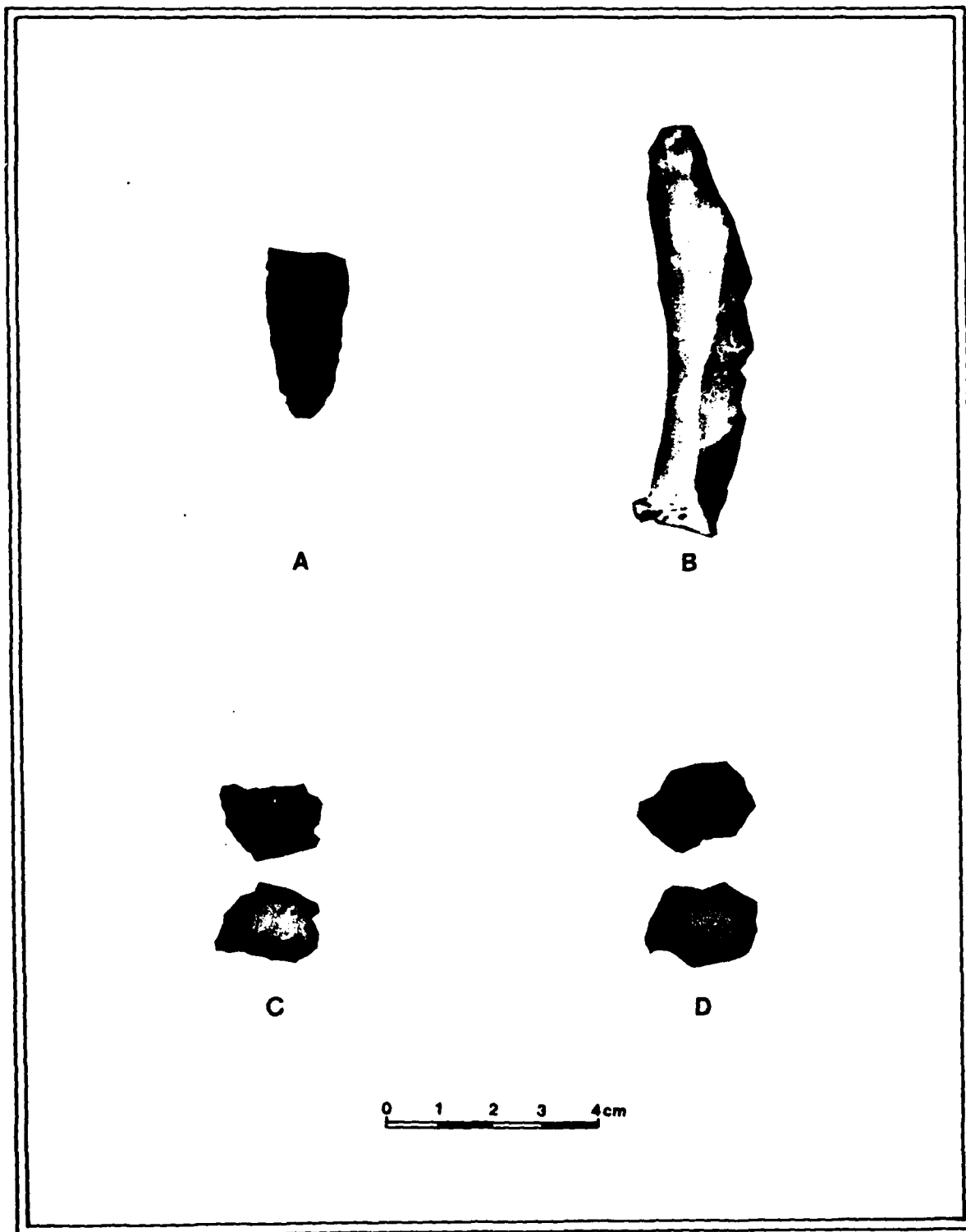


Figure 7.10 Blades and Notch Flakes.

TABLE 7.3 Observations Used to Examine Bifacial Forms.

Artifact Fragment Orientation

- distal
- medial
- proximal
- lateral

Cortex

- distal
- proximal
- lateral
- facial

Material Discontinuities Outside of Fracture Area

- planes of weakness (diagenetic)
- solution cavities
- inclusions
- localized rough textured area

Location of Impact Area

- distal
- lateral
- basal

Flake Morphology Outside Fractured Area

- step fractured flake terminations
- hinging flake terminations
- feathered flake terminations

Edge Condition

- flaked preparation or refinement
- ground facets present on edge
- crushed edges

Edge Morphology

- crude
- medium
- refined

Suggested Cause of Fracture

- load exertion
- miscalculated platform
- end truncation or shock
- raw material
- intentional

Observations of Natural Bedding Planes Relative to Artifact Orientation and/or Fractured Surface

- vertical planes
- horizontal planes
- planes parallel to fracture
- planes opposite fracture
- amorphous planes
- nodule interior
- absent

Surfaces were scanned for flaking technique, and fragments were oriented to ascertain placement on the original biface, assessing the proportions of the fragments relative to the location of cortex on each piece (Table 7.4).

Table 7.4 Location of Cortex on Biface Fragments by Level.

Depth	Distal	Lateral	Facial	Ubiquitous	Absent
90-100	1	-	-	-	-
100-110	1	1	-	-	-
110-120	1	-	-	-	2
120-130	1	-	1	-	1
130-140	1	-	1	1	3
140-150	-	2	-	-	6
150-160	-	1	1	1	5
160-170	-	-	1	1	2
170-180	-	1	1	-	-
180-190	1	-	1	-	2
190-200	-	-	-	-	-
200-210	-	-	1	1	1
TOTAL	6	5	7	4	22

There are nearly equal numbers of biface fragments possessing cortex in a localized area. Those possessing cortex on at least one face and one side or edge are termed ubiquitous. Other specimens bear localized cortex exclusively in the areas identified. Few bifaces possess localized cortex on distal, lateral, or facial parts, inhibiting the significance of this comparison. Presence or absence of limestone cortex on bifaces and fragments can entail two different modification states at discard time.

Relative position of cortex on bifaces and fragments reflects the trajectory stage only when specific hypothetical mental templates are taken into account. Acknowledging the presence of Turkey Tail-like points in the deposits under study, the period of time represented here encompasses a portion of the temporal span where such forms as notched and unnotched cache blades were produced. Localized distal cortex occurs frequently on these presumably finished items (i.e. turkey tails and other bipointed and ovate refined bifaces).

In fragmentary specimens, discerning the refinement state of each biface is often problematic. Bifaces with distal cortex exhibit undifferentiated bases and tips. When dealing with fragments, it is often impossible to recognize distal and proximal ends. It might be agreed that cortex oriented on distal ends of bifacial forms generally occurs more often than it does on sides of bifacial forms which present the greatest area of working edge.

The orientation of biface fragments with distal cortex in the upper portion of Zone I is significant. A rough trend seems to occur with facial through distal cortex, from the base of Zone I to the surface. The presence of facial cortex implies use of decortication flakes for biface manufacture and that edges were freed of existing cortex. Lateral and distal cortex is difficult to correlate with the original state of the raw material. However, it is limited to either decortication flakes or lateral cortex on flakes struck from relatively whole nodules with cortex already removed from the side. Whichever these may be, cortex remaining on distal ends of biface fragments occurs in the upper deposits, where cache blade manufacture should occur if present. Later discussion will focus on specific evidence for cache blade manufacture at the Cole site. For present purposes, location of cortex in the biface sample is seen to include both early stage bifaces (facial and ubiquitous cortex) and also more refined bifaces. Some also present indications of a particular bifacial trajectory.

7.3.2.2.1 Edge morphology of bifaces

The vast majority of bifaces and fragments are crude; however, only 50% bear cortex. Figure 7.11 emphasizes edge morphology over any other separate or combined observation to place the bifaces into respective categories: crude, moderate, and refined. These edge morphological categories are useful, and often correlate with morphology elsewhere on bifacial specimens, such as flaking and overall form. Examples are shown on Figure 7.2 C, D, and E.

Edge morphology relates to a specific refinement condition at the time of discard, providing minimal re-use of refuse occurred. Certain regular patterns of edge preparation can be suitable in platforming for further reduction or provide a special cutting or scraping edge as it exists. Thus, ultimately, there are at least two functions for every edge configuration identifiable. The important aspect of edge morphology differentiation involves a consideration of both potential use as a tool and also the reduction sequence leading to a functioning tool.

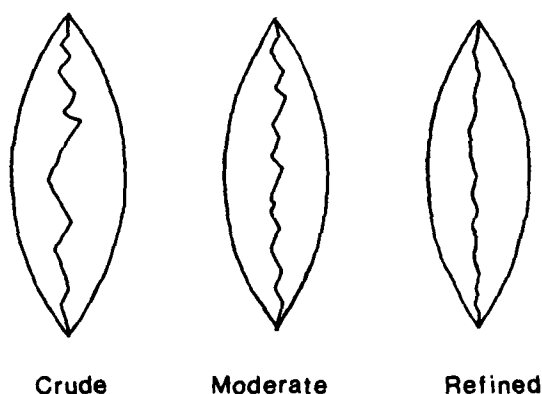


Figure 7.11 Edge Morphology

Table 7.5 presents observations of the edge condition of biface fragments. Classification was based on ground or crushed edges, multiple occurrences of edge wear, and the absence of wear. Absence of observed wear occurs twice as often as any of the other categories. Eight levels contain biface fragments which possess grinding or minute edge crushing. Grinding and crushing can be produced individually or simultaneously, depending on force and direction of impact, and hardness of opposing surfaces. Macroscopic crushing was evident on only four specimens. Some difference, at least in terms of functional representation, is indicated. However, function in this case may wholly refer to manufacturing, edge preparation, or use.

Table 7.5 Biface Fragment Edge Condition Distribution

Depth	Ground Edge	Crushed Edge	Multiple	Absent
90-100	-	-	-	1
100-110	1	-	-	1
110-120	1	1	1	-
120-130	1	1	-	1
130-140	1	1	-	4
140-150	3	-	-	5
150-160	2	-	1	5
160-170	1	-	-	3
170-180	2	-	-	-
180-190	1	1	-	2
190-200	-	-	-	-
200-210	1	-	-	2
TOTAL	14	4	2	24

N=44

Ground edges were found to be the most significant indicators of differential edge modification between episodes of flaking. These grinding facets were observed on localized areas adjacent to breaks or isolated between negative bulbs of percussion.

There are no immediate indications of a correlation between the presence of grinding facets and adjacent fracture (truncated) surfaces. Grinding can be used as a method to prepare and strengthen an edge for removal of a single flake of specified dimension. Grinding can also complete the preparation of a total bifacial edge.

As sequential flake detachments occur, conspicuous grinding facets will decrease until entirely removed from the edge, or until breakage such as a transverse fracture or biface truncation (fatal error) occurs. Difference between observed wear and lack thereof could be an accidental relation to the refinement state of the individual segment and not to the original biface as a whole. Many of the biface fragments have grinding facets covering a low percentage of the existing area.

Highly refined edge flaking can be cited as a characteristic of completion, signifying the end of a manufacturing sequence. At the same time, this edge

quality can be placed in a functional sequence involving re-dulling and resharpening. These same notions are applied to less refined edges, including those classified as crude.

Now that use-wear studies (Hayden 1979) have drawn great attention to attributes of functioning tool kits, the problem of defining clear-cut manufacturing sequences becomes difficult. Bifacial reduction stages can also reflect use-wear. Difference between manufacturing morphology and resulting wear versus use-wear can be subtle. All of this is tangled in what Jelinek (1976:20) refers to as stylistic as opposed to functional attributes. He feels that few archaeologists have been able to adequately control either in lithic analysis. In order to gain a clear understanding of either one, both need to be given similar attention while analyzing manufacturing sequences or use-wear. Value of this type of analysis is limited in the incomplete data base at a manufacturing loci.

Cultural materials from Zone I strongly indicate a primary focus of activity centering on manufacturing tools. The scant use-wear evident on some artifacts is too insubstantial to glean useful information about behavioral subsistence and processing of plant and animal products. There are no good indications of activities other than manufacturing and maintaining tool kits in the overall assemblage.

Table 7.6 Summary of Four Variables Observed on Bifaces
From Zone I: Fragment Orientation, Edge Morphology,
Edge Condition, and Location of Cortex.

Level	Lateral Fragment	Tip	Base	Tip/Base	Midsection
90-100				(O/D)	
100-110			(O/L)	X/D	
110-120	* /A			(O/A) X/D	
120-130			X/A	X/D	(*/F)
130-140	* /A X/U	* /F O/D	X/A	(O/D)	
140-150	(*/A) X/A X/L	(*/A)	O/A	X/L	* /A (O/A)
150-160	O/A O/L (X/F)	3 O/A	X/U		(*/A)
160-170	O/A	O/F		O/A (O/U)	
170-180			(O/L)		(O/F)
180-190		O/A	(*/B)	X/F	
190-200					
200-210			* /F (X/U)	O/A	
Totals	10	8	9	11	5
N=43					

Legend

X Crude edge
O Moderate edge
* Refined edge
() Edge ground

A Cortex absent
D Distal cortex
L Lateral cortex
B Basal cortex
F Facial cortex

Four values drawn from observations of biface fragments (i.e. orientation, edge morphology, location of cortex, and condition) were plotted to compare overall morphology of biface fragments by level (Table 7.6). Fragment orientation relates to the portion of the original biface which the fragment represents. Edge morphology records one of three possible edge refinement states. Location of cortex is noted relative to the original fragment orientation. This records one of five possible locations where cortex is present. Condition of the edge is limited here to the presence or absence of grinding facets. Each biface fragment was assigned four values, one from each of these observation sets. Attempts were made with these four variables to ascertain patterning which might show some differences in manufacturing trajectories through time.

Presence of cortex on distal ends of biface fragments in upper portions of Zone I is significant. This indicates a degree of shared qualities with the Early Woodland practice of sometimes leaving cortex intact on distal or proximal ends of refined bifaces or cache blades. Bifaces from Zone I with this trait, rather than possessing refined edge morphology, were aborted in an early stage of reduction. This left little bifacial refuse to account for other segments of the manufacturing trajectory of cache blades.

After plotting occurrence of the variables used in Table 7.6, there are few indications, other than that discussed above, to ascertain a manufacturing shift within Zone I. Deposits at 160 cm bd and above produced the only refined biface fragments which lacked cortex. Moderately refined edge morphology on bifaces lacking cortex is weighted toward the lower deposits. A total of 10 of 11 bifaces with these characteristics occur below 140 cm BD. Below this, only three specimens account for other co-occurrences of edge morphology or cortex categories. The enhancement of control over technical application through time may be responsible for this. This notion rests upon the assumption that fatal errors will be manifest among the range of bifacial modification states. Nichols and Allstadt (1978:2) suggest error rates for experienced flint knappers will vary with the artifact being made. The implication is that errors will continually occur for a variety of reasons. Artifacts with different size requirements (i.e. length, width, thickness) automatically necessitate adjustments on the part of the knapper to manufacture consistent stone products. This entails using different sorts of hammers or punches and requires adjusting motor skills to apply special amounts of force more accurately. When raw material has flaws the picture is even more complicated. Even with steps taken to lessen possible unresolvable breakage or fatal errors, techniques used to produce desired effects may have to be eliminated. When this is the case, the finished product will not compare well with others made from material without flaws. On the other hand, choosing to use all of the standard techniques and stages of manufacture, regardless of the raw material's quality would cause a series of fatal errors. Fragments resulting from fatal errors would enter the archaeological record, exhibiting segments of the manufacturing trajectory which would otherwise be concealed. Large biface or cache blade manufacture required mastery of special bifacial reduction skills. Selection of proper tools, edge or platform preparation, and force adjustment are some of these. Evidence for large biface/cache blade manufacture will be taken up again in this report, citing additional data from the biface and flake samples.

7.3.2.2.2 Inclusions and Fracture Planes on Bifacial Forms

These observations were made to identify and isolate potential failure causes within the biface and projectile point classes. This determined the causes of observed fractures in these two categories. A discontinuity in an otherwise homogeneous mass near or within an area of trauma does not automatically identify fracture cause. It is much more complex than this. It is true that finding a discontinuity, such as a plane facet or inclusion tends to prescribe the cause of a fatal error, but this is also relative to the factors of technical application.

Various material discontinuities divert normal flake fracture development. Thus, there are fracture morphology changes that can be cited as significant for certain bifacial truncations. While a diagenetic plane of weakness may allow a release of tension prior to flake detachment, many planes of weakness will not be fully freed by force along their entire extent. In the biface sample, these are truncations which demonstrate an area of imperfection which caused an incomplete conchoidal fracture development. Planes are relatively easy to identify since they will occur as a flat surface and lack indications of conchoidal fracture. A cluster of imperfections can cause an irregular fracture development which becomes a fatal error during manufacture.

The three types of inclusions in Wyandotte Chert (planes of weakness, textural discontinuities, and solution cavities) were identified in the bifaces. These were used to analyze the sample for specific causes of fatal errors due to these raw material discontinuities (Table 7.7). One half of the bifaces contained material discontinuities relating to their destruction.

Table 7.7. Material Discontinuities Observed on Biface Fragments within Fractured Areas

Depths in Cm Bd	Planes of Weakness	Textural Discontinuities	Solution Cavities	Multiple Impurities	Absent
90-100	(1)	1	-	-	-
100-110	1 (1)	1	-	1	-
110-120	-	1	(1)	-	3 (2) (1 heat)
120-130	(1)	(1)	-	-	3 (1)
130-140	1 (1)	1 (1)	2 (1)	1	1 (3)
140-150	3 (2)	-	1	-	4 (6)
150-160	1	1	(1)	-	6 (7)
160-170	1	-	1 (1)	-	2 (3)
170-180	(1)	1	(1)	-	-
180-190	1 (2)	1	1	1 (1)	(1)
190-200	-	-	-	-	-
200-210	-	1	1 (1)	1 (1)	(1)
Totals	8 (9)	6 (2)	6 (6)	4 (2)	24 (20)

Numbers in parentheses indicate the co-occurrence of traits observed on the surface of the bifaces outside the fractured area.

Examples - 1 (1) is a single biface fragment with a discontinuity inside the fractured area and also on the surface of the artifact fragment.

3 (2) represents three separate biface fragments; however, only two of these share co-occurring traits as in the above example.

A plane of weakness is the result of geologic bed formation which is a process (diagenesis) related to the period when sedimentary rock (chert) was formed. Planes of weakness, being ancient material fractures, are usually stained by minerals or possess small crystals which grew inside these fine cracks in the chert bed allowing partial bonding of the original fracture. Since the surface of a plane of weakness differs from that of a freshly broken surface in chert, it is possible to consistently identify planes of weakness in the biface sample.

Textural discontinuities relate specifically to changes in the homogeneity of the chert. Within the Wyandote chert zone there are many irregularities in the chert. Nodular chert in particular, exhibits a range of forms from pure hydrated silica to balls of limestone bonded with minimal silica. There are also clusters of crystals and other mineral constituents which are common in the chert overall but occur sporadically.

Solution cavities are the third type of inclusion. Crabtree's (1972:70) definition of inclusion contains solution cavities since they ruin the homogeneity of the raw material as a whole. Solution cavities in the lithic assemblage comprise a variety of types formed by different agencies in the original sediment and appear most readily as small circular holes in the raw material. Many of these seem to be oolitic and crystalline casts left vacant during formation, or remnant inclusions, which were chemically eroded from the raw material.

Multiple impurities imply the presence of one or more of the three variables per biface fragment. Multiple impurities account for the lowest number (4) of biface fragments. Planes of weakness were found to be the most common material discontinuity (9 biface fragments). A close correlation between planes of weakness present within the fractured surface and those present outside the area of fracture is significant, with 8 of 9 specimens exhibiting these traits. Textural discontinuities and solution cavities are present in the same frequency when they occur inside a fractured surface. Solution cavities occur on the bifaces inside and outside the fractured surface and are evenly distributed throughout Zone I. Textural discontinuities, on the other hand, do not present the same distribution. Textural discontinuities not associated with a fractured surface occurred only twice in the deposits between 140 and 120 cm bd. This indicates that while textural discontinuities are not common (six out of a total of 44) there were only two instances out of eight where a fatal error did not occur associated with it.

Half of the biface sample demonstrating no material imperfections was broken for reasons other than material quality (Table 7.7). These were problems of technical application which would best be described as fractures relative to errors in flaking. If the amount of force or the angle of the blow is not correct in bifacial reduction, the result will be thick or short flake scars, which can inhibit further thinning and shaping to complete a useable tool. These are referred to as hinge and step fractures (Crabtree 1972:68&93).

The mechanical problem of material quality has not been discussed, except where it can be shown to be a factor in understanding the biface refuse. Planes of weakness and solution cavities are readily seen in naturally

weathered raw material. They offer a measure of predictability as to modification potential and problems. Textural discontinuities, on the other hand, are often localized phenomena that may not be manifest until modification has already begun. Prehistoric use of chert with structural weaknesses allows us to view various bifacial manufacturing trajectories in the form of discarded fragments. What is manifest morphologically in the biface samples is the result of both natural and cultural factors.

Two basic mechanisms causing fatal errors to occur were recognized. These were natural and culturally induced fractures. The simple and most direct way to sort natural and cultural fractures is to explicate existing material weakness within fractures. These fractures, which follow natural planes of weakness, etc., are best understood related to the reduction process itself. The various morphological differences in the sample are in part due to the amount of reduction that took place before the occurrence of a fracture following a material discontinuity. Weak areas become increasingly vulnerable to fracture as the artifact is refined. Reduction lessens the amount of mass to absorb percussion shock waves. These travel through the stone as vibrations emanating from the point of impact, even during flake detachment.

Both natural and cultural mechanisms of fracture are governed at a higher level by technical application. Technical application is the process by which the knappers themselves applied control over raw material. This acknowledges technological systems, which chose to ignore, failed to compensate, or modified reduction strategies to reach desired stone products. There is also the separate problem of accounting for reduction failures with no obvious material imperfections. Within Zone I, the biface sample can be sorted into two groups: those that fractured because of material imperfections and those that fractured because reduction techniques were misapplied.

7.3.2.2.3 Technical Application Problems

Certain flaking characteristics can be cited as representing accidents, that, in some instances, cause undesirable effects in lithic reduction. Two characteristics often regarded as knapping errors are hinge fractures and step fractures. Crabtree's (1972: 68, 93) definitions of these flake scar types refer to them as problematic flake developments, that can inhibit desired results in flaking sequences. Both are termination types. The hinge fracture terminates the flake at a right angle to the longitudinal axis, with the distal end of the flake or flake scar being rounded from the change in fracture direction. Step fractures are right angle terminations; they are a break or truncation of the distal end of the flake. Crabtree notes this involves a dissipation of force or flake collapse.



Figure 7.12 Hinge and Step Fractures

The likelihood of fatal error due to the presence of hinge and step fractures on the biface fragments must be assessed in light of the earlier discussion, which specified biface truncations due to material imperfections. Hinge and step fractures are flake terminations differing from a feathered termination. Hinge and step fractures do not conform to the even surface produced by feathered termination. Hinge and step fractures terminate with an abrupt or thick edge that does not conform to the existing surface. Any of these flake terminations can be distorted due to material flaws. When this occurs the material imperfection will normally be present to allow natural as opposed to culturally induced flake scar morphology to be separated.

Table 7.8 summarizes these fracture types for the biface fragments. Some specimens exhibited more than one example of either fracture type. Step fractures occurred nearly twice as often as hinge fractures. Overall, combinations of both occur most frequently. Judging from the presence of hinge and step fractures half the biface fragments suggest a consistent problem in technical application.

Table 7.8 Surface Morphology of Biface Fragments

DEPTH	STEP FRACTURES	HINGE FRACTURES	MULTIPLE FRACTURES	ABSENT	TOTAL/LEVEL
90-100			-	1	1
100-110	-	-	2	-	2
110-120	1	-	-	2	3
120-130	-	-	1	2	3
130-140	-	-	3	3	6
140-150	1	2	1	4	8
150-160	2	1	1	4	8
160-170	-	1	1	2	4
170-180	1	-	-	1	2
180-190	1	-	1	2	4
190-200	-	-	-	-	-
200-210	1	-	2	-	3
	7	4	12	21	44

N=44

Multiple fractures relate to biface fragments exhibiting both hinge and step fractures. These are not recorded in the separate columns for hinge and step fractures. Likewise specimens possessing one fracture type are excluded from the column for evidence of multiple fractures.

Traits observed regarding occurrences of material discontinuities relative to fractures were compared to occurrence of actual flaking characteristics, such as hinge and step fractures. Table 7.9 presents the occurrence of these variables on fragmented bifaces by level. Several comments should be made regarding this array. Of 44 fragmentary specimens, only seven were found to completely lack any observable traits which would suggest a

correlation between material or surface morphology and a fractured surface. These occurred in the middle portion of the deposits within 50 cm vertically. While the major reduction activity increases frequency, it is here that more of the possible range of occurrences (completions and failures) will be seen. This assumes that completed tools, which meet specific requirements, will be represented only by flake debitage in the manufacturing area. A utilization loci devoted exclusively to bifacial manufacture of stone tools should, in general, contain only bifaces and fragments which did not conform to the requirements suitable for viable tools to be used outside that area.

Table 7.9. Comparison of Material Discontinuities and Flaking Discontinuities in the Biface Sample

Depth	Material Discontinuity Outside Frac. 1	Material Discontinuity Inside Frac. 2	Flaking Discontinuity 3	Co-occurrence				
				1 & 2	1 & 3	2 & 3	1 & 3	Absent
90-100	-	-	-	1	-	-	-	-
100-110	-	-	-	-	-	-	2	-
110-120	-	2	1	-	-	-	-	-
120-130	1	-	-	-	1	-	-	1
130-140	2	1	-	-	-	1	2	-
140-150	-	2	1	-	-	1	2	2
150-160	-	-	3	1	-	1	-	3
160-170	-	1	1	-	-	-	1	1
170-180	1	-	-	-	-	-	1	-
180-190	-	1	-	1	-	-	2	-
190-200	-	-	-	-	-	-	-	-
200-210	-	-	-	-	-	1	2	-
N= 44	4	7	6	3	1	4	12	7

Material discontinuities outside fracture surface relates to planes of weakness, etc. not associated with a fatal error.

Material discontinuities within the fractured surface suggest a positive association with fatal error in biface manufacture. Types of discontinuities are the same as those for observation outside the fractured area.

Flaking discontinuities combine step and hinge fractures.

As shown in Table 7.9, the number of specimens exhibiting a material discontinuity in a fractured area implies a relationship between flaws and fractures. Of the biface fragments in the sample, one-half have fractures that can be attributed to raw material discontinuities. Of these, those present inside the fractured area occur twice as often as those with the discontinuity not associated with the fracture. Combined occurrences of traits 1 and 2 were identified relatively few times in the sample. The co-occurrence of all three traits accounts for the highest number (12) of biface fragments. All three discontinuities are shared among the largest number of biface fragments, which implies that poor quality raw material and technical application prevails in the sample. The notion that refuse contains undesirable by-products or rejects is appropriate. However, this does not account for the presence of poor quality material which could have been rejected by the knapper.

The center of Zone I may allow extrapolation of information regarding differential raw material quality selection within the deposits. Of eight specimens recovered from this level, only two present traits characterized by raw material flaws. One specimen carried material discontinuities within the fracture and on the surface of the artifact. Another specimen carried an imperfection within the fractured area and a flaking problem. However, the six remaining specimens are equally divided between flaking discontinuities and a lack of any observed discontinuities. The basic pattern of material discontinuities and flaking discontinuities is broken in this level. Relative absence of morphological imperfections in specimens recovered from 150-160 cm BD indicates higher standards of raw material selection. Fractures occur but lack material and flaking imperfections.

Much of the sample of biface fragments reflects a pattern of poor quality material and workmanship. This is accountable by a hypothesis in which items of least utility will be discarded. Anything of use will be further modified or removed as a tool. Nevertheless, assuming intent to make viable tools was the case, the extant morphology of the biface fragments is useful for discussing and comparing differences or trends. Poor quality material and workmanship continued throughout Zone I with an abrupt and short lived change in the middle of the cultural zone. This change is manifest in the biface sample in level 150-160 cm BD, where minimal occurrences of raw material discontinuities suggest an increased attention to higher quality chert. This change occurs just prior to the appearance of biface types possessing distal cortex.

7.3.2.3 Projectile Points

Projectile points (hafted bifaces) from Zone I were subjected to a battery of observations. These included complete versus fragmentary material discontinuities inside and outside fracture areas; the degree of edge refinement (crude or refined); flaking discontinuities; edge bevel; and the occurrence of cortex. These are generally the same observations made of the unhafted bifaces; however, the presence of recognized hafting elements represents an additional stage in the manufacturing sequence. With few exceptions, the "projectile point" sample does not represent finished products but rather discards. These discarded hafted forms represent a

"step" closer to the finished, idealized product of the knappers' mental template (Deetz 1967:43) than do unhafted bifaces. Projectile points or bifaces with or without a hafting element should be regarded to represent products of contrasting manufacturing trajectories.

A total of 22 specimens (complete and fragmentary) were recovered and analyzed. A summary of observations made is presented in Table 7.10. Thirteen of the points exhibit crude edges. When facial and lateral cortex are considered, it generally appears most specimens are well within the stage of secondary flaking and shaping. Except for the Turkey Tails and Buck Creek Barbed examples, points analyzed do not appear to have advanced to a stage of manufacture where the knappers mental template or goal (i.e. a culture or chronologic specific point "type") can be recognized. Most specimens (17) were discarded due to manufacturing errors.

There is little or no evidence of point or other tool refurbishing in materials recovered from Zone I. Presence of a hafting element on bifacial forms must be viewed with caution. While in most cases these artifacts represent a stage in the manufacture of stemmed projectile points, they are not a finished artifact form. It is likely that had they been completed, most would bear little resemblance to the forms in which they were discarded.

There were only two projectile point classes identified. A Buck Creek Barbed and two "classic" Turkey Tail bases. As stated in the prehistoric perspective (Chap 4.1), both of these point types are attributed to cultural manifestations of the terminal Archaic to Early Woodland transitional period (1500-250 B.C.). Descriptions have been presented previously in this chapter (7.2.4). The importance of the Buck Creek Barbed specimen in terms of a chronological "marker" has been discussed. While it represents the only complete diagnostic specimen recovered from the site, it has been considered, within this lithic analysis, only as a representation of a finished product in the lithic reduction sequence.

The presence of the Turkey Tail point in the assemblage is best represented by two proximal ends or "haft snaps." Positive identification of both examples is made based on distinctive morphological characteristics and visual comparison of width relative to thickness with specimens in collections at the Glenn A. Black Laboratory of Archaeology.

Haft snaps are thought, in most cases, to represent tools fractured in use rather than manufacture. However, because Turkey Tails are generally thought to serve a sociotechnical purpose rather than a functional one (Binford 1963:187; Didier 1967:11-12), the two examples (Figure 7.10) most likely represent manufacturing errors. These errors resulted in fractures running across the base of the blade. Subsequently, the haft snap would have been discarded and a new hafting element would probably have been executed on the base of the blade segment. Haft production (stems or notches) is a critical step in manufacturing stages of any class of hafted tool, and it can generally be minimized by shifting technique to gain better control. In the example of hafting "classic" Turkey Tail blades, this step becomes more problematic and error prone because of their size relative to notch width.

	Complete	Fragmentary	Material Discontinuity Outside Fracture	Material Discontinuity Inside Fracture	Edge Morphology Crude	Refined	Flaking Discontinuity	Edge Bevel	Distal Cortex	Facial Cortex	Basal Cortex	Cortex Absent
Turkey-Tail Cluster												
120-130	-	x	-	x	-	x	-	-	-	-	-	x
150-160	-	x	-	-	-	x	-	-	x	-	-	-
Contracting Stem												
110-120	x	-	-	-	x	-	-	-	-	-	-	x
120-130	-	x	x	-	-	x	-	-	-	-	-	x
130-140	-	x	x	x	x	-	-	-	-	-	-	-
140-150	x	-	-	-	x	-	x	-	-	-	-	x
150-160	-	x	-	-	-	x	-	-	x	-	-	-
160-170	-	x	x	-	x	-	-	-	-	-	-	x
190-200	-	x	-	-	x	-	x	x	-	-	-	x
Straight Stem												
120-130	-	x	-	x	x	-	x	-	-	-	-	x
140-150	-	x	-	-	x	-	x	x	-	-	-	-
170-180	x	-	-	-	x	-	x	x	-	x	x	-
	-	x	x	x	x	-	x	x	-	x	x	-
Buck Creek Cluster												
150-160	x	-	-	-	-	x	-	x	-	-	-	x
Indeterminate												
140-150	-	x	-	-	x	-	-	-	-	-	-	-
150-160	-	x	-	-	-	x	-	-	-	-	-	x
170-180	-	x	x	-	x	-	x	-	-	-	x	-
180-190	-	x	x	x	-	x	x	-	-	-	-	x
200-210	-	x	-	x	-	x	-	-	-	-	-	x
Totals	5	17	7	8	14	8	10	6	2	2	7	13

Table 7.10 Projectile Point Characteristics.

7.3.2.3.1 An Unusual Initial Stage of Projectile Point Manufacture

An example of an early projectile point manufacturing stage is shown in Figure 7.13. This specimen is a unilaterally edge trimmed flake recovered from 150-160 cm BD in unit Clc. It is bifacially flaked along the proximal end and one lateral edge of the original flake. A shallow side notch is present on the right side, adjacent to the striking platform. The lateral margin or blade edge has been turned at least once with existing edge alignment parallel to the opposite unworked edge. This is the only specimen of its kind discovered. There are no obvious manufacturing signs which would account for its disposal, except possibly that the distal end is truncated. The interesting aspect of this specimen is that it possesses a plane of weakness that has not fractured. Discard could have occurred because of the recognized propensity to fracture along this plane during further flaking. Whatever the reason for its discard, the fact that it took place allows us to view an example of initial projectile point manufacturing that includes the beginning of a hafting element, prior to completing a continuous bifacial edge on the original flake. It is probable that the hafting element morphology would have changed significantly had the specimen been totally worked. The presence of comparable flakes with length, width, and thickness sufficiently massive to accommodate Terminal Archaic/Early Woodland projectile point manufacture are minimal in the deposits.

Cook's (1980:22) chart for manufacture of chert objects assumes a distinct bifacial stage prior to production of hafting elements on projectile points. The edge trimmed flake exemplifies simultaneous production of a hafting element and bifacial thinning and shaping. Importantly, a blank or preform stage does not exist for this specimen. To what extent this represents a traditional approach to projectile point manufacture is not known. However, it does suggest that all bifacial forms do not share a similar reduction trajectory. Additionally, flake or block dimensions will inhibit or enhance more or less flaking per specimen.

In the case of flakes meeting thickness requirements, the standard reduction method would be optimal rather than prescribed. Highly controlled flake or blade detachments will produce finished tools without necessitating modification after detachment. In a case where less control is taken to reduce a core or block into useable flakes, a range of sizes and thicknesses will be exhibited from which to choose. Flakes selected for bifacial modification will hypothetically represent a range of dimensions which will require more or less reduction to produce a consistent product. Hafted and unhafted bifacial products will possess or lack surfaces relating to the original state prior to bifacial reduction on an individual basis, depending on the amount of reduction required. The frequency at which the original surfaces occur depends largely on one of two things: the degree of selectivity and the degree of control over flake production (i.e. control of dimensions).

7.3.2.3.2 Notching Errors

In two cases, it was possible to verify manufacture of projectile point hafting elements in Zone I. In the inspected sample, two flakes exhibiting hafting elements were identified (Figure 7.10 C and D). One flake from unit A3c level 150-160 cm BD relates to either a notch or stem on the original

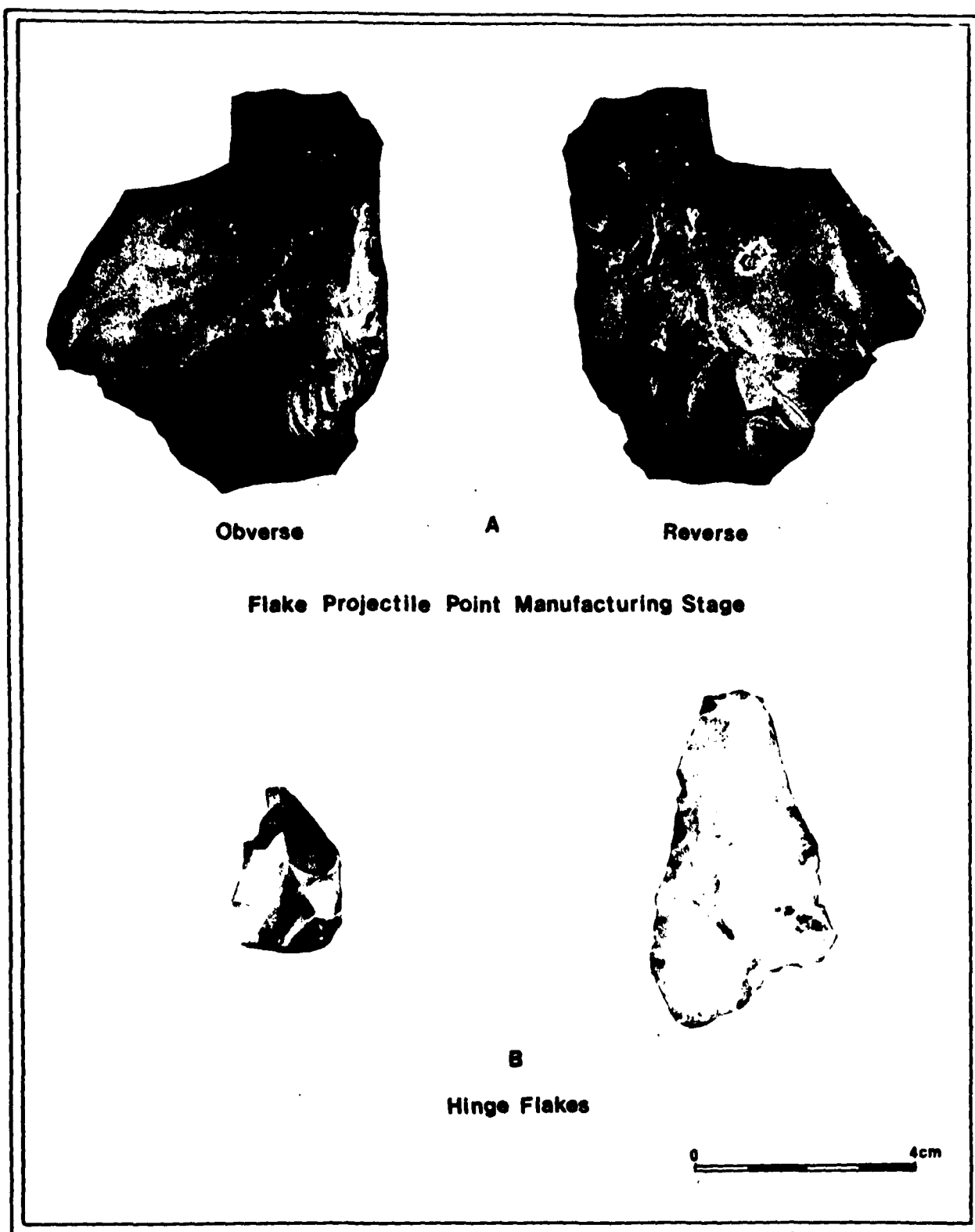


Figure 7.13

point with with a portion of the basal edge intact. This flake was detached from some form of straight or contracting stem point. The second flake is from unit Clc level 130-140 cm BD. This flake exhibits a portion of the shoulder and notch of the original point.

The basis for recognition of these fatal errors in notching application rests on experimental replication studies. Examples of various forms of fatal errors in manufacturing have been recorded. These comprise a lithic comparative collection used to help identify subtle attributes of prehistoric material which either go unrecognized or defy reconstruction of factors involved in their production.

A variety of manufacturing errors have been recognized that pertain to localized points on hafting elements. Figure 7.14 relates to one such experimental error, resulting in a detached flake with two diagnostic features. First, a portion of the shoulder edge was removed, bearing both faces of the original projectile point. Along with this, part of the curvature of the original notch is present just below the striking platform. An additional characteristic is the presence of crushing and rounding of the original notch, indicating several futile attempts to initiate a flake detachment. Important here is the presence of a different edge morphology and curvature that contrasts with the portion of the flake which represents the shoulder of the projectile point. These attributes allow a reconstruction of the original tool fractured during manufacture. The notch flake produced by experimentation distinctly resembled the notch flakes shown on figure 7.10.

A total of 22 hafted bifaces (projectile points) were recovered from Zone I. These specimens were classified according to the presence of a distal, bilateral indentation or hafting element. While all of these points are generally diagnostic of the Late Archaic through Early Woodland time periods, only two can be compared to "accepted" projectile point types (two Turkey Tails and one Buck Creek Barbed).

Excepting the complete Buck Creek Barbed point, all of the other points represent rejects rather than finished tools. The majority of these exhibit flaking patterns similar to the unhafted bifaces in that technical application was a recurring knapping problem. Knapping errors (i.e. misguided force or angle) account for half of the projectile point fragments, while the remainders are related to a complex of variables, of both flaking and raw material imperfections.

With the exception of the Buck Creek and two classic Turkey Tail specimens, it appears that many of the projectile points represent production of a haft element without a preceding unhafted biface or preform stage. Therefore, these specimens were probably produced by simultaneous manufacture of the bifacial form with a hafting element. A single unique example, exhibiting a very early stage of projectile point manufacture, exemplifies the lack of a preform stage of manufacture. Assuming that unique flaked stone products are under-represented in a manufacturing site, this example of initial manufacture of a hafting element is an important link in the interpretation of the manufacturing trajectories of projectile points recorded in the cultural debris from Zone I at the Cole site.

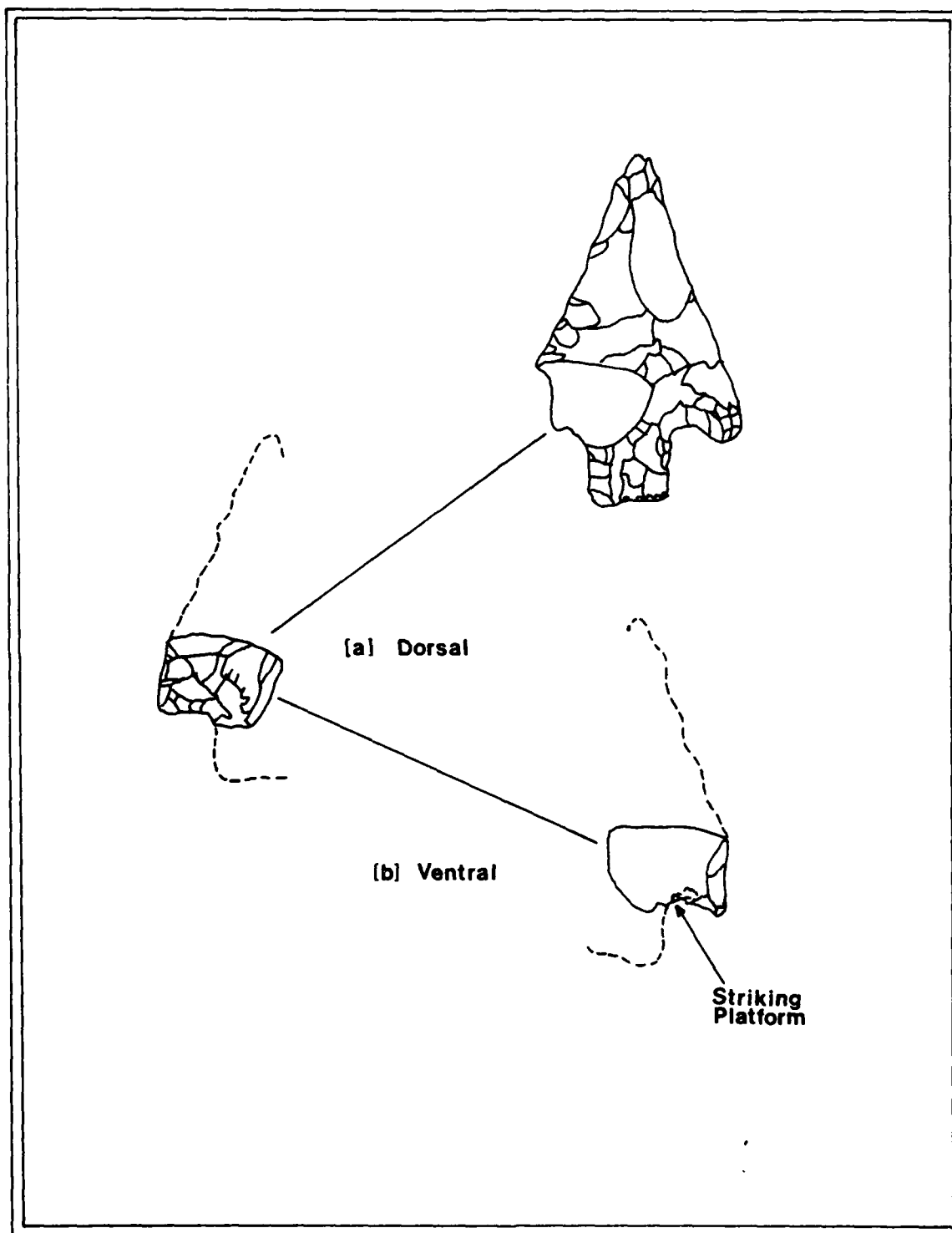


Figure 7.14 Notch Flake Experimental Replication.

7.3.2.4 Microflakes

Abundant microflakes were recovered from waterscreen and flotation columns. Analysis of these materials was limited to general observations to allow research potentials to be identified. Table 7.11 lists the observations used to examine the microflake sample. All observations were undertaken with the naked eye. Aid of a microscope or handlense would be appropriate for characterizing varying wear intensity and/or use wear; however these studies were not undertaken.

Table 7.11 Microflake Observation Criteria

Chert

- Oolitic
- Non-oolitic

Whole flakes

Those exhibiting both striking platform and complete termination

Cortex

Many small flakes do not possess cortex. When it occurs in microflakes, it would generally relate to initial stages of manufacturing rather than finishing or edge refinement.

Pressure flakes

These are flakes derived from pressing rather than percussion. Morphologically, they share characteristics with percussion flakes. However, those examined from experimental studies allow some degree of confidence in sorting flakes derived from pressure.

Flakes with platforms

This records all flakes possessing a point of applied force, which produced the flake.

Ground and/or crushed platforms

This observation helps determine the degree of original edge refinement prior to flake detachment. It also suggests the method of detachment (i.e. pressure or percussion).

Most of the microflakes were fragmentary. Microflakes can result from secondary sources of fragmentation other than flake detachment. Pressure flakes produced via hand-held methods can crush and pulverize during or soon after detachment if not disposed of immediately. This is quickly discovered by experimentation. From inspection of the sample, it is apparent that they can be used to identify the presence of highly refined edge modification behavior, since specific flake parts can be identified.

Oolitic and non-oolitic varieties of Wyandotte derived cherts are present. Oolites were apparent even with the small size of the individual flakes examined, although it is impossible to state definitely the number of

flakes made from oolitic chert, given flake size relative to the varying density of ooley bodies. As microflakes, these cherts are equal in quality. Cutting edge refinement was not limited to a single specific fossiliferous or non-fossiliferous local chert.

Any portion of a series of manufacturing stages can be represented in a microflake sample. In the sample, there are substantial differences in flake width and platform width suggesting differing modes of detachment. Cortex is present on some flakes implying shatter from a much larger flake, or minute flakes resulting from initial reduction, rather than completion. Ground and crushed platforms present an array of morphologies representing types of edge rejuvenation from resulting use-dulling or various types of attrition from platform preparation and flaking variation. Examples of possible pressure flakes were apparent, judging from flake morphology and the minute platforms observed. Regardless of what technique they might represent, these flakes indicate that highly refined edge modification has occurred within the deposits. Projectile points were thoroughly examined and few bore essential signs of this degree of edge refinement. This is another indication that bifacial forms within the deposits are as much a waste product as are the flakes resulting from their manufacture. The fragmentary nature and crudity of the bifaces suggest manufacturing errors and formal rejections. It is largely from the flake debitage that we see the remains of progressive refinements leading to completion. Thus, most tools of adequate form and dimensions were finished and carried out of the area of manufacture for use elsewhere and are not present for study within the context of manufacture.

Reassembly of microflakes has been accomplished in some studies (Sheets 1975:340; Frison 1974:100, Fig. 1.56) using flakes, cores, and bifaces to ascertain continuity within clusters of debris. Materials at the Cole site may be suitable for comparable research. Additional specialized microflake analysis might be able to specify the activity which produced the microflakes. In this context the hypothetical explanation is tool completion in a manufacturing area. However microflakes from rejuvenation of a previous cutting edge could look much the same.

7.3.3 Chert Selection Factors

At this stage of the analysis, it is appropriate to compare different chert qualities of artifacts from Zone I. The study of chert quality within the Wyandotte chert zone (Chap. 3.2, 3.3) is used to approach the lithic debris considering the quantitative and qualitative aspects of the available cherts and what was actually used by the inhabitants.

The interest in chert studies in recent years has been to study geographic extents of particular chert bearing strata and to compare prehistoric utilization loci within and outside these natural areas. Much more than this can be done using chert quality to give additional substance to those studies. Chert quality can be a basis for studies within quarry and workshop sites where only a single chert type may be recognized. At the Cole site the overall pattern throughout prehistory is one oriented to the plentiful Wyandotte chert with a near absence of other chert materials.

There can be a host of reasons for particular raw material frequencies at a given archaeological site. Most often, two are offered as explanations. The first is the availability of a particular chert near a habitation site. Often, it is apparent that chert most common in the immediate area is the predominate raw material present at habitation sites. High availability of the chert resource is one possible explanation for the frequency of the artifactual material debris on archaeological sites. The second is raw material preference. Raw material preference factors may even determine site location at the expense of any other subsistence or resource proximity variables. Probably the most important aspect of prehistoric raw material utilization patterns is one that is seldom approached in the literature. This is the aspect of material quality. Raw material quality is a variable rarely considered in availability or preference study approaches. It is the key variable. The inherent problem is that particular qualities of a chert resource are selected (i.e. grain size, mass, freedom from planes, etc.) from within the range of a particular chert type that we may recognize. It can either be restricted or extensive. Thus, viewing availability from the aspect of varying quality may present a very different picture of raw material utilization. When a raw material is abundant, an archaeological site in the area may contain tools and debris of a particular quality that is actually a scarce commodity considering the local chert deposits as a whole. Grades of particular raw materials were given great attention in prehistory. Certainly, this emphasis on raw material quality was the vehicle promoting experimentation, which eventually led to synthetic means of increasing quality by heat treatment.

Wyandotte chert is not conducive to qualitative improvement. Several independent experiments, including those by John W. Richardson and others at the Glenn A. Black Laboratory of Archaeology at Indiana University, have noted a consistent tendency for a rough texture to occur on flaked surfaces following subjection to intense and prolonged heat exposure. What is apparently involved is a near reversal of the effects of heat treatment noted in experiments using other cherts (see Purdy and Brooks 1971; Crabtree and Butler 1964). Original quality is usually improved by heat treatment for more potential and optimal serviceability of cutting edges. Results of experiments with Wyandotte cherts have made the opposite effect a characteristic feature of this material (Boissvert et al. 1979:70).

A rough "sugary" texture was observed on artifacts recovered during the excavation. Attempted heat treatment is not indicated, since there appears to be no particular manufacturing stage selected for heat alteration. Heat fractures occur in the full range of crude to highly refined and hafted tools. The sugary texture on Wyandotte chert suggests disposal in fires. Our materials fit well within this interpretation.

The Wyandotte chert study (Chap. 3.3) described the range of raw material forms and qualities available within the region. This information identified the natural spectrum from which prehistoric peoples could potentially draw to produce tool kits. Examination of a variety of collections in the region noted that results of the chert study outline materials found consistently on archaeological sites throughout the region. Fundamentally, there is a very low frequency of other chert types apart from Wyandotte chert zone derivatives present.

The next step is to compare the natural expression with that of the cultural use expression. Identifying natural structural forms in unmodified material is simple in comparison to dealing with the reduction processes used to derive comparable information inherent on the cultural level. For example, limestone cortex configuration is called upon to assess the use of bedded cherts as opposed to nodular cherts. Other features, such as nodule centers can be used when present.. Bedding planes can also be inspected. However, any of these observations are dependent upon the reduction, utilization, and disposal patterns of the users.

Table 7.12 Wyandotte cherts Observed in Bifacial forms

DEPTH	OOLITIC NODULAR	OOLITIC BEDDED	OOLITIC INDETER.	NON- OOLITIC NODULAR	NON- OOLITIC BEDDED	NON- OOLITIC INDETER.	?
90-100	1	-	-	-	-	-	-
100-110	-	-	-	1	-	1	-
110-120	-	-	-	1	-	2	-
120-130	1	-	-	1	-	3	-
130-140	1	-	1	4	-	2	1
140-150	-	-	-	6	-	4	-
150-160	-	-	1	6	-	5	-
160-170	1	-	-	3	-	2	1
170-180	-	-	1	3	-	2	-
180-190	-	-	1	3	-	-	-
190-200	-	1	-	-	1	-	-
200-210	-	-	-	1	-	3	-
TOTALS	4	1	4	29	1	24	2
TOTAL OOLITIC			9				
TOTAL NON-OOLITIC			54				

Data accumulated regarding formal and qualitative aspects of Wyandotte chert does not suggest that Cole site inhabitants always obtained the same quality of raw material, considering specific amounts of silica per mass. If this were the case, it would suggest extended quality maintenance costs, involving time, labor, and transport. Considering quantity and quality of material present, acquisition of raw material generally would not appear to reflect labor intensive efforts.

Table 7.12 summarizes observations of chert qualities of the biface and projectile points (bifacial forms with hafting elements). Since these two categories represent the bulk of bifacial forms, it is necessary to include all similar objects in order to discuss a pattern regarding utilization.

The chert study concluded there is a distinct qualitative difference between Wyandotte cherts in terms of amounts of hydrated silica relative to available mass. A measure of confidence was established in recognizing oolitic versus

non-oolitic Wyandotte cherts. Specific specimens in the artifact sample, consistently exhibit the highest grades of oolitic chert available. This is the narrow margin where the qualities of oolitic and non-oolitic cherts overlap and are essentially equal.

A second aspect of availability approached in the chert study focused on the array of actual weathering states observed within the bedrock decomposition continuum, including subsequent mechanical weathering through gravel contexts. Emphasis was on condition of selected raw materials, which relates to the context from which they were acquired. The discussion centering on recognition of quarrying activity, recognized the limits to which this acquisition behavior could be identified. Identifying the range of natural weathering (primarily the degree of waterwear as opposed to terrestrial chemical weathering) will suggest possible patterns of raw material curation observed at the Cole site.

The bulk of refuse containing portions of original exteriors reflects a collection oriented toward material within a terrestrial weathering regime. In other words, limestones adhering to nodule remnants tend not to be worn away in the sample. Inspected diagenetic plane surfaces are basically free from smoothing which would suggest long-term inclusion in gravel. Diagenetic planes break differentially according to hardness of various bonding agents and their degree of resistance to mechanical weathering. In a natural setting, the last and most profound agent causing plane separation is a gravel context.

When nearly the total lithic complement presents cortex in some form, it usually indicates a terrestrial derivation for raw material acquisition. The Cole site, has produced positive evidence of use of river gravel cherts. To obtain some information on this raw material, a search of the collections was made and waterworn materials from the excavation were analysed. The total lithic complement was not examined so the sample of waterworn materials was selected irrespective of vertical and horizontal placement in the deposits. The intention was simply to ascertain some range of material forms present.

There is no question that the original source for artifacts with heavy water worn surfaces was from river gravel cherts. Familiarity with upland streams and terrestrial weathering obtained during the chert reconnaissance indicated the drastic chemical staining and surface smoothing characteristic of ancient river gravel deposits simply do not occur in the upland weathering regime. There is a continuum of degrees of weathering from bedrock decomposition, residual material on land, and heavily waterworn gravels in the river valleys. Observations differentiated moderate and heavy water-wear, and slight evidence of water-wear. Fragments showing only slight water-wear could be confused as gravel cherts when they may actually be from a terrestrial source. Little or no obvious terrestrially weathered chert fragments are present that are unmodified by man. The sample of materials from gravels also includes two residual unmodified blocks that appear distinctly waterworn but retain limestone cortex over parts of the surface.

There is no direct evidence in materials under study which would suggest curation of totally unworked terrestrial cherts. Only if substantial amounts of terrestrial cherts of varying quality were curated would one expect to find a few unmodified terrestrial cherts included in the refuse. Even so, a

high frequency of limestone cortex appears on flakes of varying sizes throughout Zone I at the Cole Site.

7.3.3.1 Stylistic Preferences and the Use of Terrestrial and River Gravel Cherts

One major difference between terrestrial and gravel cherts is the amount of mass potentially available. Long term inclusion in gravels will reduce the size and shape of homogeneous masses of hydrated silica, even after fracture planes have been freed. Consistent acquisition of specific large dimensions would necessitate utilization of terrestrial cherts. This generalization refers to the region as a whole where the Wyandotte chert zone is the dominant chert bearing strata.

The vertical evidence in Zone I indicates a continuous use of gravel cherts along with terrestrial cherts. In view of mass limitations in river gravels the presence of waterworn cortex on artifactual material is surprising considering the substantial chert resource present on land near the site. A plausible explanation to account for bifacial reduction using gravel chert is in the natural wear patterns themselves.

Chert fragments subjected to plane fragmentation will often possess flat faces and 90 degree edge angles. These characteristics often require modification in the form of beveling or sharpening (platform preparation) prior to bifacial reduction. This process shapes the face of the object to allow controlled flake detachments. It is not necessary to lower the edge angle in order to detach flakes of desired proportions; however, doing so can increase the odds of consistently producing desired results. Certainly, for core and blade production, a steep edge angle may be warranted, but bifacial reduction often entails consistent replication of cross-sectional symmetry during modification.

Aspects of gravel wear may require less labor cost to produce a specific bifacial tool. The basic morphology of bifacial products often appear in gravels, so that minimal reduction is necessary to manufacture desired dimensions from selected items. Natural biface-like shapes can be collected which were originally tabular fragments subjected to considerable rounding of existing edges, reducing high edge angles. Thus, certain otherwise problematic reduction stages may be eliminated by selecting raw material from gravels which resemble natural "preforms".

In nearly all cases, there was no difficulty identifying natural water-wear and battering characteristic of natural gravel wear patterns from that of cultural wear. One piece possessed waterworn flake scars, indicative of tool manufacture, use, and disposal. There was evidence of recuration of the artifact at a later date in waterworn form with subsequent reduction taking place. One highly waterworn pebble bears crushing characteristics of repeated localized battering on another hard surface indicating its function as a hammerstone.

Producing required edge morphology during initial reduction would appear to be a universal trait of bifacial reduction. Deviations from this involves employment of mental templates which are in part responsible for decision making mechanisms, whereby standard reduction methods will be altered depending on size, thickness, shape, and edge angle, etc. of specific raw

materials to consistently manufacture tools meeting required specifications. Gravel cherts, in this sense, would not be selected simply on the basis of a single quality, such as degree of homogeneity of hydrated silica, but for a multitude of reasons, which may or may not be apparent. One of the main reasons would appear to be selection for shape that is conducive to producing bifacial forms, with less reduction necessary, compared to residual block fragments.

7.3.3.2 Identification of Nodular non-oolitic Cherts

Criteria for identifying specific chert forms present from flake debitage was accomplished by several means. Given the inherent fragmentation of the non-oolitic lense cherts, they are often so fragmentary in archaeological context as to be readily confused with the nodular non-oolitic. Yet these two chert forms have different potential in reduction systems. To bring some accuracy into motion, presence or absence was first limited to identifying the non-oolitic nodular chert. This chert form has several characteristics readily observable in prehistoric debitage, such as the spherical cortex exterior, concentric bedding planes (or banding) scattered throughout the hydrated silica, and centers which often appear as a circular area filled with minor textural discontinuities. These centers often contain either a distinct loading of quartz or other crystals, strains of chalcedony, limestone, and dolomite, which do not conform in quality to the surrounding chert. In other instances, these centers will be distinguished by distinct color change (usually lighter than the rest of the nodule), while texturally homogeneous.

Table 7.13 Flakes Derived from Reduction of Nodular Chert with Limestone Cortex

Depth	Primary	Secondary	Waste
90-100	-	-	-
100-110	-	1	-
110-120	1	1	2
120-130	-	-	-
130-140	2	-	1
140-150	-	-	1
150-160	5	-	-
160-170	1	2	1
170-180	1	1	3
180-190	2	1	-
190-200	-	-	1
200-210	-	1	-
	12	7	9

To obtain a sample representative of these nodular non-oolitic cherts, the total debitage recovered from ten excavation units was examined. Table 7.13 exhibits 28 flakes which meet the above requirements. These materials were selected with a high degree of discrimination, thus the number does not account for indistinct subtle features of flakes which could otherwise be confused with the non-oolitic lense cherts. In the absence of cortex, the waste flake category is assigned wholly on the basis of recognition of nodular

centers whereas, primary and secondary flakes were assigned using cortex and/or the presence of nodular centers. The importance of recognizing the use of nodules, as opposed to other cherts, lies in the distinction given these cherts for optimal conditions to maximize possible size of finished products. As with the use of gravel cherts, the use of nodular chert is also continuous throughout the deposits in Zone I.

Any study of prehistoric raw material selection patterns must take into account selection factors not only for flaking qualities, but also for functional qualities. Greiser and Sheets (1979:295) take this further and suggest that raw material selection ". . . commonly occurred for reasons beyond 'flakability'." Their overall concern is one that attempts to reconstruct use-wear patterns. They point out a specific constellation of variables, each of which are inherent in any attempt at explaining particular frequencies of various raw materials. A few of these have been discussed. Considering most tools in a stylistic framework limited by the technology of the prehistoric cultural tradition from which they were produced, Jelinek (1979:24) would see this carryover directly related to the raw material selected for production. In other words, the process of material selection may be correlated with stylistic aspects of the technology. This is thought to be the case at any site producing a substantial lithic complement. There are problems in recognizing this aspect of style. The recognizable traits of the lithic technology of the cultural tradition could be masked at a given loci simply on the basis of the nature and quantity of available raw material, not to mention the obvious differential lithic expression, due to specific subsistence attention at a given time. The Cole site does not indicate restraint regarding raw material quality. Zone I is a situation where the only masking would be due to cultural factors and none other.

7.3.4 Cache Blade Manufacture: The Hinge Flaking Technique.

The hinge flaking technique, as named here, will be defined on the basis of analysis results, incorporating a study of distinctive bifacial forms (cache blades) from several areas outside Crawford and Harrison counties, Indiana. Flake debitage was analyzed to ascertain the presence of flakes characteristic of the "Hinge Flaking Technique."

Occurrence of specific hinge flake types has been used to construct a model to account for intentional use of hinge flakes in specific instances. Use of a deliberate hinge flaking technique appears to be directly associated with the manufacture of large, thin bifaces or "cache blades", which appear in quantity during the Late Archaic/Early Woodland transitional period.

7.3.4.1 Description of the Hinge Fracture

The hinge fracture is one of a variety of flake terminations that are manifest on the distal ends of flakes, resulting from a host of lithic trajectories, both bifacial and unifacial (Figure 7.15). There are few limits to which this can be expressed culturally and technologically. Factors of load relative to mass are only one set of variables that produce hinge flake morphologies. Another set of variables is of a technological nature. It forms a basis, by which mechanical properties are understood and used to plan reduction strategy. Hinge fractures, like all other fracture types, are a phenomenon of

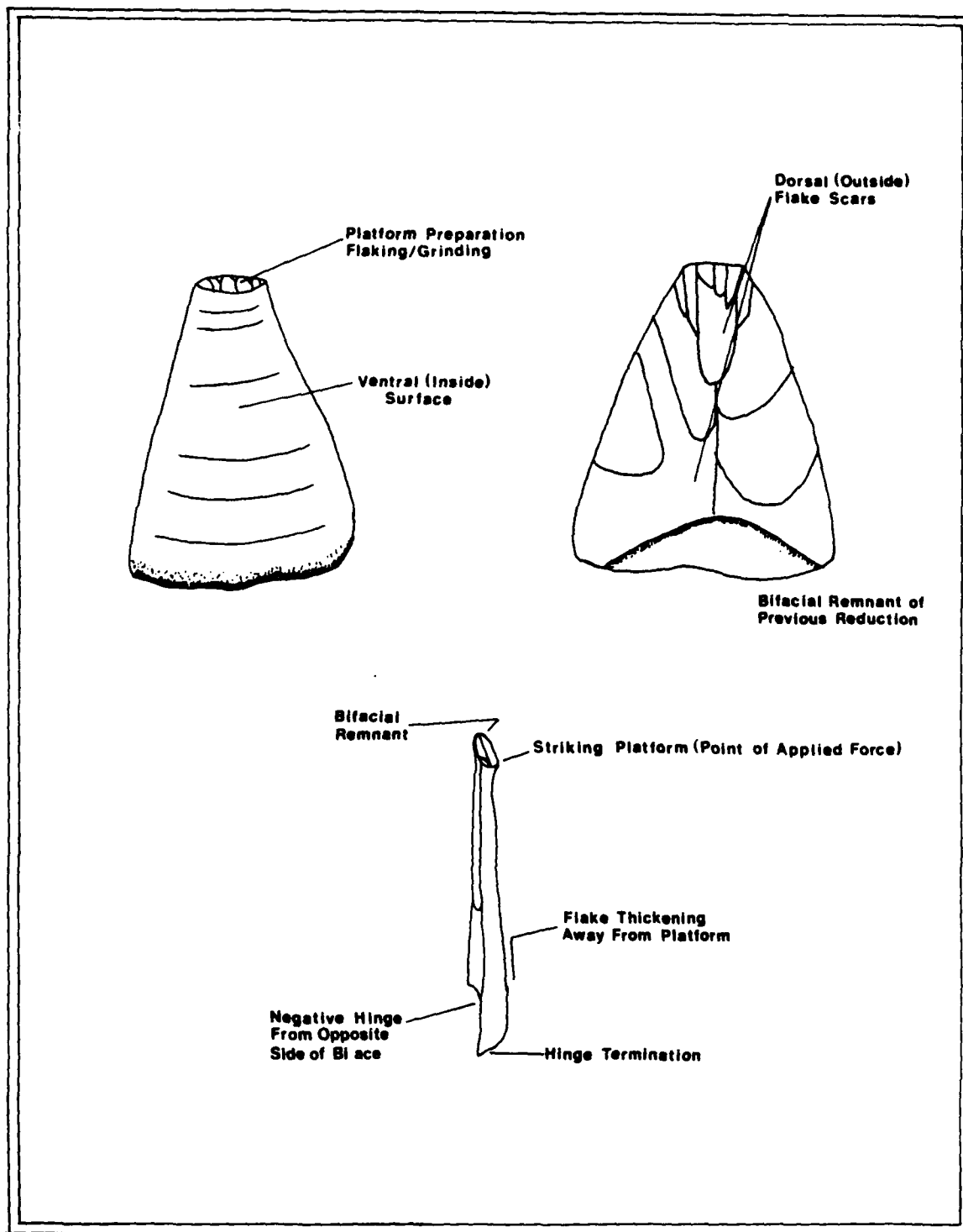


Figure 7.15 Hinge Flake Characteristics.

culture, either produced under highly controlled conditions or made entirely by accident. The reason for observed hinge fractures and their frequency of occurrence within defined contexts will be explained in light of a clear understanding of the technological tradition that produced it.

7.3.4.2 Experimental Use of the Hinge Fracture Technique

Johnson (1976:20) follows Callahan's (1976) stages of bifacial reduction, which are, 1) material selection; 2) initial edging; and 3 and 4) progressive facial thinning. Stages one and two are of no consequence here, while three and four prescribe flakes to be driven at least to the center of the biface and contact or undersect flake scars detached from the opposite side. These last stages, when mastered, provide controlled execution of the hinge fracture technique discussed. The element of control optimizes a sequential production and removal of hinge terminations until desired ratios are met on a bifacial artifact (see Figure 7.16).

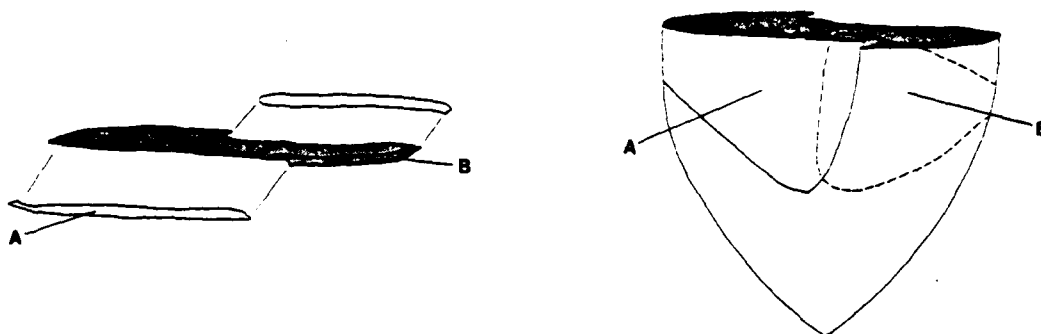


Figure 7.16 Hinge Flaking Technique

a. Hinge flake production

b. Sequential removal of pprevious hinge and production of a new hinge progressively thinning the biface.

3.4.4 Examples of the Hinge Flaking Technique in Existing Literature

As early as 1964, Green and Fitting noted some of the essential features of the hinge flaking technique on Turkey tail points. They note that:

"... primary scars on all points would be classed as diminutive and flat ... are expanding and occur on both faces of the point ... A slight medial ridge on some blades is suggestive of a bitriangular crossection. Closer examination revealed that this was caused by the crests of a few flakes and never was characteristic occurring along the full point length (1964:84)."

It is assumed they are describing the large hinge fractures apparent in their plates, but it is doubtful that these occurred associated with initial stages of reduction. The term primary, as they use it, refers to the largest flake scars still intact on one or more faces of the artifacts.

A cache of 34 Turkey tails found in southwestern Michigan was described by Green and Fitting (1964). These specimens are made entirely of Wyandotte-like chert and exhibit a high frequency of the presence of the hinge fracture technique. Although photographs of the cache do not allow visual examination of the total surface of each specimens, 76% exhibit robust hinge terminations at the midline of the artifacts. One would expect a somewhat higher frequency, if the sides of the artifacts not shown were examined.

One of the two ovate "preforms" illustrated from Havana Mound 6 (Mason County, Illinois) bears a classic example of the diagnostic hinge flaking technique utilized on large cache blade forms (Monte-White 1968:54). This specimen exhibits hinge termination well within, and slightly beyond, the central zone of the bifacial form. Closer examination reveals a series of smaller, less distinct hinge/step terminations projecting toward the central area detached from separate focal points along the margin. The hinge flaking technique continued to be used well into the Middle Woodland. However, it doubtfully occurs much later than that. In addition, the hinge fracture is a common form of flake scar on bifacial forms throughout prehistory, although its use as a thinning technique as reported here does not appear to be consistently employed in lithic technologies of the Midwest until Late or Terminal Archaic.

7.3.4.5 Variants of the Hinge Flaking Technique

Figure 7.17 illustrates idealized distal ends or termination variants of flakes, all possible permutations of the hinge flaking technique. Regular feathered terminations (2,3, and 4) and classic hinge fracture types (1,2, and 4) are included. Of primary importance here is the presence of various terminations in conjunction with a negative flake scar termination represented on the dorsal surface of the flake. These normally occur near the distal end on flakes with which they occur. This represents basic observations of simultaneous flake detachments in the process of bifacial thinning. Furthermore, an addition of negative flake scars from previous flake detachments presents special characteristics which can be exhibited along with the major flake termination types.

7.3.4.6 Cache Blade Sample Exhibiting Characteristic Hinging Flake Scars Diagnostic of the Hinge Flaking Technique

Three caches composed of 36 bipoined (lenticular) and ovate cache blades were examined for the presence of the hinge flaking technique. It was found to occur in very high (100% obverse, 92% reverse) frequency (Table 7.13). These caches derive from areas outside of the Harrison/Crawford County region (Fulton Co., Henry Co., and Shelby Co., Indiana) and all are made from cherts derived from the Wyandotte chert zone (Harrison County chert). This makes them suitable specimens for analysis and should be an accurate reflection of cache blades produced during portions of the Late Archaic through Middle Woodland periods. Figure 7.18 shows examples of the types of cache blades examined.

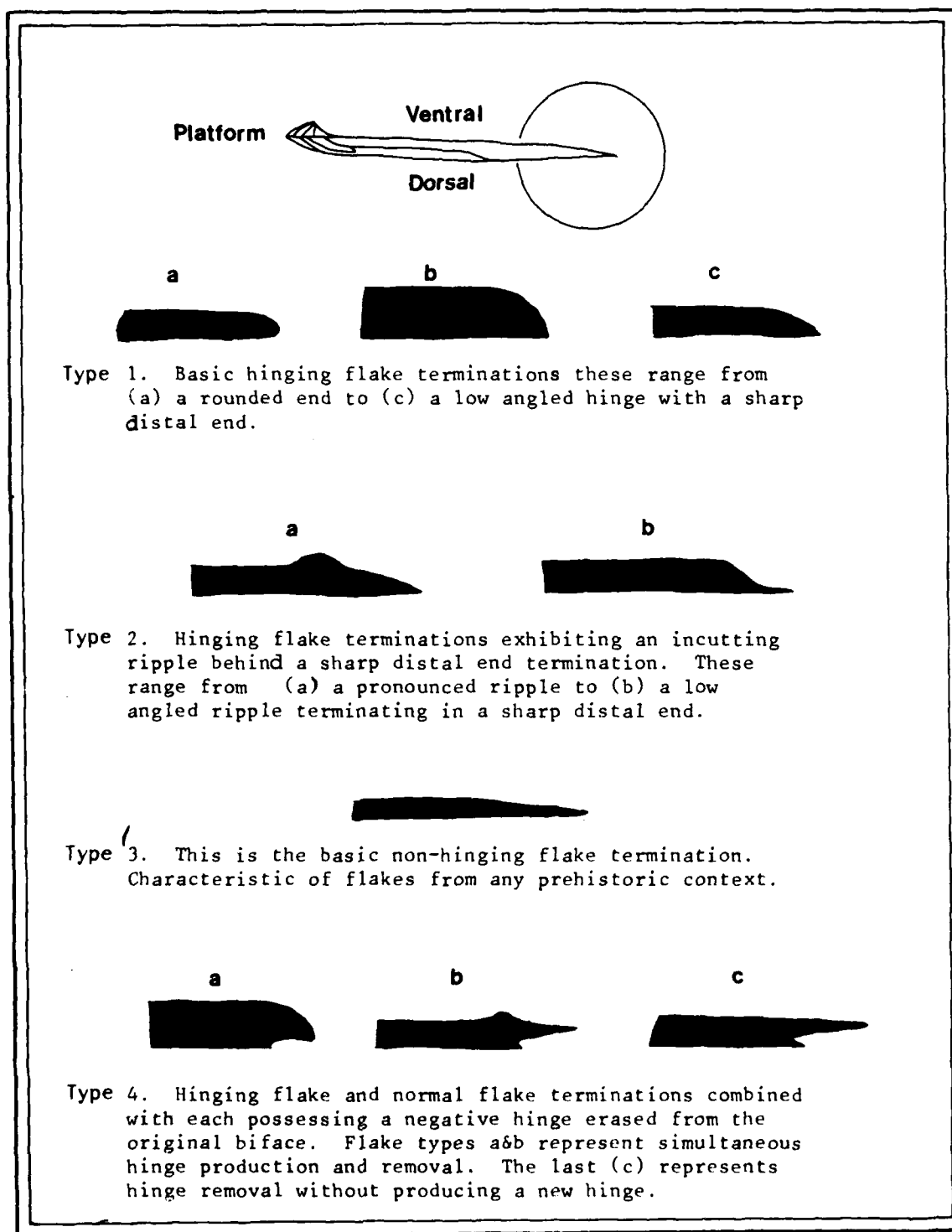


Figure 7.17 Hinge Flake Types.

SHAPE	Number	Hinge Type 1	Hinge Type 2	Obverse	Reverse	Flake Length >3 < 4cm	Flake Length >4 < 5cm	Flake Length >5cm	Edge Grinding Present	Nodule Center Present	Distal Cortex Present
Ovate	2	2	2	2	2	0	2	2	2	2	N/A
Lenticular	7	7	3	7	6	0	4	6	7	6	6
Total	9	9	5	9	8	0	6	8	9	8	
CACHE FULTON CO. INDIANA N-9											
Ovate	8	8	6	8	7	3	6	7	8	5	N/A
Lenticular	7	5	4	7	6	1	6	4	7	6	6
Total	15	13	10	15	13	4	12	11	15	11	
CACHE HENRY CO. INDIANA N-15											
Ovate	10	9	6	10	10	0	6	6	10	9	N/A
Lenticular	2	1	2	2	2	0	0	2	2	2	2
Total	12	10	8	12	12	0	6	8	12	11	
CACHE SHELBY CO. INDIANA N-12											
Ovate	20	19	14	20	19	3	14	15	20	16	N/A
%	95	95	70	100	95	15	70	75	100	80	
Lenticular	16	13	9	16	14	1	10	12	16	14	14
%	81	81	56	100	88	6.3	63	75	100	88	
Totals	36	32	23	36	33	4	24	27	36	30	
%	89	89	64	100	92	11	67	75	100	83	

Table 7.14 Hinge Flake Frequencies on Cache Comparative Collections.

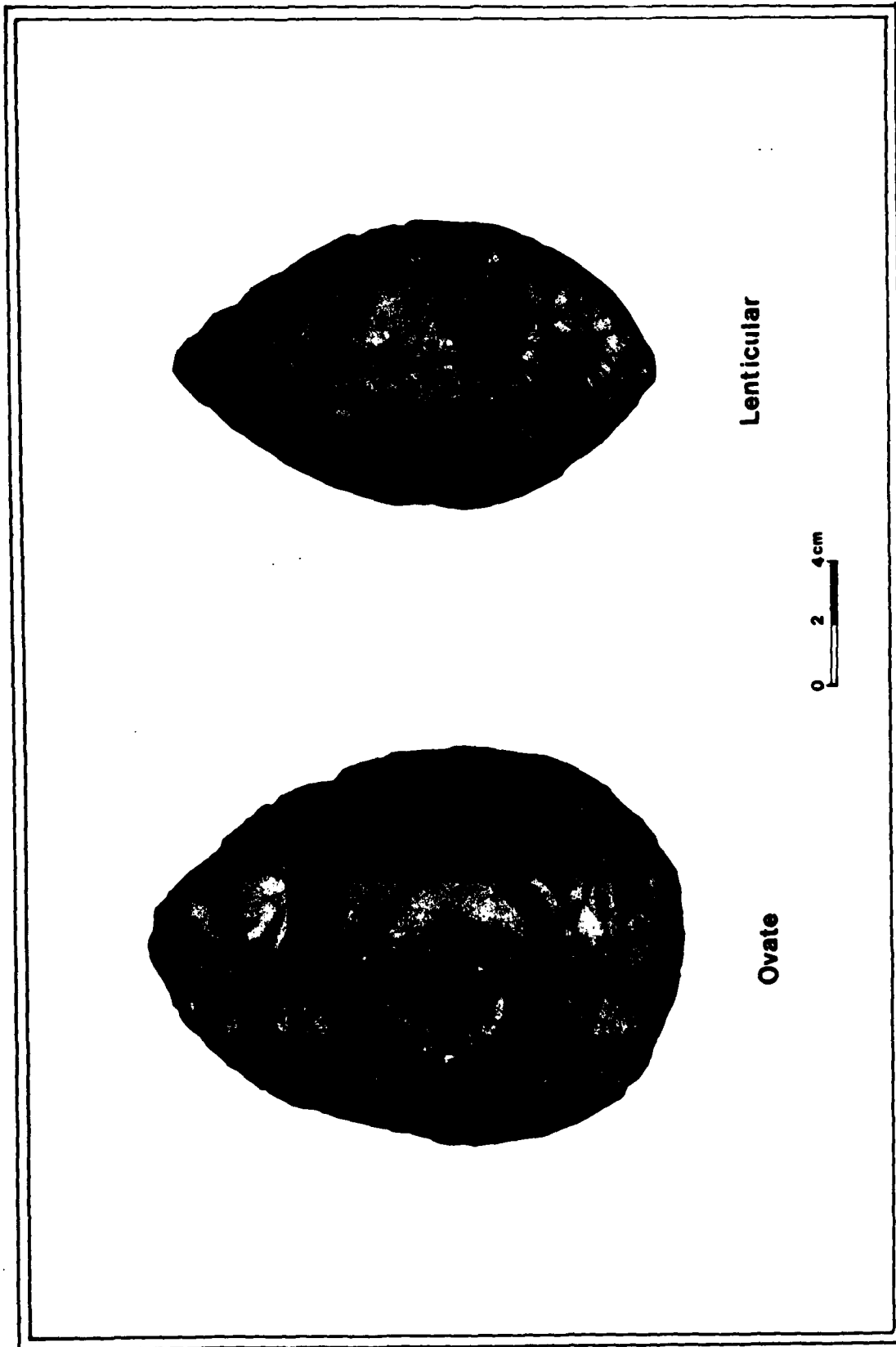


Figure 7.18 Cache Blade Photos.

Additional characteristics of these cache blade forms were taken into account to make adequate comparisons between finished cache blades possessing the hinge flaking technique, and flakes diagnostic of its use. The presence of hinge types 1 and 2 were recorded. These were also found to occur in fairly high frequency. Hinge Type 1 occurred on 89% of the specimens, while Hinge Type 2 occurred on 64%. Edge grinding occurred in 100% of the specimens. Nodule centers were found to be the general area of hinge flake termination; thus, flakes possessing requisite morphological characteristics, plus evidence of a nodule center, could be used to discern the use of the technique. The presence of distal cortex was found to occur on 14 of the 36 specimens.

Hinge flake scar length was recorded in three size ranges. The smallest was over 3 cm and less than 4 cm in length. The next falls between 4 cm and 5 cm in length. The largest hinge flake scars recorded were greater than 5 cm in length. A full 75% of the hinge flake scars measured were in the largest size range. Hinge flake scars in the middle range are present in a 67% frequency. The smallest size range for hinge flake scars was present in only 11% frequency. These same length ranges and the other observations used to analyze the three caches from Fulton, Henry, and Shelby counties were the standard of observations for the Cole site hinge flake analysis. Flake scar length and flake length for present purposes are recorded in order to eliminate small flakes and flake scars, thus reducing the sample size. The lengths chosen are significant for flakes exhibiting the hinging flake technique that is most pronounced and diagnostic.

7.3.4.6 Evidence for the Use of the Hinge Flaking Technique

Flake debitage was analyzed following criteria established from examining the cache blade sample. A total of 15 excavation units provided 550 flake specimens for analysis (9% sample of all the flake debris from Zone I). Many of these were fragmentary and eliminated from further analysis. Once sorting for whole specimens was complete, the sample was reduced again to include only those flakes which were 3 to 4 cm in length or larger. The final sample size numbered 39 specimens (Table 7.15). Since all flakes greater than 3 cm are included from the original sample, the actual number of flakes characteristic of the hinge flaking technique is also smaller. A total of 16 hinge flakes are identified out of the 39 selected with regard to size.

In nearly all cases circled (Figure 7.15), the hinge flake identified possesses characteristics other than those of hinge terminations. The presence of cortex was limited to flakes with an absence of cortex or less than 50% cortex present on the dorsal surface, etc., except in one case. The absence of cortex often entails substantial bifacial refinement which fits the degree of refinement necessary to reproduce the hinge flaking technique.

Almost all of the hinge flakes identified exhibited both prepared striking platforms, by the presence of refined bifacial flaking, and a ground edge on the platform. These flake platform morphologies are readily observed upon close examination of the edges of cache blades. Figure 7.13B shows an example of flakes with attributes characteristic of the hinge flaking technique.

Flakes characteristic of the hinge flaking technique are significant as to size and the level in Zone I in which they appear. Hinging flakes of the 3 to 4 cm length range appear earliest in in level 170-180 cm BD. These account

TABLE 7.15 ATTRIBUTES OF FLAKES
GREATER THAN 3 cm IN LENGTH

DEPTH	Cortex	Edge Morphology	Ground Platform	Bifacial Platform	Flake Length				Hinge Type	Flake Type			Nodule Center Present
90-100	W	-	-	X	-	(X)	-	-	X	-	-	-	X
N=2	S	2	-	X	X	-	-	-	-	-	X	-	-
100-110	W	2	-	X	X	-	-	-	-	-	X	-	-
N=4	W	2	X	X	-	(X)	-	-	-	-	X	X	X
110-120	W	1	X	X	-	-	(X)	-	X	-	-	-	-
	W	2	X	X	-	(X)	-	-	X	-	-	-	X
	S	2	X	X	(X)	(X)	-	-	-	X	-	-	-
	W	1	X	X	-	(X)	-	-	-	X	-	-	-
N=5	P	2	-	X	(X)	-	-	-	-	-	X	X	-
120-130	W	1	X	X	(X)	-	-	-	-	X	-	-	-
	S	3	-	X	-	X	-	-	-	-	X	-	-
N=12	W	1	X	X	-	-	X	-	-	-	X	-	-
130-140	W	2	X	X	(X)	-	-	-	-	X	-	-	-
	P	3	-	-	-	-	X	-	-	-	X	-	-
	S	1	X	X	X	-	-	-	-	-	X	-	-
N=16	W	1	X	X	(X)	-	-	-	X	-	-	-	-
140-150	W	1	X	X	(X)	-	-	-	X	-	-	-	-
	P	3	X	X	X	-	-	-	-	-	X	-	-
	S	1	X	X	-	-	(X)	-	-	X	-	-	-
	P	3	-	-	-	X	-	-	X	-	-	-	?
	S	2	-	X	(X)	-	-	-	-	X	-	-	-
	S	1	-	-	-	-	X	-	X	-	-	-	-
	W	1	X	X	X	-	-	-	-	-	X	-	-
	W	2	X	X	X	-	-	-	-	-	X	-	X
N=230	W	1	X	X	X	-	-	-	-	-	X	-	-
150-160	W	1	X	X	(X)	-	-	-	X	-	-	-	-
	W	2	X	X	(X)	-	-	-	X	-	-	-	-
	S	3	-	-	-	X	-	-	-	-	X	-	-
	S	2	-	-	-	-	X	-	-	-	X	-	-
	P	3	-	-	-	-	X	-	-	-	X	-	-
N=200	W	2	X	X	X	-	-	-	-	-	X	-	-
160-170	W	1	-	-	-	X	-	-	-	-	X	-	-
	W	2	X	X	-	-	X	-	-	-	X	-	-
	W	3	X	X	X	-	-	-	-	-	X	-	-
	S	1	X	X	X	-	-	-	-	-	X	-	-
N=67	W	3	-	-	-	-	X	-	-	-	X	-	-
170-180	S	3	-	-	-	X	-	-	-	-	X	-	-
N=14	S	3	-	X	(X)	-	-	-	X	-	-	-	-

Total flakes examined= 550.

(X) Flakes Diagnostic of the Hinge Flaking Technique

Figure 7.15 Attributes of Flakes.

for the largest number of flakes characteristic of the hinge flaking technique. Small hinging flakes, in general, represent a gradation into accidental hinge fractures, which are well represented on the biface fragment sample. Thus, for the smallest hinging flakes studied, the degree of overlap with accidental hinge fractures is greatest. The presence of refined bifacial platforms with edge grinding does not appear until level 150-160 cm BD.

Larger flakes characteristic of the hinge flaking technique appear much later in the deposits. Flakes of the 4 cm to 5 cm length range with robust characteristics of the hinge flaking technique do not appear until level 110-120 cm BD. Flakes with feathered terminations of this size extend much lower in the deposits to 170-180 cm Bd.

The largest flakes recovered were over 5 cm long but were seldom over 7 cm. There are only three specimens of this size which exhibit the essential characteristics of the hinge flaking technique. Level 160-170 cm BD contains flakes of this length range. Level 140-150 cm BD produced the first evidence of the hinge flaking technique on flakes of this length.

Along with the staggered appearance of flake lengths characteristic of the hinge flaking technique, flake termination types 1-4 behave in a similar manner. In the lower portions of Zone I 11 of 14 flakes are feathered terminations (type 3). Above the lower foot (30cm) of the zone, hinging flakes occur in 50% frequency. Negative hinges (type 4) occur on two feathered terminations in the upper 7.8 inches (20cm) of the zone.

Guendling's excavations at the Cole site (1977, Trench 10) produced comparable manufacturing debris. Characteristic flakes of the hinge flaking technique are present, along with three cache blade fragments. All three of these exhibit hinging flake scars. Examination of a sample from Trench 10 and the sample from the 1980 excavations indicated that although present neither produced evidence of a large scale cache blade manufacture. Guendling's Trench 10 was placed just north of the 1980 Resource Analysts, Inc. excavation unit. Both of these investigations provide comparable data from two separate tests on the eastern extremity of the Cole site. The implication is that cache blade manufacturing may have been a localized activity specific to that area. This is borne out of inspections of cultural debris from all of the 1977 test trenches. Trench 10 was unique in terms of quantity and quality of manufacturing debris.

7.3.4.7 Concluding Remarks

Many writers have attested to the hinge fracture principle as a problematic configuration, akin to step fracturing on flaked lithic surfaces. When produced, neither is optimal for continued facial modification and/or thinning of bifacial forms observed in prehistory and perceived through replication experiments. Nichols and Allstadt (1978:1) comment that "... there is no reason to believe, at present, that it [hinge fracture] has ever been a desirable result." The hinge fracture, according to Crabtree (1972:68) is, "... a fracture at the distal end of a flake at its proposed terminal point", which for our purposes here required modification. This should now include industries which can exhibit purposeful and optimal use of the hinge fracture. To the contrary Crabtree and Nichols and Allstadt, in reviewing experimental studies take the approach that hinge fractures pose limitations

for further modification and explore no further. This notion should be used with caution with regard to prehistoric assemblages. Experimentation can be useful for identifying hinge fractures, which for individual trials, can be definitely related to fatal errors that cannot be resolved. This is essentially only related to the individual replicator's knowledge of the limitations and the advantages of the hinge fracture on the level of the technology within which the knapper operates. Thus, direct comparison cannot easily be made between replication studies and prehistoric material.

The important aspect of the hinge flaking technique is that flakes exhibiting essential characteristics are diagnostic of cache blade manufacture. Since cache blades were an item of exchange and relate to special burial practices during the Early and Middle Woodland Period, there is now a basis for identifying a specific funerary related bifacial trajectory at manufacturing sites. In addition, sites believed to date between Terminal Archaic and Middle Woodland that do not produce other forms of diagnostic material (such as pottery or projectile points), can invite analysts to rely more closely on lithic debitage for estimates of temporal range and socio-cultural information. Adapting the use of the hinge flaking technique for required cache blade thinning is one recognizable element in the development of craft specialization during Early and Middle Woodland Periods in the Midwest.

7.3.5 Significance of the Lithic Assemblage

The Cole site is a buried multicomponent site situated in the floodplain of the Ohio River. Zone I (90-210 cm BD), identified by the 1980 Resource Analysts, Inc. data recovery project, was composed primarily of refuse reflecting manufacture of a variety of chert objects relating to the Late Archaic/Early Woodland transitional and Middle Woodland periods. Various cultural materials (i.e. cores, bifaces, flakes) were analyzed in order to understand the manufacturing trajectories, viewing the material first as refuse and proceeding from there to characterize the nature of the lithic cultural activity at the site.

The Cole site is situated in a very substantial lithic resource area, imposing few limitations for raw material quantity or quality procurement. It was found that the major terrestrial chert sources were utilized as a primary resource; (although gravel cherts were also habitually procured), suggesting that there are stylistic preferences for chert quality and quantity operating throughout Zone I. Bifacial forms were analyzed for raw material quality to characterize the cultural behavior surrounding reduction strategies and reasons for breakage and discard. A limited number of cores were found to relate to early bifacial manufacture, rather than for use as cores from which to detach flakes for further reduction.

Fragments composed nearly the total sample of bifaces. In general, these were found to best represent rejected fragments that were of no utility in and of themselves. The presence of distal cortex on crude biface fragments in the upper levels of Zone I correlates with the cache blade manufacturing that took place at the site. Edge grinding was present on 14 out of 44 specimens. Moderately refined edge morphology lacking cortex was present on biface fragments which occurred in the lower half of Zone I.

Natural and cultural mechanisms operating to present a complex of factors accounting for rough surface morphology and the breakage of bifaces were simplified by selecting material flaws situated in fractured areas to account for observed breakage. In the absence of raw material discontinuities, crude flaking characteristics were supplied to account for extant biface fragments. After a study of natural and cultural mechanisms of breakage, it became apparent that the highest percentage of biface fractures was due to a combination of both poor raw material quality and problems in technical application of knapping ability.

Interpretation resulted in a two-fold explanation. As the biface fragment sample was refuse, the least important fragments of bifacial forms remain in the archaeological record. Uncontrolled wastage of material, such as knapping practice, is applicable. Secondly, as the extant biface sample is thought to be representative of purposeful manufacturing tasks, the only plausible explanation is that those knappers with the least experience will be represented by more biface fragments than those experienced knappers, i.e. specialists versus novices.

Analysis of biface fragment raw material quality brought forth additional cultural information. One of the primary goals of the study was to approach lithic material from a diachronic perspective, seeking to identify trends or culture change within the time span signally the beginning of the Formative Period. Raw material quality/procurement, indicated through the biface fragment analysis, suggested a distinct shift to higher quality raw material selection in the middle of Zone I. Debris densities also increase above the middle of the deposits while the number of biface fragments is on a steady decline in upper levels. These data represent a shift to a specific terrestrial chert source of high quality to maintain supply levels in the blossoming regional trade network, within which items such as Turkey tail points and unnotched cache blades were commodities.

A total of 22 hafted bifaces or projectile points were recovered. These specimens were classed according to the presence of a bilateral indentation or hafting element. While these projectile points are diagnostic of time, and to a lesser degree culture, relatively few of them compare with standard projectile point types. Only two Turkey tail bases compare with the literature type. The remainder of the projectile point sample was sorted according to straight and contracting stem and indeterminant categories. A single complete Buck Creek cluster projectile point was the only other projectile point worthy of a type name.

Nearly the entire projectile point sample represents pieces rejected during manufacturing. The majority of these specimens exhibit flaking patterns similar to the unhafted biface sample in that technical application was a recurring problem. Edge morphology is crude, unlike most finished hafted tools. Flaking discontinuities account for half of the projectile point fragments. The remainder are fragmented because of a complex of variables relating to flaking and raw material imperfections.

The projectile point sample on a whole was also analyzed to ascertain the manufacturing trajectory of these specimens. Nearly all of these were probably produced without a clearly defined unhafted biface or preform stage prior to the production of a hafting element. Exceptions are two Turkey tail

point bases and the Buck Creek cluster point. The majority of the specimens were in all probability produced by simultaneous manufacture of the bifacial form with a hafting element. A single projectile point, exhibiting a very early stage of manufacture, exemplifies the lack of a preform stage of manufacture. A single unfinished notch occurs with the initial bifacial edge trimming. This projectile point was discarded before completion and is made from a large flake. This is the only case from Zone I where a flake is present exhibiting initial projectile point manufacture. Assuming that unique flakes and flaked stone products will be under-represented in a manufacturing area, this projectile point, exhibiting evidence of initial manufacture, is a very important link to understanding the variety of manufacturing trajectories recorded in the refuse from Zone I.

Two flakes were notching error flakes, relating to projectile point hafting element manufacture. These represent projectile point manufacture and are diagnostic of that activity without considering any other evidence of projectile point manufacture. Flakes such as these are sufficiently diagnostic of manufacturing activity to characterize that activity in assemblages which lack other lines of evidence for projectile point manufacture.

A small sample of microflakes recovered by flotation methods was analyzed for refined bifacial edge reduction. This was accomplished to add substance to the overall understanding of the function of the manufacturing station. All examined bifacial forms, bifaces, and projectile points generally reflect crude edge morphology. Thus, there is a dearth of information on specimens that were finished and curated outside the manufacturing area. This information was obtained from a selected flake sample. From the microflake sample, it was determined that highly refined edge manufacture was not limited to a specific oolitic or non-oolitic chert. As expected, flakes characteristic of highly refined edge modification are present in high frequency in the middle of Zone I where manufacturing debris is most substantial.

The hinge flaking technique described in the text relates to a specialized manufacturing trajectory to produce cache blades in both notched and unnotched forms. Initial recognition of the prehistoric use of the technique was accomplished by analyzing collections and published literature. After establishing criteria to consistently identify the hinge flaking technique, the flake debitage was examined to ascertain the use of the technique. Cache blade manufacture was positively identified from the flake sample. Several lines of evidence from this analysis indicates that Zone I refuse records lithic evidence for the beginning of craft specialization in the Formative of Eastern North America.

Bifacial forms and flakes in direct association may be misleading. The flake sample recovered can in fact bear signs of greater manufacturing control than that exhibited on bifacial forms from the same deposit. Flake debitage may present the only extant evidence relating to the manufacture and completion of viable chipped stone products which were curated and discarded outside the manufacturing areas. These are just some of the peculiarities characteristic of manufacturing debris in general with which this analysis has dealt.

Schiffers' (1979:17) appeal to better formulated methods is quite appropriate. " . . . We are going to have to begin thinking about the properties of raw materials that genuinely affect their use characteristics and patterns of modification, and define variables on that basis . . ."

CHAPTER 8. SUMMARY AND CONCLUSIONS

The purpose of this chapter is to present a summary of the work accomplished, present the analysis conclusions, and identify further research potentials of the Cole site.

8.1 GENERAL SUMMARY

Data recovery at the Cole site consisted of excavation of three test trenches and one large contiguous 30x24 ft block. Trenches examined the portion of the site to be affected by the construction of a boat ramp access road and identified cultural remains in a portion of this area. The block excavation was located in the area to be prepared as a boat ramp. Data recovery was intended to mitigate the impact to the portion of the site proposed for modification.

Excavation extended to a total depth of approximately 14 ft with auger tests to a depth of about 19 ft below ground surface. The excavation penetrated two cultural zones. Zone I was a substantial 3ft (91cm) thick zone of lithic debris. Zone II was a thin sparse level with few cultural inclusions. Each zone occurred in a sloped configuration presumed to reflect the surface of the aboriginal occupation locus. Figure 8.1 illustrates the cultural zones in a plan view and a west to east cross-section of the block.

Both Zone I and Zone II extend beyond the limits of the block excavation. Cultural Zone I may correspond with Zone I in Trench 10 (Guendling et al. 1977) to the west. This trench is approximately 30 ft (9m) west of the block excavation (Figure 5.1). In Trench 10, Zone I is divided into Zone IA and IB. No such division was observable in our excavation. Cultural materials from these separate tests support the correlation of these zones. Tracing Zone I east from the block is more difficult due to the poorly defined nature of cultural zones in our trench 1. Trench 1 was only 9 ft (3m) east of the block, but Zone I could not positively be identified in the trench. Trench 2 was 75 feet (23m) east of Trench 1 near the bank of the Blue River. The zone of concentrated lithic debris in Trench 2 at 5.2 ft (160cm) to 6.6 ft (205cm) BS may correspond to Zone I but this correlation is extremely tenuous.

The factor of sloping cultural zones may result in corresponding zones occurring at depths of more than one or two feet of difference in 30 or 40 feet of horizontal distance. The termination of Zone II within the limits of the block also illustrated the horizontally discontinuous nature of cultural deposits at the site. This phenomenon of horizontally discontinuous and vertically variable cultural zones makes correlations across the site impossible to confirm without examining areas between extant trenches and the block.

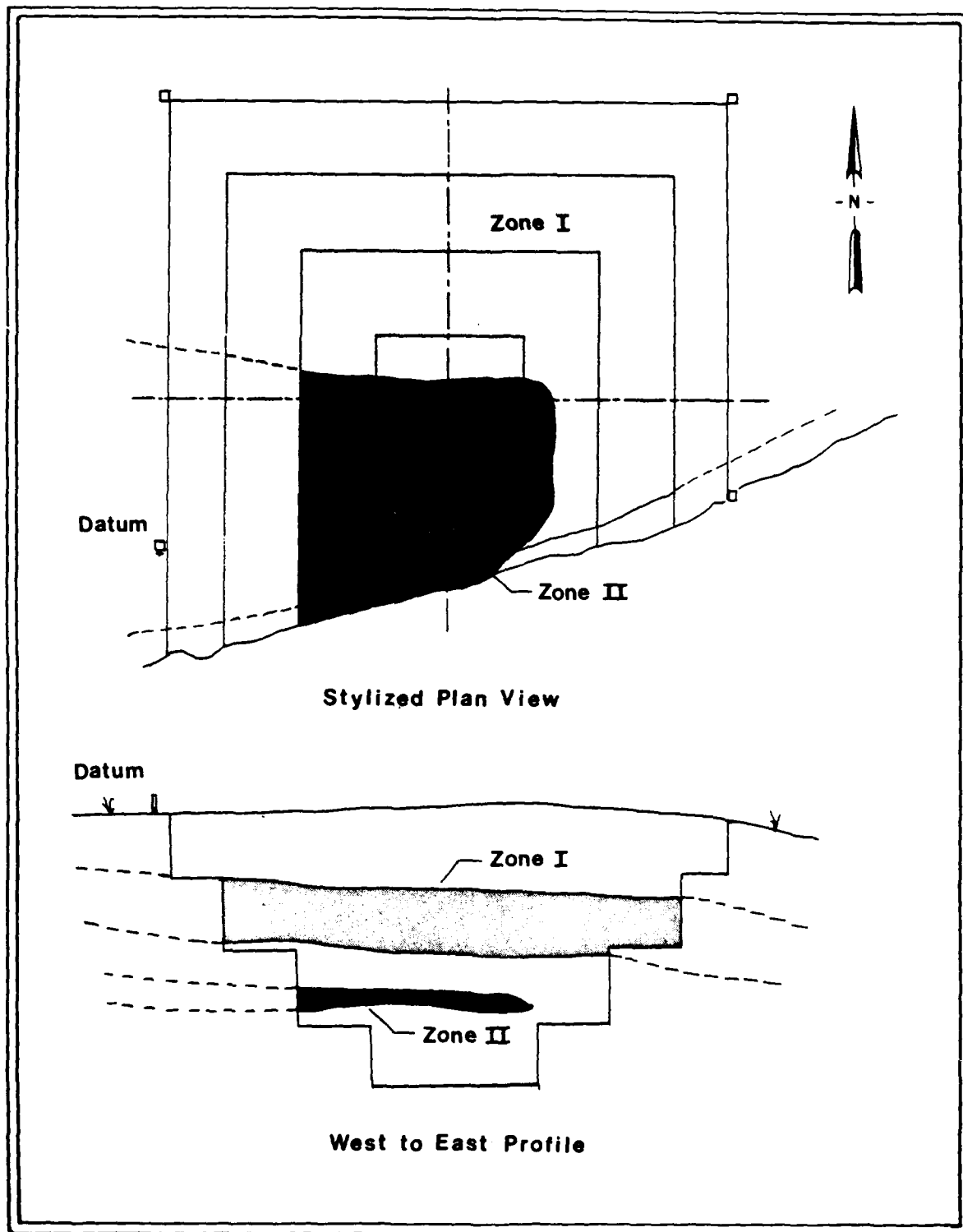


Figure 8.1 Configuration of the Cultural Zones.

Zone II did not yield adequate data to allow significant analytical results. Zone I was analysed and determined to be a lithic manufacturing station essentially devoid of evidence of other functional attributes. Analysis conclusions were presented in Chapter 7.3.4.7. In addition to the data recovery at the site, related studies were conducted to investigate geological aspects of the cherts which were so abundant in the examined deposits.

A geological survey was conducted in the surrounding uplands to identify and collect samples of chert resources in the bedrocks of the Crawford and Harrison County area. Data obtained indicated a minimum of five distinct geological parent members bearing chert. Each was identified and located in the geological stratigraphy of the area. Detailed descriptions were presented on morphology and potential for use as a lithic raw material for manufacturing stone tools. Analysis indicated the chert type commonly known as "Harrison County chert" was the most abundant and highest quality lithic material of the five major chert zones present in Harrison County. This high quality gray to dark blue gray chert occurs in the upper Fredonia Member of the Ste. Genevieve Limestone of the Blue River Group. It has been formally recommended that this chert type be named Wyandotte chert, as it was first so mentioned in the literature. The generic "Harrison County chert" could legitimately be applied to any of the five chert types in that county. Wyandotte chert also occurs outside of Harrison County.

Another study of the Wyandotte chert zone was conducted to identify quality and other factors which may have affected prehistoric exploitation of this material. A reconnaissance obtained various samples of Wyandotte chert for experimental quality testing. Three distinct lithofacies were observed, each with a different range of utility for lithic reduction. Tabular non-oolitic, oolitic nodular, and non-oolitic nodular cherts were analysed to identify natural material limitations to allow cultural selection factors to be isolated and observed. Raw material flaws were characterized for each variety of Wyandotte chert including; diagenetic planes of weakness, textural discontinuities, solution cavities, and percentages of silica relative to mass potential. Non-oolitic nodular was determined to be of the highest consistent quality and greatest mass potential. Observations formulated concerning lithic resource capabilities of each lithoface were utilized as a basis for the analysis of lithic manufacturing debris recovered from the excavations at the Cole site.

8.2 ANALYSIS CONCLUSIONS SUMMARY

Analysis of recovered data indicated that the investigated portion of Zone I at the Cole site consisted primarily of lithic refuse reflecting the manufacture of a variety of chert objects relating to the Late Archaic/Early Woodland transitional and Middle Woodland periods. Recovered materials indicated a lithic manufacturing locus composed entirely of waste products and broken or aborted biface fragments at various stages of incompleteness. Detailed study of natural and cultural mechanisms of breakage indicated both raw material quality and problems of technical application were factors contributing to unintentional artifact truncations. Study of raw material quality/procurement suggested a distinct shift to higher quality material

selection in the middle of Zone I. A shift to non-oolitic nodular cherts for specific flaking qualities and large mass potential is indicative of an attempt to maintain supply levels for manufacturing of large items such as Turkey tail points and unnotched cache blades. Manufacture of these commodities is presumed to be in response to a developing regional distribution pattern.

Identification of the manufacture of cache blades was based on the observation of a specialized manufacturing trajectory in the Cole site refuse. This has been herein described as "the hinge flaking technique." Hinge fractured flakes have been traditionally interpreted as a problematic configuration or undesirable result in lithic reduction. Several lines of evidence in our analysis indicate Zone I refuse records lithic evidence of a specialized flaking process for cache blade manufacture. Our results have indicated that hinge flakes exhibiting essential characteristics are diagnostic of cache blade manufacture and evidence this activity even in the absence of such end products.

8.3 RESEARCH OBJECTIVES OF THE DATA RECOVERY

Five research questions were outlined, around which the data recovery effort was structured. The first was the question of chronology: how many vertically separate occupation zones exist in the area of planned impact? Question two considered subsistence: what were the strategies utilized by the different populations and how did they differ and change through time? The third inquiry involves the lithic technology: what were the various technologies employed through time, how did they change, and what was their relationship to the subsistence strategies? Question four considered site function and seasonality through time. The final question dealt with the prehistoric environment and prehistoric man's interaction with it. Results of this investigation were reported in the previous chapters and are summarized below. As with most archaeological investigations, this project has resulted in more unanswered questions and only partially answered some of the above research questions.

8.3.1 Chronology

Zone I has been determined to represent a transitional Late Archaic/Early Woodland to Middle Woodland period temporal span. Zone II was of an indeterminate cultural affiliation predating Zone I. Zone I was dated by diagnostic artifact correlation using pottery sherds similar to the Crab Orchard types and the Turkey tail and Buck Creek projectile points. No absolute dates were determined but the zone is estimated to range from 1500 B.C. to A.D. 300. Carbon dates to "bracket" the zones are forthcoming.

8.3.2 Subsistence

Data recovered were not suitable to address subsistence questions. Although the prehistoric environment presented local populations with abundant floral and faunal resources, the sample of these types of archaeological remains recovered by the present study were of little or no consequence in contributing to the existing data. This does not indicate the absence of

such data in other areas of the site but rather suggests that such subsistence activities did not occur at the specific area of the investigation.

8.3.3 Lithic Technology

As a manufacturing locus, the investigated portion of Zone I contributed data suitable to address questions pertaining to lithic technology. The lithic analysis conclusions have been presented in Chapter 7.3.5. Based on results of our investigations, the most prominent potential of the Cole site is the data it contains for research studies of lithic technology analysis. Specific research potentials include study of:

- cache blade manufacture technology
- Turkey tail blade manufacture
- the diagnostic hinge flaking technique
- trade/exchange dissemination location models
- lithic technology evolution through the cultural sequence
- material quality versus technical application problems in lithic manufacturing systems

8.3.4 Site Function

All data recovered indicate a lithic processing function. Negative evidence of domestic or other related activities implies the absence of these functions in the excavated area. Other functional activities undoubtedly exist elsewhere on the site. While seasonal flooding would have precluded long term "village" settlement, short term seasonal camps were probably the most common settlement type at the site. The most logical function of the Cole site, especially during Early and Middle Woodland periods, would have been a locus for lithic workshops. Presence of fire-cracked stones may indicate a cold weather season period of exploitation.

8.3.5 Environment

Paleo-environmental data was not obtained from the excavation. The natural environment presents several factors affording the Cole site its particular desirability. The ecological setting and the nearby chert resources attracted human populations throughout prehistory. The Ohio and Blue Rivers provided abundant aquatic and riverine resources. The Ohio River undoubtedly functioned as a transportation artery in the dissemination of ideas, material culture, trade materials (specifically Wyandotte cherts), and populations. The forest/riverine ecosystem of the floodplain provided a plentiful range of exploitable natural resources.

Floodplain deposits present at the Cole site are similar to those involved in floodplain development in other areas of the middle Ohio Valley. Suspended sediments are responsible for the homogeneity of the deposits as evidenced by the general tendency toward increased sandiness with depth in the exposed deposits of the block excavation. Cultural materials buried within these deep sediments constitute the Cole site.

8.4 INTERPRETATIONS

As a lithic manufacturing station, the investigated portion of the Cole site appears to have had a very specific function of preparing end products to be utilized at other locations. The lithic processing at the site represents only one component in a lithic trajectory. Beginning at the raw material procurement site, chert was obtained and underwent initial processing to reduce materials into blocks, cores, and large primary flakes. Materials arrived at the Cole site in these modified forms as blanks and flake blanks, where they were further reduced to bifaces, hafted bifaces, and cache blades. Refuse by-products of these processes remained in the archaeological record and finished products were removed from the site.

The Cole site appears to be a specific station in a series of staged manufacturing processes related to an emergent pattern of widespread regional distribution of Wyandotte chert products. Evidence of the extent of this distribution pattern occurs in the form of Wyandotte chert artifacts on sites distant from the source area.

Cache blades and Turkey tail caches are found on numerous sites throughout the central Eastern United States dating to the Early and Middle Woodland periods. A classic example of the massive extent to which these commodities were produced and removed to other areas is the recovery of over 12,000 cache blades at the Crib Mound site in southwestern Indiana. Total weight of the blades was over 4380 pounds and the volume of the single pit was over 800 cubic feet. Scheidegger (1968, 1979: 43) identifies these materials as from a source in Harrison County, Indiana. Smaller caches of 30 to 100 blades have been reported from numerous areas in Indiana and other states, (Haggard 1972; Wells 1973; Lawson 1978). Cache blades of blue-gray hornstone [Wyandotte chert] have been recovered in west central Illinois from the famous Havana Mound Group site and more than 20,000 specimens were reportedly collected here in early archaeological explorations (Montet-White 1968: 131).

Wyandotte cherts are also widely distributed in the form of Turkey tail cache blades in Indiana, Illinois, Ohio, Wisconsin, and Michigan (Didier 1967). In these regions, Turkey tail points are made almost exclusively of Wyandotte chert. Didier suggests these items were being manufactured in south central Indiana only and offers the total absence of chipping debris at cache sites as evidence (1967: 29). The function of these points is generally considered non-utilitarian or perhaps ornamental or socio-technic rather than technomic (Binford 1963: 187). Didier suggests the primary impetus for distribution of Turkey tails was a flint-copper exchange between the Great Lakes area and the groups obtaining Wyandotte cherts from southern Indiana (1967: 35).

Occurrences of large caches of Turkey tails in the Scioto and Miami Rivers regions in Ohio appear to be in association with Adena sites. At the Fort Hill site in Highland County, Ohio, Wyandotte chert debris in large quantities suggests a "factory" manufacturing items from this chert material during Hopewell times (Potter 1968: 43). Streuver and Houart (1972) include Indiana hornstone [Wyandotte chert] in an inventory of major Hopewell Interaction Sphere raw materials.

Some Hopewell sites, such as the Daughtery-Monroe site in the central Wabash Valley and the Mann Site in southwestern Indiana, exhibit very selective use of Wyandotte chert for their tools with a notable absence of manufacturing debitage of this material at the occupation sites (Pace and Apfelstadt 1978: 29; Kellar 1979)

Much evidence suggests that during the transitional Late Archaic/Early Woodland to Middle Woodland periods, an emergent pattern of manufacture and distribution of Wyandotte chert cache blades, Turkey tail caches and other finished products resulted in heavy exploitation of this raw material at this time. Cultural materials in Zone I at the Cole site are believed to reflect this pattern.

Inhabitants at the Cole site during Zone I occupations appear to have been involved in activities related to this distribution pattern, specifically in the manufacture of cache blades and Turkey tail points. As noted by Didier: ...groups in Southern Indiana mined the Harrison County flint and made most, if not all, of the varieties of turkey-tails and these groups circulated them to other groups at considerable distances from them via the major rivers and lakes ... (1967: 41).

Didier recommended additional work needed to be conducted in Harrison County (1967: 41). Our investigations have identified three variations in the lithofacies of the Wyandotte chert zone and identified a manufacturing site related to the Turkey tail distribution pattern. Although the controlling cultural factors influencing this distribution pattern are not known, identification of the function of the Cole site as a single component in what may be an elaborate trade system may eventually allow an understanding of the mechanisms behind the massive apex of exploitation of the localized chert resources during Late Archaic through Middle Woodland times.

The potential of sites such as the Cole site has been expressed by House:

Since the lithic technology of a past society is articulated, directly or indirectly, with all other aspects of the past cultural system, lithic analysis need not be an end in itself but a means toward reconstruction of these other aspects as well. In this regard, knowledge of lithic resources and lithic resource procurement strategies becomes basic to a variety of research problems...manufacture of tools of nonlocal "expensive" versus locally available raw materials usually takes place at base camps rather than at extractive loci. Analysis of raw materials in debitage samples, then, may be a source of information on site function in a settlement system. The mechanism of movement of materials over long distances--whether by special expeditions for procurement, quarrying and performing by local groups and exchange with other groups, or a market system--is presumably related to the overall economic and social organization of a society (1977: 370).

Results of this data recovery project have identified the tremendous research potential of sites such as the Cole site. "Formulation of models to explain movement of lithic raw materials through cultural systems requires a knowledge of the nature of lithic resources, their distribution and abundance, and the technological potential and limitations of each raw material" (House 1977: 370). Additional studies of Cole site materials such as trace element analysis of chert materials (Luedtke 1979) may eventually allow distribution patterns of Wyandotte cherts, and the function of sites like the Cole site within these patterns, to be understood from the perspective of the overall cultural systems motivating them.

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APPENDICES A-F

APPENDIX A
Scope of Services

APPENDIX A

CULTURAL RESOURCES (DATA RECOVERY) AT

MARY ANN COLE SITE (12CR1)
ORIO RIVER, CANNELTON POOL,
CRAWFORD COUNTY, INDIANA

SCOPE OF SERVICES

I. General Statement of Services: The Services to be provided under this contract are those required to conduct, in the area specified below, a data recovery program of subsurface (Phase III) archeological investigations in Crawford County, Indiana, and to furnish a final, professional quality report of the investigations. Specific excavation methodology and the timetable for accomplishment of work is delineated below.

This contract is to be accomplished to meet the requirements of both the letter and spirit of P.L. 91-190 (N.E.P.A.), P.L. 93-291 (Reservoir Salvage Act of 1960, as amended), P. L. 89-665 (Historic Preservation Act of 1966), Presidential Executive Order 11593, and Corps of Engineers Regulation 1105-2-460. This data recovery program shall be of a scope and quality to meet recognized study and reporting standards of the State of Indiana and the Heritage Conservation and Recreation Service.

II. Study Area and Project Description: The Mary Ann Cole Site (12CR1) is a deeply buried, stratified prehistoric archeological site situated on a terrace on the right (west) bank of the Blue River and near the confluence of the Blue River with the right (north) bank of the Ohio River near Leavenworth, (Crawford County), Indiana. The portion of this large site to be excavated is located on a parcel of land immediately adjacent to and upriver from the old Lock and Dam No. 44 (Ohio River Mile 663.2). Upon completion of proposed construction, the project area will provide public access facilities in the form of a boat ramp, parking areas, and picnic areas for the benefit of the public.

III. Corps of Engineers Project Scheduling: At present, construction of the proposed public access facility is tentatively planned to begin in late fall of 1979 or early spring of 1980.

IV. Fiscal Arrangements:

A. Budget. An estimated budget separated into amounts of time and money to be allocated to the various research tasks proposed is to be part of the proposal. The specifics of salary and other costs, expressed in quantified terms, are to be shown along with pay rate and duration of work to yield a total product figure. Salary levels are governed by the current base salary pay rates for that individual when not otherwise employed on the research project (41 CFR 1-15.309-7). In support of the budget outline, an attachment will be prepared which justifies the expenditures clearly tying the work tasks to the time and dollar amounts. Considerable care should be exercised in this

justification sufficient to allow an opportunity to assess the reasonableness of the proposed charges. This endeavor will include a Schedule-of-work diagramming the duration of each field and laboratory operation outlined in the Research Methods section of the proposal.

B. Payments. The contract will be lump-sum (fixed price) type. Partial payments may be made up to ninety percent (90%) of the total amount allotted, based on percentages of completion of the investigation. Ten percent (10%) will be withheld until receipt and acceptance of the final report.

C. Endorsements. The proposal submitted for consideration must bear the endorsement, by means of signatures, of the proposed Primary Principal Investigator and of an official representative of the Institution or organization submitting the proposal.

V. Excavation and Report Schedule: The following schedules, if at all possible, shall be adhered to except under conditions beyond the control of the Contractor, during the conduct of the work covered by the Scope of Services.

A. Excavation Schedule. Fieldwork shall begin within ten (10) days following receipt of Notice to Proceed from the Louisville District and must be completed within ten (10) weeks of beginning date.

B. Laboratory Analysis Schedule. Laboratory analysis, interpretation, and preparation of draft report may begin concurrent with fieldwork, and must be completed by the end of the 42nd week following the first day of fieldwork.

C. Report Schedule. A draft report, complete with all necessary mapping, photographs, and figures, will be due in the office of the Contracting Officer at the end of the 42nd week following the first day of fieldwork. Contracting Officer will review the draft report and return it to the Principal Investigator(s) for any necessary revisions or changes by the end of the 47th week following the first day of fieldwork. The Contracting Officer reserves the right to request additional evaluation of the draft report through peer review. The final report (see paragraph VII "Report Format" and Appendix B below) will be due at the end of the 52nd week following the first day of fieldwork.

D. Progress Report. During the conduct of the fieldwork, weekly progress reports shall be submitted by telephone. Bi-weekly progress analysis and report preparation, a written progress report shall be submitted by the 10th of each month covering work accomplished during the previous month.

VI. Contractor Services: The Contractor shall be responsible for conducting in the manner prescribed the fieldwork detailed below. Failure to fully meet the fieldwork and reporting requirements of this Scope of Services may be cause for termination of work for default of contract, or for an evaluation of unsatisfactory upon completion if the project.

* Revised 24 October 1979

A. Manpower and Facilities. Supply the necessary personnel, facilities, supplies, materials, and other equipment to conduct archeological excavations within the specified portions of the project area.

B. Literature Search. Contractor shall utilize the studies entitled Test Excavations at the Mary Ann Cole Site, Crawford County, Indiana (1977) by Randall L. Gundersen, Cheryl Ann Munson and James H. Keller and Cultural Resources of the Ohio Valley in Indiana (1977) by Cheryl Ann Munson, William F. Lipa and David F. Barton as the basic literature searches for this excavation. Single copies of these reports will be furnished upon request to the Contractor. The National Register of Historic Places must also be consulted.

C. Excavation Methodology. Suitable mitigation of the portion of the Mary Ann Cole Site (12CR1) to be affected by construction activities may be achieved by the hand excavation of a single large excavation unit. This unit shall be situated in the southeastern corner of the recreation area in the vicinity of the bank and slopes to be graded preparatory to boat ramp construction. To adequately provide for the safety of the crew members excavating on this deeply buried site, the unit which will measure 24 feet by 30 feet at the upper level shall be stepped inward on its three (3) landward sides and open or provided with an earthen ramp on its southeastern edge (see Department of the Army - Corps of Engineers EM 385-1-1, General Safety Requirements Manual, Section XIII, "Excavations," pp. 162-166). Prior to the initiation of hand excavation, approximately one (1) to two (2) feet of culturally sterile alluvium may be mechanically removed; earth so moved shall be disposed of in a spoil area to be designated by the Project Engineer. On the basis of previous archeological testings, it is not anticipated that excavation shall be necessitated at a depth greater than twelve (12) feet below present ground surface. To supplement data collected from this block excavation and previous subsurface testing, three (3) additional backbone test units may be opened in the bed of the proposed access road situated immediately north of the boat ramp site and on the right (west) bank of Blue River (See Figure 1).

D. Data Recovery. Since much remains to be learned regarding the pre-history of the Middle Ohio Valley, the most basic archeological consideration should be the establishment of a firm and as finely detailed cultural chronology as possible on the basis of demonstrated radiographic relationships and radiometric evaluations. Statistical techniques may have to be utilized to separate some cultural components. Attention should also be directed toward ascertaining the nature of occupation during the various periods represented including site utilization, settlement, and subsistence patterns. The problem of cultural change should also be addressed within a localized as well as regional context. In particular, there should be an evaluation of the differences and similarities in patterns between the Mary Ann Cole Site and other occupations in the Ohio River Valley. Finally, a consideration of paleoenvironmental change and its relationship to changing

patterns may be in order. To accomplish this degree of analysis and interpretation, proposals submitted should provide for radiocarbon (C-14) dating, floral, faunal and pollen identification, burial analysis, and appropriate geological studies.

E. Documentation of Investigations. The Contractor's field crew shall maintain a complete and thorough record of field activities, including field notebooks, forms and maps. A complete photographic record of all investigations will also be made, with negatives systematically labeled and organized to provide quick and easy retrieval. Xerographic copies of all field notes, forms and field maps shall be made and turned over to the Contracting Officer on the same date as, but separate from, the final report to help insure against their loss. All original notes, forms, and maps will be retained and curated with the artifact collections by the Contractor. The Contracting Officer also retains the right to request prints of any or all of the photographic negatives at no additional cost to the Contractor.

VII. Report Format: The report of investigations will include discussions in detail of the preceding services rendered. A detailed recommended final report format is outlined in Appendix B and should be followed or amended as appropriate. The Government Scope of Services shall be included as an appendix in the final report of investigations. The final report is expected to be a polished research report, suitable for publication, reflecting contemporary organizational and illustrative standards of the professional archeological journals. Contractor shall furnish to the Contracting Officer one (1) camera-ready copy of the draft report. The final report will be furnished to the Contracting Officer in twenty-three (23) professionally bound copies and two (2) unbound camera-ready copies. All final reports must meet the following conditions:

A. Title Page. The title page of the report must be dated and bear an appropriate inscription indicating the source of funds used to conduct the reported work.

B. Authorship. If a report has been authored by someone other than the Primary Principal Investigator, the cover and title page of the publishable report must bear the inscription Prepared Under the Supervision of (Name), (Primary) Principal Investigator. The Primary Principal Investigator is required to sign the original copy of the report.

C. Abstract. An abstract suitable for publication in an abstract journal must be prepared. This should consist of a brief, quotable summary useful for informing the technically oriented professional public of what the author considers to be the contributions of the investigation to knowledge.

D. Foreword. If a report has been authored by someone other than the contract Primary Principal Investigator, the Primary Principal Investigator must at least prepare a foreword describing the overall research context of

the report, the significance of the work, and any other related background circumstances relating to the manner in which the work was undertaken.

E. Page Size and Margins. Text materials shall be typed on fully white, offset bondpaper, 120# substance (Government weight, 1,000 sheets 25 x 38), or equal, 8" x 10-1/2" with a 1-1/2" binding margin on left side, 1/2" on the right, and 1" at top and bottom, and 1 line spacing with double spacing between paragraphs. Final printed and bound copies of the report shall conform to similar page size requirements.

F. Illustrations. Drawings or plates shall not have an image larger than 10" x 16" with sufficient margin for binding on the left side.

G. Pagination. All pages must be consecutively numbered.

H. Photographs. All photographs will contain an appropriate scale and/or directional arrow located clearly in the frame.

I. Soil Descriptions. All soil horizons and strata will be described along standard scientific terms. Color descriptions will be made in Munsell terminology.

J. References Cited. A single, complete bibliography will list all sources and references cited within the body of the report as well as technical appendices as required for special studies if not incorporated in the text of the report.

K. Publicity. Neither the Contractor or his representative shall release or publish any sketch, photograph, report or other material of any nature obtained or prepared under this contract without specific written approval of the Contracting Officer or a designated representative prior to the time of final acceptance of the report by the Government. For the purpose of this Scope of Services, publications shall include presented papers, books, monographs, articles, theses and/or dissertations.

L. Government Rights. All reports, drawings, maps, photographs, notes and other work developed in the performance of this agreement shall be and remain the sole property of the Government and may be used on any other work without additional compensation to the Contractor. The Contractor agrees not to assert any rights and not to establish any claims with respect thereto. The Contractor agrees to furnish and provide access to all retained materials on the request of the Contracting Officer.

In the event of controversy or court challenge, the Principal Investigator may be called upon to testify on behalf of the Government in support of his findings. Payment for such testimony shall be limited to \$100.00/day plus expenses.

M. Responsibility for Materials and Related Data. Except as otherwise provided in this contract, the Contractor shall be responsible for any materials and related data covered by this contract until they are delivered to the Government at the designated delivery point and after delivery at the designated point, but prior to receipt by the Government.

One set of clearly marked U.S. Geological Survey 7.5' quadrangles and 1" equal 200 feet scale project maps indicating the precise locations of all cultural resources within and immediately adjacent to the project area located during fieldwork will be furnished the Louisville District on the same date as, but separate from, the final report.

N. National Technical Information Service (NTIS). The report, through the Contracting Officer, will be maintained on microfiche by the National Technical Information Service (NTIS) and will be available to interested persons from NTIS. Each report is to include Form NTIS-35 (provided the Contractor by the Contracting Officer, Appendix C) as its first page. Blocks 4, 5, 7, 9, 11, 12, 13, 14, 15, 16, 17b and 21 of Form NTIS-35 will be completed by the Contractor.

Specific locations of sites found or otherwise identified as the result of investigations under the contract which might be subject to vandalism will be deleted from the copy of the report furnished to NTIS by the Louisville District.

VIII. Personnel and Institutional Standards. Agencies, institutions, corporations, associations, or individuals will be considered qualified when they meet the minimum criteria given below. As part of the supplemental documentation, a contract proposal must include vitae for the Principal Investigator(s), main supervisory personnel, and consultants in support of their academic and experiential qualifications for this research. In the event that support personnel have not been identified at the time of the contract proposal, vitae on supervisory positions may be omitted until such time as they are identified with the provision that those to be selected meet the minimum professional standards stated below and that their retention is subject to approval by the Contracting Officer's authorized representative. Individuals lacking such formal qualifications may present evidence of a publication record and references from archeologists to do meet these qualifications.

A. Principal Investigator. Primary Principal Investigator for this contract shall hold the Ph.D. degree. He shall be responsible for the technical validity and professional quality of the material presented in the final report of findings, and will sign the report. The Primary Principal Investigator shall spend a minimum of five (5) percent of contract time in direct supervision of the project if assisted by a co-Principal Investigator. In the event a co-Principal Investigator is not selected or is unable to fulfill his responsibilities, the Primary Principal Investigator shall spend a

minimum of twenty (20) percent of contract time in direct supervision of the project.

The co-Principal Investigator shall hold the Ph.D degree or academic qualifications acceptable to both the Primary Principal Investigator and the Corps of Engineers. Upon accepting this position, the co-Principal Investigator shall spend a minimum of fifteen (15) percent of contract time in direct supervision of the project.

B. Principal Investigator Responsibilities. The Principal Investigator(s) are expected to take an active part in each phase of the project, including the necessary fieldwork. They shall spend a minimum of two days of each week of fieldwork on the project site to insure that field crews are, in fact, making timely progress and keeping abreast of the schedule of work outlined above. They shall satisfy themselves that their field parties are receiving full benefit of their professional direction.

C. Field and Laboratory Supervisors. Persons in charge of an archeological project or research investigation contract must have a Master's Degree in Anthropology or an equivalent level of professional experience in field project formulation, execution, and technical monograph reporting, acceptable to both the Principal Investigator(s) and the Corps of Engineers. Suitable professional references may also be made available to obtain estimates regarding the adequacy of prior work. If prior projects were of a sort not ordinarily resulting in a publishable report, a narrative should be included detailing the proposed project supervisor's previous experience along with references suitable to obtain opinions regarding the adequacy of this earlier work.

D. Archeologist. The minimum formal qualifications for individuals practicing archeology as a profession are a B.A., or B.S. degree from an accredited college or university, followed by two years of graduate study with concentration in anthropology and specialization in archeology during one of these programs, or at least one year of professional experience as a substitute for graduate studies.

E. Consultants. Personnel hired or subcontracted for their special knowledge and expertise (historians, geologists, geographers, etc.) must carry academic and experiential qualifications in their own field of competence. Such qualifications are to be submitted to the Contracting Officer or a designated representative. If the consultant has not been retained at the time of contract negotiations, qualifications may be omitted until such time as they are identified, subject to approval of the Contracting Officer or a designated representative.

F. Institutional or Corporate Qualifications. Any institution, organization, etc., obtaining this contract, and sponsoring the Principal

Investigator(s) or project supervisor meeting the previously given requirements, must also provide or demonstrate access to the following capabilities.

1. Adequate field and laboratory equipment necessary to conduct the operations defined in this scope of work. However, this qualification may be waived under circumstances of extreme need through negotiation.

2. Adequate facilities necessary for proper treatment, analysis, and storage of specimens and records likely to be obtained from a given project. This does not necessarily include such specialized facilities such as pollen, geochemical, or radiological laboratories, but does include facilities sufficient to properly preserve or stabilize specimens for any subsequent specialized analysis.

G. Disposition of Data. When the recovered data has been removed from nonfederally owned lands, such as state, municipal, corporation, or private, then negotiated arrangements must be made for permanent curation. Such arrangements will be negotiated between the Louisville District, State Historic Preservation Officer, Office of State Archeology (when appropriate), and the property owner in accordance with Heritage Conservation and Recreation Service Policy. The materials recovered from federal lands are the property of the government and will normally be maintained at the institutional facility of the Principal Investigator(s) on a "permanent loan" basis. Materials should always be retained and maintained in the state in which they were recovered and the arrangements for such storage and curation will be made by the Principal Investigator(s). Arrangements may also be made by the Contracting Officer with reputable museums and universities to provide storage and curatorial services for material recovered as a result of activities performed by government personnel or by contract with private firms or institutions lacking adequate facilities of this nature. Some materials may be required by the Corps of Engineers for interpretive displays for the information and benefit of the public.

IX. Government Participation. Key government personnel will be available to Contractor to furnish such information as is available, and to insure Contractor access to all non-sensitive data, documents, and records in the District Office files needed for the contract. Contractor personnel will be expected to work in close coordination with the Contracting Officer, his representatives, or other assigned government personnel.

There shall be several meetings between the Contractor and his personnel, and the Contracting Officer and his representatives. A formal prework conference will be held prior to initiation of fieldwork to discuss Government Safety Regulations, coordination between Contractor personnel and the Contracting Resident Engineer, project scheduling, and related matters. The Contractor will be required to attend all such meetings convened by the Contracting Officer on mutually agreed-upon dates. Additional informal, unscheduled

meetings for the purpose of clarification, assistance, coordination, or other reasons may also be called either by the Contractor or the Contracting Officer or his representatives. Such meetings may be held at the office of the Contracting Officer, but must will be at the project site or other location as mutually agreed upon. All meetings are considered a part of the contract and no extra payment will be made for attendance.

The Government through any authorized representative, may at all reasonable times, inspect or otherwise evaluate the work being performed hereunder and the premises in which it is being performed. If any inspection or evaluation is made by the Government on the premises of the Contractor or subcontractor, the Contractor shall provide and shall require his subcontractors to provide all reasonable facilities and assistance for the safety and convenience of the Government representatives in the performance of their duties. All inspections and evaluations will be performed in such a manner as will not unduly delay the work. Close coordination will be maintained between the Principal Investigator(s) and the Government to insure that the Government's best interest is served.

X. Guidelines: These investigations will be conducted in accordance with "Identification and Administration of Cultural Resources" (U. S. Army Corps of Engineers Regulations, ER 1105-2-460) and "Recovery of Scientific, Prehistoric, Historic and Archeological Data: Methods, Standards and Reporting Requirements" (36 CFR Part 65).

XI Data and Services Furnished by the Government: The following data and services shall be provided to the Contractor by the Government:

1. Identification and Administration of Cultural Resources (U. S. Army Corps of Engineers Regulation ER 1105-2-460).
2. 36 CFR Part 65, Recovery of Scientific, Prehistoric, Historic and Archeological Data: Methods, Standards, and Reporting Requirements, published in the Federal Register, Vol. 42, No. 19, 28 January 1977 (Appendix E).
3. U. S. Army Corps of Engineers Manual EM 385-1-1, "General Safety Requirements" dated 1 June 1977.
4. U. S. Geological Survey 7.5' quadrangles of the project area (2 sets).
5. Project maps of 1" equal 200' scale (2 sets).
6. Available aerial photographs of the project area will be supplied for use in the Louisville District only.

XII. Special Conditions: When cultural resources studies are possibly related to a specific group of people whose descendants are still living in

the general area, these people should be informed of the studies, and consulted, especially where interpretive developments are being considered. Human skeletal remains gathered by this program of studies will not be placed on public display without prior written approval of the Contracting Officer or a designated representative.

APPENDIX B

Glossary

APPENDIX B GLOSSARY

Accretion 1. The gradual addition of new land to old by the deposition of sediment carried by the water of a stream. 2. The process by which inorganic bodies grow larger, by the addition of fresh particles to the outside. 3. A theory of continental growth by the addition of successive geosynclines to the craton. 4. In soils, the process of illuviation is usually one of the addition of minerals by accretion.

Aeolian 1. Applied to deposits arranged by the wind, as the sands and other loose materials along shores, etc. (from Eolus, the god of winds). 2. Applied to the erosive action of the wind, and to deposits which are due to the transporting action of the wind.

Argillaceous Applied to all rocks or substances composed of clay minerals, or having a notable proportion of clay in their composition, as shale, slate, etc. Argillaceous rocks are readily distinguished by the peculiar, "earthy" odor when breathed on.

Assemblage The total of related cultural traits and artifacts associated with any one archaeological manifestation.

Artifact Anything made by man. In archaeology - chert tools, implements and other objects that are demonstrably of human alteration or manufacture.

Atlatl A spear-throwing device acting as an extension lever thereby lengthening the arm and the arc of the swing. Improves distance and accuracy.

Auger A boring tool with a screw-threaded bit.

Backfill Replacing excavated soils in a finished unit.

Backsight The procedure of aligning the transit on the site grid by sighting to a pre-established point.

Baseline An arbitrary North-South or East-West line on the site grid which intersects the site datum point.

Biface Core Chert nucleus from which flakes or blades have been removed on at least two faces/surfaces.

Biociation The association of a set of flora and fauna.

Boring A vertical column of soil removed from the ground to be interpreted as a generalized representative indication of the buried soil profile.

Burned Bone Bone oxidized by fire. Usually occurs in a cultural context.

Cache blade Broad, thin mass produced chert blade.

Calcareous Containing calcium carbonate.

Carbon/Organic Material Terms applied to vegetable matter which has been reduced to carbon (the chemical element) without evidence of burning.

Charcoal The term is applied to burned vegetable matter.

Chert Crypto-crystalline (high-density) stone utilized for chipped stone tool manufacture.

Clastic Consisting of fragments of rocks or of organic structures that have been moved individually from their places of origin.

Conchoidal A type of rock or mineral fracture giving smoothly curved surfaces. Characteristic of quartz and obsidian.

Context The discrete location of archaeological remains in the situation of their original deposition or disposal. When soil stratigraphy is altered archaeological context is destroyed.

Core A chert nucleus from which flakes have been removed.

Cuesta A sloping plane which is terminated on one side by a steep slope.

Cultural Debris Any material resulting from human activity, i.e. remains, such as chert, pottery, bone, charcoal, fire cracked rock, etc.

Cultural Resources Historic and prehistoric cultural entities regarded as a finite set of non-renewable research and analysis study resources.

Cultural Resource Management Investigation, assessment, and evaluation of cultural resources (i.e. archaeological sites) threatened by impacts related to land use changes.

Datum Permanent control point from which calculations or measurements are made.

Debitage Waste by-products of lithic reduction.

Diagnostic Artifact Artifact occurring in and representative of a specific cultural tradition or time period.

Dryscreen Sifting excavated soil through mesh screens, commonly of 1/2" and 1/4" size to recover materials that might otherwise be overlooked because of their small size.

Detritus Fragments resulting from disintegration - chert being broken by flaking, i.e. flakes.

Distal Furthest, generally refers to the tip pointed end of a projectile point or stone tool.

Ecotone The transition zone from one ecozone to another.

Escarpment A steep face terminating high lands abruptly.

Facies General appearance or nature of one part of a rock body as contrasted with other parts.

Faunal Remains Animal remains.

Feature Subsurface disturbance of human cultural origin such as a refuse pit, firehearth, post hole, etc.

Fire Cracked Rock (FCR) Rock broken by use as heating stones repeatedly exposed to fire.

Flake A chip of chert or flint removed from a stone in tool manufacturing processes.

Floral Remains Plant remains.

Flotation Water flotation/separation technique used to sort excavated earth, to recover small animal bones, charcoal and seeds that might normally be lost.

Fluvial Processes Produced by river action.

Grid Dividing a site into regular sized squares to allow a system of controlling and recording horizontal placement of excavation units and recovered cultural materials.

Ground Stone Tools Axes, pestles, adzes, ornaments, etc. which have been manufactured from hard stones by pecking and smooth grinding.

Hammerstone Hard cobble used to remove flakes from a chert core; usually exhibits scars from battering.

Historic Designates that small portion of Man's existence documented by written records. In the Ohio Valley this begins about 1600 A.D.

Horizon In connection with a specific site, it means a certain horizontal or laterally extending soil or occupation zone.

Humus The surface soil zone containing and made from rotting and decayed vegetation remains.

In Situ Term used to indicate that an object is in its natural position or place. In archaeology it indicates that an artifact is in the place where it was originally deposited.

Knapper One who forms stone implements by controlling the fracture of the material. An artificer. A stoneworker using material exhibiting a conchoidal fracture.

Lanceolate Leaf-shaped.

Line Level Small device used to measure depths below a horizontal line attached to a datum point.

Lithic Debris Rock detritus, usually referring to chert waste flakes, and other by-products of stone tool manufacture.

Lithofacies The rock record of any sedimentary environment, including both physical and organic characteristics.

Lithology 1. The physical character of a rock, generally as determined megascopically or with the aid of a low-powered magnifier. 2. The microscopic study and description of rocks.

Loam Soil consisting mainly of sand, clay, silt, and organic matter.

Loess A homogeneous, nonstratified, unindurated deposit consisting predominantly of silt, with subordinate amounts of very fine sand and/or clay; a rude vertical parting is common at many places.

Manuport An object which is displaced from its natural context by human transportation. For example, a water-worn river cobble on a ridge crest.

Mesothermal Deposit from warm waters at intermediate depth under conditions in the medium ranges of temperature and pressure.

Mica A mineral, consisting of phyllosilicates, having a sheet-like structure, highly prized for ornamental purposes by Adena and Hopewell groups.

Mitigation The alleviation of adverse effects of development and construction on cultural resources.

Obsidian Black volcanic glass, having no crystalline structure and therefore easily controlled in flaked tool manufacture.

Oolite A spherical to ellipsoidal body 0.25 to 2.00mm in diameter, which may or may not have a nucleus, and has concentric or radial structure or both. It is usually calcareous, but may be siliceous, hematitic, or of other composition.

Oolith The individual spherite of which an oolite is composed.

Pleistocene Geologic time period preceding the present conditions. Characterized by cycles of massive continental glacial advances.

Plowzone The portion of the soil profile which has been disturbed and mixed by plowing.

Preform Biface intended for further reduction/refinement into tools.

Prehistory Designates the expansive portion of Man's existence prior to the written record.

Progradation A seaward advance of the shoreline resulting from the nearshore deposition of sediments brought to the sea by rivers.

Projectile Point The tip of an arrow, spear, javelin, etc. Made of stone, antler, bone, wood, or metal, it is designed to cut an incision so the shaft of the projectile can penetrate the victim.

Proximal Nearest, generally refers to the basal portion of a projectile point or other stone tool.

Punctate Point or depression on ceramic vessels, usually found on the rim. Made with some sharp or pointed tool while clay is still plastic.

Screen A wire mesh through which soils are passed to recover artifacts.

Sherd Broken fragment of ceramic pottery vessel.

Shovel Test Examination of less than 1 cubic foot of surface soil for cultural indicators by using a shovel to expose the soil.

Site Any locality occupied or utilized by man.

Slot Trench An exploratory trench cut at the base of a finished excavation unit to confirm the absence of deeper cultural deposits.

Soil Stain Discoloration of soil due to natural or cultural disturbances of the soil profile.

Strath 1. Generally used for a broad river valley. If it has been elevated and dissected, the erosion remnant is called a strath terrace. 2. Valley deeply filled with alluvial deposits, particularly glacial outwash, not now occupied by stream.

Stratigraphy The concept of layered soil deposits with older layers deeper and layers progressively younger upward.

Stratum A subsurface prehistoric occupation, as indicated by the presence of cultural materials or refuse discolored soils.

Subsistence Occupation of obtaining those elements and materials utilized to support life, i.e. food, water, etc.

Survey or Reconnaissance Search techniques conducted to locate and identify cultural resources.

Swale A slight, marshy depression in generally level land.

Systematic Surface Collection Non-random provenience controlled 100% pick-up of all cultural materials by grid units.

Tectonic Of, pertaining to, or designating the rock structure and external forms resulting from the deformation of the earth's crust. As applied to earthquakes, it is used to describe shocks not due to volcanic action or to collapse of caverns or landslides.

Temper Material included in plastic clay to bond and strengthen the walls of fired ceramic vessels.

Terra rossa Residual red clay mantling limestone bedrock.

Test Excavation Controlled vertical removal of a measured square unit of soil for the purpose of preliminary assessment of site significance. Excavation is limited to the extent necessary to determine a site's potential eligibility for nomination to the National Register of Historic Places.

Test Trench Test excavation unit characterized by a vertical depth of length exceeding its width. Utilized to expose soil profiles.

Traction The entire complex process of carrying material along the bottom of a stream.

Tradition A recognized set of specific diagnostic cultural traits occurring in a restricted spatial and temporal range.

Transit Precision engineering device used to establish and control the site grid and measure elevations and depths. Used with a stadia rod.

Trowel A small pointed hand tool used for careful excavation of archaeological deposits.

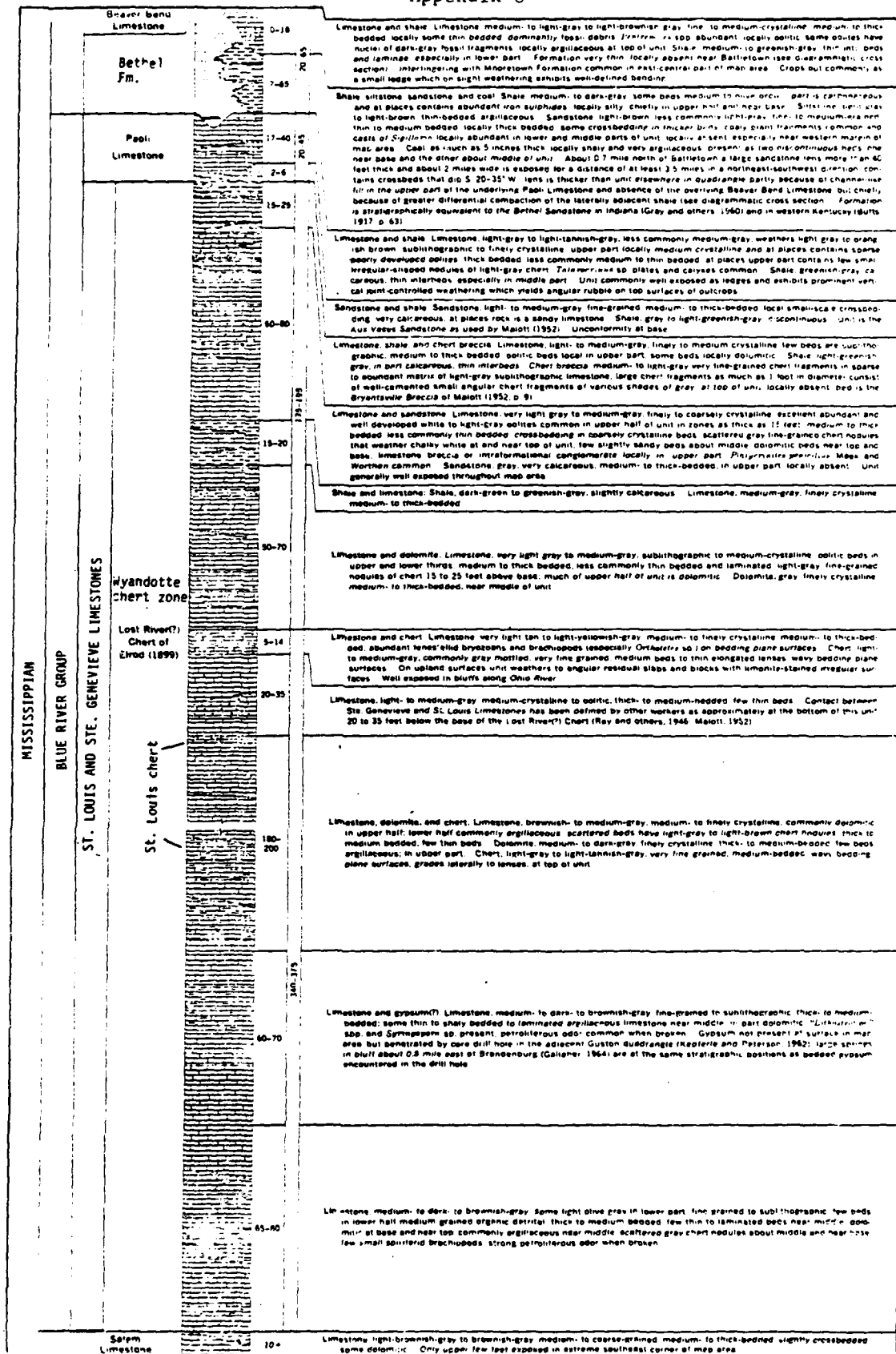
Unit Test excavation pit designated by grid coordinates.

Valley train A long narrow body of outwash confined within a valley.

Waterscreen Method of processing excavated deposits by using a water pump to wash it through 1/16" mesh screen to recover very small archaeological materials.

APPENDIX C
Geologic Column

Appendix C



APPENDIX D
Waterscreen Results

A4d

Level	Primary		Secondary		Waste		Blocky		Sandstone		Hardstone		Charcoal		Bone burned		Silicified limestone	
	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.
90-100	-	-	-	-	1	2.1	-	-	-	-	3	3.7	-	-	-	-	-	-
100-110	-	-	-	-	-	-	-	-	1	.3	-	-	-	-	-	-	5	6.1
110-120	-	-	-	-	1	.4	-	-	1	.15	1	16.8	-	-	-	-	-	-
120-130	1	3.0	1	1.5	2	.4	-	-	4	21.45	2	6.1	-	-	-	-	-	-
130-140	-	-	4	13.7	3	8.5	-	-	4	15.5	1	11.0	-	-	-	-	-	-
140-150	2	3.4	6	6.0	17	8.7	1	3.0	11	57.8	2	11.4	-	-	-	-	-	-
150-160	4	12.3	4	7.8	9	13.6	-	-	20	113.55	-	-	-	-	-	-	-	-
160-170	7	43.5	8	37.2	22	21.9	-	-	16	109.2	4	311.1	-	-	-	-	2	55.75
170-180	-	-	3	.55	12	5.9	-	-	7	8.7	2	.1	-	-	2	.1	-	-
180-190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
268	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
290-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300-310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
310-330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
330-350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

B4d

Level	Primary		Secondary		Waste		Blocky		Sandstone		Hardstone		Charcoal		Bone burned		Silicified limestone	
	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.
90-100	-	-	1	2.3	-	-	-	-	3	1.6	2	.4	-	-	-	-	-	-
100-110	-	-	-	-	-	-	-	-	1	2.5	-	-	-	-	-	-	-	-
110-120	1	.6	1	6.7	-	-	-	-	1	53.9	2	.1	-	-	-	-	-	-
120-130	-	-	-	-	4	2.35	-	-	8	13.6	-	-	-	-	-	-	-	-
130-140	1	.6	-	-	3	1.5	-	-	3	3.5	4	.3	-	-	-	-	-	-
140-150	-	-	-	-	6	1.1	-	-	7	25.4	3	.2	-	-	-	-	-	-
150-160	2	2.6	-	-	3	1.2	-	-	4	6.4	3	97.6	-	-	-	-	-	-
160-170	2	6.3	6	7.5	8	6.5	-	-	7	72.5	1	12.4	-	-	-	-	-	-
170-180	4	5.4	4	3.0	33	7.5	-	-	27	100.3	-	-	5	.1	-	-	-	-
180-190	-	-	-	-	1	6.8	1	2.55	4	171.3	-	-	-	-	-	-	-	-
190-200	-	-	-	-	-	-	-	-	4	5.85	1	.6	-	-	-	-	-	-
300-310	-	-	-	-	-	-	-	-	-	-	1	37.7	-	-	-	-	-	-
310-320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
320-330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
330-350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350-370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Waterscreen Results From Units A4d and B4d.

C1d

Level	Primary		Secondary		Waste		Blocky		Sandstone		Hardstone		Charcoal		Bone burned		Silicified limestone	
	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.
90-100	-	-	-	.2	-	-	-	-	1	2.2	3	.15	-	-	-	-	-	-
100-110	-	-	-	-	2	.4	-	-	1	.5	1	28.0	-	-	-	-	-	-
110-120	1	.2	-	-	4	1.9	-	-	2	1.25	2	1.5	-	-	-	-	-	-
120-130	1	.35	1	.7	20	18.15	-	-	5	7.7	3	.3	-	-	2	.1	-	-
130-140	2	.6	3	1.75	54	9.0	-	-	25	52.6	15	.6	1	.1	-	-	2	.6
140-150	11	13.7	14	12.3	47	16.7	-	-	29	143.4	2	2.8	-	-	-	-	-	-
150-160	-	-	1	2.7	9	34.3	3	118.25	18	331.8	2	129.3	-	-	-	-	-	-
160-170	2	1.6	3	1.8	3	.6	-	-	-	-	-	-	-	-	-	-	-	-
170-180	-	-	-	-	2	.1	-	-	1	1.7	-	-	3	.1	-	-	-	-
180-190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
280-290	-	-	-	-	1	.3	-	-	3	7.2	1	.4	-	-	-	-	-	-
290-300	-	-	-	-	-	-	-	-	1	3.5	1	12.35	-	-	-	-	-	-
300-310	-	-	-	-	-	-	-	-	1	2.4	-	-	-	-	-	-	-	-
310-320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
320-330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
330-350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350-370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

D1d

Level	Primary		Secondary		Waste		Blocky		Sandstone		Hardstone		Charcoal		Bone burned		Silicified limestone	
	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.
90-100	1	2.6	-	-	1	.1	-	-	-	-	-	-	-	-	-	-	-	-
100-110	-	-	-	-	3	.5	-	-	-	-	1	2.9	-	-	-	-	-	-
110-120	1	.1	-	-	8	2.35	-	-	3	9.7	3	.3	-	-	-	-	-	-
120-130	-	-	1	.1	8	4.8	-	-	3	13.0	5	.1	28	.6	-	-	-	-
130-140	-	-	3	10.7	-	-	-	-	3	9.4	-	-	-	-	-	-	-	-
140-150	1	.6	3	4.5	7	3.3	-	-	8	81.4	3	9.4	-	-	-	-	1	2.6
150-160	1	4.0	2	.8	6	13.3	-	-	10	30.9	2	35.1	5.6	-	-	-	1	.5
160-170	-	-	-	-	-	-	-	-	18	81.8	4	18.2	-	-	-	-	-	-
170-180	1	1.1	1	3.7	13	4.2	-	-	9	41.2	1	.1	-	-	-	-	-	-
180-190	-	-	-	-	1	.5	-	-	1	2.1	1	1.1	-	-	-	-	-	-
190-200	-	-	-	-	-	-	-	-	-	-	1	150.8	-	-	-	-	-	-
300-310	-	-	-	-	-	-	-	-	3	3.4	2	32.0	-	-	-	-	2	4.2
310-320	-	-	-	-	-	-	-	-	6	29.45	-	-	-	-	-	-	-	-
320-330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
330-350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Waterscreen Results From Units C1d and D1d.

APPENDIX E
Unit/Level Density Charts

APPENDIX E

A series of twelve charts are presented in this appendix to illustrate the nature of material density in the block excavation and to show the sloped configuration of the deposits. Each chart is keyed to the grid system below. Charts 1 through 6 are west to east cross-sections of each grid row. All charts show unit totals for chert debris. Numerals are totals for chert debris by unit/level. Alphabetic symbols are: C for each ceramic sherd; B for each biface; and P for each projectile point. Totals for each chart (row) are shown on the lower right corner of the charts.

CHART #		7	8	9	10	11	12		
		A1a	A1b	A1c	A1d	B1d	B1c	B1b	B1a
Quadrant A	1	A2a	A2b	A2c	A2d	B2d	B2c	B2b	B2a
	2	A3a	A3b	A3c	A3d	B3d	B3c	B3b	B3a
	3	A4a	A4b	A4c	A4d	B4d	B4c	B4b	B4a
	4	C1a	C1b	C1c	C1d	D1d	D1c	D1b	D1a
Quadrant C	5	C2a	C2b	C2c	C2d	D2d	D2c	D2b	D2a
	6	C3a	C3b	C3c	C3d	D3d	D3c	D3b	D3a
	DATUM	C4a	C4b	C4c	C4d	D4d	D4c	D4b	

WEST-EAST

LEVEL	UNIT	A2b	A2c	A2d	B2d	B2c	B2b	
90								#1
100	2							
110	1		6		1			
120	3		6	1				
130	5		3	6				
140	15		14	3	1			
150	70 CCB		26 CBB	5	2	1	2	
160	117		87 BB	28	14 CC		2	
170	56		96 P	71	40	7	2	
180	6		28	58	57	11	7	
190				15	27 BB	20	3	
200					1	6	37	
210	6					13	45 PB	
TOTAL 281		266	187	143	58	98	1033	

	A3b	A3c	A3d	B3d	B3c	B3b	
90							#2
100	7	1					
110	5	4				3	
120	7	4	5	13	1	1	
130	22	7 B	10 B		1 B	1	
140	40	22 C	4	6	3	6	
150	141 P	39 PBB	21	8	3	3 C	
160	102 C	143 CBB	4	26	5	4	
170	18	7	80	22	10 C	16	
180			49 B	74	18	19	
190				8 BB	38 P	26	
200				3	9 B	8	
210					2		
TOTAL 342		227	173	160	90	87	1079

	A4b	A4c	A4d	B4d	B4c	B4b	
90							#3
100	8 CC	1	1	3			
110	5	5 CC	3			1	
120	13	10	6	5	3 C	1	
130	62		7	9	2	5	
140	73 CP	28	16	9	2	1	
150	198 BBPC	71 B	48 B	18	3		
160	116	120 BBBP	69 BB	30	7	10	
170	10	23	77	40	15	13	
180		4	15	57		12	
190				18	14	16	
200					3	13	
210						4 B	
TOTAL 485		262	242	179	49	76	1293

WEST-EAST

LEVEL	UNIT	C1b	C1c	C1d	D1d	D1c	D1b	
90								#4
100	4		12 C	2 B	3	1	1	
110	15		8	8	8	3	5	
120	30		13	1	9	2	4	
130	99		14	25	15	1	1	
140	189 PC		44 CB	71 B	4	2	2 C	
150	136 C		66 CC	45	21 B	10	3	
160	16		28	51	38	18	13	
170	4		6	22	40	23 BP	11	
180			2	2	28		20 B	
190					2	14 B	15	
200	1						1	
210								
TOTAL 494			193	227	168	74	76	1262

	C2b	C2c	C2d	D2d	D2c	D2b	
90							#5
100	15 C	13 C	12	2		2	
110	25 C	1	7 BB	8	5 C	4	
120	73	13 P	7		4	1	
130	129 PPB	29	22	9	2		
140	123 B	45	33 C	22 B	6	5	
150	29 P	23	52	30	29 C	9	
160	8	9	23 CBP	14	32 P	17	
170	3		4	13	27 B	26	
180				1	11 P	9	
190					5	1	
200	1				B		
210							
TOTAL 406		133	160	99	121	74	993

	C3b	C3c	C3d	D3d	D3c	D3b	
90							#6
100	22	8	4		1		
110	53	16	5	5	5	2	
120	146	30 B	8		2	3	
130	109 P	80 B	22	13	5	4	
140	60 B	42	34 B	20	12 B	7	
150	13	30 P	39	41	27	8	
160	5	9	21	24 B	24 CP	37	
170	1	3	2	3	26 B	37 B	
180			1	1	16 C	30 BB	
190						4	
200						2	
210							
TOTAL 409		218	136	107	118	134	1042

SOUTH-NORTH

UNIT	C3b	C2b	C1b	A4b	A3b	A2b	
LEVEL							
90							#7
100	22	15 C	4	8 CC	7	2	
110	53	25 C	15	5	5	1	
120	146	73	30	13	7	3	
130	109 P	129 PPB	99	62	22	5	
140	60 B	123 B	189 PC	73 PC	40	15	
150	13	29 P	136 C	198 BBPC	141 P	70 CCB	
160	5	8	16	116	102 2	117	
170	1	3	4	10	18	56	
180						6	
190							
200		1	1				
210					6		
TOTAL	409	496	494	485	342	281	2417

	C3c	C2c	C1c	A4c	A3c	A2c	
90							#8
100	8	13 C	12 C	1	1		
110	16	1	8	5 CC	4	6	
120	30 B	13 P	13	10	4	6	
130	80 B	29	14		7 B	3	
140	42	45	44 CB	28	22 CC	14	
150	30 P	23	66 CC	71 B	39 PBB	26 CBB	
160	9	9	28	120 BBBP	143 CBB	87 BB	
170	3		6	23	7	96 P	
180			2	4		28	
190							
200							
210							
TOTAL	218	133	193	262	227	266	1299

	C3d	C2d	C1d	A4d	A3d	A2d	
90							#9
100	4	12	2 B	1			
110	5	7 BB	8	3			
120	8	7	1	6	5	1	
130	22	22	25	7	10 B	6	
140	34 B	33 C	71 B	16	4	3	
150	39	52	45	48 B	21	5	
160	21	23 CBP	51	69 BB	4	28	
170	2	4	22	77	80	71	
180	1		2	15	49 B	58	
190						15	
200							
210							
TOTAL	136	160	227	242	173	187	1125

SOUTH-NORTH

UNIT	D3d	D2d	D1d	B4d	B3d	B2d	
LEVEL							
90							#10
100		2	3	3			
110	5	8	8			1	
120			9	5	13		
130	13	9	15	9			
140	20	22 B	4	9	6	1	
150	41	30	21 B	18	8	2	
160	24 B	14	38	30	26	14 CC	
170	3	13	40	40	22	40	
180	1	1	28	57	74	57	
190			2	8	8 BB	27 BB	
200					3	1	
210							
TOTAL	107	99	168	179	160	143	856

	D3c	D2c	D1c	B4c	B3c	B2c	
90							#11
100	1		1				
110	5	5 C	3				
120	2	4	2	3 C	1		
130	5	2	1	2	1 B		
140	12 B	6	2	2	3		
150	27	29 C	10	3	3	1	
160	24 CP	32 P	18	7	5		
170	26 B	27 B	23 BP	15	10 C	7	
180	16 C	11 P			18	11	
190		5	14 B	14	38 P	20	
200				3	9 B	6	
210					2	13	
TOTAL	118	121	74	49	90	58	510

	D3b	D2b	D1b	B4b	B3b	B2b	
90							#12
100		2	1				
110	2	4	5	1	3		
120	3	1	4	1	1		
130	4		1	5	1		
140	7	5	2 C	1	6	2	
150	8	9	3		3 C	2	
160	37	17	13	10	4	2	
170	37 B	26	11	13	16	7	
180	30 BB	9	20 B	12	19	3	
190	4	1	15	16	26	37	
200	2		1	13	8	45	
210				4 B			
TOTAL	134	74	76	76	87	98	545

APPENDIX F
Supervisory Personnel Vitae

VITA

John T Dorwin
President and Senior Archaeologist

Education:

Albion College, Albion, Michigan, 1957-59
Purdue University, Ft. Wayne, Indiana, 1959
Indiana University, Bloomington, Indiana
A.B. 1962
M.A. 1964
Ph.D. 1970

Indiana University School of Public and Environmental Affairs 1977

Major Field: Anthropology
Internal Major: Archaeology
Internal Minor: Ethnology
Minor Field: History

Dissertation: The Bowen Site: An Archaeological Study of Culture Process in the Late Prehistory of Central Indiana.

Partial Listing of Archaeological Experience:

Principal Investigator

1980 Archaeological Mitigation at the Mary Ann Cole Site on the Ohio River in Crawford County, Indiana; US Army Corps of Engineers, Louisville, Kentucky.

L'Anse - Lac Vieux Desert Trail, Cultural Resource Survey. USDA Forest Service, Ottawa National Forest, Ironwood, Michigan.

Cultural Resource Survey of 21,000 Acres of Forest Service Lands. USDA Forest Service, Hiawatha National Forest, Escanaba, Michigan.

Historic and Prehistoric Archaeological Investigations, Detroit 201 Facilities Plan, Giffels/Black and Veatch, Detroit, Michigan.

1979 Cultural Resource Survey of 7,500 Acres of Forest Service Lands. USDA Forest Service, Wayne National Forest, Athens, Ohio.

Cultural Resource Reconnaissance of 75 Miles of
Alternative Highway Corridors, South Bend/Elkhart,
Indiana Bypass. D.E. McGillem and Associates,
Indianapolis, Indiana.

Archaeological Survey and Test Excavations at Moss Lake,
US Fish & Wildlife Service, Muscatatuck National Wildlife
Refuge, Seymour, Indiana.

Archaeological Borings at Grandview and Corps of
Engineers Properties, Spencer County, Indiana; American
Electric Power Service Corporation, Canton, Ohio.

Archaeological Test Excavations of Three Sites Located by
Boring on Corps of Engineers Property, Spencer County,
Indiana; American Electric Power Service Corporation,
Canton, Ohio and WAPORA, Inc., Chicago, Illinois.

Archaeological Borings on the Indiana and Michigan
Electric Company Property, Spencer County, Indiana;
American Electric Power Service Corporation, Canton, Ohio
and WAPORA, Inc., Chicago, Illinois.

Archaeological Test Excavation of a Site Located by
Boring on the Indiana and Michigan Electric Company
Property, Spencer County, Indiana; American Electric
Power Service Corporation, Canton, Ohio and WAPORA, Inc.,
Chicago, Illinois.

Archaeological Surveys of Various Segments of Highways,
Indiana State Highway Commission, Indianapolis, Indiana.

Archaeological Survey and Test Excavations on 133 Miles
of Pipeline Right-of-Way, southern Indiana; Texas Eastern
Transmission Corporation of Indiana, Jasper, Indiana.

Archaeological Mitigation in the Ohio River Floodplain at
Marble Hill Nuclear Generating Station, Madison Indiana;
Public Service Indiana, Plainfield, Indiana.

1978

Archaeological Reconnaissance of the Hune Bridge and Ring
Mill Canoe Access Areas on the Little Muskingum River in
the Wayne National Forest, Ohio.

Archaeological Survey of Forsyth County Memorial Park.
Forsyth County Commissioners, Winston-Salem, North
Carolina.

Archaeological Survey of the Greensboro/High
Point/Winston-Salem Regional Airport Extension. Airport
Authority, Greensboro, North Carolina.

- 1977 Cultural Resource Survey and Testing at the Gibson Station Generating Facility, Gibson County, Indiana. Public Service Indiana.
- Long Lake Bayou Cultural Resources Survey and Reconnaissance, Phillips County, Arkansas Corps of Engineers, Memphis District.
- 1975 Spikebuck Town, a Protohistoric Cherokee Village, Clay Co., North Carolina.
- 1974 University of North Carolina at Wilmington, Underwater Archaeological Field School. Survey of Civil War blockade runner wrecks in vicinity of Cape Fear, North Carolina.
- 1973 Spikebuck Town, Clay Co., North Carolina.
- 1972 Cross Site, a Multi-Component Woodland Village and New Stadium Site, a Protohistoric Cherokee Village, Cullowhee, North Carolina.
- 1971 Dedmon Site, a Multi-Component Late Woodland-Early Mississippi Site on the Tennessee River in Western Kentucky and the Deep Shelter in the Mountains of Rowan County, in Eastern Kentucky.
- 1969 Directed excavation of two of the four El Abra Rock Shelters, near Zipaquirá, Columbia. These were stratified sites with historic Chibcha materials on the surfaces and Early Man artifacts dated to over 10,000 B.C. at the bottom.
- 1967 Early Man Site survey in Columbia and Salvage excavations at Yankeetown Site, Warrick County, Indiana. This is a deeply buried multi-component Woodland/Mississippian Site.
- 1966 Historic site excavation at Ft. Knox II, Vincennes, Indiana. Auger tested deeply buried levels at the Yankeetown Site.

Teaching Experience:

- 1971-76 Assistant Professor, Western Carolina University
- 1969-71 Assistant Professor, University of Kentucky
- 1969 Visiting Assistant Professor, University of Kentucky, Spring
- 1966-68 Teaching Associate, Indiana University

1962-66 Teaching Assistant, Indiana University

Courses Taught:

Introductory Cultural Anthropology
Introductory Physical Anthropology and Archaeology
Physical Anthropology (Intermediate level)
Cultural Ecology
American Indian Ethnology
Archaeological Method and Theory
Field School in Archaeology
North American Archaeology
South American Archaeology
Old World Archaeology

Administrative Experience:

1980 to present President & Senior Archaeologist Resource Analysts, Inc., Bloomington, Indiana
1977-79 Senior Archaeologist and Vice President, Soil Systems, Inc., Bloomington, Indiana.
1972-76 Directed Western Carolina University Archaeological Program.
1974 Organizer and first director of the University of North Carolina at Wilmington's Underwater Archaeology Field School.
1969-71 Associate Director, Kentucky Archaeological Survey.

Special Skills:

Public Administration
Organization
Finance
Scuba Diver Certified by NAUI, PADI, YMCA
Research Diver Classification University of North Carolina
Marine Biomedical Institute
Photography and Darkroom
Transit and Plane Table Survey

Professional Societies and Honors:

American Anthropological Association
Society for American Archaeology
Society for Historical Archaeology
Associate in Current Anthropology
American Society for Conservation Archaeology
American Folklore Society
Past North Carolina representative on SAA
Committee on Public Archaeology

Past President of North Carolina Archaeological
Council

Sigma Xi Honorary

Trowel and Brush Honorary

Society of Professional Archaeologists

Certification by SOPA:

-Field Research

-Collection Research

-Archival Research

-Archaeological Administration

-Teaching

1967 Ford Foundation Fellowship

1969 University of Kentucky Foundation Grant

1973-74 University Patrons of Quality Grants, Western Carolina
University

1973-75 Moss Charity Trust Grant 1973-1975

Selected Bibliography:

1966 Fluted Points and Late Pleistocene Geochronology in
Indiana. Indiana Historical Society, Prehistory
Research Series. Vol. 4, No. 3, Indianapolis.

1967 Iodine Staining and Ultraviolet Photography Field
Techniques. American Antiquity, Vol. 32, No. 1, pp.
105-07. Salt Lake City.

1971 Archaeological Investigation of the Deep Shelter,
Rowan County, Kentucky. With Donald T. Warholic,
Larry Meadows, and Edward Henson. National Park
Service, Southeast Region, Macon, Georgia.

The Bowen Site: An Archaeological Study of Culture
Process in the Late Prehistory of Central Indiana.
Indiana Historical Society, Prehistory Research
Series. Vol. 4, No. 4. Indianapolis.

1974 The Wolcott Site, Green River Cove, North Carolina.
North Carolina State University Agricultural
Experiment Station. Raleigh, North Carolina.

1975 Prehistoric Site Selection in the Upper Hiwassee River
Drainage. Archaeology Section, Division of Archives
and History, Raleigh, North Carolina.

1978 "Archaeology of the Americas" in Encyclopedia
Americana Annual Year Book, Grolier Inc., New York.

Not included are numerous reviews and more than fifty cultural
resource management reports.

VITA

Jeffery A. Myers
Archaeologist

Education:

Indiana University, Bloomington, Indiana AB 1977
Major: Anthropology
Concentration: Archaeology
Minor: Ancient History

Employment:

1980 Archaeologist, Resource Analysts, Inc., Bloomington, IN.
1980 Survey Archaeologist, Soil Systems, Inc., Marietta, GA.
1978-80 Survey Archaeologist, Soil Systems, Inc., Bloomington, IN
1978 Survey Archaeologist, Southern Illinois University
1976-78 Archaeological Field Assistant for various surveys and excavations

Experience:

1980 Project Director, Muscatatuck National Wildlife Refuge YCC Archaeological Program. Test Excavations of a Multi-component Site, a Late Archaic Site and a Late Woodland Site with Youth Conservation Corps Student Trainees. Jackson County, Indiana. U.S. Fish and Wildlife Service. Authored report.
1980 Project Field Supervisor of Mitigation Data Recovery Excavations, Mary Ann Cole Site, 12 Cr 1. Leavenworth, Crawford County, Indiana, U.S. Army Corps of Engineers-Louisville District. Partial authorship of report.
1980 Project Supervisor, 10th Street/Taylor Road Survey and Test Excavations. Columbus, Bartholomew County, Indiana. D. E. McGillem and Associates, Indianapolis, Indiana. Authored report.
1980 Project Supervisor, Chestnut Street Improvements, Survey, Huntingburg, Dubois County, Indiana. D. E. McGillem and Associates, Indianapolis, Indiana. Authored report.

- 1980 Mitigation Excavations of Urban Historic Sites in Wilmington Boulevard District, Wilmington, Delaware. Department of Transportation.
- 1980 Survey of Proposed Sewage Treatment Facilities Improvements, City of Waycross, Ware County, Georgia.
- 1980 U.S.19 Highway Survey, Andrews to Almonds, Graham, Swain, and Cherokee Counties, North Carolina. Department of Transportation.
- 1979 Project Assistant Field Supervisor, Archaeological Survey of Relocation corridor of U.S.R.24, Cass and Miami Counties, Indiana, Indiana Highway Commission.
- 1979 Project Supervisor of Additional Survey and Test Excavations at the Muscatatuck National Wildlife Refuge, Seymour, Jackson County, Indiana. U.S.Fish and Wildlife Service, Late Woodland Villages and 19th century farmstead. Authored report.
- 1979 Field Supervisor, Wayne National Forest Archaeological Survey with Test Excavations of 7,500 acres of Strip Mine Permit Areas. Athens, Perry, Hocking and Lawrence Counties, Ohio. U.S.Forest Service. Authored report.
- 1979 Great Lakes Navigation Season Extension Feasibility Study Project. Conducted Cultural Resources Literature Search for the Ohio shoreline of Lake Erie. Document prepared for U.S. Army Corps of Engineers. Detroit District. Special emphasis on inventory of underwater shipwreck sites. Partial authorship of report.
- 1978 Assistant Supervisor of Mitigation Excavations. Marble Hill Nuclear Generating Station. Madison, Indiana.
- 1978 Field Supervisor of Survey of Proposed Maintenance Garage Improvements, Muscatatuck National Wildlife Refuge. Jackson County, Indiana. Authored report.
- 1978 Field Supervisor of Survey and Test Excavations of Richart and Stanfield Lakes at the Muscatatuck National Wildlife Refuge. Authored report.

- 1978 Field Assistant, Archaeological Reconnaissance of Hune Bridge and Ring Mill Canoe Accesses on the Little Muskingum River, Wayne National Forest. Marietta, Ohio. Authored report.
- 1978 Survey Archaeologist on Smithland Pool Survey Project. Ohio River, Southern Illinois University, Cave-In Rock, Illinois.
- 1977 Field Assistant, Patoka Reservoir Salvage Archaeology Project, Indiana University. French Lick, Indiana.
- 1977 Fieldworker of Salvage Survey and Test of Haug Site, Dubois County, Indiana, Indiana University.
- 1977 Field Assistant. Testing and Excavation at Mann Site, Posey County, Indiana, Indiana Historical Society.
- 1977 Project Assistant, Monroe County, Indiana Survey Project-Bean Blossom Creek Drainage Basin. Indiana University.
- 1977 Fieldworker, Salem, Indiana, Surface Survey of Delaney Creek Lake Recreation Area. Indiana University.
- 1976-77 Surface Survey, private lands, northern half of Monroe County and adjacent areas in Morgan, Johnson, and Brown counties.
- 1976 Fieldworker, JE41 Salvage Test of Stratified Archaic Midden Site in Jefferson County, Indiana. Indiana University.
- 1976 Fieldworker, Subsurface Deep Test of Marble Hill Nuclear Generating Station, Madison Indiana. Indiana University.
- 1976 Student, Archaeological Field School at Angel Mounds, Newburgh, Indiana. Indiana University, Dr. James H. Kellar.

Contract Reports: (manuscripts on file at RAI)

- 1980 Data Recovery at Mary Ann Cole Site. In preparation for the U.S.Army Corps of Engineers. (Partial authorship).
- 1980 The 1980 Muscatatuck National Wildlife Refuge YCC Archaeological Program: The Archaeological Section and the YCC Evaluation Section. U.S.Fish and Wildlife Service.
- 1980 Survey and Testing of Archaeological Resources for Project M-G 150 (1), Tenth Street and Taylor Road, Columbus, Indiana. D. E. McGillem and Associates.
- 1980 Chestnut Street Improvements--Cultural Resource Reconnaissance. Huntingburg, Indiana. D.E.McGillem and Associates.

Jeffery A. Myers VITA

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- 1979 Archaeological Survey and Test Excavations, Proposed Rich Lake, Moss Lake, and Endicott Marsh, Muscatatuck National Wildlife Refuge. U.S.Fish and Wildlife Service.
- 1979 Cultural Resources Survey and Evaluation of Potential Strip Mine Permit Areas, Wayne National Forest, Ohio. U.S.Forest Service.
- 1978 Archaeological Survey of the Proposed Maintenance Complex, Muscatatuck National Wildlife Refuge, Seymour, Indiana. U.S.Fish and Wildlife Service.
- 1978 Cultural Resource Reconnaissance, Inn Parking Garage, Spring Mill State Park, Lawrence County Indiana. Clyde E. Williams and Associates.
- 1978 Archaeological Survey and Test Excavations at the Proposed Richart and Stanfield Lakes, Muscatatuck National Wildlife Refuge. U.S.Fish and Wildlife Service.
- 1978 Archaeological Reconnaissance of the Hune Bridge and the Ring Mill Canoe Access Areas on the Little Muskingum River, Wayne National Forest, Marietta, Ohio. U.S.Forest Service.

Related Work Experience:

Advanced Scuba Diver Certification P.A.D.I. Southern Indiana Scuba.

Archaeological Contract and Budget Proposal Preparation

Archive and Literature Search Documentation.

Practical Coursework in National Register Nomination Procedures.

Laboratory Analysis, Artifact Illustration, Drafting/Graphics, Transit, Field Photography.

Professional Memberships:

Society for American Archaeology
National Geographic Society
Indiana Historical Society
Southern Indiana Scuba Club

Research Interests:

Prehistoric Archaeology
Historic Preservation
Underwater Archaeology
Lithic Technologies

VITA

Kevin Joseph Crouch
Associate Archaeologist

Education:

Anticipated January 1981 B.A. from Indiana University.
Major: Anthropology
Concentration: Eastern United States Archaeology
Minor: Geology

Employment:

1978 to present Survey Archaeologist, Resource Analysts, Inc. (formerly Soil Systems, Inc.), Bloomington, Indiana.
1978 Retail Clerk for Preston Safeway Grocery. Indianapolis, Indiana.
1977-78 Archaeological Technician, Indiana Historical Society, Glenn A. Black Laboratory of Archaeology. J.H. Kellar, Director.
1976-77 Archaeological Technician/Work Study Student. Glenn A. Black Laboratory of Archaeology, Indiana University. Cheryl A. Munson, Curator, J.H. Kellar, Director.
1974-75 Retail Clerk, Woolco Department Store.

Field Experience:

1980 Assistant Supervisor, Archaeological Data Recovery at Mary Ann Cole Site, Crawford County, Indiana. Deeply buried/stratified floodplain lithic workshop site. 3.5 months, John T Dorwin Ph.D., Principal Investigator.
1980 Field Assistant, Survey for and Testing of Archaeological Resources for Project M-G 150 (1), Tenth Street--Taylor Road Improvements, Columbus, Indiana, 1 week. John T Dorwin, Ph.D. Principal Investigator.
1979 Field Supervisor, Cultural Resource Survey and Evaluation of Proposed Undertakings, Chippewa National Forest, Minnesota. 1 month. William H. Adams Ph.D., Principal Investigator.
1979 Field Assistant, Test Excavations at Two Archaeological Sites, 12Br351 and 12Br352 in Bartholomew County, Indiana. 2 weeks. John T Dorwin, Ph.D., Principal Investigator.

- 1979 Project Supervisor of Archaeological Monitoring at New Hope Coal Loading Facility, Spencer County, Indiana. 3 months. John T Dorwin, Ph.D., Principal Investigator.
- 1979 Survey Archaeologist, American Electric Power Generating Facility, Spencer County, Indiana; test excavations. Funded by American Electric Power Service Corporation. 1 week. John T Dorwin, Ph.D., Principal Investigator.
- 1979 Assistant Supervisor, Archaeological Testing at Waverly Plantation, Columbus, Mississippi. 1 month. William H. Adams, Director.
- 1978-79 Field Supervisor of Mitigation Excavations. Marble Hill Nuclear Generating Station. Jefferson County, Indiana. 3 months. John T Dorwin, Ph.D., Principal Investigator.
- 1978 Assistant Supervisor, Wayne National Forest Archaeological Survey of 7,500 acres and limited testing of sites in Strip Mine Permit Areas. Athens, Ohio. 3 months. John T Dorwin Ph.D., Principal Investigator.
- 1977 Field Assistant. Excavations at Mann Site, Middle Woodland Ceremonial Complex. Posey County, Indiana. 2 months. J.H. Kellar, Supervisor.
- 1977 Project Assistant, Monroe County, Indiana Survey Project--Bean Blossom Drainage Basin. Indiana University, Bloomington, Indiana. 2 months. J.H. Kellar, Director.
- 1976 Field Assistant, Reconnaissance and Testing, Monroe Reservoir. Indiana University, Bloomington, Indiana. 1 month. P.J. Munson, Supervisor.
- 1976 Field Assistant, Archaeological Field School at Angel Mounds, Newburgh, Indiana. Indiana University. 6 weeks. J.H. Kellar, Director.
- 1976 Project Assistant, Lafayette Lake/Wildcat Creek Archaeological Reconnaissance. Lafayette, Indiana. Indiana University. 2 months. J.H. Kellar Ph.D., Principal Investigator Cheryl A. Munson, Supervisor.
- 1976-79 Environmental Impact Statement Reconnaissance: Surveys and Reports. Various Counties in Indiana. Numerous.
- 1975 Salvage of Early Woodland Burials, Johnson County, Indiana. Indiana Historical Society. J.H. Kellar, Ph.D., Director.

- 1974-75 Field Laborer, Post Ouiatenon, Michigan State University Museum. Lafayette, Indiana. 2 months. Judy Tordoff, M.A., Supervisor.
- 1973 Student, Post Ouiatenon, Tippecanoe County Historical Society. Lafayette, Indiana. 1 month. Larry Chowning.
- 1973-79 Surface Surveys of Private Lands in Johnson, Marion, Monroe, Morgan, and Tippecanoe Counties, Indiana.

Laboratory Experience:

- 1980 Analysis of Lithic and Ceramic materials recovered from the Mary Ann Cole Site (12Cr1). 3 months.
- 1979 Laboratory Supervisor of materials recovered at New Hope Coal Loading Facility. 2 months.
- 1978-79 Cultural Material Identification; Soil System, Inc., Bloomington, Indiana.
- 1977 Laboratory Supervisor, Analysis of Middle Woodland Period Materials from the Mann site, Glenn A. Black Laboratory of Archaeology/Indiana Historical society. 4 months. J.H. Kellar Ph.D., Director.
- 1976 Laboratory Assistant, Glenn A. Black Laboratory of Archaeology, Indiana University. 6-5 months. Cheryl A. Munson, Supervisor.

Related Work Experience:

- 1974-75 Harron School of Art, Graphics, Sculpture, and Ceramics.
- 1976-79 Laboratory Analysis, Graphics, Photography, and Darkroom Work.
- 1979 Photographing and plate layout for RAI C.R.M. Reports.

Professional Memberships:

Smithsonian Associates
Society for Historical Archaeology
Indiana Historical Society
Society for American Archaeology

Research Interests:

Prehistoric Lithic Technology
Prehistoric Archaeology in Eastern United States

Historic Sites and Industrial Archaeology
Historic and Proto Historic Indian Occupation of Great Lakes Area.

Special Interest:

Cultural Resource Management
Material Culture Identification/Analysis

Cultural Resource Management Reports

- 1977 Guendling, Randall L., Kevin J. Crouch, Cheryl Ann Munson and James H. Kellar.
Lafayette Lake Archaeological Reconnaissance; a Preliminary Assessment of Prehistoric Cultural Resources. Prepared for U.S. Army Corps of Engineers, Louisville District, Glenn A. Black Laboratory of Archaeology, Bloomington.
- 1979 Crouch, Kevin J., Resource Analysts, Inc. (formerly SSI) Archaeological Mitigation at Marble Hill Nuclear Generating Station, Jefferson County, Indiana. Prepared for Public Service Indiana. Resource Analysts, Inc., (formerly SSI)
- 1979 (with Gary J. Napper) Resource Analysts, Inc. (formerly SSI) Archaeological Monitoring at the New Hope Coal Loading Facility, Spencer County, Indiana. Prepared for Foertsch Construction Company, Inc.
- 1980 (with Richard J. Vanden Heuvel) Final Report of the Test Excavations Along the Texas Eastern Products Pipeline Company of Indiana Right-of-Way. Submitted to the Texas Eastern Products Pipeline Company of Indiana by Soil Systems, Inc., Bloomington.
- 1980 (with Timothy B. Riordan, Clark A. Dobbs, William H. Adams, and Gary J. Napper) Cultural Resource Study of Proposed Undertakings in the Chippewa National Forest, Minnesota. Prepared for USDA Forest Service, Superior National Forest, Duluth, Minnesota. Resource Analysts, Inc., (formerly SSI)
- 1980 In Preparation; Archaeological Data Recovery at Mary Ann Cole Site (12Cr1), Ohio River Cannelton Pool; Crawford County, Indiana. By Jeffery A. Myers, and Kevin J. Crouch, edited by John T Dorwin Ph.D., Resource Analysts, Inc., Bloomington.
- 1976-80 Environmental Impact Statement Archaeological Reconnaissance Reports, various counties in Indiana. Numerous. Glenn A. Black Laboratory of Archaeology, Indiana University and Resource Analysts, Inc. (formerly SSI)

VITA

Jane Bouchard
Laboratory Supervisor/Assistant Archaeologist

Education:

1974-78 Indiana University, Anthropology and
Folklore

Employment:

1979 to Laboratory Supervisor, Resource Analysts, Inc.,
present Bloomington, Indiana.

Fieldwork:

1980 Field Director, So. Bend/Elkhart By-pass Intensive Survey,
St. Joseph and Elkhart Counties, Indiana.

1980 Field Technician, Phase II Test Excavations of Kneeland -
Bigelow Camp (logging camp) and town of Big Rock,
Montmorency County, Michigan.

1980 Survey Archaeologist, Potato Creek State Park Survey of
selected areas.

1980 Laboratory Supervisor, Archaeological Data Recovery at
Mary Ann Cole Site, Crawford County, Indiana. Deeply
buried/stratified floodplain lithic workshop site.

1979 Survey Archaeologist, South Bend/Elkhart Bypass,
Reconnaissance and Survey.

1978-79 Field Technician and Assistant Supervisor, FAI-270
Project. Intensive field excavation of Late Archaic to
Mississippian sites; total mitigation; James Porter,
Director.

1977 Field Technician, Patoka Reservoir Archaeological Salvage
Project; excavation of Archaic and Woodland sites;
surveying; laboratory analysis, mapping; James Kellar and
Cheryl Munson, Principal Investigator.

1976 Student, Angel Mounds, Indiana University Field School;
excavation of Mississippian village; James Kellar,
Director.

Related Professional Experience:

- 1979-80 Laboratory Supervisor, Tennessee-Tombigbee Waterway Archaeological Investigations. Responsible for processing of over 100,000 artifacts.
- 1978-79 Laboratory Assistant, FAI-270 Project; flotation and sorting of fractions; lithic typology, pottery reconstruction, mapping, report editing.
- 1978 Laboratory Assistant, Patoka Reservoir Archaeological Salvage Project; chemical flotation for microflakes and charcoal, supervision and instruction of flotation process, cataloging artifacts, statistical analysis of lithic materials, mapping.
- 1978 Glenn A. Black Laboratory, Bloomington. Course on the Oracle Data Retrieval System--a computerized system of Indiana's surveyed sites and artifactual material.
- 1978 Glenn A. Black Laboratory, Bloomington. Vegetational reconstruction using tree species and size from early 1800s State Land Surveys.
- 1977 Glenn A. Black Laboratory, Bloomington. Updating all Indiana site survey forms; transferring and consolidating all known sites to a single set of topographic maps.
- 1976 Glenn A. Black Laboratory, Bloomington. Categorizing and coding Mississippian pottery for a subsequent computer analysis.

Contributing Authorship:

- 1980 An archaeological survey and assessment of four picnic areas, ten cabin sites, associated roadways, and hiking trail of Potato Creek State Park, St. Joseph County, Indiana, Resource Analysts, Inc., Bloomington, Indiana.
- 1979 Archaeological reconnaissance and records and literature search of five alternate corridors of the South Bend/Elkhart Bypass, Soils Systems, Inc., Earth Systems Division, Bloomington, Indiana.

Report in Progress:

- 1981 An intensive archaeological survey of lines N and A of the proposed U. S. 20 bypass, St. Joseph and Elkhart Counties, Indiana, Resource Analysts, Inc., Bloomington, Indiana.