[Editors' note: Please be advised that an article in this volume contains descriptions and illustrations of Native American human remains.]

INDIANA ARCHAEOLOGY

Volume 2
Number 1
November, 1998

Indiana Department of Natural Resources

Division of Historic Preservation and Archaeology

ACKNOWLEDGMENTS

State of Indiana

Frank L. O'Bannon
Governor

Joseph E. Kernan
Lieutenant Governor

Indiana Department of Natural Resources

Larry D. Macklin
Director

John T. Costello
Deputy Director

Division of Historic Preservation and Archaeology

Jon C. Smith
Director

James R. Jones III, Ph.D.
State Archaeologist

Editors: James R. Jones III, Amy L. Johnson, Robert G. McCullough

Cover design: James A. Mohow, James R. Jones III

This publication has been financed with federal funds from the National Park Service, Department of the Interior and administered by the Division of Historic Preservation and Archaeology, Indiana Department of Natural Resources. However, the contents and opinions do not necessarily reflect the views and policies of the Department of the Interior. Regulations of the U.S. Department of the Interior strictly prohibit unlawful discrimination in federally assisted programs on the basis of race, color, national origin, age or handicap. Any person who believes he or she has been discriminated against in any program activity or facility operated by a recipient of federal assistance should write to Director, Equal Opportunity Program, U.S. Department of the Interior, National Park Service, P.O. 37127, Washington, D.C. 20013-7127.

DNR
Indiana Department of Natural Resources

INTRODUCTION

This second volume of the *Indiana Archaeology* Journal brings you articles covering a variety of archaeological topics. Through these articles, it is hoped that the reader will have a greater appreciation and understanding of the current research being conducted into Indiana's prehistoric and historic past.

As was stated in the first volume of the journal, our goal is to publish scholarly, synthesis, and educational articles, so that information is available for professionals and public alike. We solicit, in particular, articles on Indiana archaeology, articles from the Midwest related to Indiana archaeology, articles related to topics in Indiana archaeology, and articles on methodology, theory, analysis, interpretation, etc. relevant to the practice of archaeology in our state and the Midwest. We hope that professional archaeologists, other professionals in fields related to archaeology, and knowledgeable amateur archaeologists and other nonprofessionals will submit articles for publication. We sincerely invite professional archaeologists to participate in peer review of submitted articles related to their areas of expertise. We also invite other institutions as partners in this publication endeavor.

For information on subscription to *Indiana Archaeology*, please contact the Division of Historic Preservation and Archaeology at the address below.

For information on manuscript submission, form, style, editorial policy, publication deadlines, etc. please contact the editors at the address below.

The National Park Service, Department of the Interior, has graciously provided the funding for this publication. The printing was completed by First Quality Printing.

For further information, please contact:

Division of Historic Preservation and Archaeology
402 West Washington Street, Room W274
Indianapolis, Indiana 46204
Phone: 317/232-1646
Fax: 317/232-0693

INDIANA ARCHAEOLOGY

Volume 2 Number 1

Table of Contents

THE HARDY MANUAL CABIN SITE (12Sj337): USING ARCHAEOLOGY TO DEVELOP INTERPRETIVE PLANS FOR AN HISTORIC AFRICAN-AMERICAN CABIN SITE

Mark R. Schurr
Department of Anthropology
University of Notre Dame

INTRODUCTION

Histories of the settlement and development of St. Joseph County, Indiana (Anonymous 1880; Howard 1907) focus on the roles of European immigrants and their descendants. The Huggart settlement is a rare example of an early rural African-American community (Karst 1981). The settlement was first founded by Samuel Huggart, who bought 80 acres of land in Union Township (northwest of the present town of Lakeville). In 1848, Samuel and his brother Andrew probably arrived to inhabit the property. They were joined by other African-Americans in the following years, and the community expanded in the 1850s and 60s until it collapsed in the early 1880s when most of the members sold their land holdings and moved to South Bend. Table 1 gives a chronology of land purchases and sales abstracted from Karst (1981). Using land purchases as a guide, the settlement expanded during the 1850s and 1860s, and then ended relatively abruptly in the 1980s with the deaths of the founding members and the departure of their sons from the area. A farm of at least 40 acres seems to be the minimal unit needed by a member of the community.

Hardy Manual was one of the residents of the Huggart settlement. He bought 40 acres of land from Benjamin Bass (another member of the community) in 1861. Manual built a cabin on his land. A log structure reputed to be the remains of that cabin was first documented as an historic site by Karst (1981). It has been assigned the archaeological site number 12Sj337. Figure 1 shows the setting of the cabin as it appears today.

Hardy Manual sold the land containing the cabin to George Feagler in 1885, marking the date when this portion of the Huggart settlement passed out of African-American hands. Feagler's descendants have lived on the property since that time. The Manual cabin has been used as a maple sugar shack (for the production of maple syrup) since about 1890 and has been extensively modified for this purpose throughout the years. Modifications included the addition of a cupola to the roof to vent steam from syrup production, the addition of a poured concrete floor, and electrical wiring. The cabin has also been severely damaged by decay and insects and is endangered. The area surrounding the cabin is part of the working farmstead of George and Lydia Easterday. Mrs. Easterday is a granddaughter of George Feagler, who bought the property from Hardy Manual in 1885.

In 1995, the Historic Landmarks Foundation of Indiana and the Northern Indiana Center for History began developing a plan to preserve or interpret the structure and the role of the Huggart Settlement in the history of St. Joseph County. Consultants were engaged to report on the present condition of the structure, assess its historic integrity, and outline possible strategies for the cabin's preservation and interpretation (Hood & McKee, n.p. [1995]). Options that were under consideration included stabilization of the cabin in its present location, removal and storage until a permanent location for the cabin could be found, or reconstruction of a portion of the cabin within an interpretive center in another location, perhaps in nearby Potato Creek State Park. All of these options appeared to be very expensive.

A major concern highlighted by Hood and McKee was the possibility that the cabin was not in its original location. This was suggested by many features of the cabin as it now stands which would not be expected in a cabin constructed in the 1860s. These include the absence of top and bottom courses of logs; lack of sleeper logs; carpentry of the roof, gables, windows, and doors; and the absence of visible 19th century artifacts in the vicinity of the cabin. Because the architectural features of the cabin were puzzling, the 1996 excavations were conducted to determine whether or not the cabin was in its original location. The results of these investigations could then be used to guide further work at the cabin.

PROCEDURES USED IN THE FIELD INVESTIGATIONS

Field work at the site began with a day of transit survey in the wooded area north of the cabin and a thorough inspection of the ground surface in the field immediately to the west of the cabin. This work was done on May 16, 1996 when surface visibility was excellent. The location of Feature 3, a square depression associated with piles of field stones in the wooded area north of the cabin was mapped (Figure 2). It was originally thought that Feature 3 might be the remains of a root cellar or other similar structure, but an interview with Lydia Easterday reported that the wooded area had formerly been used as a pasture and that she recalled no structures there.

During the week of June 2 to 8, the University of Notre Dame field school and personnel from the Northern Indiana Center for History (NICH) conducted excavations at the site. A reference grid was established by designating the northeast corner of the cabin as E1000 N1000 with an arbitrary working elevation of 100 m (corresponding with an elevation of approximately 865' Above Mean Sea Level). The north-south axis of the grid was aligned with the east side of the cabin (as nearly as this could be determined from a wall that was not straight and had an outward bow). It was later determined that the grid axis was aligned to a bearing of 1.96° (1° 57' 36") east of magnetic north. The grid was referenced to other structures in the vicinity that could serve as "permanent" reference points.

Three 1 meter-square units were placed adjacent to the cabin (two on the east site and one on the west, Figure 2). Two of the units (the one at the northeast corner of the cabin and the one along the west wall) were extended to the cabin. A surface collection was also made in the garden to the south of the cabin (the cleared area at the bottom of the hill in Figure 1).

Units were identified by their grid coordinates. The units were excavated in either arbitrary levels with a maximum thickness of 10 cm, or in archaeological levels defined by changes in soil color, texture, or artifactual content. Archaeological levels with a thickness greater than 10 cm were subdivided into arbitrary 10 cm levels to maintain additional controls over the excavation. Soil colors were described using the Munsell system (1990 edition). All excavated soils were screened through ¼ inch hardware cloth. Each archaeological level and feature was documented using the appropriate form and by scaled maps with a resolution of 0.5 cm. Artifacts with significant spatial relations to each other or to other features were piece-plotted. All artifacts collected were recorded in a field specimen log to maintain associations between specimens and their archaeological contexts. Color slides and black and white photographs were taken when warranted to document the excavations and a log book of all excavation photographs was maintained. The completed field records and the photographs are curated at the Archaeology Laboratory, University of Notre Dame. All artifacts collected during the excavation were processed and catalogued at the Archaeology Laboratory along with their associated documentation. The artifacts were then transferred to the NICH where they will be curated.

RESULTS OF THE FIELD INVESTIGATIONS

As noted, three 1 m square excavation units were placed adjacent to the cabin. Two of these were later extended to provide profiles of the intersection of the cabin walls with the underlying soil. One unit was located at the northeast corner of the cabin. After completion, the western profile wall of this unit showed the relationship of the northeast corner of the cabin with the ground surface. Two features (Features 1 and 2) were defined in this unit. Feature 1 was a thin lens of yellow clay (apparently derived from the local subsoil). The feature lay over an electrical wire that provides the ground for the electrical wiring that is now in the cabin, and was clearly of recent origin. Feature 2 was a concentration of strap iron, wood molding, and asphalt roof shingles that also dated to the 20th century and was therefore irrelevant to the Manual occupation.

Another unit was located slightly to the east of the southeast corner of the cabin. It produced abundant historic artifacts (primarily from the 20th century) and did not contain any features. Two units were located along the western side of the cabin under a window opening at the southern end of the wall. The eastern profile wall of these units showed the relationship between the wall of the cabin and its intersection with the ground. The concrete floor in the cabin could also be seen in profile.

The excavations provided architectural evidence that the cabin was not constructed using traditional methods expected for a 19th century log cabin. Units immediately adjacent to the cabin foundation (at the northeast corner and along the western wall) revealed that there was no foundation or sill under the cabin (Figures 3 and 4). In both units, the log visible at ground level is the bottom course of the wall and, as expected, these logs proved to be very badly decayed without a foundation or sill to protect them from soil contact. No corner or foundation stones were present at the northeast corner of the cabin (Figure 3). The concrete floor that is now present in the cabin was visible in profile in the eastern profile of the unit along the western wall of the cabin. No evidence of another floor or stratum that might represent a 19th century floor was visible in the profile, and the soil below the concrete floor appeared to consist of undisturbed subsoil.

ARTIFACTUAL REMAINS

The excavations adjacent to the cabin produced a very large collection of artifacts. Most artifacts were cleaned, catalogued, and packed in labeled bags for curation at the NICH, but some artifacts (such as amorphous pieces of rusted iron or broken pieces of asphalt floor tile) were weighed and then discarded (samples of all discarded artifacts were retained). Two hundred and forty-two catalog numbers were assigned to 2350 individual items (Schurr 1997, Appendix II). Most of the artifacts collected were manufactured in the 20th century.

Artifacts near the cabin were almost overwhelmingly abundant and reflect a diverse array of material types and activities. Only two artifacts (out of more than 2000 collected near the cabin) could possibly date to the Manual occupation. These were a hand-wrought iron latch plate (Cat. No. 12SJ337/188) and a hand-wrought iron hook from a door or shutter (Cat. No. 12SJ337/174).

The types of artifacts expected at a domestic habitation site from the mid-19th century (transfer printed pottery, ironstone pottery, amethyst glass, bottles with laid on neck rings or lips formed with a lipping tool, coins of the period, coarse earthenware or crockery, buttons of bone, pearl, or white glass, fragments of kerosene lamp chimneys, etc.) were not present. This negative artifactual evidence is consistent with the hypothesis that the cabin was moved from its original location. The only two artifacts likely to date to the Manual occupation (the latch plate and hook) were both pieces of architectural hardware that could have been moved with the cabin and discarded when modifications were made to it.

They could also have come from elsewhere as by-products of salvaging old wood for sugaring. This was undoubtedly the source for the many nails and other items such as door hinges and latches found at the site.

The surface collection from the garden did contain several 19th century artifacts, including amethyst solarized glass, ironstone pottery, canning jar fragments, and stopper-sealed bottle necks. The artifacts came from a scattered concentration on the south edge of the garden. Lydia Easterday reported that a privy once stood in the general vicinity of the debris scatter. The historic artifacts scattered in the garden may indicate that a rubbish-filled pit or material discarded on the south edge of the garden is being disturbed by cultivation and erosion. This hypothetical feature may merit further investigation, but it might not be possible to tell solely from artifactual remains if the rubbish was produced by the Hardy or the Feagler household because manufacturing dates for the artifacts in the surface collection span the transition between the two landowners (and in general, they are more consistent with an "early Feagler" occupation than they are with a "late Manual" one). There is no guarantee that the artifacts could help interpret the Manual site. This illustrates one of the difficulties inherent in interpreting a continuously occupied site in the absence of historic documents detailing structure locations.

CONCLUSIONS

The 1996 excavations at the Manual log cabin found no archaeological features or artifacts that could be used to interpret the Manual occupation. From the results of the excavations, it appears very unlikely that the Manual cabin is in its original location. Even if it is in its original site, this location has provided little or no evidence of subsurface information that can be used to better understand and interpret the life of Hardy Manual and the Huggart settlement.

These results seem to contradict the oral history of Lydia Easterday, who was told that her father was born in the cabin. This contradiction can be reconciled if Mrs. Easterday's father was indeed born in the cabin at a time when it was in its original location, or just after it was moved and perhaps being used as a temporary dwelling while the frame house that presently stands to the east of the cabin was being built around 1890.

Based on the St. Joseph County atlas of 1875, the Manual cabin may have been closer to Mulberry road (on the east edge of the property) and south of where the Easterday home now stands. If this was indeed the case, the original location of the cabin has been substantially altered by gravel mining. It is therefore very unlikely that archaeological remains of the original Hardy Manual homestead still exist.

On one hand, the results of the excavations were disappointing, because they did not provide any evidence that could be used to understand the Huggart settlement. On the other hand, they are an excellent example of how even negative information can be extremely helpful for historic planning. Prior to the field work, the Historic Landmarks Foundation of Indiana and the Northern Indiana Center for History were discussing several different plans for the stabilization and interpretation of the structure. All of the plans were very expensive because the structure was in very bad shape. The archaeology field work helped to avoid large investments of time and money into what would have been a dubious reconstruction. Instead, an historical marker commemorating the Huggart settlement was dedicated at Potato Creek State Park on October 1, 1998.

It might be possible to take a wider perspective and examine the Huggart settlement as a regional settlement. While other farmsteads in the settlement have almost certainly been destroyed, relatively undisturbed sites may still remain. It would be extremely worthwhile to identify and investigate any remaining sites before further attrition of the archaeological record can occur.

Acknowledgments. The field work at the Hardy Manual cabin was conducted by the students in Notre Dame's 1996 Archaeology Field School and by personnel from the Northern Indiana Center for History under the direction of Bill Firstenberger and Mary Renshaw. The Historic Landmarks Foundation of Indiana and the Northern Indiana Center for History provided the impetus for the project. Nancy

Hanson (HLF) coordinated the various groups involved in the project and Kim Darby (also of the HLF) helped coordinate and develop the initial plans for the investigations. Dr. Rick Jones, Division of Historic Preservation and Archaeology, Indiana Department of Natural Resources, helped develop the research design and provided essential advice. The Center for Social Concerns, University of Notre Dame, made it possible for us to travel to the site. Evan and Lydia Easterday allowed us to conduct the field work on their property.

Table 1. Chronology of Land Purchases and Significant Events (abstracted from Karst [1981]).

1834	Samuel Huggart buys 80 acres for $100 ($1.25 / acre) in Union Township, northwest of the present town of Lakeville (E ½ of the NW ¼ of Section 29, Township 36 N Range 2E).
1848	Samuel Huggart and his brother Andrew probably arrive to inhabit the property.
1860	Benjamin Bass purchases 120 acres adjacent to the Huggarts.
1860	Bass sells 60 acres to Noah Boone.
1861	Bass sells 40 acres to Hardy Manual.
1861	Bass purchases 40 more acres (he also owned land elsewhere in St. Joseph County and in Cass County, Michigan).
1861	Farrow Powell buys 80 acres.
1862	Farrow Powell buys 40 acres.
1863	Samuel and Andrew Huggart buy 80 more acres, then sell two 40 acre tracts to their children (James and Wesley).
1881	Andrew Huggart dies.
1885	Hardy Manual sells to George Feagler.
1888	Noah Boone sells.
1887	James Huggart sells.
1890	Wesley Huggart moves to South Bend.

Figure 1. The Manual log cabin and its setting (looking north, with garden in the foreground).

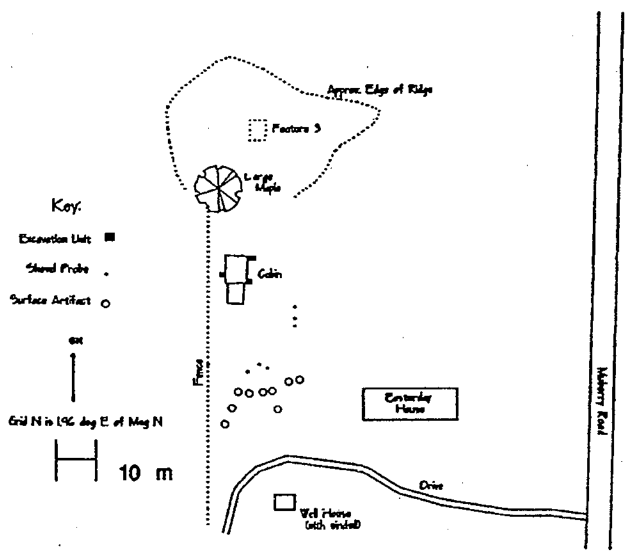


Figure 2. Map of the Manual Cabin site (12Sj337).

Figure 3. Excavation unit at the northeast corner of the cabin.

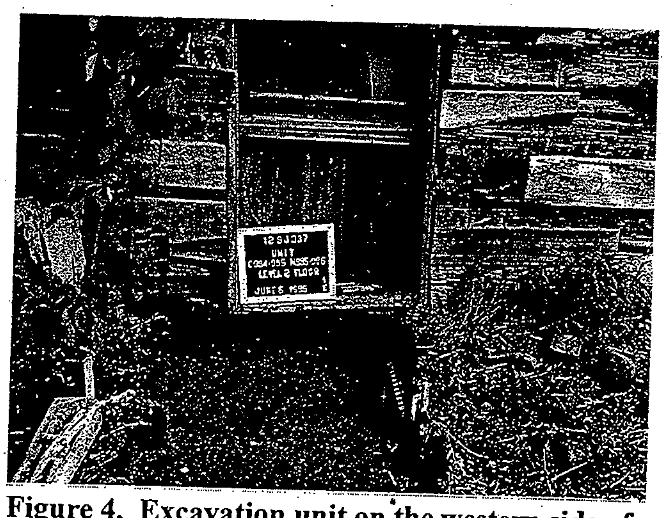


Figure 4. Excavation unit on the western side of the cabin.

REFERENCES CITED

Anonymous

1875 *An Illustrated Historical Atlas of St. Joseph Co., Indiana.* Higgins, Belden, & Co., Chicago.

Anonymous

1880 *History of St. Joseph County, Indiana.* C. Chapman & Co., Chicago.

Hood, V.P., and L. McKee

(n.p. [1995]) *The Hardy Manual Log Cabin, Lakeville, Indiana.* Consultant's report. Leatherwood, Inc., Franklin, Tennessee.

Howard, T.A.

1907 *A History of St. Joseph County, Indiana.* Lewis Publishing Company, New York.

Karst, F.A.

1981 A Rural Black Settlement in St. Joseph County, Indiana, Before 1900. *Indiana Magazine of History* 77(1):252-267.

Schurr, Mark R.

1997 The 1996 Archaeological Investigations at the Hardy Manual Cabin Site (12 SJ 337): an Historic African-American Cabin Site in St. Joseph County, Indiana. Archaeology Laboratory. University of Notre Dame. *Reports of Investigations* 97-1.

LATE PREHISTORIC FAUNAL REMAINS FROM CENTRAL AND SOUTHERN INDIANA

Rexford C. Garniewicz
Glenn A. Black Laboratory of Archaeology
Indiana University

INTRODUCTION

The Indiana University field school's focus on the Oliver Phase occupation in central and southern Indiana has led to the excavation of six Late Prehistoric sites (see citations below): Clampitt (12Lr329); Cox's Woods (12Or1); Bundy-Voyles (12Mg1); Sugar Creek (12Jo289); Crouch (12Jo5); and Heaton Farm (12Gr122). All of these sites were occupied sometime between the late 13th to mid-15th centuries. General locations for these sites are shown in Figure 1.

Prior to this work, the only analysis of faunal material from an Oliver Phase site (Bowen site, 12 Ma 61) was conducted by Dorwin (1971). The development of a larger database on Late Prehistoric faunal remains from south central Indiana permits the first overview of animal utilization at all of these sites.

This overview is divided into four main sections. It provides a brief description of the study sites, narrates the techniques of recovery and analysis, supplies the data obtained at each site, and compares and contrasts animal exploitation at these sites. Although the preservation of bone ranges from poor to excellent, this material provides valuable information on the procurement of fauna and the seasonality of site occupation by the Late Prehistoric inhabitants of this area.

SITES

The Clampitt site is situated on the East Fork of the White River near the confluence of Guthrie Creek. This stockaded village is located on an elevated terrace of sand capped glacial outwash. The landscape surrounding it is gently undulating, with fairly steep uplands just across Guthrie Creek. Radiocarbon dates for Clampitt fall between A.D. 1283 and A.D. 1415 (Redmond 1994).

The Cox's Woods site is located on the south bank of Lick Creek in Orange County. A small floodplain occurs across the creek to the north, and sandstone bedrock outcrops in the uplands to the south of the site. Lick Creek runs over bedrock where it passes the site and would be easily crossed except during flood stages. For most of the summer it is only 6-12 inches deep. This stockaded Oliver Phase village dates to the late 14th century A.D. (Redmond and McCullough 1996).

The Bundy-Voyles site is situated on the upper floodplain of the White River near Martinsville, Indiana. The linear distribution of surface material parallels a lower, filled cutoff meander. Extensive buried midden deposits occur along the slope. Prehistorically, a rock riffle in the White River provided a convenient connection between the upland forest to the west and the riparian forest and floodplain environment on the east side of the river. The calibrated intercept dates for the site range from A.D. 1285 to A.D. 1435 (McCullough and Wright 1997a).

The Sugar Creek site is located on an outwash plain to the east of Sugar Creek. Again, a rock bottom provides easy access to the uplands to the west of the modern channel. A slightly undulating area of undifferentiated glacial outwash to the east continues to the Big Blue River. Approximately 2 km downstream from the site these two watercourses join to form the Driftwood River. Composed of a series of undefended houses, this site dates to the late 13th century (McCullough and Wright 1997a).

The Crouch site is located on a high ridge overlooking a former wetland. The ridge is composed of complex drift, though the site occurs on stratified sand/clayey sand. Located 3.5 km from the main channel of the West Fork of the White River, this site is different from both Bundy-Voyles and Sugar Creek in terms of its situation and the cultural material recovered. Radiocarbon dates indicate that the site was occupied between A.D. 1290 and A.D. 1410; however, the shell tempered pottery is most closely associated with Fisher type ware in Northern Illinois and differs in construction, form, and decoration from typical Oliver Phase ceramics (Robert G. McCullough, personal communication).

The Heaton Farm village is located north of Bloomfield and east of the West Fork of the White

River. Structures appear to be arranged around a closed depression formed by early Holocene sand dunes. A combination of topography and distance from the river suggest that the prehistoric inhabitants deliberately selected a "hidden" locale. Calibrated radiocarbon dates suggest that the late prehistoric component at this site dates to between A.D. 1295 and A.D. 1450 (McCullough and Wright 1997b).

METHODS

During excavation, all intact cultural deposits were screened through 1/4-inch mesh with 10 liter flotation samples taken from all features. Material from the plowzone was not systematically sampled. As a result, plowzone and surface-collected material do not form a significant component of this analysis.

At sites, or areas of sites, where bone preservation was poor, bone observed *in situ* was excavated using bamboo picks. All bone recovered was packed in aluminum foil for protection during transport. All faunal material was washed, using water pressure and a soft brush. The material was then allowed to slowly air dry before being numbered and repackaged for analysis.

Once material was ready for identification, specimens were identified and coded according to the Vertebrate Faunal Analysis Coding System developed by Shaffer and Baker (1992). In addition to contextual information, the taxon, element, portion of element, side, criteria for aging, age, sex, degree of burning, and presence and absence of cut-marks were recorded. In regard to taxon identification, there were several levels. Many fragments of poorly preserved bone were only identifiable as vertebrate. Other non-diagnostic specimens were only identifiable as mammal, bird, fish, reptile, or amphibian. These specimens were placed within general size classes if possible. The remaining specimens were identified to a family, genus, or species level and are listed accordingly.

RESULTS

Sites with Poor Bone Preservation

The first two sites investigated--Clampitt and Cox's Woods--exhibited poor bone preservation. Acidic soils destroyed most bone, except for material in deep pits (Clampitt) or material overlain by limestone cobbles (Cox's Woods). The usefulness of the resultant data is limited to species lists, since any variation in body part representation or abundance of small species is probably the result of taphonomy, not of cultural processes. These data are presented in Table 1.

Some of the material from the Bowen site (Dorwin 1971) is also presented in presence/absence form. Since the quantification of material at Bowen is inconsistent with the techniques used at the sites in this study, it is included in the presence/absence section despite superior preservation. If species are present at either Clampitt or Cox's Woods their presence/absence is checked for at Bowen. There are a large number of species present at Bowen which are not found at either Clampitt or Cox's Woods. For a complete species list from Bowen see Dorwin (1971:287).

Deer, turkey, and raccoon are the most abundant species at Bowen and are probably present at all three sites. Smaller species are under-represented in the samples from Clampitt and Cox's Woods due to poor preservation. This is probably true for raccoon and is particularly true of small mammals, birds, and all fish.

Elk was also important at Cox's Woods. Due to its large size, skeletal material would probably be preserved at Clampitt if elk was taken. The same is true of bear at all three sites; if skeletal remains were brought back, it is unlikely that they would not be preserved.

The eastern cottontail (Sylvilagus floridanus) was uncommon prehistorically in most of Indiana. Extensive forests provided an unfavorable habitat. In modern situations, cottontails are more common in overgrown fields of weeds, briers, and brush near croplands (Martin 1986:387). Other than Cox's Woods, Bowen, and Heaton Farm (discussed later), only two other open-air sites in Indiana have produced rabbit remains: Fifield in Porter County (Faulkner 1972) and Angel in Vanderburgh County (Black 1967). In addition to the single specimen from Cox's Woods, ten specimens were recovered from the

Bowen site (Dorwin 1971:287). Since three of the five sites in Indiana producing this species are Oliver Phase, this species may reflect particular agricultural practices. The current optimal habitat for cottontails is abandoned agricultural fields with 10-12 years of growth.

The only fish species of particular interest is the freshwater Drum (Apoldinotus grunniens). This particular fish is readily identified by its unique pharyngeal bone and is frequently seen in archaeological assemblages where other fish may be overlooked. A bottom feeder in medium to large rivers and lakes, this fish occurs in most reaches of the White River. It is readily available at Clampitt; however, the closest modern distribution places it almost 30 miles from Cox's Woods.

The particular bone may have been curated as it is an interesting form; still, its recovery would require some movement, perhaps to a seasonal camp on the White River.

Sites with Good to Excellent Bone Preservation

The remaining sites exhibit good to excellent bone preservation, and the results for mammals are presented in number of identified specimens (NISP) and minimum numbers of individuals (MNI) in Table 2. Proportions of mammals, birds, fish, reptiles and amphibians are presented in Table 3. More detailed information on context, meat weight, body part representation and specimens not identified to species is presented in previous publications (Garniewicz 1996,1997).

DISCUSSION

Mammalian Remains

The majority of meat weight calculated from minimum number of individuals from all four sites is from deer, elk, and bear. Due to small sample size, the meat weight of larger species may be over-represented. Other important food sources include raccoon, beaver, muskrat, and squirrel at 12Mg1; and possibly bison at 12Jo289.

Deer (and elk) are easiest to hunt during the fall when both species are in rut. Elk are also more vulnerable right before the rut (late summer) when they tend to congregate in large numbers. Both species may be hunted by drive and stalking techniques throughout the year; however, these techniques, as well as hunting by the decoy method, are most productive in the fall. In the winter, if snow was deep enough to impede travel, deer and elk could be overtaken by the proficient use of snowshoes.

Winter was prime hunting for a number of other mammalian species which are easiest to take during hibernation or winter dormancy. These include, most notably, the bear, raccoon, and beaver.

Bear were most commonly hunted in the winter after going into hibernation since they are "very difficult to hunt when in full control of their senses" (Reidhead 1981:123). Dens were either discovered opportunistically during other winter activities or by organized parties looking for them. Bear were often driven out of their dens by the use of fire or smoke and shot with arrows upon their exit.

Ethnohistorically, the bow and arrow was sometimes the weapon of choice when hunting bear. As Perrot reports, the sound of guns frightened nearby bears ([Blair 1991(1):126-131] cited in Reidhead 1991:123). Bear remains are fairly uncommon as food refuse at prehistoric sites in Indiana, though they do seem to increase in frequency in the late prehistoric period. This may be due to the extensive use of the bow and arrow. It is interesting that all four of these sites contain bear remains, despite possible seasonal differences in occupation.

Beaver were likely caught in the winter by breaking up their lodge and capturing them in air pockets under the ice or by breaking ice above these pockets and capturing them at the resultant air holes. Beaver may be hunted in the summer by the use of harpoons (not recovered from any of these sites), and they may also be stalked on land in the fall when they come out of the water and work on land during daylight (Smith 1975:84). These warm weather techniques are much less productive in terms of overall return for investment as well as in the quality of fur and meat.

Raccoons rarely occupy dens more than 1/4 mile from water, though they do venture into the uplands in the fall to feed on mast. The two techniques which were used prehistorically were with deadfalls and by taking them from denning trees in the winter.

Raccoons are renowned for their ability to adapt to the presence of humans, and they may have been difficult to trap prehistorically. Several sources praise the efficiency of taking them from dens (Quimby 1962:223; Twitchell and Dill 1949, cited in Reidhead 1981). This technique is most efficient in the winter when fallen leaves make dens visible. Recent research on age and sex distributions of prehistoric raccoon remains suggests that with the advent of intensive crop raising, trapping becomes the predominant technique for acquiring raccoon (Garniewicz 1998). This is probably related to the damage inflicted on corn crops during the summer and fall.

Squirrels may provide interesting information on hunting zones and degree of forestation. Grey squirrels primarily inhabit heavily wooded areas whereas fox squirrels are most dense where the forest is broken up (Smith 1975:111). As Reidhead records, "Squirrels were hunted with bows, snares, traps, nets, and by taking them from their nests" (1981:150). Bow hunting would obviously be the most profitable in the fall and early winter when the trees were bare and squirrels were actively building up their fat reserves on mast.

Muskrats are primarily nocturnal and difficult to hunt. In the Jesuit relations, the Huron are recorded muskrat hunting under certain conditions (Thwaites

1896-1901(8):43-44). Specifically, during the spring, muskrats are sometimes forced out of their holes by high water (Reidhead 1981:138). During this time, when they were seen on the surface they were pursued by canoe at which time they dive. Anticipating the location where a muskrat would surface, the hunters paddled to it and clubbed the animal. If they missed the spot, they continued the pursuit. Spring hunting of muskrat is also recorded among the Mistassini Cree (Rogers 1973).

Muskrats can be trapped; however, the extent of this activity prehistorically is difficult to determine. Ethnographically, most if not all records relate to the use of steel traps; and the relative efficiency of deadfalls or other traps is difficult to determine.

Most of the aquatic fauna (beaver, muskrat, etc.) from 12Mg1 probably came from surrounding sloughs and oxbow lakes which are now drained. These habitats are more productive, especially for these species, than the nearby White River.

At 12Mg1, most deer would have been killed between August and December. Bear and beaver would most likely be killed during the winter, and squirrels most likely taken after the leaves fell around November 1 and continuing into the winter. Thus, the majority of hunted meat probably would have been most readily taken in the fall and winter.

The most notable exception to this is the procurement of muskrat. Though they provide only a small proportion of the meat at the site, they occur in relatively large numbers compared to other sites (for all time periods). Optimal procurement is in early spring when deer are not an economically viable resource. However, it is problematical that optimal procurement is when the river is flooded and the site is probably unoccupied. It is possible that they are easier to procure in February, since when the breeding season approaches, males and females pair and drive all others out of their dens. Fighting ensues when muskrats encroach upon the area of a pair, and muskrats driven from their home ranges may be on the move during this period.

Non-Mammalian Remains

Although the vast majority of material recovered from each of these sites was mammalian (79-99% of identified specimens), there were also a number of non-mammalian species present. The proportions of various taxa are presented in Table 3, and more specific lists of species are presented in Garniewicz (1996, 1997).

Avifauna

The bulk of bird remains from all four sites are turkey (*Meleagris gallopavo*) with little attention paid to migratory waterfowl or smaller forest species. One specimen each of crane (*Grus sp.*) was present at 12Mg1 and 12Jo289, and 12Gr122 also contained two specimens identifiable as crow (*Corvus sp.*).

Turkeys are recorded as being extremely

abundant in the early historic period (Schorger 1966:51). The floodplain with its adjacent talus slopes and uplands provides an optimum setting for the wild turkey (Martin 1986:404). Although floodplains provide the favored setting in the spring and summer, wild turkeys tend to move to upland forests during the fall and winter to exploit mast (Reidhead 1981:152). Sites 12Mg1, 12Jo289, and 12Gr122 were situated so that exploitation could be year round. At 12Jo5, turkeys would only be abundant (20/sq. mi.) in the fall and winter. During the reminder of the year they would probably be 4-5/sq mile.

Fish and Reptiles

Fish and reptiles make up a small component of the food at all four sites, though reptiles (particularly turtles) at Bundy-Voyles are second only to mammals. Fish species present include both "game" fish (largemouth bass, and the group including sunfish, blackbass, and crappies) and "rough" fish (catfish, gar, and suckers).

Turtles are represented at the four sites include snapping, softshell, musk, pond or painted turtle, and the box tortoise. Only aquatic species are present at 12Mg1; whereas the single specimen from 12Jo5 is a terrestrial species (*Terrepene sp.*). Both terrestrial and aquatic species are present at 12Jo289 and 12Gr122. Aquatic species are easiest to acquire in the winter (Winters 1969), whereas terrestrial species are more often collected during the summer and autumn. During the summer, most species are relatively solitary; however, in the winter aquatic species tend to congregate in the mud or in abandoned muskrat burrows to hibernate. It is, therefore, most efficient to acquire them during hibernation. *Terrepene sp.* hibernate in the ground from late October to April; however, once the ground is frozen they are difficult to find or acquire. During a short period from mid-May to mid-June, box turtles are highly mobile, and if one is out in the Indiana countryside during this period they are likely to see several in a day (Reidhead 1981:155).

Most turtles could probably be taken opportunistically in small numbers. Snappers are on land during June to lay eggs, and during dry summer periods they migrate to new water holes. Likewise, terrapins may occasionally be seen on land. Softshelled turtles (*Trionix sp.*) are the exception. These species are extremely wary of people. They are sometimes seen on sandbars during the summer, but when approached they rapidly head for water. They are currently most commonly taken by baited lines or nets. Their abundance at these sites would be surprising except for the fact that they leave visible burrows under shallow water on the sides of sandbars and may be readily taken in the late spring and early summer.

The only turtle species which suggests an important aspect of the local environment is the musk turtle (found only at 12Mg1). This species is found in permanent bodies of water with soft muddy bottoms. Specifically, it was probably collected from one of the many sloughs which occurred on the floodplain surrounding the site.

It is probable that many of the fish recovered from 12Mg1 were also procured from sloughs as they dried out and the density of fish in them increased to the point where they were a lucrative source of protein.

CONCLUSIONS

Of particular interest but difficult to quantify is the relative importance of hunting in comparison to maize horticulture. Cleland (1976) has proposed a focal-diffuse model which has varied in popularity over time. In general, he states that the Late Prehistoric period is characterized by a focal pattern of resource utilization. This primarily relates to agricultural economies where Middle Mississippian are the most focal, followed by Upper Mississippian and Late Woodland adaptations. In the latter, "agricultural resources are simply an element of a diffuse economy"(Cleland 1976:73).

We suspect that one of the effects on whether an animal economy is focal or not is the duration of occupation. Site 12Jo5 is probably a site with fairly short-term fall-winter occupation; thus, the large storage pits, few material remains, and relative abundance of species like deer, bear, and elk. The Bundy-Voyles site probably had a much longer period of occupation. Site occupation occurs from June to January based on the dental eruption data from deer mandibles (Garniewicz 1997), and May occupation is probable as required to plant crops. Muskrats which are unusually abundant at the site are perhaps easiest to procure between February (breeding) and April (high water). It is important to note that there is no other evidence for occupation in this season; and it is likely that at peak spring floods the site would have to be abandoned. The key factor is that a longer duration of occupation leads to the appearance of a more diffuse economy since there is seasonal variation in faunal procurement.

Though relatively diffuse compared to the other two Oliver sites, in terms of proportions of various taxa, 12Mg1 is comparable to Fort Ancient sites with good preservation. Whether controlling for seasonality and duration of site occupation can make the focal-diffuse model more applicable needs to be examined. Future work should certainly include a broader scale comparison of Oliver Phase sites to other Upper and Middle Mississippian assemblages.

Table 1. Presence/Absence Data on Sites With Poor Preservation.

Species	Clampitt	Cox's Woods	Bowen
White-tailed Deer	X	X	X
Turkey	X	X	X
Raccoon	-	-	X
Elk	0	X	X
Bear	0	0	0
Eastern Cottontail	-	X	X
Eastern Fox Squirrel	X	I	X
Grey Squirrel	-	X	X
Grey Fox	X	-	-
Woodchuck	X	-	X
Beaver	X	-	X
Muskrat	X	-	X
Eastern Mole	-	I	X
Crane (Grus sp.)	-	X	-
Duck (Anas sp.)	X	-	-
Freshwater Drum	X	X	X
Redhorse	X	-	?
Turtle	X	X	X

X = Present 0 = Absent - = Absent (possibly due to poor pres.).
I = Intrusive (well preserved specimens from disturbed contexts).
? = Possibly Present (Fish not identified to species by Dorwin).

Table 2. NISP/MNI Data on Sites With Good to Excellent Bone Preservation.

	12Mg1		12Jo5		12Jo289		12Gr122	
Species	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI
Bos/Bison					1	1		
Canis sp. (dog/coyote)	2	1			X	X	1	1
C.canadensis (beaver)	26	2			2	2(1)*	12	1
C.elephus (elk)	1	1	2	1	3	2(1)*	14	1
D.virginiana (opossum)	1	1					X	X
E.dorsatum (porcupine)	5	1						
M.monax (groundhog)	24	3					3	1
M.mephitis (skunk)	1	1					1	1
O.virginian. (whitetail deer)	1179	12	485	20(4)*	479	12(5)*	1782	9
O.zibeth. (muskrat)	41	3						
P.lotor (raccoon)	99	7			1	1	10	1
S.aquaticus (mole)			2	1	2	2(1)*	X	X
S.carolin. (gray squirrel)	27	4			1	1		
S.niger (fox squirrel)	5	2			4	1	1	1
Sciurus sp. (squirrel)	16	4					1	1
Sylvilagus sp. (rabbit)							1	1
T.striatus (chipmunk)					9	2(2)*		

Table 2. Continued.

	12Mg1		12Jo5		12Jo289		12Gr122	
Species	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI
U.cinereo. (gray fox)	3	1	1	1			3	1
U.americanus (black bear)	4	1	1	1	1	1	X	X

*for 12Jo5 and 12Jo289, MNI are given using two techniques; treating features as independent and summing them for a composite MNI (shown without parentheses) and treating the site as a single sample and calculating an MNI for the site (shown in parenthesis). X indicates present but not in sample studied.

Table 3. Proportions of Major Taxonomic Groups, Various Sites.

	12Mg1		12Jo5		12Jo289		12Or1		12Gr122	
Taxon	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Mammals	5301	79	1857	99	1309	97	1764	96	2558	95
Fish	394	6	5	0	2	0	1	0	11	1
Birds	177	3	15	1	25	2	61	3	91	3
Reptiles	826	12	2	0	10	1	15	1	28	1
Total	6698	100	1879	100	1346	100	1841	100	2688	100

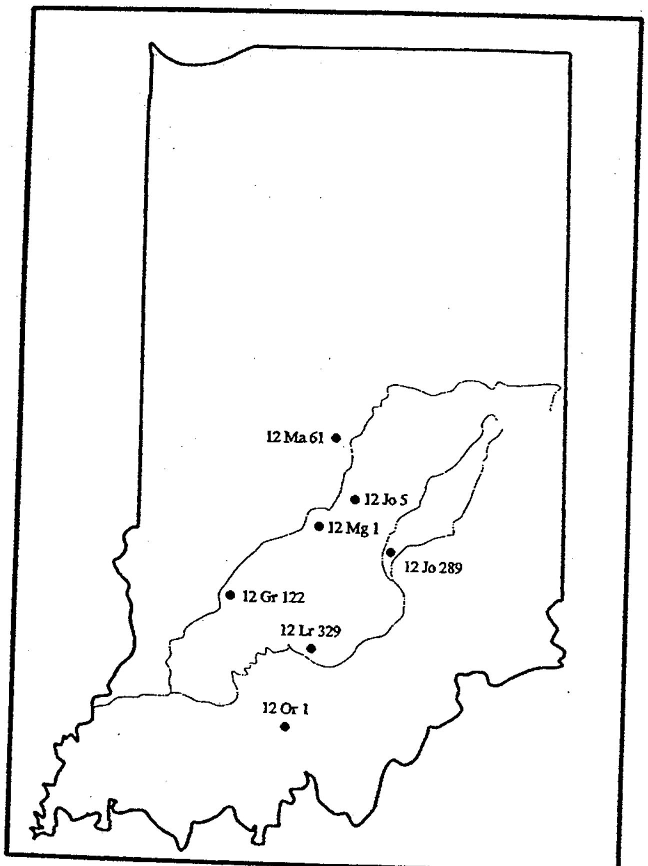


Figure 1. Locations of the sites discussed in the text.

REFERENCES CITED

Black, Glenn A.

1967 *Angel Site: An Archaeological, Historical, and Ethnological Study*. 2 vols. Indiana Historical Society, Indianapolis.

Blair, Emma

1911 *The Indian Tribes of the Upper Mississippi Valley and Region of the Great Lakes* (2 vols). The Arthur H. Clark Co., Cleveland.

Cleland, Charles E.

1976 The Focal-Diffuse Model: An Evolutionary Perspective on the Prehistoric Cultural Adaptations of the Eastern United States. *Midcontinental Journal of Archaeology* 1(1):59-76.

Dorwin, John T

1971 The Bowen Site: An Archaeological Study of Culture Process in the Late Prehistory of Central Indiana. *Prehistory Research Series* 4(4). Indiana Historical Society, Indianapolis.

Faulkner, Charles H.

1972 The Late Prehistoric Occupation of Northwestern Indiana: A Study of Upper Mississippi Cultures of the Kankakee Valley. *Prehistory Research Series* 5(1). Indiana Historical Society, Indianapolis.

Garniewicz, Rexford C.

1996 Appendix D: Analysis of Faunal Remains. In Excavations at the Cox's Woods Site (12 Or 1), A Late Prehistoric Oliver Phase Village in the Pioneer Mothers Memorial Forest, Orange County, Indiana, by Brian G. Redmond and Robert. G. McCullough. Indiana University. Glenn A. Black Laboratory of Archaeology. *Research Reports* No.17:142-145.

1997 Appendix 3: Faunal Analysis. In An Archaeological Investigation of Late Prehistoric Subsistence-Settlement Diversity in Central Indiana, by Robert G. McCullough and Timothy M. Wright. Indiana University. Indiana University. Glenn A. Black Laboratory of Archaeology. *Research Reports* No. 18:283-305.

1998 Age and Sex Determination from the Mandibular Dentition of Raccoons: Techniques and Applications. Paper presented at the 8th International Congress of the International Council for Archaeozoology. University of Victoria, Victoria, BC, Canada. August 23-29th, Abstract no. 146, p. 119.

Martin, Terrance J.

1986 *A Faunal Analysis of Fort Ouiatenon, an Eighteenth Century Trading Post in the Wabash Valley of Indiana.* Unpublished Ph.D. Dissertation, Department of Anthropology, Michigan State University, East Lansing.

McCullough, Robert G., and Timothy M. Wright

1997a An Archaeological Investigation of Late Prehistoric Subsistence-Settlement Diversity in Central Indiana. Indiana University. Glenn A. Black Laboratory of Archaeology. *Report of Investigations* 96-14:283-305.

1997b Population Dynamics of the Late Prehistoric: A Case Study from the Lower West Fork of the White River. Indiana University. Glenn A. Black Laboratory of Archaeology. *Report of Investigations* 97-18.

Quimby, George I.
1962 A Year with a Chippewa Family, 1763-64. *Ethnohistory* 9:217-239.

Redmond, Brian G.
1994 The Archaeology of the Clampitt site (12 Lr 329): An Oliver Phase village in Lawrence County Indiana. Indiana University. Glenn A. Black Laboratory of Archaeology. *Research Reports* No. 16.

Redmond, Brian G., and Robert G. McCullough
1996 Excavations at the Cox's Woods Site (12 Or 1), a Late Prehistoric Oliver Phase Village in the Pioneer Mothers Memorial Forest, Orange County Indiana. Indiana University. Glenn A. Black Laboratory of Archaeology. *Research Reports* No. 17.

Reidhead, Van A.
1981 A Linear Programming Model of Prehistoric Subsistence Optimization: A Southeastern Indiana Example. *Prehistory Research Series* 6(1). Indiana Historical Society, Indianapolis.

Rogers, Edward S.
1973 The Quest for Food and Furs: the Mistassini Cree, 1953-1954. National Museums of Canada. National Museum of Man. *Publications in Ethnology* 5.

Schorger, A.W.
1966 *The Wild Turkey, Its History and Domestication.* University of Oklahoma Press, Norman.

Shaffer, Brian S. and B.W. Baker
1992 A vertebrate faunal analysis coding system. University of Michigan. Museum of Anthropology. *Technical Report* 23.

Smith, Bruce D.
1975 Middle Mississippi Exploitation of Animal Populations. University of Michigan. Museum of Anthropology. *Anthropological Papers* 57.

Thwaites, Reuben Gold (editor)
1896-1901 *The Jesuit Relations and Allied Documents*. 73 vols. Borrows Brothers Co., Cleveland.

Twitchell, A.R., and H.H. Dill
1949 One Hundred Raccoons from One Hundred and Two Acres. *Journal of Mammology* 30:130-133.

Winters, Howard Dalton
1969 The Riverton Culture: A Second Millennium Occupation in the Central Wabash Valley. Illinois State Museum. *Reports of Investigations* 13. The Illinois Archaeological Survey *Monograph* 1.

PALEOPATHOLOGY AT THE LATE WOODLAND, ALBEE PHASE, COMMISSARY SITE (12Hn2): IMPLICATIONS FOR SEDENTISM AND MAIZE CONSUMPTION

Christopher W. Schmidt, Ph.D. and
Matthew A. Williamson, Ph.D.
Archeology and Forensics Laboratory
University of Indianapolis

INTRODUCTION

A number of recent osteological and paleoethnobotanical studies have shed new light on the lifeways of Albee Phase people in Indiana (e.g., Bush 1994; Havill et al. 1998, Schmidt 1998). The aforementioned studies independently concur that, most likely, maize contributed to the Albee diet, with evidence coming from a variety of dietary indicators including botanical (e.g., Bush 1994), skeletal (e.g., Havill et al. 1998) and dental remains (e.g., Havill et al. 1998; Schmidt 1998). As a part of an ongoing research interest in the Albee Phase, the current study seeks to elucidate the osteological evidence and consequences of the Albee diet as it is manifest in the Albee Phase Commissary site (12Hn2) human remains. We focus our efforts upon this site because it represents the largest collection of Late Woodland skeletal remains ever recovered from a single cemetery of this temporal period in Indiana. Moreover, neither direct subsistence evidence nor a habitation area were excavated with the remains, thus making an osteological study the most appropriate vehicle for our investigation of the diet and the consequences thereof.

Stated succinctly, our research question is this: Is the Commissary paleopathological profile consistent with what is expected for a maize-reliant population? This is pursued via comparisons of the Commissary pathology profile to those of prehistoric non-maize-reliant, non-sedentary; maize-reliant, semi-sedentary; and maize-reliant, sedentary populations from Indiana and Illinois.

RELATIONSHIP OF PATHOLOGICAL SKELETAL LESIONS, SETTLEMENT PATTERN (SEDENTISM AND POPULATION NUCLEATION), AND MAIZE-RELIANCE

In the New World, paleopathology has illuminated the idiosyncratic frequencies and expressions of skeletal pathological lesions for foragers, horticulturists, and maize-reliant agriculturists, each representing an increasing degree of population nucleation and sedentism (Cohen and Armelagos 1984; Larsen 1995). It has been widely documented that, among the latter, pathological conditions indicating non-specific physiologic stress, anemia, and poor dental health are expressed with greater frequency (and often more severity) than what is typically seen in most non-sedentary, non-maize reliant groups (Cohen and Armelagos 1984; Larsen 1984, 1992, 1995). These pathological conditions include (but are not limited to) *cribra orbitalia*, periostitis, linear enamel hypoplasia, and dental caries. Since comparative data for these particular pathological conditions are in relative abundance, they are the focus of the current study.

It is generally accepted that the greater frequency of these pathological conditions in sedentary, maize-reliant populations is due to the cultural practices that surround maize agriculture. While greatly simplified, the following summary assembles most of the current supporting arguments: Maize agriculture requires at least some degree of sedentism in order to plant, maintain, and harvest the fields. Sedentism, in turn, creates a number of problems for the population. One of these is a relative decrease in the variety of foods consumed, since agriculturists tend to have a diet that is dominated by the crops that they grow. While they may augment their diets with wild foods, the fact that their populations remain in one region for long periods of time limits their access to certain food types, thus limiting their exposure to some nutrients. A second problem with sedentism is hygiene (e.g., Stuart-Macadam 1992). The disposal of human waste and the maintenance of clean water sources are serious issues that must be addressed. If not dealt with appropriately, individuals increase their likelihood of encountering pathogens that proliferate in human waste. A third issue is population nucleation. If the area used for habitation is, in some way socially or politically circumscribed, the amount of land available to the general population is limited. The result is an increase in the number of people per unit area of land. Dense human populations are generally considered to be very attractive environments for biotic pathogens (Ortner and Putschar 1985).

Another consideration is the diet itself. Maize has been directly implicated in the increase of pathological lesions on the teeth -- dental caries (Larsen et al. 1991; Milner 1984; Scuilli and Schneider 1986). Populations which consume appreciable quantities of cariogenic foods, such as maize, will have more individuals with carious lesions than populations that do not (Larsen et al. 1991; Powell 1985; Schmidt 1998). It has also been suggested that an over-reliance upon maize can lead to anemic conditions which are manifest as cribrotic lesions on the orbital roofs and marked porosity on the cranial vault (e.g., Williamson 1998).

Unfortunately, despite the rather direct connection between maize consumption and dental caries, there is much uncertainty as to why the frequency of certain pathological conditions, such as *cribra orbitalia* and periosteal reactions, is greater in maize-reliant, sedentary populations. In all likelihood, the vagaries of sedentism mentioned earlier play an important role in their expression and frequency. However, it is possible that unknown factors are also influencing their presence. The fact of the matter is that it is virtually impossible to draw a straight causitive line between each potential consequence of maize-reliance and sedentism (i.e., decreased hygiene, population nucleation, etc.) and the presence of specific pathological lesions. The increases in pathological lesion frequencies reported in the literature must be viewed as a result of the combined affects of all of the known and potential consequences of maize-reliance and sedentism. A synergy of these consequences creates an environment that induces (or at least does not buffer against) higher frequencies of pathological lesions (when compared to non-sedentary, non-maize-reliant populations).

In sum, except for the dental caries data, our study of skeletal pathological lesions is unable to distinguish sedentism and maize-reliance as independent causitive factors and, thus, they have to be considered in unison as contributors to the pathology profiles that we generate. However, the well-documented association between sedentism/ maize-reliance and relatively high frequencies of pathological lesions allows us to characterize and compare the pathological profiles of these populations, even if all of the underlying reasons for this association are not well understood.

MATERIALS

The Commissary site is located in east central Indiana near the town of New Castle in Henry County. It is situated on a promontory approximately 50 feet above the Big Blue River valley to the west and the Little Blue River valley to the south in the southern region of the Tipton Till Plain (Swartz 1983). Primarily a mortuary site, recovered artifacts, such as Jack's Reef Pentagonal points, and grit-tempered cord-marked pottery, suggest that Commissary dates to the Albee Phase of the Late Woodland period (Houck and Swartz 1972). While there has been some disagreement over the chronometric age of the site, it now seems largely accepted that Commissary dates to around A.D. 1100 (Burkett and Cochran 1985), a time that is consistent with other Albee Phase occupations in that part of the state (McCord and Cochran 1994).

Of the over 100 individuals represented at Commissary, about half (n = 53) were suitable for skeletal pathological study. For the periosteal reactions analysis, the total includes left and right tibiae, thus giving a sample size (n = 79) that appears larger than the actual number of individuals studied. For the dental study, only adults with teeth were included: 36 individuals, 13 males and 14 females with nearly equal age distributions.

The paleopathological data derived from the Commissary skeletons were compared to published data representing several temporal periods from the Dickson Mounds site in central Illinois. The caries data from Commissary were compared to data derived from Late Woodland; late, Late Woodland (Oliver Phase); and Mississippian sites in Indiana. Ideally, both the skeletal and the dental data would be compared to sites from Indiana. Unfortunately, the requisite comparative skeletal data are not available at this time.

Perhaps no other archaeological site in the New World has had human remains so thoroughly examined as those from Dickson. The comparative data represent three temporal periods: Late Woodland, Mississippian Acculturated Late Woodland, and Middle Mississippian. According to Goodman et al. (1984) the Late Woodland (A.D. 900-1050) at Dickson was characterized by foraging with settlements consisting of around 75-125 people. It is probable that some level of horticulture also characterized these people (see, Scarry 1993 for discussion on Late Woodland horticulture). As the Mississippian culture spread from the lower Illinois River valley it began to influence the Late Woodland populations around Dickson. These Mississippian influenced populations, termed Mississippian Acculturated Late Woodland (A.D. 1050-1150), had a mixed economy of foraging and agriculture. Settlements were slightly larger, and with the advent of agriculture, perhaps more permanent. Between A.D. 1150 and 1350, the Middle Mississippian had established itself at Dickson. Several sites in the area suggest intensive agriculture and larger settlements, many of which had densely populated habitation areas surrounding a common plaza. Settlements consisted of up to several hundred individuals (Goodman et al. 1984).

The comparative sites for the dental caries analysis include four Albee Phase (A.D. 700-1100) sites (Albee [12Su1], Bucci [12Gr388], Shepherd [12Gr60], and Shafer [12Gr109]) from west-central Indiana, the late, Late Woodland (Oliver Phase - A.D. 1050-1400) Bowen site from central Indiana, and the Middle Mississippian (A.D. 1250-1450) Angel site from southwestern Indiana. The Albee subsistence was probably based upon nuts and/ or starchy and oily seeds in addition to some maize (Havill et al. 1998; Schmidt 1998). The Albee sites are largely mortuary and little is known about their habitation density or permanence. The best documented Albee Phase habitation site in Indiana, Morell-Sheets, suggests that Albee habitation was seasonal (McCord and Cochran 1994; Bush 1994). (We should add that in the current study, although Commissary is an Albee Phase site, to avoid confusion only the four comparative sites will be referred to as "the Albee sites"). The Bowen site occupants were probably swidden agriculturists who relied on maize as a dietary staple (Dorwin 1971; McCullough 1994; Schmidt 1998). The site was probably inhabited year-round for several years before the population moved to a different settlement

(McCullough, personal communication). The Angel site occupants were intensive agriculturists who relied heavily upon maize (Schurr 1992; Schmidt 1998). The site was occupied year-round for perhaps as long as two centuries by as many as 3,000 people (Black 1967).

DETERMINING THE PATHOLOGICAL PROFILE

Of the four pathological conditions studied herein, two are skeletal and two are dental. *Cribra orbitalia* is where the cortical bone in the orbit roof is replaced by expanding, blood-producing diplöe. A host of conditions can lead to *Cribra orbitalia* including congenital hemolytic anemias (e.g., thalassemia and sickle cell), iron deficiency anemia, cyanotic congenital heart disease, and polycythemia vera (Ortner and Putschar 1985; Steinbock 1976); all of which affect the skeleton during childhood (although the lesions may persist into adulthood). Among prehistoric New World humans, it is suggested that iron-deficiency anemia is the most likely cause of cribrotic lesions, although at this time, it is not possible to determine the specific cause (e.g., infection, nutritional deficiency, parasites or any combination of these). Therefore, *cribra orbitalia* is considered a non-specific physiological stress indicator (Steinbock 1976; Ortner and Putschar 1985).

Like *cribra orbitalia*, periosteal reactions are non-specific indicators of physiologic stress. They are manifested as deposits of woven bone resulting from the separation of the periosteum from the underlying cortex as a result of a local or systemic infection. Called periostitis, these bony inflammations are produced by the stretching and compressing of blood vessels (Jaffe 1972). Periosteal reactions can occur on any bone, but are most commonly documented on long bones such as the femur, tibia, and fibula (Steinbock 1976; Ortner and Putschar 1985).

Linear enamel hypoplasia (LEH) is manifest as transverse bands visible on dental enamel that mark a cessation in normal enamel formation. Hypoplastic events are non-specific stress indicators and are created only when the tooth crown is forming. Because tooth crowns develop from *in utero* until approximately the 15th year of life, the record of stress they bear is limited to that experienced during childhood. However, because enamel is acellular and cannot heal, enamel hypoplastic lines are permanent records of a physiological disruption. Many factors can induce enamel hypoplasia, including stress brought about by nutrition and infection (Pindborg 1970; Rose et al. 1985; Goodman and Rose 1991).

Dental caries is the focal demineralization of dental tissues as a result of oral bacteria metabolizing sugars, especially sucrose. Dental caries is a pathological condition that is fairly uncommon in populations that subsist on wild foods. In contrast, populations which subsist on domesticated foods such as maize or other grains tend to have much higher instances of caries. Caries is expressed as small to large pits (cavities) on the occlusal surface, interproximal surfaces, neck, and roots of teeth and are most common in the molars (Pindborg 1970; Larsen et al. 1991).

All told, the pathological profile is comprised of mean frequencies of each of the pathological conditions within a given population, as well as, intrapopulational associations and correlations among these frequencies. Interpopulational comparisons are made qualitatively and quantitatively although only the former is applied here.

METHODS

Periostitis was scored as either 'present' or 'absent' among the tibia of all adults and subadults. Its presence was confirmed if the lesion represented a clear deposition of bone on the external surface of the cortex. "Striated" or minor "plaque-like" deposits in the absence of appreciable periostosis (increase in shaft diameter) were insufficient for a score of 'present'. The scoring basis for *cribra orbitalia* was the presence of erosive lesions and expanded diplöe on the orbital roof of individuals with a skeletal age below 18. Presence of cribrotic lesions needed only to be unilateral to be scored as 'present' fot a given individual. In addition, no distinction was made between active or remodeled periosteal or cribrotic lesions.

All procedures for scoring the dental pathological conditions followed standards presented in Buikstra and Ubelaker (1994). All data derived from the Commissary site was done so by the authors. The presence of LEH and caries was scored for all teeth among adults only. Hypoplastic events were scored as present if a transverse band of distinct thickness could be determined. Carious lesions were determined visually and were confirmed only if the pit had a slightly irregular margin or some degree of marginal staining present under low magnification (usually 10X). Only occlusal lesions were included in this study. For the caries analysis, the teeth were lumped into two groups: anterior (incisors, canines, and premolars) and posterior (molars).

RESULTS AND COMPARISONS

cribra orbitalia

Among Commissary subadults, 14 of 34 (41 %) had at least one orbit with evidence of *cribra orbitalia*. When compared to populations from the Dickson site in central Illinois, it is clear that the Commissary percentage is greater than that for the Late Woodland there. Lallo et al. (1978) found evidence of *cribra orbitalia* among 13.6 % of the Late Woodland subadults, 31.2 % of the Mississippian

Acculturated Late Woodland subadults, and 51.5 % of the Mississippian subadults. Table 1 summarizes these data.

Periostitis

Among the Commissary subadults, 40.3 % of the tibiae had periostitis. At Dickson Mound, the Late Woodland and Mississippian Acculturated Late Woodland combined had 27 % of the subadult tibiae affected. For the Middle Mississippian, 67 % had periosteal reactions. The Commissary adults had 84% of the tibiae affected. Combining adults and subadults, the percentage of Commissary individuals with periosteal reactions is 67. For the Dickson Mounds Late Woodland and Mississippian Acculturated Mississippian the percentage is 26.6 while the Middle Mississippian had 84 % affected (Lallo et al. 1978). The combined adult and subadult periostitis results are summarized in Table 2.

Linear Enamel Hypoplasia

Of the 22 adults from Commissary that were suitable for analysis, 17 (77.3 %) had at least one tooth with evidence of at least one hypoplastic event. By comparison, the Dickson Late Woodland had 45% affected, the Mississippian Acculturated had 60% affected, and the Middle Mississippian had 80%

affected. The LEH comparisons are summarized in Table 3.

Caries

The percentage of Commissary individuals with at least one occlusal lesion on at least one molar is 47.2 %. By comparison, 31.1 % of the Albee individuals had at least one carious molar. These values contrast with Bowen and Angel which had 62.0 % and 82.0 %, respectively. For those with lesions on the anterior teeth, 19.4 % of the Commissary individuals, 11.1 % of the Albee individuals, 66.7 % of Bowen, and 34.0 % of Angel individuals were affected. Table 4 summarizes the percentage of individuals with caries.

Of those with at least one carious lesion, the average Commissary person had 11.3 % of their anterior teeth and 44.6 % of their molars affected. The percentage of carious anterior teeth for Commissary is a bit less than the Albee value (16.0 %) and noticeably below the Bowen (26.5 %) and Angel (23.6 %) values. For the molars the story is about the same, although the Commissary value is just above that of Albee (42.7 %) while Bowen (52.0 %) and Angel (63.9 %) are much greater. Table 5 summarizes the percentage of carious teeth values.

DISCUSSION AND CONCLUSION

The frequencies of periosteal reactions and *cribra orbitalia* suggest that the overall pathogen load and occurrence of iron-deficiency anemia was high. Likewise, the frequency of dental hypoplasia suggests that a large percentage of the population, over three-quarters, withstood some type of physiological childhood stress that was great enough to temporarily arrest dental formation. These frequencies hover around what is expected for sedentary, maize-reliant populations. In fact, when compared to the Dickson populations, it seems that the environment in which the Commissary people lived was quite similar to that suggested by the Mississippian Acculturated Late Woodland and Middle Mississippian.

The primary difference between the Commissary population and the sedentary, maize-reliant populations is in the frequency and severity of carious lesions. Fewer people at Commissary had carious lesions (and among those who did, they had fewer lesions per mouth) than what was exhibited by the Middle Mississippian, Angel, people. In fact, the Commissary caries values even fail to match those of the late, Late Woodland Oliver Phase values. It seems that the people of Commissary relied much less on cariogenic domesticates, like maize, than did these later, maize-reliant Bowen and Angel people. Interestingly, the intermediate level of caries expression at Commissary is consistent with the supplemental role of maize purported by Bush (1994).

The skeletal and dental evidence suggests a sedentary and/ or nucleated settlement pattern in the absence of intensive maize reliance at Commissary. These results paint an interesting, although not necessarily unique, picture of life at the Commissary site. In fact, evidence of modest maize consumption among populations that were otherwise culturally Mississippian has been documented in the lower and middle Mississippi River Valley (Rose et al. 1991). Thus, our study and that of Rose and colleagues agree that there is evidence for population nucleation and/ or sedentism predating significant maize-reliance in these regions.

In conclusion, the Commissary skeletal pathology and dental hypoplasia data are qualitatively more similar to those of the Mississippian Acculturated and Middle Mississippian populations than to the Late Woodland at Dickson. The caries data, however, are quite consistent with those from the Albee sites and contrast noticeably with those of the Middle Mississippian. Altogether, it is apparent that the pathological profile of Commissary is similar to sedentary, maize-reliant populations, except for a conspicuously inferior degree of maize dependence.

Acknowledgments. We would like to thank Don Cochran and Beth McCord of Ball State University for access to the Commissary remains and Dr. Stephen Nawrocki for comments and criticisms.

59

This project was funded, in part, by a grant from the Indiana Academy of Science (128-95).

Table 1. Summary of *cribra orbitalia* comparisons. The Dickson Mound populations are Late Woodland (LW), Mississippian Acculturated Late Woodland (MALW), and Middle Mississippian (MM) (Lallo et al. 1978).

Sites	**n**	**%**
Commissary	34	41.0
LW	44	13.6
MALW	93	31.2
MM	101	51.5

Table 2. Summary of tibial periosteal reactions comparisons. The Dickson Mound populations are Late Woodland (LW), Mississippian Acculturated Late Woodland (MALW), and Middle Mississippian (MM) (Lallo et al. 1978). Adults and subadults combined.

Sites	**n**	**%**
Commissary	79	67.0
LW and MALW	353	26.6
MM	194	84.0

Table 3. Summary of LEH comparisons. The Dickson Mound populations are Late Woodland (LW), Mississippian Acculturated Late Woodland (MALW), and Middle Mississippian (MM) (Goodman et al. 1984).

Sites	**n**	**%**
Commissary	17	77.3
LW	9	45.0
MALW	27	60.0
MM	37	80.0

Table 4. Summary of dental caries comparisons, the percentage of individuals with at least one carious tooth.

	Anterior Teeth		**Molars**	
	n	**%**	**n**	**%**
Commissary	36	19.4	36	47.2
Albee	45	11.1	45	31.1
Oliver	21	66.7	21	62.0
Angel	50	34.0	50	82.0

Table 5. Summary of dental caries comparisons, percentage of teeth affected per individual among those with at least one carious lesion.

	Anterior Teeth		**Molars**	
	n	**%**	**n**	**%**
Commissary	7	11.3	17	44.7
Albee	5	16.0	14	42.7
Oliver	14	26.5	13	52.0
Angel	17	23.6	41	63.9

REFERENCES CITED

Black, Glenn A.
1967 *Angel Site: An Archaeological, Historical, and Ethnological Study.* Indiana Historical Society, Indianapolis.

Buikstra, Jane E., and D.H. Ubelaker
1994 Standards for Data Collection from Human Skeletal Remains. Arkansas Archaeological Survey. *Research Series* No. 44.

Burkett, Frank, and Donald R. Cochran
1985 The Commissary Site (12-Hn-2) Revisited. *Proceedings of the Indiana Academy of Science* 94:93.

Bush, Leslie L.

1994 Botanical remains from the Morell-Sheets site, 12 My 87, an Albee Phase Occupation in West Central Indiana. In Current Research in Indiana Archaeology and Prehistory: 1994, edited by Brian G. Redmond. Glenn A. Black Laboratory of Archaeology, *Research Reports*, No. 15:6-9.

Cohen, M.N., and G.J. Armelagos (editors)

1984 *Paleopathology at the Origins of Agriculture*. Academic Press, Orlando.

Dorwin, John T

1971 The Bowen Site an Archaeological Study of Culture Process in the Late Prehistory of Central Indiana. *Prehistory Research Series* 4(4). Indiana Historical Society, Indianapolis.

Dragoo, D.W.

1949 Casual Observations on Angel Mounds Skeletal Material. *Proceedings of the Indiana Academy of Science* 58:50-52.

Goodman, A.H., D.L. Martin, G.J. Armelagos, and G. Clark
1984 Indicators of Stress From Bone and Teeth. In *Paleopathology at the Origins of Agriculture*, edited by M. N. Cohen and G. J. Armelagos., pp. 271-305. Academic Press, Orlando.

Goodman, A.H., and J.C. Rose
1991 Dental Enamel Hypoplasias as Indicators of Nutritional Status. In *Advances in Dental Anthropology*, edited by M. A. Kelley and C. S. Larsen, pp. 279-294. NewYork: Wiley-Liss.

Havill, L.M., A.A. White, and K. Murphy
1998 Bioarchaeological Analysis of Four Late Woodland Mortuary Populations from West Central Indiana. Paper presented at the 43rd Annual Meeting of the Midwest Archaeological Conference, Muncie.

Houck, G.K., and B.K. Swartz, Jr.
1972 The Commissary Site: A Woodland Cemetery. *Proceedings of the Indiana Academy of Science* 81:56-57.

Jaffe, H.L.
1972 *Metabolic Degenerative, and Inflammatory Disease of Bone and Joints*. Lea and Febiger, Philadelphia.

Lallo, J., G.J. Armelagos, and J.C. Rose
1978 Paleoepidemiology of Infectious Disease in the Dickson Mounds Population. *Medical College of Virginia Quarterly* 14:17-23.

Larsen, Clark S.
1984 Health and Disease in Prehistoric Georgia: the Transition to Agriculture. In *Paleopathology at the Origins of Agriculture*, edited by M.N. Cohenand G. J. Armelagos, pp. 364-392. Academic Press, Orlando.

1985 Dental Modifications and Tool Use in the Western Great Basin. *American Journal of Physical Anthropology* 67:393-402.

1987 Bioarchaeological Interpretations of Subsistence Economy and Behavior from Human Skeletal Remains. In *Advances in Archaeological Method and Theory*, vol. 10, edited by M. B. Schiffer, pp. 339-445. Academic Press, Orlando.

1992 Transitions in Health, Diet, and Behavior: Bioarchaeology in Spanish Colonial Florida. Paper presented at the 25th Annual Chacmool Conference, Calgary.

1995 Biological Changes in Human Populations with Agriculture. *Annual Reviews in Anthropology* 24:185-213.

Larsen, Clark S., R. Shavit, and Mark C. Griffin

1991 Dental Caries Evidence for Dietary Change: An Archaeological Context. In *Advances in Dental Anthropology*, edited by M. A. Kelley and C. S. Larsen, pp. 179-202. Wiley-Liss, New York.

McCord, Beth K., and Donald R. Cochran

1994 Morell-Sheets: An Albee Phase Habitation. Archaeological Resources Management Service. Ball State University. *Reports of Investigation* 38. Muncie.

McCullough, Robert G.

1994 Climatic Change and Swidden Agriculture: Implications for the Late Prehistoric Period of Indiana. Paper presented at the 110th Annual, Meeting of the Indiana Academy of Science, Programs and Abstracts.

Milner, G.R.
1984 Dental Caries in the Permanent Dentition of a Mississippian Period Population from the American Midwest. Coll. Antropol. 1:77-91.

Ortner, D.J., and W.G.J. Putschar
1985 Identification of Pathological Conditions in Human Skeletal Remains. *Smithsonian Contributions to Anthropology* No. 28. Smithsonian Institution Press, Washington D.C.

Pindborg, J.J.
1970 *Pathology of the Dental Hard Tissues.* W. B. Saunders and Company, Philadelphia.

Powell, M.L.
1985 The Analysis of Dental Wear and Caries for Dietary Reconstruction. In *The Analysis of Prehistoric Diets*, edited by R. I. Gilbert and J. H. Mielke pp. 307-338. Academic Press, Orlando.

Rose, J.C., K.W. Condon, and A.H. Goodman
1985 Diet and Dentition: Developmental Disturbances. In *The Analysis of Prehistoric Diets*, edited by R.I.

Gilbert and J.H. Mielke, pp. 281-306. Academic Press, Orlando.

Rose, J.C., M.K. Marks, and L.L. Tieszen
1991 Bioarchaeology and subsistence in the Central and Lower portions of the Mississippi River. In *What Mean These Bones? Studies in Southeastern Bioarchaeology*, edited by M.L. Powell, P.S. Bridges, and A.M. Wagner Mires, pp. 7-21. The University of Alabama Press, Tuscaloosa.

Scarry, C.M. (editor)
1993 *Foraging and Farming in the Eastern Woodlands*. Gainesville, University of Florida Press.

Schmidt, Christopher W.
1998 *Dietary Reconstruction Among Prehistoric Humans from Indiana: An Analysis of Dental Macrowear, Dental Pathology, and Dental Microwear.* Unopublished Ph.D. dissertation, Purdue University, West Lafayette.

Schurr, Mark R.
1992 Isotopic and Mortuary Variability in a Middle Mississippian Population. *American Antiquity* 57:300-320.

Sciulli, P.W., and K.N. Schneider
1986 Dental Caries and Horticulture in Prehistoric Ohio. *Pennsylvania Archaeologist* 56:21-28.

Steinbock, R.T.
1976 *Paleopathological Diagnosis and Interpretations*. C.C. Thomas, Springfield.

Stuart-Macadam, P.
1992 Anemia in Past Populations. *In Diet, Demography, and Disease: Changing Perspectives on Anemia,* edited by P. Stuart-Macadam and S. Kent, pp. 151-170. Aldine De Gruyter, New York.

Swartz, B.K. Jr.
1983 The Commissary Site: An Early Late Woodland Cemetery in East Central Indiana. Ball State University. *Contributions to Anthropological History* No. 3. Muncie.

Williamson, Matthew A.
1998 *Regional Variation in Health and Lifeways Among Late Prehistoric Georgia Agriculturalists.* Unpublished Ph.D. dissertation, Purdue University, West Lafayette.

EARLY AND LATE ALBEE MORTUARY COMPONENTS IN WEST CENTRAL INDIANA

Andrew A. White
Southern Illinois University at Carbondale
and
Glenn A. Black Laboratory of Archaeology
Indiana University

INTRODUCTION

In his *Survey of the Wabash Valley in Illinois* (1963), Howard Winters published the original description of the Albee complex. He based his description on surface collections from several sites, as well as previous excavations at the Albee Mound and Shaffer cemeteries. The present definition of Albee in west central Indiana continues to be based largely upon these two cemeteries More recent excavations (e.g. Tomak 1970: 151; Cochran et al. 1988; Anslinger 1990; McCord and Cochran 1994) have produced additional information and an array of radiocarbon dates that center Albee in the approximate time period envisioned by Winters: A.D. 800-1000 or later (McCord and Cochran 1994:116).

Cochran et al. (1988) suggested that Albee is preceded in northern Indiana by Intrusive Mound from A.D. 700-900, and that Albee itself extends from A.D. 900-1100. Based upon a bioarchaeological analysis, it is proposed that several west central

Indiana mortuary sites presently included as Albee contain elements related to both Seeman's (1992) Jack's Reef horizon and later Late Woodland developments. Specifically, four sites are considered: the Albee Mound, Shaffer, Shepherd, and Bucci cemeteries. Though an association between these sites has been recognized since the late 1960s (Tomak 1970; Neumann n.d.), little research has been conducted concerning the relationships between them. Using fluoride content analysis, burial position, and diagnostic artifact associations, "early" and "late" groups are constructed, and differences in the prevalence and location of dental caries are investigated.

THE ALBEE MOUND, SHAFFER, SHEPHERD, AND BUCCI CEMETERIES

The sample used in this study is drawn from four mortuary sites: the Albee Mound, Shaffer, Bucci, and Shepherd cemeteries (Figure 1). The Shaffer, Shepherd, and Bucci cemeteries are located in Greene County, Indiana, on the western side of the west fork of the White River. The Albee Mound cemetery is located along the Wabash River in Sullivan County, Indiana. Together, the excavated portions of these sites contained approximately 163 burials. Age at death was estimated for each individual (when possible) using standard tables of dental eruption (Bass 1987: 289-290) and epiphyseal fusion (Johnston

1961:79), as well as the degree of pubic symphysis development (Todd 1920; Suchey et al. 1984). Though an attempt was made to estimate age as accurately as possible for each individual, the analyses presented below generally use only the gross age classes of infant (0-3 years), child (3-15 years), young adult (15-18 years) and adult (18+ years). Sex was estimated when possible using pelvic (see Bass 1987:200-206) and cranial (Bass 1987:81) morphology. Where use of these indicators was not possible, variables such as femur head size and general robusticity were considered. No attempt was made to estimate the sex of juveniles. To avoid confusion, burials will be referred to by using the site number as a prefix to the burial number.

Albee Mound Cemetery

The Albee Mound cemetery was located east of Prairie Creek on the edge of the Wabash River bottomland in Sullivan County, Indiana (Figure 1). J. Arthur MacLean began excavating the Albee Mound during the summer of 1926, unearthing 41 burials incorporating at least 45 individuals before the excavation was finished in the summer of 1927 (MacLean 1931). Information on the excavations of the Albee Mound cemetery is apparently limited to MacLean's two published articles (1927, 1931), as the original excavation notes do not appear to be extant (Faust 1961:3).

MacLean approached the mound as though it was artificial, excavating in vertical sections, "undercutting and alleying at ends of section[s]" ten feet long and three feet wide to remove large sections of earth "presumably without burials" (MacLean 1931:144, Plate 5). This method resulted in the unintentional and premature loss of context of several burials (i.e., MacLean 1927:29, 1931:123). The unexpected presence of natural sand and loess deposits as well as cultural silt deposits within the mound, coupled with MacLean's belief that the mound's height had been considerably reduced, led him to conclude that mound was a culturally modified natural formation (MacLean 1927:14). In his final report, MacLean stated that the mound was not Hopewell, as he had expected, but rather an "apparently natural form . . . in parts at least" used by a "culture not very remote" (MacLean 1931:114).

Numbers assigned to the burial inventory do not match the burial numbers published by MacLean. Lynch (1975) provides an index showing both the inventory numbers and MacLean's numbers. The burial numbers used here correspond to MacLean's (1927, 1931) numbers.

Shaffer Cemetery

The Shaffer cemetery (12Gr109) and village (12Gr73) is a large multicomponent site located near the confluence of the Eel River and the West Fork of the White River, south of present day Worthington (Figure 1). A portion of the site (203 m^2) was excavated in 1931, unearthing approximately 35 burials and a cremation feature. This excavation encompassed only a small percentage of the total estimated site area, and several additional burials have been unintentionally discovered in the years since. There are at least two mounds associated with the site (Black 1933). Primary sources of information on the Shaffer cemetery include Black's (1933) published report as well as his original field notes and unpublished photographs on file at the Glenn A. Black Laboratory of Archaeology.

During the initial phase of the 1931 excavation, most of the work was done by two local collectors, Fred E. Dyer and Oscar E. Bland, who "invited the Historical Bureau to participate. . . . It was deemed fitting [for Glenn Black] to attend in an advisory capacity only and obtain, if possible, artifacts for the Museum" (Black 1933:269). During the second phase of the excavation, work was carried out under the auspices of the Indiana Historical Bureau, and the artifacts that Black excavated became the property of the Bureau (Black 1933:276). Though Black did not succeed in securing many artifacts from the initial phases of the excavation, many of these artifacts were curated (Tomak 1970:152; Glenn A. Black Laboratory of Archaeology Site Survey Files [GBLSSF]).

In 1964 or 1965, Tomak, along with Dr. Georg

Neumann of Indiana University, excavated two burials that had been disturbed by gas drilling in the general vicinity of the cemetery (GBLSSF). A cremation deposit, nearly identical in description to the one that Black excavated in 1931, was also found at this time (Tomak 1970:152). In 1972, an employee of a gas company drilling on the site uncovered another burial and associated artifacts while digging a posthole (GBLSSF). Gas company activities disturbed another burial and associated artifacts in 1993 (UI-10-93), which was subsequently recovered by the Indiana Department of Natural Resources (Mangold et al. 1993).

In his published report of the excavation, Black stated that all the skeletal material was saved, with the exception of one skull (Black 1933:282). Unfortunately, of the 35 burials excavated by Black, only nine are currently available for study. Only 12 of the burials excavated by Black (Burials 12Gr109-01, 12Gr109-02, 12Gr109-03, 12Gr109-04, 12Gr109-05, 12Gr109-08, 12Gr109-13B, 12Gr109-17, 12Gr109-18, 12Gr109-25, 12Gr109-27 and 12Gr109-28) were formally curated at the time, and only nine (Burials 12Gr109-03, 12Gr109-04, 12Gr109-05, 12Gr109-08, 12Gr109-13B, 12Gr109-17, 12Gr109-25, 12Gr109-27 and 12Gr109-28) are presently extant in collections. The disposition of Burials 12Gr109-01, 12Gr109-02 and 12Gr109-18 is unknown.

The skeletal material from Black's excavation also included some material with no specific provenience, including a collection of several mandible fragments. This material has been labeled simply "12Gr109." For purposes of clarity, the extraneous skulls found with Burials 12Gr109-13A and 12Gr109-35A are here treated as separate burials (Burials 12Gr109-13B, 12Gr109-13C and 12Gr109-35B, respectively). The two burials (12Gr109-xx' and 12Gr109-xx") excavated by Tomak and Neumann are presently curated, but the whereabouts of the cremation deposit reported by Tomak are unknown. The burial salvaged by the Indiana Department of Natural Resources (Burial UI-10-93) is curated.

Bucci Cemetery

The Bucci cemetery (12Gr388) was located on an upland bordering Four Mile Marsh (Figure 1). The site was discovered in 1968 in the course of moving a house prior to the commencement of surface mining activities (Tomak 1970:156). Neumann and several students salvaged 43 burials from the site before its destruction (Tomak 1970:156). Burials reportedly were also discovered when the house was built (*Linton Daily Citizen*, July 9, 1968).

There was apparently a multicomponent habitation site adjacent to the cemetery, as revealed by "flint chips, hammerstones, full grooved axe, a few potsherds, [and] a few Archaic points" (Tomak GBLSSF). The local newspaper reported that Neumann dated the burials to the Late Woodland period based in part on a single sherd (*Linton Daily Citizen*, July 12, 1968).

Primary information on the Bucci cemetery is limited to Neumann's brief field notes (on file, Indiana University Bioanthropology Laboratory), and his comments published in the newspaper articles cited above. Additionally, some documentation is available in the GBLSSF and in Tomak (1970).

Shepherd Cemetery

The Shepherd cemetery (12Gr60) is located on an upland bordering the White River floodplain (Figure 1). Approximately 45 burials were recovered from the disturbed areas of the site before the excavation was stopped. According to records (GBLSSF), a local collector convinced the landowner to entrust him with the excavation, and proceeded to pot the site. Primary information on the Shepherd cemetery is limited, as with the Bucci cemetery, to Neumann's field notes and the description given by Tomak (1970).

The cemetery was discovered in 1963 by Tomak and John F. Tincher (GBLSSF), though it had apparently been disturbed prior to this date by "pitting" of either natural or cultural origin (GBLSSF; Neumann n.d.). Tomak linked the Shepherd cemetery to the Sullivan Mound Group reported by Black (1933:237) in his Greene County Survey (GBLSSF). In his notes, Neumann described the site thusly:

> The entire area excavated had previously been disturbed, and most of the burials were fragmentary and incomplete. There was no discernable pattern to the burials, and the entire area appeared as a mixture of bones and sand with an accumulation (more or less complete burial) of bones encountered periodically--broken bone was found throughout the cemetery area [Neumann n.d.].

Burials from the Shepherd cemetery are presently curated in collections. In some cases, the numbers used to label the boxes containing the skeletal material do not correspond to Neumann's descriptions from the field. Where an obvious difference existed between Neumann's description and the remains labeled with that number, the burial in the written description was designated with the suffix "JT," as in 12Gr60-08JT. "JT" signifies that the burial in question exists as a written description only (usually a description written by J. Tincher, hence the use of "JT"), though further work may allow some remains to be matched to field descriptions.

CONSTRUCTING EARLY AND LATE ALBEE MORTUARY COMPONENTS

Pace and Apfelstadt (1980:14) observe that the upper Wabash Lowland is a natural and cultural "shatter zone," characterized by a marked degree of northern and southern admixture. At least two of the five sites that Winters (1963) used to define the Albee complex were mixed sites, with earlier Middle Woodland-Late Woodland (Allison-LaMotte) components. Both the Shaffer site and the Catlin site (12Ve4) were associated with small, conical earthen mounds similar in description to those associated with almost all of the Allison-LaMotte sites Winters investigated (Winters 1963:47,52). The Shaffer site was associated with at least two mounds, one of which reportedly contained a copper celt and mica ornaments (Black 1933:323). The Catlin site was associated with at least 13 earthen mounds, and apparently possesses a complex occupational history spanning the last 8,000 years (Pace and Coffing 1978:5). Collections from both of these sites were used by Winters (1963:69) in compiling his trait list for the Albee complex.

The complexity of some of the sites used in Winter's definition of Albee suggest that an analysis of Albee mortuary remains should begin with a consideration of the temporal dimensions of the sample. The Shaffer cemetery is appropriate for such an analysis, both because of Winters' use of material from the site and because of the availability of a portion of the remains, as well as the supporting documentation. Additionally, burial positions and artifacts at Shaffer suggest the presence of a Middle

Woodland mortuary component. Following analysis of Shaffer, an analysis of burial position and artifact associations using burials from all four cemeteries is presented.

The Shaffer Cemetery: Artifact Associations, Burial Position, Depositional History, and Fluoride Content

By examining the Shaffer cemetery in detail, it was hoped to determine if mortuary components other than Late Woodland were present in the excavated sample, and to formulate a means of identifying similar components in the excavated samples of the other three cemeteries considered here. This determination was reached through a consideration of diagnostic artifact associations, burial position, stratigraphic superposition, and relative dating using fluoride content. A summary of burial position and artifact associations for Shaffer burials is presented in Table 1.

1. *Diagnostic Artifact Associations.* Diagnostic artifacts recovered from the Shaffer cemetery and village site in both surface and subsurface settings suggest a complex history. There is evidence of occupation of the site spanning the Middle Archaic through Late Woodland periods (GBLSSF), with apparent intensive occupations in both the late Middle Woodland (Harrel 1979:24-25, 30) and early Late Woodland periods.

Four burials (12Gr109-01, 12Gr109-04, 12Gr109-18 and 12Gr109-25) were associated with artifacts diagnostic of the Late Woodland period. Burial 12Gr109-01 was associated with a ceramic vessel. Burial 12Gr109-04 was associated with a ceramic vessel and flintknapping paraphernalia. Burial 12Gr109-18 was associated with flintknapping paraphernalia and a triangular projectile point discovered amid the lithic debitage associated with the burial. Burial UI-10-93, excavated in 1993, is reported as Late Woodland in origin (Mangold et al. 1993) and was associated with a ceramic vessel and other artifacts.

There are two burials (12Gr109-08 and 12Gr109-28) associated with artifacts traditionally recognized as diagnostic of the Middle Woodland period. Burial 12Gr109-08 was associated with a two-holed slate gorget. Burial 12Gr109-08 was associated with a cut and ground deer mandible ornament and several lamellar blades. Both of these associations are somewhat weakened, however, as both burials show some degree of disturbance, and the Middle Woodland items that Black discovered with them are often found outside mortuary contexts.

There are no burials thus far excavated from the cemetery associated with diagnostic Early Woodland artifacts. It is probable, however, that the cremation deposit excavated by Black (1933:280-281) is of Early Woodland affiliation (White 1995). A Late Archaic-Early Woodland stemmed projectile point was excavated by Black from the cemetery area, though it was not associated with a burial (Black 1933:279, Find 28).

The identifiable Middle-Late Archaic mortuary component is limited to a single burial. Justice (1987:122) identified the group of "6 flint knives, or spears" (Black 1933:275) associated with Burial 12Gr109-15 as Benton cluster projectile points diagnostic of the Middle-Late Archaic period. The skeletal material consisted of "the twelfth dorsal vertebra, the five lumbar vertebra, and a portion of the right pelvic bone only" (Black 1933:275). This burial is no longer extant, and it is difficult to reckon anything about burial position save that the individual was interred upon his/her back. Black reported that an additional projectile point of the same type was found in the cemetery area, though it was not associated with a burial (Black 1933:280).

It is clear, based only on diagnostic artifact associations, that there are at least two distinct mortuary components (Late Woodland and Middle-Late Archaic) represented at the Shaffer cemetery. The distribution of diagnostic artifacts suggests that Middle Woodland burials may also be present.

2. *Burial Position*. There are several different burial positions at the Shaffer cemetery. Some burials are fully extended, some have the legs loosely flexed on the back, and some are interred on the side with the legs more tightly flexed. Carr (1994) has noted that

burial position is often influenced by ideological factors rather than social factors. In other words, burial position may reflect different cultural systems rather than intra-societal differentiation.

Based on the admittedly small sample of burials with diagnostic associations from Shaffer, there appears to be a correlation between diagnostic artifacts and burial position. The distinguishing feature of the burials associated with Late Woodland diagnostics is leg flexure. The four of these for which burial position is known are either partially or tightly flexed (Table 1, Figure 2). There are three additional burials, unassociated with currently recognized diagnostic artifacts, that exhibit partial leg flexure: 12Gr109-05, 12Gr109-21 and 12Gr109-22.

Both burials "associated" with Middle Woodland artifacts are primary inhumations placed with the arms at the sides, extended on the back. There are six additional burials lacking diagnostic artifacts that exhibit extension of the legs and arms: 12Gr109-03, 12Gr109-13, 12Gr109-17, 12Gr109-27, 12Gr109-29 and 12Gr109-35. The suggestion that Middle Woodland burials tend to be extended is not new. It has been suggested that the mounds in the Wabash Valley date to several periods (e.g., Pace and Coffing 1978), including the Middle Woodland period. Though many of the mounds have not contained burials, the burials that have been observed to date have been in an extended position. Stephens, who worked mostly in the Wabash drainage in

Illinois, collected information "from persons who have dug unsystematically in these mounds," and compiled a list of reported traits, one of which is the presence of extended burials, to the exclusion of all other burial positions (Stephens 1974:27). Black noticed this trend during his 1932 Greene County survey (Black 1933:311), and Gorby remarked on it in 1886:

> The skeleton of the Mound Builder [in Indiana] is easily distinguished from [later burials] on account of its position in the mound. . . . The skeleton is nearly always found disposed at length, with the arms carefully adjusted at the sides [Gorby 1886:305].

3. Depositional History. Burial, by definition, is intrusive. Each new grave that is created has the potential to both disturb previous burials and be disturbed by subsequent burials. The depositional history of the Shaffer cemetery offers clues to the relative ages of the burials interred there. The first problem in this case, however, is determining which burials overlap stratigraphically.

The maps provided by Black, in both his field notes and published report, plot burials in the cemetery using a burial symbol rather than real scale drawings. Because each burial is represented by a "point," the spatial relationships portrayed in his map do not accurately depict the real space relationships between burials. By reconstructing a plan view of the cemetery assuming that each point on Black's map represents a point on the skull (approximately at nasion) it is possible to build a reconstruction that closely approximates the relationship between Burials 12Gr109-03, 12Gr109-04 and 12Gr109-05 as pictured in Figure 3, the only picture taken by Black (1932, Plate 8) that shows the spatial relationship between several in situ burials.

Based upon a hypothetical grave length of 1.25 meters for a primary adult burial[1] with legs partially flexed and 1.75 meters for a primary adult burial that is extended, a more precise plan view of the cemetery can be constructed that might show areas of stratigraphic disturbance between earlier and later burials. A speculative reconstruction of the cemetery is presented in Figure 4.

There are two areas in the cemetery in which there appears to be a vertical overlap between burials of known position. Burials 12Gr109-03 and 12Gr109-04 overlap with one another, as do 12Gr109-27 and 12Gr109-25. It is clear that Burial 12Gr109-04

1This figure is taken from Cochran *et al.* (1988:17), and represents the longest measured dimensions of a burial feature associated with a burial with legs partially flexed at the Hesher cemetery (Burial 10).

was interred subsequent to 12Gr109-03 (Black 1933:272). Black (1933:272) describes Burial 12Gr109-03 as "extended," even though all the bones below the lumbar vertebrae were removed during the interment of 12Gr109-04, a burial with legs loosely flexed.

Burial 12Gr109-27, an extended burial, is deeper than 12Gr109-25, a loosely flexed burial. Given that the portion of 12Gr109-25 presumably nearest to 12Gr109-27 (the lower skeleton) was undisturbed, it seems likely that this burial was interred subsequent to 12Gr109-27.

4. *Fluoride Content Analysis.* Portions of seven burials from the Shaffer site were subjected to fluoride content analysis with the assistance of Dr. Mark Schurr at the University of Notre Dame. Fluoride content analysis is a relative dating technique that measures the fluoride content of buried bone, which increases through time by the absorption of fluoride from groundwater (Schurr 1989). The method used here is basically the same as that outlined by Schurr (1989).

Rib fragments were selected from all seven available adult burials (12Gr109-3, 4, 8, 17, 27, 28, xx' and UI-10-93). Only adult burials were included. Several of the burials excavated by Black had been coated with a preservative. In order to remove this preservative, the rib fragments to be tested were soaked in acetone for 24 hours or more. The acetone was changed at least once per specimen. The bone was then ultrasonically cleaned twice in de-ionized water to remove adhering soil. In order to minimize differences in fluoride content due to variable bone density, rib fragments were split and the trabecular bone removed with a scalpel. The bone fragments were then dried for 24 hours at 70 degrees centigrade and ground into a homogeneous powder using an agate mortar and pestle. A precision scale was used to measure out samples of bone weighing approximately 0.00050 grams. Bone samples were dissolved in 50 microliters of perchloric acid (0.5 molar), and mixed with 100 microliters of deionized water and 100 microliters of Tisab II buffer. Fluoride content was measured with an ion selective electrode. Measured levels of fluoride content are given in Table 2.

The relationship of 12Gr109-03 and 12Gr109-04 is critical to determining the applicability of fluoride content analysis to burials from the Shaffer cemetery. From the archaeological context, it is apparent that 12Gr109-03 is older than 12Gr109-04, and the higher fluoride content of 12Gr109-03 confirms this relationship. Measured fluoride content, calculated to a 2 sigma range, is presented in Figure 5.

The results of the remainder of the analysis confirm the expectation that all the extended burials are probably older than Burial 12Gr109-04. Unfortunately, it was impossible to perform fluoride content analysis on the other partially flexed adult burial from Black's excavation (12Gr109-21), as its whereabouts are unknown. The high relative fluoride content of UI-10-93, rather than being indicative of greater antiquity, is probably due to differences in soil type or groundwater characteristics between the location of UI-10-93 and the location of Black's excavation. The spatial relationship of UI-10-93 to the burials from Black's excavation is unknown, as the exact location of Black's excavation is unknown (Mangold et al. 1993).

In summary, the portions of Shaffer cemetery excavated by Black contain at least three culturally and temporally distinct mortuary components. Extended burials seem to be earlier than the partially flexed burials, and were probably interred during to the Middle Woodland occupation of the site. It is suggested that fully extended burial posture be regarded as a possible marker of Middle Woodland mortuary behavior in the middle Wabash Valley. Given the small size and poor archaeological control of the sample used here, however, this suggestion is a cautious one. The possibility of Middle Woodland burials being mixed in with Late Woodland burials in the sample has been sufficiently demonstrated to warrant the removal of extended burials (12Gr109-03, 12Gr109-08, 12Gr109-27, 12Gr109-28, 12Gr109-29, 12Gr109-35A and 12Gr109-13A) from the mortuary and skeletal analyses conducted here.

Winters included three types of artifacts presumably from Black's 1932 Shaffer cemetery excavation in his Albee trait list: lamellar blades, rectanguloid slate gorgets and cut deer mandibles, all excavated from a mortuary context (Winters 1963:69; see Black 1933:274, 278-79). Winters apparently felt that the mortuary component from Shaffer was related solely to the Late Woodland occupation of the site. Tomak also believed that the burials at Shaffer were contemporary, and hypothesized that the presence of "lamellar blades and rectangular gorgets . . . [may] reflect indigenous influences on a newly arrived northern group" (Tomak 1970:166). Tomak felt that the presence of turtle carapace artifacts in association with both Late Woodland and Middle Woodland artifacts effectively blended the two cultural periods together (Tomak 1970:166). Both modified and unmodified turtle shells, however, have been documented as mortuary and non-mortuary inclusions in various cultural contexts, including Allison-Lamotte (Clouse et al. 1970:82-83). Because the burials associated with these artifacts have been shown to probably predate the Albee component of the site, it is suggested that these items be removed from the Albee "trait list" until they can be more convincingly associated with Albee.

The single Archaic burial (12Gr109-15) was too deteriorated at the time of excavation to allow inferences about burial position, save that the individual was interred on his/her back.

Early and Late Albee Mortuary Components

Though bioarchaeological studies are becoming increasingly common, they infrequently attempt to directly address the potential of change through time and often treat skeletal populations as though they represent "snapshots" of real populations (e.g., Custer et al. 1990:166). The mortuary analysis presented here is focused on the variability of burial positions at the Albee Mound, Shaffer, Bucci and Shepherd cemeteries, and how it relates to change through time. Carr (1994) found that body position, orientation and the arrangement of artifacts in the grave were more often influenced by ideological factors rather than social factors. Hodder (1982) has advanced similar ideas. In this way, burial position can potentially serve as a temporal marker between groups.

As an ideological indicator, burial position is appropriate because of its simplicity. It is overt, intentional, and often collective. For the sample under consideration here, the first focus will be on delimiting the important variables of burial position and assigning as many burials as possible to a burial typology. Then, there will be an assessment of the temporal significance of the observed burial position variability using artifact associations.

1. *Burial Position*. Even with the exclusion of extended burials, there is still a fair amount of

variability evident in the treatment of the dead at the Albee Mound, Shaffer, Bucci and Shepherd cemeteries. Terms such as "flexed" and "loosely flexed," though commonly used, are somewhat vague and potentially obscure more information than they reveal. To avoid the pitfalls of an over-generalized typology, each burial was first considered as a combination of specific attributes: torso position (interred on the side or back), right arm position (flexed or extended), left arm position, inter-arm relationship (both arms extended, right flexed and left extended, etc.), and degree of leg flexure (loose, tight, or indeterminate). See Figure 6 below.

One advantage to using this approach was that available data from partial or disturbed burials could be included in the analysis. In many cases, it is unclear what is meant by the terms "flexed" or "partially flexed." In the case of the Shepherd and Bucci cemeteries, burial position attributes often had to be determined from sketch maps drawn by the investigator and/or his crew. By coding individual attributes, for example, leg position could be coded simply as "flexed" with no further determination of the degree of flexure. Burial position attributes for burials from the Bucci cemetery were coded only when plainly apparent on the project maps. Likewise, burial position attributes for burials from the Shepherd, Shaffer, and Albee Mound cemeteries were coded from photographs or drawings of in situ burials or from precisely worded descriptions.

To search for non-random distributions among attributes that would be expected given the presence of consistent burial position regimens, the Chi-square test (Table 3) was used. Five attribute distributions were non-random at $p=0.05$ level: torso position/degree of leg flexure, torso position/right arm position, degree of leg flexure/left arm position, torso position/inter-arm relationship, and torso position/left arm position. It is currently fashionable to compensate for the redundancy of performing many tests on the same sample by dividing the critical alpha (in this case, 0.05) by the number of tests performed. For 8 tests, the "corrected" alpha level would be 0.0063. At this level, torso position/degree of leg flexure and torso position/right arm position remain significant.

The five combinations of attributes that show a high probability of non-random distribution suggest that there are two clusters of burial attributes. There is a very strong tendency for burials interred on the side to have the legs tightly flexed and both arms flexed, usually toward the face. Conversely, burials interred on the back tend to have the legs loosely flexed. Arm position varies among burials interred on the back, including individuals with one or both arms flexed or extended. Further, the presence of a correlation between both torso position and degree of leg flexure and arm positioning confirms that the peculiar positioning of burials interred on the back with legs partially flexed to the side is not merely a result of post-burial effects such as earth pressure, but rather deliberate placement.

There is no one defining attribute that segregates the population of the Albee Mound, Shaffer, Bucci and Shepherd cemeteries into groups with complete reliability. It is possible, however, to construct groups based on the observation of combinations of attributes. These criteria cannot be used in every case, and are not useful for unusual burials, such as 12Su1-31A, 12Su1-31B and 12Su1-41 (see MacLean 1931). For the purposes of this study, burials interred on the back with the legs partially flexed will hereafter be referred to as partially flexed (as in Figure 2). Burials interred on the side with legs tightly flexed will hereafter be referred to as tightly flexed (as in Figure 2). These burial positions form the basis for the formation of two groups, hereafter referred to as Groups 1 and 2. Group 1 is generally composed of burials interred on the back with legs partially flexed. Group 2 is generally composed of burials interred on the side with the legs tightly flexed and arms flexed to the face.

Using these criteria, 15 burials can be assigned to Group 1 (Table 4). Sex estimation was possible for only seven of these individuals (four males and three females). Four juveniles are also included in this group. Burial 12Su1-35 had the legs tightly flexed, but was apparently interred on the back and is thus included in Group 1. Twenty-three burials can be assigned to Group 2 (Table 5). Sex estimation was possible for 15 of these individuals (seven males and eight females). Four juveniles are also included in this group.

2. *Diagnostic Artifact Associations.* Approximately 78 percent of the burials from the four cemeteries under consideration here were not associated with artifacts of any kind. Most of those that were associated with artifacts were not associated with diagnostic artifacts. There are, however, some diagnostic associations that help to place the two groups relative to one another. Associations of ceramic artifacts will be discussed first, and then associations of lithic artifacts.

Excavations have recovered a total of nine complete or partial ceramic vessels associated with burials from the Albee Mound, Shaffer, Bucci and Shepherd cemeteries. Four of these vessels are from Shaffer, two from Bucci and three from the Albee Mound. There were no ceramic vessels associated with burials from the Shepherd cemetery, though Tomak reported the discovery of a few sherds and an unassociated vessel (Tomak 1970:155-156). The cultural affinity of these vessels has never been questioned, as they are all recognized as belonging to a generalized early Late Woodland ceramic tradition. Winters' original type description of Albee Cordmarked identified the "folded, wedge-shaped or cambered rim" (Winters 1967:88) as a distinctive feature.

Subsequent investigation has widened the range of features considered characteristic of Albee ceramics (Anslinger 1990:47-49). Based upon an excavated sample of 2000 sherds from the Morell-Sheets site (12My87) in Montgomery County, Indiana, McCord and Cochran (1994:59-68) have proposed a preliminary ordering for several decorative and vessel form features of Albee pottery. They suggest (1994:68) that uncollared rims are the earliest forms and collared, crosshatched rims are the latest. Characteristics of ceramic vessels associated with burials from the Albee Mound, Shaffer and Bucci cemeteries are summarized in Table 6. Three of the four vessels associated with Group 1 burials have uncollared rims. The fourth has a wedge-shaped rim. The single vessel associated with a Group 2 burial appears to have a collared or wedge-shaped rim. This suggests that the Group 1 vessels are relatively early.

In addition to ceramic artifacts, the excavated mortuary sample includes a total of 25 hafted bifaces associated with 11 burials (Table 7). There are hafted biface associations from each of the cemeteries except Bucci. The hafted bifaces associated with burials from the Albee Mound, Shaffer and Shepherd cemeteries fall within three "clusters," as proposed by Justice (1987): the Unnotched Pentagonal (Justice 1987:215-217), Jack's Reef (Justice 1987:217-220) and Late Woodland/Mississippian Triangular (Justice 1987:224-230) clusters.

As shown in Table 7, projectile points associated with Group 1 burials belong to the Jack's Reef cluster. Seeman (1992) suggests a date range of A.D. 700-900 for Jack's Reef cluster points in the Middle Ohio Valley. Projectile points associated with Group 2 burials are triangular, in some cases serrated. Though it is difficult to precisely estimate the age of the triangular projectile points from the Shepherd burial (e.g., Seeman and Munson 1980:61; Railey 1992), they are generally isosceles in shape (Neumann n.d.), and probably are later than the equilateral triangles which tend to predominate in early triangular assemblages (e.g., Geier 1983; Stothers and Pratt 1981).

In sum, artifact associations suggest that a substantial degree of time-depth is embodied in the excavated sample of burials from the Albee Mound, Shaffer, Bucci and Shepherd cemeteries. Simply put, the delineation of two relatively consistent burial regimens and the recognition of temporally sensitive artifact associations within the sample make it possible to treat Groups 1 and 2 as "early" and "late" mortuary samples, respectively. Group 1 is composed of burials generally interred on the back with legs partially flexed. Two of the burials from the Albee Mound cemetery associated with Jack's Reef cluster projectile points (12Su1-14 and 12Su1-32), as well as the three burials from the Shaffer cemetery associated with uncollared ceramic vessels (12Gr109-01, 12Gr109-04 and 12Gr109-25), were interred on the back with the legs partially flexed (see MacLean 1927, 1931; Black 1933). The arm positioning of these burials varies, often with one arm extended and one arm flexed. The positions of three additional burials from the Albee Mound cemetery associated with Jack's Reef cluster projectile points (12Su1-11 and 12Su1-12) and an uncollared ceramic vessel (12Su1-33) are unknown (see MacLean 1931).

Group 2 is composed of burials generally interred on the side with the legs tightly flexed and arms drawn to the face. Only 22 percent of burials interred in this fashion were associated with artifacts of any kind, as compared to 64 percent of the Group 1 burials. The only burial in the sample for which there is both a certain temporal association and burial position is Burial 12Gr60-37 from the Shepherd cemetery, which was "tightly flexed" and associated with eight serrated and non-serrated triangular projectile points (Neumann n.d.). There is little burial position data available from the three additional burials from the Shepherd cemetery (12Gr60-02JT, 12Gr60-06JT and 12Gr60-15) associated with serrated triangular projectile points. Burial 12Gr60-15 is described by Neumann as "partly flexed" and in "fragmentary condition" (Neumann n.d.). As described above, Neumann's use of "fully flexed" and "partly flexed" is somewhat inconsistent. It is consequently difficult to precisely interpret his written notes. Both 12Gr60-02JT and 12Gr60-06JT are described by Neumann, through secondhand accounts, as "disturbed," and no further speculation is offered concerning burial position (Neumann n.d.).

CARIES ANALYSIS

Dental analysis of Groups 1 and 2 was concentrated on comparing differences in the frequency of interproximal and occlusal caries. Differences in caries frequency have been shown to be correlated with differences in subsistence practices (e.g., Turner 1979; Cook and Buikstra 1979; Larsen 1982; Milner 1984). Almost universally, hunter-gatherer groups have shown lower frequencies of caries than agriculturalist groups (Larsen 1987:378). The increase in caries frequency observed in conjunction with the shift to agriculture has been attributed to both malnutrition affecting tooth development and a high level of carbohydrates in the diet (Ortner and Putschar 1985:439).

The presence of interproximal and occlusal caries was recorded for the dentition of each individual in the sample when possible. Occlusal and interproximal caries are defined here as by Ortner and Putschar (1985:439-441). Note that the interproximal caries category used here includes caries on both the crown and root. Caries severity was recorded using Koritzer's (1977) levels. Larsen (1982:208) reported that the molars of both agricultural and non-agricultural groups had a significantly higher frequency of caries than non-molars. Given the small sample size available in the present study, it was thus deemed most appropriate to compare frequencies of carious molars.

Frequencies of molar interproximal and occlusal caries exhibited in the teeth of individuals from each group are presented in Figure 7 and Table 8. Frequencies of molar caries by group are presented in Table 9. Interproximal caries were completely absent from the 50 molars available from Group 1 burials. The frequency of molar occlusal caries is also lower in Group 1 burials. Note that the carious tooth ratios are slightly different when caries type is not differentiated, as carious molars frequently manifest both occlusal and interproximal caries. Because caries is a progressive disease process, it is necessary to consider the age of individuals in the sample. Given the poor accuracy of the age estimation methods utilized here, the two groups may be considered at least roughly comparable.

Epidemiologically speaking, it is possible to analyze the lifetime prevalence of molar caries using either individual burials or teeth as the population at risk. For clarity and comparison, both methods are presented here. The lifetime prevalences given here are calculated by combining all the molars in each group. Though somewhat untidy, this will afford a suitable approximation without attempting to correct for the difference in age between teeth from the same individual and between different individuals. The lifetime prevalence of interproximal caries in Group

1 molars is 0 percent (0/50). The lifetime prevalence of occlusal caries in Group 1 molars is 8 percent (4/50). The lifetime prevalence of interproximal caries in Group 2 molars is 19 percent (11/57). The lifetime prevalence of occlusal caries in Group 2 molars is 21 percent (12/57).

The odds ratio can be calculated to express the difference in lifetime prevalences of occlusal caries in Group 1 and Group 2 (Waldron 1994:63). The odds ratio is calculated as the ratio between (Group 1 prevalence/1 - Group 1 prevalence) and (Group 2 prevalence/1 - Group 2 prevalence). The odds ratio of occlusal caries between Groups 1 and 2 is 0.33 (0.08/0.92 / 0.21/0.79).

If we consider Group 1 to be a control group, it is possible to calculate the relative risk of a molar becoming carious in Group 2. Relative risk is a quotient comparing the occurrence of an event (caries, in this case) in the presence of a factor (membership in Group 2) and the occurrence of an event in the absence of that factor (membership in Group 1) (Austin and Werner 1982:63). Relative risk is calculated by dividing the percentage of teeth with caries in Group 2 by the percentage of teeth with caries in Group 1. The relative risk of occlusal caries in Group 2 molars is 2.63 (21 percent/8 percent). In other words, Group 2 molars are more than two and a half times as likely to have occlusal caries. The relative risk of interproximal caries in Group 2 molars is not calcuable, given that there were no interproximal caries observed in Group 1.

The frequency of caries changes slightly if caries type is not differentiated (Table 10). Molars from Group 2 individuals exhibit a lifetime molar caries prevalence of 33.3 percent when caries type is not differentiated. The 8.0 percent lifetime prevalence of caries in Group 1 molars does not change because there is only one type of caries (occlusal) present among the observed Group 1 molars. It is also instructive to observe undifferentiated caries frequency among all teeth from Group 1 and 2 individuals. The lifetime prevalence of undifferentiated caries among Group 1 teeth is 4.4 percent. The lifetime prevalence of undifferentiated caries among Group 2 teeth is 25.2 percent.[2]

2Given the fragmentary nature of the remains, it was often difficult to identify tooth fragments and accurately assess the presence or absence of caries from individuals from the Bucci cemetery. Consequently, it is possible that a bias towards the identification of evaluation of molars was introduced during the examination of these individuals, who make up a large portion of Group 2. As noted by Larsen (1982:208) and as visible in Table V.III, molars have a higher frequency of caries than other teeth. As also seen in Table 10, however, molars represent 44.2 % of the teeth from Group 1 and 49.6 % of the teeth from Group 2. It is not felt that the slightly higher proportion of molars in Group 2 teeth is responsible for the drastically higher frequency of caries in general.

Interpreting caries data from small samples using either the teeth as a population or individuals as a population is problematic. A disproportionate amount of teeth may be contributed by relatively few individuals who are not representative of the population on the whole. Likewise, carious teeth may experience greater loss before or after death which may affect recovery rates and subsequently cause errors in assessing the presence or absence of caries in a particular individual. For these reasons, the caries data presented above are also presented as caries lifetime prevalences among individuals (Table 11).

When comparing rates of lifetime prevalence among individuals, the small sample size becomes an even more apparent hindrance. Two individuals from the Group 1 population included in this analysis had dental caries. Given that the molar sample was drawn from only five individuals, however, the two individuals with dental caries make up 40% of the individuals in the Group 1 sample. These two individuals (Burials 12Su1-21 and 12Su1-35) contributed 22 molars to the sample, or 44% of the molars from Group 1.

There were four individuals with interproximal caries and five individuals with occlusal caries included in the Group 2 sample. Altogether, seven individuals from the Group 2 population included in this analysis had dental caries. These seven individuals make up 70% of the individuals in the Group 2 sample, and contributed 46 molars to the sample, or 81% of the molars from Group 2.

Using either teeth or individuals as the sample, similar results are obtained, with Group 2 individuals displaying higher lifetime prevalences of both types of caries. The relative risks, however, are slightly lower. The relative risk, calculated as discussed above, for combined caries is 1.75. The relative risk for occlusal caries is 1.50. The relative risk for interproximal caries is uncalcuable. The odds ratio for occlusal caries in Group 2 is 0.44 (0.4/0.6 / 0.6/0.4). It is clear that individuals from Group 2 display a greater prevalence of both occlusal and interproximal dental caries. The high prevalence of interproximal caries in Group 2 is particularly striking, as there are no individuals with interproximal caries in Group 1.

The data collected on caries is consistent with the expectations raised by the archaeological data. The difference in caries frequency between the two groups compares very favorably with differences in caries frequency observed in agricultural and non-agricultural populations from eastern North America as presented by Milner (1984) and Larsen et al. (1991). Milner (1984) reported that populations with hunting/gathering subsistence practices had 0.4 - 7.8 percent carious teeth. Conversely, Late Woodland and Mississippian populations had 4.5 - 43.4 percent carious teeth (Milner 1984). Group 1 had 4.4 percent carious teeth, while Group 2 had 25.2 percent carious teeth. Though there may be discrepancies in the way caries are counted and defined among various studies, the pattern is still very clear (Larsen et al. 1991:186), and the groups examined here fit this pattern.

DISCUSSION

It is clear that the two segments of the mortuary population from the four sites examined here are somewhat different, both in terms of their temporal placement and at least one facet of their skeletal biology (caries prevalence). It seems that burial position and artifact associations vary along a continuum, with loosely flexed, artifact-rich burials at one end and tightly flexed artifact-poor burials at the other. The groups considered here to be representative of either end of this continuum offer the opportunity to look at shorter time frames within the Albee "tradition", and better grasp the changes that are taking place.

Dental analysis and artifacts associated with Group 1 burials suggest an affiliation with the earliest "Albee." The earliness of Group 1 is supported, also, by excavations at the Morell-Sheets and Hesher sites. A gradual increase in the use of maize by Albee peoples is evident at the Morell-Sheets site (Bush 1994, 1998), which dartes from approximately A.D. 800-1200 (McCord and Cochran 1994). Collared sherds dominate the ceramic assemblage from the site, accounting for 93% of the rim sherds collected

(McCord and Cochran 1994:44). Jack's Reef cluster projectile points were absent from Morell-Sheets, and the triangular projectile points from the site fit variously into the Levanna, Madison, and Hamilton Incurvate varieties as defined by Justice (1987) (McCord and Cochran 1994). The data from Morell-Sheets suggest that most of the Group 1 burials from the four cemeteries considered here probably predate the heaviest use of the Morell-Sheets site. The uncollared vessels from Shaffer and Albee Mound are perhaps roughly analogous to the uncollared Wayne Cordmarked vessels described by Fitting (1965:158-159), which were associated with Jack's Reef cluster projectile points at the Fort Wayne Mound in southeastern Michigan (Halsey 1968). Though the vessel forms used in funerary ritual are not necessarily the same as those used in everyday activities, it seems unlikely that collared rims, if in heavy use, would be under-represented to such a great degree.

Based upon the uncollared vessels and Jack's Reef projectile points associated with Group 1 burials, and the lack of interproximal caries, it is proposed that Group 1 is composed in part of individuals from the Jack's Reef horizon (Seeman 1992), and is comparable to Intrusive Mound in Ohio (Seeman 1992), Kipp Island Phase in New York (Ritchie 1969), Riviere au Vase Phase in southeastern Michigan (Bechtel and Stothers 1993; Fitting 1965), and other similar manifestations in Ontario and along the east coast.

CONCLUSION

Winters (1967:68) considered the appearance of Albee material in the Wabash Valley a notable discontinuity in the local Woodland sequence. The data presented here suggests that "Albee" as Winters conceived it, may encompass a rather rapidly changing tradition. The presence of two projectile point types that are apparently temporally discrete, as well as the dietary differences suggested by dental analysis, are difficult to reconcile with a single Albee "phase." As noted by McCord and Cochran (1994:63), the vessels associated with 12Gr109-01 and 12Gr109-04 do not conform to Winters' original type description of Albee Cordmarked, in that they are uncollared. In fact, a majority of the vessels recovered from the Albee Mound cemetery itself do not fit Winters' (1963) type description (McCord and Cochran 1994:63).

Albee is situated at the crossroads of relatively rapid changes in technology and subsistence, witnessing both the introduction of the bow and arrow and the intensification of maize agriculture. Coupled with an archaeological signature that is at once both ephemeral and enigmatic, interpretation of how these changes are manifest in the archaeological record has been rather slow to develop. It seems there is much to be gained by looking at Albee in a broader temporal and geographical context, and attempting to integrate mortuary and non-mortuary data. Future work will examine the skeletal biology of these groups in more detail, and begin to put these findings into the larger context of both Albee archaeology and the broader patterns of contemporary Late Woodland change that are evident across the upper midwest and the Great Lakes.

Table 1. Burial position, diagnostic associations, age and sex at Shaffer cemetery. From Mangold et al. (1993). All other position and orientation information is from Black (1933).

Burial No.	Leg Pos.	Rt. Arm	Lft. Arm	Diag	Sex	Age	Orientation
12Gr109-08	extended	extended	extended	MW	F?	17-18 Yr	E
12Gr109-28	extended	extended	extended	MW	M	50+ Yr	E
12Gr109-03	?	extended	extended	-	M	Adult	E
12Gr109-13	extended	?	?	-	?	?	NW
12Gr109-17	extended	extended	extended	-	F	18-21 Yr	E
12Gr109-27	extended	extended	extended	-	F	22-30 Yr	NW
12Gr109-29	extended	extended	extended	-	?	?	NW
12Gr109-35	extended	extended	?	-	?	?	W
12Gr109-01	flexed	?	?	LW	?	?	NE

Table 1. Continued.

Burial No.	Leg Pos.	Rt. Arm	Lft. Arm	Diag	Sex	Age	Orientation
12Gr109-04	flexed	extended	flexed	LW	M	18-23 Yr	S
12Gr109-25	flexed	extended	flexed	LW	?	6-9 Mo	E
UI-10-93*	flexed	flexed	flexed	LW	F	20-25 Yr	E
12Gr109-18	?	?	?	LW	?	?	?
12Gr109-21	flexed	extended	flexed	-	?	?	N
12Gr109-22	flexed	?	?	-	?	?	N
12Gr109-05	flexed	?	?	-	?	1-2 Yr	SW
12Gr109-15	?	?	?	LA/MA	?	?	?

Table 2. Measured fluoride content of adult burials from the Shaffer cemetery.

Burial No.	Sample (mg)	F- (ppm)	% F-	S	Depth	Burial Position
12Gr109-17	0.65	12.9	1.98	0.12	60"	Extended
	0.54	11.6	2.15			
	0.54	11.9	2.20			
UI-10-93	0.62	08.3	1.34	0.04	?	Flexed
	0.56	07.8	1.39			
	0.50	07.1	1.41			
12Gr109-03	0.51	05.7	1.12	0.05	24"	Extended?
	0.58	05.7	0.98			
	0.57	05.2	0.91			
12Gr109-08	0.45	04.1	0.92	0.02	54"	Extended

Table 2. Continued.

Burial No.	Sample (mg)	F- (ppm)	% F-	S	Depth	Burial Position.
	0.51	04.8	0.95			
12Gr109-27	0.54	04.1	0.76	0.14	48"	Extended
	0.50	03.9	0.78			
	0.60	05.4	0.90			
	0.42	03.9	0.93			
	0.65	07.3	1.12			
12Gr109-28	0.66	04.8	0.72	0.02	37"	Extended
	0.66	05.0	0.76			
	0.52	04.1	0.78			
12Gr109-xx'	0.64	04.8	0.75	-	?	?

Table 2. Continued.

Burial No.	Sample (mg)	F- (ppm)	% F-	S	Depth	Burial Position
12Gr109-04	0.46	02.7	0.59	0.05	30"	Partially Flexed
	0.47	02.9	0.61			
	0.43	02.9	0.68			

113

Table 3. Significant Chi-square results ($p<0.05$), distribution of burial position attributes.

Variables	n	Chi-square	df	p
Torso position/degree of leg flexure	37	10.85	1	<0.001
Torso position/right arm position	31	7.94	1	<0.005
Torso position/left arm position	29	4.29	1	<0.05
Torso position/inter-arm relationship	22	7.28	2	<0.05
Degree of leg flexure/left arm position	35	5.6	1	<0.025

114

Table 4. Burials assigned to Group 1.

Burial	Sex	Age	Orient.	Deg. Leg Flexure	Direc. Leg Flexure	Rt. Arm Position	Lft. Arm Position
12Su1-14	M	A	-	Loose	Left	Flxd/abdomen	Extnd/side
12Su1-30	M	A	?	Loose	Right	Extnd/side	Flxd/abdomen
12Gr109-04	M	A	N-S	Loose	Right	Flxd/abdomen	Extnd/side
12Gr388-16	M	A	N-S	Loose	Right	Flxd/abdomen	?
12Su1-21	F	A	?	Loose	Left	Flxd/abdomen	Flxd/face
12Su1-35	F	A	?	Tight	Left	Extnd/abdomen	Flxd/knee
12Gr388-18	F	YA	NE-SW	Loose	Left	Flxd/face	?
12Gr109-01	J	I/C	NE-SW	Loose	Right	Flxd/abdomen	Flxd/abdomen
12Su1-32	J	C	?	Loose	Left	?	Flxd/abdomen

115

Table 4. Continued.

Burial	Sex	Age	Orient.	Deg. Leg Flexure	Direc. Leg Flexure	Rt. Arm Position	Lft. Arm Position
12Gr109-25	J	I	E-W	Loose	Right	Extnd/side	Extnd/side
12Gr109-22	J	I/C	N-S	Loose	?	?	?
12Su1-01	?	YA/A	?	Loose	Left	Flxd/chest?	?
12Gr109-21	?	YA/A	N-S	Loose	Right	Extnd/side	Flxd/face
12Gr388-11	?	A	E-W	Tight	Left	Flxd/abdomen	?
12Gr388-17	?	C	SE-NW	Loose	Left	Flxd/face	Flxd/abdomen

Table 5. Burials assigned to Group 2.

Burial	Sex	Age	Orient.	Side	Deg. Leg Flexure	Direc. Leg Flexure	Rt. Arm Position	Lft. Arm Position
12Gr388-01	M?	A	N-S	Left	?	?	Flxd/face	?
12Gr388-02	M	A	E-W	Right	?	Chest	Flxd/face	Flxd/face
12Gr388-13	M	A	E-W	Left	Tight	Chest	Flxd/face	Flxd/face
12Gr388-39	M	A	NE-SW	Left	Tight	Chest	?	?
12Gr388-24	M	?	E-W	Right	Tight	Chest	?	?
12Gr388-43	M	A	E-W	Left	Tight	Chest	Flxd/face	?
12Gr60-37	M	A	SE-NW	?	Tight	?	?	?
12Gr60-39	F	A	N-S	Right	Tight	Chest	Flxd/face	Flxd/face
12Gr388-25	F	A	SE-NW	Left	Tight/loose	Chest	Flxd/face	?
12Su1-19	F	A	?	?	?	?	Flxd/face	Flxd/face
12Gr60-40	F	A	SE-NW	Left	Tight	Chest	Flxd/face	Flxd/face
12Gr388-10	F	YA/A	N-S	Right	Tight	Chest	?	Flxd/face

Table 5. Continued.

Burial	Sex	Age	Orient.	Side	Deg. Leg Flexure	Direc. Leg Flexure	Rt. Arm Position	Lft. Arm Position
12Gr60-26	F	A	SE-NW	Right	Tight	Chest	?	Flxd/face
12Gr388-32	F	A	N-S	Right	Tight	Chest	?	Flxd/face
12Gr388-34	F	A	E-W	Right	Tight	Chest	?	Flxd/face
12Su1-41A	?	C	?	Left	Tight/loose	Chest	?	?
12Su1-41B	?	C	?	Right	Tight	Chest	?	Flxd/face
12Su1-36	?	I	?	Left	Tight	Chest	Flxd/face	?
12Gr60-10	?	C/YA	N-S	Left	Tight	Chest	Flxd/face	Flxd/face
12Gr388-36	?	A	NE-SW	Left	Tight	Chest	Flxd/face	Flxd/face
12Gr60-20	?	YA	NE-SW	Left	Tight/loose	Chest	Flxd/face	?
12Gr388-42	?	A	E-W	Right	Tight	Chest	?	Flxd/face
12Gr388-33	?	A	E-W	Right	Tight	Chest	?	Flxd/face

Table 6. Ceramic vessel burial associations from Shaffer, Albee Mound and Bucci cemeteries.

Burial	Group	Vssl Loc.	Rim	Decoration	Finish	Reference
12Su1-33	-	?	Uncollared	Tl-imp rim	Cordmarked	MacLean 1931
12Su1-35	1	Rt. Shldr	Wedge	Tl-imp rim	Plain	MacLean 1931
12Gr109-01	1	Rt. Shldr	Uncollared	None	Cordmarked	Black 1933
12Gr109-04	1	Knee	Uncollared	Tl-imp neck	Cordmarked	Black 1933
12Gr109-25	1	Rt. Shldr	Uncollared	None	Cordmarked	Black 1933
UI-10-93	-	Rt. Shldr	Uncollared	Punctate	Cordmarked	Mangold 1993
12Gr388-05	-	Shldr	Uncollared?	Tl-imp rim	Cordmarked	Tomak 1970
12Gr388-31	-	Legs?	?	?	Cordmarked	Tomak 1970
12Su1-36	2	Rt. Shldr	Collared?	Incised neck	Plain	MacLean 1931

Table 7. Lithic projectile point associations from Albee Mound, Shaffer and Shepherd cemeteries.

Burial	Position	Group	Point Loc.	Type	Number	Reference
12Su1-14	PF	1	Lft Shldr	Jack's Reef	7	MacLean 1927
12Su1-32	PF	1	Skull	Jack's Reef	1	MacLean 1931
12Su1-01	PF	1	Rt. Shldr	?	1	MacLean 1927
12Su1-11	?	-	?	Jack's Reef	1	MacLean 1927
12Su1-12	?	-	?	Jack's Reef	1	MacLean 1927
12Gr109-18	?	-	?	Triangle	1	Black 1933
12Gr60-02JT	?	-	?	Serrated Triangle	1	Tomak 1970
12Gr60-06JT	?	-	?	Serrated Triangle	1	Tomak 1970
12Gr60-10	TF	2	?	?	1	Neumann n.d.
12Gr60-15	"PF"	-	?	Serrated Triangle,Triangle	2	Neumann n.d.
12Gr60-37	TF	2	?	Serrated Triangle,Triangle	8	Neumann n.d.

Table 8. Summary of interproximal and occlusal caries present in individuals from Groups 1 and 2.

Burial	Group	No. Teeth M1	M2	M3	No. Interprox Caries M1	M2	M3	No. Occlusal Caries M1	M2	M3	Age	Sex
12Su1-14	1	4	4	4	0	0	0	0	0	0	45-50 Yr	M
12Su1-21	1	2	4	4	0	0	0	2	0	0	40-50 Yr	F
12Su1-35	1	4	4	4	0	0	0	0	0	2	39-44 Yr	F
12Gr109-04	1	3	3	3	0	0	0	0	0	0	18-25 Yr	M
12Gr388-16	1	3	3	1	0	0	0	0	0	0	Adult	M
Subtotal	**1**	**16**	**18**	**16**	**0**	**0**	**0**	**2**	**0**	**2**	-	-
12Su1-19	2	0	0	1	0	0	0	0	0	0	25-35 Yr	F
12Gr388-01	2	0	2	1	0	0	0	0	0	0	18-25+ Yr	M?
12Gr388-02	2	4	4	4	0	0	0	2	2	0	23-35 Yr	M
12Gr388-32	2	2	4	4	0	2	2	0	2	0	Adult	F
12Gr388-33	2	2	2	2	0	0	0	0	0	0	29-35 Yr	M

Table 8. Continued.

Burial	Group	No. Teeth M1	M2	M3	No. Interprox Caries M1	M2	M3	No. Occlusal Caries M1	M2	M3	Age	Sex
12Gr388-34	2	2	1	2	0	0	0	1	1	0	Adult	F
12Gr388-42	2	2	2	2	0	0	0	1	0	0	Adult	?
12Gr60-26	2	1	2	2	0	2	2	1	0	1	30-35 Yr	F
12Gr60-39	2	1	0	0	1	0	0	1	0	0	Adult	F
12Gr60-37	2	4	2	2	1	1	0	0	0	0	50+ Yr	M
Subtotal	**2**	**18**	**19**	**20**	**2**	**5**	**4**	**6**	**5**	**1**	-	-
Total	**1 & 2**	**34**	**37**	**36**	**2**	**5**	**4**	**8**	**5**	**3**	-	-

Table 9. Lifetime prevalence of interproximal and occlusal caries among molars of Groups 1 and 2.

Tooth	Group	% with Interproximal Caries	% with Occlusal Caries
M1 (n=16)	1	0.0 %	12.5 %
M2 (n=18)	1	0.0 %	0.0 %
M3 (n=16)	1	0.0 %	12.5 %
M1 (n=18)	2	11.1 %	33.3 %
M2 (n=19)	2	26.3 %	26.3 %
M3 (n=20)	2	20.0 %	5.0 %

Table 10. Occurrence of undifferentiated caries in molars and all teeth of individuals from Groups 1 and 2.

Burial	Comp.	No. Molars	No. Carious	% Carious	No. Teeth	No. Carious	% Carious
12Su1-14	1	12	0	0.0 %	28	0	0.0 %
12Su1-21	1	10	2	20.0 %	17	3	17.6 %
12Su1-35	1	12	2	16.7 %	28	2	7.1 %
12Gr109-04	1	9	0	0.0 %	26	0	0.0 %
12Gr388-16	1	7	0	0.0 %	14	0	0.0 %
Total	**1**	**50**	**4**	**8.0 %**	**113**	**5**	**4.4 %**
12Su1-19	2	1	0	0.0 %	6	0	0.0 %
12Gr388-01	2	3	0	0.0 %	3	0	0.0 %
12Gr388-02	2	12	4	33.3 %	32	6	18.8 %
12Gr388-32	2	10	4	40.0 %	16	5	31.3 %
12Gr388-33	2	6	0	0.0 %	6	0	0.0 %
12Gr388-34	2	5	2	40.0 %	5	2	40.0 %

Table 10. Continued.

Burial	Comp.	No. Molars	No. Carious	% Carious	No. Teeth	No. Carious	% Carious
12Gr388-42	2	6	1	16.7 %	9	1	11.1 %
12Gr60-26	2	5	5	100.0 %	12	12	100.0 %
12Gr60-39	2	1	1	100.0 %	1	2	50.0 %
12Gr60-37	2	8	2	25.0 %	24	2	8.3 %
Total	**2**	**57**	**19**	**33.3 %**	**115**	**29**	**25.2 %**

Table 11. Lifetime prevalence of caries in individuals from Groups 1 and 2.

Group	No. with Caries	Prevalence	No. with Interproximal	Prevalence	No. with Occlusal	Prevalence
1 (n=5)	2	40.0%	0	0.0%	2	40.0%
2 (n=10)	7	70.0%	4	40.0%	6	60.0%

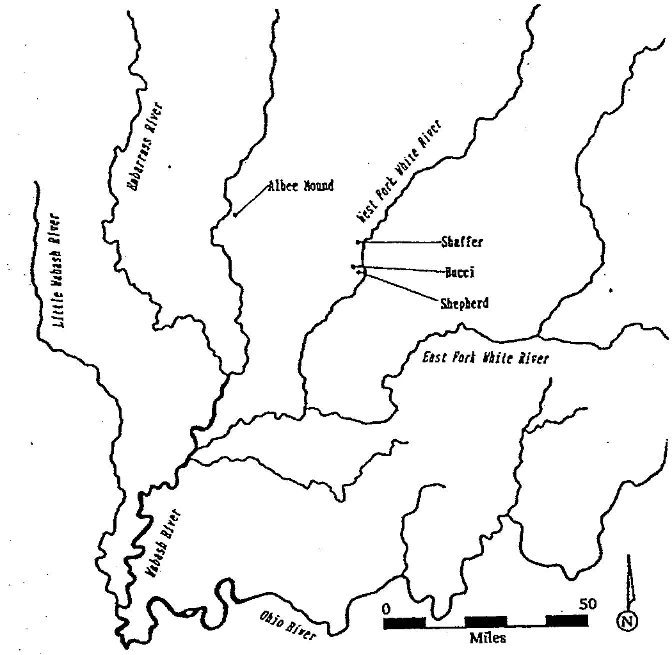


Figure 1. Location of Albee Mound, Shaffer, Bucci and Shepherd cemeteries.

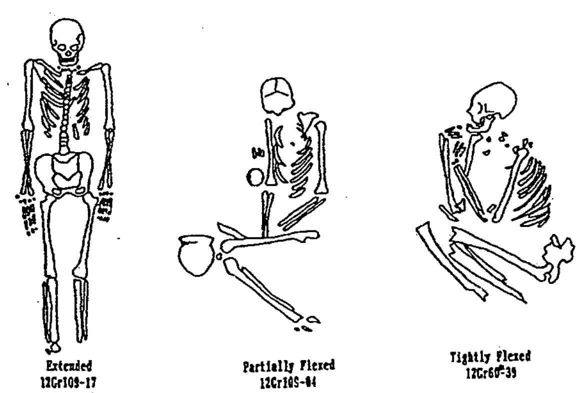


Figure 2. Examples of extended, partially flexed and tightly flexed burials.

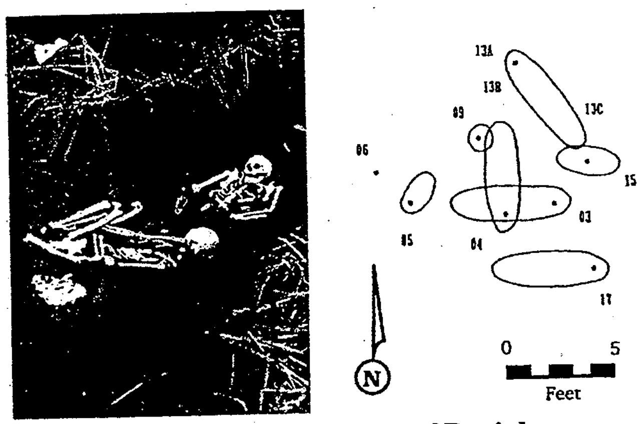


Figure 3. Relative positioning of Burials 12Gr109-03, 12Gr109-04 and 12Gr109-05 illustrated by Black's (1932) photograph and partial view of reconstructed plan of Shaffer cemetery.

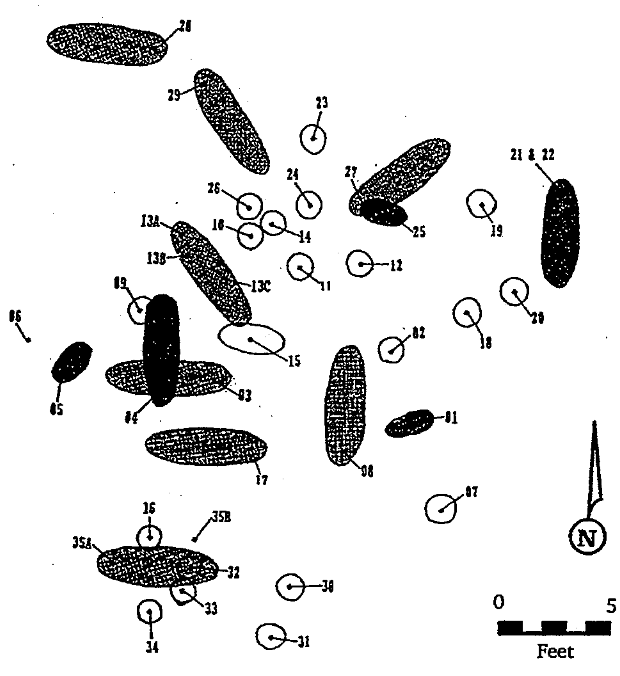


Figure 4. Reconstructed plan view of Shaffer cemetery.

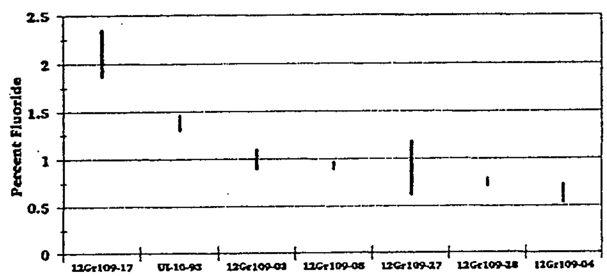


Figure 5. Measured flouride content of adult burials from the Shaffer cemetery, 2 sigma range.

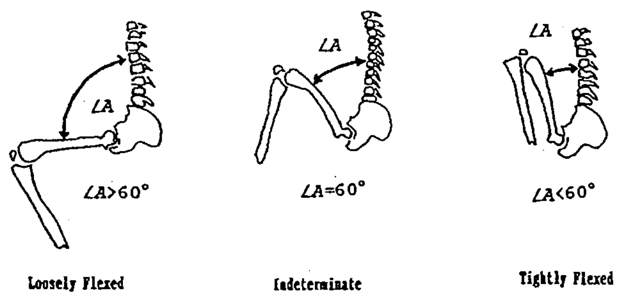


Figure 6. Determination of degree of leg flexure.

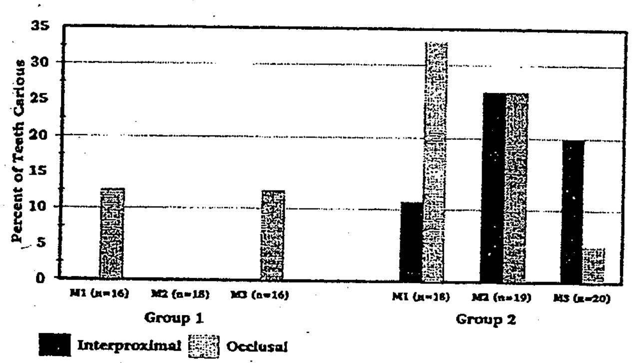


Figure 7. Frequency of molar occlusal and interproximal caries among Component I and II burials.

REFERENCES

Anslinger, C. Michael

1990 The Akers Site: A Late Woodland Albee Phase Burial Mound in Warren County, West Central Indiana. Indiana State University Anthropology Laboratory. *Technical Report* No. 10. Terre Haute.

Austin, D.F., and S.B. Werner

1982 *Epidemiology For the Health Sciences.* Charles C. Thomas, Springfield, Illinois.

Bass, William M.

1987 *Human Osteology: A Laboratory and Field Manual* (3rd edition). Special Publication No. 2 of the Missouri Archaeological Society, Columbia.

Bechtel, S.K., and David M. Stothers

1993 New Perspectives on the Settlement-Subsistence System of the Late Woodland Western Basin Tradition, ca. 500-1300 A.D. *North American Archaeologist* 14 (2):95-122.

Black, Glenn A.

1932 Unpublished field notes and photographs from archaeological survey of Greene County. On file, Indiana University, Glenn A. Black Laboratory of Archaeology, Bloomington.

1933 The Archaeology of Greene County. *Indiana History Bulletin* 10(5).

Bones Uncovered Under House Near Switz City.

1968 *Linton Daily Citizen*. July 9.

Bush, Leslie L.

1994 Floral material. In Morell-Sheets: An Albee Phase Habitation, by Beth. K. McCord and Donald R. Cochran. Archaeological Resources Management Service. Ball State University. *Reports of Investigation* 38. Muncie.

1998 Preliminary Data on Late Woodland and Late Prehistoric Plant Procurement Strategies in Southern Indiana. Paper presented at the Midwest Archaeological Conference, October 23, 1998, Muncie.

Carr, C.
1994 Social and Ideological Determinants of Mortuary Practices. Paper presented at the annual meeting of the Society of American Archaeology, 1994, Anaheim.

Clouse, R.A., John W. Richardson, and E.V. McMichael
1970 Interim Report of the Daughtery-Monroe Site: An Allison-LaMotte Village. *Proceedings of the Indiana Academy of Science* 80:74-83.

Cochran, Donald R., Lisa Maust, Eric Filkins, Mitch Zoll, S. Staley, and Ron Richards
1988 The Hesher Site: A Late Albee Cemetery in East Central Indiana. Archaeological Resources Management Service. Ball State University. *Reports of Investigation* 24. Muncie.

Cook, Della C., and Jane E. Buikstra
1979 Health and Differential Survival in Prehistoric Populations: Pre-natal Dental Defects. *American Journal of Physical Anthropology* 51:649-664.

Custer, Jay F., K.R. Rosenberg, G. Mellin, and A. Washburn
1990 A Re-examination of the Island Field Site (7K-F-17), Kent County, Delaware. *Archaeology of Eastern North America* 18:145-212.

Faust, Richard D.
1961 *The Physical and Cultural Relationships of a Late Woodland Indian Group of the Wabash Valley.* Unpublished Master's Thesis, Department of Anthropology, Indiana University, Bloomington.

Fitting, James E.
1965 Late Woodland Cultures of Southeastern Michigan. Museum of Anthropology. University of Michigan. *Anthropological Papers* No. 24. Ann Arbor.

Geier, Clarence R.
1983 Some Thoughts on the Taxonomic and Temporal Implications of Late Woodland Triangular Projectile Points from Sites in the Ridge and Valley Province of Virginia. *Archaeological Society of Virginia Quarterly Bulletin* 38(4):197-233.

Gorby, S.S.
1886 The Pre-historic Race in Indiana. Indiana Department of Geology and Natural History. *Fifteenth Annual Report*, pp. 286-313. Indianapolis.

Halsey, John R.
1968 The Springwells Mound Group. In Contributions to Michigan Archaeology. Museum of Anthropology. University of Michigan. *Anthropological Papers* No. 32. Ann Arbor.

Harrel, G.P.
1979 *A Phase I Assessment of Archaeological Resources in the Bloomington-Worthington-Merom Transmission Line Route.* On file, Indiana University, Glenn A. Black Laboratory of Archaeology, Bloomington.

Hodder, Ian
1982 *The Present Past.* B. T. Batsford, London.

Johnston, F.E.
1961 Sequence of Epiphyseal Union in a Prehistoric Kentucky Population from Indiana Knoll. *Human Biology* 33:66-81.

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

Koritzer, R.T.
1977 An Anthropological Approach to the Study of Dental Pathology. In *Orofacial Growth and Development*. Edited by A.A. Dahlberg and T.M. Graber, pp. 283-299. Mouton Publishers, The Hague.

Larsen, Clark S.
1982 The Anthropology of St. Catherines Island. 3. Prehistoric Human Biological Adaptation. *Anthropological Papers of the American Museum of Natural History* 57(3). New York.

1987 Bioarchaeological Interpretations of Subsistence Economy and Behavior from Human Skeletal Remains. In *Advances in Archaeological Method and Theory*, vol. 10, edited by Michael A. Schiffer, pp. 339-445. Academic Press, New York.

Larsen, Clark S., R. Shavit, and Mark. C. Griffin
1991 Dental Caries Evidence for Dietary Change: An Archaeological Context. In *Advances in Dental Anthropology*, edited by M.A. Kelley and C.S. Larsen, pp. 179-202.

Logan, W.N.
1927 Archaeological Investigations in Greene County, Indiana. *Proceedings of the Indiana Academy of Science* 37:165-174.

Lynch, M.P.
1975 *Mortuary Practices in the Albee Mound Site*. Ms. on file, Indiana University Bioanthropology Laboratory, Bloomington.

MacLean, J.A.
1927 Excavation of Albee Mound. *Indiana History Bulletin* 4 (3).

1931 Excavation of Albee Mound. *Indiana History Bulletin* 8 (4).

Mangold, William L., Stephen P. Nawrocki, and J. Scherbaur
1993 The Shaffer Site (12Gr109): Additional Information on an Albee Phase Site in the White River Valley. Paper presented at the annual meeting of the Indiana Historical Society, 1993, Indianapolis.

McCord, Beth K., and Donald R. Cochran
1994 Morell-Sheets: An Albee Phase Habitation. Archeological Resources Management Service. Ball State University. *Reports of Investigation* 38. Muncie.

Milner, G.R.
1984 Dental Caries in the Permanent Dentition of a Mississippian Period Population from the American Midwest. *Coll. Anthropol.* 8:77-91.

Neumann, G.K.
n.d. Unpublished field notes from the excavation of the Shepherd (12Gr60) and Bucci (12Gr388) cemeteries, Greene County, Indiana. On file, Indiana University Bioanthropology Laboratory, Bloomington.

Ortner, D.J., and W.G.J. Putschar
1985 Identification of Pathological Conditions in Human Skeletal Remains. *Smithsonian Contributions to Anthropology*, No. 28. Reprinted. Smithsonian Institution Press, Washington, D.C.

Pace, Robert E., and Gary A. Apfelstadt
1980 *Allison-LaMotte Culture of the Daugherty-Monroe Site, Sullivan County, Indiana.* On file, Indiana University. Glenn A. Black Laboratory of Archaeology, Bloomington.

Pace, Robert E., and S. Coffing
1978 *Archaeological Reconnaissance, PSI Cayuga Generating Station, Vermillion County, Indiana.* Indiana State University Anthropology Laboratory and Museum. Terre Haute.

Professor Identifies bones Uncovered Near Switz City.
1968 *Linton Daily Citizen.* July 12.

Railey, J. A.
1992 Chipped Stone Artifacts. In *Fort Ancient Cultural Dynamics in the Middle Ohio Valley*, edited by A.G. Henderson, pp. 137-169. Monographs in World Archaeology No. 8. Prehistory Press, Madison.

Ritchie, W.A.
1969 *The Archaeology of New York State*. Natural History Press, Garden City, New York.

Schurr, Mark R.
1989 Fluoride Dating of Prehistoric Bones by Ion Selective Electrode. *Journal of Archaeological Science* 16:265-270.

Seeman, M.F.
1992 The Bow and Arrow, the Intrusive Mound Complex, and a Late Woodland Jack's Reef Horizon in the Mid-Ohio Valley. In *Cultural Variability in Context: Woodland Settlements of the Mid-Ohio Valley*, edited by Mark F. Seeman, pp.41-51. Midcontinental Journal of Archaeology Special Paper No. 7. The Kent State University Press, Kent, Ohio.

Seeman, Mark F., and Cheryl Ann Munson
1980 Determining the Cultural Affiliation of Terminal Late Woodland-Mississippian Hunting Stations: A Lower Ohio Valley Example. *North American Archaeologist* 2(1):53-65.

Stephens, Denzil
1974 Excavations at the Stoner and Lowe Sites. Illinois State Museum Research Series. *Papers in Anthropology*, No. 2.

Stothers, David M., and G. Michael Pratt
1981 New Perspectives on the Late Woodland Cultures of the Western Lake Erie Region. *Midcontinental Journal of Archaeology* 6(1):91-122.

Suchey, J.M., P.A. Owings, D.V. Wisely, and T.T. Noguchi
1984 Skeletal Aging of Unidentified Persons. In *Human Identification:Case Studies in Forensic Anthropology*, edited by T.A. Rathbun and Jane E. Buikstra, pp. 278-297. Thomas, Springfield.

Todd, T.W.
1920 Age Changes in the Pubic Bone I: The Male White Pubic. *American Journal of Physical Anthropology* 3:285-34.

Tomak, Curtis H.
1970 *Aboriginal Occupations in the Vicinity of Greene County, Indiana.* Unpublished Master's Thesis, Department of Anthropology, Indiana University, Bloomington.

Turner, C.G. II.
1979 Dental Anthropological Indications of Agriculture Among the Jomon People of Central Japan. *American Journal of Physical Anthropology* 5:619-636.

Waldron, T.
1994 *Counting the Dead: The Epidemiology of Skeletal Populations.* John Wiley & Sons, New York.

White, Andrew A.
1995 *A Preliminary Bioarchaeological Investigation of the Albee Mound, Shaffer, Shepherd and Bucci Cemeteries, Sullivan and Greene Counties, Indiana.* Ms. on file, Indiana University Bioanthropology Laboratory, Bloomington.

Winters, Howard D.

1963 An Archaeological Survey of the Wabash Valley in Illinois. Illinois State Museum. *Reports of Investigations* 10.

1967 An Archaeological Survey of the Wabash Valley in Illinois. Revised edition. Illinois State Museum. *Reports of Investigations* 10.

HOW MUCH IS ENOUGH?: AN EXPERIMENT IN FLOTATION SAMPLING STRATEGY FROM THE HEATON FARM SITE, 12Gr122

Leslie L. Bush
Glenn A. Black Laboratory of Archaeology
Indiana University

INTRODUCTION

Sampling for botanical remains presents a host of problems, not the least of which involves making decisions about remains that are only incompletely visible in the field. Distributions of lithics, ceramics and many other artifact types can be assessed with some degree of accuracy in the field, allowing archaeologists to adjust their strategies accordingly. Botanical remains afford no such luxury. It is therefore important to establish what field indicators signal the presence of differential distributions of archaeological botanical remains.

This paper explores whether the cultural (and natural) zones within features routinely identified by field archaeologists are reliable guides for flotation sampling. For this purpose, all archaeological features may be divided into two types: homogenous and non-homogenous. "Homogenous" features are those in which no stratigraphy or zonation of any kind is visible in field, including differences of soil texture, soil color, artifact type, or artifact density. Functionally, these features range from storage pits to FCR pits to trash pits and are often interpreted as having been filled in quickly. "Non-homogenous" features are those in which stratigraphy and/or zonation is visible in the field. Zones may be due to cultural processes or natural ones (e.g., bioturbation).

One common way to sample for flotation from homogenous features is to take soil samples of approximately 10 liters from 10-centimeter arbitrary levels from a column in the center of the feature after it has been profiled. Brian DeRoo (1991) has demonstrated that such a central column typically represents the contents of the entire feature. This sampling strategy, however, can easily involve taking ten or even twenty samples from a single feature, making processing and analysis of even a single feature a significant economic burden. Nonetheless, many archaeologists have been reluctant to abandon the strategy for good reason. Even if no patterning is visible in the soil in or artifact distributions, it is difficult to dismiss the possibility that patterning might in fact be present in those tiny botanical remains, patterns which would be missed if only a single sample were taken. If, as argued here, these homogenous features are truly homogenous in terms of their botanical remains as well as other, more visible, artifacts and ecofacts, then samples taken from each column should the same. A single sample should suffice for the entire feature.

Conversely, for features with distinctive zones or strata, it is important to establish whether at least one sample should be taken from each zone, or whether tiny botanical remains have moved around so much in the soil that a single sample will approximate the botanical distribution for the entire feature. It is possible that charred botanical remains tend to move around more in the soil than other artifact or ecofact classes. The well-publicized Wadi Kubbaniya barley certainly appeared to be in association with 17,000-year-old charcoal, but turned out to be a mere 5,000 years old (Wendorf et al. 1984 in Miksicek 1987). Closer to Indiana, what was previously thought to be Middle Woodland or Archaic maize from several sites has been AMS dated to much later time periods (Fritz 1988). If it is true that homogenous-looking features are botanically homogenous, and stratified or zoned features contain botanically distinctive zones or strata, field archaeologists can sample for flotation with much more confidence that charred botanical remains do not move through the soil without leaving visible traces of their movements. In short, it can be expected that differences observed in the field will correspond to differences observed in the laboratory.

THE HEATON FARM SITE

Excavations at the Heaton Farm site (12Gr122) provided an opportunity to test these various possibilities and determine optimal sampling methods for the two classes of features. While only seven features and one control context were examined, strong trends in the results suggest that the data can be usefully extrapolated to other sampling situations.

Heaton Farm is a multi-component occupation on the bluffs overlooking the West Fork White River in west central Indiana, northwest of Bloomfield. The site is one of the largest Late Prehistoric villages known in the lower West Fork valley, dating from the thirteenth to early fifteenth centuries. The site area also contains evidence of occupation by Late Woodland Allison-LaMotte peoples during the sixth century. Artifacts dating as far back as the Early Archaic have been found on the site, but occupation of the site area by people earlier than the sixth century seems to have been short-term and sporadic. Excavations have focused on the Late Prehistoric components at Heaton Farm, but some Allison-LaMotte features were also encountered, and two of them have been included in this study. Botanical remains for the study are taken from flotation samples excavated in 1996 and 1997. For more detailed information on the site and the 1996 excavations, see McCullough and Wright (1997).

METHODS

Soil samples for flotation of at least 10 liters were taken from every cultural context on the site, as well as several control (i.e., non-cultural) contexts. Therefore, samples as large as practical were taken from each cultural stratum, zone or area of all features, postmolds, and house trenches. When cultural layers were deeper than 25 cm, the layers were subdivided into 10-centimeter layers, and flotation samples were taken from these arbitrary levels.

All flotation samples were processed at the Glenn A. Black Laboratory of Archaeology, Indiana University and were sorted and identified by the author according to standard archaeobotanical methods. Identifications were made using the comparative collection of the Glenn A. Black Laboratory of Archaeology, the Indiana University herbarium, and standard reference works (Core, et al. 1979; Hoadley 1990; Martin 1954; Martin and Barkley 1961; Montgomery 1977; Schopmeyer 1974). Botanical items were identified to the lowest possible taxonomic level, usually the genus. Although some taxa could be identified to species, others could be identified only to family.

CONTEXT DESCRIPTIONS

Samples from four homogenous features (Features 7, 8, 19 and 20) and three non-homogenous features (Features 11, 17 and 22) were chosen for analysis based on their having sufficient depths to include at least three 10-centimeter arbitrary levels or at least two cultural zones. In addition to homogenous and non-homogenous features, a control sample from what was identified in the field as sterile matrix was also examined to more conclusively establish that feature botanical content is different from that of matrix, and specifically that it differs in containing few or no botanical remains.

Homogenous features

Three of the four homogenous features were pits of Late Prehistoric cultural affiliation. These and some other Late Prehistoric features on the site contained both grit-tempered (Oliver-like) and shell-tempered (Mississippian-like) sherds. This unique combination of ceramic features that occurs in the lower West Fork of the White River has tentatively been called the Heaton Phase (Tomak 1983). It is possible, however, that the two ceramic types represent occupation of the area by two different Late Prehistoric groups.

Except for some bioturbation on its western edge, Feature 7 was a straight-sided pit that was oval in plan and had a maximum diameter of 94 centimeters (Figure 1). The fill was brown and organic with a light density of artifacts throughout. The feature seems to have been a storage pit that was later used for refuse disposal. It extended 51 centimeters below the plowzone, and four flotation samples from arbitrary 10-centimeter levels were taken from a column in the center of the northwest half.

Feature 8 was a shallow pit of Allison-LaMotte cultural affiliation (Figure 2). It was dark in color and contained high densities of fire-cracked rock as well as many large potsherds. Feature 8 was circular in plan with a maximum diameter of 94 centimeters and extended 31 centimeters below the plowzone. In profile, two zones were apparent: a dark, central zone with a lighter, disturbed zone surrounding it. Both flotation samples used in this analysis were taken from the central zone.

Feature 19 is the third of the four homogenous pit features (Figure 3). Like Feature 7, it was oval in plan. It measured 114 centimeters at its maximum diameter and extended 70 centimeters below plowzone. As can be seen from the profile, it was originally a bell-shaped storage pit. Parts of the walls appear to have collapsed in the pit prior to its use for trash disposal. Five flotation samples were taken from a column in the center of the north half of this feature.

Feature 20, the final homogenous pit feature examined, was slightly smaller and shallower (Figure 4). It measured 81 centimeters in maximum diameter and was only 37 cm deep. It produced three flotation samples for the project.

Zoned features

The three non-homogenous features examined for this study were all pit features exhibiting cultural or natural zones. Very similar to Feature 8, Feature 11 was a shallow pit of Allison-LaMotte cultural affiliation and contained large quantities of fire-cracked rock (Figure 5). It measured 93 centimeters in maximum diameter and only 15 centimeters in depth below plowzone. This feature exhibited a dark central zone containing high densities of artifacts. The outer zone was lighter and contained lower densities of artifacts; it represents a post-depositional dispersal of artifacts from the central zone by bioturbation and/or leaching due to water percolation. The Heaton Farm site is situated on Alvin-Bloomfield complex soils, which range from "well-drained" to "somewhat excessively drained," in the words of the county soil conservationist (McCarter Jr. 1988:17), so this sort of leaching is not unexpected. Feature 11 in effect straddles the distinction made here between "homogenous" and "non-homogenous": the soil layers do look different but they probably represent the same episode of cultural deposition. Despite appearances to the contrary in Figure 5, Feature 11 is superimposed by Feature 17 and not the other way around. (This is clear in plan, if not in this particular profile.) In both features, flotation samples were very carefully taken from areas away from the superimposing edges.

Feature 17 was a much larger zoned pit feature of the same "Heaton Phase" Late Prehistoric cultural affiliation as the four homogenous features. It was 122 centimeters in maximum diameter and 63 centimeters deep. Four flotation samples were taken, from Zone G, the main body of the feature; from Zone L, a disturbed area; from Zone N, a dark, charcoal-filled area; and from Zone R, a burned lens.

Feature 22 is also a feature of Late Prehistoric cultural affiliation, but it is one of several features, located mostly in the eastern area of the investigation, that contained only shell-tempered ceramics and so may represent a different cultural occupation than do the "Heaton Phase" features such as Features 7, 17, 19 and 20 (Figure 6). The zones in this feature were distinguished by soil color (e.g., Zone E was a very dark Munsell 10 YR 2/1) and by different densities of artifacts within the zones. Zone B, for instance, contained the vast majority of the feature's ceramics. Four flotation samples were taken from this feature, one from each of the zones shown in Figure 6 and one from a Zone D that does not appear in this particular cross-section.

Control sample

A control sample of 16 liters was taken from sterile matrix among a cluster of Late Prehistoric and Allison-LaMotte pit features. The sample yielded no charred botanical remains greater than 2 millimeters (the usual threshold for identifying wood, nutshell and corn remains) and only seven tiny flecks of wood charcoal. Many insect parts and seven taxa of uncharred (i.e., modern) botanical remains were observed.

RESULTS

Statistical testing

Results from flotation analysis indicate that, for the homogenous features, flotation samples taken in arbitrary 10-centimeter levels are equivalent. Figure 7 shows the botanical remains from Feature 7 as a percentage of the total by count. Visual inspection of this figure does show the flotation samples to be similar, but in the interest of a more rigorous test a statistical analysis was performed as well.

Small sample sizes and non-normal distributions mean that few of the numbers generated in archaeobotanical projects are amenable to testing by the most common tools of statistical analysis. Fortunately, we are in the presence of an exception here. The Chi-square test for homogeneity was designed to test exactly this sort of situation--and, even better, botanical data tend to fit, or can easily be made to fit, the requirement of an expected value of 5 for each taxon (Hildebrand and Ott 1983; Moore and McCabe 1989). In the Chi-square test, the null hypothesis is that any of the feature levels processed by flotation will yield the "same" botanical collection. That is, botanical remains obtained from each level can be thought of as independent samples from the same population ("population" being meant in the statistical sense, not the ecological sense). If the null hypothesis is rejected, as expected for zoned or stratified features, then there is a relationship between the zone or feature layer and the particular botanical remains found. In this case, it does matter which level or zone was sampled, and the samples can be thought of as coming from different populations.

Homogenous features. For Feature 7, the Chi-square test indicates that the samples are in fact equivalent (χ^2=35.55, df=24, p=>.05), just as predicted for a series of samples from a homogenous feature.

Features 8 and 20 are very similar, not so much in terms of the plant remains present but in the results of analysis. Figure 8 shows botanical remains from Feature 8 by percentage of total counts (χ^2 =3.69, df=3, p>0.5), and Figure 9 shows the botanical remains from Feature 20. (χ^2=14.5, df=10, p=>.05)

Feature 19 is also similar, but exhibits an anomaly in level A4 (Figure 10). In this level, the densities of hickory nutshell and maize are reversed from what they are in all other levels of the features; so the Chi-square test for the feature as a whole results in a rejection of the null hypothesis that all levels are equivalent. That is, the result indicates that there are significant differences among the botanical collections from the different levels in this feature. (χ^2=70.36, df=28, p=<.05) There are two possibilities that would explain this result. The first is simply a sampling anomaly that resulted in Type I error: that random chance and not predictable cultural or natural processes produced the relatively high levels of maize and low levels of nutshell in level A4. Alternatively, there may have existed actual cultural or natural strata within the feature that were missed in excavation. Examination of the artifacts from this feature by level, however, indicate no patterning suggestive of a missed stratum (see Table 1). The first possibility (Type 1 error) therefore seems most likely--and in fact, if level 4 is omitted from the chi-square analysis, the null hypothesis is not rejected, meaning the that the samples are equivalent. (χ^2=28.5, df=21, p=>0.05)[1]

Zoned features. Analysis of botanical remains

---

[1] It is possible that the total materials in Feature 19 and other homogenous features were originally deposited in a series of episodes, each of which contained its own distinctive set of materials (e.g., hearth cleanings from different meals). Simulation models have shown that even a modest amount of sediment mixing, whether by cultural or natural processes, is sufficient to obscure patterning (see Clark 1988:Fig.6). Therefore the feature contents, whatever their original patterning, must be considered homogenous by the archaeologist since there is currently no way to recover such lost patterns. Level A4 of Feature 19 may represent a remnant of former patterning within the feature.

from all three of the zoned features indicates that botanical collections from zones within features are different. This finding helps support the previous result that botanical collections from homogenous features are truly homogenous. It is possible that botanical collections from a flotation column in mid-feature may appear homogenous simply because all botanical collections from the site are simply not well-differentiated. Establishing that non-homogenous features do in fact contain non-homogenous botanical collections helps rule out this possibility.

Data from Feature 22 are shown in Figure 11. (χ^2=266.77, df=21, p=<0.05). Figure 12 shows the data from Feature 17 (χ^2=67.58, df=15, p=<0.05). Feature 11 (Figure 13a) is particularly interesting because of it contains two zones, one of which is a diffusion of materials from the other by post-depositional processes. In fact, the patterns of botanical taxa from the two zones look very similar--a fact that is evident in the Chi-square analysis (χ^2=11.5, df=6, p=>0.05). Examination of the absolute densities of botanical material demonstrates, however, that Zone A contains three to four times the number of botanical remains that Zone B does (Figure 13b). Thus, while there are indisputable differences between levels, they are only differences of quantity and not quality, a finding that could have been predicted from the appearance of the zones in the field.

DISCUSSION

To summarize the main results of this study: homogenous features were found to be entirely homogenous (with the exception of level A4 from Feature 19), and zoned features in all cases were found to exhibit significant differences in the botanical collections from different zones. The question of optimal sampling is easily answered for non-homogenous features: taking flotation separately from each zone visible in the field is a good, conservative rule of thumb. It errs of the side of occasionally requiring samples from areas such as Level B of Feature 11 that are not qualitatively different from the main body of the feature. Those types of levels should be visible in the field, however.

A concern from which this experiment arose had to do with the movement of charcoal through the soil. From the data gathered for this project, it seems that while charcoal does move around in the soil after deposition (Feature 11), its movement will leave traces in the archaeological record that are visible in the field. Zone B of Feature 11 showed traces of artifact movement within the area, and botanical remains were in fact found there. In contrast, the matrix sample showed no signs of disturbance, and no remains were found at the usual threshold of archaeological visibility. (As noted above, a total of seven wood charcoal flecks were noted in the matrix sample, but all were less than 2 mm in size).

The finding that charcoal appears to leave traces of its movement in the soil is not inconsistent with situations noted earlier, in which presumably early maize was AMS dated to later times. Many paleoethnobotanists (notably Asch and Asch 1985) had voiced concern over the contexts in which some early maize fragments were found long before the AMS dates were run. The tests were performed precisely because their archaeological contexts were suspect (in most cases, the stratigraphic level was mixed or disturbed). Thus, for the vast majority of situations in which archaeologists sample for flotation, stratigraphy or zonation visible in the field is an extremely reliable guide.

Sample size

Results of this study indicate that optimal sampling for large, homogenous features and zones within non-homogenous features can be accomplished with a single sample. But how large must that sample be? The answer here is much more difficult because the necessary follow-up question to "How much is enough" is "Enough for what?" In this project, the sampling goal was a minimum sample of 10 liters in the field, and the actual samples taken in the field for this study from homogenous features ranged from 9.5 to 15.5 liters. As has been demonstrated, these samples are sufficiently large to produce a stable botanical distribution for each level such that the levels are statistically equivalent. So if the goal is a general picture of the botanical distribution in a particular feature, then a single 10 to 15 liter sample is "enough"--at least for features with the same or greater density of botanical remains as those at the Heaton Farm site.

It should be stressed here that the representativeness of a sample is determined not by the total number of liters processed (or even by the percentage of feature fill processed if less than 100%) but by the total botanical remains present in the sample (see Pearsall 1989:123-125). The confidence interval for a any single taxon is given by

$$\pm 2\sqrt{p(1-p)/n}$$

where p is the fraction of the sample represented by a taxon and n is the total number in the sample. The equation makes clear that "n" (the total number of botanical remains recovered), rather than the size (volume) of the flotation sample, determines the quality of the botanical sample. Thus, in a sample contain 100 botanical items, of which 10 are maygrass, the arithmetic works as follows:

$$\pm 2\sqrt{.1(1-.1)/100}$$

or $\pm .06$

and, at a 95% confidence level, we can say that maygrass consists of 10±6% of the collection. In a sample containing 300 items, of which 30 (10%) are maygrass, at a 95% confidence level, 10±3.5% are maygrass.

The implications of this arithmetic for sampling homogenous features are clear: if taking one sample produces 100 botanical items, taking three samples will reduce the width of the confidence interval by less than half but will triple the time and expense of taking the samples. Field archaeologists must therefore have good information about sampling strategies in order to balance the goals of excavation with its costs. In practice, the mathematics of the confidence interval means that features from, for example, a Mississippian village that burned during its occupation can be safely sampled at a much smaller absolute number of liters than can features from a Middle Archaic encampment whose inhabitants left very little in the way of botanical remains.

There are other cases for which the 10-liter-per-cultural-context sampling strategy proposed here will require adjustment. For research goals that require data on uses of rare plants such as wetlands taxa, maize during the Middle Woodland period, or tobacco at almost any time, a 10-liter sample will probably not be sufficient. Jack Rossen has recently reported that it took enough soil to fill a 14-foot U-Haul to detect wetlands utilization at an Archaic site in McCracken County, Kentucky (Rossen 1996).

CONCLUSION

The conclusions of the sampling experiment can therefore be summarized as follows:

* Samples for flotation should be taken from all discernable cultural areas, even those within the same pit.
* One sample per area is "enough" for most research questions, even for very large areas.
* A 10-liter sample is adequate, though minimal, for most research questions at sites like Heaton Farm.
* The above recommendations apply only when general information about routine uses of botanical material is sought. For research questions involving rare taxa, large samples will be necessary.

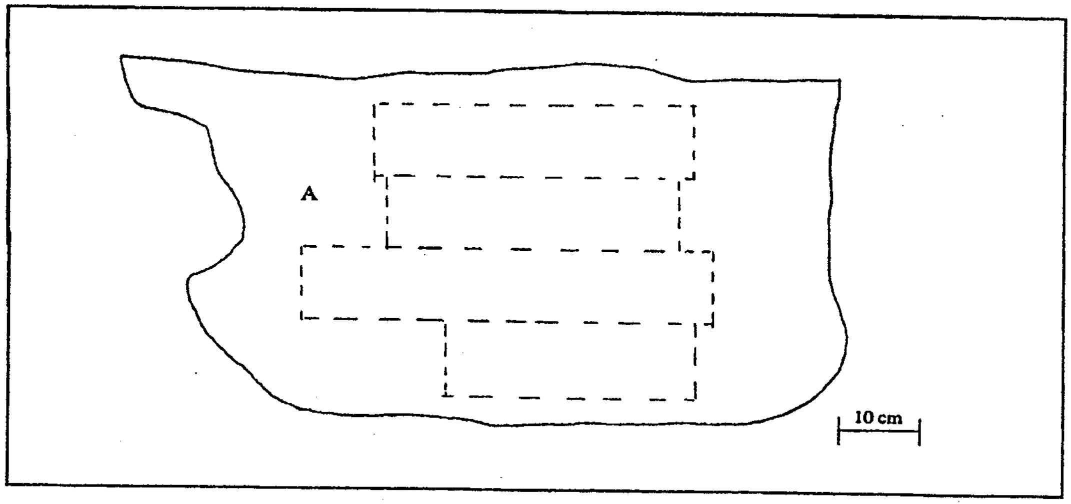
Although the number of features and control contexts examined for this project is small, trends in the data are strong enough to suggest that the above recommendations can be usefully applied other archaeological sites.

Acknowledgments. The author would like to thank Bob McCullough for his help and encouragement in this project. The staff of Indiana University's Stat/Math Center provided advice on the uses and significance of various statistical methods.

Table 1. 1/4" screen artifacts from the north half of Feature 19, by level.

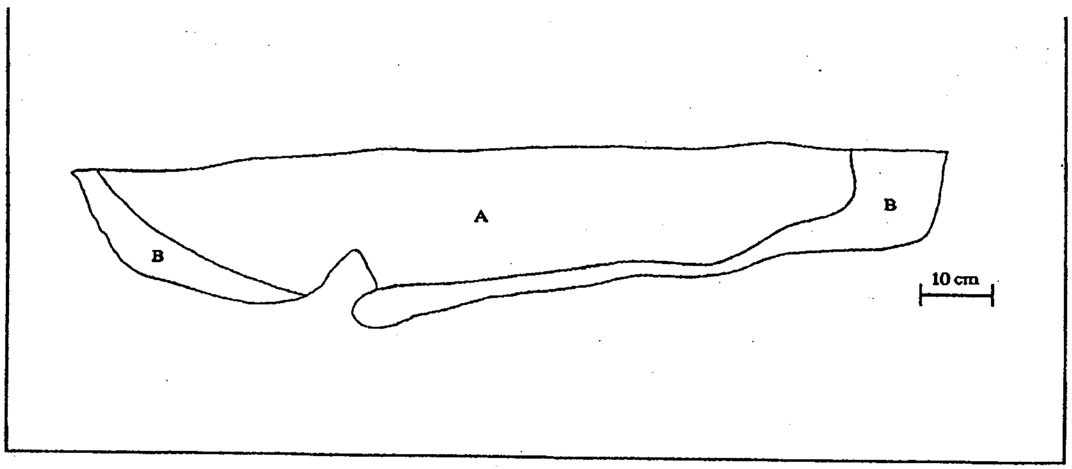
Level	ceramics (number/weight in grams)	chert flakes (number/weight in grams)	FCR (number/weight in grams)	bone (g)	charcoal (g)
A1[a]	12/10	-	116/140	2	2
A2	7/19	2/1	90/278	4	2
A3	7/22	-	61/241	1	4
A4	7/15	1/1	38/256	4	3
A5	10/10	1/1	37/178	2	9
A6	2/5	-	30/52	2	3

[a] Level A1 was a 5-centimeter level excavated to expose fresh feature fill before beginning the flotation column. All fill from this level was screened. Artifact counts and weights have been doubled to make them better comparable with data from other levels, all of which were 10 cm in depth.



A Feature 7 fill. Compact sandy loam. Contains many charcoal flecks, some ceramics, FCR, bone and nutshell. 10 YR 3/3 (dark brown).

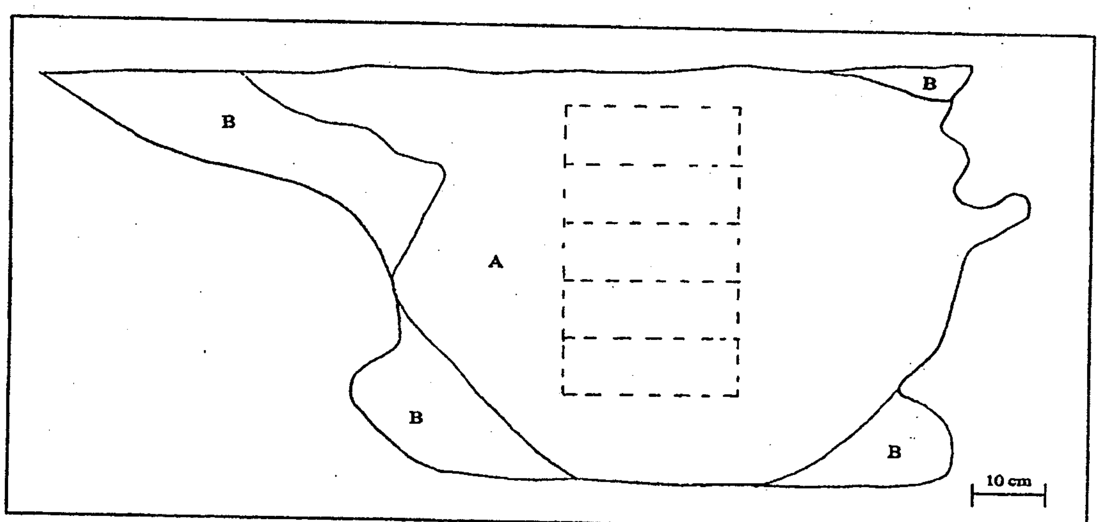
Figure 1. Profile of Feature 7, with location of flotation samples.



A Feature 8 fill. Compact sandy loam, much more organic than subsoil. Contains very high densities of FCR and ceramics, some bone (especially bird bone) and light densities of charcoal flecks and chert. 10 YR 2/2 (very dark brown).

B Zone of disturbance. Sandy loam similar to subsoil but darker and slightly more organic. Contains no artifacts. 10 YR 4/4 (dark yellowish brown).

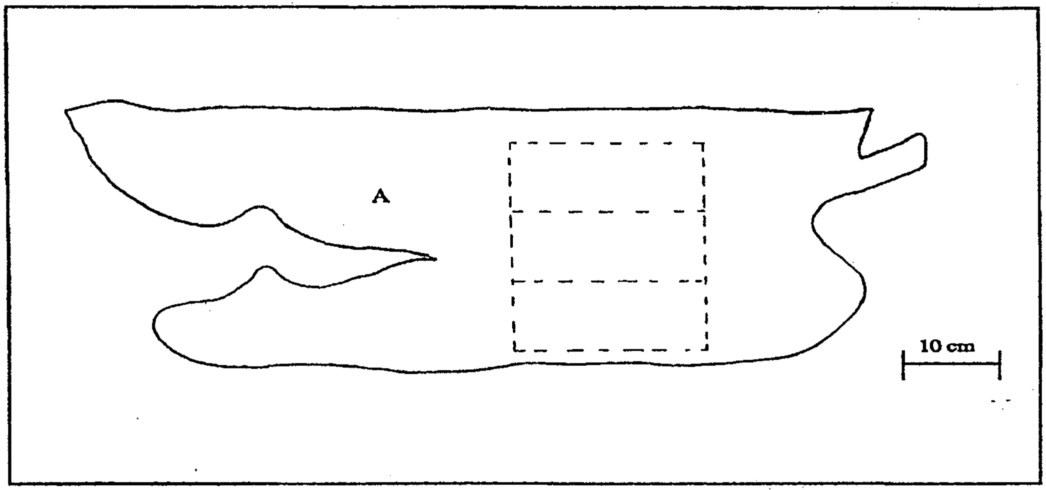
Figure 2. Profile of Feature 8.



A Feature 19 fill. Sandy loam. Contains charcoal flecks, bone, some ceramics, chert, FCR, sandstone and shell. 10 YR 3/3 (dark brown).

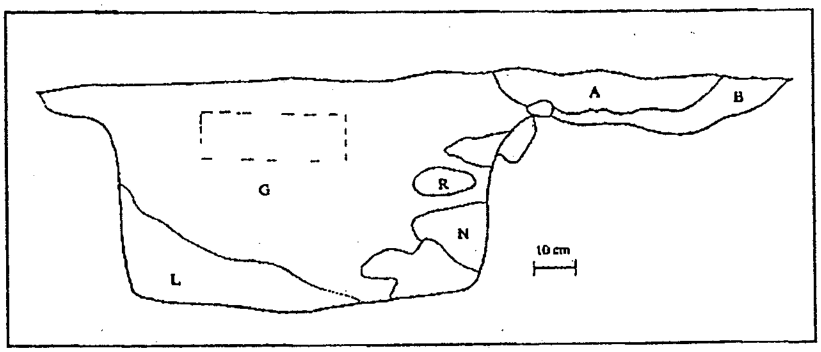
B Disturbed zone. Sandy loam. Contains no artifacts, but shape suggests these areas were part of the original feature wall. A wall collapse presumably resulted in the disturbance. 10 YR 3/4 (dark yellowish brown).

Figure 3. Profile of Feature 19, with location of flotation samples.



A Feature 20 fill. Sandy loam, wetter and more organic than subsoil. Feature cuts through laminations in subsoil. Contains charcoal flecks, very light densities of ceramics, chert, FCR, and bone. 10 YR 3/4 (dark yellowish brown) and 10 YR 4/6 (dark yellowish brown).

Figure 4. Profile of Feature 20, with location of flotation samples.



A Feature 11 fill. Compact sandy loam. Contains FCR and ceramics with some bone and chert. 5 YR 2.5/1 (black) and 10 YR 3/3 (dark brown).

B Feature 11 disturbed zone. Sandy loam, but less compact than Zone A. Contains FCR, ceramics, bone and chert, but in lower densities than Zone A. 10YR 3/4 (dark yellowish brown) and 10YR 4/6 (dark yellowish brown).

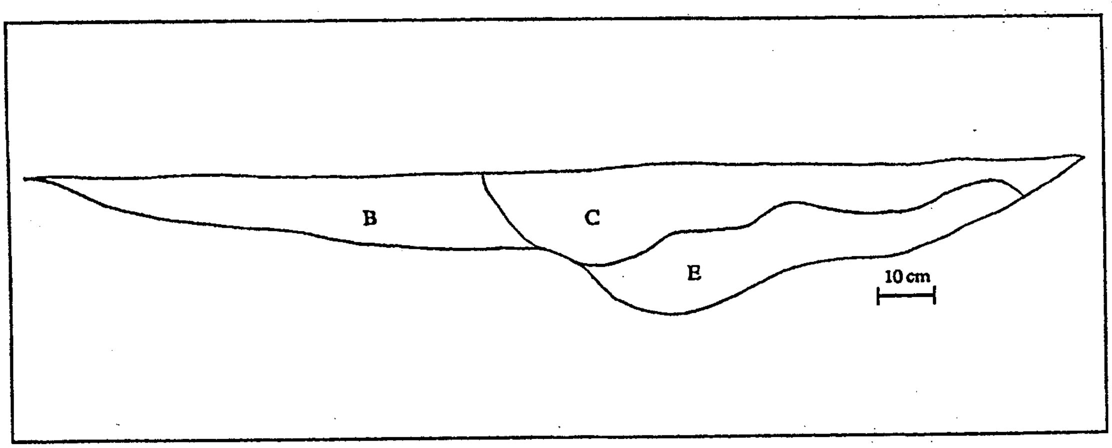
G Feature 17 fill. Sandy loam. Contains charcoal flecks, FCR, sandstone, chert, ceramics, bone, and shell. 10 YR 3/4 (dark yellowish brown) and 10YR 4/6 (dark yellowish brown).

L Feature 17 disturbed area. Sandy loam. Very light densities of charcoal flecks, FCR and bone. Probably a wall collapse similar to Area B of Fea. 19. 10 YR 4/6 (dark yellowish brown).

R Feature 17 area of burned soil. Sandy loam. Entire zone taken for flotation. 10 YR 2/2 (very dark brown) and 5 YR 4/4 (reddish brown).

N Feature 17 fill. Sandy loam. Contains more charcoal flecking than other feature zones. Entire zone taken for flotation. 10 YR 2/2 (very dark brown), 10 YR 4/4 (dark yellowish brown) and 10 YR 3/3 (dark brown).

Figure 5. Profile of Features 11 and 17, with location of flotation sample from Zone G of Feature 17.



B Feature 22 fill. Sandy loam, with some clay. Contains moderate charcoal flecking, some ceramics and a deer skull fragment. 10 YR 3/6 (dark yellowish brown).

C Feature 22 fill. Sandy loam, with some clay. Contains charcoal flecks but no other artifacts. Mottled 10 YR 4/4 (dark yellowish brown) and 10 YR 2/1 (black) from Area E.

E Feature 22 fill. Sandy loam. Heavily disturbed by burrowing, but color remains black (10 YR 2/1). Contains heavy charcoal flecking but no other artifacts.

Figure 6. Profile of Feature 22.

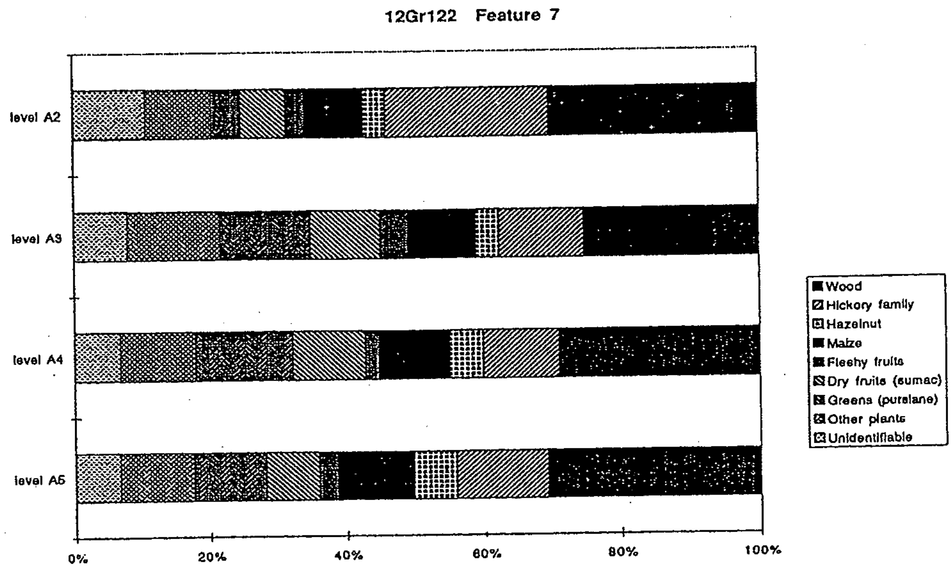


Figure 7. Botanical remains from Feature 7, as percentage of total by count.

169

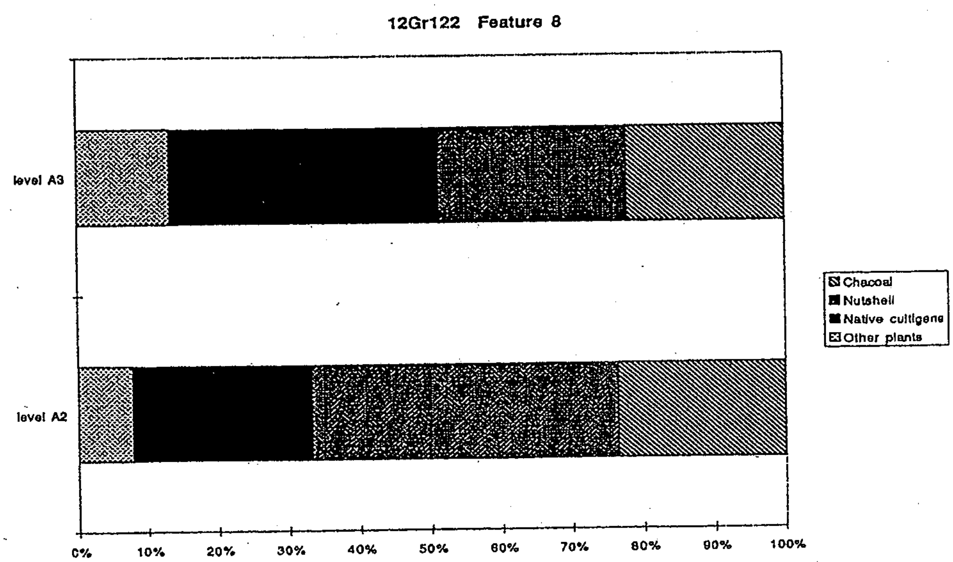


Figure 8. Botanical remains from Feature 8, as percentage of total by count.

170

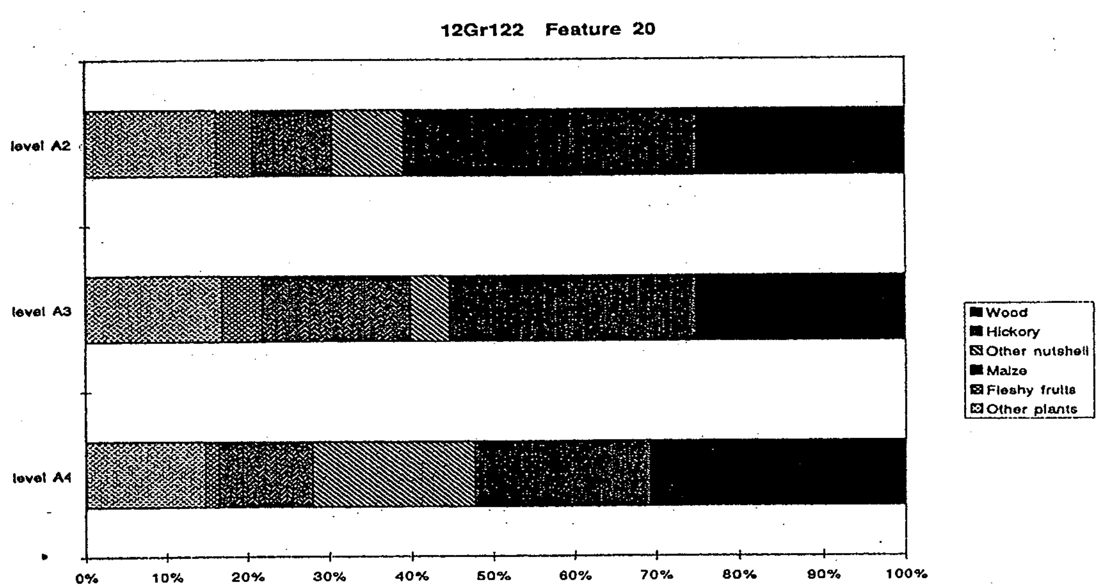


Figure 9. Botanical remains from Feature 20, as percentage of total by count.

171

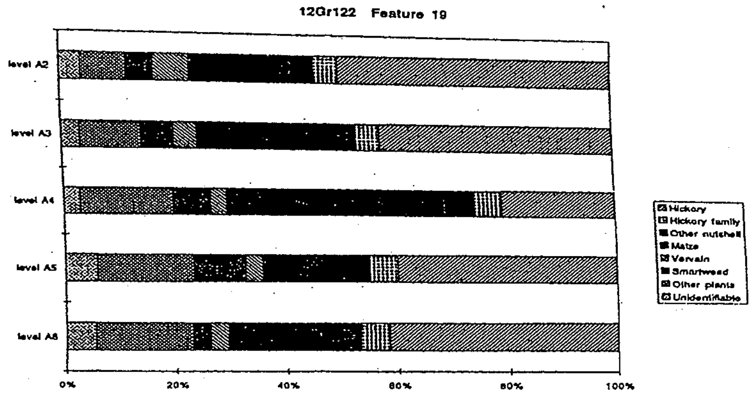


Figure 10. Botanical remains from Feature 19, as percentage of total by count.

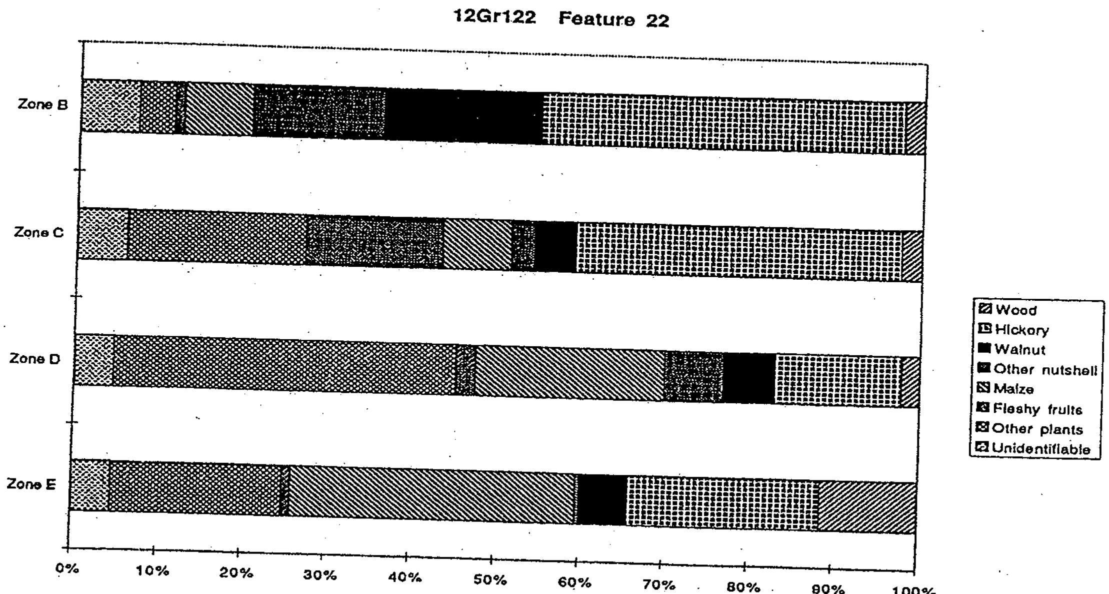


Figure 11. Botanical remains from Feature 22, as percentage of total by count.

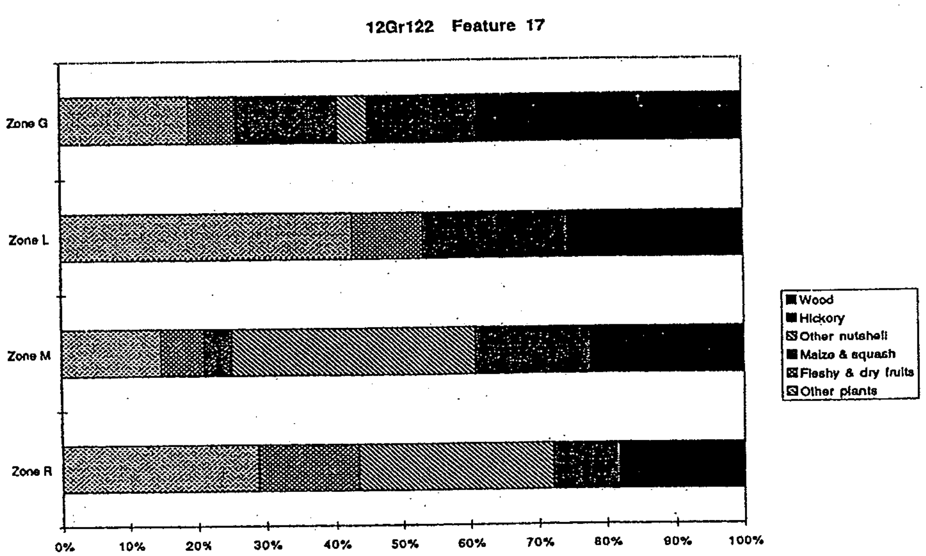


Figure 12. Botanical remains from Feature 17, as percentage of total by count.

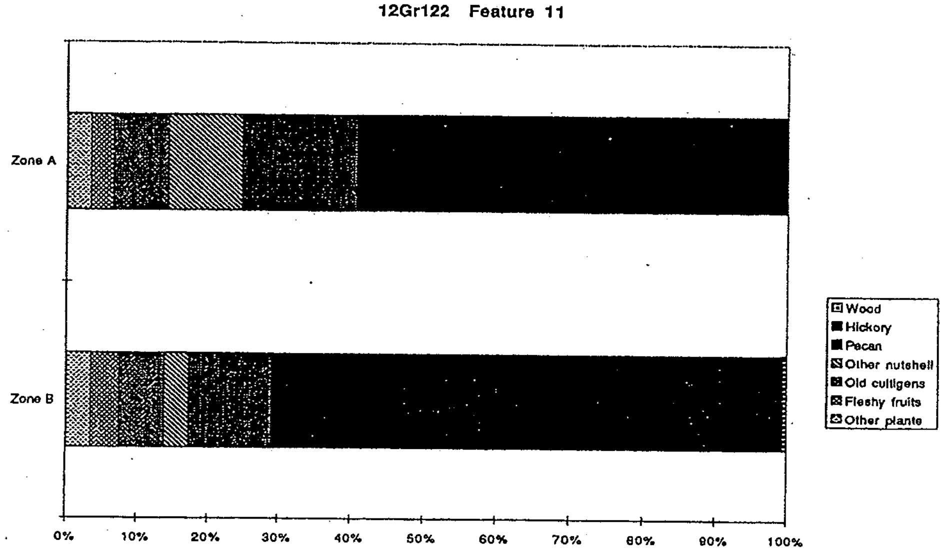


Figure 13a. Botanical remains from Feature 11, as percentage of total by count.

175

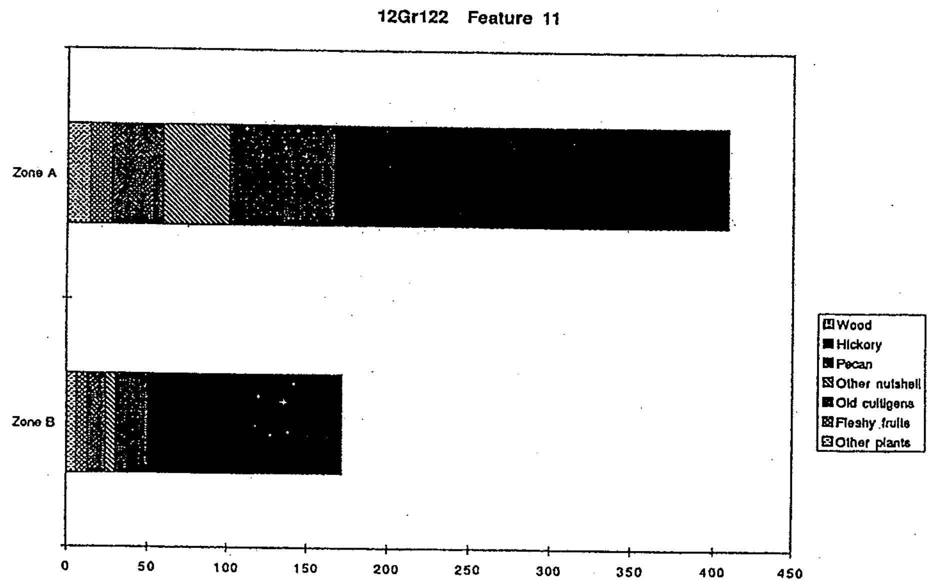


Figure 13b. Botanical remains from Feature 11, by absolute count.

176

REFERENCES CITED

Asch, David L., and Nancy B. Asch

1985 Prehistoric Plant Cultivation in West-central Illinois. In *Prehistoric Food Production in North America*, edited by R.I. Ford, pp. 149-203. Museum of Anthropology. University of Michigan. Anthropological Papers Vol. 75, Ann Arbor.

Clark, J.S.

1988 Particle Motion and the Theory of Charcoal Analysis: Source Area, Transport, Deposition, and Sampling. *Quaternary Research* 30:67-80.

Core, H.A., W.A. Cote and A.C. Day

1979 *Wood Structure and Identification.* 2nd ed. Syracuse University Press, Syracuse.

DeRoo, B.D.

1991 Flotation Data Sampling Strategies in Archaeological Research: an Experiment at the Elam Site (12 Ae 195), Allegan County, Michigan. Unpublished Master's thesis, Department of Anthropology, Western Michigan University, Kalamazoo.

Fritz, G.J.

1988 "Newer", "Better" Maize and the Mississippian Emergence: a Critique of Prime Mover Explanations. Paper presented at the 46th International Conference of Americanists, July 1988, Amsterdam.

Hildebrand, D.K., and L. Ott

1983 *Statistical Thinking for Managers*. 2nd ed. Duxbury Press, Boston.

Hoadley, R.B.

1990 *Identifying Wood: Accurate Results with Simple Tools*. The Taunton Press, Newtown, Connecticut.

Martin, A.C.

1954 Identifying Polygonum Seeds. *Journal of Wildlife Management* 18:514-520.

Martin, A.C., and W.D. Barkley

1961 *Seed Identification Manual*. University of California Press, Berkeley.

McCarter, P. Jr.

1988 *Soil Survey of Greene County, Indiana*. United States Department of Agriculture, Soil Conservation Service, Washington, D.C.

McCullough, Robert G., and Timothy M. Wright
1997 Population Dynamics of the Late Prehistoric: a Case Study from the Lower West Fork of the White River. Indiana University. Glenn A. Black Laboratory of Archaeology. *Report of Investigations* 97-18.

Miksicek, C.H.
1987 Formation Processes of the Archaeobotanical Record. In *Advances in Archaeological Method and Theory* Vol. 10, edited by Michael. B. Schiffer, pp. 211-247. Academic Press, Inc., New York.

Minnis, P.E.
1981 Seeds in Archaeological Sites: Sources and Some Interpretive Problems. *American Antiquity* 46(10):143-152.

Montgomery, F.H.
1977 *Seeds and Fruits of Plants of Eastern Canada and the Northeastern United States*. University of Toronto Press, Toronto.

Moore, D.S. and G.P. McCabe

1989 *Introduction to the Practice of Statistics*. W. H. Freeman and Company, New York.

Pearsall, D.M.

1989 *Paleoethnobotany: a Handbook of Procedures*. Academic Press, Inc., New York.

Rossen, J.

1996 Marsh Munchies and Swamp Snacks: Archaic Plant Utilization at the Hedden Site, McCracken County, Kentucky. Paper presented at the 13th annual Kentucky Heritage Council Archaeological Conference, March 1996, Louisville.

Schopmeyer, C.S.

1974 *Seeds of Woody Plants in the United States*. Agricultural Handbook 450. Forest Service. U. S. Department of Agriculture. Washington, D.C.

Tomak, Curtis H.

1983 A Proposed Prehistoric Cultural Sequence for a Section of the Valley of the West Fork of the White River in Southwestern Indiana. *Tennessee Anthropologist* 8(1):67-94.

Wendorf, F., R. Schild, A. Close, D. Donahue, A. Jull, T. Zabel, H. Wieckowska, M. Kobusiewica, B. Issawi and N. Hadidi
1984 New Radiocarbon Dates on the Cereals of Wadi Kubbaniya. *Science* 225:645-646.