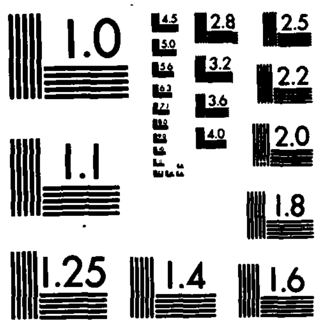
AD-A144 104 BUG HILL: EXCAVATION OF A MULTICOMPONENT MIDDEN MOUND IN THE JACKFORK VAL..(U) NEW WORLD RESEARCH INC POLLOCK LA J H ALTSCHUL ET AL. 25 NOV 83 DACW56-81-C-0144 1/5

UNCLASSIFIED F/G 5/6 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

BUG HILL:
EXCAVATION OF A MULTICOMPONENT MIDDEN MOUND IN THE JACKFORK VALLEY, SOUTHEAST OKLAHOMA

Jeffrey H. Altschul

NEW WORLD RESEARCH
REPORT OF INVESTIGATION NO. 81-1
1983

Project Funded By
U.S. Army Corps Of Engineers, Tulsa District

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: 81-1	2. GOVT ACCESSION NO.: AD-A144104
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (*and Subtitle*): Bug Hill: Excavation of a multicomponent midden mound in the Jackfork Valley, Pushmataha County, Oklahoma	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER: 81-1
7. AUTHOR(s): Jeffrey H. Altschul	8. CONTRACT OR GRANT NUMBER(s): DACW56-81-C-0144
9. PERFORMING ORGANIZATION NAME AND ADDRESS: New World Research, Inc. P.O. Box 410 Pollock, LA 71467	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: Department of the Army Tulsa District, Corps of Engineers P.O. Box 61, Tulsa, OK 74121	12. REPORT DATE: November 25, 1983
	13. NUMBER OF PAGES: 425
14. MONITORING AGENCY NAME & ADDRESS (*if different from Controlling Office*): Same as above	15. SECURITY CLASS. (*of this report*)
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (*of this Report*)

This document has been approved for public release and sale; its distribution is unlimited.

17. DISTRIBUTION STATEMENT (*of the abstract entered in Block 20, if different from Report*)

18. SUPPLEMENTARY NOTES

Contributing Authors: Donald Johnson, William Johnson, Glen Fredlund, James Moorehead, Mark T. Swanson, Kathleen Mary Byrd, Andrea Shea, Carol Weed, Jerome Rose, Arthur Bogan, Cynthia Bogan, Larry Banks, Murray Marks, Earl Riddick, John E. Keller

19. KEY WORDS (*Continue on reverse side if necessary and identify by block number*)

Archaeology, Ouachita Mountains, southeast Oklahoma, Sardis Lake, Jackfork Valley, Midden Mound, Archaic, Woodland, Caddoan, Wister phase, Fourche Maline phase

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

In late 1981 and early 1982, New World Research, Inc. carried out an interdisciplinary, culture-ecological study at the Bug Hill site (34Pu116) in Pushmataha County, Oklahoma. The work was conducted for the Department of the Army, Tulsa District Corps of Engineers. The Bug Hill site is an accretional midden mount set on the Holocene age Jackfork Terrace, along an intermittent tributary of Jackfork Creek. Analyses indicated that the site was occupied from the Middle Archaic to the Historic

Period. The site was the locus of intense occupation from the Late Archaic through the Early Caddoan Periods (ca. 1600 B.C. to A.D. 1000). Throughout this time, the site served predominantly as a base camp with the focus of the various occupations centered on the procurement and production of chipped stone tools and the utilization of lowland forest and riverine resources. Through time increasing emphasis was placed on the collection of wild plants, culminating in the possible use of domesticates (especially sunflower) during the Early Caddo. Correlated with the change in subsistence was an increasing specialization in the use of space both within structures and over the entire site. Many of these changes may be associated with the residents of the Jackfork Valley participating in or being influenced by cultural phenomena emanating from the Caddo centers along the Arkansas and/or Red Rivers.

After the Early Caddo Period, the site was used intermittently as a locus for short-term camps. Evidence of a brief historic occupation dating to the late nineteenth century was also found.

The research conducted at Bug Hill altered our understanding of prehistoric occupation in the Ouachita Mountains in several ways. Genetic and nutritional studies of the human skeletal remains provide strong evidence for biological continuity from the Late Archaic through the Early Caddoan Periods. Paleoenvironmental studies suggest that while shifts in Jackfork and North Jackfork Creeks may be correlated with changes in the nature of the occupations, the overall environmental setting remained relatively stable. Subsistence strategies definitely tend toward increasing use of plant foods through time, although this tendency is more of a change in degree than in kind. Studies of the chipped and ground stone artifacts indicate that the long held notion that stone tools in the Jackfork Valley were knapped from river gravels is substantially in error. Instead, most lithic raw materials derive from the Johns Valley Shale Formation which runs in a linear band along the north edge of the Jackfork Valley. Initial reduction appears to have taken place at the source with preforms being finished into tools at the site. Overall, the pattern of occupation at Bug Hill is characterized by strong continuity. This latter trait is perhaps indicative of a more general characteristic of Ouachita Mountain valley base camp communities.

BUG HILL:

EXCAVATION OF A MULTICOMPONENT MIDDEN MOUND IN THE JACKFORK VALLEY, SOUTHEAST OKLAHOMA

By

Jeffrey H. Altschul

Project Funded By

U.S. Army Corps of Engineers,
Tulsa District

New World Research, Inc.
Report of Investigations No. 81-1

1983

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continuation)

TABLE OF CONTENTS
(Continuation)

TABLE OF CONTENTS
(Continuation)

TABLE OF CONTENTS
(Continuation)

TABLE OF CONTENTS
(Continuation)

LIST OF FIGURES

LIST OF FIGURES
(Continuation)

LIST OF FIGURES
(Continuation)

LIST OF FIGURES
(Continuation)

LIST OF FIGURES
(Continuation)

LIST OF FIGURES
(Continuation)

LIST OF TABLES

LIST OF TABLES
(Continuation)

LIST OF TABLES
(Continuation)

LIST OF TABLES
(Continuation)

ACKNOWLEDGEMENTS

A project the size of Bug Hill is never conducted without the aid and support of a great many people. Over the past two years I have been fortunate to work with a large and diverse group of people from all walks of life. All set extremely high standards for themselves and this report has benefited from each and everyone.

First and foremost, I would like to thank the personnel of the Tulsa District Corps of Engineers. A great deal of the success of this project belongs to Mr. Mike Corkran and especially Ms. Cheryl Smith. Ms. Smith has been responsible for the 1981-82 Bug Hill project from its inception. Her enthusiasm and heartfelt concern for the prehistory of the region resulted in firm stands on many issues. Cheryl, however, has always been open-minded and if convinced of our position she would go out of her way to be flexible and accomodating. While Cheryl may not have written a single word of this report, she has, without a doubt, been a major contributor; being at the same time our harshest critic and staunchest supporter.

Many Corps personnel were extremely helpful in processing this contract. All seemed to be genuinely interested in the project and took the time to come to the site and ask questions. I would especially like to thank in this regard Lt. Colonel Welch, Lt. Colonel Waldrop, and Mr. Steven Shaw.

Bug Hill is appropriately named. Field conditions were both difficult and unpleasant. Given these conditions I was constantly amazed at the dedication and professionalism of the field crew. Much of the credit for the success of the field work must go to Mr. Mark T. Swanson and Mr. Jeff A. Homburg. Swanson served as field supervisor

(as well as Historic Archaeologist) and was responsible for keeping notes on all levels and features (well over 1,000 pages) as well as in charge of running the excavation. Homburg acted as Swanson's assistant, insuring that a high standard of excellence was consistently met. Both men met the challenge of their responsibilities with professional integrity and good humor.

The laboratory was set up by Dr. Prentice M. Thomas, Jr. Under the guidance of Dr. Thomas and myself, the lab washed, processed and catologued well over a million artifacts in less than three months. The operation was again headed by Homburg who was ably assisted by Ms. Barbara Ribling.

A major thrust of the Bug Hill project was aimed at obtaining and analyzing materials covering a wide range of research topics. In this endeavor, I have worked with a large number of highly trained specialists. While we did not always agree, we made sure that our disagreements remained at an intellectual level. The frank, and often heated, exchanges of ideas certainly sharpened my own notions about Bug Hill and I only hope my colleagues have benefited as much. All specialists working on the Bug Hill project are listed below.

Dr. William Johnson	University of Kansas	Palynology
Mr. Glen Fredlund	University of Kansas	
Mr. Larry Banks	Corps of Engineers, Southwest Division	Lithic Raw Materials
Dr. Kathleen M. Byrd	Louisiana Department of Culture, Recreation and Tourism	Zooarchaeology and Bone Artifacts
Ms. Andrea B. Shea	Tennessee Department of Transportation	Paleobotany
Mr. James Morehead	Independent Consultant	Lithics
Dr. Arthur Bogan	National Academy of Natural Sciences	Malacology
Ms. Cynthia Bogan	National Academy of Natural Sciences	
Dr. Donald Johnson	University of Illinois	Geomorphology
Dr. Jerry C. Rose	University of Arkansas	Bioarchaeology
Mr. Murray K. Marks	University of Arkansas	
Mr. Earl B. Riddick	Northwest Arkansas Radiology Associates	
Ms. Carol S. Weed	New World Research	Ceramics
Mr. Mark T. Swanson	New World Research	Historic Artifacts
Ms. Irene Stehle	DiCarb Radioisotopes	Radiocarbon dating
Dr. David Drucker	Geochron Laboratories	Radiocarbon Dating
Dr. R. Taylor	University of California, Riverside	Radiocarbon Dating
Dr. John E. Keller	Southern Archaeological Consultants, Inc.	Lithic Reduction Sequence

In addition to the specialists listed above, I would like to thank the community of archaeologists in Oklahoma. Among others, I had valuable discussions with Dr. Don Wyckoff, Dr. Bob Brooks, Dr. Rain Vehik, Larry Neal, Christopher Lintz, Mike Mayo, and Dan Rogers. I am especially grateful to Dr. Vehik of the Archeological Research and Management Center, who graciously allowed us to use all field notes, drawings, and other materials from ARMC's 1979 excavation of Bug Hill in our analysis. Furthermore, Dr. Vehik permitted Dr. Rose to re-analyze the skeletal material from 1979 and let us use the stratigraphic profiles of the 1979 block excavation in this report.

The production of this report was handled exclusively by the staff of New World Research. Dr. Prentice M. Thomas and Ms. L. Janice Campbell edited the report. Ms. Susan Keuer-Jones drew all the figures and developed all plates in the text. Ms. Jones also designed the cover, while Mr. A. Merrill Dicks is responsible for the cover drawings. Mr. Gregory Sands deJean, Mr. Steve Wightman and Mrs. Renee Morrison typed the report, and Ms. Carol S. Weed and Ms. Joyce Barnhill produced it.

Finally, I would like to extend a personal note of thanks to all the residents of the "Narrows" in the Upper Jackfork Valley. These people took us into their homes, cooked for us, helped us dig, and accepted us as family for three months. The story recounted in the following pages is their story, their heritage, and I only hope that the strength and pride they showed us is reflected in it.

JHA
Pollock, Louisiana

CHAPTER ONE

INTRODUCTION

The Bug Hill site (34Pu116) is located in the Jackfork Valley, an interior river valley of the Ouachita Mountains Province (Figure 1). The valley is formed by three mountains (Middle, Flagpole, and Wolf) that rise as high as 1000 ft (304.8 m) above the valley floor. The site situated at 580 ft (176.7 m) AMSL (Above Mean Sea Level), lies in the middle of the valley along a relict channel of North Jackfork Creek. Intermittent streams flow to the north of the site, while the confluence of the more permanent Jackfork and North Jackfork Creek is about 400 m southwest of Bug Hill (Figure 2).

The Bug Hill site is one of four midden mounds recorded in the late 1970s and early 1980s in the Jackfork Valley. While this site type is well documented in the northern part of the western Ouachitas, the location of four midden mounds as far south as the Jackfork Valley came as somewhat of a surprise. These sites, built up over thousands of years of occupation, are perhaps unique in their potential for studying long-term culture change and stability. This potential was not lost on the archaeological community. Interest in Bug Hill was heightened due to its position in the proposed floodpool of Sardis (Clayton) Lake[1]. The construction of Sardis Lake includes impounding

---

[1] In 1982, the United States Congress changed the name of the proposed reservoir from "Clayton" Lake to "Sardis" Lake in honor of the town which will be totally inundated. Unfortunately, nearly a decade of archaeological research has referred to the project as "Clayton Lake." While we will refer to the lake as "Sardis Lake," every effort will be made to refer to the area as the Jackfork Valley to minimize confusion.

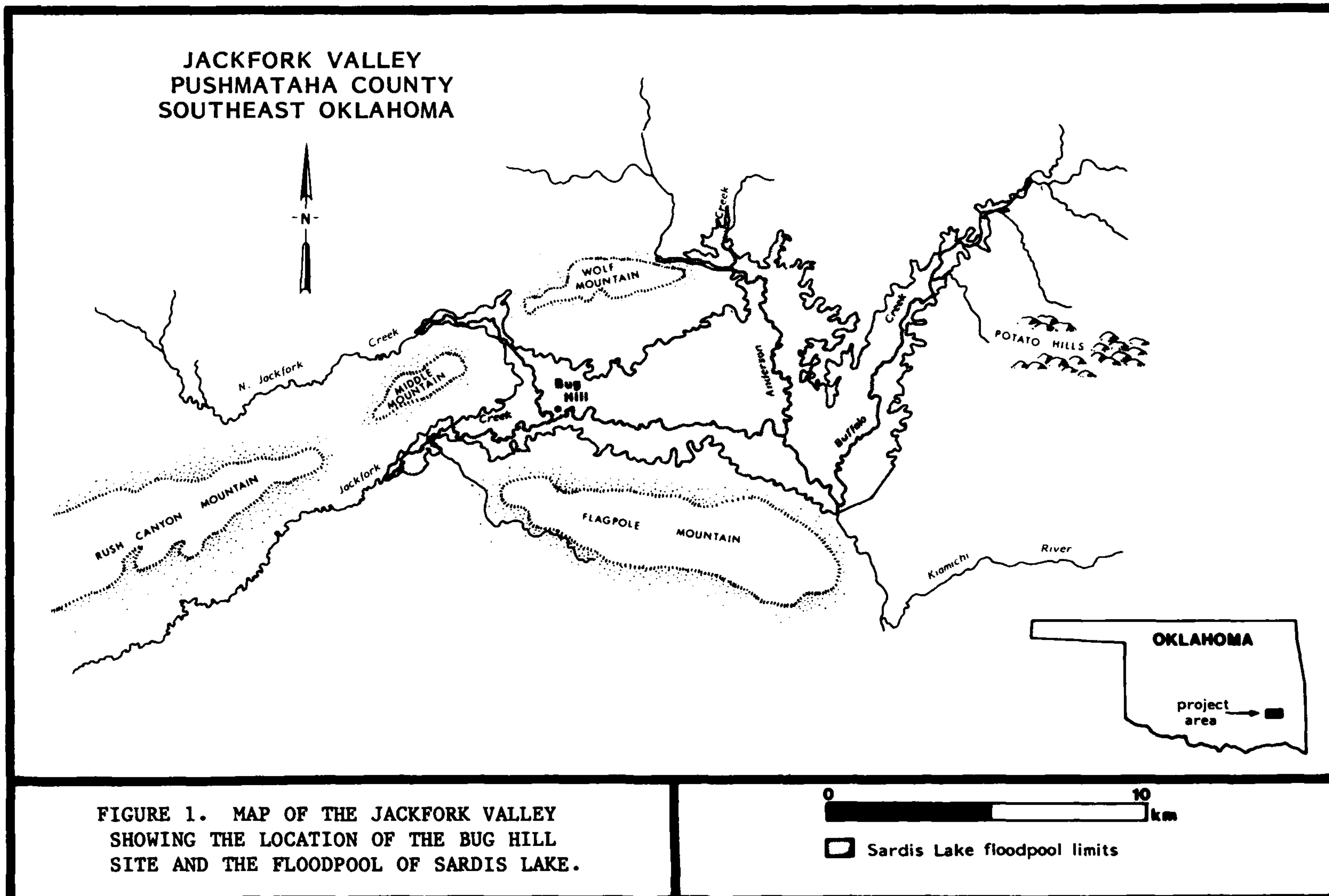


FIGURE 1. MAP OF THE JACKFORK VALLEY SHOWING THE LOCATION OF THE BUG HILL SITE AND THE FLOODPOOL OF SARDIS LAKE.

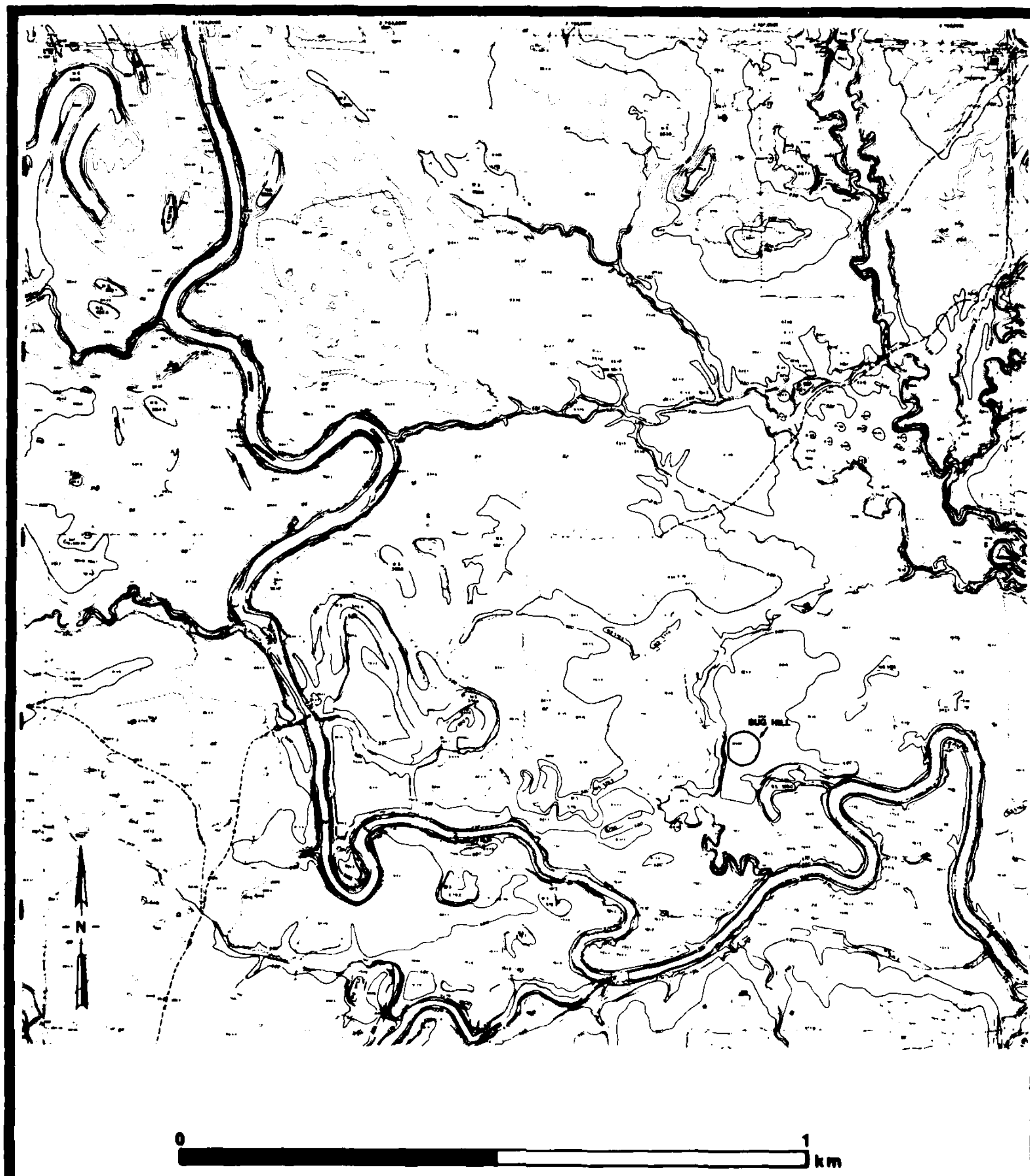


FIGURE 2. TWO FOOT CONTOUR MAP OF THE UPPER JACKFORK VALLEY SURROUNDING BUG HILL.

portions of Jackfork Creek, North Jackfork Creek, Anderson Creek, and Buffalo Creek. The dam, located on Jackfork Creek, 32 mi (51.4 km) downstream from its headwaters, will effect a 275 sq mi (712.2 sq km) drainage area. The result will be a lake with a surface area of 14,360 ac (5811.3 ha). The Bug Hill site will lie under 20 ft (6 m) of water and thus mitigation of adverse impact through data recovery was deemed necessary.

Since 1979 two major archaeological projects have been conducted at the Bug Hill site. This report presents the findings of the second of these projects, an interdisciplinary study of the cultural ecology of the Bug Hill Site. The study was conducted by New World Research, Inc. (NWR) under Contract No. DACW56-81-C-0144 with the Department of the Army, Tulsa District, Corps of Engineers (CE). Fieldwork was performed between September 1981 and January 1982 with analyses of the remains being completed by July 1983.

PROJECT OBJECTIVES AND REPORT ORGANIZATION

The 1981-1982 investigations at Bug Hill had two primary objectives: 1) to study the changing cultural-ecological relationships between the various occupations and the prevailing environmental conditions; and 2) to analyze Bug Hill's changing position in the various settlement systems of the Jackfork Valley.

In the most general terms, we wanted to understand why people for over 2500 years repeatedly occupied Bug Hill. To do so, we needed to answer a number of specific questions. Were environmental conditions relatively stable? Did subsistence strategies remain relatively constant? Were changes in subsistence strategies (if any) associated with technological and/or sociopolitical changes? Beyond site specific issues, we wanted to determine whether Bug Hill's position in the settlement structure of the Jackfork Valley changed over time and if so whether these changes were associated with valley-wide and/or regional trends.

To accomplish these goals, information on a variety of different cultural and environmental issues was needed. Thus, in conjunction with the analysis of archaeological remains, a number of specialized studies were conducted by independent consultants. Consultants were encouraged to incorporate Bug Hill into their own research. In the case of the bioarchaeological analysis and the raw materials study this research resulted in extensive studies which stand by themselves as independent research reports. The results of these studies that pertain to the archaeology of Bug Hill, have been condensed and are presented as subsequent chapters. The portions of these reports, however, that are of more specific interest to specialists are presented as Appendices.

The following report is organized in four sections. The first three chapters provide pertinent background information as well as a basic statement of our understanding of midden mound archaeology. Our research strategy and fieldwork results are then presented in Chapter Four. The third section comprises Chapters Five through Thirteen which detail the various specialized organic and material analyses. Chapters Fourteen and Fifteen relate the results of the fieldwork and the analyses to the original project objectives and present our final interpretations and conclusions.

ARCHAEOLOGICAL BACKGROUND

Previous Pertinent Investigation in the Jackfork Valley

Initial archaeological investigations in the Sardis Lake project area began in 1972 with a reconnaissance survey by Neal (1972). During a month-long survey, 31 prehistoric sites were recorded. A testing program was then devised and completed in 1976 (Bobalik 1977). This program involved limited test excavations and posthole excavations at 38 sites. These sites included the 31 recorded by Neal in 1972 as well as two additional sites located by the 1976 project and five of six sites recorded by a second reconnaissance survey conducted between December 1976 and January 1977 (Drass 1977: 595-657). Also at this time more extensive work was performed at the Sallee-G site, 34Pu99, prior to its destruction by dam construction (Bobalik 1978) (see Figure 3 for location of this and other recorded sites in the Jackfork Valley).

The results of the initial work indicated that the project area was occupied during five cultural periods; Archaic, Woodland, Early Caddoan, Late Caddoan, and Historic (Bobalik 1977: 555-574; 1978). The most intense utilization of Jackfork Valley seemed to be during the Late Archaic, Woodland, and Early Caddoan periods. Potential Paleo-Indian and Early Archaic components were indicated by surface remains, but no corresponding subsurface deposits were found. It should be noted, however, that the contracts between the CE and the Oklahoma Archeological Survey contained no provision for testing for deeply buried sites.

Overall, the initial work failed to determine the intensity and nature of the valley's occupation. In part this was due to the dense forest cover, the limited nature of the testing, the inability to establish chronological control, and the possibility that many sites were multicomponent. The preliminary work of Neal (1972) and Bobalik (1977, 1978) indicated that ceremonial centers, villages, and small, year-round habitation sites were absent in Jackfork Valley. Most sites seemed to be either long- or short-term base camps or special purpose (extraction) camps. In addition, many sites appeared to have housed specialized activities including lithic reduction, hunting, vegetal and other resource processing, and storage.

In 1978, the CE, Tulsa District, initiated Phase I investigations in the proposed Sardis Lake area. These investigations, conducted by

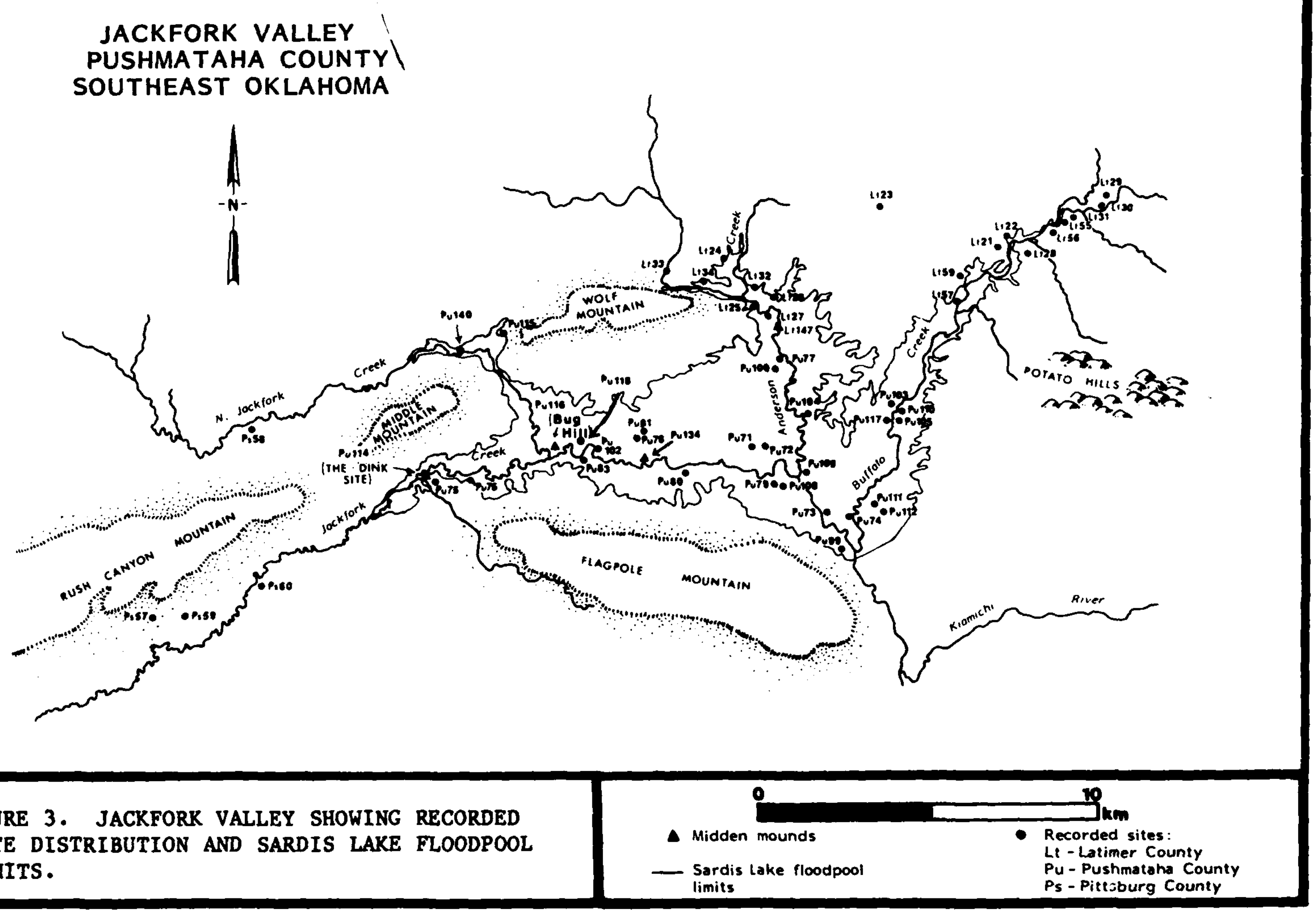


FIGURE 3. JACKFORK VALLEY SHOWING RECORDED SITE DISTRIBUTION AND SARDIS LAKE FLOODPOOL LIMITS.

the Archaeological Research and Management Center (ARMC) of the University of Oklahoma, concentrated on eight sites with the stated objectives being the development of a regional chronology and the assessment of site function (Vehik and Galm 1979). Several components could be securely dated to either the Fourche Maline phase of the Woodland period or the Early Caddoan period. Most of the excavations, however, yielded inconclusive results with undated Archaic, Woodland, or Caddoan components being defined.

To follow up unresolved problems, Phase II excavations were conducted at six sites in 1979. Three of these sites had been partly excavated in 1978. During the course of Phase II, the existence of two midden mounds in the Jackfork Valley was brought to the attention of the principal investigator, Rain Vehik. One of the sites, Bug Hill, was subsequently included in the Phase II investigations. The second midden mound, the Dink site (34Pu114), was visited but was not subjected to archaeological investigations.

Both the Bug Hill and the Dink sites are extremely similar in composition and cultural materials. Since 1979, two additional midden mounds have been reported to the CE (34Pu134 and 34Lt147). In 1981, the author visited one of these sites (34Pu134), which lies about 1.35 km east of Bug Hill. In appearance and surface information this site is no different than either Bug Hill or the Dink site.

The upper Jackfork Valley area is optimally located near a number of ecological zones. It is somewhat surprising, therefore, that only four midden mounds have been reported. While similar sites may still be unrecorded, it is also possible that this situation reflects cultural factors, such as a strong concern with territoriality, defense or proximity to lithic outcrops.

Given these factors, it was anticipated that excavations at Bug Hill would very likely yield important data for understanding local and regional prehistory. Prior to the 1979 ARMC excavations, a site contour map was produced and a horizontal grid, oriented north-south, was imposed over the site. Thirteen 2 m x 2 m squares (52 sq m) and four 1 m x 1 m squares (4 sq m) were systematically excavated and three backhoe trenches of varying lengths and depths (24 sq m) were mechanically cut. Including the backhoe cuts, 2.4 percent of the site was excavated. However, because the backhoe cuts were primarily aimed at obtaining a better understanding of the nature and composition of the mound, they were only monitored for burials and cultural material prior to having their profiles drawn. Consequently, only 56 sq m (or 1.6 percent of the site) were actually excavated by hand, of which 24 sq m were concentrated in one section of the mound.

Though the excavated area was small, the amount of cultural material recovered was imposing. Most excavation units had cultural deposits over 1.5 m thick, with those in the east-central part of the mound reaching depths of over 1.8 m. The midden was rather homogenous in composition and only four modest changes in silt loam were recorded. The natural levels could not be correlated with specific cultural components.

The 1979 excavations uncovered a variety of cultural features from nearly every level, including rock concentrations, ash/clay concentrations, post molds, pits, and burials. In addition to features, the midden was rich in cultural materials, as evidenced by over 275,000 lithics, 102 groundstone fragments, 87 miscellaneous stone pieces, 372 sherds, as well as pieces of baked clay, copper (1), worked bone (192), worked antler (82), worked shell (27), and miscellaneous historic artifacts (110). In addition, over 250,000 vertebrate remains, 768 identifiable mussels, and 13,871 gastropods were recovered (Vehik 1982a).

The 1979 excavation established Bug Hill as an accretional midden mound. From the artifacts recovered four distinct cultural components were defined corresponding to the Late Choctaw, Early Caddoan, Woodland, and the Late Archaic periods. Given the small area excavated very little could be concluded about intrasite spatial or temporal variability, settlement/subsistence patterning, or intersite relationships. Vehik (1982a) suggested that Bug Hill was used either as an intermittent base camp or special purpose site throughout its history. Regardless of the cultural occupation, the primary activities seemed to have centered around manufacturing lithic implements and acquiring and processing floral and faunal resources.

Besides the inability to resolve basic time/space issues, the 1979 excavations at Bug Hill also raised several new problems. One of these problems had to do with human burials. In all, evidence for 13 human interments was recovered, of which nine were either infants or children. Due to the small area uncovered, the representativeness of this sample was questioned. Furthermore, because the midden was rather homogeneous, it was simply not possible, except in a few cases, to establish the chronological relationships of the burials.

SUMMARY

The 1981-82 Bug Hill project built on nearly ten years of research in the Jackfork Valley. For the most part problems associated with chronological ties and cultural affiliation had been worked out. Other problems, however, still remained. Some of these focussed on unknowns about Bug Hill itself. But the majority of issues the 1981-32 project intended to address had less to do with the specific site than the type of site under investigation. In the next chapter we will explore some of the issues and problems common to all sites of this type. These, then, will form the underpinnings of our research strategy.

CHAPTER TWO

RESEARCH ORIENTATION

MIDDEN MOUND ARCHAEOLOGY

To a large extent, investigation of Bug Hill is important not only in terms of what the data will say about the people who lived there, but also in terms of how these data can be related to similar sites. As such, the orientation of this study was toward understanding the cultural ecology of the site as well as its wider regional implications: in particular to examine some of the confusion surrounding the chronology, function, and temporal change at midden mounds, of which Bug Hill is but a single example.

One of the topics of major interest to archaeologists working in the Ouachita Mountains has been the nature and cultural affiliation of a type of site widespread throughout the region: the black midden mound. Sites of this type, variously called "black knolls" or "black mounds" by local residents, have been found distributed along the banks of streams of many of the river valleys of the Ouachitas. While varying in size, these mounds share a number of common traits. They are all accretional formations, the result of midden deposits accumulating over many generations. They are all further distinguished by a dark, greasy soil which is the main component of the midden. Finally, they are all characterized by tremendously rich artifact and organic material collections.

Archaeologists have been drawn to midden mounds in eastern Oklahoma and western Arkansas for over 40 years primarily because of this last characteristic. Between 1939 and 1942, the Works Progress Administration (WPA) sponsored a program of survey and excavation on at least 24 sites, 18 of which were black midden mounds, along the Poteau River and Fourche Maline Creek in the area of present-day Wister Lake in eastern Oklahoma. At the same time, WPA sponsored excavations took place at four sites in southwestern Arkansas; three of these sites, the Means, Cooper and Poole sites, were similar in nature to the midden mounds of the Wister Valley (Dellinger and Dickinson 1941; Dickinson and Dellinger 1941; Schambach 1970; Wood 1963).

The WPA excavations produced several tons of cultural materials, a stockpile of fieldnotes and records, but few published reports (cf. Newkumet 1940a, 1940b, 1940c, 1940d, 1940e). Much of the post-WPA period has been spent sifting through these materials and records. Published analyses now exist for several of the WPA excavations including the Sam (Proctor 1957), Wann (Sharrock 1960), Copeland (Guilinger 1971) and Williams I (Irvine 1980) sites from the Wister Lake area and the Poole (Wood 1963), Cooper and Means sites (Schambach 1970) from southwest Arkansas.

Since World War II, most archaeological research in southeast Oklahoma has been in response to water control projects (see Figure 4 for areas of intense investigations). Midden mound excavations have continued, but on a somewhat sporadic basis. Much of this work has remained centered in the Wister Lake region. Bell (1953; Bell and Baerreis 1951; Williams 1953) conducted excavations at the Scott site among others in the late 1940s. More recently, Wyckoff (1976; Wyckoff and Woody 1977; Powell and Rodger 1980) directed work at the McCutchan-McLauglin site, while at about the same time, Galm supervised additional excavations at the Scott and Wann sites and portions of a third midden mound, the Curtis Lake site (Galm and Flynn 1978a, 1978b; Galm 1978a, 1978b, 1981; Mayo 1975).

Archaeologists, thus, have retained their interest in midden mounds. Yet, this interest has been somewhat of a mixed blessing. While we know vast amounts about the material remains contained in these mounds, we actually know very little about the inhabitants who produced them. In part, this situation is due simply to the mass of material generated by any single excavation. Given the lack of stratigraphic breaks and the apparent longevity of the sites, it has been virtually impossible to distinguish meaningful cultural components. The result has been an undue emphasis on the artifacts and other cultural traits themselves with much less consideration given to the type of social unit or units represented.

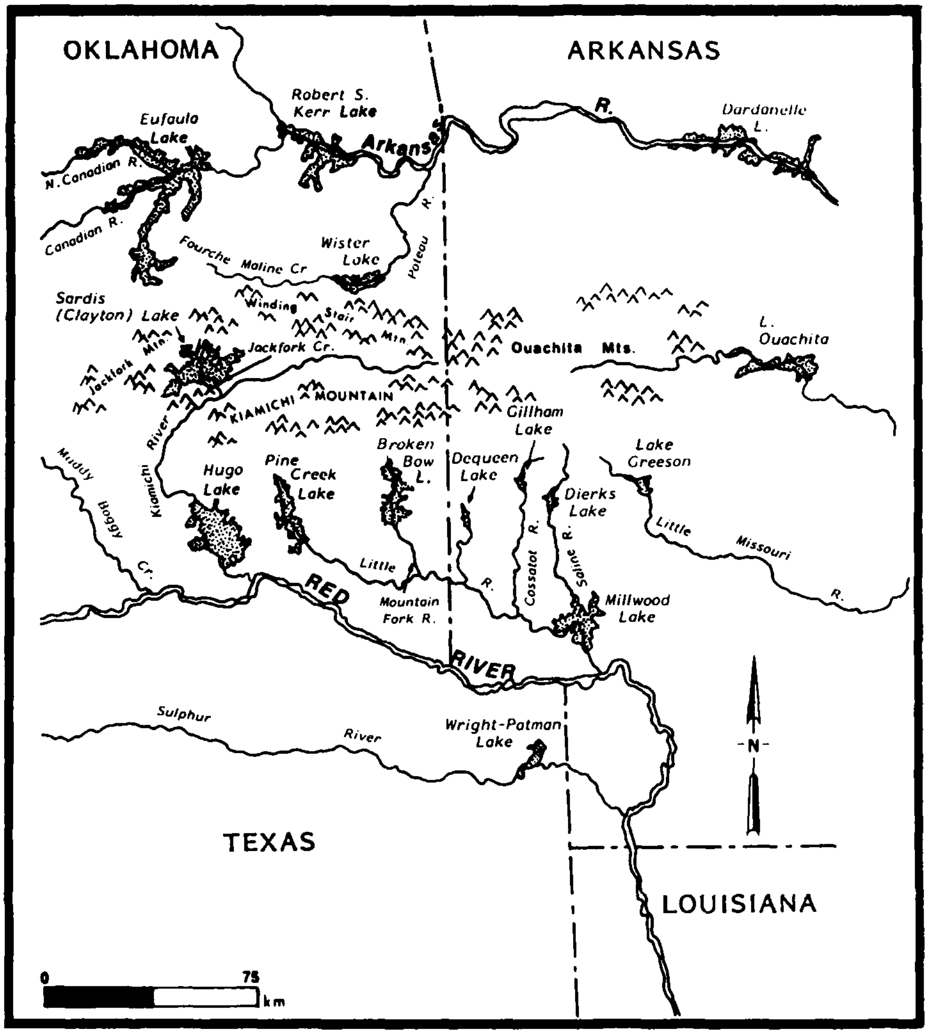


FIGURE 4. MAP OF THE OUACHITA MOUNTAINS SHOWING RESERVOIRS WHERE MAJOR ARCHAEOLOGICAL INVESTIGATIONS HAVE BEEN CONDUCTED.

PROBLEMS WITH THE FOURCHE MALINE

From the start of the WPA projects, archaeologists recognized the unique status of midden mounds in the prehistory of the Ouachitas and the larger Caddo region. As early as 1946, Newkumet suggested grouping the Wister Lake midden mounds into a complex which he designated the Fourche Maline focus (Kreiger 1947:198-202). Bell (Bell and Baerreis 1951:19-27) produced the first full definition of the Fourche Maline in 1951 consisting primarily of a composite sketch of the major traits exhibited by the excavated sites. Salient traits included accretional mounds composed of black, greasy midden soil; human burials placed throughout the deposits with no apparent body orientation, grave goods or burial pit; dog burials (rare); a chipped stone industry dominated by projectile points; various groundstone, worked bone and worked shell implements; and a ceramic industry dominated by a thick, granular plain ware (Williams Plain). Bell placed the focus in the Woodland horizon with ties both to the Archaic and latter Caddoan periods.

Although perhaps not meant to be, Bell's characterization still remains largely unaltered as the basic definition of the Fourche Maline. In his description, all occupations of a midden mound are treated as equivalent units of the Fourche Maline. That is, each site is viewed as a single, continuous component. As a consequence, the Fourche Maline appears to last an extremely long time, starting sometime in the Late Archaic as indicated by pre-pottery levels near the base of the mounds and not ending until the Gibson Aspect of the Caddoan period based on diagnostic ceramics found near the top.

The chronological problems inherent in Bell's Fourche Maline construct were apparent immediately. As Bell (1953:331) himself wrote in the conclusions of the Scott site report,

> ...the Fourche Maline focus as it...[has] been recognized is either not a single complex or...it existed with some modifications over a long period of time from an Archaic pre-pottery period through early Woodland, and possibly longer. At the present time, it is not possible to clearly differentiate time or cultural differences because of inadequate data. With a detailed comparative analysis of individual Fourche Maline sites, a clearer picture will become available.

Unfortunately, despite numerous attempts, the last 30 years of research have not greatly clarified this picture (see Proctor 1957; Sharrock 1960; Wyckoff 1970a, 1976; Guilinger 1971; Galm 1978a, 1978b, 1981; Galm and Flynn 1978a, 1978b; Vehik 1982a). To a large degree, these attempts have all been stymied by a lack of recognizable occupation floors or clear stratigraphic breaks. Researchers have been forced to develop chronologies either by comparing relative frequencies of various traits throughout the midden of a single site or by relying on the assumption that each site represents a single, continuous component, and examining traits between the sites themselves. In either case, the analyses have been largely unsuccessful. Due to the tremendous amount of mixing and churning endemic to these sites, it has been impossible to segregate meaningful cultural components within any specific site. At the same time, using the site as the unit of analysis has proved to be of limited utility because all sites overlap in their occupational histories.

The problems with the Fourche Maline construct magnified when researchers outside the Ouachitas tried to utilize the concept in examining regional trends. Johnson (1962) identified the Fourche Maline focus as the northern segment of the La Harpe Aspect. This aspect supposedly represents an Archaic period culture, or group of related cultures, which extended in a north/south belt throughout east Texas and southeast Oklahoma. These cultures are believed to have undergone roughly uniform historic developments from the Early Archaic until the onset of the Caddoan period (Johnson 1962:143-44). From work in the Broken Bow and Pine Creek reservoirs in southeast Oklahoma, Wyckoff identified and excavated a number of sites with components assigned to the La Harpe Aspect (Wyckoff 1965, 1966, 1967a, 1967b, 1967c, 1968a, 1968b, 1970a, 1970b, 1974). Within the aspect, Wyckoff established a number of complexes, one of which, the Lamas Branch complex, was rather similar to the Fourche Maline focus. According to Wyckoff, the apparent similarities were due to proximity and contemporaneity. Thus, by implication, Wyckoff put the bulk of the Fourche Maline focus squarely within the Late Archaic.

At about the same time Wyckoff was working in southeast Oklahoma, Schambach (1970) and Hoffman (1969, 1970a, 1970b) identified a series of pre-Caddoan materials from sites in the Little River drainage and mid-Ouachita regions of southwest Arkansas as Fourche Maline. Schambach (1970) differentiated this material from that of the Wister region by referring to the Arkansas sites as part of the Lowland Fourche Maline culture, while the Ouachita sites were considered part of the Highland Fourche Maline. This distinction allowed for the apparently greater influence exerted by the Marksville centers of the Lower Mississippi Valley on Lowland Fourche Maline sites as opposed to the relative cultural isolation exhibited by the sites in the Ouachitas. Schambach, thus, clearly emphasized the 'ceramic' nature of the Fourche Maline. As he (Schambach 1970:411) states,

> The 'old' Fourche Maline [i.e. Bell's 1951 definition] is, as far as I can tell, generally conceived of as a predominantly Archaic culture that took on pottery around the time of Christ and lasted otherwise unchanged, in its essential Archaicness [sic], right up to the inception of Caddoan culture (Proctor 1957; Sharrock 1960). This concept is clearly based on evidence, or what might better be called non-evidence, from the Fourche Maline Creek sites. These are deep sites with four feet or more of midden...Evidently, it was not possible to separate this material into discrete assemblages so all of it was thrown into Fourche Maline...
>
> Since there is good evidence at Cooper and unequivocal evidence at Means that these and other Archaic projectile points did not last into the... [Fourche Maline], I will run the slight risk of assuming the same thing is true of eastern Oklahoma. I am, therefore, stripping the Fourche Maline of all its Archaic and other accouterments and setting it forth anew, based only on the traits assigned to it at Cooper and Means.

Given the confusion surrounding the concept, it is not surprising that Fourche Maline sites have been identified as far north as

Cherokee County, Oklahoma (Hardin and Robinson 1975), east along the Arkansas drainage and mid-Ouachita region of Arkansas (Hoffman 1969; Schambach 1970, 1982), south to the Red River (Bobalik 1978) and west into Latimer County, Oklahoma (Shaeffer 1965; Prewitt 1974). In each case, the exact Fourche Maline traits linking the area in question with the type sites in the Wister Valley differ. The situation has now come to a point where the term Fourche Maline is context dependent, meaning different things to different people.

Archaeologists now have finally reached an impass; either we drop the concept of the Fourche Maline or we refine it into a meaningful construct. In general, there are two basic problems. First, the Fourche Maline extends over too long a time period and either must be temporally restricted or subdivided into a number of shorter phases. Second, the focus was defined originally with reference to one particular type of site, the midden mound, and does not take into account contemporaneous settlement patterns or changes in those patterns over time.

Thus far, archaeologists have been unable to subdivide midden mound material into anything more than crude cultural components, based primarily on the presence or absence of pottery (cf. Schambach 1982, for a detailed synthesis of the Arkansas material). Recently, Bell (1980:119-20) tried to systematize these differences by proposing a three-fold division of the Fourche Maline focus. Three phases were identified for the Wister area: an early pre-ceramic phase representing Late Archaic occupations, known as the Wister phase (pre-A.D. 100); a subsequent intermediate interval, termed the Fourche Maline phase (A.D. 100-700/800), characterized by the introduction of ceramics, but lacking developed Caddoan traits; and a final phase of Caddoan reoccupation (post-A.D. 800).

Bell's sequence is based on the assumption that the postulated changes in material culture (e.g. the introduction of ceramics) reflect disjunctive cultural processes. To date, midden mound excavations have produced no evidence supporting this position. Traditionally, this negative evidence has been viewed as indicative of the extreme cultural and adaptive stability characterizing the occupation of these mounds (Galm and Flynn 1978a, 1978b; Galm 1981; Wyckoff 1970a, 1974).

Bell's sequence is useful if one divorces the underlying developmental assumptions and treats it simply as a chronological framework. Indeed, there is tremendous merit in systematizing the sequence so that what is meant by the Fourche Maline is the same everywhere. One must remember, however, that the boundaries are more-or-less arbitrary, based more on archaeological needs than culture change.

The 1981-82 Bug Hill project applied Bell's Wister Valley sequence to the Jackfork Valley. In the following chapters we refer to the Wister phase of the Lake Archaic period and the Fourche Maline phase of the Woodland period in discussing our results. During the Caddoan period cultural affiliation and therefore phase designations are more difficult to assign. Previous work has shown that cultural manifestations from the Jackfork Valley dated to the Caddoan period have ties to both the Red (Hochatown and Sanders phases) and the Arkansas (Harlan and Spiro phases) River drainages (Galm and Vehik 1979; Vehik 1982a; 1982b). For purposes of this report, we have found it simplest and least confusing to divide the Caddoan period between Early (ca. A.D. 900-1200) and Late (post A.D. 1200). In the few cases when a more refined chronological control is needed (e.g. Chapter Thirteen) phase designations Caddo I-V will be used.

The fuzziness surrounding the definition of the Fourche Maline points up a more basic theoretical issue; that is, determining the role of midden mounds in a settlement system and analyzing whether this role remained the same or changed over time. If we could demonstrate that the focus of various occupations differed, then we might be able to associate these changes with more general cultural shifts. From this perspective, we could evaluate whether proposed cultural differences, such as the distinction between the Wister phase and the Fourche Maline phase make "functional" sense.

There are two aspects to resolving this issue. The first involves reconstructing settlement patterns in large physiographic regions. These patterns document not only locational preference, but also changes in the range and frequencies of various site types over time. Although large numbers of sites were located in both the Jackfork and Wister valleys, in neither case were surveys systematic or complete (cf. Galm 1978a; Bobalik 1977). Indeed, this lack of a complete survey combined with the dense forest cover prevalent in both areas make it really quite remarkable that so many sites were found.

In addition to the lack of settlement data, the chronological problems associated with midden mounds extend over into surrounding single component sites. In the past, the tendency has been to call all non-ceramic sites Late Archaic, all sites with decorated ceramics Caddo and everything else Fourche Maline. The lack of reliable patterns from these areas, then, should come as no surprise (see Galm 1978a; Bobalik 1977).

The second aspect of this problem concerns the midden mounds themselves. Traditionally, these sites have been viewed as semi-permanent base camps (see Bell and Baerreis 1951; Bell 1953; Wyckoff 1970a, 1980; Galm 1978a, 1978b; Galm and Flynn 1978b). But as Galm (1981:212) has recently pointed out, the use or repeated use of a mound as a base camp could effectively "mask" other types of less intensive occupations, such as hunting bivouacs or fishing camps. Over the occupational history of any single midden mound, the site may have served as the locus of scores of transient camps, yet hosted only a few base camp settlements.

MIDDEN MOUND ARCHAEOLOGY AND BUG HILL

Throughout this section, there has been one recurrent theme: the inability to "see" within a midden mound. Despite their richness, their longevity, and the large number of excavations, our understanding of midden mounds and their position in larger settlement systems has not progressed beyond preliminary statements made over 30 years ago. There is still no concensus as to whether midden mounds represent one culture or whether various internal occupations reflect different ones. The problem is not a lack of data, but, instead, not knowing how to group the data already available.

Our failures to resolve these issues are, in part, due to the inability to recognize occupational floors or stratigraphic breaks. Most archaeologists have been resigned to lump all deposits together, viewing a mound as the result of repeated occupations that were extremely stable and similar in nature. This interpretation fails to recognize that repeated use of the same locale by vastly different types of occupations could also result in a midden mound. Many of the mounds were occupied for over a thousand years and even in a very conservative culture it is extremely unlikely that change did not occur. The fundamental problem in midden mound archaeology is that because we cannot "see" where we are in a midden mound, we are unable to determine the "rate" of change.

The excavations at Bug Hill could not be expected to resolve all the issues discussed above. What was expected was a research design geared toward isolating occupational surfaces, dating those surfaces and tying the various occupations into the larger Jackfork settlement system as a whole. The extent to which we were successful in this endeavor is documented in the remainder of this report.

CHAPTER THREE

GEOMORPHIC SETTING[1]

Donald Lee Johnson

INTRODUCTION

The geomorphological study at Bug Hill was directed at two goals: 1) to establish site formation process and natural/cultural soil and stratigraphic control across the site; and 2) to document the Middle and Late Holocene fluvial history of Jackfork Creek and North Jackfork Creek in the vicinity of Bug Hill. The information gained helped us to understand how Bug Hill was formed and to determine the geomorphic conditions prevailing at the time of occupation. These interpretations, then, guided the placement of excavation units and the interpretation of their stratigraphy.

---

[1] The following chapter is abstracted from two reports prepared by the author for the CE, Tulsa District, under a separate contract from the 1981-82 archaeological investigation. The reports represent a major contribution to the geomorphology of the area and have been combined with minor editing with permission of the author.

SOIL GEOMORPHIC INVESTIGATION

Site Setting

The Jackfork Valley and the mountains that define it lie within the Ouachita Mountains structural province of east-central Oklahoma. The valley is rather narrow to the west (where Bug Hill is situated) but broadens downstream (eastward) to more than 6 km (4 mi) where Anderson Creek joins Jackfork Creek. Within Jackfork Valley, a broad, Late Pleistocene/Holocene terrace occurs which has a surface elevation of approximately 177 m (580 ft). This terrace, referred to as the "outer floodplain" by Nials (1979), is referred to hereafter as the Jackfork Terrace. The Bug Hill midden mound rests upon this terrace and rises about 1.5 m (5 ft) above it. A number of mound microrelief features ('mima' or 'pimple' mounds) occur on this terrace (and on presumed bedrock remnants) at various places within Jackfork Valley. These mounds appear as circular features on close interval contour maps such as Figure 2; they rise a meter or more above the terrace and range from 6 m to 15 m in diameter.

Field Methods

Geomorphic investigations at Bug Hill consisted of obtaining and describing eleven soil profiles. Ten of these were taken on the mound (Numbers 1-10), while one was obtained off the mound (Number 11) and presumably represents a normal non-anthropic terrace soil. Several additional "normal" terrace soils were examined in natural exposures in the area, and it was by this means that Profile Number 11 was judged to be a typical terrace soil not affected by human occupation.

Seven of the profiles (Numbers 1-4, 7 and 10-11) were described and sampled from 5.7 cm (2.25 in) diameter cores pulled with a portable hydraulic coring rig (Johnson and Alexander 1976; 1977). The other four (Numbers 5-6, 8-9) were from pre-existent backhoe trenches reopened by the CE for this purpose. The combined core and trench sampling strategy proved to be essentially non-intrusive. The trade-off in disadvantage, however, is that a 5.7 cm diameter core provides a very limited view of the pedon and polypedon (soilscape). Many features that are observable in pits and natural exposures may very well be missed in a core.

Cores were described and sampled on the site as soon as they were pulled. Cores and trench profiles were sampled by horizon at 10 cm increments, packaged and shipped to the laboratory.

The locations of all 11 profiles are given on the map of Figure 5. Although the profiles were made prior to the 1981-82 field season, we have superimposed the transit-generated grid and locator data onto the final contour map of the site to show the spatial relationship between these cores and all test units.

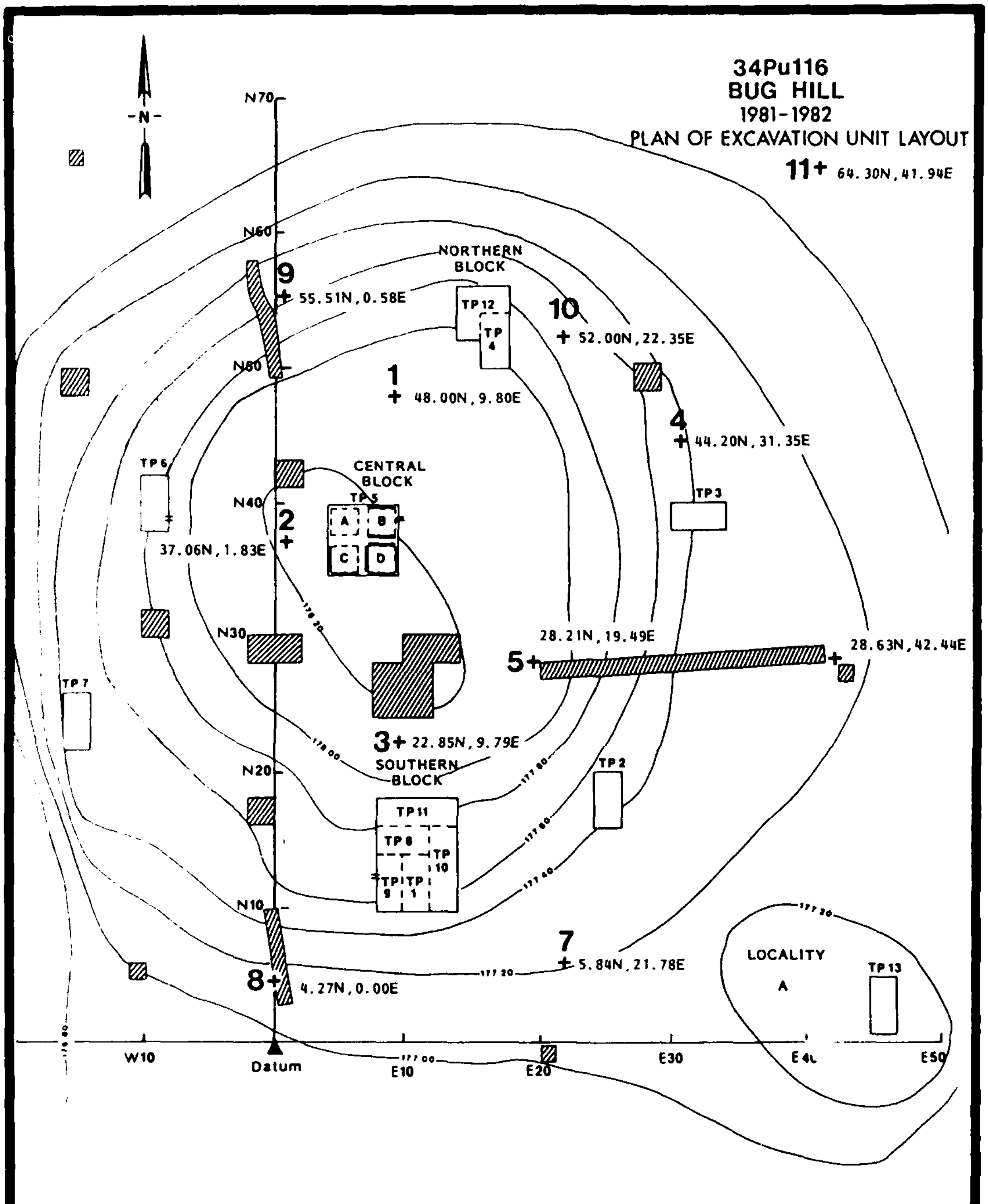


FIGURE 5. SOIL CORE LOCATIONS SUPERIMPOSED UPON THE SITE MAP OF BUG HILL.

0 25 m

- Waterscreened columns
- = Pollen columns
- University of Oklahoma's 1979 test pits and trenches
- + Johnson's soil cores

Laboratory Methods

Laboratory methods included particle size analysis (hydrometer method), pH (1 part soil, 2 parts H_2O), cation exchange capacity (titration method), calculated percent base saturation, organic matter analysis (Walkey Black method) and phosphorus (P2, or strong Bray).

Results

The character of the soils at the Bug Hill site proper are highly reflective of the predominating influence of aboriginal humans and the organic rich debris which they accumulated here. The soils are, in general, very high in organic matter (Figure 6) and have relatively high base saturations (Figure 7). Nevertheless, a pattern is discerned in the data that shows that the 11 soils analyzed fall clearly into three populations: those that occur on the highest part of the mound (i.e., the thickest midden soils, Numbers 1-5); those that occur on the side slopes of the mound where the midden material is thinner (Numbers 6-10); and Number 11 which is off the mound (see Appendix I for soil descriptions of representative cases of each population). These three populations are, respectively, identified as populations A, B and C and are most apparent in the pH and base saturation relationships (Figure 7). It is probably most instructive to first examine Profile 11, the sole population C member, because it is free of any midden material, and represents a normal soil for the Holocene Terrace upon which it has developed.

Population C Soils, Aquic Hapludalfs

Profile 11 has the best expressed argillic horizon (Figure 8), is most acid (pH 4.8 - 5.3), has the lowest base saturation and cation exchange capacity (52 percent and 3.9, respectively) (Figure 9) and the lowest organic matter content. In fact, this soil is completely unlike Population A and B soils. It is classified as an Aquic Hapludalf, whereas the others are classified as either Cumulic (anthropic) Hapludalfs or Mollic Hapludalfs. Pedons on this terrace away from the Bug Hill site are very similar to Profile 11 in that they also have strongly expressed profiles (eluvial and argillic horizons, many moderately thick clay films, 7.5YR matrix hues).

Population A Soils, Cumulic (Anthropic) Hapludalfs

Profiles 1 - 5 constitute population A soils and occur in the highest and deepest parts of the midden deposits. They are both chemically and physically distinct from population B and C soils. They have the highest cation exchange capacities, essentially 100 percent base saturations and have the greatest organic matter accumulations (Figures 6, 7, and 9). Likewise, they are the most alkaline in reaction (Figure 7) and tend to react strongly or violently under cold dilute HCl. They differ texturally from B and C populations in that clay increases with depth, peaking at 110 - 180 cm, then decreases. Conversely, clay in the B and C profiles peak at about 75 cm depth,

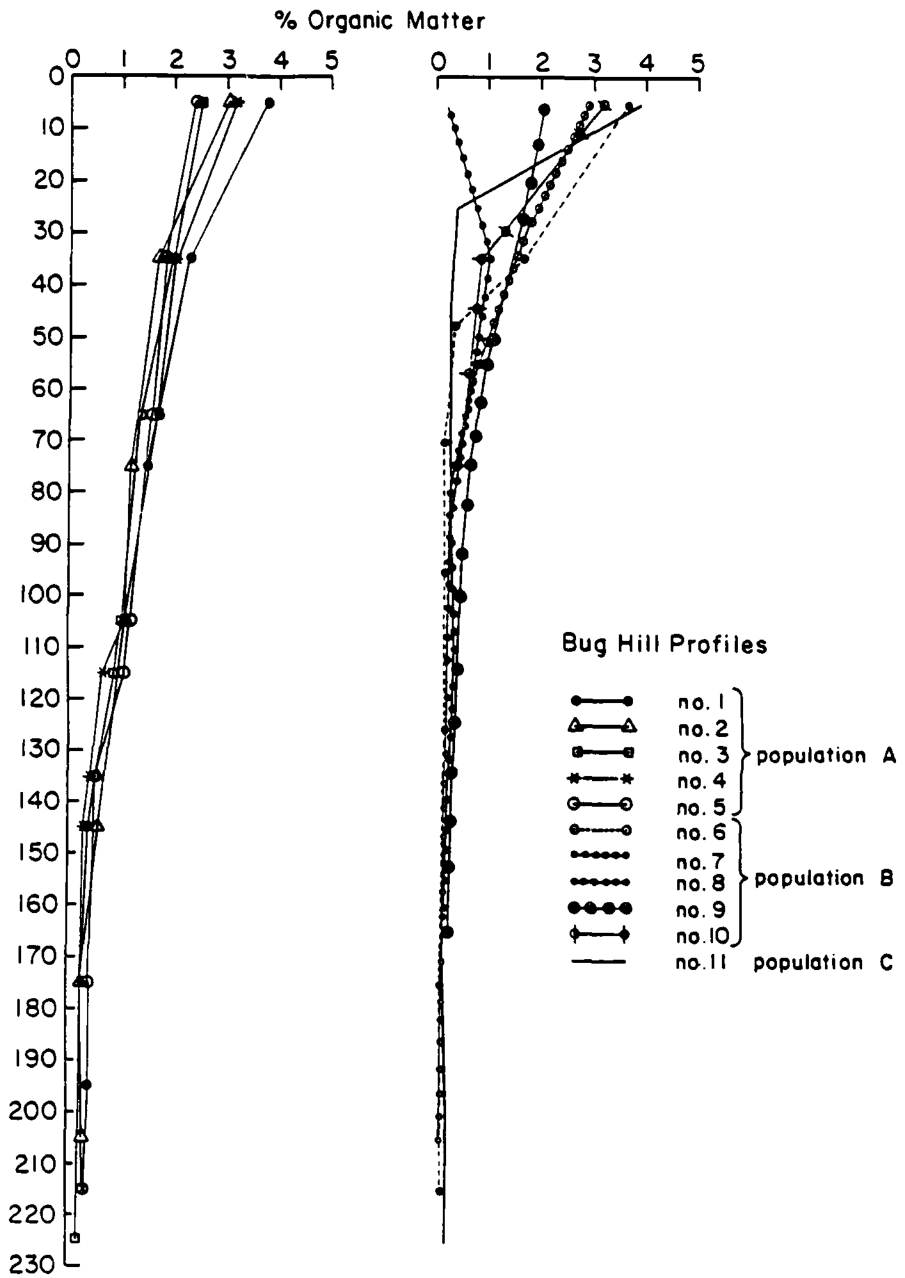


FIGURE 6. SOIL PROFILES BY PERCENT OF ORGANIC MATTER.

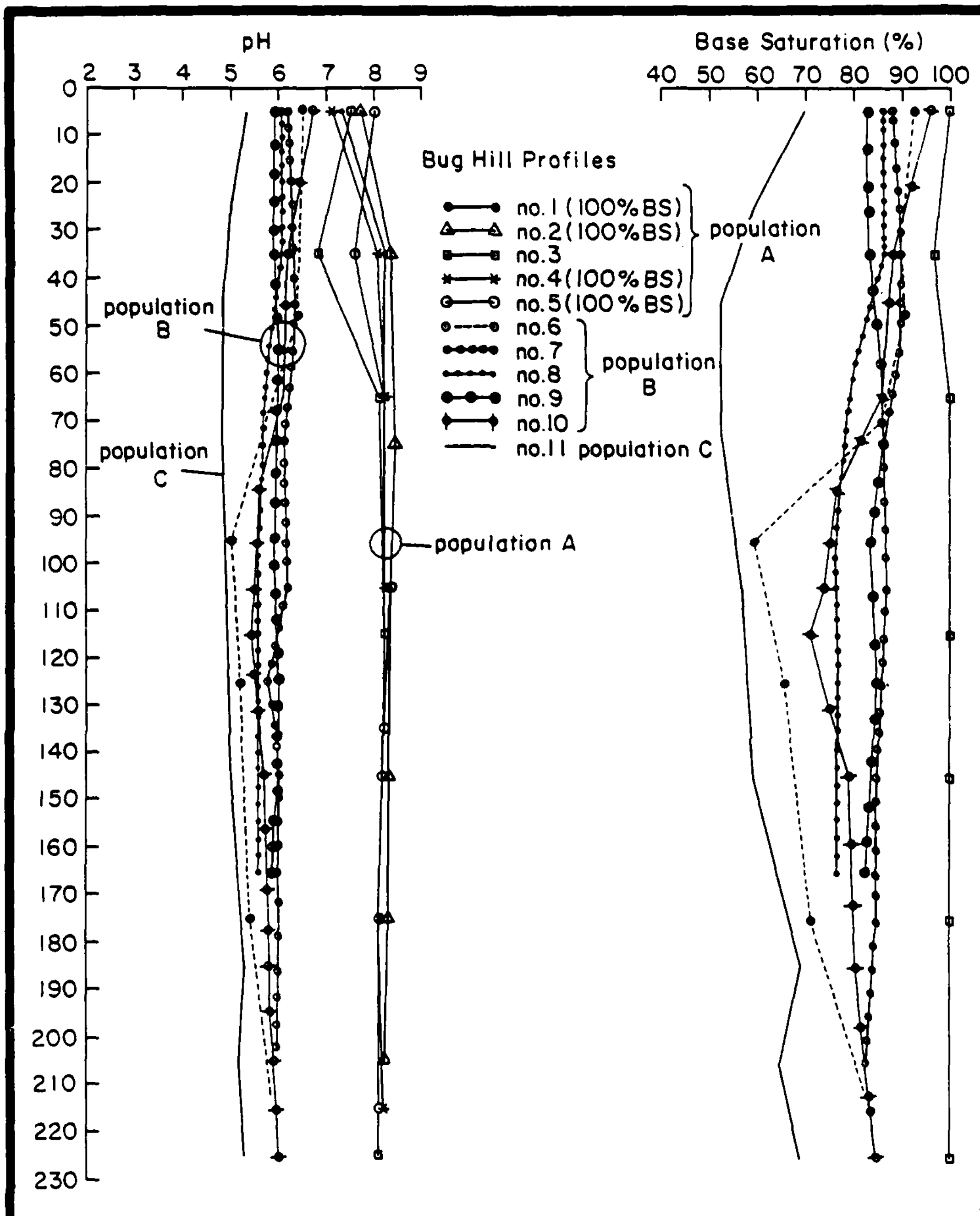


FIGURE 7. SOIL PROFILES BY P_H NUMBER AND PERCENT OF BASE SATURATION.

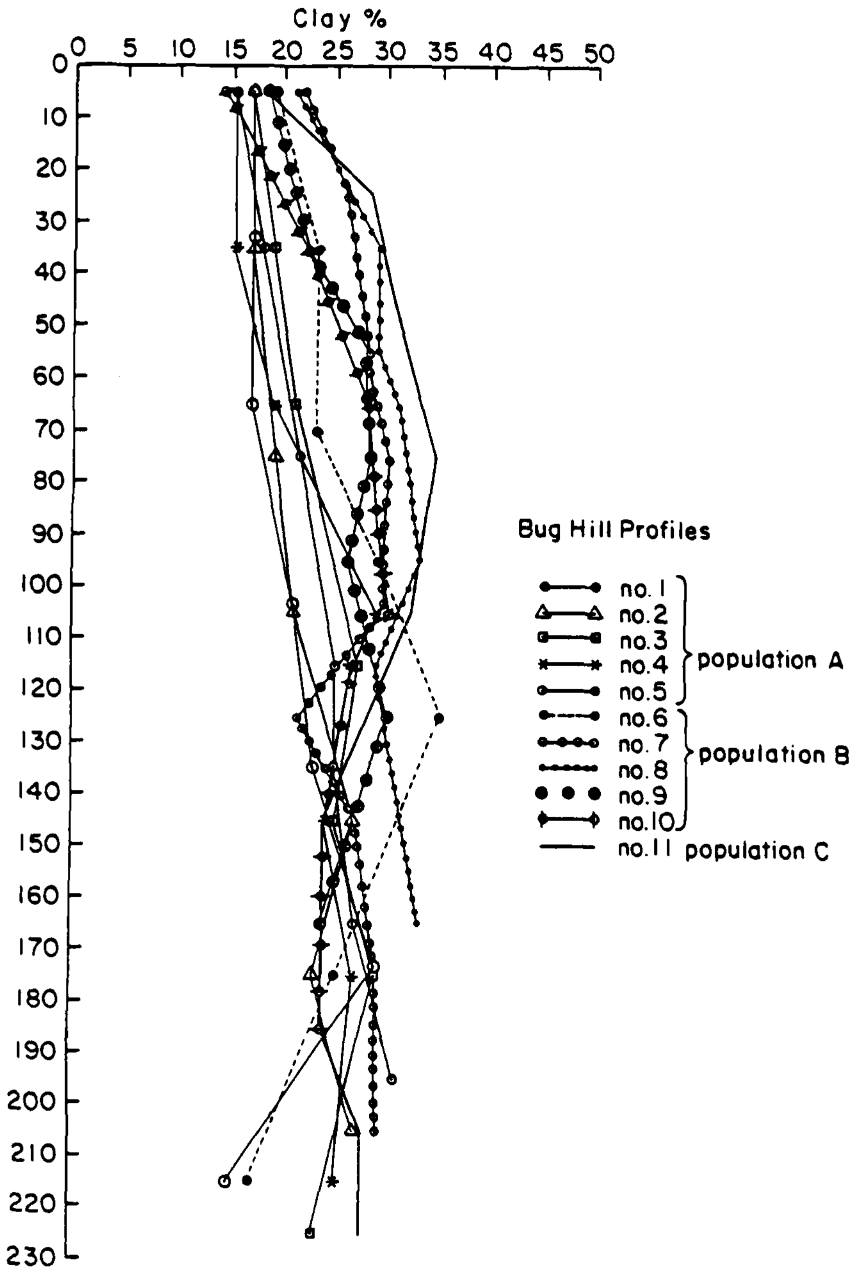


FIGURE 8. SOIL PROFILES BY PERCENT OF CLAY (ARGILLIC HORIZON).

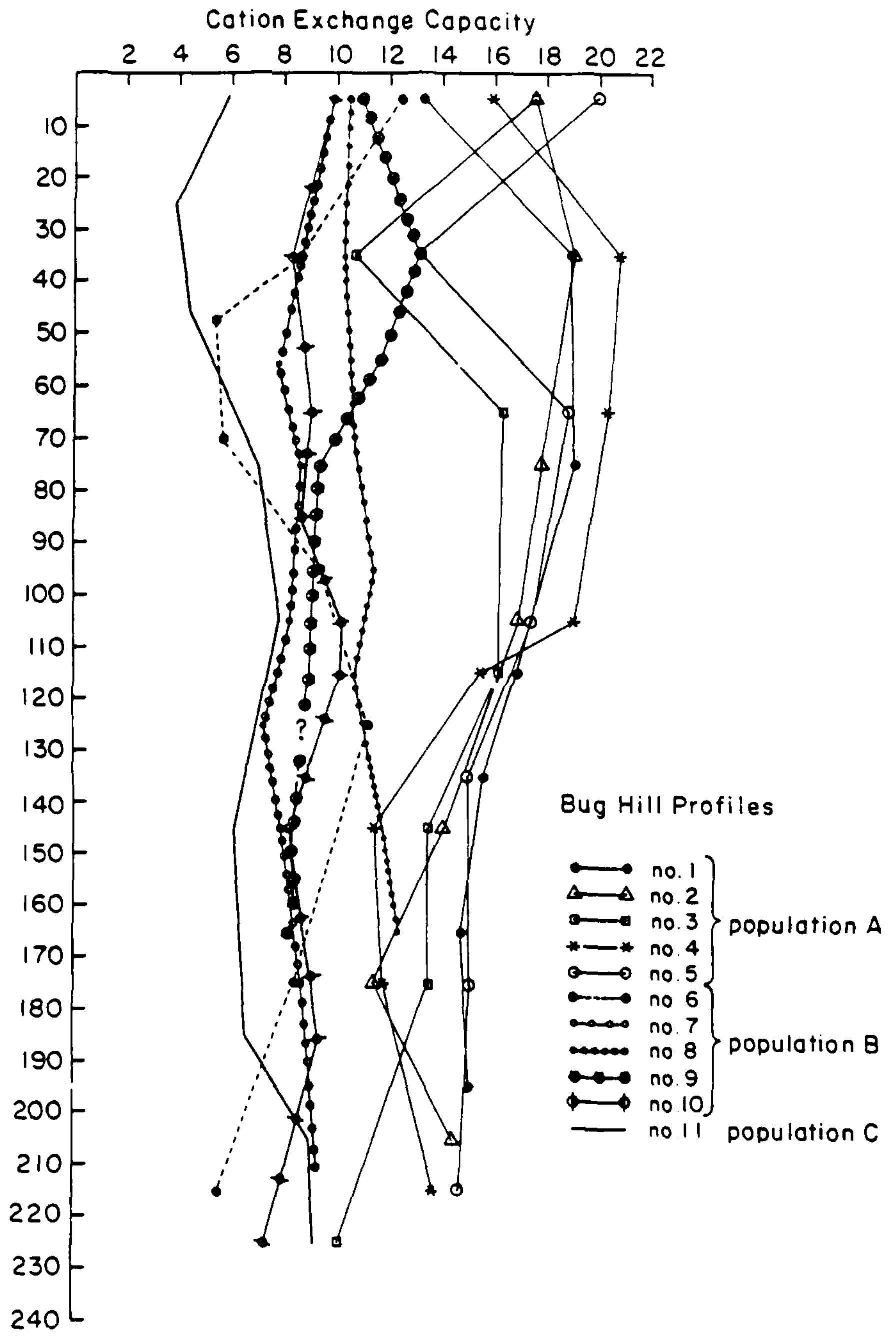


FIGURE 9. SOIL PROFILES BY CATION EXCHANGE CAPACITY.

drops off slightly below that level, then stays relatively constant (Figure 8). The A horizons of these soils have a collective average thickness of 1.4 m. Not surprisingly, the A profiles tend to contain more bone and shell material. Bioturbation has been particularly intense, though not enough to completely obliterate lower boundaries. A few of the A group epipedons have been partially leached of carbonates (Figure 6) presumably since site abandonment.

Population B Soils, Mollic Hapludalfs

Soils in this group tend to be intermediate between populations A and C in their chemical and physical properties (Figures 5 and 8). They occur spatially on the sloped sides of the mound, they contain less organic matter and they have thinner A horizons (79 cm average collective thickness). These soils appear to have experienced less bioturbation than population A soils.

The B population soils are all acid in reaction, non-calcareous, and are presumed to have been leached (it is highly probable that the entire site was calcareous at the time of abandonment). Because the mound slopes receive surface run-on and subsurface run-through from upslope, the mound side-slopes are considerably more leached than on the flatter upper levels (pH's range from 5.0 to 6.7, but with subsoils less than 6.0).

Age and Regional Significance of the Jackfork Terrace

The age of the Jackfork Terrace on which the Bug Hill mound occurs is inferred to be of early to middle Holocene age. This age assignment is based on three lines of evidence:

1. The terrace sediments bear a striking resemblance to the loess-derived Rodgers alluvium which occurs all across Missouri, from Kansas City to Springfield, to lower Pomme de Terre River, to the central Gasconade River, and to St. Louis (Brackenridge 1981; Haynes 1976, 1981; Johnson 1977a, 1977b, 1981a, 1981b; Graham et al. 1981).

2. The soil developed in the Rodgers-like alluvium on the Jackfork Terrace exhibits the same degree of profile similarity and degree of development as do soils formed in the Rodgers alluvium in the localities mentioned above.

3. The C^{14} dates on charcoal and burial samples obtained in 1979 at Bug Hill clearly indicate a Late Archaic component in the early history of the site (see also radiocarbon discussion in this volume, Chapter Five). The dates came from within the midden mound, which rests upon the Jackfork Terrace. Thus, the terrace predates the midden, and is estimated to be middle to early Holocene in age.

The surprising similarity in age and morphology of the Rodgers-like alluvium of Jackfork Terrace (and its soils) to the Tlb terrace of the Osage River Basin, Missouri (which was well-studied and C^{14} dated analogs stretching from Kansas City to St. Louis) makes the Bug Hill site and the terrace upon which it rests regionally very important. Terminal Pleistocene and Holocene sedimentological processes and events, thus, appear to correlate across the Ozark/Ouachita region.

FLUVIAL-MEANDERING HISTORY OF THE JACKFORK VALLEY

The second part of the geomorphic investigations involved documenting the fluvial-meandering history of the upper Jackfork Valley. This study was based on: 1) an analysis of previous work (Vehik 1982a, Johnson 1981a, Nials 1979); 2) field observations in May/June and November, 1981; 3) examination of airphotos[2] and both wide and close interval contour maps[3]; and 4) study of geologic logs of cores[4] drilled across Jackfork Creek at the bridge embankment.

Results

Careful examination of the airphotos and maps indicates that many meander scars characterize the confluence zone and surround the Bug Hill site (Figure 2; Figure 10). The great majority of these scars principally reflect the dynamics of North Jackfork Creek, which appears dominant in the area. Figure 10 was produced by enlarging the relevant portions of the U.S.G.S. 7.5 minute Sardis quadrangle map upon which was overlaid meander scar information taken from the airphotos and the close interval (2 ft) contour maps (Figure 2).

Figure 10 also shows the location of the geologic bore holes at the bridge embankment immediately to the southeast of the Bug Hill site. Figure 11 shows depth of alluvium to bedrock as determined in the six holes cored, as related to the west profile of Jackfork Creek.

---

[2] "Lake Area Mosaic," U.S. Army Engineer District, Corps of Engineers, Tulsa, December 1972 (1350-DM-93/2); scale 5.64 in (6 cm) = 1 mi.

[3] The large interval contour map is the 7.5 min, 1971 U.S.G.S. Sardis, Oklahoma, topographic map: the close interval contour (Figure 2 in this report) maps were prepared by Aerial Photo Service, Inc., Tulsa, for Tulsa District Corps of Engineers, March 16, 1976 (Project No. 76-25), sheets for sec. numbers 5-8 of T2N, R18E and numbers 1, 12-13, of T2N, R17E, Sardis, Oklahoma.

[4] Provided by the U.S. Army Corps of Engineers, Tulsa District.

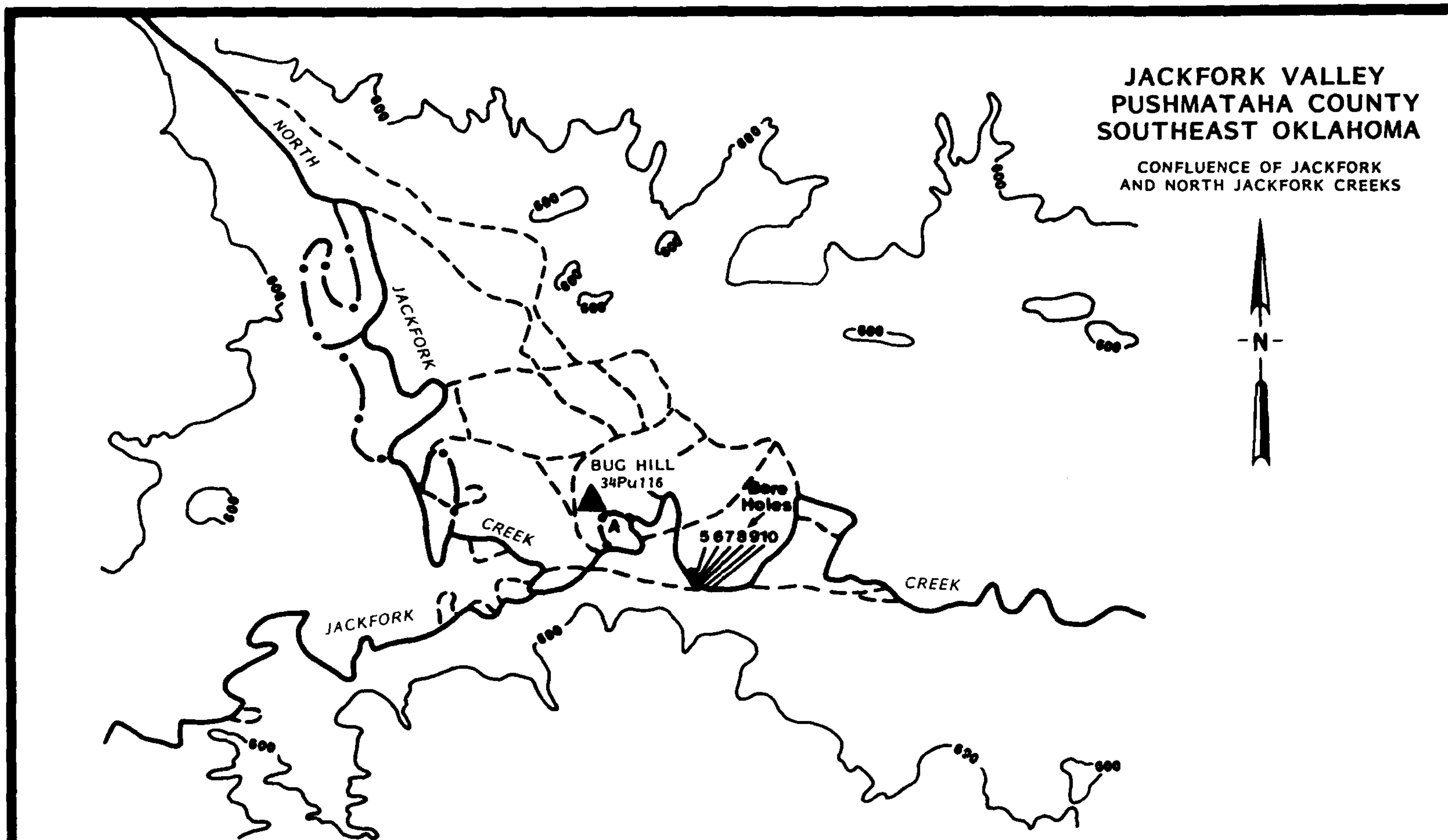


FIGURE 10. MIDDLE TO LATE HOLOCENE ABANDONED CHANNELS AND CUT-OFF MEANDERS OF NORTH JACKFORK AND JACKFORK CREEK.

0 1 km

Middle to late Holocene abandoned channels and cutoff meanders

Very late Holocene cutoff meanders

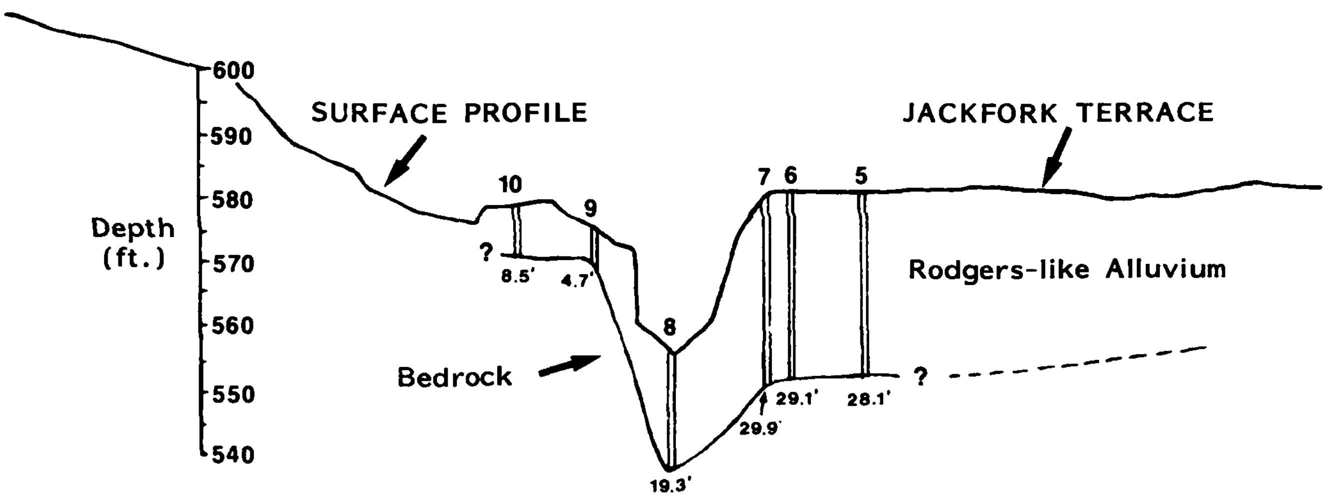


FIGURE 11. WEST PROFILE OF GEOLOGIC BORE HOLES ACROSS JACKFORK CREEK AT BRIDGE EMBANKMENT.

DISCUSSION

Bedrock and Valley Fill Considerations

The Ouachita Mountains in which Sardis Lake is located are comprised of sandstones and shales that are folded, steeply dipping and truncated. Shales are the least resistant to erosion and form valleys whereas sandstones are more resistant and form ridges, thereby creating a valley/ridge landscape typical of the area. Jackfork Basin is underlain by the Stanley Shale along its southern margin (Corps of Engineers 1981); more resistant shales and sandstones occur on its northern side. The thalweg (i.e., the confluence zone) of Jackfork Creek is, therefore, not surprisingly located in the lowest part of the basin which is along its south edge, above the shale. Because of these bedrock relationships, it is probable that Jackfork Creek and its ancestral streams have long occupied the south side of Jackfork Basin, and that the creek has been in its approximate present location for a very long time, certainly during all of the Holocene (the last 10,000 years).

The buried bedrock surface which underlies the alluvial fill of Jackfork Basin must be undulatory because of its differentially resistant character. This fact is indicated by bedrock outlyers projecting upward through the valley fill on the northern half of the basin (i.e., the Potato Hills, etc.). Therefore, the valley fill must also be of variable thickness, but for reasons given above, is probably thickest in the southern basin along the axis of Jackfork Creek. The valley fill attains a maximum thickness of about 9 m (30 ft) at the north end of the bridge embankment immediately adjacent to Jackfork Creek. At this locality, the valley fill surface is 177 m (580 ft) elevation, and is the mid-Holocene aged Jackfork Terrace on which the Bug Hill site is situated.

All of these geologic relations suggest that the 'Rodgers-like' sediments of the Jackfork Terrace are thickest near the axis of Jackfork Creek and thin away from it to the north where the bedrock gradually rises. The one possible exception to this general picture is in the confluence zone where North Jackfork and Jackfork creeks join. This zone includes not only the present confluence point, but also all past confluence points. The cutting power of North Jackfork Creek may have eroded more deeply into the relatively resistant bedrock in this part of the north side of Jackfork Basin, so that the alluvial fill is probably thicker along the changing thalweg zone.

Meandering History

Because the Jackfork Terrace on which Bug Hill occurs is inferred on pedologic and radiocarbon grounds to have stabilized (i.e., ceased major alluviation) at least by middle Holocene time, sometime probably around 4000 - 5000 years ago, it is probable that the meandering activity of North Jackfork Creek has gradually slowed since that time. Other things being equal, raw alluvium without pedogenic horizons (e.g. argillic horizons) should be more easily erodable by streams than pedogenetically altered alluvium, and, therefore, from that standpoint alone should allow more stream meandering. Further, because the Jackfork and the North Jackfork systems are now slightly entrenched, they should presently have a lower meandering vigor, with commensurately lower meander cut-off frequency than when they were actively alluviating. Most of the meander scars in this area, especially north of Bug Hill, are very shallow and appear relict.[5] Oxbow lakes are rare or absent, and relief between meander scar thalwegs and adjacent floodplain surfaces is low compared to recent (late Holocene) fresh-appearing cut-off meanders. Nevertheless, some meander cut-off events occurred in the later Holocene, but without coring and dating information from these old scars, we are left with only informed estimations of their precise ages.

The linear depression scar immedately adjacent to the Bug Hill site on the west is interpreted as being a relict channel of North Jackfork Creek which was abandoned in middle Holocene time (3000 - 5000 years ago). The water in it appears to be presently fed by overbank flooding episodes of Jackfork Creek, and by sluggish streams that now occupy abandoned channels to the north. This abandoned channel records the time when the confluence of Jackfork and North Jackfork creeks was immediately adjacent to and south of the Bug Hill site. This apparent fact may be the most fundamentally important factor in explaining the location of the site. The meander scar on the southeast side of Bug Hill (Scar A of Figure 10) is interpreted as a later Holocene cut-off of Jackfork Creek.

The Bug Hill site appears to have been ideally located with respect to optimal human use of the fluvial environment of the Jackfork Basin. The site was originally on the east bank of North Jackfork Creek very near its confluence with Jackfork Creek. When North Jackfork Creek changed its course, an event which is inferred to have occurred sometime after the site became occupied (presumably after 3000 years ago), the relict channel remained, and presumably held at least an intermittent channel lake as now. Since Jackfork Creek then occupied the south side of Jackfork Basin as it does now, the site was still optimally situated with respect to fluvial procurement resources: namely those of the active Jackfork Creek which impinged on the site to the southeast, and those of the adjacent North Jackfork relict channel lake on the west. The cut-off of meander bend A is inferred to have occurred in the later Holocene sometime after North Jackfork Creek abandoned its channel to the west of the site. It is very possible that cut-off A was an active channel of Jackfork Creek into very late Holocene, perhaps even protohistoric, time.

---

[5] Some of the shallowing, however, may have been accelerated by sediment-bearing streams that flow south into the area from higher ground on the north; some of the streams now occupy old meander and creek channel thalwegs.

CONCLUSIONS

Three main conclusions can be drawn from the geomorphic investigations at Bug Hill.

1. The physical and chemical properties of soils at the site show that three populations of soils occur, each of which reflects differential site formation process. Population A soils are very dark, young, calcareous, over-thickened (cumulic) soils with high pH's, high base saturations and high cation exchange capacities. Their dark, thick, base-rich character reflects a preponderance of calcic and organic materials brought to the site by aboriginals. Population C soils (Profile 11), conversely, are leached and acid in reaction; have well-expressed horizonation and profile development (argillic and A2 horizons), are of middle and early Holocene age and occupy the Jackfork Terrace. Population B soils are intermediate between Group A and C soils in their chemical and physical properties.

Bioturbation by rodents and tree roots has been most extensive in Group A soils, less so in Group B soils and still less in soils from Group C.

2. The age of Jackfork Terrace, on which the Bug Hill midden mound rests, is principally of middle and early Holocene age, and is provisionally correlated with the T1b terrace of the lower Pomme de Terre River, Missouri. The terrace, and the Bug Hill site, contain Archaic components and, thus, are important entities in establishing a regional soil/stratigraphic/geomorphologic/archaeologic/geochronologic model for the Ozark/Ouachita area.

3. The fluvial-meandering history of the Jackfork Valley suggests that the majority of meander scrolls and scars, and abandoned creek channels that are present in the northern and northeastern portions of the Jackfork and North Jackfork creeks confluence zone are relict and date from middle to late Holocene time. The combination of an ancestral confluence point occurring immediately adjacent to the Bug Hill site, and the continued close proximity of Jackfork Creek throughout late Holocene time, plus the fluvial resources of first one lake (on the west), and then another lake (on the southeast) endowed the site with optimal human exploitation opportunities.

CHAPTER FOUR

RESEARCH STRATEGY AND EXCAVATION RESULTS

The research design for the 1981-82 field season was a compromise between theoretical goals and physical parameters. Many of the issues discussed in Chapter Two can only be resolved with "clean" strata, such as living floors or related features which can be associated with a single occupation or component. Johnson's discussion of the physical characteristics of Bug Hill (Chapter Three) has important implications for isolating such "clean" strata. In the first part of this chapter we explore these implications and show how they affected our excavation strategy. The field results are then presented.

MIDDEN MOUNDS: PHYSICAL CHARACTERISTICS

Mounds, like Bug Hill, are accretional formations, built up over time by deposits of organic residues. Depending on local conditions, other processes can be involved. For instance, sites experiencing recurrent seasonal flooding often have alluvial soils forming a main component of the mound. This type of deposition seems to have been important in the development of Locality A, southeast of the main site, but does not appear to have been major factor in the build-up of Bug Hill itself (Johnson, Chapter Three and Appendix I).

The midden is composed primarily of organic material, mixed together with large quantities of fire-cracked rock. The exact uses of fire-cracked rock have never been determined, though it has long been presumed that rock was brought into a site, heated, and then used in food preparation activities (House and Smith 1975). Besides simply adding bulk to the mound, the rock acts to improve drainage.

In the 1981-1982 field season we recovered over four metric tons of fire-cracked rock from approximately 250 m^3 of excavated soil. The rock was distributed throughout the midden. Further, fire-cracked rock was not confined solely to Bug Hill proper, but was found throughout the deposits at Locality A.

The build-up of organic residues and fire-cracked rock has left the soils of Bug Hill, like most midden mounds, relatively loose, well-drained, and rich in organic matter. These conditions have made midden mounds extremely attractive locales for burrowing animals and vegetation. Remnants of rodent runs, mammal burrows, insect trails, root systems and tree falls are abundant at all levels throughout the midden at Bug Hill. These disturbances have destroyed or obscured many cultural features and have contributed to a general mixing of cultural deposits. At most midden mounds, the degree of bioturbation has made it impossible to distinguish cultural assemblages or stratigraphic breaks.

Besides bioturbation, interpreting excavation results is complicated by the varying nature of midden mound soils. While the soils at Bug Hill are generally very high in organic matter and have relatively high base saturations, there are clear differences between soils on top of the mound and those on slopes. In his study of Bug Hill, Johnson (Chapter Three) divided these soils into two groups. Soils on top of the mound, Population A, are highly alkaline (pH around 8) and extremely dark with boundaries between soil horizons often obliterated by bioturbation. Soils on the slopes of the mound, Population B, are more leached due to surface run-off and subsurface run-through. Population B soils tend to be acidic (pH's range from 5 to 6.7), are slightly lighter in color and are less exposed to agents of bioturbation.

These soil differences have had an impact on artifactual preservation. Bone and shell preservation is excellent on top of the mound, but rapidly deteriorates on the slopes and by the edges of the site these materials are either extremely fragile or fragmentary. Conversely, features such as pits or postmolds are both hard to see and usually badly disturbed on top of the mound. Determining relationships between features or isolating occupational surfaces are nearly impossible. Yet, on the slopes of the mound, features and floors are relatively easy to detect.

EXCAVATION STRATEGY

In designing an excavation strategy for Bug Hill, we needed to have a clear notion of the research issues to be addressed, the types of data needed to be obtained, and how the physical characteristics of the midden would affect the recovery of these data. From previous excavations at Bug Hill and other midden mounds, we knew that the midden would be tremendously rich in artifactual and faunal materials and that isolating stratigraphic breaks related to cultural occupations within the deposits would be extremely difficult, if not impossible.

The lack of success by previous investigators in isolating cultural components from midden mounds led us to question whether obtaining a "representative" sample of materials was really a desirable goal. To obtain such a sample requires testing the mound using some form of probability sampling, preferably with small excavation units (e.g., 2 m x 2 m test pits). The results, then, could be used to provide more-or-less unbiased, precise, and accurate estimates of relative frequencies of artifact types and faunal remains. But the utility of knowing how many Gary points or deer bone fragments one would recover if the entire site were excavated is unclear. Without being able to tie stratigraphic levels to cultural occupations one is left making statements about general trends in the horizontal and vertical distributions of artifacts which in the past have not advanced our understanding of midden mounds very far.

To address the issues discussed earlier in Chapter Two, culturally meaningful strata needed to be isolated. Previous excavations at Bug Hill indicated that such strata existed. Postmolds had been found and occupational floors tentatively identified. Even so, Vehik (1982a) was still not able to outline clear postmold patterns or demonstrate conclusively that particular strata were occupational surfaces. This result was primarily a consequence of the small size of the excavation units used. With the exception of the one block excavation, the primary excavation unit was a 2 m x 2 m test pit (though some 1 m x 1 m pits were also excavated). Although features were found in nearly every pit, due to the relative homogeneity of the midden soils, Vehik was usually unable to relate features or postmolds from one pit to another.

The only portion of the site which could be interpreted with any success was the southern edge of the top of the mound, where an irregular shaped 4 m x 6 m contiguous area was excavated. Lines of postmolds were discerned, but even here the unit was too small to characterize the nature of the structure. Given these results, the CE required at least two 25 sq m blocks be excavated as part of the 1981-82 field season. The real question, then, was how to place them.

We devised a three staged excavation strategy. During the first stage, six 2 m x 4 m test pits were "purposefully" placed in areas of the site which had not been tested in 1979 (Figure 12). All six units were located on the slopes of the mound where midden soils would be somewhat lighter and features easier to discern. We used 2 m x 4 m units to ensure that large enough areas were exposed to discern postmold patterns or relationships between features, thereby providing an adequate base for determining where to expand excavations.

Following the testing program, block excavations were undertaken in three areas and designated the Central, Southern, and Northern blocks. On top of the mound, a 25 sq m excavation unit, termed the Central Block, was placed between several of the ARMC test pits. From the 1979 excavations, we knew this area was the deepest and richest (in terms of artifacts) part of the site. Consequently, we did not

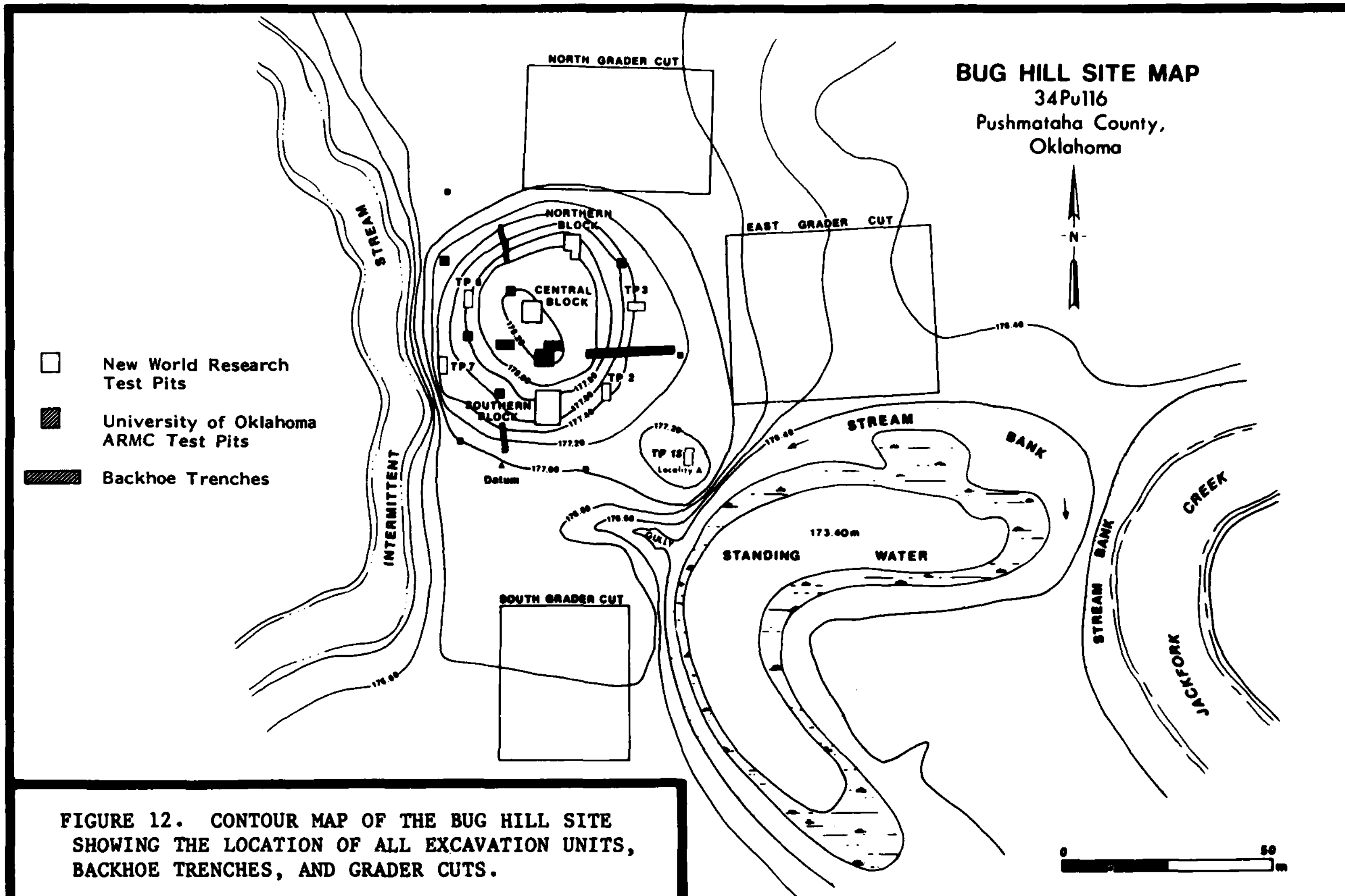


FIGURE 12. CONTOUR MAP OF THE BUG HILL SITE SHOWING THE LOCATION OF ALL EXCAVATION UNITS, BACKHOE TRENCHES, AND GRADER CUTS.

"test" this area but purposefully placed a block excavation in the center.

The remaining two block excavations were expansions of previous 2 m x 4 m test pits. The southern block was the most extensively excavated portion of the site encompassing a 48 sq m area on the southern slope of the mound. The northern block expanded off Test Pit 4 and was composed of an irregular shaped 20 sq m area.

The third part of the excavation strategy involved a study of off-mound activities. Originally, this study was limited to mechanically stripping three roughly square areas to the north, east and south of the mound. These regions, which together encompassed approximately one acre, were stripped first by a log skidder and then by a road grader to a point where cultural features, if they existed, would have been exposed.

During the course of work in the east grader cut, we noticed a small rise southeast of the mound bordering an old meander of Jackfork Creek. This rise, designated Locality A, was littered on the surface with fire-cracked rock and lithic debris. In consultation with the CE, a decision was made to place a 2 m x 4 m unit, Test Pit 13, in the center of the rise.

EXCAVATION RESULTS

In all, 133 sq m were hand excavated during the 1981-82 season of work at Bug Hill. This total includes test pits excavated during the initial stage (Test Pits 1, 2, 3, 4, 6, 7), the block excavations in the second stage (Southern, Central, and Northern blocks), and the excavation unit (Test Pit 13) placed on the crest of Locality A (Figure 13). In addition, 4700 sq m were mechanically stripped in areas off the mound itself. In this section, the results of these excavations are discussed by location at the site. For example, all of the excavations in the Southern Block are discussed together. Prior to the individual areal discussions, however, a brief description of field methods and site stratigraphy is presented.

FIELD METHODS

The field methods employed were standard, state-of-the-art techniques. A north-south, east-west grid was overlaid onto the site using the datum established by ARMC (Vehik 1982a). Between 1979 and 1981 the site was cleared of trees and shrubs in preparation for the inundation of Sardis Lake. Because of the improved visibility we were able to correct a number of errors in the 1979 site contour map. Later, the site contour map and grid system were extended to encompass Locality A, the meander scar of Jackfork Creek, and the areas mechanically stripped. The site datum, located on the south edge of the mound, was designated ON-OE. Using the 2 ft contour maps of the

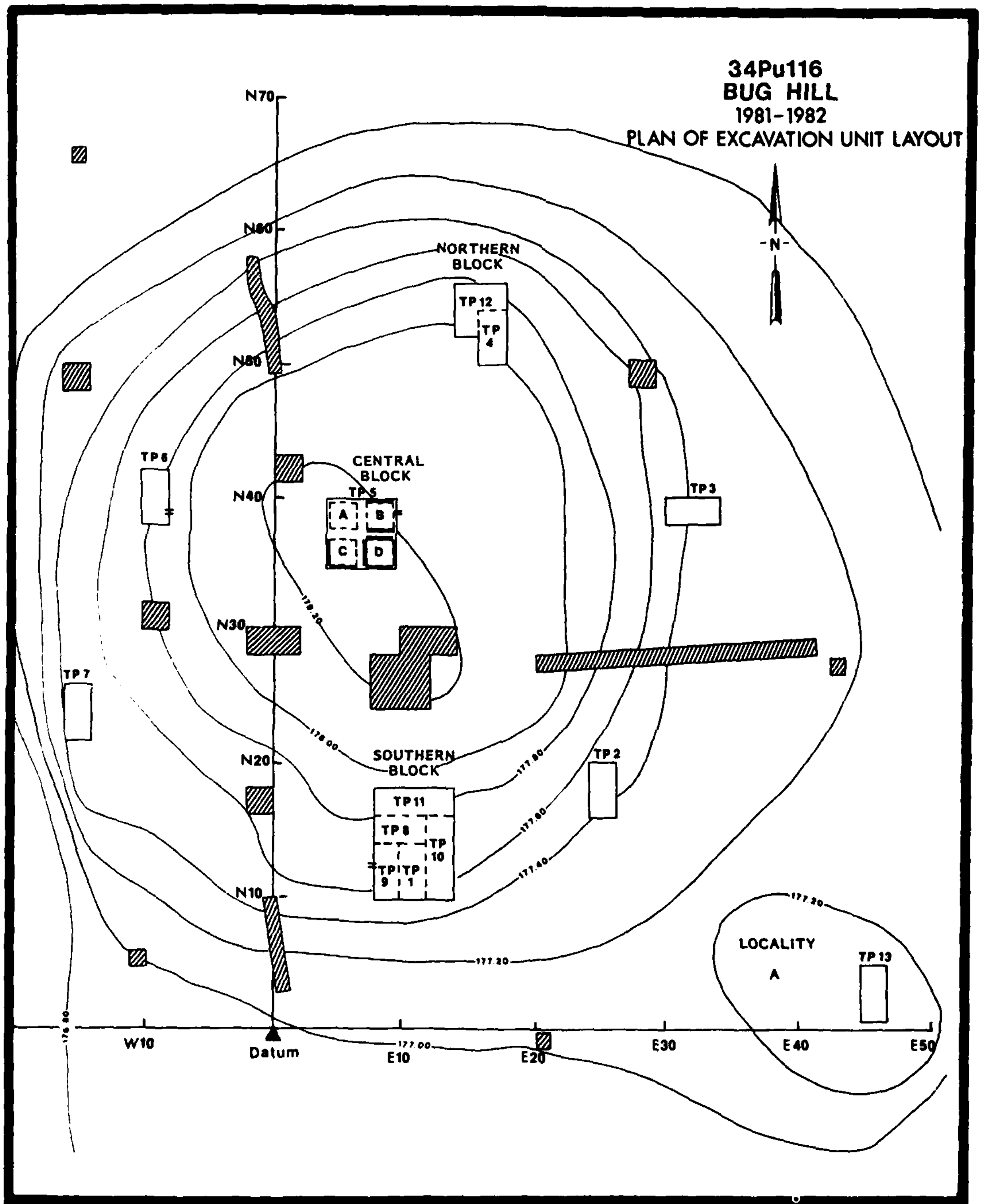
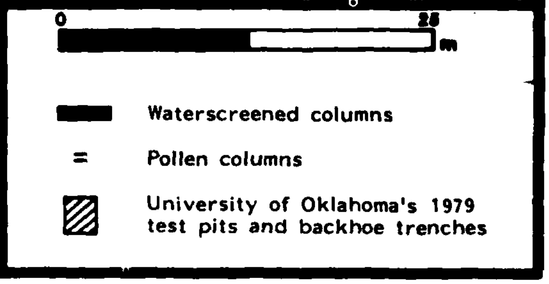


FIGURE 13. CONTOUR MAP OF THE BUG HILL SITE SHOWING PLACEMENT OF EXCAVATION UNITS.



Sardis Lake project area supplied by the CE, we calculated the elevation at the datum to be roughly 177 m AMSL. The actual elevation may be off by as much as 30 cm due to error in constructing and interpolating the 2 ft map. All measurements were taken from the datum and elevation readings were based on the 177 m AMSL figure. This latter practice differs from that used by the ARMC crew who gave the datum an arbitrary elevation of 98.80 m.

Horizontal control was maintained in the excavations by subdividing each large testing unit into 1 m x 1 m proveniences. The grid location of each square was identified by the coordinates of the southeast corner. When occupation floors were detected, horizontal control was tightened further by subdividing the 1 m x 1 m squares into 50 cm x 50 cm provenience units. Hand excavation proceeded by arbitrary 10 cm levels, except where stratigraphic breaks could be discerned. Artifact recovery was achieved by waterscreening through 1/4 in hardware mesh, with materials bagged by provenience and level.

Two flotation columns (15 cm x 15 cm x 10 cm thick) were taken from the southeast and northwest corners of each test pit, unless prohibited by local circumstances (e.g., tree stumps). The only exception to this rule was in the Central Block excavation, where one flotation column was taken in addition to 2 sq m of material removed from the baulk and waterscreened through 1/16 in hardware mesh.

Three pollen columns were taken in the field by William Johnson (Fredlund and Johnson, Chapter Nine). These columns were located in the east profile of the Southern Block and the west profiles of the Central Block and Test Pit 6.

Finally, radiocarbon samples were taken from all features, floors, posts, and general excavation levels whenever concentrations of charcoal were found of sufficient size and integrity (see Chapter Five).

Features and burials were found throughout the midden. Upon detection, they were completely exposed, photographed, and the horizontal plan drawn. Features were then cross-sectioned and the profiles drawn and photographed. Half the feature fill was saved for flotation while the remaining half was waterscreened through 1/4 in hardware mesh. Features that extended beyond one 1 m x 1 m unit and/or one 10 cm level (such as an ash/clay concentration) were internally subdivided and excavated according to provenience and level.

Upon encountering a burial, a concerted effort was made to discern a burial pit. If a pit was located removal of the burial proceeded by using the boundaries of the pit as borders of an excavation unit. In most cases, however, burial pits were not found. Arbitrary areas around the skeleton were staked off and the removal of the burial material proceeded as if there was a burial pit. Skeletons were first exposed, drawn, and photographed from a number of different angles. The bones were then individually removed and given identification tags corresponding to the plan drawing. Several flotation samples were taken from the soil surrounding the burial while the remaining matrix was waterscreened through 1/16 in hardware mesh. [This was done even when no burial pit was noticed.]

STRATIGRAPHY

To provide an adequate impression of the general stratigraphic picture as well as the subtle variations between different sections of the site, we have constructed a north-south stratigraphic cross-section using the west profiles of the Southern Block, the Central Block and the Northern Block excavations from 1981-82 (Figure 14). We have also included the west profiles of Test Pits N24E10 and N26E10 excavated in 1979 which fall on the same general north-south line. Additional stratigraphic information for Bug Hill can be found in Vehik (1982a) and Johnson (Chapter Three and Appendix I).

Four general stratigraphic zones were identified in the course of the excavation. Most of these extended across the site though they tended to be thicker in the central and northern sections. Each of these strata is described below.

Ap - a relatively thin plowzone extends over most of the site. Local residents stated that the area around and including the site had been plowed by mule and planted in corn during the 1930s. The plowzone is composed of very dark brown (10YR2/2) silt loam characterized by numerous roots and rodent disturbances. Cultural materials of all types abound, but they are usually in fragmentary condition.

I - This stratum was only recognized on top of the mound and does not correspond to any recognized in 1979. The soil consists of very dark brown (10YR2/2) loosely compacted silt loam with disturbances of all types noted throughout. Flecks of charcoal and baked clay as well as pieces of fire-cracked rock form an integral part of the matrix. Large quantities of cultural materials were recovered, though features were scarce. In general, this stratum represents the darkest, most alkaline midden soil of the site and its restriction to the top of the mound is more a function of drainage and greater amounts of organic residue than cultural practices.

II - Stratum II represents the basic matrix of the midden. This stratum corresponds to the deposit Vehik (1982a:24-25) termed Stratum IIa and probably most of the deposit referred to by Vehik as Stratum I. The soil is more compacted and has a greater clay content than either the plowzone or Stratum I, as defined during the NWR excavations. Overall, the soil is a compact dark brown (10YR3/3) silt loam mottled with less compact very dark brown (10YR2/2) silt loam. Stratum II is thickest in the center and northern portions of the site averaging about 50 cm in depth and thins out gradually in all directions. Baked clay inclusions, patches of ash, charcoal flecks as well as substantial amounts of cultural materials were noted throughout the stratum. Features were discerned at various levels in nearly every

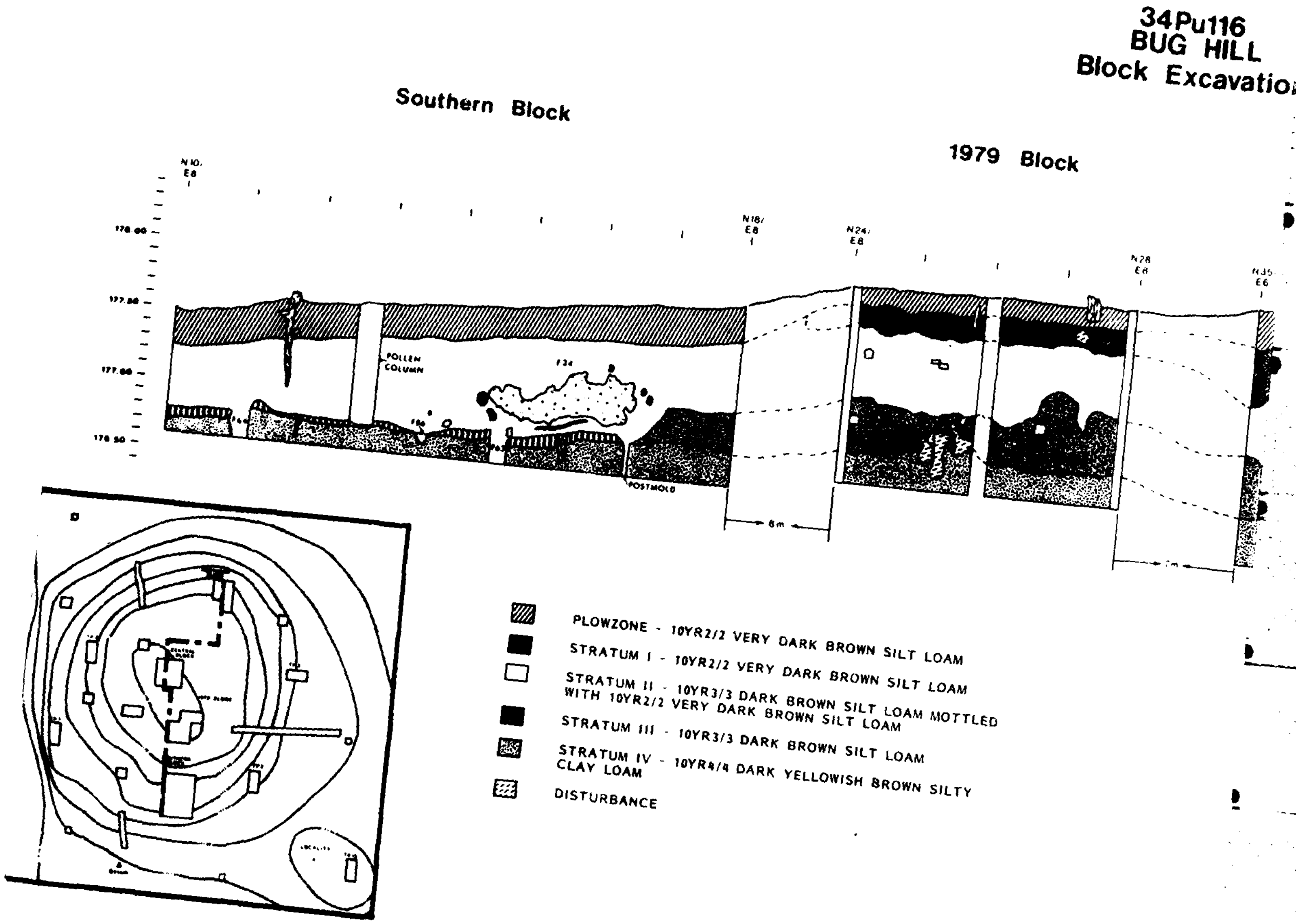
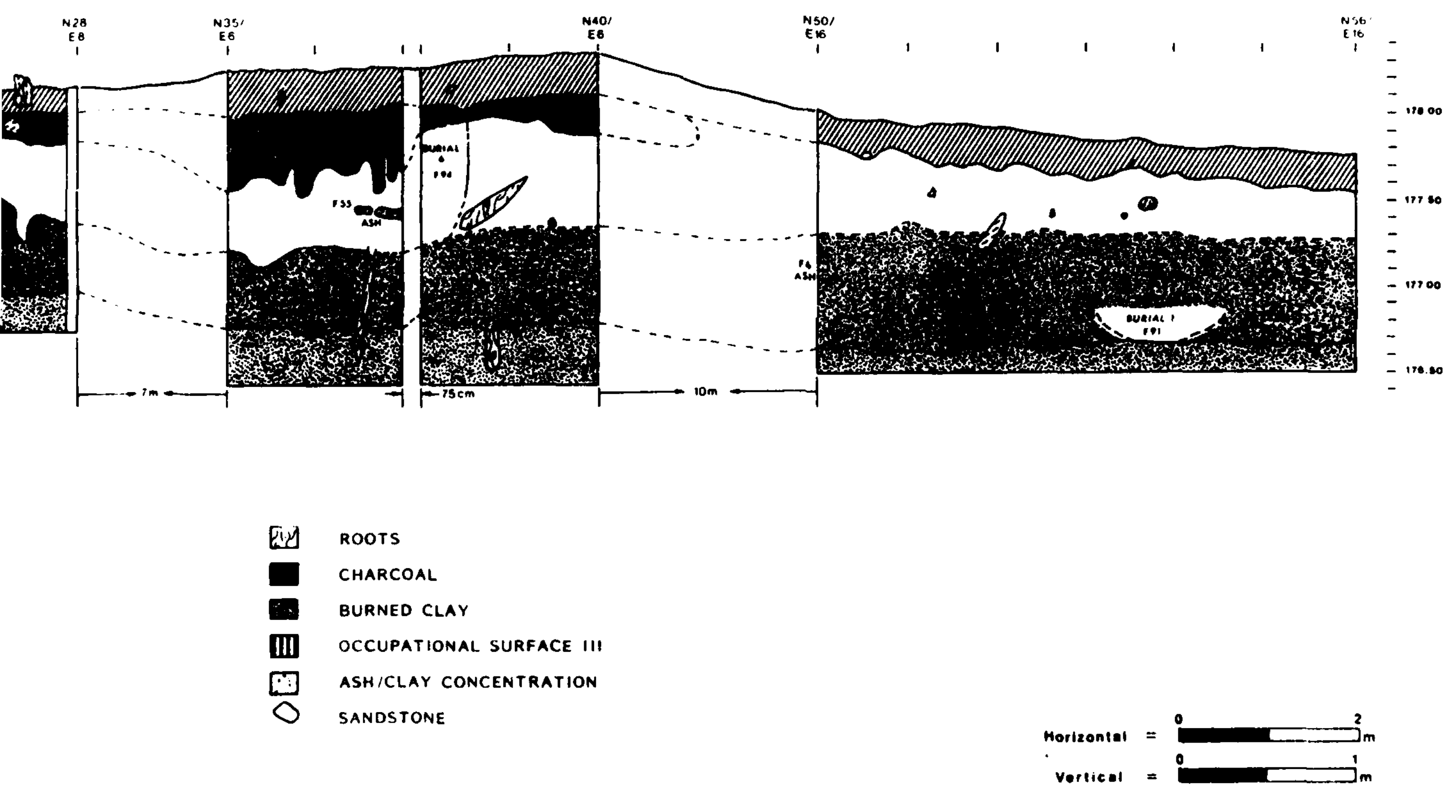


FIGURE 14. STYLIZED NORTH-SOUTH CROSS-SEC

34Pu116
BUG HILL
ock Excavations

Central Block **Northern Block**



TH-SOUTH CROSS-SECTION OF THE BUG HILL SITE.

2

test pit. In the Central Block, Stratum II was divided into two substrata, IIa and IIb, on the basis of differing sets of postmold patterns. In the Southern Block, two occupational floors and a set of features which were interpreted as a third occupational surface were noted within Stratum II.

III - The basic midden matrix blends into Stratum III (Vehik [1982a:25] called this deposit stratum IIb). The primary characteristic which distinguishes this stratum from the preceding one is a gradual increase in clay content. In general, this stratum is somewhat more leached and compacted than the previous one, yielding a more acidic and lighter color (10YR3/3) silt loam. Cultural materials abound, but in relatively smaller numbers than in Stratum II, and cultural features are easier to discern. In many areas, the border between Strata II and III is more arbitrary than fixed and is indicated as such by a dotted line in the profiles.

IV - The Jackfork Terrace was encountered at roughly the same elevation throughout the site (ca. 176.70 m AMSL). The terrace was relatively easy to identify for unlike the A soil horizons which comprised the midden deposits above, the terrace was composed of soils of a IIb_{2tb} soil horizon (see Chapter Three and Appendix I). Soils on top of this terrace had only slightly developed prior to the build-up of the midden (see Chapter Three). The terrace itself consists of well-compacted, dark brown (10YR4/4 to 3/3), silty clay loam. Cultural materials are present for the first 75 cm, but in greatly reduced numbers.

In the report of the 1979 field season, Vehik subdivided the Jackfork Terrace into two strata termed Stratum III and Stratum IV (Vehik 1982a:25). After discussion with D. Johnson in the field, we felt that such a division was unwarranted.

The overall stratigraphic picture then is relatively simple. Most of the site consists of a plowzone, several midden strata distinguished primarily on the basis of gradual changes in color and clay content, resting on the Jackfork Terrace.

SOUTHERN BLOCK

During the course of excavating Test Pit 1, it became increasingly clear that this portion of the site was unlike all others. Near the base of the midden, we isolated what appeared to be an occupational surface associated with a diverse set of cultural features. To clarify the situation, we expanded the excavation, first into a 6 m X 6 m block excavation by adding two 2 m x 4 m test pits to the west (Test Pit 9), and to the north (Test Pit 8), and a 2 m X 6 m unit immediately to the east (Test Pit 10). Almost immediately upon excavating Test Pits 8 and 10, additional living surfaces and cultural features were uncovered. A final decision was made to place another 2 m x 6 m unit (Test Pit 11) adjoining the rest of the block to the north, bringing the total excavated area to 48 sq m (6 m x 8 m).

In all, five burials and 50 features were uncovered in the course of excavating the Southern Block. Many of these features and burials could be associated with one of three distinct occupational surfaces. The following discussion focusses on each of these surfaces. Table 1 summarizes all relevant feature data, while Figure 15 presents a profile of the north and west walls of the unit. Burial data are summarized in Table 43, Chapter Twelve.

Occupational Surface I

Remnants of a living surface were discerned in Test Pit 11 at the base of level 2 (Figures 15 and 16). The first indication of this floor was noted in level 1, when a large charred log and associated burned clay (Feature 40) was found in the west part of Test Pit 11 and the upper portions of two hearths (Features 39a/c and 39b) were discerned about 2 m to the east. At the base of level 2, the central portion of Test Pit 11 (roughly 3 m east/west by 2 m north/south) was covered with relatively large clumps of burned clay, daub, ash, and charcoal. Three prepared hearths were noted variously distributed throughout the floor (Features 39a/c, 39b, and 46a). The hearths were all similar in construction, consisting of shallow, basin-shaped pits, measuring no more than 30 cm in diameter. All were filled with burned clay and ash with dense deposits of charcoal found just outside. In profile, no hearth measured more than 6 cm in depth and in general they did not appear to have been re-used often. While the hearths were excavated as features, level 3 in the remaining portion of the floor was excavated in 50 cm provenience units.

Extending west from the floor was a thin (2 to 3 cm) lense of consolidated ash which covered nearly the entire westernmost 2 m of the test pit (Feature 47). At their intersection, the ash lense dipped under the burned clay. Structural evidence is restricted to carbonized logs surrounded by large pieces of daub. Overall, the surface appears to represent the floor of a burned structure approximately 3 m in diameter (designated Structure 3). Part of the structure's interior was almost certainly located within the central 2 m of Test Pit 11. As the structure burned, large chunks of daub from the roof and walls fell onto the floor giving it in profile a pitted appearance. Ash and debris from the burning appear to have been blown to the west.

The floor clearly extends to the north and probably at one time extended to the south as well. In level 2 of Test Pit 8 (N15E12), the remains of a large charred log and areas of burned clay similar in nature to Feature 40 were uncovered. Nearby isolated fragments of a human cranium (Burial 5) were found. Unfortunately, all these materials were still in the plowzone and their contexts badly disturbed. It is highly likely, then, that the occupational surface extended at least into the northern portion of Test Pit 8. As the mound slopes to the south, however, all evidence of the floor has systematically been lost to plow zone.

TABLE 1. SOUTHERN BLOCK FEATURES.

Feature Number	PROVENIENCE (point of detection) T.P.	Square(s)	Level	Depth Below Datum	Dimensions Length x Width x Depth	Description	Occupation Surface (all features found in Stratum II)	Probable Function	C14 Date	Artifacts	Faunal Remains	Carbonized Seeds (#) and Nut Shell (gm)	Comment
2	1	N13E11 N13E12	10	176.67-176.89	180 x 80 x 22	ash/clay concentration	III	house burning		Marshall point (1), cobble-tested (1), biface frag (1), nutting stone (1)	turtle (all) (122); small mammal (8), carnivor (2), deer and large mammal (92), unidentified (20)	1.21 g hickory 1.01 g acorn	fea. 2 joins fea. 76 to the east (T.P.9) and fea. 59 to the north (T.P.8 & 10) to form one large amophous area of intense burning.
3	1	N13E11-E12 N14E11-E12	4	177.33-177.46	50 x 40 x 13	circular rock-lined pit	II	storage pit				.1 g hickory	
4	1	N10E11	10	176.82-176.87	40 x 25 x 5	ash/clay concentration	III	hearth		Gary point (1), Nolan point (1)	unidentified (4)	.02 g hickory	small, unprepared fire pit
5	1,8,9, and 10	N10-N16 E9-E13	10 top (10 in T.P.1)	176.77-176.82	entire pit	compacted, dark surface	III	living floor	A.D. 1013 + 610 (Di-Carb) A.D. 1110 + 125 (Geo-chron)		T.P.1 only: turtle (13), small mammal (1), large mammal (7), unidentified (37)	pigweed (1), goosefoot (4), bedstraw (1), grass family (1), smartweed/knotweed (2), 1.57 g hickory	
7a&b	1,9	N12E10-E11	10	176.75-176.82	90 x 50 x 7	fired clay surrounded by ash	III	(7a) reused as central hearth (7b) storage pit		Gary point (1)	turtle (11), bird (1), small mammal (2), carnivore (2), deer and large mammal (17), unidentified (56)	.06 g acorn .10 g walnut	associated with fea. 65 (T.P.9); related to outer line of postmolds (struc. 2)
8	1	N13E11	11	176.49-176.76	45 x 39 x 27	basin-shaped pit	III	central post			turtle (1), bird (1), deer and large mammal (12), unidentified (39)	daisy (1), goosefoot (1), .26 g hickory	associated with structure 1
9	1	N12E11	11	176.45-176.71	35 x 33 x 26	basin-shaped pit	III	central post		unidentified projectile point (1)	turtle (1), snake (1), small mammal (1), deer and large mammal(6), unidentified (16)	.25 g hickory	associated with structure 2; not identified until Level 11, probably started 5 cm higher
10	1	N12E12	11	176.77	amorphous	compact, dark surface	III	living floor			turtle (1), unidentified (3)	.07 g hickory	orignally thought to be distinct, but turns out to be a continuation of fea. 5
11	1	N10E11-E12	11	176.61-176.71	30 x 24 x 10	elliptical-shaped pit	III	storage pit reused as hearth			deer and large mammal (6), unidentified (2)		not identified until Level 11, probably started ca. 5 cm higher
12	1	N10E12	11	176.23-176.71	35 x 34 x 48	irregular circular pit	III	trash/storage pit			turtle (12), carnivore (1), deer and large mammal (24), unidentified (59)	goosefoot (1), grape (1), 1.15 g hickory, .03 g acorn	not identified until Level 11, probably started ca. 5 cm higher
13	1	N10E12	11	176.66-176.71	13 x 27 x 5	elongated oval pit	III	trash/storage pit					not identified until Level 11, probably started ca. 5 cm higher
14	1	N13E12	11	176.62-176.73	48 x 35 x .1	elliptical pit	III	trash/storage pit		biface fragment (1)	turtle (9), deer and large mammal (9), unid. (20)	.12 g hickory	not identified until Level 11, probably started ca. 5 cm higher

TABLE 1. SOUTHERN BLOCK FEATURES - CONTINUED.

Feature Number	PROVENIENCE (point of detection) T.P.	Square(s)	Level	Depth Below Datum	Dimensions Length x Width x Depth	Description	Occupation Surface (all features found in Stratum III)	Probable Function	C14 Date	Artifacts	Faunal Remains	Carbonized Seeds (#) and Nut Shell (gm)	Comment
15	1	N10E11	11	176.61-176.71	24 x 28 x 10	roughly circular pit	III	trash/storage pit			turtle (1), deer and large mammal (9), unid. (8)	.10 g hickory .01 g acorn	not identified until Level 11, probably started ca. 5 cm higher
17	1	N13E12	11	? - 176.70	30 x 30 x ?	roughly circular pit	III	trash/storage pit			turtle (25), small mammal (7), large mammal (17), unidentified (65)	.82 g hickory	not identified until Level 11, probably started ca. 5 cm higher
30	10	N14E13-E14 N15E13-E14	5	? - 177.26	130 x 80 x ?	roughly circular dark, humic stain	II	processing area		Gary (3), Lange (1), unid. straight stem (1), cobble-tested (3), blocky debris (2), biface frag (5), unid. point frag (4), mano-bifacial (1), pitted (2), metate (2), mis. ground frag (1)	fish (1), turtle (362), snake (4), amphibian (2), bird (3), small mammal (25), dog/carnivor (3), deer and large mammal (263), unidentified (850)	.12 g hickory .01 g acorn	very difficult to discern borders
31	8	N14E10	5	177.18-177.26	40 x 35 x 8	circular rock-lined pit	II	trash/storage pit				.07 g hickory	
32	9	N12E10	5	177.11-177.26	70 x 65 x 15	bell-shaped ash concentration	II	hearth		corner-notched point (1), multi-faceted core (1), biface fragment (1)		.08 g hickory .02 g acorn	
34	8,11	N15E9-E11 N16E9-E10	7	177.05-177.40	amorphous; covers northwest portion of T.P.8 and southwest portion of T.P.11	ash/clay concentration	III	house burning		Gary (1), unid. core-multiple platform (1), blocky debris (2), point frag (2), biface frag (11), mano-uniface (1), bifacial (1)	fish (5), turtle (384), snake (8), bird (15), small mammal (21), deer and large mammal (376), unidentified (813)	grape (1) .15 g hickory 101 g acorn	associated with Feature 43 and Features 2/76/59
35	8	N15E12	7	172.25-177.28	22 x 9 x 3	ash/clay concentration with large carbonized log	III	structural remains	A.D. 940 + 45 (Dicarb)				probable root fall of Structure 6
36	10	N15E13	5	177.19-177.28	6 x 7 x 9.5	carbonized post	III	post	A.D. 1010 ± 45 (Dicarb)				probably associated with Feature 5!
37	8,10	N14E13-N15E13	7	177.07-177.12	105 x 95 x 4.5	ash/clay and charcoal concentration with carbonized post	III	house burning and post	A.D. 920 + 125 (Dicarb)				probably associated with burning of Structure 2; continuation of Feature 44
38	10	N14E14	5	177.20	?	mottled area of dark, humic soil	II	N/A	A.D. 1500 + 55 (DICarb)				probably not a feature, but just mottled with humic soil due to its proximity to Fea. 30

TABLE 1. SOUTHERN BLOCK FEATURES - CONTINUED.

Feature Number	PROVENIENCE (point of detection) T.P.	Square(s)	Level	Depth Below Datum	Dimensions Length x Width x Depth	Description	Occupation Surface (all features found in Stratum III)	Probable Function	C14 Date	Artifacts	Faunal Remains	Carbonized Seeds (#) and Nut Shell (gm)	Comment
39	11	N16E11-E13 N17E11-E13	1-3	177.43-177.63	(39a)40 x 30 x 8 (39b)60 x 40 x 16 (39c)60 x 40 x 20	three shallow, baked clay depressions with associated charcoal	I	hearths			.01 g acorn	daisy (1), goosefoot (6), spikerush (1), sumac (1)	poorly prepared hearths; similar to fea. 46a
40	11	N16E10	0-1	177.79-177.82	72 x 40 x 3	carbonized log with ash/clay concentration	I	possible root support					partially located in the plowzone
41	8	N15E12	7	176.98-177.04	15 x 15 x 6	circular baked clay mold with charcoal fill	III	postmold					
42	8	N16E10	8	176.95-176.86	15 x 15 x 9	circular impressed baked clay mold with fill built over a carbonized post	III	postmold	A.D. 1190 ± 85 (Dicarb)		turtle (1), deer and large mammal (1), unidentified (4)		(see Figure 25 (fea. 42))
43	8,9	N15E10-E11 N14E10-E13 N13E10-E13	7,8	176.82-177.05	amorphous; covers about 300 x 200 x 20	ash/clay concentration	III	house burning		biface fragments (3)	fish (1), turtle (53), snake (2), carnivore (1), small mammal (6), deer and large mammal (51), unid. (44)	.15 g hickory .02 g acorn	represents the same event as fea. 34 and fea's. 2/59/76
44	10	all squares but N10E14	7	176.99-177.02	oriented NE-SW 400 x 60 x 3	ash/clay mixed with large amounts of charcoal	III	house burning	A.D. 645 ± 125 (Geochron) A.D. 1010 ± 45 (Dicarb) A.D. 1010 ± 45 (Dicarb)		turtle (12), carnivore (2), small mammal (2), deer and large mammal (15), unidentified (44)	persimmon (2) .93 g hickory .01 g acorn	oriented approximately the same as postmolds in level 10
46	11	N16E10-E11 N17E10-E11	2,3	177.49-177.53	200 x 125 x 4	compact, pitted baked clay floor	I	house floor and fill	A.D. 1860 ± 80 (Dicarb)	see Table 12		goosefoot (1)	probable house floor and fill
46a	11	N17E12	2,3	177.48-177.55	20 x 15 x 14	shallow, baked clay depression with associated charcoal	I	hearth		ovid scraper (1)			similar to 39a, b and c
47	11	N16E9-E10 N17E9-E10	2,3	177.47-177.56	100 x 135 x 2	thin lense of consolidated ash	I	structural burning					probably related to burning of Feature 46
53	11	N16E12	4	177.38-177.43	58 x 84 x 5	dense concentration of faunal remains including 5 complete Turtle carcases, and deer bone along with a dispersed ash/clay matrix	II	unknown		Gary point (1), Yarborough (1), unidentified point fragment (1)		.06 g hickory .01 g acorn	
57	10	N12E14-N15E14	9	ca. 176.52-176.82	oriented 16° east of north 560 x 20 x ca.30	outer lines of N-S postmolds	III	postmolds					outer wall of structure 2
58	10	entire pit	9	176.67-176.82	oriented 16° east of north 560 x 40 x ca. 15	two inner lines of N-S postmolds	III	postmolds					outer walls of structure 1

TABLE 1. SOUTHERN BLOCK FEATURES - CONTINUED.

Feature Number	PROVENIENCE (point of detection) T.P.	Square(s)	Level	Depth Below Datum	Dimensions Length x Width x Depth	Description	Occupation Surface (all features found in Stratum III)	Probable Function	C14 Date	Artifacts	Faunal Remains	Carbonized Seeds (#) and Nut Shell (gm)	Comment
59	8,10	N14E12 N14E13 N13E13	9	176.70-176.73	35 x 35 x 3	roughly circular ash/clay depression built over Fea. 17 (storage/trash pit)	III	hearth	modern (DiCarb)		turtle (30), deer and large mammal (21), unidentified (35)		association with Fea. 2 unclear, but ash/clay between the two seems to be continuous
61	8,11	(8)N15E9-E12 (11)N16E9-E12	9 10	ca. 176.52-176.82	oriented 16° east of north 120 x 680 x ca. 15-30	three lines of E-W postmolds	III	projectile points found in postmolds associated with Structure 1		Scallorn arrow point (1), Gary point (1)			outer walls of Structures 1 and 2
62	8	N14E9	9	? - 177.82	60 x 70 x ?	crescent-shaped ash concentration to the south of dark, humic stain	III	storage/trash pit			turtle (56), small mammal (2), deer and large mammal (29), unidentified (92)	pokeweed (1)	badly disturbed by roots
63	8	N14E9	9	176.64-176.79	20 x ? x 15	basin-shaped pit	III	storage/trash pit		biface fragment (1)	turtle (12), deer and large mammal (6), unid. (30)	sumac (1)	in west profile
64	9	N11E9	9	176.66-176.82	30 x ? x 15	basin-shaped pit with well-packed clay sides	III	storage/trash pit			turtle (2), rodent (1), small mammal (1), deer and large mammal (6), unidentified (35)	104 g hickory	in west profile
65	9	N12E10	10 top	176.75-176.82	30 x 40 x 7	fired clay surrounded by ash	III	central hearth			turtle (13), snake (1), deer and large mammal (4), unidentified (22)	.09 g hickory .03 g walnut	associated with Structure 1
76	9	N13E10	10 top	177.77-176.81	amorphous; covers 100 x 100 x 4	mottled ash/clay concentration	III	house burning					associated with Features 2 and 59
77	11	N17E11	9	176.56-176.81	29 x 29 1/2 x 25	basin-shaped pit lined with baked clay on the bottom	III	storage/trash pit			turtle (3), small mammal (2), deer and large mammal (3), unidentified (36)		associated with Fea. 96 (baked clay liner)
81	9	N11E9	10 top	176.57-176.77	22 x 22 x 20	basin-shaped pit gouged on the west side, but otherwise tapered to the bottom	III	central post			fish (1), turtle (15), small mammal (3), deer and large mammal (18), unidentified (47)	.16 g hickory	Structure 1
84	9	N11E9	10 top	? - 176.72	20 x 30 x ?	circular pit with root disturbances obscurring the bottom	III	central post			turtle (6), bird (1), small mammal (2), deer and large mammal (3), unidentified (17)	.05 g hickory .01 g acorn	Structure 2
85	9	N11E10	10 top	176.60-176.72	31 x 38 x 12	basin-shaped pit tapered to the bottom	III	central post		Marshall point (1)	turtle (2), small mammal (1), deer and large mammal (5), unid. (7)	persimmon (8), sumac (1), 108 g hickory, 101 g acorn	Structure 1
86	9	N13E9	10 top	176.70-176.82	27 x 34 x 12	circular soil stain with substantial root disturbance	III	storage/trash pit			turtle (3), small mammal (5), deer and large mammal (7), unidentified (3)		probably not a cultural feature

TABLE 1. SOUTHERN BLOCK FEATURES - CONTINUED.

Feature Number	PROVENIENCE (point of detection) T.P.	Square(s)	Level	Depth Below Datum	Dimensions Length x Width x Depth	Description	Occupation Surface (all features found in Stratum III)	Probable Function	C14 Date	Artifacts	Faunal Remains	Carbonized Seeds (#) and Nut Shell (gm)	Comment
87	8,9	N13E9 N14E9	10 top	? - 176.82	19 x 15 x 7	circular soil stain with mottled matrix	III	storage/trash pit(?)					probably not a cultural feature
88	9	N13E9	10 top	176.62-176.82	47 x 36 x 20	basin-shaped pit with tapered sides	III	central post		biface (1)	fish (2), turtle (25), snake (2), small mammal (2), deer and large mammal (21), unidentified (60)	.03 g hickory	Structure 1
89	9	N13E10	10 top	176.66-176.82	29 x 27 x 16	basin-shaped pit with tapered sides	III	central post			turtle (5), deer and large mammal (1), unidentified (7)	.01 g hickory	Structure 2
95	8	N14E11	11	176.57-176.64	17 x 55 x 7	two areas of baked clay separated by ash/clay mottled zone	?	small, unprepared hearths					
96	11	N17E11	11	176.54-176.56	15 x 17 x 2	compact clay	III	clay liner to storage/trash					associated with Feature 77

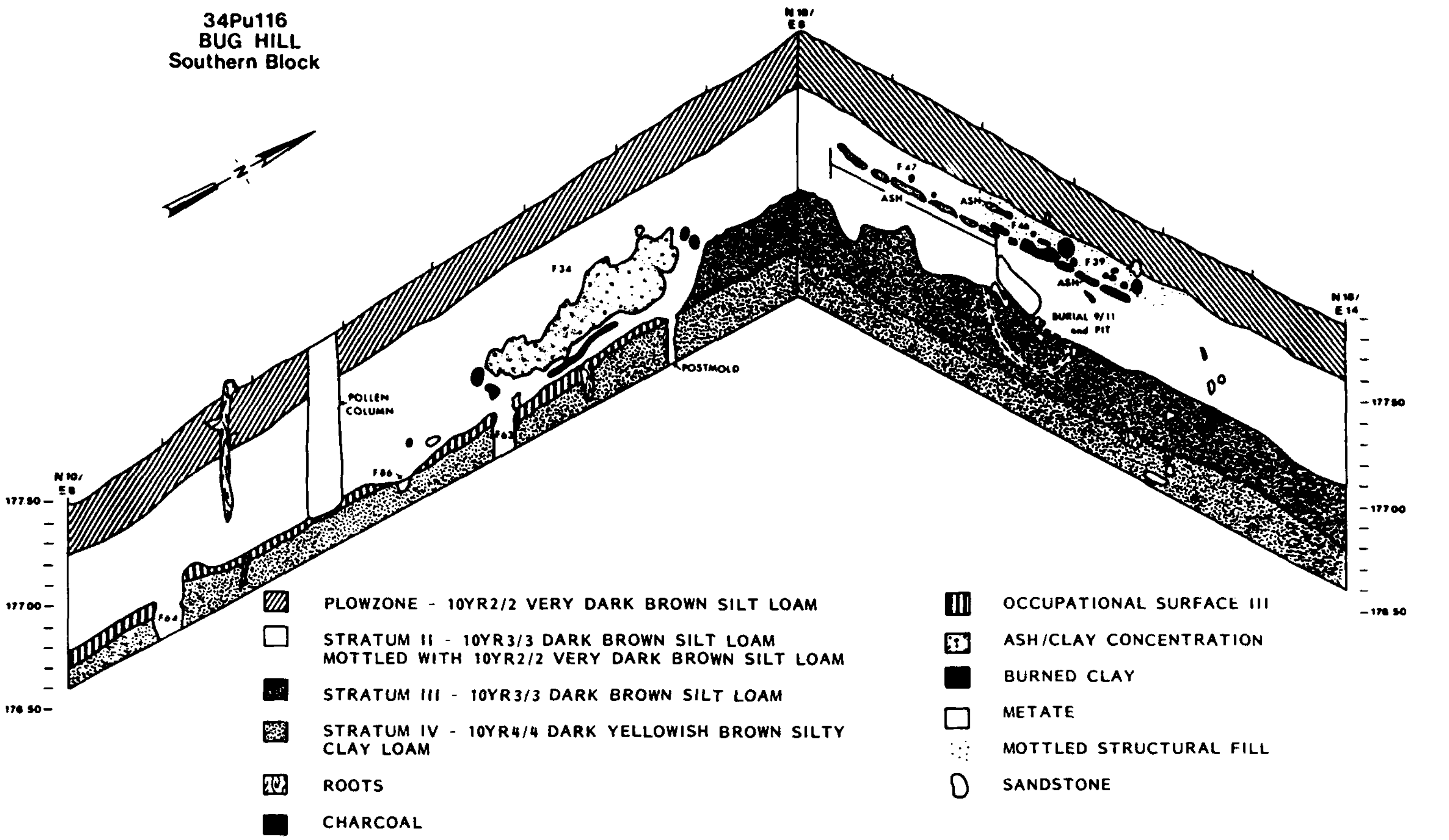
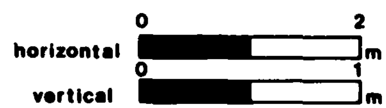


FIGURE 15. NORTH AND WEST WALL PROFILES OF THE SOUTHERN BLOCK.



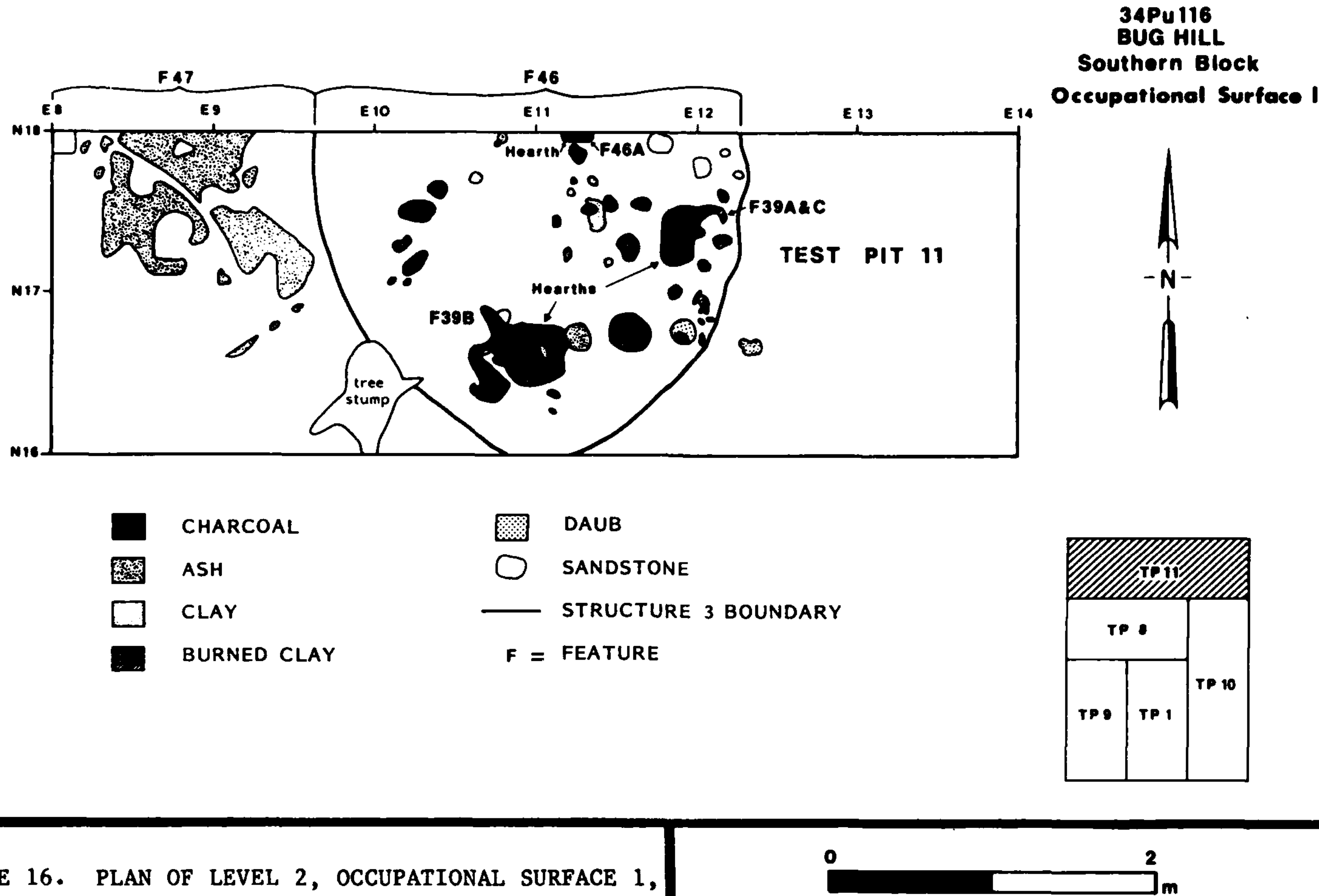


FIGURE 16. PLAN OF LEVEL 2, OCCUPATIONAL SURFACE 1, SOUTHERN BLOCK.

Occupational Surface II

A second occupational surface was recognized at the base of level 5 encompassing all of Test Pits 8 and 11 and the northern portions of Test Pits 1, 9, and 10 (Figure 17). This surface was more difficult to delineate than the preceding one. Its definition was based on two lines of evidence: 1) a localized increase in the organic content of the soil; and 2) the co-association of several features at the same stratigraphic level. Two of the features appear to be processing areas. The first, designated Feature 30, was situated in the northmost 2 m x 2 m square of Test Pit 10. Upon detection, we felt that this feature represented a large trash pit. Feature 30 was characterized by extremely dark (10YR2/1), greasy, humic soil and associated with large quantities of faunal remains. However, upon excavation, the borders of the feature could not be clearly defined. Instead, the entire northern portion of Test Pit 10 (and surrounding portions of Test Pits 8 and 11) became mottled with the dark humic soil and it appeared that rather than being a separate pit, the feature was part of a larger processing area. Artifacts associated with this area included several metate fragments, manos, projectile points, biface fragments, and fire-cracked rock. Animal bones of all types were recovered as well as four isolated human bones (one phalange and a human tooth from N15E13 and two cranial fragments from N15E12, level 5).

The second processing area (Feature 53), was located in the east-central portion of Test Pit 11. This feature consisted of a dense concentration of animal bone, primarily turtle shell. Three complete turtle carapaces, set on their dorsal side, and the remains of at least two others make up the central context of this feature. Scattered among the turtle shells were several large deer vertebrae, and two mussel shells. Two projectile points, one groundstone fragment, and numerous pieces of fire-cracked rock were found among the faunal remains. Several small clumps of ash, baked clay, and charcoal were observed near the feature.

West of the processing areas were three features which may or may not be related to them. Two of these features (3 and 31) were rock-lined pits. While well-made, the fill of these features was essentially no different than the surrounding matrix. The third feature (32) consisted of a bell-shaped hearth, filled with consolidated ash, in the north half of Test Pit 9 (Figure 18).

In general, the data from the base of level 5 are more consistent with a temporary bivouac situation, or situations, than a semi-permanent base-camp. While all the features are found near the same level below the surface, the bases of Features 3 and 53 are between five and ten centimeters higher than the tops of the remaining features. It is quite possible, then, that they represent a separate, later occupation of the same general type.

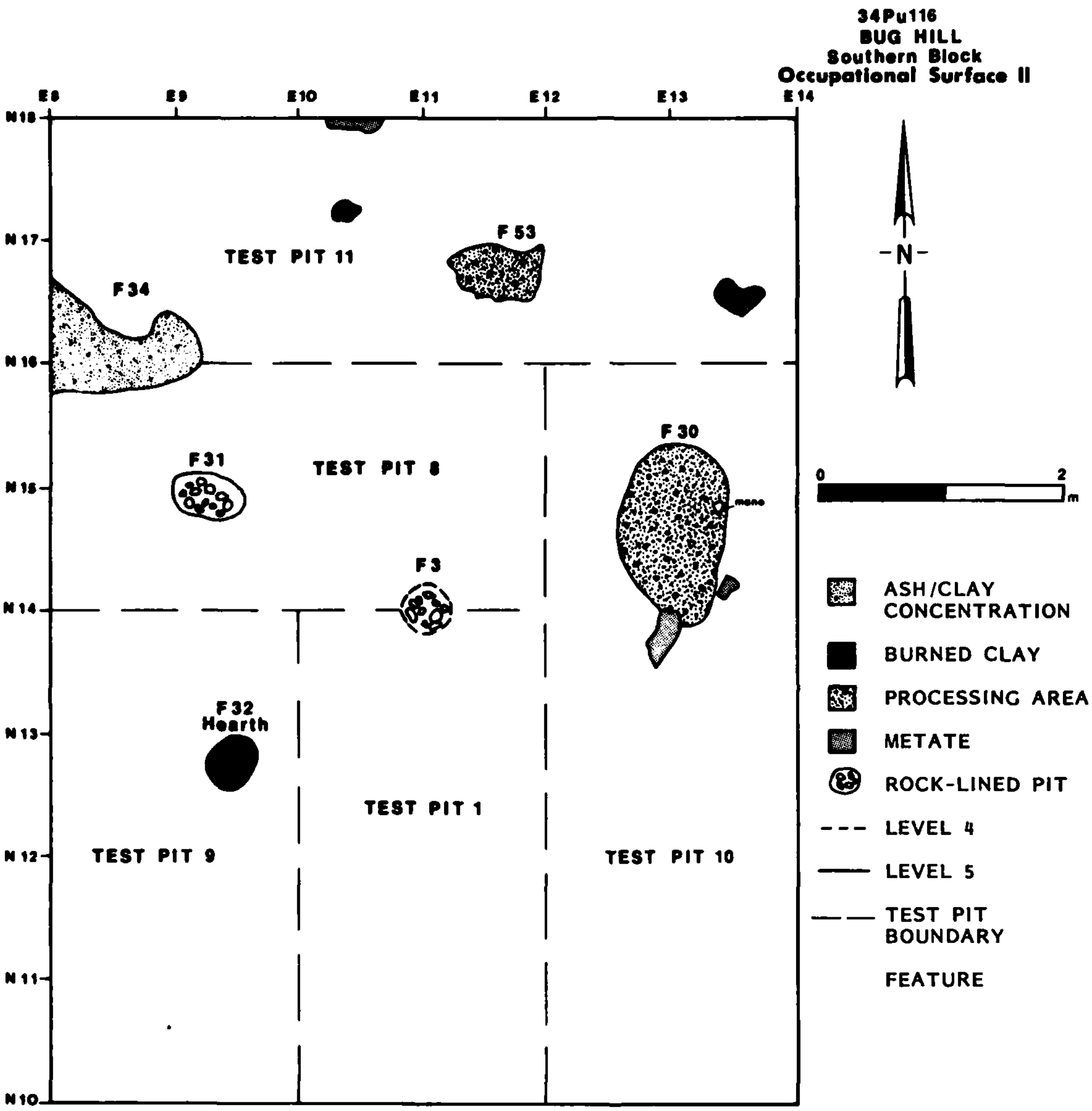


FIGURE 17. PLAN OF LEVELS 4 AND 5, OCCUPATIONAL SURFACE II, SOUTHERN BLOCK.

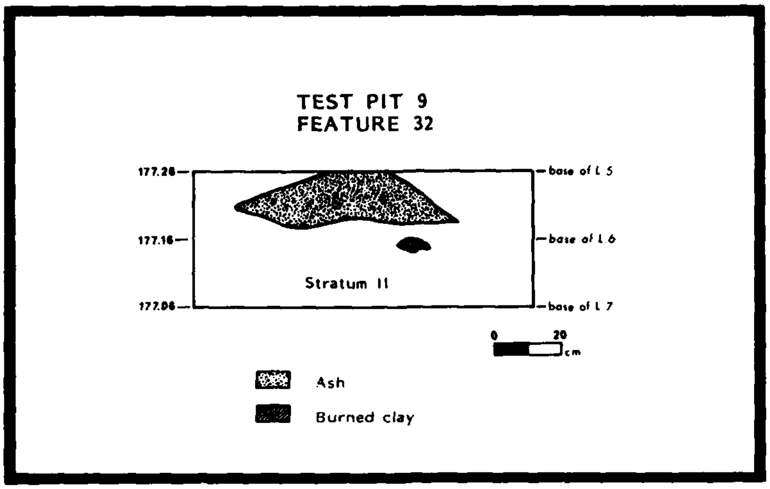


FIGURE 18. CROSS SECTION LOOKING NORTH, FEATURE 32, BELL-SHAPED HEARTH, OCCUPATIONAL SURFACE II, SOUTHERN BLOCK.

Occupational Surface III

Stratigraphy

Below the second occupational surface the stratigraphy of the Southern Block becomes much more complicated. In the northern and western portions of the block, Stratum II blends into Stratum III around the top of level 7 (refer back to Figure 14). Rather than continuing south, or gradually lensing out, Stratum III is abruptly truncated along a line running west from the N17E8 corner of Test Pit 11 east through Test Pit 8 and into the east wall of Test Pit 10. South of this line, we found a burned post (Feature 36); a burned post within an ash/clay concentration (Feature 37); a burned post underlying a pit (Feature 42); a large carbonized log (Feature 35); a postmold (Feature 41); and large quantities of charcoal flecks (Figure 19). A second line, also dotted with large pieces of charcoal (Feature 44), was found separating the two strata running from the northeast corner of square N13E14 in Test Pit 10 to the southwest corner of square N10E13, also in Test Pit 10. These lines, then, outlined a roughly rectangular area in which the basic midden matrix (Stratum II) continued to the base of Level 9. Between levels 7 and 10, the matrix was frequently broken by large amorphously-shaped concentrations of baked clay and ash (Features 2, 34, 37, 43, and 44).

At the base of level 9, a definite soil change was noted. Inside the same general area outlined at the base of level 7, we found a very dark (10YR2/2) thin, compacted layer which contained large inclusions

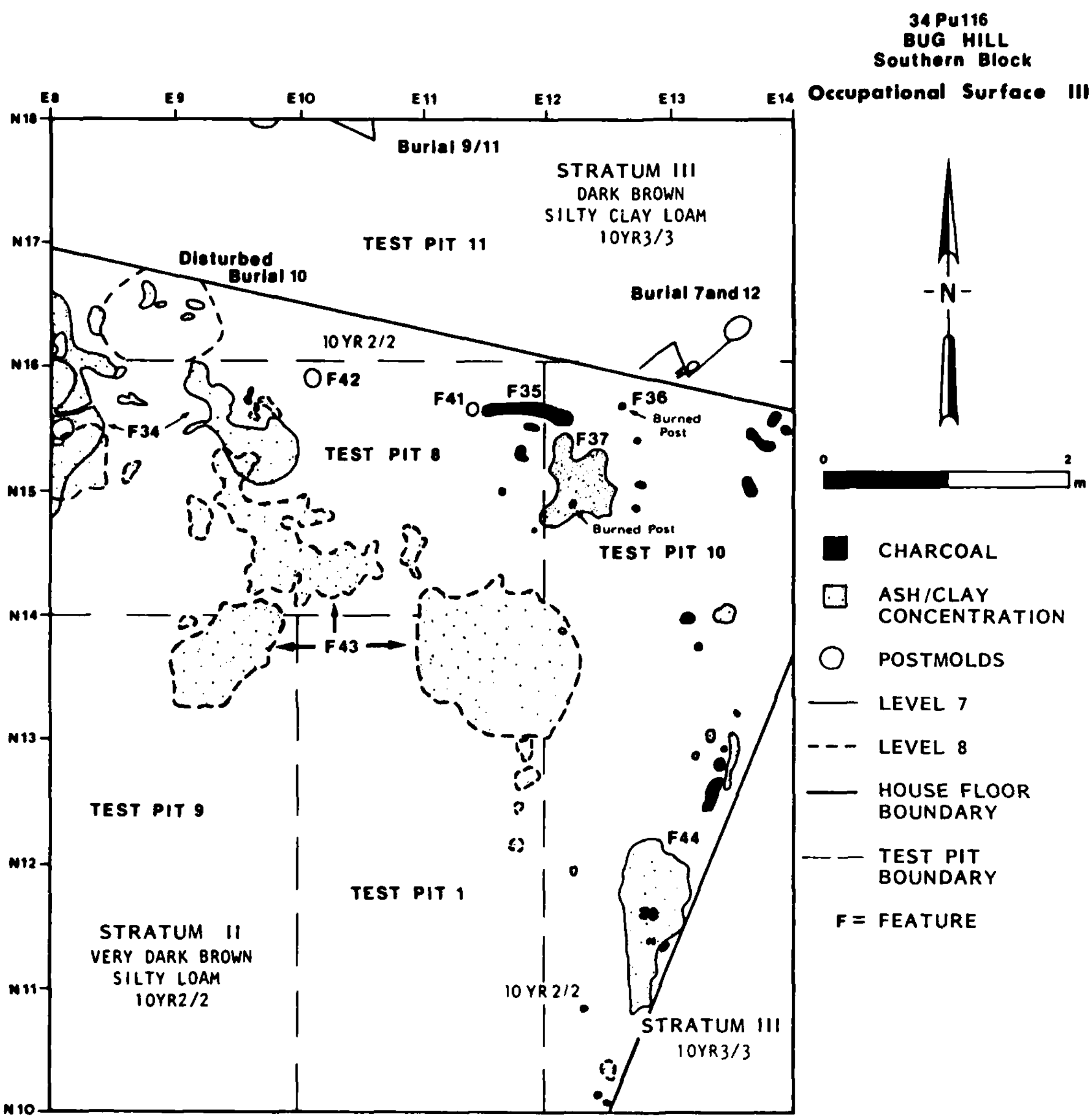


FIGURE 19. PLAN OF LEVELS 7 AND 8, OCCUPATIONAL SURFACE III, SOUTHERN BLOCK.

of baked clay, charcoal and ash. This layer was interpreted as a living floor. It was bordered to the north and east by the compact silty clay loam of the Jackfork Terrace (Figure 20). Located just outside the floor were four lines of posts set in the terrace soil. Two more-or-less parallel lines ran in a roughly east-west direction through Test Pits 10, 8, and 11, while the other two parallel lines fell on a perpendicular north-south axis through Test Pit 10.

From the earlier excavation of Test Pit 1, we knew the floor was approximately 5 cm thick. During the excavation of Test Pit 1, the floor had not been recognized as such and the excavation of level 10 followed standard procedures (1 m x 1 m proveniences and 10 cm arbitrary levels). During the expanded block excavations, however, tight horizontal and vertical control was maintained on this floor with the surface divided into 50 cm sq provenience units and excavated entirely as a separate level (level 10 top). Thus, each 1 m x 1 m standard provenience was divided into four 50 cm x 50 cm proveniences. Of these four, three were excavated by hand while one was saved for flotation.

As the living floor was removed, a third parallel line of posts was found both to the south of the east-west set in Test Pit 8 and to the west of the north-south lines in Test Pit 10. Besides the three lines of posts, 28 features were identified at the base of the living floor. Among these are a series of ash/clay concentrations (Features 2, 59, and 76) located along the borders of Test Pits 1, 8, and 9, which give some clues as to the ultimate fate of the structures.

These ash/clay concentrations, as well as those found variously distributed in the matrix above (Features 34, 37 and 43), probably all relate to the same burning event (Figure 21). Evidence of burning was found from the base of the living floor in level 10 all the way to the base of level 5. These ash/clay deposits indicate intense burning covering an area between the north half of Test Pit 1 and the southwest corner of Test Pit 11. These deposits were not distributed as a homogeneous soil layer but rather as discontinuous, patchy areas. Feature designations were based on horizontal and vertical distinctions with Feature 34 confined to the northwest corner of Test Pit 8 and southwest corner of Test Pit 11, in levels 6 through 8, Feature 37 found at the same stratigraphic level in the northern portion of Test Pit 10, Feature 43 encompassing the central portion of the blocks, in level 8 and 9, and Features 2, 53, and 76 covering a similar area in level 10.

In general, the most compact and consolidated ash/clay occurred in Test Pit 1, level 10 (Feature 2). Burning appears to have been extremely intense in the northern portion of this pit with a thin lens of baked clay lying just under the ash. From this area, the burning appears to have been funnelled to the northeast, becoming increasingly amorphous in shape and less consolidated until by the base of level 5, the ash/clay is found in small, patchy deposits.

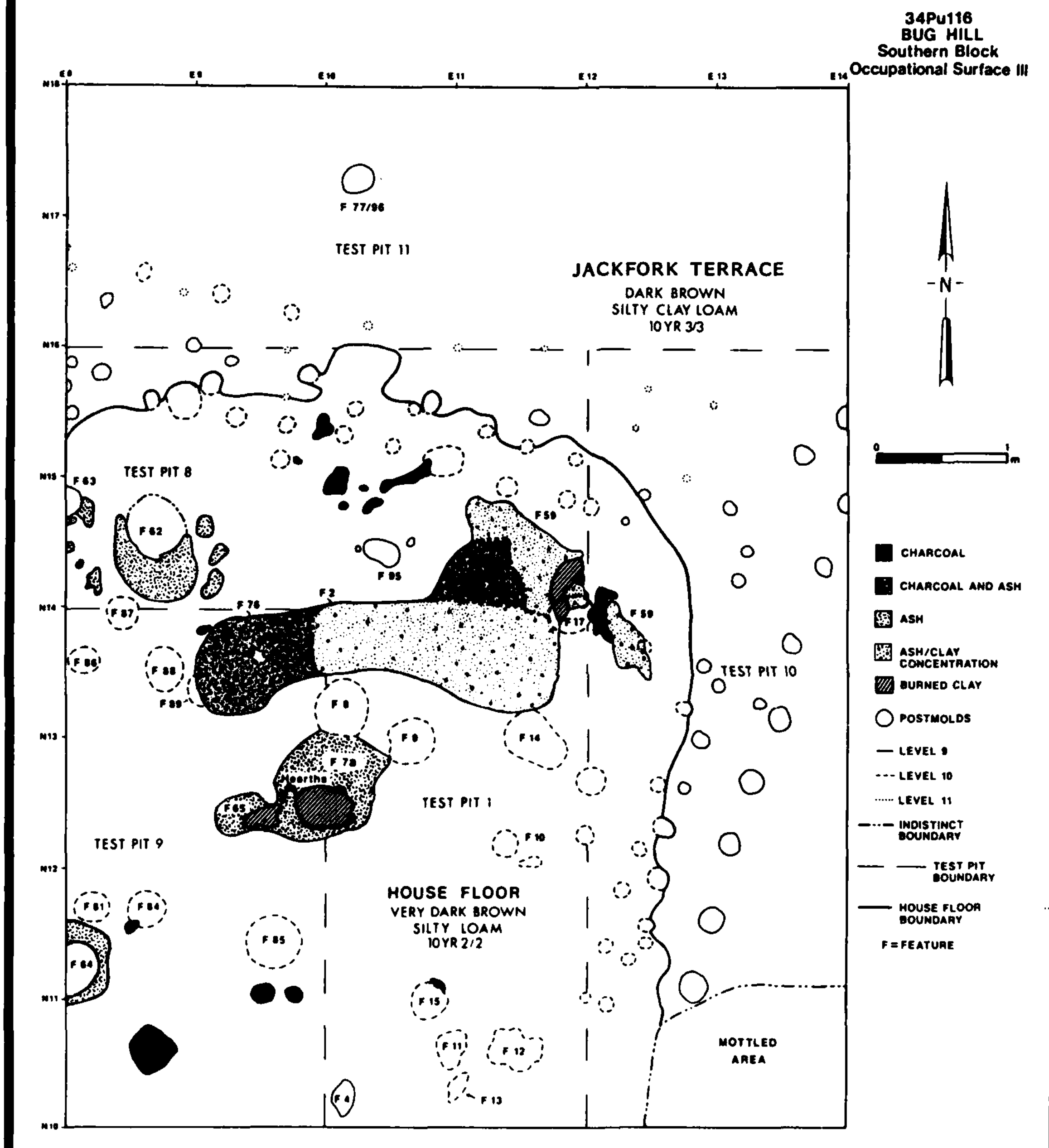


FIGURE 20. PLAN OF LEVELS 9, 10 AND 11, OCCUPATIONAL SURFACE III, SOUTHERN BLOCK.

FIGURE 21. FEATURE 34 ASH/CLAY CONCENTRATION, WEST AND NORTH PROFILES, (SOUTHERN BLOCK). Note: photograph taken prior to excavation of Test Pit 11 so north profile is 2 m south of block excavations limits.

The ash/clay concentrations most likely represent the ultimate burning of a house. This fire appears to have started in the north of Test Pit 1 and fanned out to the northwest. As the fire burned, the roof and walls collapsed leaving the outline of the structure marked by line of charcoal, baked clay and burned posts noted at the base of level 7.

In summary, then, the stratigraphic interpretation of levels 7 through 10 of the Southern Block is as follows. At some point after the midden mound had taken shape, the residents of Bug Hill cut into the mound, creating a relatively level surface on the Jackfork Terrace. A thin living floor situated between 100 and around 105 cm below the present surface (level 10 top) was created and utilized repeatedly by occupants of at least two separate houses. At some point, the last house burned, leaving about 20 cm (levels 8 and 9) of debris. Resting on top of the debris at the base of level 7 are the remnants of the collapsed roof, walls and posts. Evidence of the burning continues for another 20 cm in restricted areas of Test Pit 8 and 11 before lensing out at the base of level 5.

House Patterns

Seventy-four postmolds, 28 features, and three burials are associated with the third occupational surface. The postmolds are arranged in a set of three parallel lines along two perpendicular axes suggesting two or three house structures.

Two lines of evidence were used to resolve the number of houses represented: 1) the postmolds themselves, and 2) the features found beneath the living floor. In general, the postmolds can be divided between two groups. The outer lines consist of evenly spaced postmolds that are all large (ca. 15 cm in diameter), well constructed, relatively straight and usually very deep (i.e., the mold extends more than 30 cm into the Jackfork Terrace). These postmolds are situated in two roughly perpendicular lines. The first runs almost the entire six meters of Test Pit 10 and is oriented approximately 15° east of north. The postmold pattern is obscured near the southern wall of Test Pit 10 by a highly disturbed area of mottled soil and it is unclear how much further the line extends. The second line extends across the entire six meter extent of the Southern Block falling on a line roughly 105° east of north.

The inner lines of postmolds are more confusing to interpret. In Test Pit 8, there are basically two lines. Much like the larger outer postmolds, both are oriented roughly at 105° east of north. However, these postmolds do not follow as regular a pattern as the outer ones, making it difficult sometimes to determine on which line a post lies. A similar situation exists in Test Pit 10. Again, fragments of two lines were noted, oriented roughly 15° east of north.

In general, the inner postmolds are small and closely spaced. There does not seem to have been as much care taken in their construction with many of the postmolds set at various angles and extending only slightly into the terrace subsoil.

Number of Structures

From looking solely at the postmold patterns, it appears that we are dealing with either two or three structures. To make a finer assessment, the features found at the base of the living floor were examined. There were two aspects to this study. First, we needed to determine whether any of the interior features were actually central posts or central hearths. Second, we needed to try to relate the remaining features to specific structures.

Central Hearths: Features 7a and 65 represent two relatively large, though not especially deep hearths (Figure 20). The hearths are well-made, centered on thin basin-shaped layers of burned clay. The two are connected by a lens of ash which covers a considerable distance surrounding the hearths. In the case of Feature 7a, the hearth (Feature 7a) was prepared over an already existing pit (Feature 7b) (Figure 22). No such situation exists at Feature 65 which was built directly on the terrace.

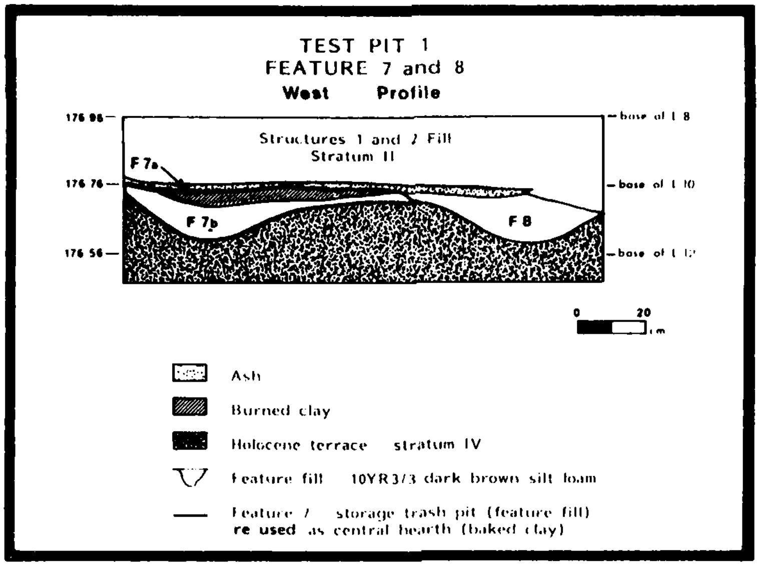


FIGURE 22. WEST PROFILE OF TEST PIT 1 SHOWING CENTRAL HEARTH OF STRUCTURE 2 (FEATURE 7) AND CENTRAL POST (FEATURE 8), AND PIT (FEATURE 7) OF STRUCTURE 1, OCCUPATIONAL SURFACE III, SOUTHERN BLOCK.

While other areas of burning were noted inside the structure (Features 2, 11, 13, 53, and 76), most of these relate to the destruction of the house and are not prepared hearths. Features 7a and 65 were the loci of intense burning and each most likely represents a separate central hearth.

Central Posts: Table 2 presents a list of the pit-like features surrounding the central hearths and rates them on the basis of location, slope, content, and fill as to their likeliness of being a central post. From the table it appears that Features 8, 9, 81, 84, 85, 88, and 89 are most likely the remnants of central posts. Figure 23 shows the profile of Feature 81, which is rather typical of the features interpreted as central posts. As can be seen, one side of the pit has been gouged. Rogers (1982) noted a similar pattern at Sprio and argues that it reflected the practice of placing the large central posts in at an angle before raising them.

The spatial distribution of these features is interesting. Features almost always occur in pairs: Features 8 and 9, Features 88 and 89, and Features 81 and 84. Feature 85 is the only one not paired, though a curious dark stain was noted in the floor of level 11, Test Pit 1 just to the east. This stain was roughly circular in shape and extremely disturbed. No feature number was assigned, but given the stain's location and shape, it is possible it represents the remnants of a central post.

TABLE 2

OCCUPATIONAL SURFACE III FEATURE EVALUATION

Feature	Shape	Diameter	Elevation Top	Elevation Bottom	Comments - Likelihood of Being a Post
7	basin	?	?	176.44	unlikely; right shape, but very close to Feature 65
8	basin	45 x 39	176.76	176.49	good
9	basin	35 x 33	176.71	176.45	good
14	elliptical	48 x 35	176.73	176.62	unlikely due to irregular form
15	irregular	24 x 28	176.71	176.61	unlikely; associated with artifacts and shallow
††	?	?	?	?	suspected solely on basis of position
62	?	60 x 70	177.82	?	unlikely; probable trash/storage pit
63	basin	20 x ?	176.79	176.64	unlikely; probable trash/storage pit
64	basin	30 x 32?	176.82	176.66	possible; right, but contained with faunal remains
81	basin	25 x 25	176.77	176.57	possible; right shape, but contained substantial faunal remains
84	basin(?)	22 x 30	176.72	?	possible; disturbed by roots
85	basin	30 x 38	176.72	176.60	excellent
86	irregular	25 x 28	176.82	176.70	unlikely
87	irregular	21 x 25	176.82	?	unlikely
88	basin	37 x 47	176.82	176.62	excellent
89	basin	28 x 29	176.82	176.66	excellent

†† unidentified soil stain

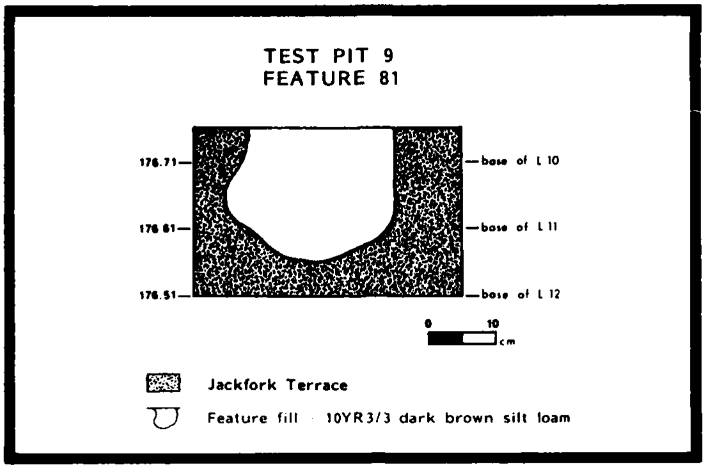


FIGURE 23. CROSS-SECTION LOOKING NC TH, FEATURE 81, CENTRAL POST. OCCUPATIONAL SURFACE III, SOUTHERN BLOCK.

Two roughly rectangular configurations emerge by matching up posts from each pair (Figure 24). The east set of posts (Features 9, 89, 84, and the undesignated stain) is centered over Feature 7a, while the west set (Features 8, 88, 81, and 85) are arranged around Feature 65. Both sets are oriented approximately 13° east of north, roughly parallel to all lines of postmolds.

<u>The Form and Relative Dates of the Structures</u>

The data allow for two structures. It remains to determine which line of outside postmolds is associated with which set of central posts and hearths and the relative dating of the two structures.

From the west profile of Test Pit 1, ash from Feature 7a can be seen overlying Feature 8 (see Figure 22). Thus, it is clear that the use of Feature 7 as a hearth post-dates not only its own use as a pit (Feature 7b) but also the central post of Feature 8. The most plausible interpretation is that both the pit and central post were contemporaneous with an earlier central hearth, presumably located to the west (Feature 65). As stated above, during the excavation of level 10 top, we noticed that a thin layer of the living floor covered the inner postmolds, but did not extend to the outer line. The stratigraphy, therefore, indicates that the inner postmolds pre-date this portion of the floor.

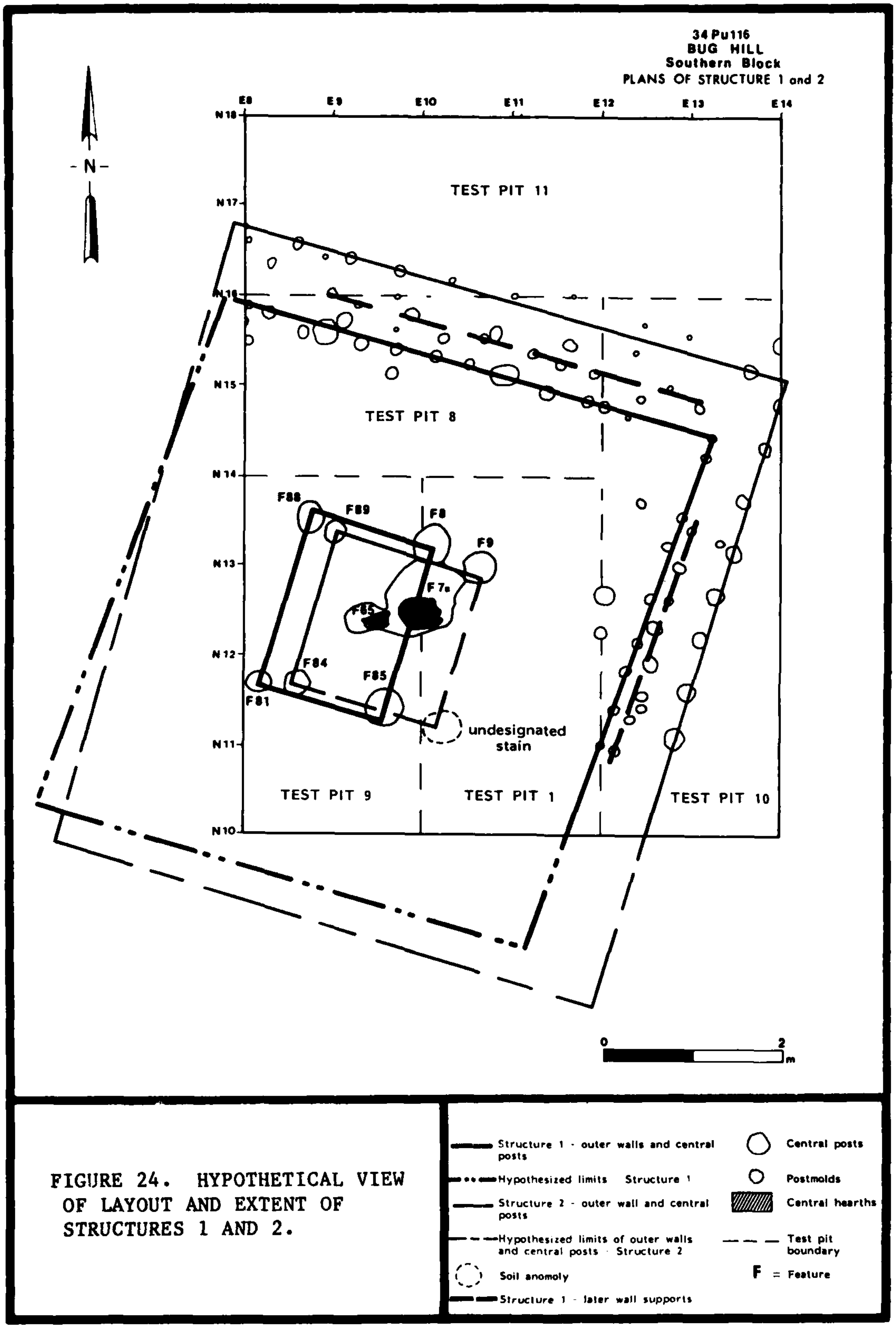


FIGURE 24. HYPOTHETICAL VIEW OF LAYOUT AND EXTENT OF STRUCTURES 1 AND 2.

Combining the two lines of evidence yields the following results (Figure 24). The oldest structure in the Southern Block (Structure 1) was set in an artificially created depression. The house was centered over the hearth of Feature 65, supported by the west set of central posts, and used the two lines of inner postmolds for its outside walls. The two sets of postmolds were probably not used simultaneously. The fact that the outside line is not complete suggests that these posts were used to refurbish and maintain an already existing structure. As the walls of the structure were pushed out, the outer postmolds were no longer being set at floor level. Instead, the postmolds began to be set on the banks of the depression. By the time the second house (Structure 2) was built, the outer wall postmolds were set on top of the old ground surface, 15 to 20 cm above the floor of the house. This interpretation is supported by the position of the burned posts of Features 36, 37, 41 and 42. The center of the second structure (Structure 2) was moved slightly to the east. Feature 7a served as the central hearth, major support of the roof was provided by the east set of central posts, and the outside lines of postmolds were used for the walls.

Feature 42 may provide the best corroborative evidence for this interpretation. This feature, which is located along the north edge of Test Pit 8, consisted of a burned charcoal post that had been capped with sandstone and then used as a small interior pit or post (Figure 25). The base of the burned post lies in Stratum III, about two centimeters above the house floor. Although the base of the

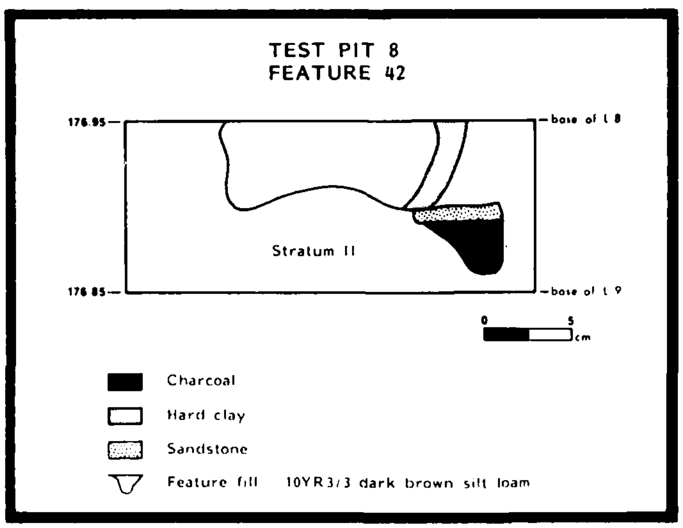


FIGURE 25. CROSS-SECTION (LOOKING NORTH) OF FEATURE 42, POSSIBLY RE-USED POST, OCCUPATIONAL SURFACE III, SOUTHERN BLOCK.

postmold was obscured, the burned post of Feature 42 was almost assuredly associated with the middle row of postmolds running east-west through Test pits 8 and 10. The most likely interpretation of this feature is that it was used as a wall support when Structure 1 was refurbished. As the northern wall of Structure 1 was moved north, the outside posts were moved up the banks of the depression and set into the old Stratum III deposits. The post finally burned. It was then capped, with the old postmold (perhaps enlarged) used for an interior post or pit in Structure 2.

Although the quality of construction was far superior in Structure 2, the two houses follow the same architectural pattern. Both were focused over a central hearth and supported by four central posts. Because only portions of two walls were found, it is impossible to know the exact shape of the structures. Using the available data, however, a reasonable reconstruction of the areal extent of the structures can be offered (Table 3). Assuming that the outside walls were roughly perpendicular to each other and that the same relative distance from the central hearth to the north and east walls were maintained to the south and west, then Structure 1 was either square or slightly rectangular in shape with the east-west wall spanning 6 m to 6.5 m and the north-south walls a distance of 6 m. Structure 2 was rectangular in shape with the east-west walls covering a distance of 6.75 m and the north-south walls a distance of about 7.5 m. The total area encompassed by Structure 2 was approximately 50 m^2 while the total area of the house excavated was 39.9 m^2, or nearly 80 percent.

TABLE 3
HYPOTHETICAL SIZE ESTIMATES OF STRUCTURES 1 AND 2

	Distance From Central Hearth To N/S Wall	Distance From Central Hearth To E/W Wall	Projected N/S Length	Projected E/W Length	Total Area
Structure 1	3-3.25	3	6-6.5	6	36-39m^2
Structure 2	3.75	3.35	7.5	6.75	50m^2

Note: all measurements in meters

Interior Features: Sixteen features were found extending from the living floor into the Jackfork Terrace. These features can be divided into two groups, basin-shaped pits and shallow hearths. The former group includes both well-made circular pits which average around 25 cm in depth (Features 7, 14, 17, 63, and 64) and more amorphously-shaped ones usually extending no more than 10 cm below the floor (Features 10, 11, 12, 15, 62, 86, and 87). Some of the latter pits are badly disturbed (Features 86 and 87) and may originally have been more regular in construction. Others, however, were clearly not built with great care. Most of these are clustered in the southeast corner of the living floor in Test Pit 1 with a number of shallow fire hearths. These hearths (Features 4, 11, 13, and 95) also show little care taken in their construction, indicating perhaps that all these features were related.

The fill from the pits was relatively similar. Substantial numbers of faunal remains were routinely recovered, suggesting that the features were used either as trash and/or storage pits. The shallow hearths are more difficult to explain. They indicate that not all burning was confined to the central hearth, but in-and-of themselves provide few clues as to their functions.

Exterior Features: One feature and three burials were found outside the house patterns at the base of the midden. All these features and burials were found to the north of the structures in Test Pits 8, 10, and 11. Feature 77/95 was a circular clay lined storage or trash pit which contained numerous clay inclusions but little bone.

Burial 10 was extremely disturbed. Skeletal fragments were concentrated directly over postmolds of the northern wall of Structure 2, but were found in substantial numbers to the south as well (see Table 43, Chapter Thirteen). At least two individuals are represented. This burial lay entirely within Stratum II. It was probably associated with the occupation of Structure 1 and interred directly outside. When Structure 2 was constructed, the burial was disturbed with large portions of the skeletal remains either destroyed or scattered.

The second burial (Burial 9/11), was an articulated adult skeleton found in the north profile of Test Pit 11 lying underneath a large metate. Soil near the skeleton was less compacted and very slightly darker in color than the surrounding matrix. It is possible that this soil represents the fill of a burial pit, although after careful trowelling and cleaning, we still could not find the borders of such a pit. The base of this burial is nearly 40 cm above the house floor. Yet, we believe Burial 9/11 was contemporaneous with the others based on its stratigraphic position. The top of the burial is at the interface of Strata II and III with the remainder of the burial intruding into Stratum III (Figure 15). All burials associated with the houses are found at the base of Stratum II. Thus, while Burial 9/11 is located higher in the midden, it corresponds to the same stratigraphic position as the other burials. The only difference is that, unlike the others, which were placed directly outside the houses, Burial 9/11 was placed on top of the older midden.

Burial 7/12 (assigned separate burial numbers in the field) was a multiple burial consisting of an adult woman and a neonate. Both skeletons were articulated with the infant being located underneath the adult's pelvis. The adult was in a flexed position with the head facing east. No burial pit was discerned and the only possible grave good was a piece of worked antler found underneath the adult's vertebrae and ribs. Burial 7/12 was found entirely within Stratum III. In the absence of a pit connecting the burial with Stratum II it is impossible to demonstrate that this burial was associated with the occupation of Structures 1 and 2. Indeed a radiocarbon date based on a long bone of Burial 7 indicates that this burial dates to the Late Archaic period (see Chapter Five). At present, there is no reason to question this date.

Southern Block: Summary

Evidence of the earliest occupation in the Southern Block appears to have been prehistorically removed. The older deposits of Stratum III extend only along the northern and western portions of the block in a line roughly parallel to Structures 1 and 2. Stratum III does appear, however, in the profiles of the 1979 backhoe cuts 10 m west of the block underlying the basic midden matrix (Stratum II) and continuing south beyond the trench (Vehik 1982a).

Sometime after the mound had been formed, the occupants of Bug Hill removed about 30 cm of Stratum III deposit in the area of the Southern Block. Within this artificially created depression, a level surface was made on the Jackfork Terrace and a roughly square, 6 m by 6 m house built. The house was oriented roughly 15° east of north. It was arranged around a central hearth and supported by four central posts.

Structure 1 appears to have been fairly long-lived. The entire length of the outer walls appears to have been strengthened and refurbished at least once. At some point, however, the house was torn down and a new one constructed. The second house, Structure 2, was somewhat larger (7.5 m x 6.75 m), but essentially the same in plan and orientation.

The outside of the houses, especially to the north, appears to have been used primarily as a burial ground. Two burials clearly associated with the occupation of Structures 1 and 2, were found paralleling the six meter extent of the northern wall. Evidence of other specialized activity was not recovered outside the houses.

Structure 2 eventually burned leaving a 20 cm deposit of ash, clay and charcoal rubble. The fire appears to have started in the northern portion of the house and fanned towards the northwest.

After the destruction of Structure 2, the Southern Block served as the locus of what appears to be intermittent camps and bivouacs. Later, a roughly circular structure, 3 m in diameter, was built in the north portion of the block. Structural evidence in the form of daub, burned posts and carbonized logs indicate that some care and time went into construction. The small size of Structure 3 and the impermanent nature of the hearths suggest a rather limited, specialized focus for this occupation. Whatever its nature, this occupation was not long-lived, with the structure eventually burning down.

CENTRAL BLOCK

The Central Block excavation was laid out over a 5 m x 5 m area on the summit of the mound. Internally, the block was subdivided into four 2 m x 2 m units designated 5A(NW), 5B(NE), 5C(SW), and 5D(SE). In turn, these units were separated by two 75 cm baulks which ran in the cardinal directions. The entire block was surrounded by a 12.5 cm wall which was to be taken down by 10 cm level and screened through 1/16 in hardware mesh after the four units had been completely excavated. Thus, 16 sq m were to be systematically hand-excavated with an additional 4 sq m taken down as a check on what the 1/4 in screens were not recovering. Due to the location of the pollen column, floatation column and other unforseen complications, however, we were forced to change the recovery of the 1/16 in material. Four square meters of materials were still recovered, although the exact proveniences were confined to Units 5B, 5C, and 5D as outlined in Figure 13.

The excavations of the Central Block uncovered 34 features, 17 of which were postmolds or groups of postmolds. Because of the large number of postmolds encountered and the difficulty in recognizing them in the dark soil of the Central Block, a series of related procedures was developed specifically for this type of feature. First, all stains from the same unit and level were assigned one feature number. Upon cross-sectioning, postmolds were then distinguished from roots and rodent burrows. In cases in which all stains were roots, feature numbers were not reassigned. Table 4 lists these features and the number of associated postmolds.

Of the remaining 17 features, fourteen were probably structurally related to the postmolds. Data from these latter 17 features are summarized in Table 5.

Stratum I

The first 70 cm below the surface contain the darkest, most alkaline soil at the site. Little variation was noted in these levels and features were nearly impossible to detect. Three features were subsequently assigned to this stratum, but except for Feature 16, these were not observed during excavation. Instead, one feature (Feature 94) was first observed at the point where it cut into Stratum IIa while the second feature (Feature 93) was only observed in the wall profile after excavations were complete.

TABLE 4. CENTRAL BLOCK FEATURES.

Feature Number	PROVENIENCE (point of detection) Unit	Square(s)	Level	Depth Below Datum	Dimensions Length x Width x Depth	Description	Strata	Probable Function	C14	Artifacts	Faunal Remains	Carbonized Seeds (#) and Nut Shell (gm)	Comment
16	C	SW 1/4	5	177.60-177.80	50 x 50 x 20 (top) 60 x 60 (bottom)	bell-shaped, clay lined pit filled with ash and numerous fire-cracked rocks	I-IIa	possible hearth reused as storage/trash pit				honey locust (1?)	
18	D	SE 1/4	8	177.46-177.50	20 x 30 x 4	mussel shell concentration	IIa	?			mussel shell		possibly associated with fea. 25 and line of post molds in 5C-5D;
23	D	SE 1/4	8	n/a	n/a	mottled area							at first, thought to be a pit, but subsequent examination indicated this stain, was non-cultural, probable tree stump
25	C	SE 1/4 SW 1/4	8	177.44-177.49	50 x 155 x 5	series of irregularly shaped ash/clay concentrations distributed around two circular depressions	IIa	postmold and probable trash/storage pit			small mammal (1), deer and large mammal (1), unidentified (9)		associated with line of posts to the north and perhaps fea. 18
51	B	NE 1/4	10	177.24-177.29	40 x 7 x 5	shallow ash/clay concentration associated with substantial faunal remains	IIb-III	?			turtle (2), carnivore (6), rodent (1), deer and large mammal (5), unidentified (11)	.27 g hickory	
55	D	NW 1/4	9	177.36-177.43	25 x 20 x 7	roughly circular patch of ash with baked clay inclusions	IIb	hearth					
70	B	SE 1/4	13	176.92-176.97	8 x 6 x 5	burned post	III	burned post	1420 B.C. ± 45 (DICarb)				
71	B	SE 1/4	13	176.55-177.01	70 x 50 x 46	basin-shaped pit; only partially contained in excavation unit	III	trash/storage pit		hemitate modified (1), unmodified (1)			this feature was not seen during excavation until 177.01; consequently, only the bottom contents of the pit were recovered
72	A	SW 1/4	11	177.11-177.16	15 x 10 x 5.5	carbonized log	III	?	420 B.C. ± 125 (DICarb)				definitely not a post, perhaps a structural support

TABLE 4. CENTRAL BLOCK FEATURES - CONTINUED.

Feature Number	PROVENIENCE (point of detection) Unit	Square(s)	Level	Depth Below Datum	Dimensions Length x Width x Depth	Description	Strata	Probable Function	Artifacts	Faunal Remains	Carbonized Seeds (#) and Nut Shell (gm)	Comment
74	C	SE 1/4	12	176.96-177.04	40 x 20 x 8	ash concentration	III	?		deer and large mammal (3), unidentified (1)		lies directly above Fea. 83c but is stratigraphically distinct
78	A	SE 1/4 SW 1/4	13	176.97-176.99	5 x 130 x 2	discontinuous semi-circle of ash	III	?				peculiar shape, but not associated with any other feature or artifacts
80	D	NE 1/4	13	176.69-176.97	50 x 50 x 28	basin-shaped pit, only partially contained in excavation unit	III	storage/trash pit	nutting stone (1), abrader frag. (1), hematite unmodified (1)	turtle (4), frog-toad (1), small mammal (1), deer and large mammal (4), unidentified (9)		probably originated somewhat higher, ca. 177.17; the pit is easier to define with depth
82	C	NW 1/4 SW 1/4	13	176.84-176.97	25 x 30 x 13	ash/clay concentration	III	?		turtle (1), deer and large mammal (3)		
83	C	NE 1/4	14	176.71-176.89	140 x ? x 18	basin-shaped pit, only partially contained in excavation unit	III	storage/trash pit	Gary (1), biface fragment (1), mono-bifacial (1), liminite	snake (1), carnivore (1), cotton rat (1), rodent (1), deer and large mammal (9), unidentified (28)		
90	C	entire pit	17	? - 176.69	amorphous	three rock concentrations distributed among a wider, more amorphous scattering of rock	III-IV	?				
92	D	SW 1/4	17	? - 176.69	35 x 50 x ?	rock concentration, no apparent depth	III-IV	?	groundstone (2)			associated with small, fragile bone fragments
93	A	SE 1/4	5	177.34-177.74	50 x 50 x 40	roughly basin-shaped pit	II	storage/trash pit		fish (1), turtle (1), deer and large mammal (1), unid. (8)	.5 g hickory, .01 g acorn	seen only in profile; flotation sample recovered
94	A	SE 1/4	5	177.34-177.70	70 x 100 x 36	oval pit	I-II	burial pit	boatstone (1), billet (1), seed beads (179)		persimmon (2), pokeweed (2), sumac (2), .85 g hickory	contained burial #6; perhaps intrusive from Stratum I

TABLE 5
CENTRAL BLOCK FEATURES AND ASSOCIATED POSTMOLDS

Feature Number	Unit	Level	Stratum	Number of Posts
	Provenience			
19	A	8	IIa	13
20	B	7	IIa	3
21	D	7	IIa	2
24	C	7	IIa	6
26	C	8	IIa	13
27	D	8	IIa	3
28	B	8	IIa	5
29	C	9	IIb	13
33	A	9	IIb	9
48	B	9	IIb	3
49	C	10	IIb	11
50	D	9	IIb	5
54	A	10	IIb	4
60	D	10	IIb	1
66	C	11	III	4
67/69	B	12	III	0*
68	A	11	III	4
73	C	12	III	0*
75	C	13	III	0*
79	D	13	III	1

* All stains were roots molds; feature numbers were not re-assigned.

Feature 16 consisted of a bell-shaped clay-lined pit. The feature, located in Unit 5C, was filled with consolidated ash and numerous hearth stones. Four thin bone-tempered sherds were also recovered from the feature. The pit may have been used as a hearth, but neither the clay-lining nor the sherds showed any indication of being burned. The hearth stones were distributed throughout the ash matrix in a haphazard manner indicating that the hearth material was in a secondary context. The most probable interpretation, then, is that the feature was used perhaps as a storage pit but ultimately as a trash pit.

Feature 93 (Unit 5A) was also a clay-lined pit. This feature, however, was basin-shaped and filled with a matrix similar in color and texture to the surrounding deposits of Stratum I. Feature 93 was noted in the east profile of Unit 5A after the excavation was complete and only a small flotation sample (approximately five liters) was recovered. Even so, substantial amounts of faunal remains and nutshell were noted, indicating the feature was probably used as a storage/trash pit.

Feature 94 was the burial pit associated with Burial 6. This burial was detected in the southwest corner of Unit 5A during the excavation of Level 8 (Stratum IIa) and clearly extended into the baulk. Given the excellent preservation of the skeleton, we decided to remove the burial completely after the remainder of the block excavation had been finished. Burial 6 consisted of two flexed juvenile males. The skeletons were accompanied by several grave goods including a boatstone, billet and 179 seed beads (see Chapter Eight).

The stratigraphic position of Burial 6 is somewhat problematic. The burial and burial pit were clearly seen in Stratum IIa. The top of the burial pit, however, could not be readily distinguished, being separated from Stratum I by a mottled zone. Two possible situations exist; either Burial 6 is contemporaneous with Stratum IIa or was placed into Stratum IIa during a Stratum I occupation. At present, we tend to favor the later hypothesis. In either case, a radiocarbon date of A.D. 460 $\pm$ 90 from a long bone is consistent with the cultural materials found with Burial 6 and thus is accepted as an accurate date of the burial.

Stratum IIa: The Upper Postmold Levels

Beginning around 70 cm below the surface (ca. 177.60 AMSL), the soil became slightly lighter in color, possibly due to greater amounts of ash in the matrix (Stratum II). The soil texture became much less homogeneous with sections being very compact and others being basically the same as the midden above (Stratum I). The ligher soil color made the sighting of features much easier.

Stratum II was subdivided into two substrata, IIa and IIb, on the basis of postmold patterns and associated features. Statum IIa encompassed arbitrary levels 7 and 8 while Stratum IIb included levels 9 and 10.

In Stratum IIa, a number of well-defined features were uncovered (Figure 26). One of these, Feature 25 (Unit 5C), consisted of a series of ash concentrations associated with a large postmold and a possible trash/storage pit. Perhaps associated with the feature was a concentration of mussel shell noted in Feature 18 (Unit 5D), about two meters to the east. North of these features was a line of postmolds. This line was located about 1 m north of Feature 25 and ran from the southwest corner of Unit 5C to the northeast corner of Unit 5B.

The line of postmolds may represent an interior or exterior wall of some type of structure. While the line extends to the northeast corner of Unit 5B, the wall may actually have ended at a large postmold (PM 15) near the middle of that unit. This postmold is located between two others (PM 14 and 16) and the line formed by the three is

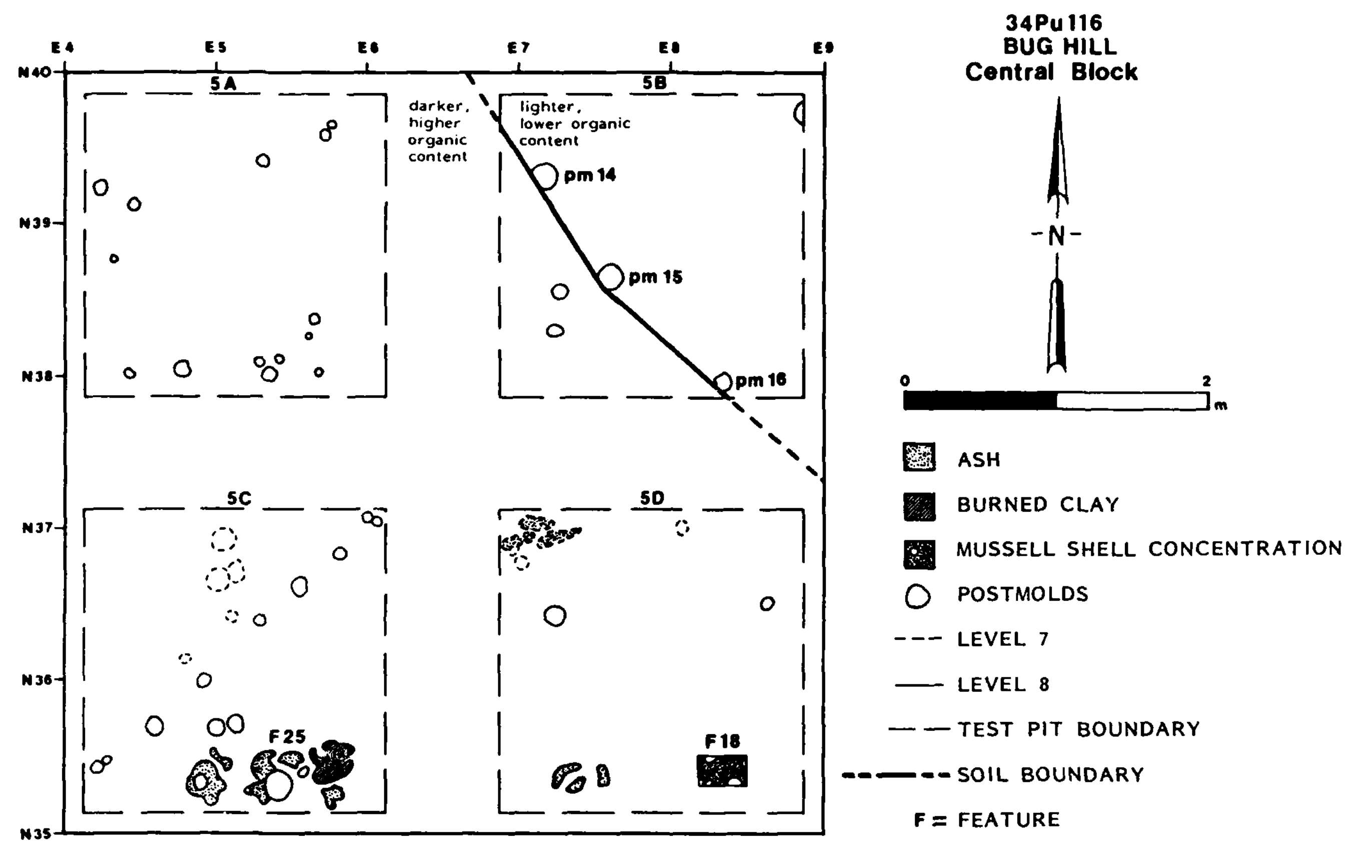
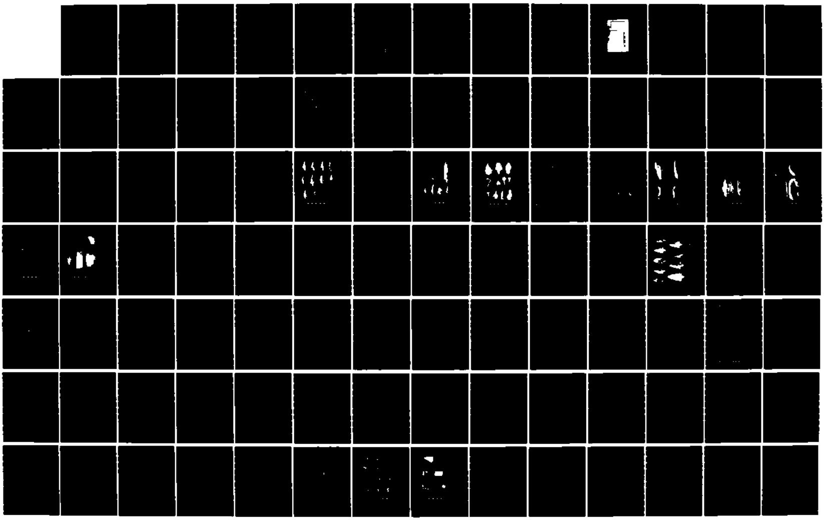
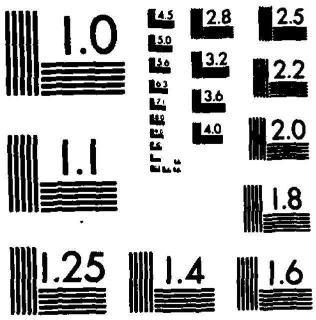


FIGURE 26. PLAN OF LEVELS 7 AND 8, STRATUM IIa, CENTRAL BLOCK.

AD-A144 104 BUG HILL: EXCAVATION OF A MULTICOMPONENT MIDDEN MOUND 2/5
IN THE JACKFORK VAL..(U) NEW WORLD RESEARCH INC POLLOCK
LA J H ALTSCHUL ET AL. 25 NOV 83 DACW56-81-C-0144

UNCLASSIFIED F/G 5/6 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

roughly perpendicular to the major southwest-northeast line. During the excavation, we noted that the portion of Unit 5B southwest of the PM 14-15-16 line was slightly darker than the remaining portion of the square.

In Unit 5A, another series of postmolds was found. While no clear patterns were observed, it is noteworthy to point out that color and texture were similar to that observed in the southwest portion of Unit 5D.

With the available data it is simply not possible to determine the type or types of structures represented. It is quite likely that the line formed by Postmolds 14 through 16 represents an outer wall of some type of structure. The line of postmolds running through Units 5C and 5B may also represent a wall of this structure with Features 25 and 18 reflecting internal activities or events. It is possible, however, that the latter line of postmolds was an internal divider of a much larger structure. The postmolds north of this line in Unit 5A are most likely contemporaneous, although it is unclear whether they relate to the same structure or a different one.

Stratum IIb: The Lower Postmold Levels

Postmolds were found throughout Stratum IIb with the majority concentrated in the east half of Unit 5C (Figure 27). Small lines of three to five postmolds could be identified, but it was impossible to tell how the lines were associated, if at all. Some of the postmolds may relate to the structure(s) tentatively identified in level 8. A line of seven postmolds was located running roughly parallel, but 30 cm to the south, of the major 5C-5B line. In a similar fashion, a line of between five and seven postmolds parallels the line running east-west in Unit 5A. This line lies about 40 cm to the north of the line in level 8.

There are two other postmold patterns in Stratum IIb worthy of note. In level 9, Unit 5D, there is a roughly T-shaped pattern of four postmolds (five, if one includes PM 126 in level 14), that cuts across the southern part of the pit. These postmolds may represent some type of structure wall (either interior or exterior) that enclosed the small fire pit (Feature 55) in the northwest corner of Unit 5D. Finally, in level 10, Unit 5C there is an arc of postmolds running south to north. This pattern is quite clear, but does not extend outside of Unit 5C and, consequently, is difficult to interpret.

Stratum III: Below the Postmolds

Below level 10 (90 cm below surface or ca. 177.30 AMSL), the soil becomes lighter in color and contains increasingly more clay (Stratum III). Features are relatively easy to see. Somewhat surprisingly, the frequency of postmolds decreases dramatically, perhaps indicative of a corresponding decrease in the intensity of occupation. Most

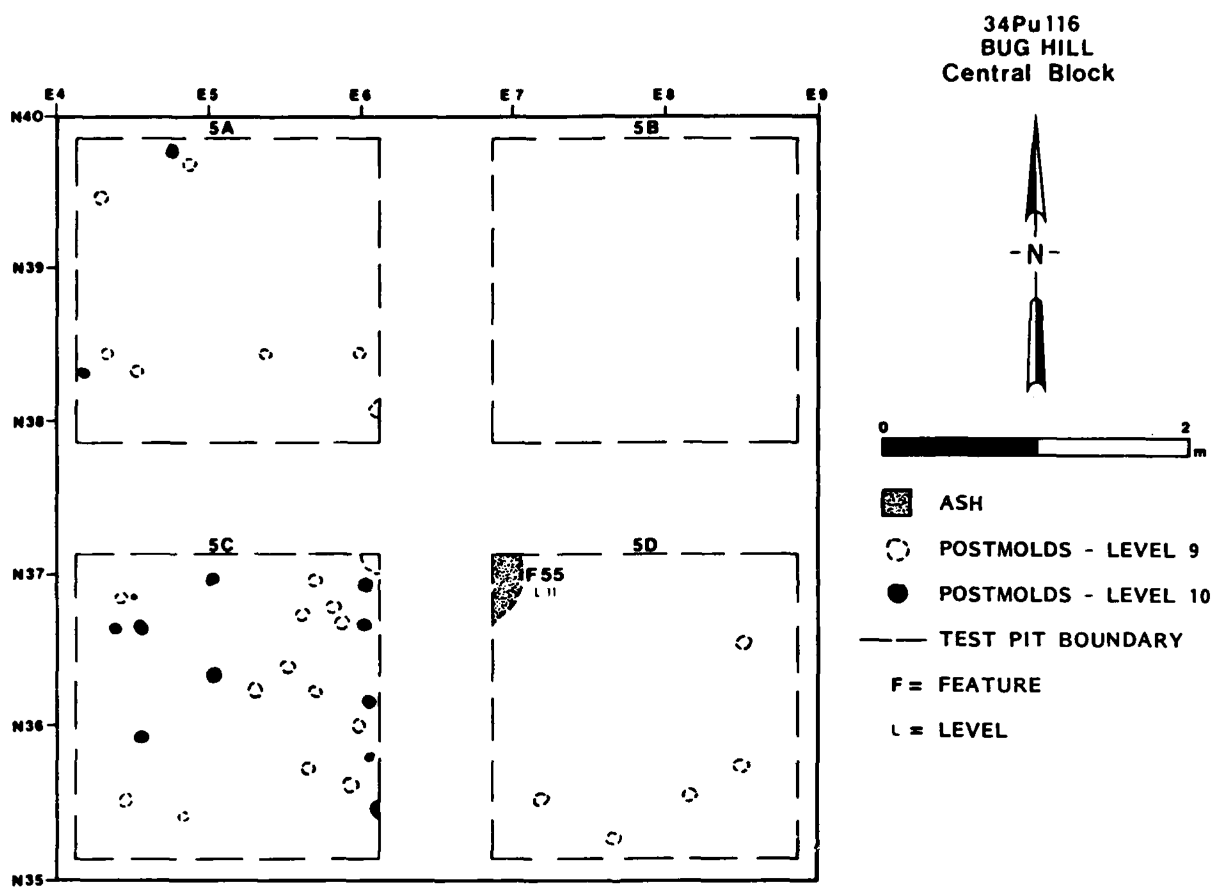


FIGURE 27. PLAN OF LEVELS 9 AND 10, STRATUM IIb, CENTRAL BLOCK.

features in Stratum III consist of either ash/clay concentrations, large storage/trash pits, remnants of burned posts or carbonized logs (Figure 28).

Four ash/clay concentrations were noted in Stratum III (Features 78 [5A], 74 [5C], 82 [5C], and 51 [5D]. All four were relatively small and none had associated artifacts. With the exception of Feature 78, these concentrations contained small numbers of animal bones. Feature 78 consisted of patches of discontinuous ash and burned clay no more than two or three centimeters thick, distributed in a nearly perfect semi-circle. No artifacts or other features were associated with this concentration.

The remains of a burned post (Feature 70) and a carbonized log (Feature 72) represent the only charcoal samples with any integrity found during the excavation of the Central Block. Both samples were dated radiometrically and provide the best estimates as to the time of occupation for the upper 20 cm of Stratum III (see Chapter Five).

In contrast to the ash/clay concentrations which appear to relate to the occupation of Stratum III, the storage/trash pits probably correspond to the occupations of Stratum II. In profile, the tops of these features (Features 71 [5B], 80 [5D], 83 [5C]) could all be discerned at the base of Stratum IIb (this was not, however, where they were detected upon excavation [see Table 5]). Features 80 and 83 were filled with flakes and faunal remains. Surprisingly, animal bones were not recovered from Feature 71. Instead, only two manos were found near the bottom of the pit.

All three pits are similar in form and construction. All three are basin shaped and appear to have been constructed during the occupation of either Strata IIa or IIb. The exact time these pits were used and the relationship between them, however, is unknown.

Stratum IV: Occupation During the Formation of the Jackfork Terrace

The Jackfork Terrace was reached at about 1.6 m below the surface (ca. 176.70 AMSL). Artifact density decreased tremendously, though substantial amounts of fire-cracked rock and unmodified sandstone continued to be recovered, especially from Units 5C and 5D (Figure 29). Four rock concentrations were noted and divided between two features (Features 90 and 92). Feature 90, restricted to level 17 of Unit 5C, consisted of three small rock concentrations together with a more wide-spread scattering of fire-cracked rock and sandstone. No associated artifacts or faunal remains were noted. Feature 92 was found in the southwest corner of Unit 5D, in level 18. While similar in nature to the rock concentrations in unit 5C, Feature 92 also contained two pieces of groundstone. Several large pieces of sandstone and one groundstone fragment were placed in a roughly circular pattern. Small, extremely fragile, unidentifiable bone fragments were recovered inside the circle as were a number of flakes. Rock concentrations were not found below level 18 and artifact density decreased to near zero.

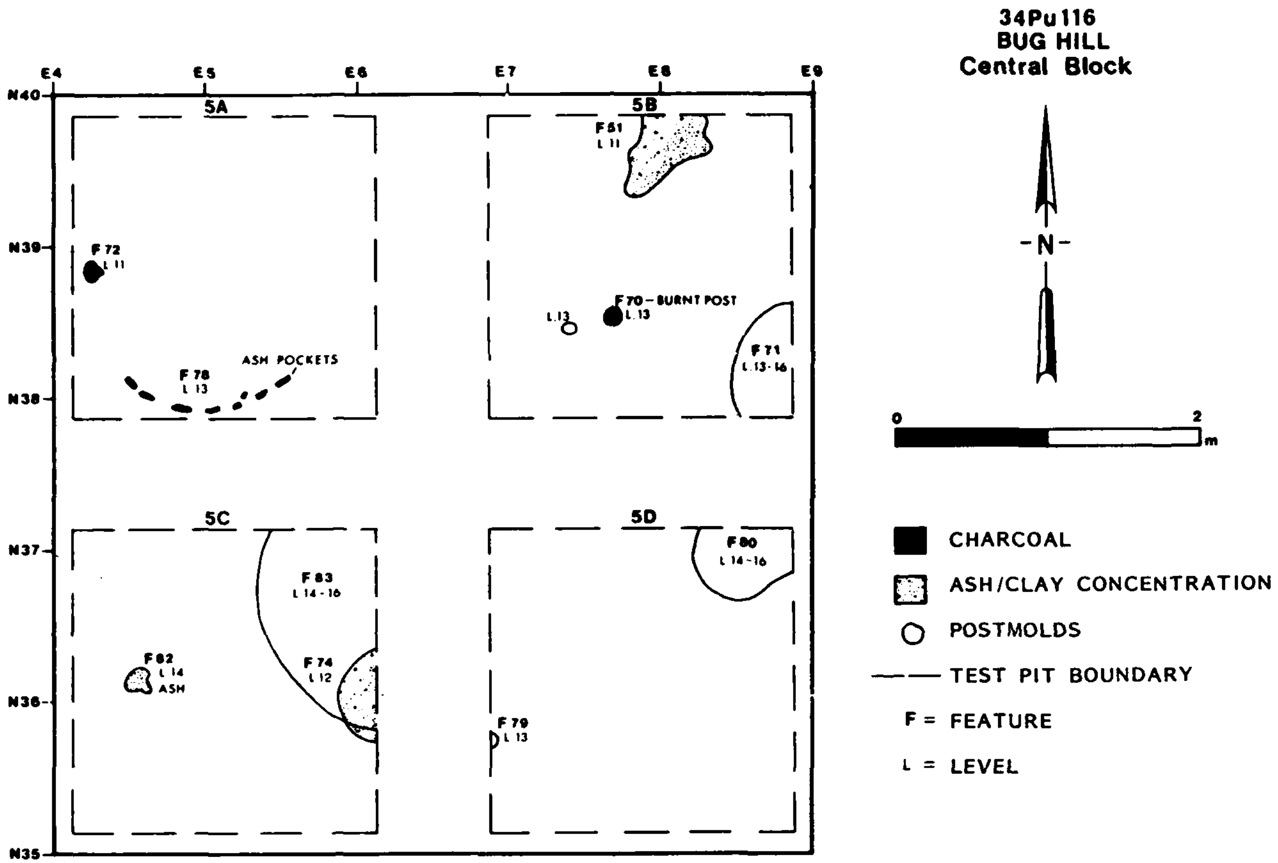


FIGURE 28. PLAN OF LEVELS 11 THROUGH 16, STRATUM III, CENTRAL BLOCK.

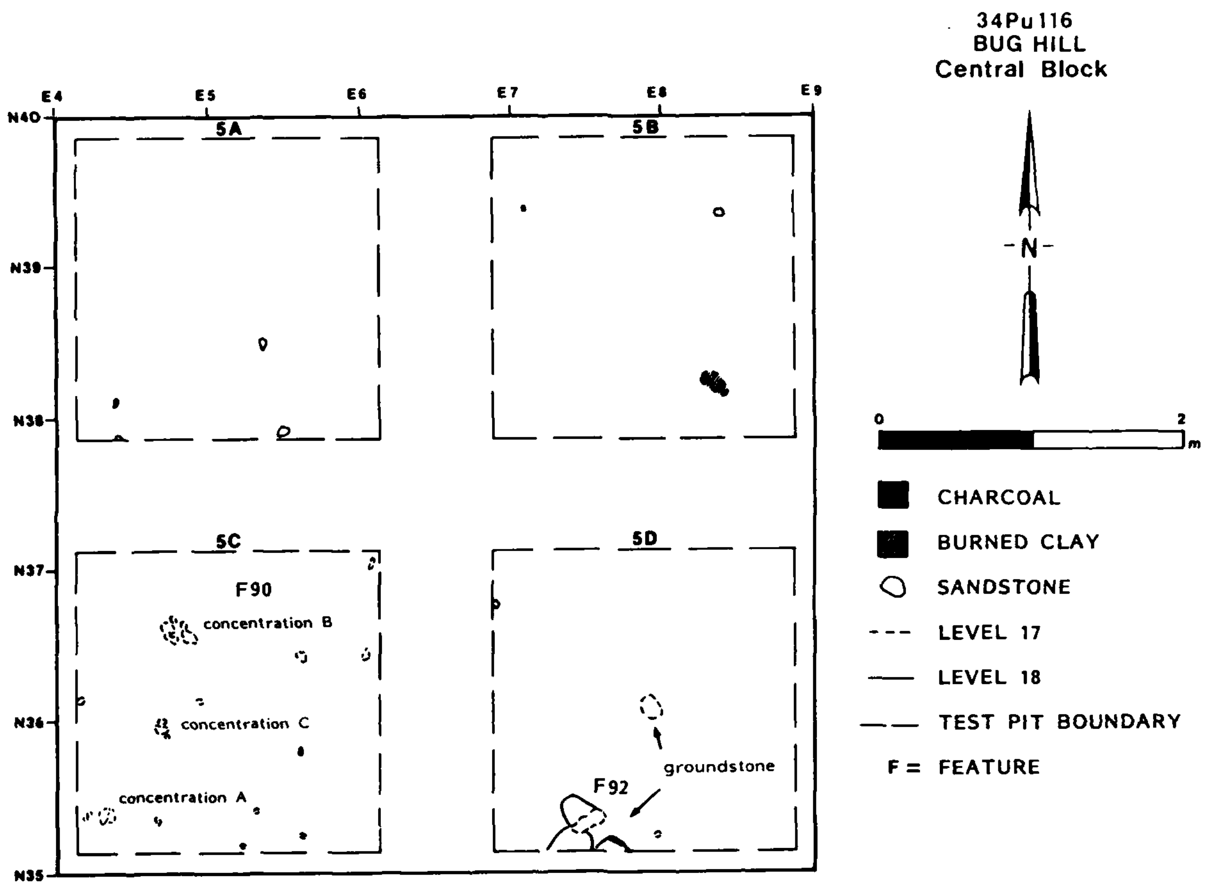


FIGURE 29. PLAN OF LEVELS 17 AND 18, STRATUM IV, CENTRAL BLOCK.

Central Block: Summary

The rock concentrations represented by Features 90 and 92 were situated below the midden in the Jackfork Terrace. These features probably reflect early transient occupations of the site during or just after terrace formation. The limited data preclude a detailed analysis of the early occupation(s) but we can note that they predate the main occupation of the site and midden formation.

Accretional midden deposits begin with Stratum III. Small ash/clay concentrations are the primary feature of this stratum. These are not distributed in any pattern and probably relate to a series of distinct occupations.

Intense occupation of the Central Block is associated with Strata IIa and IIb. Nearly all features were either found in these strata or could be associated with them. The remains of a variety of different types of structures cross-cut one another both in time and space. Almost assuredly, a number of living floors are represented, though it was impossible to separate them. Occupation continues into Stratum I, though intense bioturbation and the extremely dark soil makes it extremely difficult to interpret the remains.

The excavation results from the Central Block perhaps best represents the inherent problems associated with midden mound archaeology. The placement of excavation units on or near the center of the mound has been common practice for over 40 years. These units have always been extremely rich in remains of all types. But they are also the most difficult to interpret. The soil chemistry that is responsible for the excellent preservation also leads to the obliteration of living surfaces and the heavy disturbance of most features. We had no better success in interpreting the excavation results from the center of the mound than previous investigators. The Central Block yielded tantalizing data, but for the most part few demonstrable conclusions.

NORTHERN BLOCK AND SITE PERIPHERIES

The Northern Block expanded off Test Pit 4 upon the discovery of Burial 1, the deepest burial at the site. To fully expose the burial, three 2 m by 2 m units were placed around the burial. These three units were designated Test Pit 12 (see Figure 13). Evaluation of the stratigraphic evidence indicates that the area around the Northern Block is similar to other portions of the site tested by Test Pits 2, 3, 6, and 7. These areas are considered peripheries because they lack any evidence of intensive occupation. These excavations are discussed as a group below (Table 6).

In general, the stratigraphies of the peripheral areas were extremely similar. In all units, the basic midden martrix consisted of Stratum II deposits. These deposits were found under the plowzone and

TABLE 6. NORTHERN BLOCK AND THE SITE PERIPHERIES.

Feature Number	PROVENIENCE (point of detection) T.P.	Square(s)	Level	Depth Below Datum	Dimensions Length x Width x Depth	Description	Strata	Probable Function	Artifacts	Faunal Remains	Carbonized Seeds (#) and Nut Shell (gm)	Comment
1	2	N16E25	7	176.86–176.89	50 x 65 x 3	partially articulated deer skeleton	IV	?		deer (15)		no associated artifacts or features
6	4	N51E17	10	177.05–177.19	48 x 35 x 14	ash/clay concentration resting on a fired clay lense	III	hearth	biface, whole (1), frag (5), mano-pitted (1) nutting stone (1)		grape (1)	
22	6	N40W8	4	34 cm below surface	18 x 18 x 3	roughly basin-shaped pit associated with a dispersed ash concentration	II	storage/trash pit		large mammal bones (7), turtle bones (7)		bones were not analyzed
45	12	N53E16	8	177.21–177.39	amorphous; covers 45 x 30 x 18	small amorphous ash/clay concentration with several deer bones in close proximity	II–III	hearth		deer (14)		
52	12	N53E15	12	176.84–176.97	55 x 60 x 13	roughly circular rock-lined pit	III	trash/storage pit				
56	12	N54E18	13	176.83–176.87	15 x 15 x 4	eight points arranged in a roughly semi-circular pattern oriented to the northwest	III	point cache	Dickson dart points (8)			the points were not found in a prepared pit, but appear to have just been placed in the matrix in a fan shape
91	4+12	N53–N54 E16–E17	13–15	176.66–176.86	60 x 90 x 20	oval pit	III	burial pit	none in pit		.03 g hickory	point cache (fig. 56) located 2 m to the east

consistently averaged about 70 cm thick. The Northern Block and Test Pit 6 were the only units situated on or above the 177.60 AMSL contour. Correspondingly, these were the only units in which Stratum III deposits were found. Stratum III deposits were about 30 cm thick in Test Pit 6 and nearly 70 cm thick in the Northern Block (see Figure 14).

All deposits in the peripheral units are accretional in nature. No evidence of houses or other structures exists. The only evidence of intense use are three ash/clay concentrations and one rock-lined pit. The rock-lined pit and two of the ash/clay concentrations were found in Stratum III of the Northern Block (Features 6, 45 and 52). Both ash/clay concentrations appear to have been used as hearths. In the case of Feature 6, the ash/clay rested on a thin lense of fired clay. In contrast, Feature 45 consisted of a dispersed ash/clay concentration associated with four large deer bones. No artifacts or associated ash/clay were found in or near the rock-lined pit, a pattern reminiscent of Features 3 and 31 of the Southern Block.

The remaining ash/clay concentration (Feature 22), located in Stratum II of Test Pit 6, was associated with a small storage/trash pit. The pit had rather indistinct borders and contained numerous large mammal and turtle bones as well as fire-cracked rock. The final feature (Feature 1) from the peripheries was recovered from Stratum II of Test Pit 2. This feature consisted of the remains of a partially articulated deer skeleton. Only the hind quarters of the animal were recovered and no artifacts were associated with the bones.

Whatever else the peripheries were used for, they were clearly used as burial grounds. Of the 12 features recovered from these areas, five were burials, one was a burial pit and one was a cache of points, presumably associated with one of the burials (Table 6). In contrast to the preponderance of children found by Vehik (1982a) in the center of the mound, all the peripherial burials were either adolescents or fully mature adults. All burials were flexed, though their orientations differed. Only one multiple burial was noted (Burials 3 and 4), consisting of an adult woman and adolescent male. Moreover, only one burial pit was found, associated with the deepest burial (Burial 1) at the site and perhaps only visible because of the surrounding light colored terrace. The position of the burials within the matrix also varied, ranging from just below the plowzone (Burials 3 and 4) to lying on the Jackfork Terrace (Burial 1).

While artifacts were found in proximity to all burials, no definite association could be established. The most likely grave goods are a series of finely made, extremely large Dickson dart points found approximately 20 cm directly below Burial 8 (see Chapter Six). This cache (Feature 56), associated with several large pieces of hematite, was found at the same level as Burial 1, which was situated less than two meters to the west. Indeed, an isolated broken point, similar in all other attributes to those in the cache, was found even closer to Burial 1 (N52E17, level 15). Yet, neither the broken point nor the points in the cache were recovered in the burial pit. Three of the eight points recovered from the cache were found *in situ* (the remaining points were found in the waterscreen). These three were found lying on top of each other in a fan-shape with the bases lying on top of each other and the tips pointed to the north (see Figure 30).

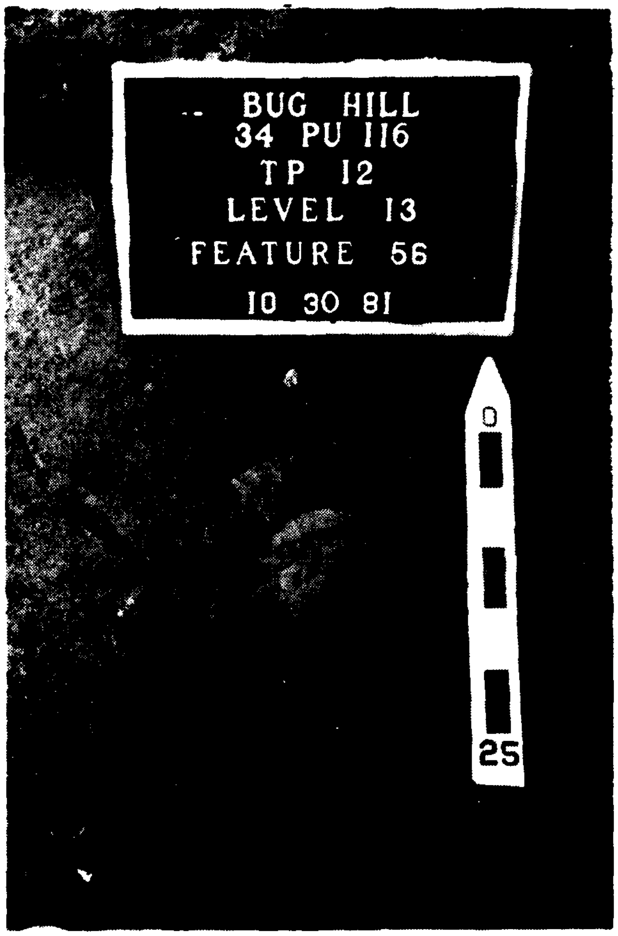


FIGURE 30. FEATURE 56, DICKSON DART POINT CACHE, NORTHERN BLOCK STRATUM III

Given the size and workmanship of the pieces, it appears they were produced exclusively for ceremonial and/or ritualistic reasons. The points exhibit no edge utilization or other evidence of use. Both Burials 1 and 8 contained large adult males, both of which dated to the Late Archaic period (see Chapter Five). The point cache was perhaps prepared for one or both of them but, at this point, it is impossible to tell for sure.

Excavation of the Jackfork Terrace

Excavation usually was stopped upon reaching the base of the midden and the top of the Jackfork Terrace. To provide information on subsurface soils, we continued the excavation for slightly over a meter (1.95 m below surface or 175.97 AMSL) in the southern 2 m x 2 m section of Test Pit 6. During this portion of the excavation, proveniences were increased in depth to 25 cm arbitrary levels. We found that the soil remained basically the same though it did become lighter in color and more compact with depth. Soil development was noted near the top of the terrace, but quickly was replaced by compact, silty clay loam alluvial deposits.

Cultural material was found throughout the Stratum IV but in decreasing numbers. A Pedernales point was found within level 14 (ca. 1.69 m below surface or 176.23 AMSL). No midden or other features were noted. In general, the terrace excavation indicated that the site may have been visited and perhaps was the locus of early transient occupations, but was never intensely occupied until the Late Archaic.

OFF-MOUND ACTIVITY AREAS

Grader Cuts

The search for off-mound activity areas was conducted in two phases. In the first phase, three areas to the north, east and south of the mound were mechanically stripped to just below the plowzone. At this point, had cultural features existed, they would have been exposed. Stains were found especially in the east grader cut. However, it was clear upon excavation that they were all the result of recent man-induced alterations made in conjunction with lake construction.

Locality A

The second phase consisted of testing a small rise, Locality A, situated between the main mound and an old meander scar of Jackfork Creek (see Figure 13). This rise was not discerned in 1979 and, therefore, not included on the site map (Vehik 1982a). In 1981, the rise was noticed during the grader cut operations. We decided not to have the grader cuts extend into the area, fearing the rise might be of cultural significance. Preliminary examination of the soils from Locality A indicated that the rise was natural in origin (Don Johnson, personal communication). Yet, its small size and peculiar orientation combined with a surface littered with fire-cracked rock and lithic debris strongly suggested at least some cultural modification.

Stratigraphy in this unit was relatively uniform. The first 10 cm were part of a humic soil layer, similar in many respects to the plowzone on the main mound. Large numbers of artifacts were found in this stratum and included a surprising number of tools and points. Most of the cultural material was fire-cracked rock which seemed as prevalent in this area as on the mound itself. The second stratum extended from the edge of the plowzone to about 60 cm below the surface. It consisted of compact silty clay loam, strong brown in color, that contained abundant cultural material. A large metate was found between 35 and 51 cm below the surface (levels 4 - 6). This metate apparently was not associated with any other cultural features or artifacts. The third stratum consisted of very compact, mottled silty clay loam with evidence of leaching and pedosols.

In summary, no soils similar to the midden deposits observed on the main mound were found at Locality A. Abundant evidence exists, however, of cultural activity. Noticeably lacking from Locality A are faunal remains; probably the result of the high acidity of the soil. Locality A was developed by both natural and cultural forces, as indicated by alluvial silts being intermixed with fire-cracked rock and lithic debris.

CHAPTER FIVE

RADIOCARBON DATES

Since 1979, 40 samples have been submitted for radiocarbon dating from Bug Hill. Eighteen of these were samples obtained during the 1979 excavation, while 22 were submitted from the 1981-82 season. Thirty-five samples consisted of wood charcoal, with the five remaining samples consisting of portions of human long bones recovered from various 1981-82 burials. The human bone samples were all dated by the radiocarbon laboratory at the University of California at Riverside. The wood samples were submitted to three different laboratories. The 1979 samples were dated by Beta Analytic, Inc., Coral Gables, Florida. Fourteen of the wood charcoal samples from the 1981-82 excavations were dated by DiCarb Radioisotope, Inc. (DiCarb), Gainseville, Florida. The remaining three 1981-82 samples were dated by Geochron Laboratory (Geochron), Cambridge, Massachusetts.

The entire sequence of radiocarbon dates for Bug Hill is presented in Tables 7 and 8. None of the dates have been corrected using the MASCA bristlecone pine correction factor. Thus, all dates at Bug Hill are comparable with each other as well as with other dates taken at sites throughout the Jackfork Valley.

The goals of the radiocarbon analysis conducted in 1979 differed somewhat from those of the present project. In 1979, Vehik (1982a:27-31) was primarily interested in constructing a valid overall cultural chronology. With this chronology in place, the analysis of the 1981-82 samples focused on two separate problems; the dating of burials and the chronological placement of identifiable occupational surfaces. A discussion of the radiocarbon analysis from both field seasons follows.

TABLE 7. 1979 RADIOCARBON DATES.

Area of Site	Test Pit	Level	Stratum	Feature No.	Feature Type/Nature of Sample	Laboratory	B.P. Date	Uncorrected Date
periphery	N50E29	2	Ip	n/a	n/a	Beta-1409	1333 ± 80	A.D. 617 ± 80
center/Block*	N26E10	3	I	n/a	n/a	Beta-1410	1091 ± 60	A.D. 859 ± 60
center/Block	N24E10	4	I-II	n/a	n/a	Beta-1411	1672 ± 70	A.D. 278 ± 70
center	N28E2	5	II	n/a	n/a	Beta-1412	2248 ± 60	298 ± 60 B.C.
periphery	N30W8	5	II	n/a	n/a	Beta-1425	2407 ± 95	457 ± 95 B.C.
center/Block	N24E10	6	II	n/a	n/a	Beta-1413	1986 ± 80	36 ± 80 B.C.
center/Block	N24E10	7	II	n/a	n/a	Beta-1414	2300 ± 55	350 ± 55 B.C.
center	N28E2	8	II-III	n/a	n/a	Beta-1415	2562 ± 70	612 ± 70 B.C.
center/Block	N24E10	9	III	n/a	n/a	Beta-1416	2943 ± 75	993 ± 75 B.C.
center/Block	N24E10	10	III	n/a	n/a	Beta-1417	3360 ± 70	1410 ± 70 B.C.
center/Block	N24E10	11	III	n/a	n/a	Beta-1418	3447 ± 70	1497 ± 70 B.C.
center	N28E2	12	III	n/a	n/a	Beta-1419	3396 ± 90	1446 ± 90 B.C.
center	N41E2	12	III	n/a	n/a	Beta-1421	3005 ± 75	1055 ± 75 B.C.
center/Block	N24E10	13	IV	n/a	n/a	Beta-1420	3555 ± 125	1605 ± 125 B.C.
periphery	N16W0	10	IV	F79-16 Burial 4	6-9 month child/charcoal sample from pit	Beta-1422	2830 ± 70	880 ± 70 B.C.
center/Block	N28E14	8	II	F79-19 Burial 3	Neonate/charcoal sample from pit	Beta-1423	3334 ± 105	1384 ± 105 B.C.
center	N28W0	0-11	III	F79-31 Burial 7	adult of unknown sex/charcoal sample from pit	Beta-1424	2238 ± 70	288 ± 70 B.C.
center/Block	N24E12	7	II	F79-36 Burial 9	adult female/charcoal sample from matrix	Beta-1166	2804 ± 85	854 ± 85 B.C.

* the term "block" indicates that the sample was obtained from the 1979 Block excavation

TABLE 8. 1981-82 RADIOCARBON DATES.

WOOD CHARCOAL

Block	Test Pit	Level	Stratum	Occupational Surface	Feature Number	Feature Type	Sample Number	Laboratory Number	B.P. Date	Uncorrected Date
Southern	11(N16E12)	2	II	I	39	hearth	1	DIC-2491	450 ± 55	A.D. 1500 ± 55
Southern	11(N16E12)	2	II	I	39	hearth	2	DIC-2543	770 ± 45	A.D. 1180 ± 45
Southern	11(N16E12)	2	II	I	39	hearth	2	GX-8692	1000 ± 125	A.D. 950 ± 125
Southern	11(N16E12)	3	II	I	46	living floor	0	DIC-2493	90 ± 80	A.D. 1860 ± 80
Southern	10(N15E13)	5	II	III	36	carbonized post	1	DIC-2497	940 ± 45	A.D. 1010 ± 45
Southern	8 and 10 (N15E12/ N15E13)	5	II	III	35	carbonized log		DIC-2496	1010 ± 45	A.D. 940 ± 45
Southern	8(N15E11)	8	II	III	42	carbonized post		DIC-2498	760 ± 85	A.D. 1190 ± 85
Southern	10(N14E11)	8	II	III	37	carbonized post	3	DIC-2499	1030 ± 125	A.D. 920 ± 125
Southern	10(N12E14)	8	II	III	44	burned house supports	8	DIC-2544	980 ± 50	A.D. 970 ± 50
Southern	10(N12E14)	8	II	III	44	burned house supports	8	GX-8694	1305 ± 125	A.D. 645 ± 125
Southern	10(N13E14)	8	II	III	44	burned house supports	6	DIC-2495	940 ± 45	A.D. 1010 ± 45
Southern	10(N15E14)	8	II	III	44	burned house supports	4	DIC-2492	940 ± 50	A.D. 1010 ± 50
Southern	9(N13E9)	10 top	II	III	5	living floor	6	GX-8693	840 ± 125	A.D. 1110 ± 125
Southern	8(N14E11)	10 top	II	III	5	living floor	2	DIC-2419	937 ± 610	A.D. 1013 ± 610
Southern	8 and 10 (N14E13)	10	II	III	59	house burning	1	DIC-2194	modern	modern
Central	5A(SW1/4)	12	III	n/a	72	carbonized log		DIC-2489	2370 ± 125	420 B.C. ± 125
Central	5B(SE1/4)	13	III	n/a	72	burned post		DIC-2488	3370 ± 45	1420 B.C. ± 45
						HUMAN BONE (All Samples From Long Bones)				
Central	5A(SE1/4)	8	I/II	n/a	Burial 6	multiple burial of two adolescent males	n/a	VCR-1539	1490 ± 90	A.D. 460 ± 90
Southern	10 and 11 (N16E13-14/ N15E13-14)	7	III	III	Burial 7	multiple burial of adult female and neonate	n/a	VCR-1540	2460 ± 130	570 B.C. ± 130
Southern	11(N17E10-E11)	6	II/III	III	Burial 9/11	adult male	n/a	VCR-1542	3040 ± 180	1090 B.C. ± 180
Northern	12(N55E17-18) (N54E17-18)	8	III	n/a	Burial 8	adult male	n/a	VCR-1541	2025 ± 170	75 B.C. ± 170
Northern	4 and 12 (N54E16-17/ N53E16-17)	13	III/IV	n/a	Burial 1	adult male	n/a	VCR-1538	3380 ± 110	1430 B.C. ± 110

CULTURAL CHRONOLOGY

The results of the 1979 radiocarbon analysis are summarized in Figure 31. Of the 18 samples, 14 consisted of wood charcoal collected from arbitrary 10 cm levels between the plowzone and level 13 (120-130 cm below the surface). Of these 14 samples, 12 were obtained from test pits located in the center of the site with eight of these collected from the 1979 Block excavation. The four remaining dates were obtained from charcoal samples found nearby four different burials.

The 1979 dates are consistent with the interpretation of Bug Hill as an accretional midden occupied more-or-less continuously from the Late Archaic to the Early Caddoan period. In general, Vehik (1982a) concluded that occupations from Caddoan and Historic periods were restricted to the plowzone. Stratum I was not recognized during the 1979 field season and therefore was not specifically dated. Stratum II dates the period from the end of the Late Archaic throughout the early portion of the Woodland period (ca. A.D. 300). Stratum III (above ca. 176.90 AMSL) lies entirely within the range of acceptable dates for the Late Archaic.

Vehik (1982a:30) argued that the lowermost 30 to 50 cm of the midden were left undated. However, after re-examining the 1979 profiles, we feel that sample Beta 1420 taken from level 13 actually derived from the interface of the top of the Jackfork Terrace and the base of the midden. This date, then, perhaps is an accurate reflection of the beginning stages of midden formation at Bug Hill. Occupations which took place during the formation of Jackfork Terrace, however, remain undated.

Two wood charcoal samples from features in the Central Block were used to expand this framework to include the 1981-82 excavations. Feature 70 (Unit 5B) consisted of a burned post detected 123 cm below the surface (176.97 AMSL) near the middle of Stratum III. This sample was dated to 1420 ± 45 B.C., consistent with other dates from similar depths and stratigraphic placements. The second date was obtained from Feature 72 (Unit 5A), a carbonized log found 13 cm below the interface between Strata IIb and III (177.16 AMSL). While this feature was located in Stratum III, it is quite possible that the log represents a post or structural support associated with the occupation of Stratum IIb. The radiocarbon date of 420 ± 125 B.C. is consistent with this interpretation.

CHRONOLOGICAL ASSESSMENT OF THE BUG HILL BURIALS

In 1979 four wood charcoal samples taken from burial contexts were submitted for radiocarbon dating. Two of these samples were obtained directly from burial pits (1979 Burials 4 and 7). These burials were situated deep in the midden in Strata III (Burial 7) and IV (Burial 4). The remaining two samples (Burials 3 and 9) were taken from

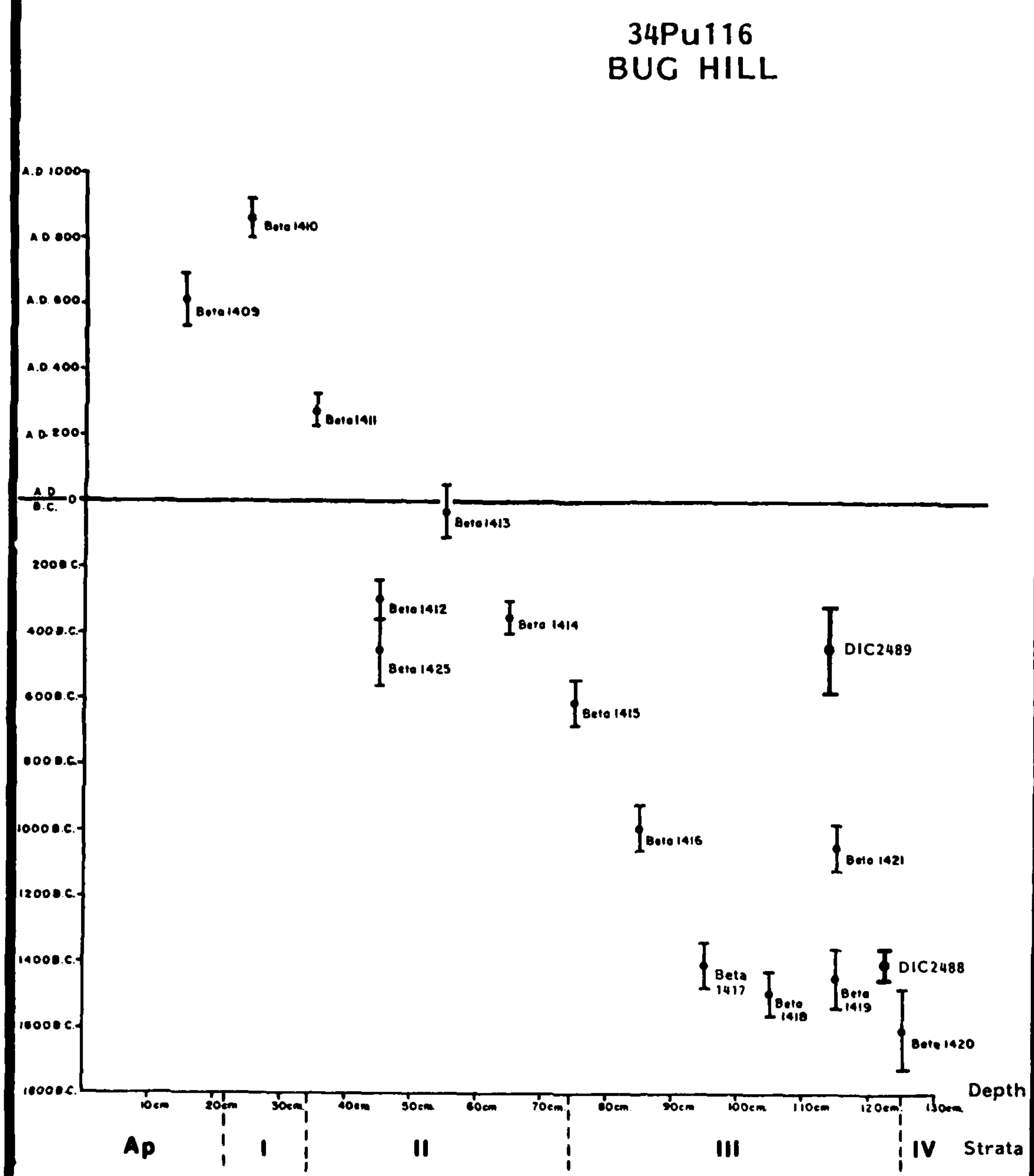


FIGURE 31. RADIOCARBON DATES OF WOOD CHARCOAL SAMPLES FROM THE BUG HILL SITE IN STRATIGRAPHIC SEQUENCE. Vertical bars indicate standard deviations. (Adapted from Vehik 1982)

burials in Stratum II in which no pit was discerned. The lack of burial pits in these two cases probably has more to do with soil chemistry than changes in cultural practices. For these burials Vehik (1982a) reasoned that carbon samples taken from the surrounding burial matrix would provide accurate dates.

All four 1979 burials dated to the Late Archaic period. Vehik (1982a) felt that the dates obtained from the Stratum II burials, those taken from burials with no discernable pits (Burials 3 and 9), were too old relative to their stratigraphic position and discounted both dates. The other two however were considered reasonable, although the date for Burial 7 (288 B.C. ± 70) seemed somewhat late for the burial's stratigraphic position.

The 1979 results were unexpected. Burials positively dated to the Late Archaic were unknown in this part of the Ouachita Mountains. Investigators viewed the Bug Hill dates with skepticism (Jerome Rose, personal communication); for many investigators it was not at all clear that the burials had been dated. All four charcoal samples were small and none of them could be directly associated with any of the burials.

The dating of the burials took on renewed importance during the 1981-82 Bug Hill project for two reasons. First, we needed to resolve the controversy surrounding the Late Archaic burial dates. Second, strong evidence existed that Bug Hill had served as a burial ground from at least the Late Archaic through the Caddoan periods. In the absence of absolute dating, however, it is extremely difficult to date burials from midden mounds. Burial pits are difficult to discern and known to vary in depth. Thus, unless we can define the origin of the pit, which is nearly impossible in a midden mound, we cannot be sure that simply because a skeleton is located deeper in the mound that it is older than those above it.

A major goal of the 1981-82 Bug Hill project was to study adaptive responses through time. An important part of this study was the analysis of the various human populations which occupied the site. Therefore, it was critical to date the burials. The method we chose to accomplish this objective was radiometric dating of portions of long bones of five burials recovered from various stratigraphic positions during the 1981-82 field season. These data, combined with the 1979 dates, were then generalized to the remaining burials.

Figure 32 graphs the elevation at the point of detection and the natural stratum for each burial against the radiocarbon date. This figure includes the five 1981-82 bone dates and the four 1979 wood charcoal dates. To tie the bone dates to the established cultural chronology we have shaded the portion of the graph that corresponds to the time period Bug Hill was most likely occupied as indicated by the 1979 wood charcoal samples.

Of the nine burials, three fall in the chronological range established by Vehik on the basis of wood charcoal samples. The three

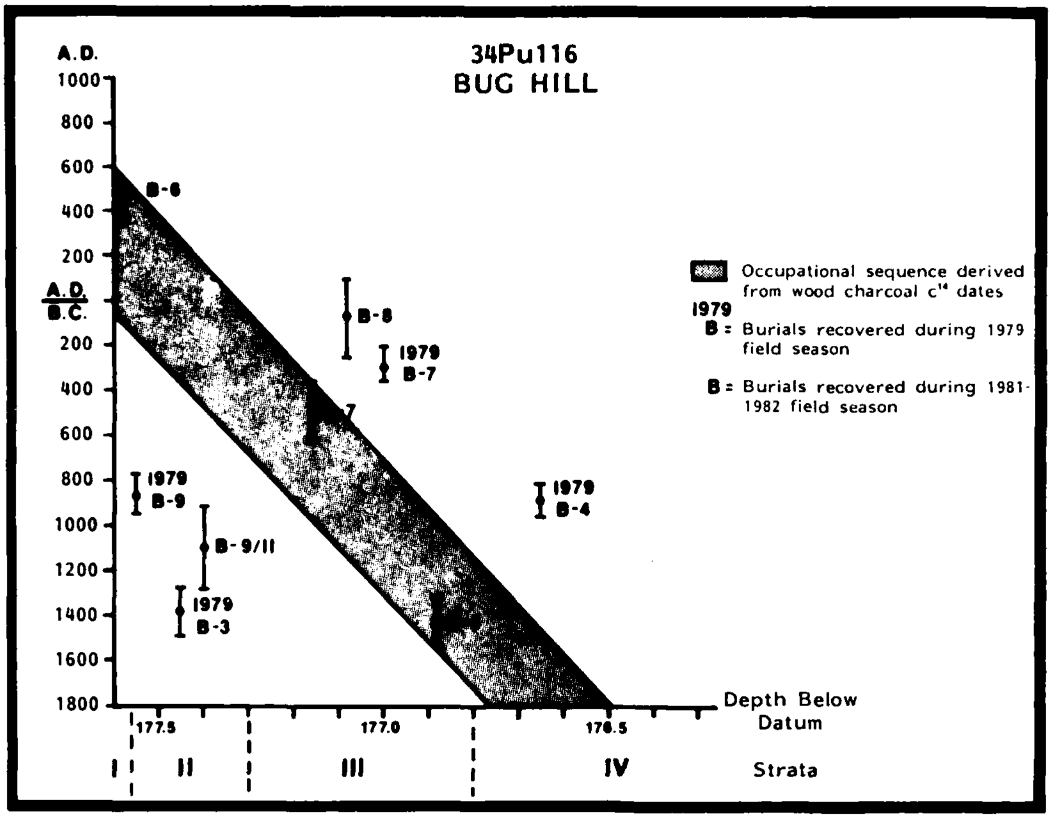


FIGURE 32. RADIOCARBON DATES FROM SELECTED BURIALS AT BUG HILL.

skeleton dates which fall in this range are all derived from 1981-82 burials. Burial 6 was found at the interface of Strata I and II in the central block. A date of A.D. 460 $\pm$ 90 comfortably places this burial within the Fourche Maline phase of the Woodland period, a date consistent with its stratigraphic position and associated artifacts. Burial 7, located in Stratum III of the Southern Block just north of Structures 1 and 2, was dated to 510 B.C. $\pm$ 130. Originally Burial 7 was believed to be associated with the occupation of these structures. These structures, however, date to the Early Caddo period, some 1500 years later. Deciding whether to accept the bone date for Burial 7 is difficult. One fact is clear, the skeleton was placed in Stratum III contexts. Without a pit showing that the burial was intrusive from above there is no compelling reason to question its date. Burial 1 was one of the deepest burials at the site, with part of the burial pit excavated into the Jackfork Terrace. A date of 1430 B.C. $\pm$ 110 is consistent with the stratigraphic placement of this burial.

Of the six remaining burials, the dates of three appear to be too recent for their stratigraphic placement. These include 1979 Burials 4 and 7 and 1981-82 Burial 8. Although it is possible that the samples simply produced "bad" dates, we feel an alternative explanation better accounts for the results. The dates of all three burials are consistent with dates of 30 to 50 cm higher in the midden. Both 1979 burials were found in burial pits (a pit was not discerned for 1981-82 burial 8). It is possible, then, that these burials reflect skeletons placed in deep burial pits. Thus, we feel the dates are accurate, with the burials associated with occupation located higher up in the midden.

The final three dates are all too old for their stratigraphic position (1979 Burials 3 and 9 and 1981-82 Burial 9/11). The two 1979 dates were rejected by Vehik (1982a) and we concur with his assessment.

The bone date from 1981-82 Burial 9/11 is difficult to understand. While the skeleton was detected in Stratum III, it was clear from the stratigraphic profile that the burial had originated in Stratum II. Stratigraphically, then, Burial 9/11 is associated with occupation of Structures 1 and 2. Yet the burial dates some 2000 years earlier than the occupation of the houses (see next section). Although there are many reasons for "bad" dates, obvious explanations such as small samples or humic acid contamination, do not appear to apply in this case (R.E. Taylor, personal communication).

There are two plausible explanations for the bone date of Burial 9/11. First, the date is simply wrong and the burial dates to the occupation of Structures 1 and 2. Alternatively, the date is accurate and reflects re-burying the skeleton at a later date. Specifically, it is possible that when the residents of Bug Hill removed Stratum III deposits prior to constructing Structure 1, they came across the skeleton and reburied it to the north of their house. At present, neither hypothesis can be rejected.

Combining the burial dates together yields the following conclusion. Nearly all burials from Strata III or IV date to the Late Archaic period. This generalization is offered even after taking into account the problem of intrusive burials from latter occupations. While this problem occurs at Bug Hill, it seems that burial pits in general were not excavated very deep. Three intrusive burials were noted in Stratum III yet all still dated to the Late Archaic. Thus, unless a burial dates to within a couple hundred years of a cultural period transition, it is more than likely that it will date to the appropriate period.

Burials located in Stratum II probably date to the Fourche Maline phase of the Woodland period. This conclusion is agreeable based on weak data. Of the four burial samples submitted from Strata I or II only one had an acceptable date. The other three cannot be explained as intrusive burials or general churning of the midden, for they were all over 1000 year too old. It should be noted that of the three unacceptable dates, two came from wood charcoal samples that could not be positively associated with the burials.

No burials dating to the Caddoan period were found in the midden outside the Southern Block. Three burials (7/12, 9/11, and 10) were found near Structures 1 and 2 (of the Early Caddo period). Two of these 1981-82 burials (7/12 and 9/11) were submitted for dating. In the case of Burial 7/12, the absence of a burial pit, the absence of grave goods (especially ceramics), and the clear placement of the burial in Stratum III, led us to reconsider our evaluation of Burial 7/12 and accepted the Late Archaic date. Burial 9/11 intrudes into Stratum III from Stratum II. The burial's date of 1090 B.C. ± 180, therefore, is inconsistent with its stratigraphic position. It is possible that the burial was found during the removal of Stratum III deposits during the construction of Structure 1 and re-buried to the north. In this case a Late Archaic date would be acceptable. Unfortunately, no data exist to support (or contradict) this hypothesis.

THE DATING OF THE SOUTHERN BLOCK

With an overall chronological framework already in place for Bug Hill, we decided to concentrate much of the radiocarbon dating of the 1981-82 samples on recognizable structures and occupational surfaces. In particular, we were interested in dating the occupational surfaces found in Stratum II of the Southern Block. Given the depth of the surfaces and the 1979 results, we expected Structures 1 and 2 to date no later than the Fourche Maline phase of the Woodland period.

In all, 62 charcoal samples were collected from the Southern Block. Of this total, 13 from Occupational Surfaces I and III were submitted for dating. (Several samples were obtained near Feature 30 of Occupational Surface II, but the charcoal appeared to be associated with the burning of Structure 2 and, therefore, was not dated.)

To ensure the reliability of the dates, charcoal samples from three distinct features were sent to two different laboratories (DiCarb and Geochron). The three features represent distinct cultural events or processes: a hearth in Structure 3 (Feature 39); the living floor of Structures 1 and 2 (Feature 2); and the roof fall of Structure 2 (Feature 44). In two cases (Features 39 and 44), the charcoal specimens were split. However, because most of the charcoal samples recovered from the Southern Block were too small to split, many of the "duplicates" submitted to the two laboratories were actually different charcoal samples found in different parts of the same feature (Table 8).

In the case of Feature 2, the living floor of Structures 1 and 2, the charcoal specimens proved to be too small to be of much use in cross-checking the laboratories. Although the dates from the two samples from Feature 2 are relatively close, the sigma attached to the DiCarb sample is so large that the actual date is of little importance.

The dates from the other two features are instructive. In both cases, the Geochron data was several hundred years older than the DiCarb data for the same sample. While two samples are insufficient to establish the existence of a pattern, a number of differences between the laboratories should be pointed out (David Drucker [Geochron], personal communications; Irene Stehle [DiCarb], personal communications). First, Geochron only inspects the samples for impurities macroscopically while DiCarb examines each sample both macroscopically and microscopically (30x magnification). Second, Geochron converts the charcoal to methane gas before counting, whereas DiCarb uses liquid scintillation based on benzene. Finally, Geochron counts each sample for 1200 minutes, while DiCarb's count is dependent on the sample and ranges between 2000 and 7000 minutes. The last characteristic probably accounts for the difference between the relatively large sigmas associated with Geochron dates and the small ones tied to DiCarb dates.

As far as the chronology of Bug Hill is concerned it is important to remember that on the basis of the dates alone we cannot say that one laboratory is right and one is wrong. Both laboratories appear to be consistent. Determining the most likely period of occupation, then, becomes as much an exercise in assessing the relative date of cultural material as it is one of evaluating the radiocarbon dates. With these notions in mind, we now turn to a discussion of the dating of the occupational surfaces.

Occupational Surface III

The fill and floor of Structures 1 and 2 were dated with 11 charcoal samples. Of these, two will not be considered further (DIC-2194 and DIC-2490). These samples were either contaminated by recent rodent burrowing (Feature 59 - DIC-2194) or were too small to provide a reliable date (Feature 2 - DIC-2419).

Of the remaining nine samples, six form a tight cluster between A.D. 920 ± 125 and A.D. 1010 ± 50 (Figure 33). These six samples were all taken from burned posts or roof fall from the burning of Structure 2 (Features 35, 36, 37, and 44). A seventh sample (GX-8693) taken from the house floor dated to A.D. 1110. This sample, however, was associated with a sigma of 125 years which places it comfortably within the established interval.

The remaining two samples appear to be in error. One, DIC-2498, was taken from a burned post, perhaps associated with Structure 1 (Feature 42). The sample, dated to A.D. 1190 ± 85, was felt to be too small by DiCarb to produce a reliable date (Irene Stehle, personal communication). The second was a duplicate of Feature 44, charcoal sample 8, which Geochron (GX-8694) dated to A.D. 645 ± 125, and DiCarb

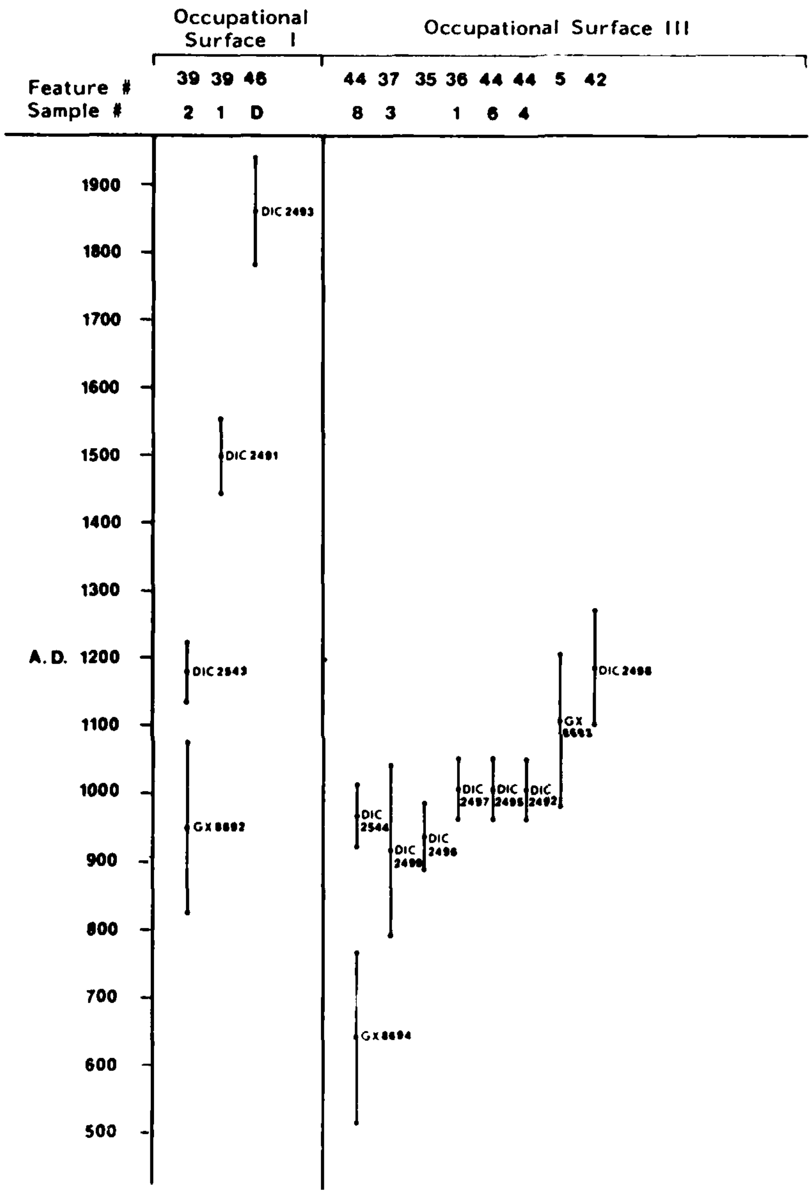


FIGURE 33. SEQUENCE OF RADIO-CARBON DATES FOR OCCUPATIONAL SURFACES I AND III OF THE SOUTHERN BLOCK.

GX = Geochron Laboratories
DIC = Dicarb Radioisotope

note: not included are samples DIC2419 and DIC2194

(DIC-2544) dated to A.D. 970 ± 45. We believe the DiCarb date more accurately reflects the date of this specimen for two reasons. First, the sample from the house floor that was submitted to Geochron (GX-8693) dated to within an acceptable range of the others from Structures 1 and 2. Second, and most importantly, the layout and form of Structures 1 and 2 correspond closely to those observed at other sites throughout the Arkansas Basin. Houses excavated at Harlan (Bell 1972) and Spiro (Rogers 1982) are extremely similar. Some of these have also been dated with multiple charcoal samples, usually producing a tight cluster of dates sometime between A.D. 900 and 1200.

Taken together, the archaeological evidence and the radiocarbon results suggest that Occupational Surface III was probably occupied sometimes between A.D. 900 and 1050. Almost all the radiocarbon samples collected from this surface relate to the burning of structures. However, because these charcoal samples date the time at which trees presumably were cut down, and not when they were eventually burned, the period A.D. 900 - 1050 actually represents our best guess as to the time of the construction of Structure 2.

<u>Occupational Surface I</u>

The radiocarbon dates from Structure 3 are more difficult to interpret. In part, this situation is due to the fact that the remnants of Structure 3 lie directly below the plowzone and many of the charcoal samples appear to have been disturbed by recent farming activities. Four dates were obtained for this surface ranging from A.D. 950 ± 150 to 1860 ± 80.

The youngest date was obtained from a large charcoal specimen found imbedded in daub from the floor of Structure 3. Although the specimen appeared to be undisturbed, peculiar fibers were found in the samples upon processing and may account for the date almost assuredly being too recent (Irene Stehle, personal communication). The oldest date of A.D. 950 ± 150 was obtained by Geochron, while a duplicate sample was dated by DiCarb to A.D. 1180 ± 45 (Feature 39, Sample 1). The third charcoal sample (Sample 2) from this feature dated to A.D. 1500 ± 50.

Both dates from Feature 39, Sample 1 appear to be too early for Occupational Surface I. Circular structures of the size and shape of Structure 3 are more characteristic of the Late Caddoan than they are of earlier ones. At present, we simply cannot explain the early dates. Thus, the best we can say at the moment is that the occupation of Structure 3 took place sometime between ca. A.D. 1200 and 1500, probably closer to the end of the interval than to the beginning.

SUMMARY

The results of the radiocarbon analyses conducted on Bug Hill materials are summarized in Table 9. In general, with the exception of the Southern Block, the radiocarbon dates are consistent with the

TABLE 9. RADIOCARBON CHRONOLOGY OF THE BUG HILL SITE.

Strata	1979 Wood Charcoal Arbitrary Levels	1979 Wood Charcoal Burials	1981-82 Wood Charcoal Features	1981-82 Bone Burials	Range of Acceptable Dates
Occupational Surface I			4(2)*		A.D.1500±50 A.D.1180±45
Occupational Surface III			11(6)		A.D.1010±50 A.D. 920±125
Ap	2(1)				A.D. 859±60
I				1(1)	A.D. 460±90
II	5(2)	2(0)	1(1)	1(0)	A.D. 278±70 420 B.C.±125
III	6(5)	2(2)	1(1)	3(3)	612 B.C.±70 1497 B.C.±70
IV	1(1)				1605 B.C.±125

* The first number refers to the number of samples dated, the number in parenthesis refers to the number of acceptable dates.

---

interpretation of the site as an accretional formation. Midden development dates from at least the beginning of the Late Archaic through the Late Caddoan periods. Late Archaic period occupation of the site appears to begin around 1600 B.C. Midden deposits associated with the Late Archaic are found throughout Stratum III and into Stratum II. Woodland period occupation, traditionally dated between A.D. 100-700 or 800, lies at the top of Stratum II and throughout Stratum I.

Intact Caddoan period deposits are confined to Stratum II of the Southern Block. In this area, Occupational Surface III probably dates from between A.D. 900 and 1050, while Occuaptional Surface I was occupied sometime between A.D. 1200 and 1500. No dates were obtained for Occupational Surface II.

Burials were tentatively dated to cultural period. Burials found in Stratum III or IV probably date to the Late Archaic period. Burials located within Stratum II most likely were interred during the Woodland period. Caddoan Period burials were found only in the Southern Block associated with Structures 1 and 2 (Occupational Surface III).

CHAPTER SIX

LITHIC ANALYSES

Jeffrey H. Altschul, James Morehead, and John E. Keller

Well over half-a-million artifacts were recovered from Bug Hill during the 1981-82 field season. A variety of classes of cultural materials were represented in the collection. Each class was analyzed separately and each analysis had distinct goals and purposes. The following three chapters present the results of these analysis. Chapters Six and Seven detail the analyses of lithic materials, which represent the overwhelming majority of artifacts recovered from Bug Hill. Chapter Eight then deals with the analyses of all remaining types of materials.

Prior to discussing the lithic analysis, a brief description of laboratory procedures is given. In addition, the definition of and rationale behind using standard analytical units is provided.

LABORATORY PROCEDURES

In the field all cultural materials from the same provenience were bagged together. The only exceptions were large pieces of fire-cracked rock which were weighed on a hanging vegetable scale, recorded and then discarded. In the laboratory provenienced materials were first washed in a cold water bath. This bath was linked to a mechanically driven recycling water system that gently agitated the materials. Artifacts were then cleaned in a warm, soapy water bath and subsequently placed in a final cold water rinse.

After cleaning, materials were sorted into artifact classes in a two staged process. In the first stage, all materials from one provenience were dry screened through 1/2 in. hardware mesh. Materials 1/2 in. and larger were then sorted into the following classes: chipped stone, groundstone, ceramic, shell (including both unioids and gastropods), worked bone, unworked bone, historic artifacts, and miscellaneous artifacts (e.g., copper, natural minerals, and fossils). Following this initial sort, all flakes 1/2 in. and larger were weighed and counted. Finally, pieces of daub and fire-cracked rock over 1/2 in. in size were weighed, recorded and discarded.

The second stage of the sorting process involved the material between 1/4 in. and 1/2 in. in size. Artifacts in this size range were first sorted to class (such as chipped stone, ceramics, or worked bone) and then combined with larger artifacts of the same class. The bulk of the remaining material consisted of flakes and bone. Because of the sheer numbers of these materials sampling procedures were adopted.

Ten percent of lithic debitage between 1/4 in. and 1/2 in. in size was analyzed. To select the sample we first weighed all the 1/4 in. to 1/2 in. material. The total weight in grams was divided by ten with the quotient used as the sample weight. Materials were then placed back on the scale until the sample weight was obtained. The flakes in this sample were, then, counted and weighed; this ten percent sample was bagged and catalogued separately.

For unworked bone a different sampling procedure was used. In this case we were interested in the total recovery of all bone fragments from specified proveniences (see Chapter Ten). Sorting the small bone fragments by hand would have been extremely time consuming. Consequently, we adopted a chemical flotation technique devised by Michael Wiaht of the Northwestern University Archaeology Program (personal communication; see also Styles 1981). All bone between 1/4 in. and 1/2 in. was submerged in a solution of zinc chloride ($ZnCl2$) with a specific gravity of between 1.95 and 2.0. The specific gravity of bone is between 1.4 and 1.9 (Bodner and Rawlett 1980). Thus, most faunal remains float in the zinc chloride bath and were removed with a hand scoop. Calcified bone did not float and had to be picked out by hand. Even so, spot checks indicated that between 90 and 95 percent recovery was obtained.

Water flotation was conducted in a modified 55 gallon drum. A shower head had been installed in the tank with water supplied from a pressurized pump. The shower head provided for gentle agitation of the sample, allowing the light fraction to be freed of the matrix and float. The light fraction was analyzed for ethnobotanical remains while the heavy fraction was merged with the appropriate waterscreen provenience.

All materials were catalogued according to Stovall Museum specifications. The Stovall Museum is the final repository of all Bug Hill materials, field notes, photographs, and forms.

ANALYTIC APPROACH

Bug Hill was excavated primarily in 10 cm arbitrary levels provenienced to 1 m by 1 m units. In all, over 1500 proveniences were excavated. Trying to discern patterns in the data using the 1 m by 1 m by 10 cm provenience as the basic analytic unit would have been a hopeless task. Given the fact that sequencially ordered natural strata were observed, we decided to analyze the material by stratum. Table 10 shows the correlation between the arbitrary levels and strata. It should be noted that the arbitrary levels were used to study subtle chronological and functional changes within and between each stratum. The results of all the artifact studies are reported below.

LITHIC ANALYSES

The analysis of the Bug Hill lithic collection was conducted as three inter-related studies. The first consisted of examining all chipped stone and groundstone artifacts. The second analyzed a sample of the debitage material as part of a study of lithic manufacturing techniques. These two studies form the bulk of this section. The third part of the lithic analysis, conducted by Larry Banks, focused on the types of raw materials available, those used and the likely sources of these materials. This study comprises Chapter Seven.

Chipped Stone and Groundstone Artifact Analysis

The study of chipped stone and groundstone artifacts had two basic goals. The first was a reconstruction of culture-historic ties. This goal, basic to any artifact analysis, was approached through the use of standard culture-historic types. These are by-and-large projectile point types, such as Gary, Ellis, or Scallorn. The objective of this study is to associate the natural strata of the mound with specific culture periods. Ideally, each stratum would be correlated with a different culture period forming a sequential progression from the earliest (Stratum IV) to the latest (Stratum I) occupation. This situation, however, does not exist at Bug Hill. Differences between natural strata do not seem to be the result of long-term occupational breaks. From the radiocarbon sequence we did expect the strata to be ordered sequentially, but with some overlap in culture periods near the borders of strata.

Once culture-historic ties were established for each stratum, we focussed on the second objective of the lithic study; an examination of tool-kits. This objective was pursued through a morphological analysis of tools. The goal of this analysis was to delineate patterns of co-association between tool types. For each stratum, then, these co-association formed the basis for tool-kit definition. The composition of each tool-kit was used as an indicator of the overall functional orientation of each component. The spatial distribution of specific parts of the tool-kit was analyzed to discern cultural patterns in the use of space. Examining each component allowed these

TABLE 10. CORRELATION BETWEEN ARBITRARY LEVEL AND NATURAL STRATA.

Block/Test Pit	Grid Coordinates North	East	Levels*	Stratum
Southern	17	9-14	X,0,1	Ip
	16	9-14	0,1	Ip
	15	9-14	0,1,2	Ip
	13-14	9-14	1-3	Ip
	11-12	9-14	2-4	Ip
	10	9-14	3-5	Ip
	16-17	9,10,13,14	2-3	II
	16-17	9-14	4-6	II
	15	9-14	3-7	II
	13-14	9-14	4-7	II
	11-12	9-14	5-7	II
	10	9-14	6-7	II
	16-17	9-14	7-10	III
	10-15	14	7-10	III
	10-17	9-14	10 bottom - 11	IV
Southern	16-17	11-12	2-3	Occupational Surface I
			features only	Occupational Surface II
	10-15	9-13	8-10 (top)	Occupational Surface III
Central	all units		1-3	Ip
			4-6	I
			7-8	IIa
			9-10	IIb
			11-16	III
			17-19	IV
Northern	53-55	15-18	3-5	Ip
	51-52	15-18	2-4	Ip
	50	17-18	1-3	Ip
	53-55	15-18	4-7	II
	51-52	15-18	5-7	II
	50	17-18	6-7	II
	50-55	15-18	8-14	III
	50-55	15-18	15	IV
Test Pit 2	all units		1-3	Ip
			4-8	II
			9-10	IV
Test Pit 3	all units		1-3	Ip
			4-7	II
			8-10	IV
Test Pit 6	all units		1-3	IP
			4-7	II
			8-15	IV
Locality A	all units		1	Ip
			2-6	II
			7-8	IV

* The original datum for the southern block was set at the highest corner of Test Pit 1 (northwest). As the block excavations expanded to the north, we decided to keep the same level designations signifying the same true elevations. Levels 10 cm above level one were designated level 0, and those between 11 and 20 cm were designated level X, and those between 11 and 20 cm above datum were designated level X.

patterns as well as the overall orientation of the tool-kits to be traced through time.

Culture-Historic Ties

All projectile point types used to study culture-historic ties were identified using standard references for corroboration (Suhm et al. 1954; Suhm and Jelks 1962; Bell 1958, 1960; Perino 1968, 1971; Webb 1963; Johnson 1962 [Yarbrough]; Shafer 1978). Types recovered at Bug Hill are listed in Table 11 (see also Vehik 1982a).

In a number of cases types represented by only a few specimens were deliberately subsumed under better represented types. For example, a very few specimens similar to the Shumla, Martindale and Castroville types were recognized in the preliminary culture-historic typology. They were collapsed into the Marshall type because all seemed to be extreme or poorly-executed specimens of Marshall. Likewise, a couple of specimens originally identified as Waukesa were added to the Gary totals. Bug Hill is somewhat outside the normal range for Waukesa and these pieces seem more likely to have been well-finished Garys'.

The same line of reasoning led to the incorporation of a number of Vehik's (1982a) categories into more general ones. Thus, the four untyped variants identified as corner-notched (I-IV) were collapsed into a more general unidentified corner-notched category. The large, straight-stemmed corner-notched category was similarly added to the unidentified, straight-stemmed category. Finally, points identified as either Marcos or Summerfield were combined as Marcos. This was done because there seems to be insufficient taxonomic distinction between the two types: Summerfield seems to be a somewhat longer, slender variant of Marcos. In addition, the two types co-occurred in the same proveniences.

In some cases, points of a particular type at Bug Hill consistently differed from the general definitions in one or a few minor aspects. These are discussed below by type.

<u>Carrollton-like (Figure 34)</u>: While these pieces resemble the Carrollton type in general morphology, the same is not true of the technology displayed. Carrolltons as originally defined have heavily ground stems and bases. The points resembling Carrolltons at Bug Hill, however, are only lightly smoothed at best. Furthermore, the Carrollton type was originally defined as the principle point type of the Carrollton focus (Crook and Harris 1952). A late component of the focus was radiocarbon dated to about 4000 B.C. (Crook and Harris 1959). One of the Carrollton-like points found at Bug Hill could possibly date from the Middle Archaic, but most were recovered from the upper portions of the deposit. Shafer (1978) has suggested that points of Middle Archaic age found at the George C. Davis such as Wells and Morrill were picked up at nearby terraces for reutilization by the later inhabitants of the site. A similar situation may have occurred at Bug Hill.

TABLE 11. DART AND ARROW POINTS.

	Southern Block								Central Block							Northern Block					Site Peripheries					Locality A			TOTALS
	Ip	II	III	IV	OSI	OSII	OSIII FIII	F&B*	Ip	I	IIa	IIb	III	IV	F&B*	Ip	II	III	IV	F&B*	Ip	II	III	IV	F&B*	Ip	II	IV	
Dart Points																													
Straight Stemmed																													
Carrollton-like	2	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	6
Bulverde	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5
Pedernales	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2
Elam	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Unidentified, small, straight stem	3	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0	0	3	3	1	0	0	0	0	0	15
Unidentified, straight stemmed	4	4	1	0	1	1	2	0	0	0	0	0	0	0	0	2	1	0	0	0	5	2	0	0	0	2	1	0	26
Morhiss-like	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Morrill-like	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Expanding Stemmed																													
Lange	3	4	0	0	1	1	2	0	0	2	1	0	0	0	0	2	1	1	0	0	5	0	0	1	0	1	0	0	25
Ensor	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	5
Edgewood	1	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	2	0	0	2	0	1	0	0	1	0	0	13
Ellis	2	2	2	0	1	0	3	1	1	2	0	0	0	0	0	2	1	1	0	0	0	2	0	0	0	0	1	0	21
Yarbrough	1	2	0	0	0	1	2	0	0	0	0	0	0	1	0	2	0	2	0	0	3	4	0	1	0	1	1	1	22
Table Rock stemmed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	0	4
Palmillas	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	2	1	0	0	0	0	0	11
Nolan	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	4
Big Creek-like	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4
Contracting Stemmed																													
Gary	91	90	5	5	4	4	29	4	12	17	3	4	8	0	2	17	14	11	1	0	50	29	2	4	2	26	6	1	441
Wells	5	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	9
Unidentified contracting stem	3	1	0	0	0	0	0	1	1	2	0	1	0	0	0	1	1	1	0	0	1	4	0	0	0	0	0	0	17
Langtry-like	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	1	0	0	0	2	1	0	0	0	0	0	10
Dickson	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	8	0	0	0	1	0	0	0	0	11
Large, contracting stem	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Corner Notched																													
Marcos	2	3	0	0	0	0	5	0	0	2	0	1	0	0	0	3	1	1	0	0	2	13	2	0	0	1	3	0	39
Marshall	5	9	2	2	0	0	3	2	0	2	0	3	0	0	0	3	2	4	0	0	2	6	1	1	0	0	1	0	48
Williams	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	2	0	0	0	0	1	0	7
Corner-notched dart	1	1	0	0	0	1	0	0	0	0	0	0	1	1	0	2	2	2	0	0	3	4	0	0	0	1	0	0	19
TOTALS	132	128	10	8	8	8	51	9	18	30	4	14	10	6	2	37	28	30	1	8	84	77	9	10	2	33	14	2	773
Arrow Points																													
Bonham	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	4
Colbert	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	6
Haskell	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	7
Keota	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Miscellaneous corner-notched	1	2	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	7
Miscellaneous side-notched	1	2	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Rockwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	4	1	0	0	0	0	0	0	8
Scallorn	20	7	0	0	3	0	4	1	7	3	0	0	0	0	0	9	1	0	0	0	11	3	0	0	0	1	3	0	73
Toyah	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
TOTALS	28	11	0	0	8	0	4	1	11	4	0	0	0	0	0	17	3	0	0	0	21	5	0	0	0	1	4	0	118

* features and burials

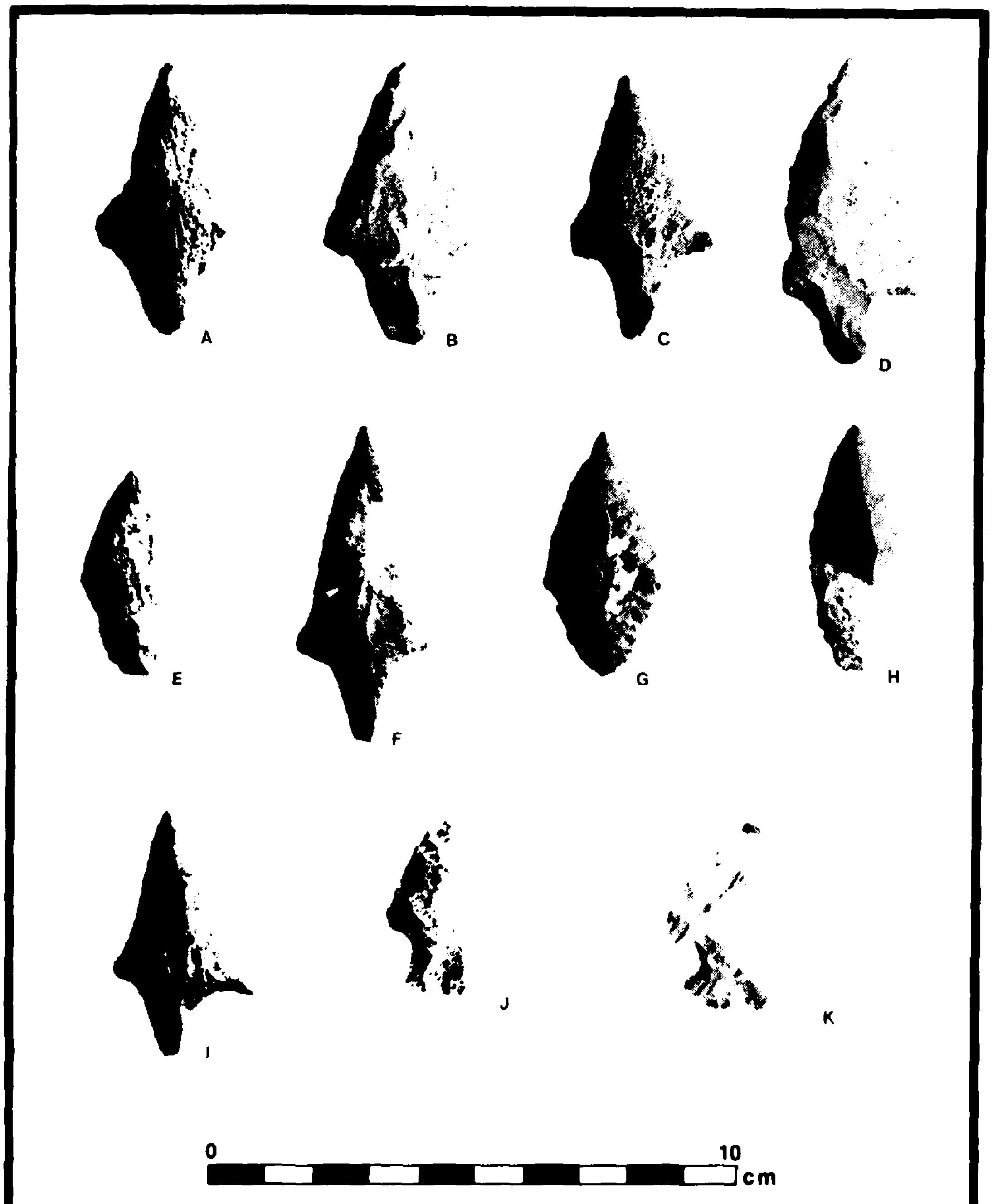


FIGURE 34. CONTRACTING-STEMMED AND EXPANDING-STEMMED DART POINTS.

a-i: Gary
j: Ellis
k: Big Creek

Langtry-like (Figure 35): While Bell and other Oklahoma archaeologists accept Langtry as a native type, Suhm et al. (1954) argue that the distribution of the original type does not extend into Oklahoma. They consider Langtry primarily a west or central Texas type. Whatever the case, Langtry-like points seem to be considerably earlier in Texas than in Oklahoma.

Nolan-like: This is a tentative identification. While the type definitions of Suhm et al. (1954), and Suhm and Jelks (1962) are somewhat ambiguous as to shape, they flatly state that the most diagnostic attribute of the type is an alternately bevelled stem. While the Bug Hill specimens do have alternate stem bevels, they are not very pronounced.

Palmillas: This type has been reported from Mexico (MacNeish 1958) to eastern Oklahoma and Louisiana. Yet, with one exception (MacNeish 1958), nowhere does it constitute a majority or even a substantial plurality. Perhaps most examples of this 'type' represent poorly made or unfinished examples of other types, a possibility supported by considerable variability in size and blade shape.

Wells-like Bulverde (Figure 34): Shafer (1978) has cited references that these types are Middle Archaic or earlier in central Texas. Such an antiquity does not agree with the stratigraphic position of these points at Bug Hill. These identifications should be considered tentative.

Unidentified, Small Straight-Stemmed (Figure 34): These are small (usually under 3.0 cm to 3.5 cm in length) dart points with straight stems. Certain specimens resemble Johnson's (1962) Phalba variety of Kent. Others could represent extreme examples of Schambach's (1982) Camden variety of Gary.

Unidentified, Contracting-Stemmed (Figure 35): This group includes a variety of point styles with contracting stems. Some of these could represent what Schambach (1982) calls the Gary variety of Gary. Most Bug Hill examples are in the deeper portions of the midden and in the terrace. Other unclassified contracting stem points are also included.

Unidentified, Straight-Stemmed (Figure 34): Unclassified points with straight stems. These points fit no standard classification.

Morphological Chipped and Groundstone Tool Types

Morphological tool types were also defined according to accepted typological classifications (e.g. Crabtree 1972, Bell 1980). Tool types recovered during the 1981-82 field season at Bug Hill are listed in Table 12 and illustrated in Figures 36 through 43. Types exhibiting peculiar characteristics or special definitional problems are discussed below.

FIGURE 35. CONTRACTING-STEMMED AND CORNER-NOTCHED DART POINTS.

Contracting-Stemmed

a: Langtry-like
b: Unidentified Contracting Stemmed
c: Unidentified Contracting Stemmed

Corner-Notched

d: Marcos/Summerfield
e: Marcos/Summerfield
f: Marshall
g: Unidentified Corner-Notched

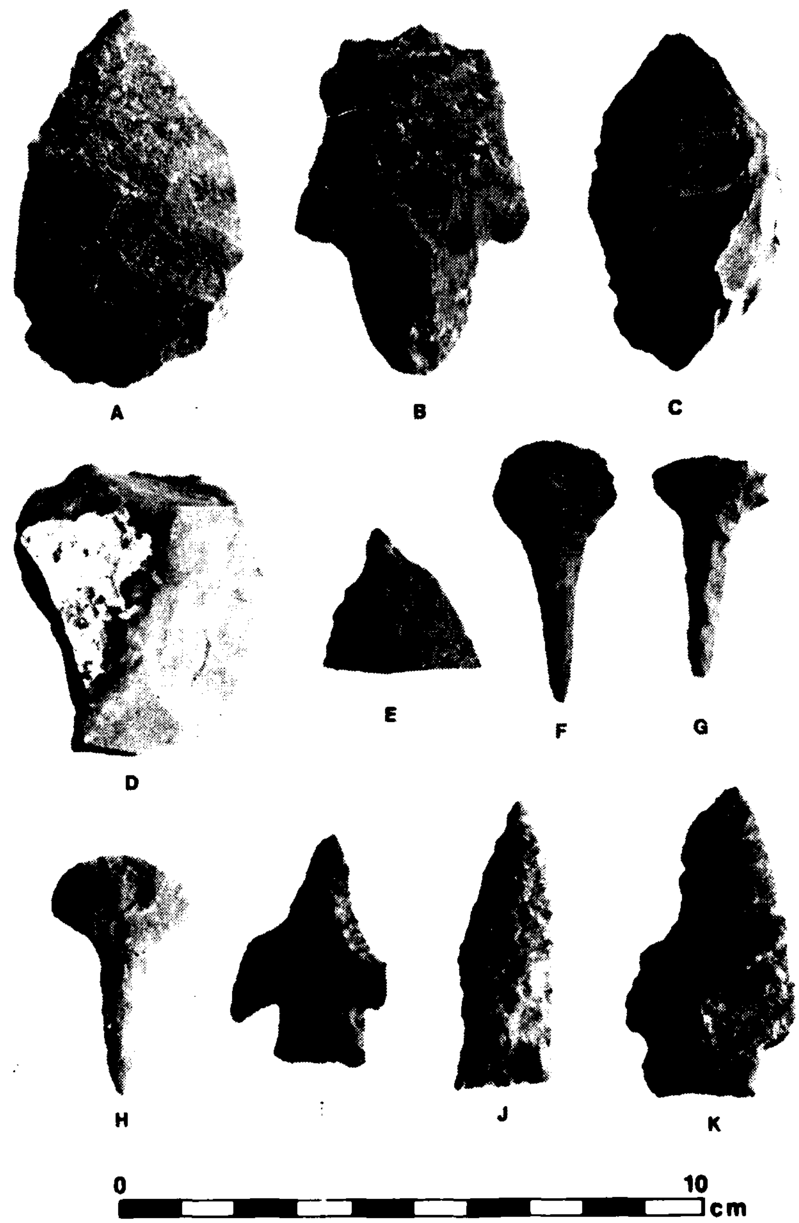


FIGURE 36. CHIPPED STONE TOOLS.

a: Endscraper
b: Endscraper on point stem
c: Sidescraper
d: Backed scraper
e: Graver
f-h: Drill
i: Drill on point stem
j: Punch/awl
k: Spokeshave on point stem

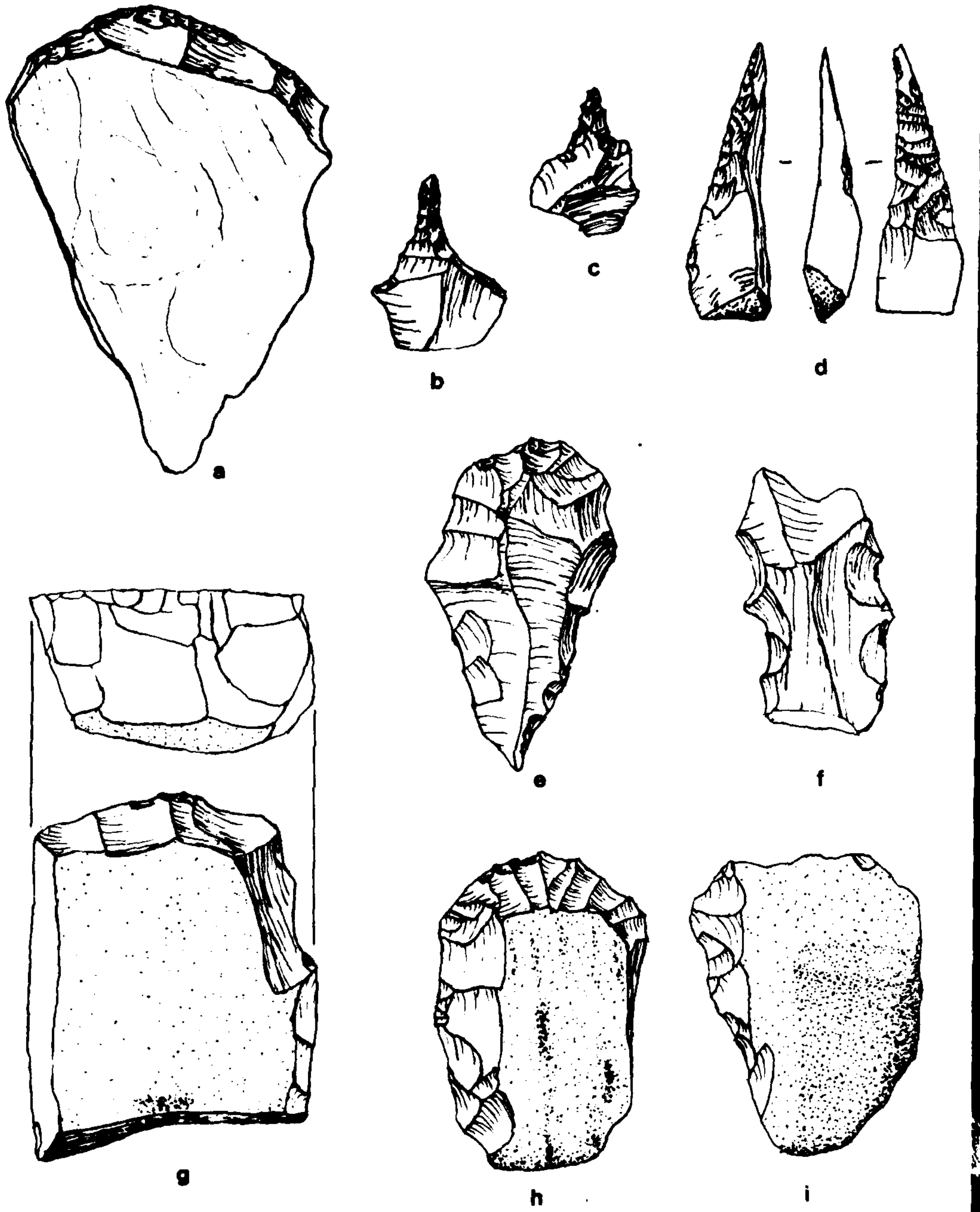


FIGURE 37. CHIPPED STONE TOOLS.

a:	Endscraper	f:	Denticulate
b-d:	Drills	g-h:	Endscraper
e:	Endscraper	i:	Sidescraper

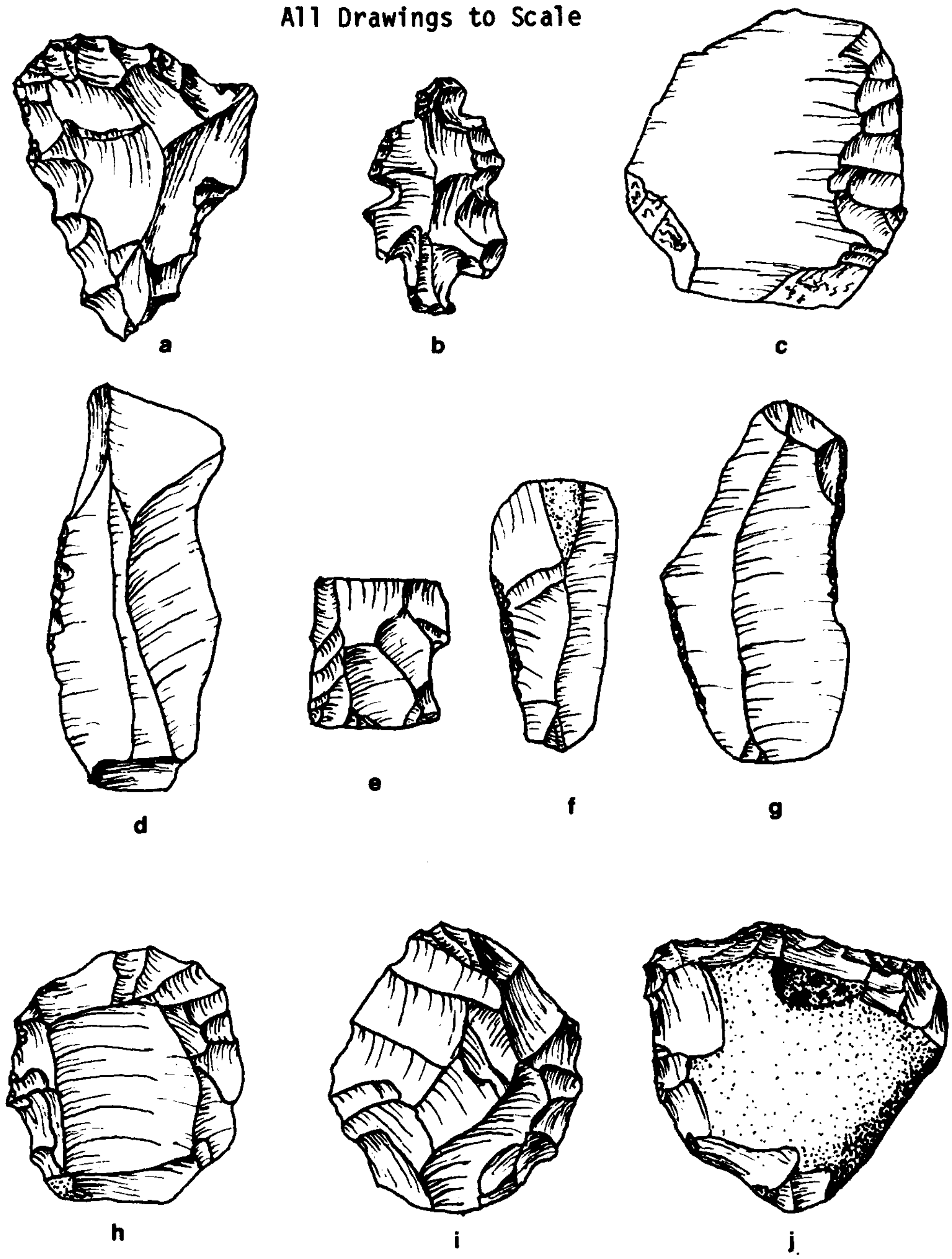


FIGURE 38. CHIPPED STONE TOOLS.

a: Endscraper
b: Modified Flake
c: Sidescraper
d: Retouched Modified Flake
e: Burin on Shaped Point
f-g: Modified Flake
h-i: Discoidal Scraper
j: Endscraper

FIGURE 39. CHIPPED STONE TOOLS.

a: Hoe/Axe
b: Celt
c: Double-bitted Axe
d: Roughout
e: Knife

FIGURE 40. TOOL MANUFACTURING ITEMS AND OTHER GROUNDSTONE.

a: Gorget-Pendant
b: Single Facet Core
c: Hammerstone

FIGURE 41. GROUNDSTONE TOOLS.

a: Unifacial Mano
b-c: Bifacial Mano
d: Cupstone

FIGURE 42. GROUNDSTONE TOOLS.

a: Pitted Mano
b: Nutting Stone

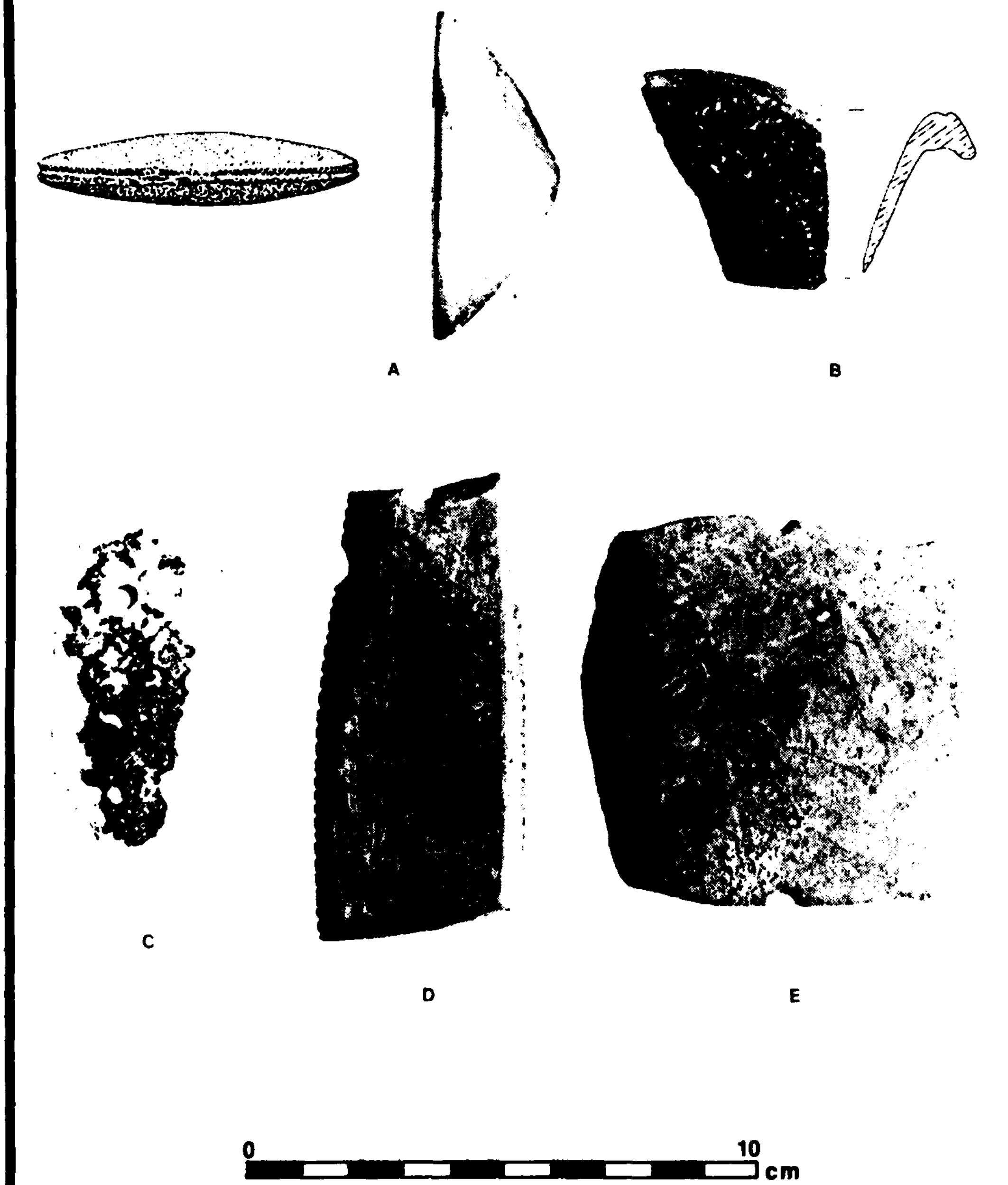


FIGURE 43. OTHER GROUNDSTONE.

a-b: Boatstone
c-e: Gorget

TABLE 12. LITHIC ARTIFACT ANALYSIS.

	Southern Block								Central Block							Northern Block					Site Peripheries					Locality A			TOTALS
	Ip	II	III	IV	OSI	OSII	OSIII FIII	F&B*	Ip	I	IIa	IIb	III	IV	F&B*	Ip	II	III	IV	F&B*	Ip	II	III	IV	F&B*	Ip	II	IV	
Cobbles																													
unmodified	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2	0	1	0	2	0	0	
split	3	3	3	1	0	0	2	0	1	0	0	2	1	1	0	3	1	3	0	0	7	5	1	0	0	0	3	0	
tested	15	5	1	2	0	3	6	0	1	2	0	1	3	1	0	9	3	7	0	0	8	9	1	2	0	0	4	0	
Cores																													
cortex platform	2	3	0	1	0	0	3	0	0	0	0	0	1	0	0	2	0	1	[illegible]	0	3	7	1	1	0	0	1	0	26
single facet	8	8	0	1	0	0	2	0	3	0	0	0	1	0	0	1	0	4	0	0	6	10	1	0	0	0	1	0	46
multi-faceted	2	10	0	3	0	1	4	0	8	1	0	0	1	1	0	2	0	4	0	0	3	3	0	0	0	0	1	0	44
multiple platform	96	81	12	6	2	0	23	1	4	12	4	4	6	2	0	36	18	25	0	0	72	49	8	2	1	1	10	1	476
chopper-like	3	4	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	14
blocky debris	123	66	15	8	12	2	24	3	2	6	4	4	11	5	0	21	1	8	0	0	41	44	9	5	1	5	4	0	424
hammerstone	0	3	1	0	1	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	1	4	1	20	0	0	1	0	36
TOTALS	253	184	33	22	15	6	69	4	19	21	8	11	25	10	0	75	23	53	0	0	142	136	22	31	2	8	25	1	1,198
Chipped Stone Tools																													
endscraper	11	3	4	3	1	0	6	0	1	5	2	0	2	1	0	2	2	9	0	0	4	12	1	0	0	0	5	0	74
sidescraper	12	4	0	2	0	0	2	0	3	0	2	1	0	0	0	2	1	1	0	0	0	1	0	0	0	0	3	0	34
discoidal/ovoid	3	0	0	0	0	0	0	0	2	0	0	0	2	1	0	0	0	2	0	0	2	1	0	0	0	0	0	0	15
backed scraper	6	3	0	0	0	0	3	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	16
denticulated surface	8	3	0	0	0	0	0	0	0	1	0	0	1	0	0	1	3	2	0	0	0	1	1	0	0	0	0	0	23
spokeshave (notch)	5	4	0	2	0	0	0	0	0	1	1	0	0	0	0	1	1	3	1	0	4	1	2	0	0	0	3	0	29
multiple notch, denticulated	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	5	0	0	2	1	0	0	0	0	0	0	14
graver	4	1	0	1	0	0	1	0	2	0	0	1	2	0	0	2	0	1	0	0	6	2	1	0	0	0	2	0	26
drill	10	10	0	1	0	0	2	1	3	0	0	1	1	0	0	1	2	2	0	0	5	2	0	0	0	0	0	0	41
punch/awl	4	1	0	0	0	0	5	0	2	0	0	1	0	0	0	0	2	1	0	0	1	2	1	0	0	0	0	0	20
scaled piece	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	0	0	0	0	0	0	8
burin	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	1	0	0	2	0	0	0	0	0	0	0	9
hoe/axe	0	3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	9
double-bitted axe	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	0	0	6
roughout	19	10	2	0	1	0	0	0	3	3	0	0	2	0	0	4	1	2	0	0	4	5	0	0	1	1	3	0	61
whole point	56	51	2	2	6	0	26	6	10	11	2	2	6	3	0	20	14	9	1	8	33	27	2	4	2	3	8	2	316
broken point	190	174	18	14	15	13	59	8	32	34	5	14	15	3	2	68	40	26	0	1	137	104	16	7	1	10	28	1	1,035
whole biface	36	38	3	3	2	0	17	2	5	6	3	3	3	1	1	11	13	6	0	1	15	19	4	0	0	1	10	0	203
broken biface	315	238	40	30	12	6	175	17	65	34	19	18	23	10	1	109	61	73	3	5	142	147	18	6	2	12	33	3	1,617
composite	0	2	1	0	0	0	0	1	0	0	0	0	0	0	0	2	0	2	0	1	1	0	0	0	0	0	1	0	11
modified flakes	28	11	1	5	0	0	7	0	3	2	1	0	4	3	0	8	4	9	1	0	16	16	1	2	0	1	5	0	128
TOTALS	713	560	71	63	37	19	303	35	134	98	37	41	63	23	4	236	147	154	6	16	380	345	47	19	6	29	102	7	3,695
Groundstone Tools																													
unifacial mano	6	5	0	1	0	0	3	1	1	4	2	1	1	0	0	6	4	4	0	0	3	12	0	2	0	0	1	0	57
bifacial mano	2	4	1	1	0	1	1	1	2	1	1	0	0	0	1	0	4	2	0	1	3	10	2	1	0	0	0	0	39
pitted mano	1	5	1	1	0	2	3	0	0	1	1	0	0	0	0	1	0	0	0	0	0	9	0	1	0	0	0	0	26
metate	7	7	0	1	0	2	1	0	2	4	1	2	0	0	1	3	0	1	0	0	4	8	1	0	0	0	1	0	46
nutting stone	1	6	1	0	0	1	5	0	3	1	2	2	2	0	1	2	4	4	0	1	7	24	1	1	0	0	2	0	71
axe	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
cupstone	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
miscellaneous ground fragment	25	36	2	4	0	1	12	0	7	12	1	2	1	0	1	17	8	13	0	0	28	24	0	0	0	0	6	0	200
TOTALS	43	64	6	8	0	7	25	2	15	23	8	7	4	0	4	29	20	24	0	2	45	87	4	5	0	0	10	0	441
Other Groundstone																													
gorget	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	1	1	0	0	0	0	9
gorget/pendant fragment	2	0	0	0	0	0	2	0	0	1	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	9
boatstone	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
modified hematite	3	3	2	0	0	0	0	0	1	2	4	2	9	0	1	3	5	8	1	0	4	8	2	2	0	0	0	1	63
modified limonite	0	1	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	7
TOTALS	7	4	5	0	0	0	4	0	1	3	4	2	9	1	3	7	8	9	2	0	4	11	3	3	0	0	0	1	91
Unmodified Hematite and Limonite																													
hematite	19	8	4	0	0	0	3	0	1	9	2	20	19	0	4	8	16	63	2	1	31	31	1	1	0	0	5	0	248
limonite	4	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	10
TOTALS	23	9	4	0	0	0	5	0	1	9	2	20	19	0	4	8	16	64	2	1	32	31	1	1	0	0	6	0	258

* features and burials

Burins: These tools are produced by one or more blows which produce a spall that is perpendicular to both faces of the piece. The most common type of burin at Bug Hill is an angle burin on a break or snap.

Scaled Pieces: These are flakes and bifaces which are usually bifacially retouched by direct blows to the edges removing wide, flat flakes. A few of these are pieces esquillees (Goodyear 1974, Tixier 1974). Some of these are called wedges in earlier Clayton reports (Bobalik 1977; Vehik and Galm 1979; Vehik 1982b).

Composite: These can be either bifacial or unifacial tools that have more than one diagnostic modification; for example, endscraper plus denticulate.

Modified Flake: Perhaps the most troublesome of all the morphological categories, modified flakes are all unifacial pieces showing secondary modification, but not of a diagnostic category. The term flake is something of a misnomer as it includes some blades and bifacial thinning flakes as well as unifacially modified tabular pieces and flat cobbles. The more regular, continuously retouched examples are similar to backed flakes or blades, except that the retouch is usually only semi-steep rather than abrupt.

Our use of the term modified flake is more restrictive than previous work at Bug Hill. Vehik (1982a) considered such items as spokeshaves and denticulates to be modified flakes. However, even after collapsing several of our categories, it is clear that Vehik identified over ten times (2317) the number of modified flakes in the 1974 collection than from the 1981-82 collection. This difference is even more striking when one remembers that the 1981-82 collection came from more than four times the amount of controlled excavation. We do not think these differences are cultural, but rather definitional. The problem hinges on the interpretation of intentional retouch as opposed to unintentional or post depositional wear (e.g., screen or shovel damage). From past excavations it has been our experience that the amount of unintentional screen damage can easily be grossly underestimated. Consequently, we have adopted a very restrictive definition of modified flakes in which there can be no doubt that the modification was intentional. By this approach we may have classified some pieces as waste material (flakes) that may actually have been intentionally modified. We are strongly convinced, however, that this type of error could not account for the entire difference between the 1979 analysis and the present one.

Results

In all, 5660 lithic tools and cores were analyzed from the 1981-82 field season. Counts of these artifacts by strata of the various excavation units are presented in Tables 11 and 12. In addition, lithic materials recovered from features and burials from specific occupational surfaces or excavation units have been added together and are also presented in these tables (see also Tables 1, 4, and 6, Chapter Four for a listing of artifacts recovered from each feature individually).

To highlight the vertical and horizontal dimensions of the assemblage, histograms of various composite tool categories have been calculated for each stratum (see Figure 44). The categories used in these histograms are described in Table 13. These categories are all utilitarian in nature. Functional attributes of these classes are not based on specific microwear studies; but instead reflect traditional, mostly untested, assumptions. It is important to remember that this section only deals with lithic tools. Other tool categories, such as worked bone and ceramics, also have functional implications which will be discussed in Chapter Eight. The functional implications of all artifact categories as a group then will be returned to in Chapters Fourteen and Fifteen.

TABLE 13

COMPOSITE TOOL CATEGORIES USED IN HISTOGRAMS

Group	Tools Sets	Possible Function
1	Denticulates and notches	Vegetable shredding, heavy cutting or sawing, shaft smoothing, fish cleaning
2	Burins, scaled pieces, gravers	Bone/antler/wood working and incising
3	Scrapers	Hide working (also planning though this functional attribute is usually restricted to steep, core-like scrapers which were a minority at Bug Hill)
4	Whole points	Cutting, hunting and piercing
5	Manos, metates and nutting stones	Vegetable processing
6	Drills and awls	Piercing
7	Hoes and axes	Woodworking

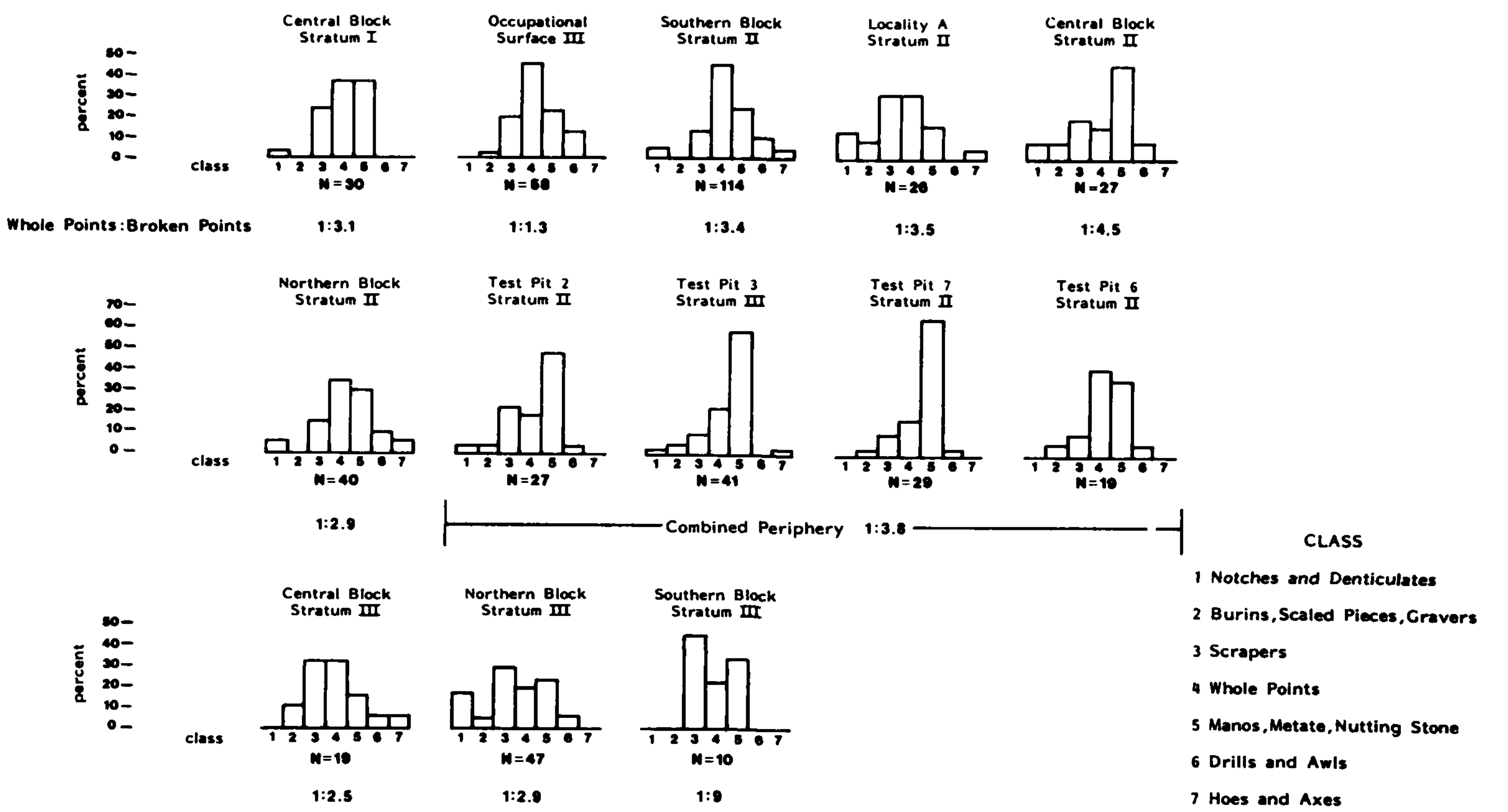


FIGURE 44. HISTOGRAMS SHOWING PERCENTAGES OF SEVEN LITHIC CLASSES FOR EACH EXCAVATION UNIT BY STRATUM.

A special note is needed concerning the restriction of the point category to "whole points" as opposed to "whole and broken points." In a controlled excavation artifact recovery is standardized. However, it does not follow that the resulting frequencies of artifact categories necessarily reflect the actual percentages of various tool categories present during the occupation. The discrepancy between the two frequencies is a result of our inability to identify broken or fragmentary pieces. If we knew that an equal relative percentage of broken pieces of each type could be identified than it would make statistical sense to lump broken and unbroken pieces into one category. At Bug Hill, however, this is not the case.

The most populous chipped stone category in the collection is broken biface. Across the site, broken bifaces average 44 percent of the chipped stone collection, ranging from a low of 32 percent in Stratum II of Locality A to a high of 58 percent in the fill and floor of Structures 1 and 2 (Occupational Surface III). This amorphous category includes all broken chipped stone tools which could not be identified to a specific tool type. As such this category contains all chipped stone that was broken during manufacturing as well as all that was broken during use.

Some of these broken bifaces may be parts of projectile points. However, because of their distinctive shape and features, projectile points can often be identified (to tool type) on the basis of small broken pieces. If we combine broken and whole points together in our histograms we are inflating the importance of this tool category. The ratio of whole points to broken points is listed below the histograms in Figure 44. For the most part this ratio ranges between 1:3 to 1:4 across the site. (Exceptions are Stratum III of the Southern Block which is based on a small sample and Occupational Surface III which will be discussed in greater detail in Chapter Fourteen). The implication of these ratios is that roughly the same proportion of points are being broken everywhere. Thus, if we included broken points, the percentage of points as a whole would increase throughout the site in roughly equal proportions. The relative proportions of other groups to one another, however, (i.e., the proportion of scrapers to groundstone) would remain fairly constant, as would the functional interpretations.

Finally, beyond the tool classes are a small number of artifacts which appear to be ceremonial or ritual in nature. These artifacts have not been grouped together and used in the histograms, because statistically they represent a minute fraction of the assemblage. Instead, these artifacts will be individually described below.

Stratum I: Culture-historic diagnostics are dominated by the Gary style. These points comprise 50 percent of identifiable stemmed diagnostics. Small arrow points account for only 11.7 percent of the assemblage. Their low incidence in Stratum I is consistent with a Woodland period occupation (see Chapter Five).

The lithic assemblage of Stratum I includes 21 cores and cobbles (13.6 percent), 121 chipped and groundstone tools and tool fragments (78.6 percent), a gorget fragment (.6 percent) and eleven pieces of hematite (7.2 percent), two of which have been modified (1.2 percent). The restricted tool categories are led by food-processing groundstone (36.7 percent), points (36.7 percent), with scrapers composing only 23.3 percent of this assemblage subset.

Burial 6 and Feature 94 (the burial pit) are probably associated with an occupation corresponding to Stratum I. From the burial pit, we recovered a variety of lithic debris, a Gary point, a whole biface and several pieces of modified hematite which may or may not have been purposely included as grave furniture. One artifact, however, found directly beneath the left pelvis of Burial 6B most likely was purposely placed. This artifact, a boatstone (see Figure 43,a), was made of specular hematite. The specimen was elliptical in shape, tapering from the top to the keel. The piece was flat on top with convex sides. A groove, approximately 1 mm wide, runs the entire length of the piece around the keel (Bell 1980:47). The entire stone measured 6.4 cm in length, 2.6 cm in width and is 1.4 cm thick. This boatstone is one of three recovered at Bug Hill in the two field seasons (Vehik 1982a:115, 118).

Stratum I is restricted to the highest portions of the mound. The only unit excavated during the 1981-82 field season to contain Stratum I was the Central Block. Because of the small size of the assemblage, no functional interpretation can be made. We considered lumping Stratum I and II in the Central Block together for this analysis, but decided to keep them separate because of the total absence of small arrow points in Stratum II. Thus, while the nature of the occupations associated with Stratum I may be obscure, they appear to be distinguishable from preceding ones.

Stratum II: A total of 1935 artifacts was recovered from Stratum II, by far the largest of any stratum. Of these, nearly half (49.5 percent) were recovered from the Southern Block or Locality A with remainder more or less equally distributed throughout the remainder of the site. The interpretation of Stratum II is complicated by marked differences in the assemblages from these two divisions of the site (see Figure 44).

Over 50 percent of all diagnostic tools from Scratum II were points of the Gary style. Dart points also represented, though in much lower numbers, were Marshall, Marcos, Yarbrough, Lange, Palmillas, Edgewood and Ellis. Arrow points constituted 7.8 percent (23 specimens) of the culture historic collection. Of these, well over half were Scallorns (14), with Rockwell, Haskell and miscellaneous side and corner-notched points also represented.

Most of the arrow points were found in either the Southern Block or Locality A. Locality A had the highest percentage of arrow points, reaching over 15 percent of that unit's Stratum II culture-historic markers. It is notable that in the Central Block and Test Pit 7 no arrow points were found (see Table 11).

The distribution of diagnostic point types is consistent with the interpretation of the radiocarbon dates indicating that Stratum II may have hosted two major occupations. Most of the site (Central Block, Northern Block and the site peripheries) appears to date to the Late Archaic/Woodland period. Gary points account for only 40.3 percent of diagnostic tools. Various corner-notched (Marcos and Marshall) and expanding stemmed (Lange, Edgewood and particularly Ellis) dart points are well represented. The presence of double-bitted axes in Stratum II of the Northern Block and site peripheries strengthens the notion of a Late Archaic/Woodland period occupation.

The Southern Block and Locality A appear to have been occupied somewhat later. Gary points dominate the collection, accounting for over 60 percent of the projectile points. Small arrow points comprise a small (around 10 percent), but significant, percentage of the culture-historic markers. All together, the diagnostic point types are consistent with the Early Caddo period dates obtained for Structures 1 and 2 in the Southern Block.

Just as the culture-historic diagnostics were differentially distributed over the site, so too were the morphological groups. This situation can best be illustrated by the three composite categories -scrapers, points and groundstone - which together account for over 80 percent of the tools. Counts of these categories have been summed and percentages of each calculated. The results have, then, been plotted on a triangular coordinate graph (Figure 45).

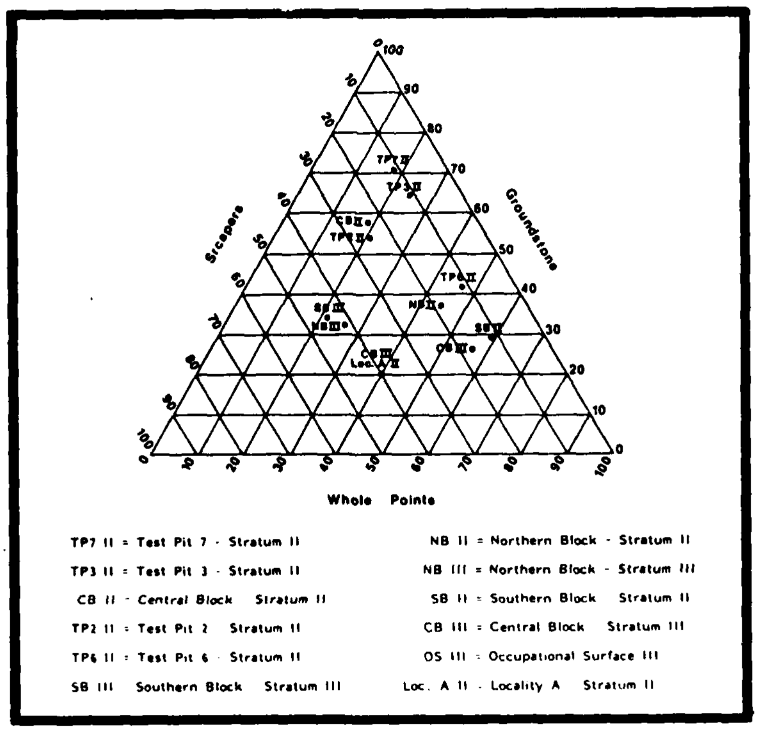


FIGURE 45. TRI-POLAR GRAPH OF THE PERCENTAGES OF WHOLE POINTS, SCRAPERS, AND GROUNDSTONE TOOLS FOR STRATA II AND III BY EACH EXCAVATION UNIT.

Two groups emerge from this analysis. The first is focussed around the Central Block and peripheral Test Pits 2, 3 and 7. This group is dominated (over 50 percent) by vegetable processing groundstone tools and contains much smaller though equal percentages of scrapers and points. The second group consists of the Northern Block and Test Pit 6. These units are distinguished by containing more equal proportions of points and groundstone tools and relatively few scraping tools.

The collections from Stratum II of the Southern Block and Locality A were neither similar to the other units nor to each other. These units were characterized by very small percentages of groundstone tools (20 - 25 percent). Between themselves, they are distinguished by Locality A's high percentage of scrapers and the Southern Block's preponderance of points.

The results of the morphological analysis mirror the culture-historic trends described above. In both analyses, the Southern Block and Locality A were distinguished from the rest of the site. Excluding these units, Stratum II is relatively homogeneous in terms of temporal and functional attributes. There is a tendency for grinding implements to be concentrated in certain units, but no clear distributional pattern emerges. This portion of the stratum probably dates to the Late Archaic/Woodland period and is characterized by a fairly strong emphasis on processing plant foods. Locality A and the Southern Block appear to be somewhat later in date (Early Caddo) and functionally diverse. Stratum II of the Southern Block appears to have been affected by the house fill of Structures 1 and 2 (see Figure 44). Locality A also may be related to the occupation of Structures 1 and 2, serving as a hide working activity area (see below).

Stratum III: The Stratum III assemblage consists of 596 artifacts. The cultural typology is again dominated by points of the Gary style. Also present are Marshall, Edgewood, Ellis, Dickson and Big Creek points and a variety of other corner-notched and straight to contracting stem points.

This assemblage strongly resembles the Wister phase of the Late Archaic as described by Galm (1981) for the Wister Valley. Differences between the Wister and Jackfork Valley point assemblages appear to be slight, confined mostly to the relative frequencies of Marshall (more common at Bug Hill) and Lange (more common at Wister) point types.

Scrapers were the most common tool (27) in Stratum III followed by the groundstone group (21), whole points (19), the denticulate-notch group (10), the burin/graver/scaled pieces group (5), drill/awl (5) and axes and hoes (2). From the counts of the three predominant groups, percentages for each were calculated and plotted (see Figure 44). The high percentage of scrapers and the rather low proportion of whole points and groundstone tools is in sharp contrast to Stratum II. One is tempted to interpret the findings as evidence for the growing importance of plant resources between occupations of the Late Archaic and the Woodland periods. In general, Stratum III lithic collections were extremely homogenous with only minor differences in the horizontal distribution of tool categories (see Figure 44).

In addition to the functional tool assemblage, a cache of eight Dickson dart points (Feature 56) was recovered from Stratum III in the Northern Block (Figure 46). A ninth point, similar in all respects to those found in the cache was recovered about 2.5 m southwest of the cache in square N53E17. All nine points may have been associated with Burial 1, which was found at the same depth, but about two meters west of the cache and/or Burial 8, which was situated about 20 cm directly above the cache.

All nine points were made from locally available chert from the Johns Valley Shale Formation (see Chapter Seven). The bases of five of the points are truncated, while four are rounded. The points range in length between 10.4 cm and 14.6 cm and between 4.9 cm and 7.2 cm in width.

None of the points show any sign of utilization. Furthermore, all eight points in the cache are slightly imperfect, with one edge tapering in a fairly straight line from the point to the stem while the other edge is slightly convex. This deviation from the typical Dickson plan is so consistent that it hardly seems like a coincidence or a mistake.

Stratum IV: Artifacts in this assemblage were recovered within the Jackfork Terrace. Many of these are suspected to be intrusive from overlying strata, especially those found underneath Structures 1 and 2 in the Southern Block. The overall assemblage of Stratum IV consists of 186 elements of which 44 (23.7 percent) are cores and cobbles, 118 are tools (63.4 percent) and 24 (12.9 percent) are other lithics. Due to mixing from above, however, no functional interpretations can be made.

Culture-historic diagnostics were again dominated by points of the Gary style. However, it is noteworthy that in the Central Block, which seems to have the "cleanest" stratification in lithics, no Garys were found. Instead, only straight-stemmed and corner-notched points of diverse types such as Williams, Pedernales, Bulverde, Big Creek and Carrollton were recovered. The same situation occurred in the Jackfork Terrace excavations in Test Pit 6. In this unit, a Pedernales point was recovered nearly a meter into the terrace (169 cm below the surface). Taken together, the results from Test Pit 6 and the Central Block indicate some type of Middle Archaic occupation with no clearly identifiable functional components.

Occupational Surface I: Only 54 artifacts were recovered from Structure 3. Cultural diagnostics include Gary, Lange, Ellis and Nolan dart points. Arrow points compose 50 percent of the identifiable points. Other than points, which dominate the morphological typology, two endscrapers, two bifaces and a hammerstone were found.

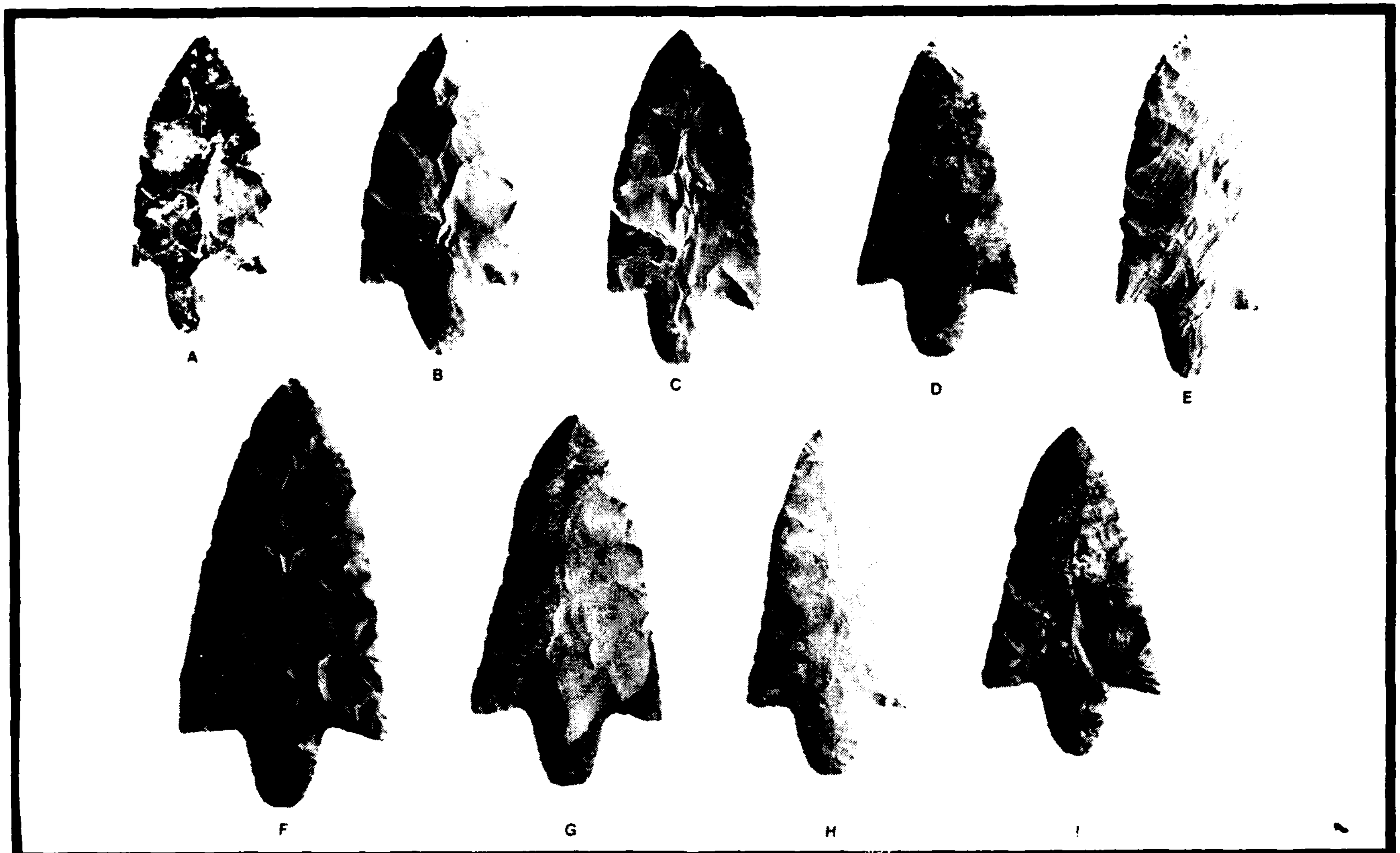


FIGURE 46. FEATURE 56 DICKSON POINT CACHE.

Occupational Surface II: Thirty-two lithic artifacts were recovered from the features between levels 4 and 6 of the Southern Block (Features 3, 30, 31, 32, and 53). This unit contained four Gary points, one Lange, one Yarbrough, an unidentified corner-notched and a straight-stemmed dart point. These data are insufficient to attribute cultural affiliations on the basis of lithic tools alone. In addition to the points, there were five point fragments and six broken bifaces. Six groundstone artifacts of the food-processing group were also recovered. Three cores, three cobbles and an abraded fragment round out the inventory.

Occupational Surface III: A total of 370 lithic artifacts were recovered from Occupational Surface III. Of these, 329 were collected from the fill and floor of Structures 1 and 2 (levels 8, 9 and 10 top in the Southern Block [includes all of level 10 for Test Pit 1]), while an additional 41 lithic artifacts were recovered from features found in the houses.

Diagnostics were again led by points of the Gary style (50.7 percent). Other well represented dart points types included Marcos (7.7 percent), Marshall (7.7 percent) and Ellis (6.2 percent). Scallorns were the only arrow type found and accounted for 7.7 percent of all points. Taken together, the assemblage is more consistent with an occupation of the Fourche Maline phase of the Woodland period than an Early Caddoan occupation as suggested by the radiocarbon dates.

Treating the house fill as a unit, the assemblage is very similar to that found in Stratum II of the Southern Block. Points are the dominant tool type in the assemblage followed by the mano/metate/nutstone group, scrapers, drills and awls.

Inspection of the floor indicated that tools may be non-randomly distributed in the house. These relationships were examined more closely by subdividing the house into quarters along lines parallel tc the orientation of Structure 2 (Figure 47). A fifth zone was defined around the central hearth to include the portion of the floor enclosed by the four center posts. We reasoned that this area may have hosted specific activities not found in other areas of the house. Due to the lack of artifacts in this zone, this area did not enter into the statistical analysis.

Percentages of the three dominant tool categories were calculated and plotted on a tri-coordinate graph (Figure 47). Two problems need to be noted before discussing the results. First, this division cuts across a number of the arbitrary north-south oriented excavation units. This problem was resolved by placing the units in question into the quarter of the house which encompassed the largest proportion of the square. Second, because the entire house was not excavated, the quarters do not cover equal areas. The patterns which emerge, however, are fairly strong and it would take dramatic changes in the tool types recovered from the rest of the house to make them completely disappear.

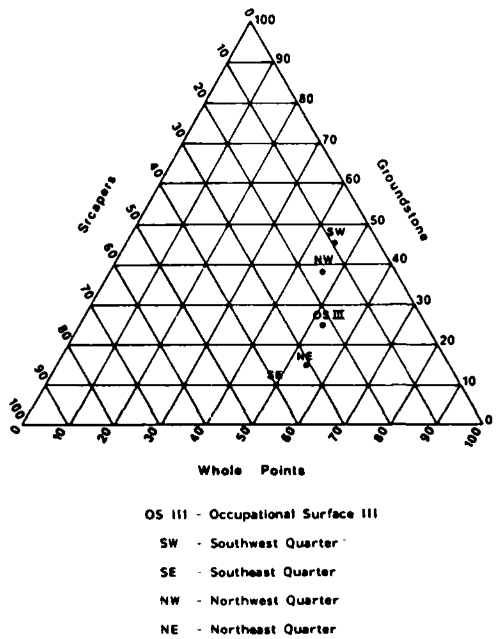
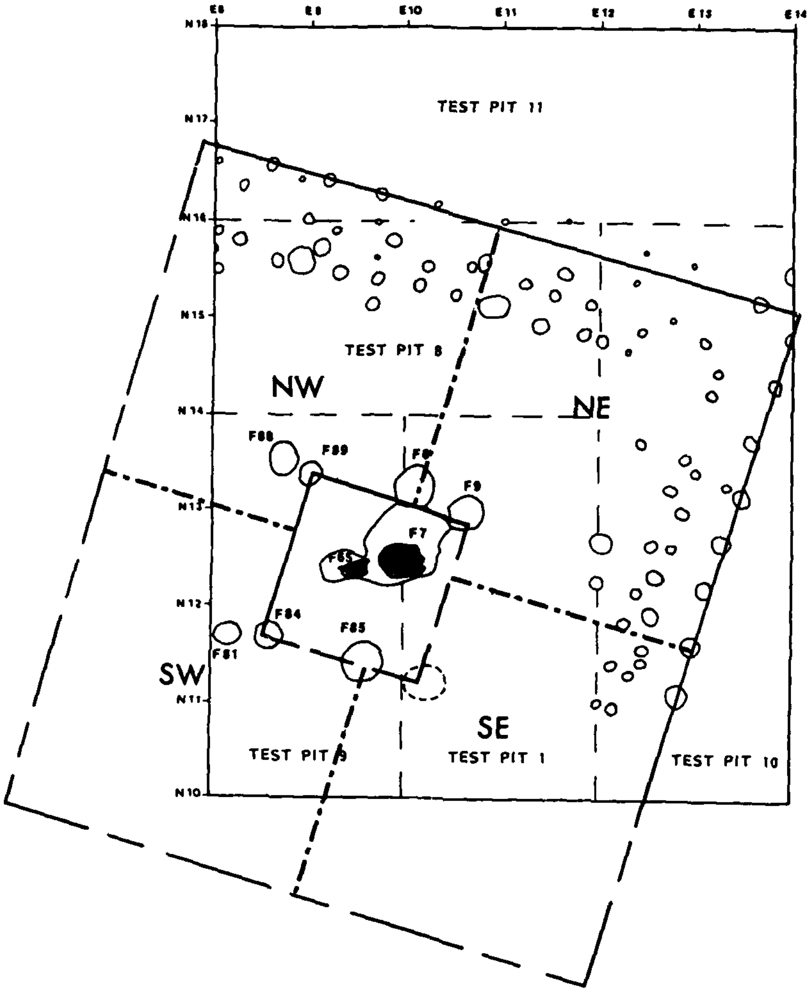


FIGURE 47. TRI-POLAR GRAPH OF THE PERCENTAGES OF WHOLE POINTS, SCRAPERS, AND GROUNDSTONE TOOLS FOR OCCUPATIONAL SURFACE III PLOTTED AS A WHOLE AND BY QUARTERS.

The results indicate a sharp east-west division in the house. This division is along a grinding/scraping axis with the eastern half of the house characterized by large percentages of scrapers (about 35 percent) and a near absence of groundstone (between 10 and 20 percent). Functionally, the assemblage from the east half of the house is quite similar to that recovered from Locality A. In the west half, the reverse holds true with the assemblage dominated by groundstone implements (about 40 to 45 percent) and extremely few scrapers (between 10 and 15 percent). The assemblage from this half of the houses resembles those found in Stratum II in the Northern Block and Test Pit 6. A chi-square test considering only the distribution of scrapers and groundstone was calculated between the east and west sections of the house and found significant at the .05 level ($X^2 = 4.62$ with 1° of freedom - data used to calculate the statistics are listed in Figure 48).

Somewhat surprisingly, the collections from both sections of the house are dominated by whole points. However, even though whole points are the most prevalent tool type, each quarter contains roughly the same percentage of them (between 45 and 55 percent).

The functional implications of these results are that activities were differentially distributed throughout the house(s). Grinding



NORTHWEST (NW) QUARTER

	N	%
Scrapers	2	15.4
Points	6	46.2
Grinding Tools	5	38.4
TOTAL	13	

NORTHEAST (NE) QUARTER

	N	%
Scrapers	4	30.8
Points	7	53.8
Grinding Tools	2	15.4
TOTAL	13	

COMMON AREA

	N	%
Scrapers	0	0
Points	3	100
Grinding Tools	0	0
TOTAL	3	

SOUTHWEST (SW) QUARTER

	N	%
Scrapers	1	9.0
Points	5	45.5
Grinding Tools	5	45.5
TOTAL	11	

SOUTHEAST (SE) QUARTER

	N	%
Scrapers	4	40.0
Points	5	50.0
Grinding Tools	1	10.0
TOTAL	10	

FIGURE 48. PLAN OF THE DIVISION OF STRUCTURE 2 INTO QUARTERS AND A COMMON CENTRAL ZONE. Note: only the northeast quarter was completely excavated.

activities were virtually restricted to the west half of the house while hide-working and other scraping activities took place in the east. The central area appears to have been kept fairly clean. Three points represent the total number of tools recovered from three levels in this area. The area surrounding the central heath, then, may have served as a common area for all occupants of the house. The ubiquitous distribution of "points" only highlights the little we know about the function of these tools.

DEBITAGE ANALYSIS

By far, the most numerous category of cultural remains recovered at Bug Hill was lithic debitage. We estimate that well over a half a million flakes were collected during the 1981-82 field season. The bulk of this collection represents byproducts of lithic manufacture. By studying the various classes of lithic debitage we hoped to determine the various processes involved in the production of stone tools.

The debitage analysis of the 1981-82 Bug Hill collection was undertaken in two stages. Each stage was designed to address a different set of issues and each used a different sample of the collection to achieve this end. The first stage was designed to capture overall horizontal and vertical trends in flake distribution. The second was an analysis of lithic reduction techniques for Occupational Surfaces I and III. Each of these stages are discussed below.

Spatial Trends

The initial objective of the debitage analysis was to determine whether the proportional number of flakes varied between different sections of the site and/or between different strata. At this level no attempt was made to distinguish between primary, secondary and tertiary flakes. However, a distinction was made between different size classes of lithic debris so that we could assess whether the distribution of "small" flakes was the same or different than that for "large" ones.

Only two size classes of flakes were considered. The first consisted of flakes 1/2 in. or larger and the second was composed of flakes between 1/4 in. and 1/2 in. in size. The analysis consisted of counting and weighing the flakes for the various size categories by provenience. All flakes 1/2 in. or larger were examined whereas ten percent (by weight) of the smaller flakes were included in the analysis (see Laboratory Procedures).

To assess the horizontal and vertical flake distribution, the average number of flakes per provenience for each stratum was computed by the formula:

$$\bar{x}\ \text{stratum } i = \frac{\text{number of flakes in stratum } i}{\text{number of 10 cm provenience units in Stratum } i}$$

where, x is the mean number of flakes per 1 m by 1 m by 10 cm provenience per stratum. The results are presented in Table 14. Basically, the number and concentration of all flakes decreases with depth. The Southern Block contains consistently higher densities of flakes of all sizes than any other part of the site, whereas Locality A has somewhat lower than average proportions of flakes.

The relationship between the different size classes of flakes is graphically illustrated in Figure 49 (the plowzone results are not graphed). There is a strong linear relationship between the two classes (Pearson's r = 0.99), indicating that the proportion of the number of 1/4 in. to 1/2 in. in flakes to the number of 1/2 in. and larger flakes remains virtually constant both horizontally and vertically. Thus, in each time period, approximately five times more 1/4 in. to 1/2 in. flakes were produced than 1/2 in. or larger flakes.

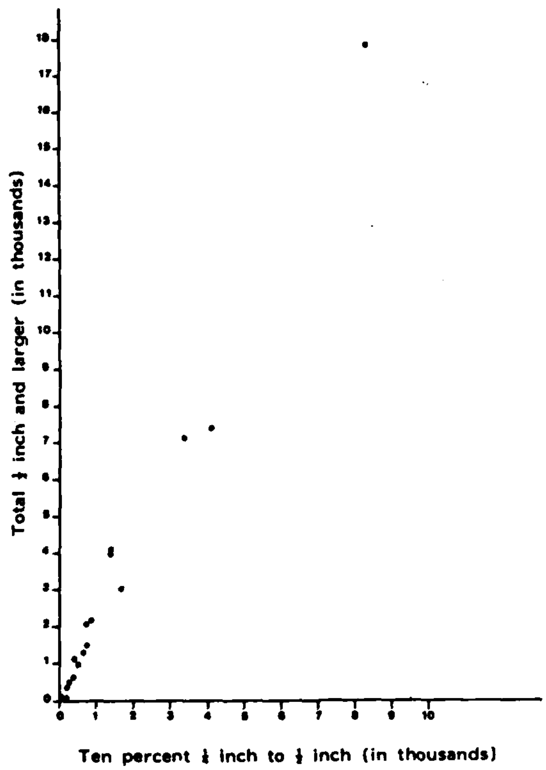


FIGURE 49. SCATTERPLOT OF THE NUMBER OF ONE-HALF INCH FLAKES VERSUS THE NUMBER OF ONE-QUARTER INCH FLAKES BY STRATA AND EXCAVATION UNIT FOR BUG HILL.

Debitage from the fill and floor of Occupational Surfaces I and III was also analyzed. The house fill and floor of Occupational Surface III contained roughly the same flake densities as the midden stratum (II) above. These figures are higher than the site average which suggests that more stone tool manufacture was conducted in this area

TABLE 14. LITHIC DEBITAGE.

	10 Percent 1/4 " Flakes	Mean # of Flakes per Provenience	100 Percent 1/2 " Flakes	Mean # of Flakes per Provenience
Southern Block				
Ip	9,189	53.1	16,696	96.5
Occupational Surface I	212	26.5	407	50.9
II	8,388	46.3	17,817	99.0
Occupational Surface III	3,340	39.8	7,247	86.3
III	882	10.5	2,197	26.2
IV	590	5.7	1,344	12.9
Central Block				
Ip	1,778	37.0	2,736	57.0
I	1,712	35.7	3,045	63.4
IIa	721	22.5	1,488	46.5
IIb	475	14.8	1,068	33.4
III	749	7.8	2,183	22.7
IV	118	2.5	398	8.3
Northern Block				
Ip	2,795	38.3	6,295	86.2
II	1,442	28.8	4,169	83.4
IV	37	1.9	113	5.7
Site Peripheries				
Ip	4,563	47.5	7,788	81.1
II	4,078	30.0	7,466	54.9
III	510	25.5	1,091	54.6
IV	236	2.8	526	6.3
Locality A				
Ip	80	10.0	259	25.9
II	468	11.7	1,212	30.3
IV	33	3.7	127	14.1
Total Site				
Ip	18,405	46.2	33,774	84.9
I	1,712	35.7	3,045	63.4
II	19,124	34.0	40,874	72.7
III	3,577	12.3	9,649	33.0
IV	1,014	1.1	2,508	9.5

than elsewhere. This conclusion is somewhat contra intuitive for it implies that people were making most of their tools inside their house and in the process depositing large quantities of flakes on the floor.

An alternative explanation is that most of the flakes in the field of Occupational Surface III post-date the destruction of Structure 2. This interpretation is supported by other data. In the section on chipped and groundstone tools, we noted that Occupational Surface III had the highest proportion (56 percent) of broken bifaces noted at the site. A relatively low percentage of these artifacts had been burned, thus, suggesting that they were deposited after the destruction of Structure 2 (see Chapter Fourteen).

In contrast to Occupational Surface III, Stratum II of Locality A is characterized by a smaller than average collection of lithic debitage. In the analysis of chipped and groundstone tools, we suggested that Locality A may have been a specialized hide-making area during the occupation of Structures 1 and 2. The low flake counts indicates that tool making activities were not taking place in this area; thereby adding strength to the interpretation that the tools found in Locality A reflect use.

Somewhat surprisingly the number and concentration of flakes from the fill of Occupational Surface I was exceedingly low. These results, together with the sparse lithic collection, may be indicative that the focus of this occupation was oriented away from lithic production.

Lithic Reduction

The analysis of lithic manufacturing techniques was confined to the debitage recovered from the floors (not including the fill) of Structures 1 and 2 (Occupational Surface III) and Structure 3 (Occupational Surface I). These "sealed" contexts provide the only strata that can be definitely associated with specific occupations. All flakes on the two house floors were analyzed separately to determine if lithic technology changed between the Early and Late Caddoan occupations.

We stressed "sealed" contexts because lithic reduction techniques identified from general midden contexts are extremely problematic. For instance, an analysis of the lithic debris from Stratum II of the Central Block would yield statements concerning the proportion of various stages of lithic manufacture. This stratum, however, dates between ca. 400 B.C. and A.D. 200, during which time the site was probably the locus of scores of occupations. None of these occupations can be isolated archaeologically. Thus, the lithic debris deposited within Stratum II may represent a number of different manufacturing processes.

The analysis of lithic debris from the house floors was based on a general lithic reduction sequence. This sequence begins with cores

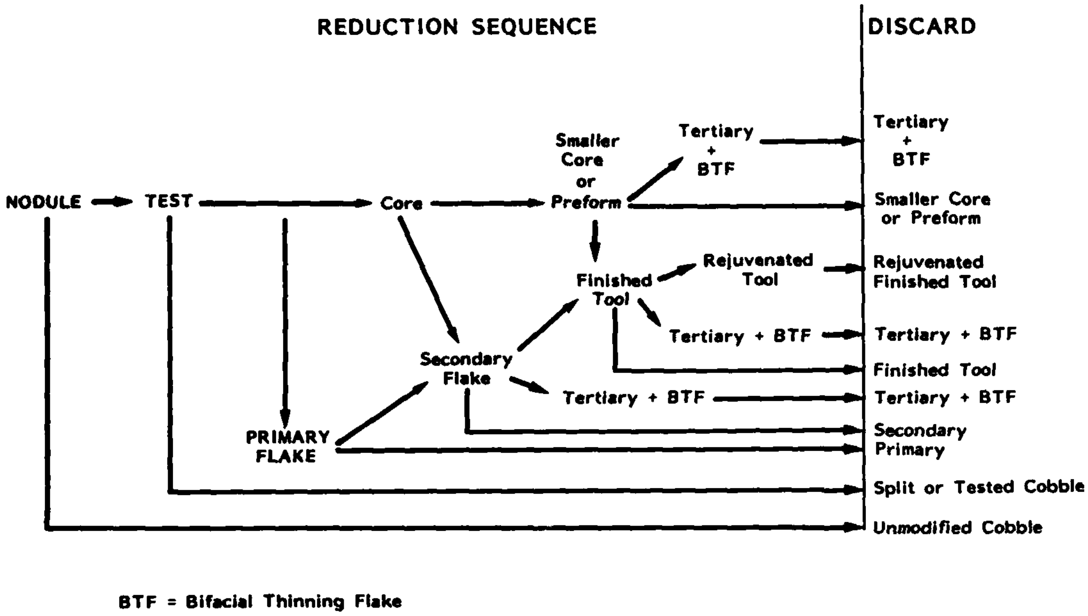


FIGURE 50. REDUCTION SEQUENCE FOLLOWED IN LITHIC ANALYSIS OF 34Pu116.

and proceeds in a subtractive process through primary, secondary, tertiary, and bifacial thinning flakes (see Figure 50). Flakes were first separated into the two size categories used in the previous analysis (1/4 in. to 1/2 in. and 1/2 in. and larger) and then classified into one of the five morphological categories. These categories follow relatively standard lithic analysis procedures and can be defined as follows:

Cores, those pieces of raw material from which flakes have been removed;

Primary flakes, these flakes display dorsal surfaces entirely covered by cortex. The ventral surface, of course, constitutes the flake surface;

Secondary flakes, these flakes exhibit both cortex and flake scars dorsally;

Tertiary flakes, these flakes exhibit a complete totally flaked dorsal surface;

Bifacial thinning flakes, These flakes are essentially a subcategory of the tertiary flake classification defined above. However, a separation is made on the presence of lipped bulbs of percussion, facetted platforms, and acute angles at the intersection of the dorsal surface and the platform.

Occupational Surface III: A total of 2197 debitage items were examined from the floor of Structures 1 and 2 (see Table 15). The results indicate a strong emphasis on the later stages of the lithic reduction sequence. Debitage larger than 1/2 in. constitutes only about 20 percent of the collection. Non-tool classes associated with the initial stages of tool manufacture, cores (3) and primary flakes (4), are only marginally represented. Tertiary and/or bifacially thinning flakes, by way of contrast, total 1897, or 86 percent of the non-broken materials. This is in substantial agreement with Vehik's figures (1982a) which also stress the importance of tool finishing at Bug Hill.

Breakage and platform destruction obscure both the exact number of tertiary flakes in the sample and the percentage of these flakes that can be defined as bifacial thinning flakes. However, it appears that bifacial thinning flakes make up sizeable majority of the flakes within the tertiary category. For example, of the 883 complete tertiary flakes, 639 (72.37 percent) could be positively identified as bifacial thinning flakes.

Primary flakes and cores, as noted previously, are conspicuous by their absence. In fact, the seven items in these two categories constitute only 0.32 percent of the total sample. Secondary flakes are somewhat more numerous, but still account for only about 13 percent of the floor debitage. The lack of material associated with the initial stages of lithic reduction does have some interesting implications for it implies very strongly that the reduction sequence is truncated. It appears that initial reduction was taking place away from Structures 1 and 2; perhaps in a quarry situation at some distance from Bug Hill proper or, at least, in some other area of the site.

Occupational Surface I: The lithic reduction sequence for the Late Caddo occupation of Structure 3 is truncated in the same fashion as that found for Structures 1 and 2. Of the 1784 flakes examined, only three cores and one primary flake were identified. Secondary flakes are more frequent but still only represent about 11 percent of the floor debitage. A relatively high proportion of the secondary flakes are larger than 1/2 in. in size.

Tertiary flakes make up the bulk of the collection. Most of these are small (less than 1/2 in.) broken flakes. Of the unbroken samples, over 85 percent are bifacial thinning flakes.

Taken as a whole, the evidence suggests a pattern of initial reduction occurring somewhere outside the immediate vicinity of Structure 3. Preforms and cores were then brought to the occupation area and finished stone tools completed.

Discussion

The debitage assemblages from the two occupational surfaces are remarkably similar. Both certainly reflect the dominance of bifacial

TABLE 15

LITHIC DEBITAGE FROM THE FLOOR OF STRUCTURES 1 AND 2 (OCCUPATIONAL SURFACE III) AND STRUCTURE 3 (OCCUPATIONAL SURFACE I).

	CORES	PRIMARY FLAKES	SECONDARY FLAKES				TERTIARY FLAKES				BIFACIAL THINNING FLAKES	TOTAL
			Whole		Fragmentary		Whole		Fragmentary			
			+1/2 in	1/4 to 1/2 in	+1/2 in	1/4 to 1/2 in	+1/2 in	1/4 to 1/2 in	+1/2 in	1/4 to 1/2 in		
Occupational Surface III	3	4	86	64	46	97	140	104	207	807	639	2197
percentage	0.2	0.2	3.9	2.9	2.1	4.4	6.4	4.7	9.4	36.7	29.1	100.0
Occupational Surface I	3	1	51	40	41	74	35	96	138	895	410	1784
percentage	0.2	0.0	2.9	2.2	2.3	4.1	2.0	5.4	7.7	50.2	23.0	100.0

tool production and the lack of materials associated with initial tool manufacture. This concern with the later stages of the reduction sequence was expected. However, the lack of primary flakes and anything but exhausted cores has some interesting implications regarding the acquisition of raw material and its probable source.

There is, for example, little evidence to support the notion that the locally available river cobbles were a primary source of raw material; not only are primary flakes lacking, but the very raw material is also missing. Indeed, visual inspection indicates that over 90 percent of the sample is high quality chert, nova-chert or novaculite from the Johns Valley Shale Formation (see Chapter Seven). The remaining pieces are more coarsely grained and internally fractured. These are similar in quality to the chert generally available as river cobbles.

Although no river worn cobbles were noted on the occupational floors, ten were identified in the fill of Structures 1 and 2 (eight had been identified as split or tested cobbles and two had been classified as blocky debris). All ten cobbles were relatively large and had only minor modification. In contrast, specimens identified as cores from the same context were generally small (5 cm or less in length) and had multiple flake removals. All cores from the fill derived from the Johns Valley Shale Formation and appear to have been continually worked so that the pieces discarded were by-and-large exhausted cores.

The implication of the study of cores and cobbles is the same as that derived from the debitage analysis. Initial reduction took place away from the Caddoan structures. Possibly the initial reduction stage could have been performed elsewhere on the site, but it is more likely that it occurred at the source of the raw material. Cores and preforms were then brought back to the site for finishing. River cobbles were collected and supplied a minor supplement to the quarried chert. However, since most river worn chert was of such poor-quality most of these cobbles were merely tested and discarded. Little evidence of change in lithic technology or manufacturing processes were noted between the two Caddoan occupations. Whether this stability also characterized the Woodland and Late Archaic occupations is unknown.

We should point out that this interpretation differs significantly from previous ones (Bobalik 1977; Vehik and Galm 1979; Vehik 1982a, 1982b). Over the past ten years, investigators have consistently argued that all stages of lithic manufacture were taking place at sites like Bug Hill. We feel these arguments have failed to appreciate the importance of the Johns Valley Shale Formation. If we are correct, then it is possible that an entire category of site type, lithic procurement and initial reduction station, has been missed and should be found running parallel to the chert bearing formations. This topic will be pursued in depth in Chapter Seven.

CHAPTER SEVEN

LITHIC RESOURCES

by

Larry D. Banks

INTRODUCTION

One of the most obvious conclusions of the analysis of chipped stone artifacts was that irregardless of possible changes in site function or social organization over time, the residents of probably every occupation at Bug Hill from the Late Archaic through the Late Caddoan period spent a considerable amount of time producing stone artifacts. It was of some importance, then, to determine the location and nature of the raw material sources that were used and if these sources changed over time. To this end, a three staged analysis of the lithic raw materials used by the prehistoric inhabitants of Bug Hill was conducted.

The first stage involved an initial laboratory visit at which time 376 artifacts were studied in sufficient detail to identify the chert types represented. Also during this visit all other trays of lithic artifacts (numbering into the tens of thousands) which had been cleaned and catalogued were scanned for possible exotic and typical pieces. A cursory examination of these pieces produced results no different from the 376 individual identifications of selected materials. The net result was that the overwhelming majority of pieces were from material types indigenous to the Ouachita Mountains, if not from the Jackfork Valley.

The second stage in the analysis was to map the chert producing formations within the Jackfork Valley and the immediate surrounding area. This stage involved examining and sampling chert formations throughout the western Ouachitas. While two field trips were made specifically to the Jackfork Valley, much of this work has been conducted over a 15 year period by the author. The results of this analysis are presented in Appendix II.

Once the formations were mapped the analysis proceeded to the third and final stage. Artifacts from four analytical strata were analyzed. The strata represented occupations dating to the Middle Archaic, Late Archaic, the Early Caddo occupation of Structure 1 and 2 and subsequent Caddo occupation of the Southern Block.

PREVIOUS INVESTIGATIONS CONCERNING LITHIC RESOURCE IDENTIFICATION AND UTILIZATION

The first contemporary references to chert procurement in the Sardis project area was based on Neal's (1972) initial reconnaissance. Although it was not mentioned in the report, Neal (personal communication 1972) suggested that site 34Lt24 was a possible lithic procurement workshop area utilizing local gravels. Neal thought a gravel source was being utilized because of cortex found on the debitage. The site was located on a small poorly developed terrace on Anderson Creek.

The first substantive archaeological literature published on the Jackfork Basin dealt with the testing of 31 sites, identified by Neal and Drass. In this report Bobalik (1977:31-44) devotes a chapter to the lithic industry in general and to the identification of lithic types (including chert) specifically. She reports eight distinguishable varieties of chippable stone and nine material classes (Type A, Bigfork chert, Zipper chert, quartzite, siltstone, novaculite, schist, Green novaculite, and quartz), all of which are known for the Ouachita Mountain region. Several of these materials were collected from the creeks in the research area. Based on this and the fact that the cortex for most of the material is smoothed, Bobalik concluded that the prehistoric inhabitants were using stream gravels (Bobalik 1977:31-44).

One year later Bobalik (1978) reported on the results of an excavation at the multi-component Sallee-G site (34Pu99), located near the Dam site. The local materials referred to by Bobalik (1978:182) are the same chert types identified in the 1977 report, but the report on site 34Pu99 contains five additional types (shale, slate, jasper, Boone and Type B). The Boone variety is not indicated as being present in the Pre-Caddoan component lithic assemblage and is represented by only one artifact in the Caddoan component (Bobalik 1978:161, 182).

The fourth volume of archaeological investigations for the Sardis Lake Project described the Phase I excavations at eight sites (Vehik and Galm 1979). Lintz (1979a: 28-37) provided the most detailed description of chert types up to that date. He succinctly discussed the problems with chert identifications in the Ouachita Mountains and used a comparative collection for discussing 11 basic categories comprised of 30 individual types. Also included were four types exotic to the Ouachita Mountains but which appeared to be represented in the recovered archaeological materials. The varieties of Woodford and perhaps other types similarly affected by weathering are included in Lintz's Type A.

A review of pertinent sections of the Phase I report (Vehik and Galm 1979) is particularly critical in understanding the utilization of the chert resources and the interpretative role for the resources. A summary of the conclusions from the various investigators (Lintz, Bobalik, Galm, Vehik, Flynn and Earman) can be stated as:

a. The chert represented in the sites is of local origin with slight, if any, evidence suggesting the introduction of non-local materials;

b. The cherts being utilized were from stream or terrace cobbles as evidenced by weathered cortex;

c. The eight sites and all cultural components represented suggest that they were used as tool-manufacturing maintenance areas;

d. The Type A chert (Lintz) represented the highest percentage of material in the sites.

GEOGRAPHIC SETTING

To interpret the uses of and the role played by lithic materials in the different cultural components represented at the Bug Hill site (34Pu116), several of the basin's environmental characteristics must be considered. The site is located near the western edge of the more open portion of the elongated east-west valley of the Jackfork drainage basin bordering the southern edge of the Winding Stair Range of the Ouachita Mountains (Figure 51). Across this range to the north lies the Gaines Creek basin of the South Canadian system. To the west of Bug Hill at a distance of about 4 km (2.5 mi) the Jackfork valley narrows rapidly from a width of about 5 km (3 mi) to 1.6 km (1 mi) because of the presence of Middle Mountain which separates North Jackfork Creek from the main stem Jackfork. North Jackfork and the upper drainage of Jackfork Creek proper flow northeastward and parallel to each other on the north and south sides, respectively, of Middle Mountain. The extreme upper end of the Jackfork Valley grades imperceptibly into the Forbes Creek Valley of the Buck Creek drainage basin which, like Jackfork Creek, is also a tributary of the Kiamichi River.

About 3.3 km (2 mi) north-northwest of the Bug Hill site the northeastward flow of North Jackfork Creek turns abruptly to the southeast and flows through a narrow chasm between Middle and Wolf mountains. This natural constriction is appropriately called the

Major Chert Sources: Jackfork and Brushy Creek Basins

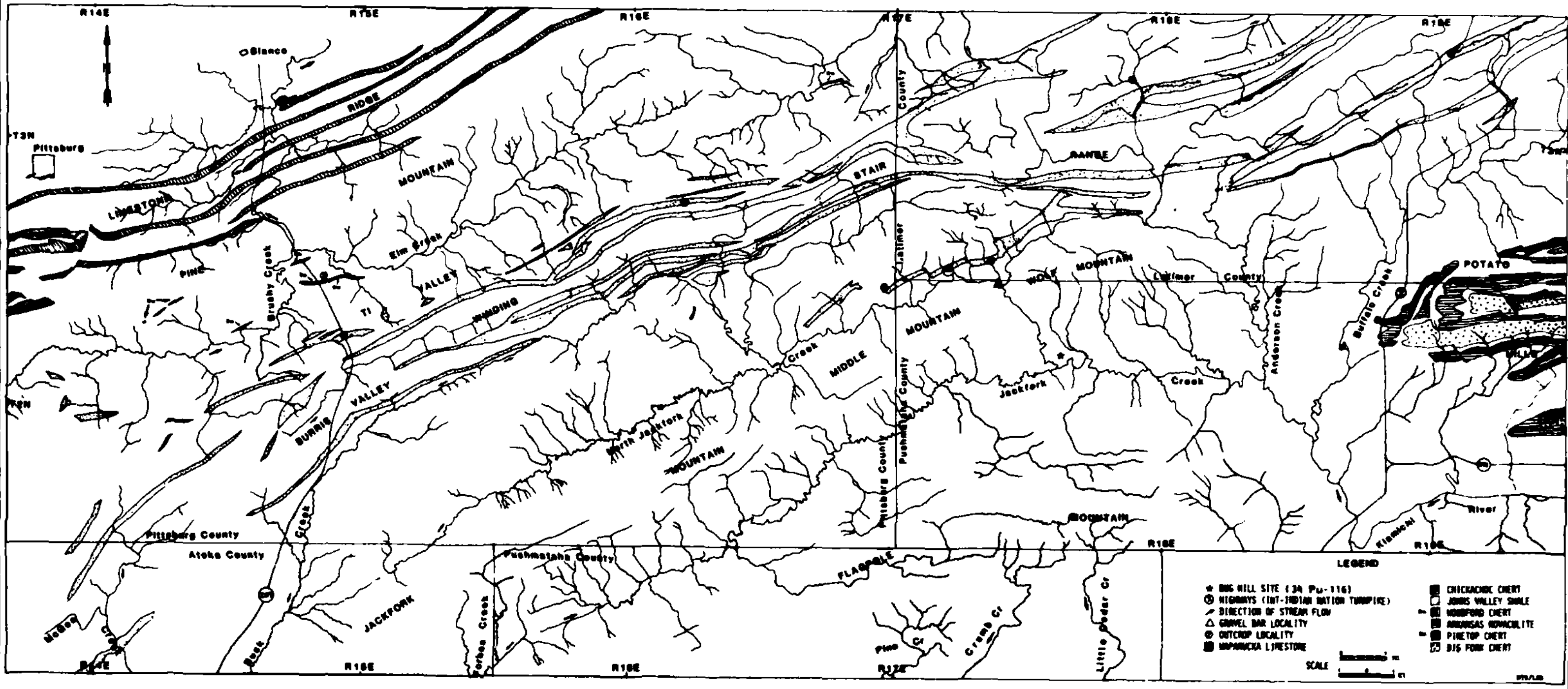


FIGURE 51. MAJOR CHERT SOURCES OF THE JACKFORK AND BRUSHY CREEK BASINS.

"Narrows" by local inhabitants (Figure 51). From this point the North Jackfork continues southeastward to its confluence with the Jackfork 1.2 km (.75 mi) west of the Bug Hill site.

At the opposite end of the Jackfork Valley, about 11.2 km (7 mi) to the east of the Bug Hill site, the Potato Hills rise above the valley floor forming its eastern boundary. The Buffalo Creek Valley continues further eastward on the north side of the Potato Hills, but for all practical purposes the western edge of the Potato Hills serve as the eastern demarcation of the Jackfork Valley. Jackfork Creek enters the Kiamichi River near this point, at River mile 107.

Other well-known structural features which figure prominently in geologic discussions of the western Ouachita Mountains and which have relevance to this study are Black Knob Ridge, Limestone Ridge, and Pine Mountain. Of the three, the latter two are shown in Figure 51. Black Knob Ridge begins some 17.6 km (11 mi) to the southwest of the southwesternmost corner of the study area shown in Figure 51, and extends on to southwest for a distance of 15.2 km (9.4 mi) to Atoka, Oklahoma.

Limestone Ridge and Pine Mountain both serve as boundaries which enclose the next major basin to the northwest of the Jackfork. That basin (Brushy Creek), however, is a tributary of the South Canadian system, and not the Kiamichi. Its sharing of lithic types with the Jackfork should be of significance in the lower South Canadian drainage.

In addition to the geologic structures which produce the chert, other geographically related features such as direction of stream flow, the terrain, and access between any given site and chert producing areas are important elements in interpretation of the uses of lithic materials. There are few, if any, places within the Ouachita Mountains which are totally inaccessible by foot traffic. But, as reflected in the journal of La Harpe, the Caddo (Wedel, in preparation) used established trails or "roads" through the mountains and certainly many portions of the rugged, craggy, and locally high-relief areas were avoided. Unquestionably, routes of easiest accessibility were sought out and used for all types of resource exploitation including chert.

It is also appropriate here to mention another aspect of the geography which should reflect not only upon the study of lithic resources but all others as well. Because the Jackfork Valley seems to be a more-or-less "closed system" as a result of the surrounding mountains, we have a tendency, perhaps unconsciously, to view the "archaeology" also as related only to the Jackfork Valley. This somewhat gratuitous assumption severely limits our ability to interpret the archaeological record. Consequently, a broader regional area must be considered for ultimate interpretation of the cultural uses of the archaeological sites which, of course, include lithic resource activities. What was the relationship, if any, between sites on the Jackfork, on the Kiamichi River, and even on the Red River? How would this relationship be reflected in lithic materials? Was the lower Jackfork the primary route of access from and to the Kiamichi Valley or was the Buck Creek Valley which enters the Kiamichi some 54.4 km (34 mi) farther downstream used?

Forbes Creek, which was mentioned previously, is the tributary valley of Buck Creek which logistically connects the Jackfork and Buck Creek valleys. For several kilometers, the lower Buck Creek flows through an extremely narrow and rugged valley, but is traversable. If an individual(s) was attempting to enter the Jackfork Basin from the lower Kiamichi Valley and particularly that reach which includes the Bug Hill site, use of the Buck Creek route would be some 8 km (5 mi) shorter than going on up to the mouth of the Jackfork and then having to essentially backtrack to the Bug Hill vicinity. It should also be noted that the most important lithic resource, the Johns Valley Shale, crops out in the upper Buck Creek Basin as it does in the Jackfork.

MAPPING THE LITHIC RESOURCES

The field data on which this study is based results from cumulative examinations and collection of chert specimens over a 15-year period by the author. In specific relationship to this study, however, exposures of the Big Fork and Arkansas novaculite formations were re-examined at Black Knob Ridge, and exposures of the Wapanucka limestone and Chickachoc chert south of Pittsburg and Blanco were examined for the first time. Exposures of Woodford-Pinetop formations were re-examined. Five separate exposures of the Johns Valley Shale and the westernmost outcrops of the Arkansas Novaculite in the Potato Hills were examined, and lastly, gravel deposits in North Jackfork and Buffalo Creeks were sampled. With the exception of the exposures at Black Knob Ridge, which are not shown on Figure 51, the localities are numbered and discussed in sequence from west to east but not in any given order of priority or sequence of examination. The letter designations used in Figure 51, for the Woodford and Pinetop formations follow those used by Hendricks et al. (1947).

The chert specimens were examined megascopically from visual analysis and use of a 10x hand lens. The color descriptions are based on the Rock Color Chart (Geological Society of America 1970), which include select chips from the Munsell system.

The complete Munsell Book of Color (1970) was not available. Consequently the coloration indicated for the specimens described is not as precise as possible. Color indices were determined on dry specimens and under natural light.

Measured sections of the formations were not taken. The field examinations were made on 20-21 May 1982 and on 11 October 1982 after a second visit to the New World Research laboratory for examination of additional artifacts.

Classification of Chert Types

The chert formations and type of materials in the Ouachita Mountains have been subjected to technical analyses of various types since the first quarter of the 19th century. These studies have been progressively refined in many respects, but there are still a number of unresolved issues centering around the chert producing formations. In fact, until recently there has been an absence of an appropriate classification system for chert types in the geological sciences upon which petrographers could agree. The flurry of geological interest in the Arkansas and Caballos novaculites, however, has been instrumental in the development of a classification system which can be uniformly applied to chert studies in general.

The classification system relied upon in this study was initially defined by Folk (1965, and reprinted in 1974), modified by McBride and Thomson (1970) and used by Bowers (1975) and Sholes (1978). Debates between petrographers over classifications may last indefinitely. At least they are still going on at this time, but the previously referenced system appears to be the best in existence. Shole's work is of particular relevance to this study because of his detailed analysis of rock types at some of the same outcrops examined for the Bug Hill investigation.

As reported by Sholes (1978:58-59) in relation to his novaculite studies, McBride and Thomson's (1970:46) modification is as follows:

Chalcedony: Quartz with a radiating fibrous structure.

Chert: A sedimentary rock composed predominantly of UFG to CG microquartz and chalcedony.

Megaquartz: Quartz grains larger than 35 microns.

Microquartz: Quartz grains smaller than 35 microns. Microquartz is subdivided into the following grain size classes:

Coarse grained (CG)	= 25-35 microns
Medium grained (MG)	= 15-25 microns
Fine grained (FG)	= 10-15 microns
Very fine grained (VFG)	= 5-10 microns
Ultra-fine grained (UFG)	= less than 5 microns.

UFG microquartz is cryptocrystalline.

Novaculite: Chert that has a milk-white color in hand specimen.

Sub-novaculite: White and off-white chert that is not milky.

Since Folk (1974), McBride and Thomson's (1970) classification of novaculite was based upon the rock types of the Caballos formation in southwest Texas, it is understandable why their definition of color for novaculite is limited to "white, or off-white." However, such a restriction does not suffice for classification of novaculite types in the Arkansas Novaculite Formation even though the two formations are lateral equivalents.

Sholes (1978:61) discusses the need for additional modification of McBride and Thomson's definition of novaculite on the basis of color and emphasizes the inappropriate but continuing need for the "novaculite" appellation. He then (1978:62-63,67) defines novaculite as a

> "chert that is generally light-colored, but is locally black, that is translucent only on thin edges, is even-textured and has a gritty rather than glass-smooth fracture surface, and is characterized by a nearly complete dominance of microquartz over chalcedony."

Also, Sholes uses highly technical analyses in differentiation between chert and novaculite, both of which occur in the Arkansas Novaculite Formation. In summation the chert is defined by Sholes (1978:75-78) as:

> "a rock consisting mainly of microquartz of variable grain size which locally contains chalcedony and megaquartz. Chert is interbedded with shale in the lower, middle, and upper chert and shale members of the Arkansas Novaculite in Arkansas and McCurtain County, Oklahoma, and throughout the formation in Black Knob Ridge, the Potato Hills, and the northern facies of Arkansas. Chert in the Arkansas Novaculite is dominantly gray to black, but is locally green (5BG5/2, 5GY7/2) and light to medium bluish gray (5B7/1-5/1). Chert is commonly color banded. Siliceous shale is a field term used to name clayey cherts or siliceous clays that break into blocks rather than plates and that are dull and opaque rather than shiny and translucent. Silt, sand, and granule conglomerate laminae up to 2 cm thick are locally present in chert beds. Radiolaria are the dominant fossils, but palynomorphs are present in Black Knob Ridge and the Potato Hills. Sponge spicules are locally present and the dominant fossil in the lower part of the formation in Black Knob Ridge. Some chert has pelletal texture."

In personal communications (September 1982), Sholes has expressed his belief that the grain-size differentiation for distinction between chert and novaculite in the Arkansas Novaculite Formation is reliably consistent.

The Chert Producing Formations

In the Ouachita Mountains there are 12 individual geologic units (Table 16) which are known to contain chert in varying quantities and quality. The units vary from being actual chert formations to shales and limestones with chert stringers or lentils. Even the lentils, however, are generally persistent enough to serve as marker beds. In addition to actual chert, two of the listed geologic groups, the Jackfork and Stanley, are also the principal producers of quartzite (more commonly referenced geologically as quartzitic sandstone). In addition to chert and quartzites, the Stanley also contains the Hatton tuff which is a principal rock type used for manufacturing polished celts. However, the tuff only occurs in the Stanley beds in McCurtain County and in western Arkansas. The presence of tuff artifacts in the Bug Hill collection would definitely be indicative of ties with that section of the Ouachitas to the southeast. Given the frequency of celt representation in collections from the Red and Little River basin Caddoan sites, the celts should also be present in the Jackfork Basin if similar subsistence strategies were employed and there were direct contact between the Jackfork and Little River or Red River sites. Hatton tuff artifacts should be expected in the Jackfork Basin, especially in Caddoan components.

The Stanley and Jackfork groups are also the dominant producers of quartz crystal in the Ouachita Mountains. The only known source of diorite in the Ouachita Mountains, which is often represented in celt form, also occurs only in the southernmost edge of the Ouachita Mountains in the Glover Creek Basin (Honess 1923:210; Banks and Winters 1975:33).

TABLE 16. STRATIGRAPHIC COLUMN OF CHERT PRODUCING FORMATIONS.

PERIOD	SERIES	GROUP	FORMATION	MEMBER
Pennsylvanian	Atoka-Morrowan		Atoka	
	Atoka-Morrowan		Chickachoc	
	Atoka-Morrowan		Wapanucka	
Mississippian	Chesterian	Jackfork	Markham Hill	
	Chesterian	Jackfork	Wesley	
	Meramecian	Stanley	Chickasaw Creek	
	Meramecian	Stanley	Moyers	
	Meramecian	Stanley	Ten Mile Creek	Battiest
Devonian			Woodford	
			Arkansas Novaculite	
Silurian			Pinetop	
Ordovician			Big Fork	

Results

The fieldwork resulted in a map of the chert producing formations of the Jackfork Valley and surrounding region (Figure 51). The data on which this map is based are presented in Appendix II.

For purposes of understanding prehistoric use of lithic raw materials at Bug Hill and the Jackfork Valley two important points need to be considered. First, almost all chert types available in the western Ouachitas occur naturally in the Johns Valley Shale formation. Not only do most chert types occur in this formation, but the chert itself is also of extremely high quality and easy to quarry. This formation overlies the Jackfork group and crops out in a series of disjointed and discontinuous exposures that follow the trend of the Winding Stair Range. Although known to geologists, this formation has been totally ignored up until now by archaeologists as a potential source of lithic raw materials.

The most realistic explanation for the past lack of recognition of the significance of this formation in relation to prehistoric lithic resources is two-fold. First, the formation is not a "chert" formation. Although the Johns Valley, Markham Hill and Caney (or Delaware Creek) shales have long been known to produce chert cobbles and boulders by geologists, they have tended to be unexamined by archaeologists because it has always seemed more likely to find exploitable concentrated chert sources in chert rather than shale formations. It has been assumed that the same or similar types of chert cobbles or boulders persistent enough to be a lithologic type common to most exposures of a shale formation would be erroneous more often than not.

Second, under natural conditions the Johns Valley formation is poorly exposed stratigraphically, and is almost completely obscured by dense vegetation in most areas. A comparison between natural ground cover, burned over and overgrazed exposures is enlightening. During this study, several areas remaining under natural coverage were examined. In each case lithic debris could be found beneath the forest humus and thick grasses although even the common erratic boulders tended to remain unnoticeable.

The second point to consider concerns stream gravels. All previous investigators in the project area considered the chert gravels in the alluvial terraces and gravel bars of existing streams to be the principal sources of raw material origin. These hypotheses were based on the facts that: (1) chert cobbles of the same material as the artifacts were obtainable in local streams; (2) the debitage and portion of some artifacts exhibited weathered cortex typical of stream gravels; and (3) cobbles are perhaps one of the most commonly accepted (by archaeologists) sources of chert for tool production by cultures of all time periods.

In the Jackfork basin stream cobbles were examined at the "Narrows" of North Jackfork Creek, above the Bug Hill site, and on

Buffalo Creek. The two areas were selected because they are strategically placed, geomorphologically, in relationship to the basic chert outcrops from which most of the stream gravels could have been derived.

The general impression derived from examination of the modern stream gravels was that most of the larger chert gravels and cobbles are so brittle and so highly fractured that systematic reliance on gravel bars for use as sources of stone tool production would have been negligible in comparison to use of the easily accessible and more productive outcrops of the Johns Valley shale. This would be especially true if production of chert raw materials in an appreciable quantity and quality was a primary objective of any given culture as it would be if chert resources were a factor in the determination of settlement patterns.

IDENTIFICATION OF BUG HILL ARTIFACTS

After completion of the fieldwork, a representative collection of the raw materials was used for comparison with the artifacts selected for identification by Dr. Jeffrey Altschul. The artifacts included complete and broken tool forms in various stages of manufacture or resharpening, cores, some debitage and a couple of fractured gravels. The results of the analysis are presented in Tables 17 through 20. This does not include the 376 artifacts examined on the first trip to NWR Research Facilities on May 11, 1982. The analysis of the chert artifacts focused on four strata: Stratum II, Southern Block (Early Caddo); Stratum III, Southern Block (Late Archaic); Stratum IV, Central Block (Middle Archaic); and Occupational Surface III, Southern Block (fill of structures 1 and 2 dated between ca. A.D. 900 and 1050...Early Caddo). Artifacts from Stratum IV of the Southern Block were also examined, but are not discussed here because most appear to be intrusive from Occupational Surface III located directly above (Jeffrey Altschul, personal communication, 1982).

On the laboratory worksheets an attempt was made to use the traditionally accepted format of typing the materials to their geologic source or primary origin, i.e., Big Fork, Pinetop Formations, etc. Several problems with this approach occurred however. The artifacts were sorted by stratum provenience, listed by catalogue number and described individually by material type. In Tables 17 through 20 the individual descriptions by catalogue number are omitted. As shown in the tables the results could easily be misconstrued without discussing the problems, and attempted solutions, with the geologic nomenclature.

With few exceptions the listed lithic types can all be found in the Johns Valley shale regardless of the primary source of origin. It may be geologically important to be able to identify the specific sources of primary origin before being transported and redeposited in the Johns Valley shale, but archaeologically such a listing could be misleading to say the least. As shown the specific listing would imply that a more geographically widespread pattern of chert procurement was employed at Bug Hill than that which was actually used. The predominant chert types listed in the tables do not even exist within the Jackfork drainage basin. In reality the procurement was almost solely one of exploiting local raw materials. The Johns Valley shale deposits are not only more geographically accessible but the redeposited chert types in them are a much higher quality of raw material for tool production than the same chert beds in their respective original deposits. This is generally true for production of even smaller tools but especially so for those in excess of seven or eight centimeters in length.

TABLE 17. RAW MATERIAL IDENTIFICATION--SOUTHERN BLOCK OCCUPATIONAL SURFACE III.

Parent Formation/ Chert Type	Probable Formation Exploited by Residents of Bug Hill	Number of Specimen	Percentage Total
Wapanucka		0	0
Chickachock		0	0
Siliceous Shale	Atoka Jackfork Stanley	4	4.6
Quartzite Jackfork Stanley	Johns Valley (also, possibly Jackfork and Stanley)	11	12.5
Wesley	Johns Valley (?)	8	9.1
Battiest	Stanley	0	
Chickasaw Chert	Johns Valley (?)	0	
Nova-Chert	Johns Valley	38	43.2
Arkansas Novaculite	Johns Valley (except for green novaculite)	6	6.8
Pinetop	Johns Valley	11	12.5
Big Fork	Johns Valley	7	8.0
Claystone	Johns Valley	0	
Siltstone	Johns Valley	0	
Petrified Wood	?	0	
Unidentified	?	2	2.3
Johns Valley Shale	Johns Valley	1	1.0
Totals		88	100.0

TABLE 18. RAW MATERIAL IDENTIFICATION--SOUTHERN BLOCK STRATUM II.

Parent Formation/ Chert Type	Probable Formation Exploited by Residents of Bug Hill	Number of Specimen	Percentage Total
Wapanucka		0	
Chickachock		0	
Siliceous Shale	Atoka Jackfork Stantley	0	
Quartzite Jackfork Stanley	Johns Valley (also, possibly Jackfork and Stanley)	14	9.2
Wesley	Johns Valley (?)	11	7.2
Battiest	Stanley	1	0.6
Chickasaw Chert	Johns Valley (?)	0	
Nova-Chert	Johns Valley	63	41.2
Arkansas Novaculite	Johns Valley (except for green novaculite)	12	8.0
Pinetop	Johns Valley	11	7.2
Big Fork	Johns Valley	27	17.6
Claystone	Johns Valley	1	0.6
Siltstone	Johns Valley	1	0.6
Petrified Wood	?	2	1.2
Unidentified	?	4	2.6
Johns Valley Shale	Johns Valley	6	4.0
Totals		153	100.0

TABLE 19. SOUTHERN BLOCK STRATUM III.

Parent Formation/ Chert Type	Probable Formation Exploited by Residents of Bug Hill	Number of Specimen	Percentage Total
Johns Valley Shale	Johns Valley	1	14.2
Quartzite Sandstone Jackfork Stanley	Johns Valley (also, possibly Jackfork and Stanley)	2	28.6
Nova-chert	Johns Valley	2	28.6
Novaculite	Johns Valley (except for green novaculite)	2	28.6
Total		7	100.0

TABLE 20. CENTRAL BLOCK STRATUM IV.

Parent Formation/ Chert Type	Probable Formation Exploited by Residents of Bug Hill	Number of Specimen	Percentage Total
Nova-chert	Johns Valley	6	75.0
Novaculite	Johns Valley	1	12.5
Pinetop	Johns Valley	1	12.5
Total		8	100.0

The clarification of terminology needed for the types listed in the tables here stems from three basic factors.

First, the nomenclatural problem of chert types in the Johns Valley shale as discussed above is not satisfactorily resolved.

Secondly, criteria for distinguishing the black, gray and blue-gray cherts of the Arkansas Novaculite formation from the black and gray cherts of the laterally equivalent Woodford formation are not distinctive enough to allow precise distinction with an appreciable degree of reliability. Subsequent to a discussion with Dr. Mark Sholes concerning the chert members of the Arkansas novaculite the decision was made to incorporate the Woodford cherts in a category with similar cherts from the novaculite formation. The term used to designate those materials, for lack of anything better, is nova-chert.

Thirdly, the number of specimens listed as an "unidentified" category is composed of artifacts which have been burned, coated with a soot-like residue or so severely altered by weathering that precise identifications cannot be made. However, all of them appear to be of the same local materials as the identified types.

In addition to the physical properties previously described for the raw materials used for comparative analysis the following descriptions are provided:

Siliceous shale: Color ranges from medium to dark gray and black. Although this rock is chippable, the fracture tends to be more brittle than conchoidal. It is opaque even on thin edges. It has a dull luster and weathers light gray, brown or red. The siliceous shale is probably from the Jackfork and Stanley groups, but it occurs also in the Atoka and possibly other formations. The real problem is that the siliceous shales lack distinguishing features needed to identify any particular formation from which the specimen may have been derived. Shale lamination and the lower silica content distinguishes the siliceous shale from the various chert stringers in the same formations.

Quartzitic sandstone: Color ranges from light-medium-dark gray to dark blue gray. Very fine to coarse grained. The finer grained specimens exhibit better conchoidal fracture, of course. The rocks are opaque, generally have a dull luster but infrequently a sheen is present, which is usually a reflection of light from quartz grains. The rocks exhibit massive structure and rarely exhibit laminae.

Siltstone: Siltstone as a source for stone tool production is defined as silt-sized (less than 0.074 mm) particles. The rock is well indurated, and often exhibits poor conchoidal fracture. It is totally opaque, and occurs in color variations from light-ashy gray, tan, brown, and red. The luster is dull to earthy. The basic visual distinction from claystone is based on particle size and texture.

Claystone: Claystone is composed of particles less than 0.01 mm. Like the siltstone, it is well indurated and has relatively poor conchoidal fracture in comparison to chert. It too is totally opaque. It varies in shades of tan, yellow, brown and red. The luster is usually dull or earthy but may be slightly vitreous. As mentioned in the discussion of cherts in the Johns Valley formation a number of cherts will weather to a siltstone or claystone-like texture. These specimens could have been derived from the Johns Valley deposits or from local stream cobbles. "Siltstone and claystone" pebbles frequently occur in the Kiamichi and Red River gravels. It is quite possible, however, that some of the pebbles and artifacts so identified in this study which exhibit properties of both silt and claystones are actually highly weathered chert.

Big Fork Chert: The Big Fork classification used here is based solely on specimens collected from the outcrops at Black Ridge east of Atoka and in the eastern edge of Stringtown, Oklahoma. The outcrops described by Miller (1955:12) as being "black" are not included. Since Miller did not use a color chart index it is possible that the term "black" is a relative term as used. The chert is described by Miller is possibly black rather than dark chocolate brown, but actual black chert was not observed in Big Fork outcrops during this study. Mark Sholes (personal communication, 1982) stated that clear separation of the Novaculite and Big Fork beds in certain areas of the Potato Hills was difficult. Based on specimens obtained in this study, the Big Fork is quite similar to the Woodford/Nova cherts with respect to general diaphaniety, luster, and tightly cemented laminae. The basic distinctions are in color. The Big Fork varies from light to medium gray (N6 to N7), brownish gray (5YR4/2), grayish brown (5YR3/2), and moderate brown (5YR5/4). It varies widely from a dull to vitreous luster in a fresh break. The fracture is brittle in bedded deposits but cobbles in the Johns Valley shale have excellent conchoidal fracture. The Big Fork is consistently opaque. The texture is fine grained to aphanitic.

Arkansas Novaculite: The cryptocrystalline silicates in the novaculite formation have been divided here into two separate categories for discussion purposes. The novaculite is defined as gritty but fine to medium grained, generally opaque but may be translucent on thin edges. The luster is usually dull under natural conditions, but is sometimes waxy. The fracture is conchoidal and it ranges in color hues of whites, grays, black, red, or yellow. The color range in the Western Ouachitas is not as extensive as it is near Hot Springs, Arkansas.

Nova-chert: This is a term coined for this report to include the cherts in the Arkansas novaculite formation (as differentiated by Mark Sholes 1978:75-78) and the laterally equivalent Woodford chert. The reason for combining the Woodford with the nova-chert is because of the temporary inability, hopefully, to provide positive distinction between the black chert of the novaculite at Black Knob Ridge and the Woodford at the Pinetop locality. The distinctions are even more difficult in the exotic cobbles and boulders of the Johns Valley shale which contains both types. The nova-chert category includes the mottled and often laminated light-medium-dark gray, blue gray, and black cherts which have excellent conchoidal fracture. Most of the nova-cherts exhibit translucency on thin edges which may be a possible distinction from the opaque Woodford, but as evidenced at Black Knob Ridge the black nova-chert is also opaque. The nova-cherts vary from dull to vitreous in luster. The very minor percentages of the lighter colored and more translucent varieties at Black Knob Ridge appear to have been much more extensive in the deposits which contributed the cobbles and boulders to the Johns Valley sediments. The nova-chert category also includes the green, yellow, brown and blue-green laminated chert exposed at Black Knob Ridge and the Potato Hills. This variety of chert from the Arkansas novaculite has not been observed in the Johns Valley deposits, nor to my knowledge in the other outcrop areas of the formation such as in McCurtain County. The green-yellow-brown and blue-green varieties are conspicuous by their absence in the Johns Valley deposits. Perhaps the green coloration results from in-place weathering which occurred subsequent to the Johns Valley shale deposition and to the Ouachita orogeny.

Wesley: The Wesley category includes the nonspicular gray-black cherts which lack both the distinctively abundant spicules of the Chickasaw Creek and the quartz-filled veins and waxy luster of the Battiest. The Wesley usually exhibits a dull luster and poor conchoidal fracture. Some of the Wesley cherts often exhibit gray and white spicules sprinkled in roughly horizontal alignment but they have not been observed to be a predominant characteristic as in the Chickasaw Creek. It is possibly some overlap occurs in this distinction between the Wesley, the Chickasaw Creek, and even the Atoka formations, but the possible differences would not alter the interpretations of cultural uses.

Results

The results presented in Tables 17 through 20 are not particularly revealing by themselves. In fact as mentioned earlier they may be more misleading than enlightening. Because of the decision to combine several chert types in the nova-chert category other researchers could have difficulty in attempting to correlate future studies with the results of this one. For this same reason precise correlations with the results of the previous lithic studies in the Jackfork basin (Bobalik 1977, 1978; Lintz 1979a, 1979b, 1979c, 1979d; Vehik 1979a, 1979b) were not possible. However, when the percentages of chert types listed by Lintz as Type A (essentially the nova-cherts in this report) are combined with Big Fork, there are some relatively close parallels between Bug Hill and other sites such as the Blessingame site (Lintz 1979c:327).

A comparison of the percentages shown in Tables 17 through 20 in this report for the different strata suggests that a greater selectivity for chert procurement was involved during the Middle and Late Archaic stages. A more realistic interpretation, however, is that the available sample size for these strata (III and IV) is simply too small to allow for reliable statements concerning selectivity.

From the artifacts examined in this study there are three material types from the Ouachita area which have not been duplicated in field collections from the Johns Valley shale. Two of the three types, may be considered local, and theoretically their absence in the Johns Valley is not understood.

Type 1: The single flake of Battiest chert [catalogue number 486(10)] may or may not represent a chert type introduced from outside the Jackfork basin. The Battiest "lentil" from the middle Stanley has not been recorded, to my knowledge, for the Jackfork Basin, but this negative evidence should not be considered absolute at this time.

Type 2: The green chert which outcrops locally in the Potato Hills was combined in concept with the nova-chert category but its representation in the collection is worth a brief discussion. In the original 376 artifacts examined in May and discussed in the introduction to this report, a single scallorn arrowpoint of the green chert was identified. In the 256 artifacts represented in the above tables, none were made from the green chert. One specimen (Catalogue No. 953) exhibited a greenish central cast and like some of the green chert pebbles found on the Lower Kiamichi River which have altered by weathering to a yellow-brown jasper-like material except for the unaltered core, it could represent the green chert from the novaculite. It is interesting that green chert arrowpoints appear to be more common in the Kiamichi sites farther downstream, on Caddoan sites along the Red River and even in the Little River basin than they do at Bug Hill. Obviously, the brittle and fractured nature of the Potato Hills and Black Knob Ridge outcrops preclude the usefulness of the extensive quantities of green chert for tool production. It is quite possible that the arrowpoint reflects an influence of limited chert types coming back into the Jackfork basin by cultural medium from the Lower Kiamichi River. This would also be in keeping with the single Tecovas dart point found in Structure 3 (Late Caddo). This specimen is also not included in the artifacts used for the above tables.

Type 3: A single small dart point made from Tecovas jasper is the only true exotic present in the entire collection. This particular variety appears to be most common in the eastern flanks of the High Plains escarpment in the Red River drainage. The type is particularly common to the Quitaque, Texas, area but it is available in knappable pebble sizes on Red River gravel bars at least as far east as Red River County, Texas. Tecovas outcrops also occur in the Texas Panhandle in the same vicinity as the Alibates dolomite (South Canadian drainage) and in northeast New Mexico (Cimmaron River drainage). Consequently, a gravel source in the South Canadian or even the Arkansas River cannot be arbitrarily dismissed. However, the chert variety of the artifact is more typical of the more southerly sources of Tecovas. An informed opinion is that the pebble came from the Red River source.

A fourth material type (catalogue no. 374-10) of petrified palm wood, might represent an influence from outside the Jackfork basin. Silicified wood, from the Pennsylvanian and Mississippian cycads and Lepidendrons, can be found in the Winding Stairs as well as other ranges of the Ouachitas, but the particular type like this specimen has not been reported to my knowledge. It is more similar to types from Tertiary formations in Northeast Texas. The petrified wood reported by Perino and Bennett (1978:32) as "Messer flint" definitely comes from the Ouachitas and it is possible that this type does also.

The apparent absence of the Wapanucka and Chickachoc cherts at Bug Hill as suggested by the Bug Hill collection is interesting from both archaeological and geological points of view. Archaeologically, it indicates little, if any, contact between Bug Hill and Brushy Creek basin in the northeastern extremity of the Ouachitas. The "Boone" chert however (which could be either Wapanucka or Pinetop) found at the Lee Kirkes and Vanderwagen sites (Bobalik 1979:121 and 326-327 respectively) and the Blessingame site (Lintz 1979c:329) may indicate the presence of Brushy Creek basin types in other Jackfork basin sites. The possibility that the chert is Boone is still viable also though. Geologically, the absence (if true) of the Wapanucka and Chickachoc types in the Johns Valley shale suggests a slightly later deposition of the Wapanucka-Chickachoc sediments that for the Johns Valley shale.

With the single exception of the lithic types discussed above, all the lithic artifacts examined during this study can be related by type to the varieties of chert, quartzite, and siliceous shales present in the Jackfork Valley. Also, it can be stated with assurance that most, if not all, of the lithic types (possibly excepting the Wesley types) are from the Johns Valley shale. The formation produces high quality cherts and quartzites derived from older formations and deposited in the geosynclinal trough with the Johns Valley shale. Such a variety of high quality lithic types in any single formation and in concentrated single localities such as those in and adjacent to the Winding Stair Range are of significant importance in the entire Ouachita Mountains. Also, most of the chert types previously called unidentifiable or exotic types have a high probability of being from local materials and from the Johns Valley outcrops in particular.

Examinations of the chert formations in Black Knob Ridge and Limestone Ridge to the southwest, west, and northwest of the study area; the Woodford and Pinetop outcrops on Pine Mountain; and the chert formations of the Potato Hills all reveal a common and singular characteristic which is critical in understanding their archaeological importance. The in situ chert beds are all so brittle and highly fractured that their value for stone tool production is minimal. The brittleness of the in situ materials in comparison to the same chert types occurring as cobbles and boulders in the Johns Valley shale may also be of geological significance. It is possible that the orogeny associated with the Ouachita deformation was accompanied by enough heat to cause increased brittleness as well as causing the beds to be so complexly folded and fractured.

The identical comparisons, even to weathering characteristics, between the artifacts examined and hand specimens collected from the Johns Valley outcrops have to be seen to be appreciated. In many instances the artifacts appeared to have been produced from the same hand specimens collected during this study.

CONCLUSIONS

The examination of chert varieties found as an assemblage in the Johns Valley outcrops are disconcerting in some respects and will require some further re-evaluation concerning chert uses in the Ouachita Mountains. The data obtained during this study essentially undermines or alters two previously held concepts:

1. The four principal regions of most significance in the Ouachita Mountains for providing quality chert for stone tool production are in central McCurtain County, the Potato Hills, the Woodford outcrops in the Winding Stair Range, and Black Knob Ridge. While these areas are the major chert producing areas of the region purely from a geological perspective, archaeologically, their usefulness in supplying needed raw material for stone was minimal in comparison to the quality, quantity, size, and variety of material types available in the Johns Valley outcrops. In fact, except for selected novaculite outcrops on the Mountain Fork, the chert cobbles and boulders in the Johns Valley are better for tool production than the same type materials in their respective formations of origin. The apparent absence of green chert from the novaculite formation in Johns Valley lithology needs to be accounted for, but at this time, there are no answers to this. Is it possible that the dominant green chert has resulted from in-place weathering which the "nova-cherts" redeposited in the Johns Valley shale were not subjected to? An alternate explanation is that the intervening area of outcrops between Black Knob Ridge and the Potato Hills which so heavily contributed to the Johns Valley deposits and were thereby essentially removed by erosion simply did not contain the green chert varieties.

2. *The presence of cortex on primary flakes or debitage is always indicative of stream cobbles.* In the vicinity of the Johns Valley outcrops this cannot necessarily be used as the primary criteria of relating lithic procurement to stream cobbles.

Understanding the effects of weathering on any particular chert type is critical in being able to make maximum use of chert identifications for anthropological interpretations. This was exemplified during the examination of the chert types in this study. Lithic types which have previously been defined by geologists and archaeologists alike as siltstone/claystone and even jasper may, in fact, result from cherts altered by combined chemical/mechanical or tripolitic weathering. Also, some of the quartzite boulders (most likely derived from the Jackfork and Stanley groups) occurring within the Johns Valley deposits tend to be more varied in color and to be finer in texture than were the parent lithic types. Cortex formed in quartzites give some of the rocks an appearance of being whitish siltstone or limestone boulders.

The Winding Stair Range represents one of the most, if not the most, important sources of chert in the Ouachita Mountains. Cobbles and boulders from the Johns Valley conceivably add chert constituents to streams feeding into the South Canadian, the Fourche Maline, and the Kiamichi basins as well as the more localized Jackfork. This regional area probably served a major role in affecting economics of all prehistoric societies operative in and adjacent to the Western Ouachita Mountains. The Johns Valley deposits also crop out farther east almost to Hot Springs, Arkansas, along the same general parallel as the Winding Stairs. In Arkansas, however, the exposures are thinner and much more sporadic than in the Winding Stair range. Indeed, examination of the Johns Valley at Shawmut Ford on the Antoine River in Arkansas revealed an apparent absence of chert boulders in the formation. The reexamination of lithic identifications from other studies such as the Mahaffey site (Perino and Bennett 1978), and Sam Kaufman site (Skinner et al. 1969), the Roden site (Perino 1981), and the Bentsen-Clark site (Banks and Winters 1975), along the Red River could possibly shed some additional light on the significance of the Ouachita Valleys, such as the Jackfork, Buck Creek, and Johns Valley to the broader Caddoan area.

The possibility that these chert sources weighed heavily in determining settlement patterns in the area cannot be overestimated. Such a possibility would most easily satisfy and explain the questions asked by others (Bobalik, Lintz, Vehik and Galm) as discussed earlier. Based on the nature of the *in situ* cherts and those found in the Johns Valley shale, most of the larger chert tools in the lower Kiamichi and Red River sites from the Ouachita Mountains would appear to have been derived, directly or indirectly, from the Johns Valley shale.

CHAPTER EIGHT

ANALYSES OF FIRE-CRACKED ROCK AND NON-LITHIC CULTURAL REMAINS

by

Jeffrey H. Altschul, Kathleen M. Byrd, Carol S. Weed,
and
Mark T. Swanson

This chapter is devoted to the analyses of all non-lithic materials and fire-cracked rock. Specifically, the classes of materials discussed are prehistoric ceramics, worked bone, fire-cracked rock, daub, minerals and fossils and historic artifacts. Each class of material is discussed individually below.

PREHISTORIC CERAMICS

Introduction

Prior to the initiation of the analysis it had been anticipated that three periods of occupation could be defined on the basis of the ceramics recovered: Woodland, Caddoan, and historic Choctaw (Vehik 1982a). Further, based on the results of the 1979 excavations, there was some evidence to suggest that very early Woodland period ceramic bearing levels, corresponding to Component I at Williams I (Irvine 1980), could be isolated stratigraphically within the collection.

At Williams I (34Lf24), a midden mound located in the Wister Valley, Component I was dated to A.D. 125 ± 105 (Irvine 1980). The ceramics associated with this component were [illegible] Williams and LeFlore Plains. In addition, data from the [illegible] (34Lf11) and Wann (34Cf27) sites suggested that as early as [illegible] both Williams and LeFlore Plains were being manufactured; thereby [illegible] marking the beginning of the Fourche Maline phase in the Wister Valley.

We expected to find a similar component at Bug Hill. Radiocarbon dates from Stratum I and the top of Stratum II range from A.D. 278±70 to A.D. 617±80, placing these deposits squarely within the accepted time frame for the Fourche Maline phase. Further, no stratigraphic breaks were found between Late Archaic and Woodland deposits, suggesting that a date earlier than A.D. 278 actually marks the onset of the Fourche Maline phase occupations at Bug Hill (see Chapter Fourteen).

In order to determine if such occupations could be isolated it was critical that the analyses of the ceramics be conducted in a manner compatible to previous research both at the site and in the larger region. To this end, the initial step of the analysis involved a detailed background and literature review to determine the possible range of ceramic types and varieties which might be expected. The most comprehensive source for Woodland and Caddoan types in eastern Oklahoma is the Irvine work (1980) which focused on the results of the ceramic analysis for the Williams I (34Lf24) site, originally excavated during the WPA era. Irvine's analyses stressed both the technological and vessel attributes of the ceramics from the site, a collection dominated by plainwares. In most instances, the definitional criteria established by Irvine for various types and varieties are those used during the course of this analysis (Table 21).

While the criteria for the placement of specific ceramic pieces into particular categories are predominantly extrapolated from Irvine (1980), regional variation in technological and stylistic attributes was also considered and incorporated into the definitions (Table 21). Pertinent sources consulted in order to determine regional varietal change included Vehik (1982a; 1982b), Vehik and Galm (1979), Brown (1971), Bell (1972), Freeman and Buck (1960), Suhm and Jelks (1962), Phillips (1970), Galm and Flynn (1978), Hoffman (1968, 1970), and Schambach (1982).

Procedures

The data from the literature review formed the basis for the code sheets used during the course of the analysis. It should be noted that no attempt was made to classify the ceramics utilizing the University of Oklahoma coding system (e.g. 02-01-01A, etc.) though the appropriate corresponding codes are listed on Table 21 for the sake of cross-reference.

The analysis was conducted maintaining 1 m sq provenience control by arbitrary excavation level. The results were then collapsed into primary excavation units and natural or cultural stratigraphic levels.

All ceramics larger than 1/4 in. in diameter were initially sorted into the following major categories: plainware body, plainware rim, plainware other, decorated body, and decorated rim. Sherds smaller than 1/4 in. were classified as crumbs and counted, but not subjected to further analyses. Ceramic bases were classified with the body category, though their presence was noted on the analysis sheets.

TABLE 21. DEFINITIONS FOR SPECIFIC PLAINWARE CERAMIC TYPES IDENTIFIED DURING THE COURSE OF THE BUG HILL 1981-82 CERAMIC ANALYSIS.

Type	Definition	Sources
Williams-Plain (Decorated)	Grog-tempered; other additives documented include grit, bone, shell, kaolin. Vessels are thick-walled (average 11.6 mm -- range is 5.6 mm to 27.6 mm). Vessel surfaces are commonly unburnished.	Irvine 1980:15 Vehik 1982a:98 Galm and Flynn 1978:96 (Type 0180A, Type 01B) Lintz 1979c (Types 01A, 01B)
LeFlore Plain	Grog and grit tempered but thin-walled (average wall thickness 6.8 mm -- range 4.3 mm to 9.0 mm). The paste is gritty and dark. Burnished dark surfaces must be present.	Irvine 1980:20 Galm and Flynn 1978 (Type 01B; varietal is Type 01E)
	Bone temper also occurs.	Vehik 1982a:98
Sanders Plain	Grog and grit tempered. Predominant classifitory element is the prominent red slipping. Slipping can occur on interior or exterior or both.	Irvine 1980:31 Lintz 1979c (Type 02A)
	Minimal shell temper may occur in addition to grog and grit temper elements.	Galm and Flynn 1978 (Type 03B)
Woodward Plain (also Decorated)	Shell tempered with fine grit inclusions and a compacted laminated paste. Smooth but uneven surfaces are common. Vessel walls average 7.9 mm in thickness -- range 4.7 mm to 15.3 mm.	Irvine 1980:30 Lintz 1979c (Type 03A) Galm and Flynn 1978 (Type 02A; varietal type considered in this analysis to include Type 04N)

With the exception of crumbs, all sherds were broken, and examined using a 10-power hand lens to determine temper inclusion. In instances where possible temper inclusions included either bone or shell the following procedures were utilized. First a drop of dilute hydrochloric acid (at 10 percent strength) was placed on the freshly broken surface in order to determine if either element was present. The differentiation between bone and shell inclusions was based on criteria established following the examination of a representative sample of sherds which had tested positive to the acid test. These sherds were examined using a 30-power lens. Bone inclusions were found to be typically highly fragmented, splintered in appearance, and ranging in color from a white to tan. Shell inclusions were also fragmentary, exhibited a plate or variegated appearance in cross-section, and ranged in coloration from white to gray-white. Sorting criteria followed for the other temper inclusions and paste types identified during the course of the analysis conform to the definitions presented on Table 21.

Following the examination of the sherds, each was classified according to temper inclusions, paste characteristics, thickness, rim or decorative style, and in certain instances exterior surface color, slipping, or burnishing. Representative examples of all types and varieties were separated out during the course of the analysis as a comparative collection. All rims and decorated sherds were also separated, and selected examples of rim forms and decorative styles are illustrated in Figures 52 through 54.

Analysis Results

A total of 1509 ceramics were recovered during the course of the excavations. Of that number 62 were decorated, and 63 were rims. With the exception of a single sherd of Pennington Incise-Punctate, all the decorated pieces were less than 5 cm in diameter and no complete design elements could be discerned. The following discussion presents the results of the prehistoric ceramic analysis.

As noted in the introduction to this section, the Bug Hill ceramic collection was dominated by plainwares. Only 3.5 percent of the collection was decorated (N=62). Of these less than 15 sherds could be placed with confidence into a named decorative category, primarily because of the uniformly small size of the sherds and the lack of complete design elements or rim pieces. A brief discussion of the various types and varieties recovered is presented below, followed by a discussion of the possible implications of their presence.

A summary table of all ceramics recovered by principal excavation unit (e.g. Southern Block) and natural strata or occupation floor is presented in Table 22. As can be readily seen, the dominant ceramic types recovered are Williams Plain, varieties of Williams Plain, or LeFlore Plain. The highest number of ceramics (N=567) conform to the classic definition of Williams Plain (Variety A). Somewhat unexpectedly, the second highest number of sherds (N=239) fit the definition

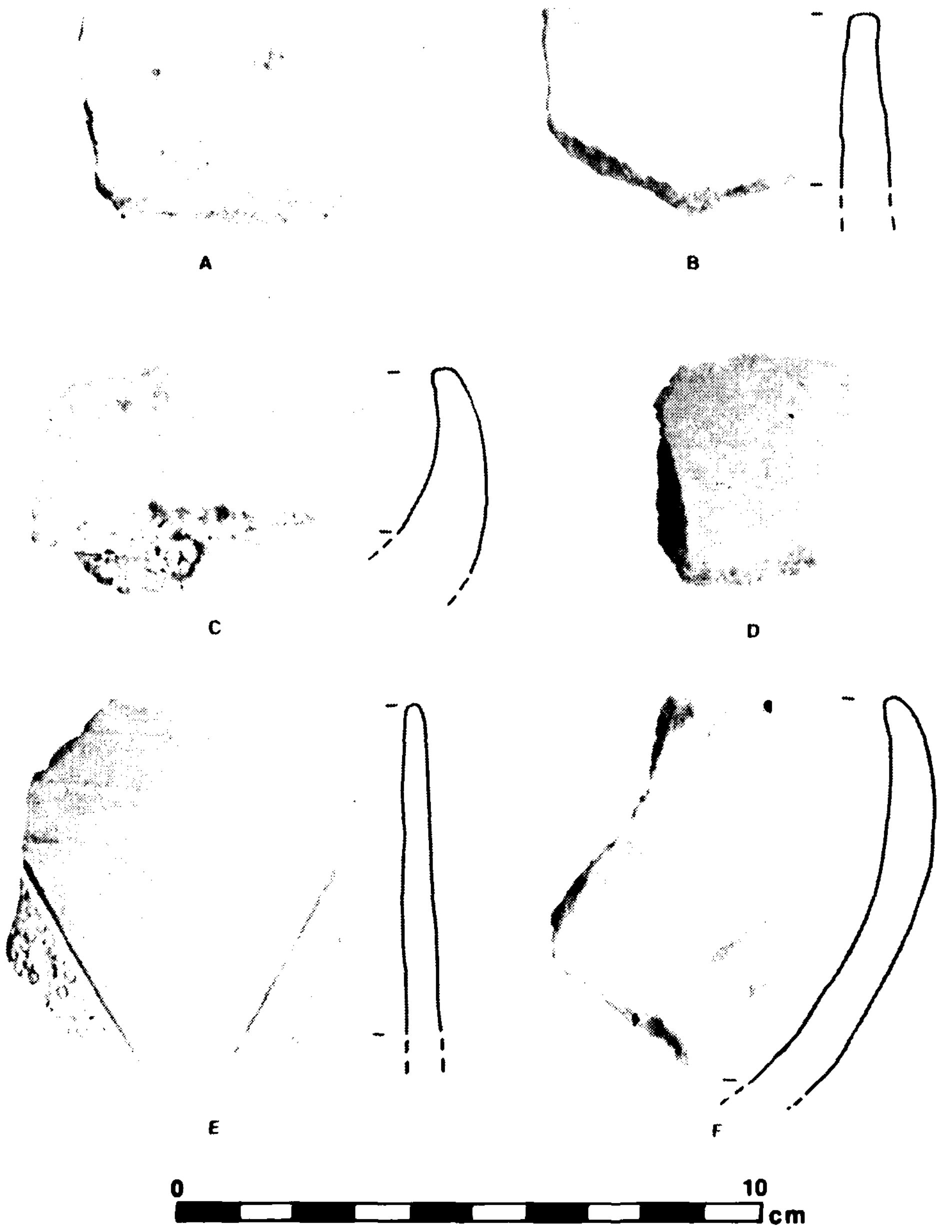


FIGURE 52. PREHISTORIC CERAMICS.

a-d: Williams Plain
e: Pennington Incise-Punctate
f: Thin grit/grog

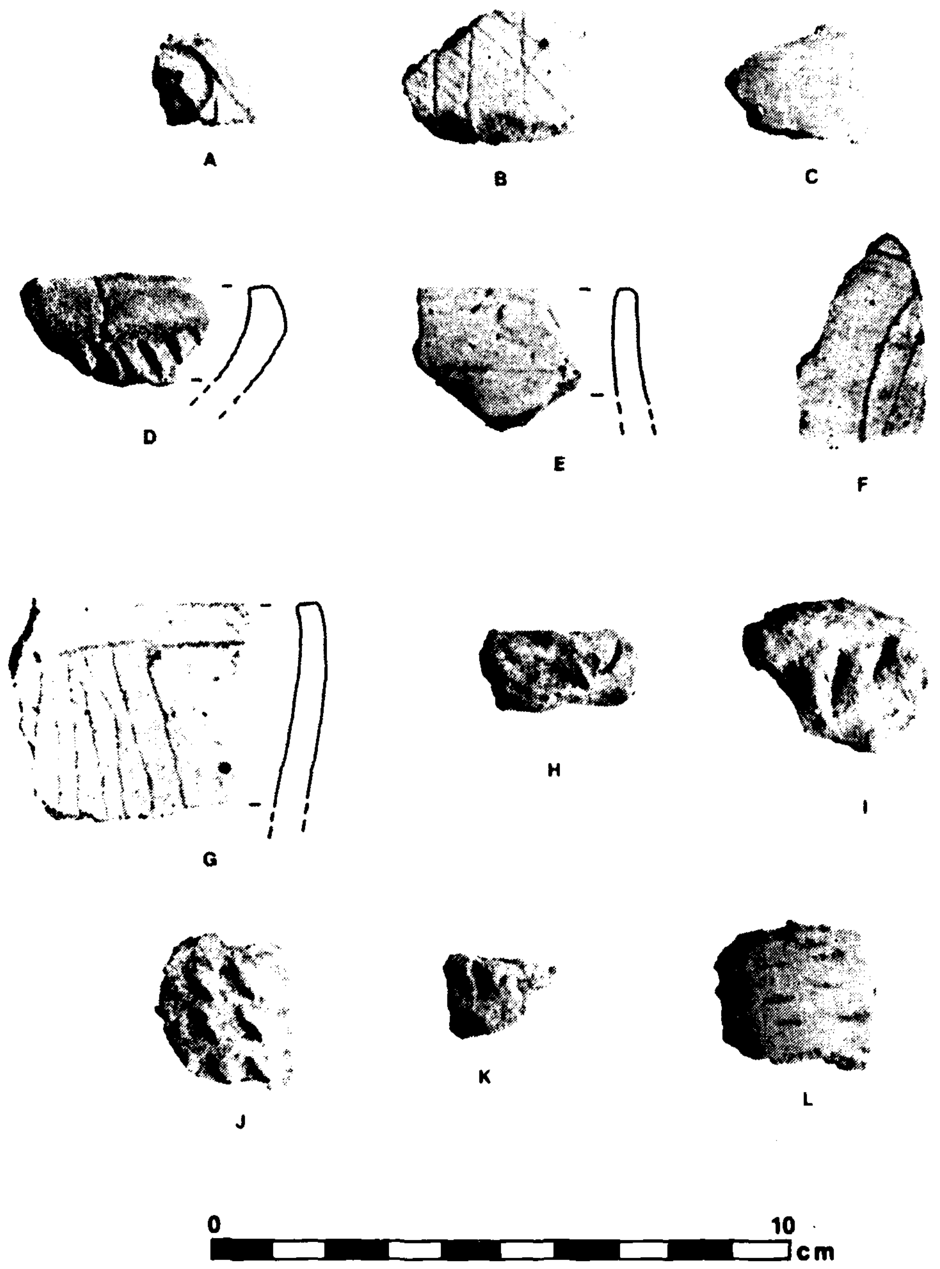


FIGURE 53. PREHISTORIC CERAMICS.

a:	Crockett curvilinear-like	e-g:	Fine Line Incised
b-c:	Fine Line Incised	h-k:	Beaver Pinched
d:	Fingernail Incised	l:	William Decorated

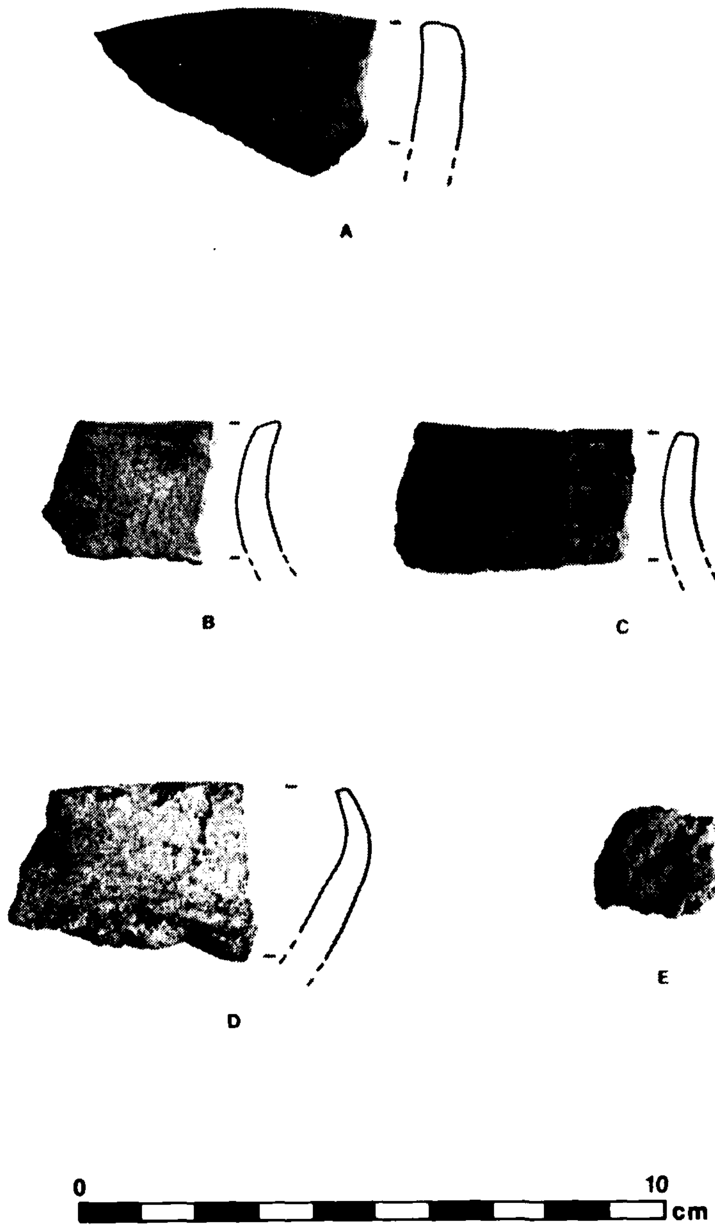


FIGURE 54. PREHISTORIC CERAMICS.

a: Sanders Plain
b-c: Leflore Plain
d: Williams Plain
e: Williams Decorated

TABLE 22. CERAMIC ANALYSIS.

	Southern Block						Central Block				Northern Block			Site Peripheries			Locality A			
	Ip	II	III	IV	O.S.I	O.S.III	Ip	I	IIa	IIb	Ip	II	III	Ip	II	III/IV	Ip	II	IV	Total
Williams Plain Variety A (grit)	198/7	47/2		4/1	3	14	54/2	10	3		64/1	8	2	102/6	22/3	4		10		545/22
Variety B (bone)	7/2				4		14	10	1		19/1	3	3	14	2			1/1		78/4
Variety C (shale)	28/2	4/1					7	4	2		5	3		15	2					70/3
Thin grit/grog	89/4	23/5			2	5	29/1	6			15	3	1	35/3	11			7		226/13
Sanders Plain Variety A											1									1
Variety B (slipped)	3										1			2	1					7
Woodward Plain (shell with fine grit)							5													5
Woodward Plain (<u>var. Reed</u>)							1	1		1	7									10
LeFlore Plain (grog/grit)	1	7/1				3/1					7/2		1	0/1						19/5
Bone, thin	1						4	/1			28/1	7		1	1					42/2
Shale	1										1									2
Fine sand, dense	/1					1					1									2/1
Fine grit	14	3/1			1			1			1/1			7/1	5			1		33/3
Crumbs	93	18			3	2	27	8	2		50	4/1		116/2	19/1			8		350/4
SUBTOTAL PLAIN	435/16	102/10		4/1	13	25/1	141/3	40/1	8	1	200/6	28/1	7	292/13	63/4	4	0	27/1	0	1390/57
Williams Decorated	1						3							1						5
LeFlore Incised							1					1								2
Beaver Pinched	5										9			2[a]		0/1				16/1
Pennington Punctate					1				1		1/1	1								4/1
Fine Incised	4/2	1		1			4		1		3/2			0/1	1					15/5
Fingernail Impressed	1	1					4				3									9
Ridged											1									1
Cord Impressed (?)								1							2[b]					3
SUBTOTAL DECORATED	11/2	2	0		1	0	12	1	2	0	17/3	2	0	3/1	3	0/1	0	0	0	56/6
GRAND TOTAL	446/18	104/10	0	153/3	14	25/1	153/3	41/1	10	1	217/9	30/1	7	295/14	66/4	4/1	0	27/1	0	1446/63
% DECORATED	2.5	1.9		20	7.1	0	7.8	2.4	20	0	7.8	6.7	0	1.1	4.6	0/100		0		3.9
% PLAINWARE	97.5	98.1		80	92.9	100	92.2	97.6	80	100	92.2	93.3	100	98.9	95.4	100/0		100		96.1

[a] with bone, interior incised line

[b] corrugated-like

NOTE: Column numbers should be read as body sherds/rim sherds. The total number of sherds in a type represent the sum of the body and rim sherds.

of a transition class defined by Brown (1971). Classed as thin grit/grog during the course of this analysis, the sherds are similar to those noted by Brown as "...an intermediate block between the thick-walled class of Williams Plain and LeFlore Plain proper" (1971:47).

The next most common types are essentially varieties of Williams Plain. Variety B (N=82) displayed grog and grit inclusions, in addition to bone, while Variety C (N=73) had grog and grit inclusions accompanied by shale inclusions. With regard to the latter category, in only two instances were sherds tempered exclusively with shale identified. Both were found in the plowzone, one in the Southern Block and the other from the Northern Block. Irvine (1980:22) reports a similar unnamed class of ceramics which conforms to Variety C from Williams I, and Proctor (1957) notes the presence of a shale tempered type from the Sam Site.

The incidence of LeFlore Plain (N=24), relatively small in relation to the entire collection, was not as great as had been initially anticipated based on the literature review. Two factors may be involved in this apparent dichotomy. First, the recognition of the thin grit/grog category noted above may account for many of the sherds which would normally be classified as LeFlore Plain. Secondly, the incidence of actual burnishing as opposed to smoothing or exterior surface floating on the sherds was quite low, and only those sherds which displayed burnishing were classed as LeFlore Plain.

The incidence of shell tempered ceramics was uniformly low. Sherds which conformed to the general type Woodward Plain (N=5) and Woodward Plain var. Reed (N=10) were identified. Both types were restricted to the Central and Northern Blocks, and with the exception of two Woodward Plain var. Reed sherds from Strata I and IIb in the Central Block respectively, all were recovered from the plowzone.

Brown (1971:226) has noted that the use of red-filming or slipping begins in the Fourche Maline phase, though it is a minority occurrence which does not become popular until Caddo times. Sanders Plain was present in the collection, though its incidence was low. A total of eight Sanders Plain sherds were noted; seven displayed the typical red slipping, while one sherd from the plowzone in the Northern Block conformed in all definitional criteria to Sanders Plain but was not slipped.

Three unnamed types, defined on average sherd thickness, temper inclusion, and paste type were also present. The first of these was classed as thin bone (N=44). The sherds averaged 5 mm in thickness, and were tempered predominately with bone, though occasional inclusions of either grog or quartz sand were also noted. Exterior surfaces tended to be pitted, and surface color was predominately gray. The sherds were not classified with the Williams Plain Variety B sherds because of average thickness, though they may represent a variation of that type.

The second unnamed type was classed as fine grit (N=36). The sherds averaged 5.3 mm in thickness, and were tempered exclusively with small grit inclusions in a uniform and paste. The sherds are most similar to a type classed as Grit Tempered by Irvine (1980:24) which apparently co-occurs with Williams Plain at Williams I. It also appears to be similar to a sand-tempered variety noted by Bell (1953:328) at the Scott Site (34Lf11), which co-occurs with both Williams Plain and Woodward Plain.

Three sherds with fine sand temper and a dense uniform paste were identified, and classed as fine sand, dense. One each was recovered from the plowzone in the Northern and Southern Blocks respectively, while the third sherd, a body piece, was found in the fill of Structures 1 and 2 of the Southern Block. The fill of these houses also yielded examples of Williams Plain, LeFlore Plain, and thin grit/grog; the incidence of fine sand temper is not great enough however to determine if the type is a minority co-occurrence with those types. The sherds do not fit the criteria for either the sand-tempered variety noted above (Bell 1953:328) nor that discussed by Hoffman (1970:6-18) for Bois D'Arc Plain.

The decorated ceramics noted during the course of the analysis were almost exclusively either incised or pinched/punctate. The highest incidence of decorated ceramics occurred in the Northern Block, and with only a few exceptions decorated ceramics recovered throughout the excavated areas were found in the plowzone.

Discussion

The analysis of the prehistoric ceramics recovered from the 1981-82 field season at Bug Hill did not result in the anticipated definition of occupational periods on the basis of ceramics alone. Indeed, if anything, the ceramic analysis confirmed the extremely conservative nature of the populations occupying Bug Hill and the Jackfork Valley during the Woodland and Caddoan periods as indicated previously by the analysis of culture historic lithic diagnostics (see Chapter Six).

Subtle changes in ceramic trends, however, are suggested when the results are collapsed into chronologically ordered strata derived from the radiocarbon analysis (see Chapter Five). From earliest to latest these strata are Strata I and II from the Central Block and Stratum II from the Northern Block and site peripheries (Woodland Period, Fourche Maline Phase); Occupational Surface III and Stratum II from Locality A (Early Caddoan Period); Stratum II from the Southern Block (Early Caddoan Period); and Occupational Surface I (Late Caddoan Period).

Table 23 presents the frequency and percentages of the five chronological assemblages for the most popular ceramic categories recovered at Bug Hill. These categories are the three varieties of Williams Plain, thin grit/grog, LeFlore Plain, and all decorated. The relative proportions of these ceramic categories are graphically

TABLE 23. PERCENTAGES OF MOST POPULAR CERAMIC TYPES BY STRATIGRAPHIC CONTEXT.

	Woodland Period Fourche Maline Phase Strata I and II Central Block Stratum II Northern Block and Site Peripheries		Early Caddoan Period O.S. III and Stratum III of Locality A		Early Caddoan Period Stratum II Southern Block		Late Caddoan Period O.S.I	
	frequency	percentage	frequency	percentage	frequency	percentage	frequency	percentage
Williams Plain								
A	46	45.5	24	57.1	49	53.3	3	30.0
B	16	15.8	2	4.8	0	0.0	4	40.0
C	11	10.9	0	0.0	5	5.4	0	0.0
Thin grit/grog	20	19.8	12	28.6	28	30.4	2	20.0
Leflore Plain	0	0.0	4	9.5	8	8.7	0	0.0
Decorated	8	7.9	0	0.0	2	2.2	1	10.0
Totals	101	99.9	42	100.0	92	100.0	10	100.0

illustrated in Figure 55 for all strata except Occupational Surface I. The exclusion of the latter is due to the small number of ceramics recovered.

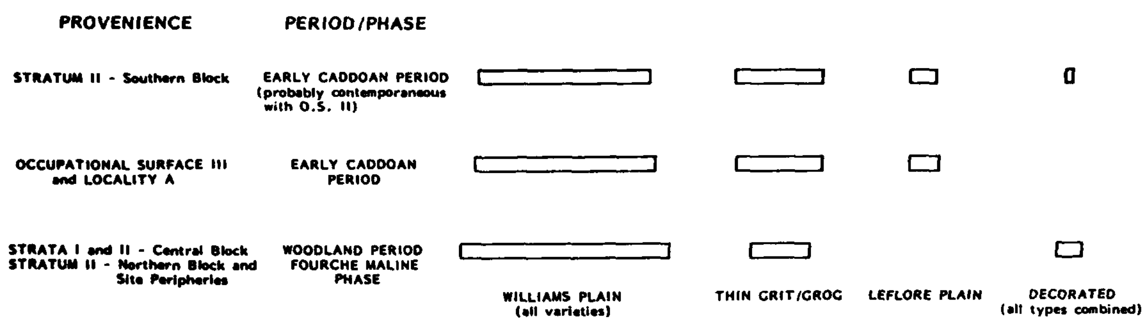


FIGURE 55. BAR GRAPH OF MOST POPULAR CERAMIC TYPES BY STRATIGRAPHIC CONTEXT.

There are three basic patterns in the ceramic data. First, greater variation existed within the pottery type, Williams Plain, during the Fourche Maline phase than during succeeding periods. Second, and perhaps concomitant with the first trend, there is a general reduction in the use of Williams Plain over time. During the Fourche Maline phase, varieties of Williams Plain average around 70 percent of the total ceramic assemblage. During the succeeding Early Caddoan Period this percentage drops to around 60 percent. Corresponding to the decrease in Williams Plain is an increase in the ceramic categories of thin grit/grog and LeFlore Plain. Because percentages must equal 100 for each assemblage it is a mathematical necessity that a drop in one category must be reflected in increases in others; so it does not necessarily follow that there was a decrease in the production of Williams Plain and an increase in the use of LeFlore Plain. Indeed, from Table 22 it appears that the production of Williams Plain remained about the same during the Woodland and Early Caddoan periods. The real change was an increase during the latter period of the production of thin grit/grog and LeFlore Plain (as well as, it might be added, an increase in the use of ceramics in general).

Finally, decorated ceramics are rare throughout the Woodland and Caddoan periods at Bug Hill. It is possible that the relatively large proportion observed for Occupational Surface I (Late Caddoan) marks a real change. However, the small sample size vitiate any conclusions reached from this surface.

MODIFIED SHELL, BONE, AND ANTLER

Introduction

Bone and antler were employed extensively by the occupants of Bug Hill. In all, 469 pieces of these materials were identified in the collection recovered in the 1981-82 field season (Table 24). The following tabulation describes the shell, bone, and antler tools found during that excavation. In each case, the tool is described. Also, an attempt is made to identify the animal from which it was made and the manufacturing technique used.

Bone

Awls (Figure 56;a-d)

A total of 45 awl tips were identified in the collection. In addition, another 107 shaft fragments, probably from these awls were also identified. The awl tips varied from quite pointed to blunt. All exhibited considerable surface polish and most showed longitudinal striations. All awls were narrow, seldom with a width over one centimeter. The total lengths were indeterminable due to the fragmentary nature of the tools, but one fragment was longer than 10 cm. It appears that most of the awls were made from fragments of large mammal bone, probably deer. Presumably the long bones were first split and the fragments then rounded and smoothed.

Flakers (Figure 56;e)

A total of three bone flakers, all from Stratum II deposits of the Southern Block, were recovered during the 1981-82 field season. All three flakers were manufactured from long bones of large mammals. Each of these tools evidenced some form of smoothing or polishing. All three flakers were broken and no estimate of approximate length could be determined.

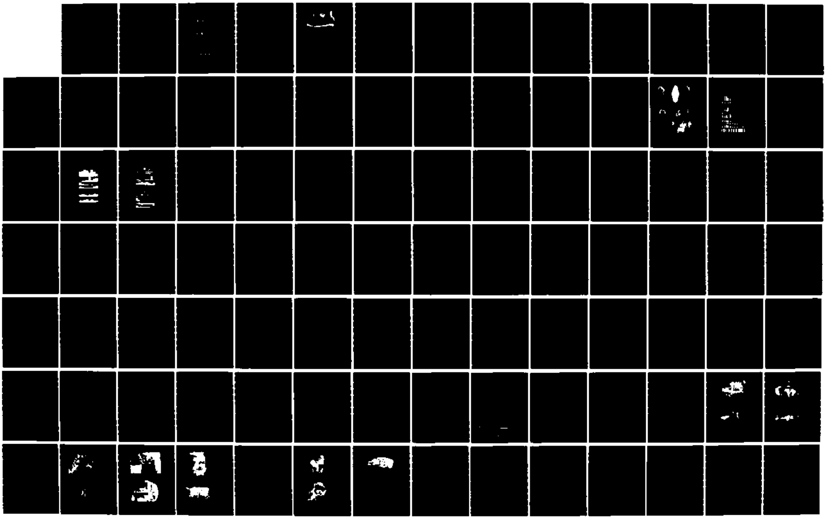
Spatulates (56;f-h)

Two varieties of spatulates were identified in the Bug Hill collection. Variety A was flat with perpendicular ends (Figure 56;f). The other, Variety B, had tapered ends with rounded tips and is concavo-convex in cross section (Figure 56;g-h).

Variety A: Two spatulates of Variety A were recovered during the excavation. The first, from Stratum III of Test Pit 6 (level 9), was

AD-A144 104 BUG HILL: EXCAVATION OF A MULTICOMPONENT MIDDEN MOUND 3/5
IN THE JACKFORK VAL..(U) NEW WORLD RESEARCH INC POLLOCK
LA J H ALTSCHUL ET AL. 25 NOV 83 DACW56-81-C-0144

UNCLASSIFIED F/G 5/6 NL



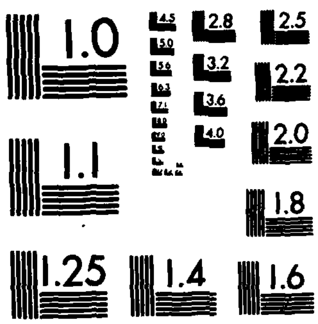


TABLE 24. MODIFIED BONE

	Southern Block					Central Block						Northern Block			Site Peripheries			Totals
	Ap	II	III	O.S.I	O.S.III	Ap	I	IIa	IIb	III	Burial 6	Ap	II	III	Ap	II	III	
Bone																		
awl tip	2	14	2		2	3	3		1	5		3	1	3	1	2	3	45
shaft fragment	17	26	3		10	3	2	2	3	2	2	5	4	5	8	11	4	107
flakers		3																3
spatulates																		
Variety A		1															1	2
Variety B																2		2
bone beads	1				1													2
seed beads											179							179
cylinders	2			1												1		4
fishhooks								1										1
perforators									1									1
miscellaneous modified bone	1		1											1				3
green-stained bone	9	19	1		1	1	1					1		2	7	5	1	48
Total	32	63	7	1	14	7	6	3	5	7	181	9	5	11	16	21	9	397
Antler																		
awl/flakers	9	21	13		9	1	2	1	3	1	1	1			1	1	1	65
shaft fragments		1							1									2
smoothers		1																1
handles		3			1													4
Total	9	26	13		10	1	2	1	4	1	1	1			1	1	1	72

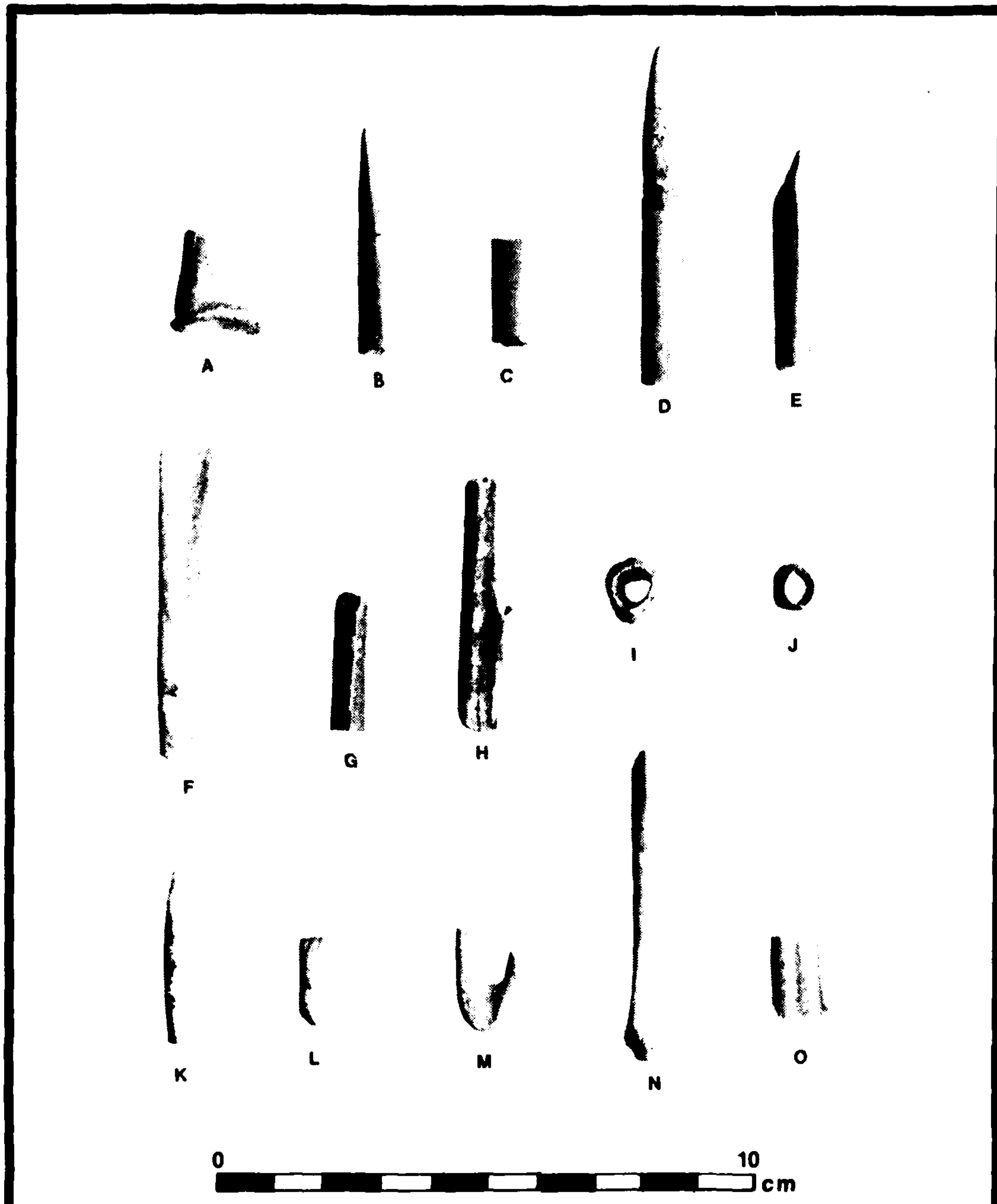


FIGURE 56. BONE ARTIFACTS.

a-d:	Awl fragments	k-l:	Cylinders
e:	Bone fragment	m:	Fishhook
f:	Spatulate, Variety A	n:	Perforator
g-h:	Spatulate, Variety B	o:	Miscellaneous polished bone
i-j:	Bone beads		

6.1 cm long and 1.1 cm wide. It was manufactured from a large mammal and was relatively flat, being only 0.4 cm thick. The ends were almost perpendicular to the long axis of the bone and were gently beveled. The bone was highly polished with longitudinal striations running the length of the bone. A very slight reddish-brown stain was noted.

The second spatulate was found in Stratum II of the Southern Block. It was incomplete, having only one end. It was 0.75 cm thick, considerable more than the bone described above, but it exhibited the same high polish. It had been slightly burned.

Variety B: Two spatulates were classified as Variety B. Both were recovered from Stratum II of Test Pit 6. These two had tapered, rounded ends. They were manufactured by cutting into the bone exposing the cavity of the bone of a bird or small mammal. The cut was thus slowly tapered toward the tip resulting in a broad rounded working surface. One showed some polish and a considerable number of longitudinal striations.

Beads (Figure 56;i-j)

Two bone beads were recovered from the Southern Block excavations; one from Stratum II and one from Occupational Surface III. One bead was manufactured from a small mammal or medium size bird while the other was from a larger mammal. The beads had been made by first cutting the bone and then flaking off additional bone fragments to reach the desired shape. The beads showed only a minimal amount of smoothing and polishing. The flake scars were still evident. Both beads were broader than long. The bead from the house fill measures 0.6 cm in length while the other one was 1.1 cm.

Bone or Shell Seed Beads (Figure 57)

One hundred and seventy-nine shell or bone seed beads were recovered from Feature 93, the burial pit associated with Burial 6 in the Central Block. The beads were highly uniform in size and shape, averaging about 0.25 cm in length and width. They appear to have been cut with the interior portion hollowed out and the exterior lightly polished.

We were unable to determine the exact composition of the beads. They were clearly not hackberry seeds or any other type of vegetable material (Andrea Shea, personal communication). Samples of broken beads had a moderate reaction when subjected to hydrochloric acid (HCl). These tests suggested that the beads were composed of either shell or calcified bone, but further discrimination was not possible (Arthur Bogan, personal communication). The beads are virtually identical to those found with Burial 12 at the McCutchan-McLaughlin site (34Lt11) near the Wister Valley (Powell and Rodgers 1980; Figure 23). In that report they are referred to as "seed beads" with no further information given.

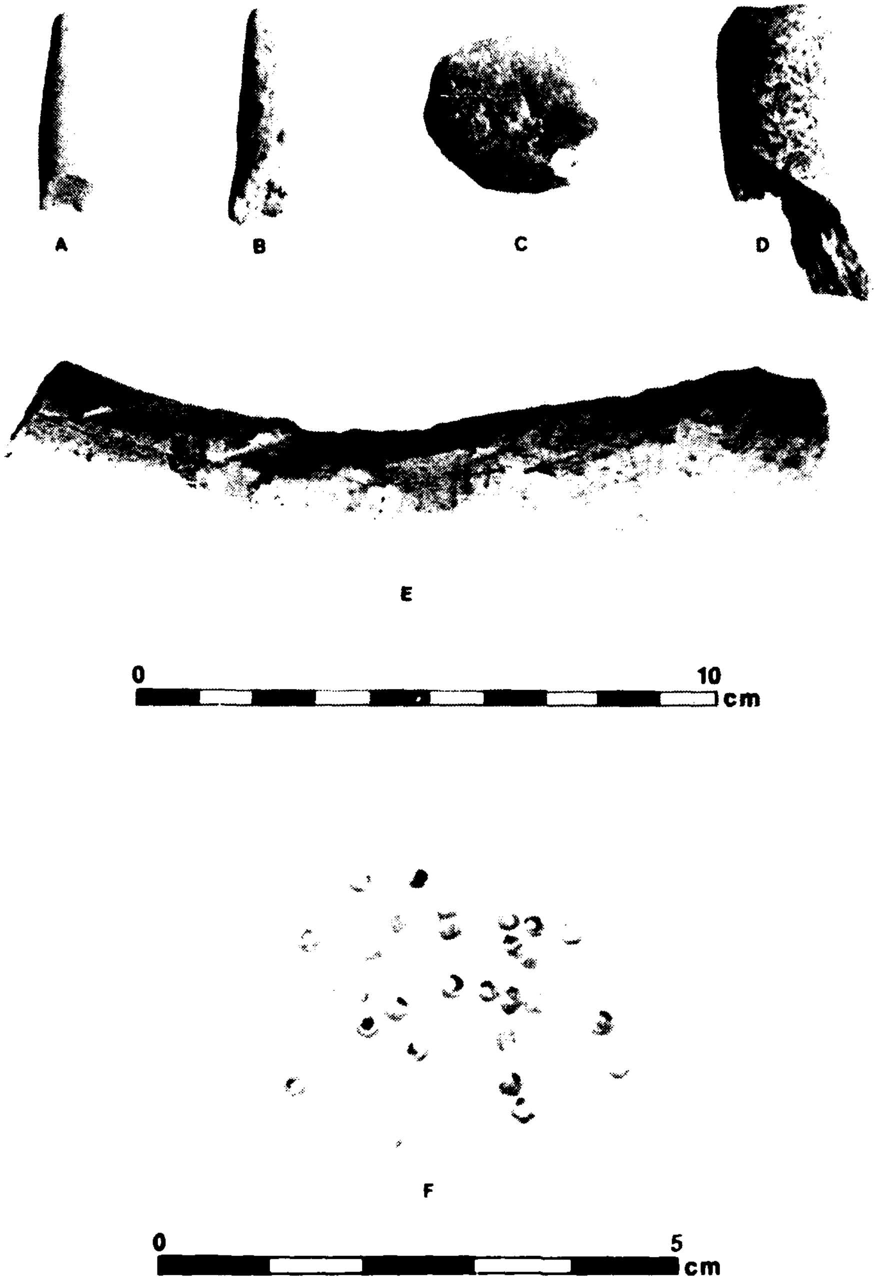


FIGURE 57. BONE AND ANTLER ARTIFACTS.

a-b: Awl/flaker
c: Graved smoother
d: Smoother fragment
e: Handle
f: Seed beads

Cylinders (Figure 56;k-1)

Four bone cylinders were recovered during the excavations at Bug Hill. One, from Burial 6 in the Central Block, was 1.7 cm long and 0.5 cm wide. This bone was bifacially flaked to a broad chisel-like surface at each end. The chisel ends were not on the same plane but rotated about 30 degrees. The entire bone was smoothed and highly polished. The other three cylinders were recovered from the Southern Block. All three were broken at each end and appear to be longer than the one described above and all showed evidence of burning. All were highly polished.

Fishhook (Figure 56;m)

One fishhook fragment was recovered from Stratum IIa of the Central Block (Unit 5C, level 8). The fishhook appears to have been manufactured from a bone of a large animal, possibly a deer. Both the tip and the upper shaft were broken but the bend of the hook showed the standard fishhook shape. Striation, smoothing and polishing, resulting from its manufacture were evident. The fishhook was 1.3 cm wide at its widest segment. Its length was indeterminable.

Bird Bone Perforator

One perforator was found in Stratum IIb of the Central Block (Unit 5B, level 10). This tool was manufactured from a long bone of a large bird. It was 5.9 cm long. The perforator end was made by cutting the bone at about a 40 degree angle one centimeter from the tip and tapering the cut toward the tip. The cut area was then smoothed. Very slight polish is evident on the tool.

Miscellaneous Modified Bone

In addition to the bone described above, a number of other modified bones were recovered from the excavations. These are described below.

A highly polished bone was found in Stratum II, of the Southern Block (Figure 56;o). It was a solid bone made from a large mammal. This artifact had two short segments joined at a right angle. The bone expanded slightly toward the center of one of the segments. There was a slight indentation or crease where the two shafts met. The bone was very smoothed with no evidence of flaking or striations.

One drilled deer metapodial was recovered from Stratum III of the Southern Block. This bone, the only entire deer long bone considered in this study, had a hole 0.7 cm in diameter punched through the posterior to anterior sides right below the distal epiphysis. The hole on the anterior side is very irregular. No evidence of smoothing, polishing or use is evident near the hole or on the entire bone.

One deer bone fragment excavated from Stratum III of Test Pit 4 (level 13), exhibited three ridges along one face of its long axis. The other side showed the natural ridge structure of a deer metapodial. The bone fragment was small, 1 cm by 1.6 cm. It exhibited a slight polish.

Green-Stained Bone

Forty-eight bones excavated from the Bug Hill site exhibited a greenish coloration distributed randomly on the bone. These bones were found in all strata between the plowzone and Stratum III, though most were recovered from Stratum II. Table 25 indicates their distribution by class for the Southern Block.

TABLE 25. GREEN-STAINED BONE

	Plowzone	Stratum II	Stratum III	O.S.III	Total
Reptilia (reptile)	2	7			9
Mammalia (mammal)	4	6		1	11
Unidentified Bone	3	6	1		10
Total	9	19	1	1	30

The green stained bone does not represent worked bone. The inclusion of this category stems from the possibility that the tint may indicate the presence of copper. It is also true, however, that subjecting bone to intense heat will leave a similar green discoloration.

Over 40 percent of the green stained bone at Bug Hill was found near the interface of Stratum II and the fill of Occupational Surface III in the Southern Block. These bones were probably exposed to intense heat during the burning of Structure 2 and this seems the most likely explanation for their green color.

The remaining green stained bones at the site are not as easily explained. Most (17 pieces) were recovered from the plowzone and are of little interpretive value. The few pieces from Strata I, II, and III are dispersed throughout the site. Most of these have clearly been burned; but a few have not and may actually represent copper stained bone.

Antler

Awl/Flakers (Figure 57;a-b)

A total of 65 deer antler tine awl/flakers were identified in the Bug Hill collection. In most cases, these appear to have been used without further modification although a few showed some smoothing. Several exhibited some battering at the tips and most had a slight polish. An additional four antler fragments, probably from these awl/flakers were also identified.

Smoothers (Figure 57;c-d)

Two antler smoothers were recovered from the Bug Hill excavations. One was excavated from Stratum IIb of the Central Block (Unit 5A, level 10). This tool was made from the beam of the deer antler. The tool was manufactured by cutting the antler perpendicular to the long axis in a segment 14.2 cm long. The antler segment was slightly curved. One half of the broad surface of one end was smoothed, presumably from use. There were no flake scars. Considerable rodent gnawing was evident along the length of the tool.

The other antler smoother, recovered from Stratum II of Test Pit 11 (level 6), was made from the burr of the antler. The smoother was broken, but almost the entire burr area was intact. This area had been smoothed through use. There was no evidence of flake scars.

Handle (Figure 57;e)

One deer antler handle was noted from Stratum II of the Southern Block. This antler tool was incomplete. One end was cut perpendicular to the long axis of the antler and the cut area was slightly rounded apparently from flaking. A hole about 0.9 cm in diameter was drilled longitudinally into the antler and, by so doing, provided a socket for the attachment of a tool.

Discussion

In general, the worked bone, antler and shell collection from the 1981-82 field season is much sparser and in poorer condition than that recovered in 1979. By and large this situation reflects differences in the areas of the site excavated during each field season. In 1979, 36 sq m were excavated near the top of the mound where bone and shell preservation is the best. In contrast, only 16 sq m were excavated in the same area in 1981-82. Not surprisingly the only calcified artifacts recovered during the second field season were obtained from the Central Block. Unlike the lithic and ceramic collections, then, the modified shell and bone recovered from Bug Hill probably represents only a small sample of the tools actually used.

The collection is dominated by three categories: 1) awls and flakers; 2) shell or bone seed beads; and 3) green-stained bone. The remaining categories are represented by only a few pieces each. Of the three major categories, the awl/flaker group is the only one with clear functional ties. These tools are distributed throughout the site with a slight concentration noted in Stratum II and the fill of Structures 1 and 2 (Occupational Surface III) of the Southern Block.

All the seed beads were found in a burial context. Most were found dispersed throughout Burial 6, a multiple burial of two teenage males. The beads may have been used as status markers, for also found in the burial pit was a boatstone and a well-polished flaker.

The nature of the green-stained bone is unclear. Vehik (1982a:121) has suggested that one possible cause for this coloration is contact with copper. Another cause could be rapid burning which is known to produce a similar green tint. At Bug Hill both causes may be at work for some pieces were burned; others, however, were not.

MISCELLANEOUS ARTIFACTS

In addition to prehistoric artifacts of stone, clay and bone, a wide variety of other tools and culturally modified materials were recovered during the 1981-82 field season at Bug Hill. Each of these categories is discussed below.

Fire-Cracked Rock

Fire-cracked rocks are perhaps the best represented category of cultural remains recovered at Bug Hill. These rocks, primarily locally available sandstone, were apparently brought to the site in fairly large pieces. They were then placed on or near a fire, presumably in association with food preparation activities (Driver and Massey 1951). After repeated hunting and cooking, the rocks fractured and were discarded.

In all, 4034.08 kg (4.03 short tons) of fire-cracked rock were recovered from the 1981-82 excavations. The distribution of this rock, as well as the number of grams per provenience, is presented in Table 26.

The highest concentration of fire-cracked rock was found on the slopes of the mound in the plowzone and Stratum II. The distribution of fire-cracked rock appears to be roughly equal in all directions. This result seems to be more an artifact of surface run-off than cultural practices.

Fire-cracked rock did not only characterize Bug Hill itself, but the smaller rise of Locality A as well. Although fire-cracked rock was not as concentrated at Locality A, given the lack of midden deposits and the proposed special purpose nature of the locale, the sheer amount of rock in this area is surprising.

No attempt was made to classify fire-cracked rock fragments on the basis of fracture scars (House and Smith 1975). However, each piece was examined to determine whether it was formerly part of a tool. In the process we noted that a fairly large number of fragments had formerly been parts of grinding tools. It is likely then that large grinding tools, such as metates were discarded into the fire where they subsequently fractured into small pieces.

Whatever else this analysis suggests, it indicates that activities associated with fire-cracked rock were widespread throughout the site. Whether this indicates extensive use or activities concentrated in a few areas followed by rather uniform methods of disposal is unclear. There does not appear to be significant change in these activities through time. Thus, regardless of shifts in other aspects of cultural behavior, the use of fire-cracked rock remained a stable and constant feature of life at Bug Hill.

Daub/Burned Clay

Over 29 kg (63.94 lbs) of burned clay were recovered from the 1981-82 excavations at Bug Hill (Table 26). Of the total amount of burned clay recovered, 26.88 kg (59.27 lbs) or over 90 percent, came from the Southern Block. Most of the burned clay was concentrated in either Occupational Surfaces I (439.6 gr/provenience), or III (149.1 gr/provenience). Most of the burned clay from the Southern Block was probably used to strengthen and protect the wooden frames of structures. Traditionally, burned clay used in this manner is termed daub and is often tempered with plant material. Indeed much of the burned clay from the Southern Block contained plant (in almost every case, cane) impressions.

Perhaps the most intriguing aspect of the distribution of burned clay in the Southern Block is the fact that nearly three times more daub per provenience was associated with Structure 3 (Occupational Surface I) than with Structures 1 and 2 (Occupational Surface III). This situation probably represents differences in building practices. Structure 3 appears to have a bee-hive shaped structure supported by a light wooden frame. After the frame was put in place, it was probably smothered with mud which then baked and turned to daub. In contrast, Structures 1 and 2 were well-built houses, constructed to be more-or-less permanent for several years. In these cases, daub was probably placed between logs comprising the walls to act more as insulation than support.

Outside the Southern Block, burned clay was found in smaller quantities throughout the rest of the site. These fragments probably do not represent structures but merely burning events. One minor concentration of burned clay was noted in Stratum III of the Northern Block and was probably associated with a small isolated hearth (Feature 6).

TABLE 26. DISTRIBUTION OF FIRE-CRACKED ROCK AND DAUB.

	Total Daub/ Burned Clay in Grams	Daub/Burned Clay Grams/ sq. m Level	Total Fire-Cracked Rock in Grams	Fire-cracked Rock-Grams/ sq. m Level
Southern Block				
Ip	6,440	37.2	613,370	3545.5
O.S. I	3,517	439.6	13,706	1713.3
II	3,829	21.3	670,406	3724.5
III	302	8.4	106,735	2964.9
O.S. III	12,525	149.1	257,529	3065.8
IV	269	2.6	60,171	578.6
Central Block				
Ip	110	2.3	104,223	2171.3
I	127	2.7	108,109	2252.3
IIa	57	1.8	42,427	1325.8
IIb	25	.8	32,638	1019.9
III	82	.9	81,037	844.1
IV	7	.2	28,617	596.2
Northern Block				
Ip	220	3.0	289,970	3972.2
II	191	3.8	204,062	4081.2
III	868	6.2	200,164	1429.7
IV	0	0	5,274	263.7
Site Peripheries				
Ip	221	2.3	426,788	4445.7
II	370	2.7	565,214	4156.0
III	40	1.7	38,428	1601.2
IV	2	.1	38,079	453.3
Locality A				
Ip	3	.4	19,976	2479.0
II	35	.9	120,330	3008.3
IV	6	.7	6,827	758.6
TOTALS				
Ip	6,994	17.6	1,454,327	3654.1
I	127	2.7	108,109	2252.3
II	20,549	36.6	1,906,312	3392.0
III	1,292	4.4	426,364	1460.2
IV	284	1.1	138,968	524.4

Copper

One thin sheet of badly-corroded copper was found in the plowzone (N53E17-level 3) of the Northern Block. The piece measured 5.4 cm in length and 4.1 cm in width. There was no evidence of pounding and the edge appeared worked by machine. The piece probably dates to the historic period.

Natural Minerals and Fossils

A number of unmodified minerals and fossils were found on the site. The minerals include galena (Southern Block - Occupational Surface III [1]), quartz (Northern Block - Stratum III [1]) and natural asphalt (Central Block - Stratum IIa [1]; Northern Block - Stratum II [1]; Test Pit 6 - Stratum Ip [1]). A total of ten fossils were recovered during the excavations. The distribution of these specimens is presented in Table 27.

TABLE 27. DISTRIBUTION OF FOSSILS

Southern Block		Northern Block	Site Peripheries			
Ip	O.S. III	III	Ip	II	III	Total
3	1	2	1	2	1	10

Historic Artifactual Material

A total of 160 historic artifacts were recovered during the 1981-82 field season at Bug Hill (Table 28). The vast majority of the historic cultural material was found in the plowzone. Most of the material was not of great age, and could still be manufactured today. There were, however, some older artifacts. One small and undecorated pearlware sherd was recovered from the Northern Block. The dates of pearlware's greatest popularity in the United States have been estimated at between 1810 and 1830 (Noel Hume 1970). Two other artifacts, dark green patent medicine bottle fragments, exhibit a pebbly surface resembling powdered metal. This would indicate a date of manufacture prior to the introduction of the chilled iron mold technique, ca. 1870 (Lorrain 1968:41). Another bottle glass fragment, originally decorated with manganese oxide that has subsequently been solarized to an amethyst color, dates to between about 1880 and 1915 (Newman 1970:74). Otherwise, the artifacts recovered from Bug Hill are common to both the 19th and 20th centuries, or are indubitably modern.

TABLE 28. HISTORIC ARTIFACTS

	Southern Block		Central Block		Northern Block	Site Peripheries		Locality A		TOTALS
	Ip	II	Ip	I	Ip	Ip	II	Ip	II	
Ceramics										
Pearlware, undecorated					1					1
Ironstone, undecorated	4		8		1	2				15
feather-edged, blue	1									1
spongeware, blue			1							1
annular decoration, brown	1									1
black						1				1
blue	1									1
undetermined decoration	1									1
green			1			1				2
red					1					1
green and red	1		4		3	2				10
Stoneware, salt glaze, undecorated			1							1
Crude earthern ware, lead glaze, undecorated	1									1
Glass										
Patent medicine bottles, body fragment, pebbly surface, dark green			2							2
Unidentified bottles, body fragment, smooth surface, aqua			1							1
clear	2									2
brown	1									1
light greeen			1		1		1			2
Melted glass, aqua			4							4
Metal										
Iron, machine cut nails			5			9				14
modern wire nails						1				1
plow harness fragment	1									1
harness ring	1					1				2
large staple								1		1
large washer	1									1
wire fragment									1	2
unidentified			3	1		5		1	1	11
Steel, gun trigger			1							1
Brass, brad			1							1
Lead, fishing weight					1					1
Tin Alloy, can fragments	2		7		1			50		60
unidentified		1							13	14
Miscellaneous										
plastic button, white						1				1
TOTALS	18	1	40	1	9	23	1	52	15	160

From the artifactual assemblage alone, we cannot determine whether an historic structure was ever located in the vicinity of the site. Even so, the past pursuit of typically rural activities can be demonstrated, especially within the metal assemblage. Farming, for example, is certainly indicated with the presence of harness rings and maybe even wire fragments. Another indication of plowing, albeit indirect, is the wide distribution across the various sectors of Bug Hill of ironstone sherds of undetermined green and red decoration. Although the fragments were too small to identify the motif, it seems very likely that they bore the same design. They are very possibly from the same vessel.

In sum, the historic artifacts recovered from the excavations at Bug Hill do not pre-date the early 19th century and the vast majority actually date much later. The artifacts are not indicative of any activities unexpected in a rural environment.

CHAPTER NINE

PALYNOLOGICAL INVESTIGATION

by

Glen G. Fredlund
and
William C. Johnson

Introduction

The palynological investigation at the Bug Hill archaeological site was directed towards two goals: 1) the reconstruction of paleoenvironmental conditions that prevailed during the occupation of the site; and 2) the documentation of botanical resources used by the prehistoric inhabitants.

There is regional evidence for a climatic variation significantly strong enough to affect the composition of the vegetation and, therefore, the resources available at the Bug Hill site (Albert 1981; Hall 1977a, 1977b, 1977c, 1978, 1980, 1982; Henry et al. 1979). Although pollen preservation was less than ideal, evidence of paleoenvironmental variation is present at Bug Hill.

The modern vegetation of the region is an oak/pine/hickory association (Blair and Hubbell 1938; Braun 1950; Rice and Penfound 1951). Dominant species of this community include short leaf pine (*Pinus echincta*), white oak (*Quercus alba*), post oak (*Q. stellata*), blackjack oak (*Q. marilandica*), mockernut hickory (*Carya alba*), sagbark hickory (*C. ovata*), pignut hickory (*C. glabra*) and black hickory (*C. texana*).

Pristine or 'pre-settlement' vegetation of the Bug Hill area was reconstructed from field notes and plates of 1895 and 1896 Federal Land Surveys (Bobalik 1977). Bobalik recognized three vegetation zones within two kilometers of the site: 1) prairie; 2) lowland forests; and 3) upland forests. This upland forest zone represents the regional oak/pine/hickory association. In the lowland forest an oak/elm/hickory/ash association dominates. Numerous other mesic species (e.g., hackberry, linden, sugar maple, red maple, sycamore, walnut and dogwood) are also common in these lowland areas. Further, these lowland areas exhibited extensive prairie openings. These areas were dominated by grasses (including bluestems, switch grass and Indian grass), but also include a variety of shrubs and forbs (Blair and Hubbell 1938; Bobalik 1977).

These regional plant associations did not evolve until post-Wisconsin times (ca. 10,000 B.P.). Prior to this, the vegetation community probably had a significant boreal constituent. There is good evidence that a spruce/pine forest predominated in the Ozarks in the late Wisconsin (Mehringer et al. 1968; King 1973; King and Lindsay 1976). Spruce and larch were displaced as far south as north-central Louisiana (Delcourt and Delcourt 1981; Kolb and Fredlund 1981); it is certain that the vegetation of the Ouachitas was also affected during this final glacial advance.

By 8000 B.C., the major plant associations of the region had probably developed. Palynological evidence from Muscotah Marsh in northeastern Kansas shows that by this time, the oak/savanna and plains grasslands had expanded into areas previously occupied by the spruce/pine Farmdalian forest (Gruger 1973). The palynological spectrum at the Domebo site in central Oklahoma supports this contention (Wilson 1966). Grass and composite pollen comprised 80 to 90 percent of the pollen at the Domebo site, while aboreal pollen had all but disappeared by 8000 B.C. Unfortunately, no radiometrically-dated palynological record for this period is available for southeastern Oklahoma. Although the major floral groups in the Bug Hill area have persisted throughout the Holocene, they have not remained in equilibrium. Changes in precipitation amounts, seasonality and frequency of burning have been the major forces affecting this equilibrium. Beginning about 6000 B.C. and lasting about 3000 years was a major dry episode, the Altithermal. During this period of lower precipitation, there were major expansions of oak/savanna and prairie grasslands along the eastern border of the Great Plains (Wright 1968; Gruger 1973; Bernabo and Webb 1977).

At the end of the Altithermal, there was an extended period of climatic amelioration. This is clearly illustrated on a regional basis by the data from Ferndale Bog in southeastern Oklahoma (Albert 1981). The lowest zone of this record representing the Altithermal was dominated by grasses and other herbaceous pollen taxa with a relatively low arboreal pollen complement. About 2500 B.C., the arboreal pollen began increasing. This period of arboreal pollen increase (dominated by oak and hickory) continued until about 250 A.D.

At that time (ca. 250 A.D.), a significant change in the pollen spectra occurs at Ferndale Bog, i.e., the rise of the pines. Prior to this event, pine pollen had been low (five to 15 percent) since the Altithermal (indicating that pine was unimportant in the overall forest composition). After about A.D. 250, pine becomes more important in the Ferndale Bog pollen profile, oscillating between 15 and 50 percent of the pollen sum (Albert 1981:69). It has long been observed that pine, and in particular shortleaf pine (Pinus echinata) and loblolly pine (P. taeda), may out compete broadleaf tress (e.g., oaks and hickories) if fire is regularly induced (Lyell 1849, Little 1953, Leopold 1967). This first rise of pine and the subsequent higher oscillations in pine pollen are generally accompanied by the influx of charcoal at Ferndale Bog (Albert 1981:69). Periodic burning could also promote erosion and may have affected the influx of sediment and pollen at Ferndale. Although burning could occur yearly, given the annual precipitation cycle, periods of drier climate would certainly intensify the effects of this variable in the ecological system. The fire component could explain the instability in the forest most apparent in the last 500 years of the Ferndale Bog record.

A second recent palynological study site, Natural Lake (Albert 1981), is located only a few miles from the Bug Hill site itself. This pollen record spans the period from about A.D. 500 to 1500. Perplexingly, it does not show the same dynamics in regional vegetation as Ferndale Bog. At Natural Lake, the pollen record indicates the oak/pine hickory forest endured throughout the 2000 years of sediment accumulation (Albert 1981:65). The conditions gradually change towards a more oak-dominated (mesic) forest till about 1000 B.P. After this peak, there is a decline in oak pollen complimented by an increase in non-arboreal pollen. This probable shift towards drier conditions continues until about 600 years B.P. There is a hint of the return of more mesic conditions after this, but it is obscured by truncation of the lake sediments (Albert 1981). Absent from the Natural Lake palynological record is any hint of a rise in the pines observed at Ferndale Bog. Pines comprise a stable 10 to 20 percent of the pollen sum, except for the marked decline to five percent at the upper, truncated end of the core. Given the assumed regional nature of wind dispersed pollen types such as pine and oak, difference between the two nearby sites of Natural Lake and Ferndale Bog remain an enigma.

In northeastern Oklahoma, evidence for Holocene environmental changes have been accumulating (Hall 1977a, 1977b and 1977c, 1978a, 1980, 1981, 1982; Henry 1978; Henry et al. 1979). These pollen and snail records agree with the general trends observed at Natural Lake. Although exact dates vary, there was a period of generally more moist climatic conditions between A.D. 500 and A.D. 850, followed by a xeric trend in the snail and pollen biotic indicators. As Hall (1982) has noted, these data do not support previously proposed models for the climate of the southern plains (Bryson et al. 1970). The more mesic period between A.D. 500 and A.D. 850 corresponds chronologically with the proposed sub-Atlantic episodes, but is the climatic inverse (i.e., moister rather than wetter conditions).

Sampling Procedures

Sediment samples for palynological extractions were collected by W. Johnson on October 30, 1981. Each sample collected was relatively large (ca. 2 kg) in order to assure that an adequate quantity would be available for multiple extraction attempts if necessary. Every precaution was used to reduce the potential of contamination during the collection of samples. A clean trowel was used to cut back the profile and place each sample into a sterile bag.

In total, 28 sediment samples were collected. Most of these were taken in two series: a column of nine samples from the eastern wall of Test Pit 6 and a column of 13 samples from the eastern wall of the Southern Block (Test Pits 9 and 1). Four additional samples were taken from the Central Block (Test Pit 5). A single post mold from Structure 2 was also sampled in the Southern Block.

Laboratory Procedures

Twenty-four of the samples collected were processed. Those organic rich samples from the upper levels of the site (Figure 58) presented some special problems for the extraction of pollen. It was necessary to modify the standard extraction procedure. Several attempts at palynomorph extraction were made on many of these samples. In all, 38 separate attempts were made to obtain a polynomorph-rich, but clean residue from the Bug Hill sediments.

The University of Kansas (KU) Palynological Laboratory, as a standard procedure, employs a heavy liquid flotation technique to separate palynomorphs and other light organics from the bulk of sediments (modified from A. Horowitz, personal communication). This technique is less severe than more traditional hydroflucric (HF) acid digestion and diminished differential separation of pollen and spore types (Bjorck et al. 1978). Heavy liquid flotation has proven to be particularly appropriate in alluvial and other clastic sediments where palynomorph concentration may be low (i.e., much larger samples can be utilized). In the standard KU laboratory procedure, a heavy liquid (i.e., zinc bromide [$ZnBr_2$] or zince chloride [$ZnCl_2$]) with a specific gravity of 1.95 is used to hold lighter organics (including pollen with an average specific gravity of 1.86) in suspension while the heavier silicious clastics sink. The organics, including the pollen, may then be recovered by reducing the specific gravity of the liquid by dilution. However, the organic content of the Bug Hill samples was such that the normal quantities of heavy liquid used could not hold all of the organics in suspension. Up tò six times as much mostly heavy liquids were needed to separate all of the organics from the rest of the sediments in Bug Hill. The resulting residue was a thick black organic colloid which was not easily oxidized by standard palynological techniques (i.e., the use of potassium hydroxide [2OH] or nitric acid [HNO_3]. This organic colloid obscured the palynomorphs thereby rendering identification and counting difficult, if not impossible. Various techniques and oxidizing reagents were experimented with in an effort to overcome this problem. In addition,

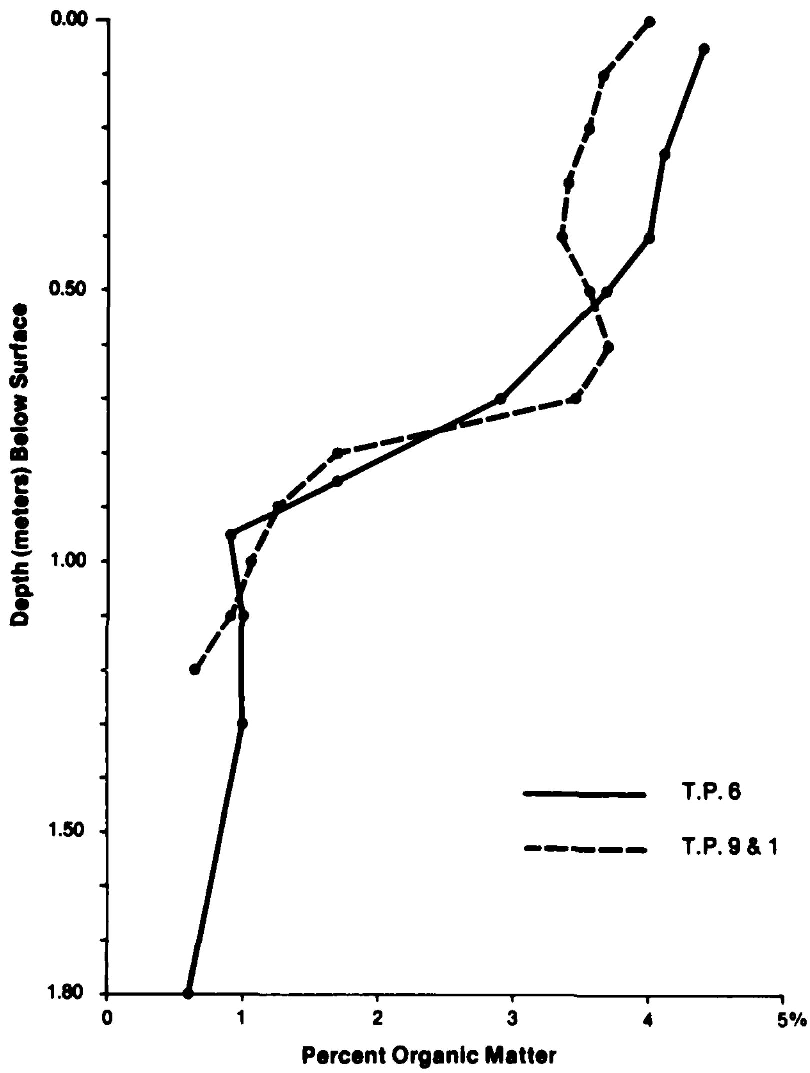


FIGURE 58. ORGANIC MATTER PROFILES.

Eucalyptus pollen, an exotic type, was added to each of the laboratory preparations prior to extraction. The successful recovery of these exotic grains in the final residues insured that the indigenous palynomorphs were not being destroyed or lost during the processing.

The best procedure developed for the Bug Hill sediments was to oxidize the colloid forming soil organics prior to heavy liquid flotation. Five percent potassium hydroxide was used for this oxidation step. This not only cleared the samples better than post-heavy liquid treatment, but also greatly reduced the quantity of the heavy liquid used. The drawback to this is that potassium hydroxide also oxidizes pollen as well as the other organics, but a greater percentage of damaged or corroded pollen is better than the alternative, unusable dirty residue. After thorough washing, the residues from these extractions were transferred to one-dram vials containing glycerial and basic fuchsin, an organic stain.

Eight permanent glass microscope slides were made from each of the clean residues. Standard 22 mm X 40 mm cover slips were sealed with paraffin. The entire area of the cover slip for each slide was scanned under 200x magnification with up to 1000x magnification being used to identify certain problematic palynomorphs. Standard references (e.g., Kapp 1969; Moore and Webb 1978; and Lieux 1980) and modern reference slides aided in the identifications of the observed microfossils. Photomicrographs of representative palynomorphs were made using a Nikon camera system mounted on a research grade Leitz microscope.

Additional soil analyses were also carried out on many of the samples. Particle size distribution (the hydrometer method) and percent organic matter (the Walkley Black method) were determined to supplement the field observations of color, texture and pH. These additional analyses allow a more direct comparison between previous soil, geomorphic studies at Bug Hill (see Chapter Three) and the columns analyzed for fossil palynomorphs.

Results

Fourteen of the samples processed contained fossil palynomorphs. The residues of the remainder contained only modern Eucalyptus marker grains introduced during the processing. All of these samples containing fossil palynomorphs were from the organic rich upper 80 cm of the midden. Below this depth, organic content and palynological preservation rapidly declines (Figure 58).

Three major classes of fossil palynomorphs were recognized: pollen, Pteridophyte spores and fungal spores and imperfecti. Pollen grains are the male genelophyte of the true flowering plants; the gemnosperms and angiosperms. Since many pollen types are released in great quantities and dispersed randomly by wind over a wide area, they may be quantitatively used to reconstruct regional vegetation (Faegri and Iversen 1975). The second class, Pteridophyta, includes those vascular plants which do not bear seeds or produce true flowers (or pollen). These include the club mosses, the horsetails, the ferns and their allies. Also included in this group for convenience of this study are the Bryophytes. These include the mosses and liverworts which although not truely vascular, are homosporous (produce only one type of spore) as Pteridophytes. Spores from these plants, like the pollen of many small herbaceous or zoophilously pollenated plants are not as widely dispersed and reflect only local conditions of the immediate site.

The third palynological class are comprised of the fungi. Unlike pollen and spores of the pteriotophytes, fungi are not normally included in palynological studies. With few exceptions (e.g., Van Gell 1978), paleoecologists have not made use of these data while ecologists and botanists have pursued them persistently (e.g., Christensen 1981). Environmental factors affect the composition of fungal communities just as they do communities of vascular plants (for examples in Oklahoma see England and Rice 1957; Mallik and Rice 1966). The palynomorphs resulting from these communities often reflect environmental changes in much the same way that pollen does. In soils, where fungi are known to be a major contributer to the distruction of pollen (Havinga 1964), it is not uncommon to find only fungal palynomorphs preserved. They deserve more attention than is commonly given them by paleoecologists.

Interpreting fungal palynomorph assemblages, however, has its unique problems and assumptions. Unlike pollen, fungal palynomorphs are produced and dispersed quite differently. They may be produced in the soil, on the soil by fruiting bodies (e.g., mushrooms) or on host plants. The problems of differential production, dispersal and preservation of fungi must be realized as they have been for pollen, before confident interpretations are possible.

Taxonomy is a major problem for fungal palynologists. Even mycologists dealing with living organisms are frequently restricted to a form-general classification. A single form-genera of the imperfecti (non-sexual stage) may represent a number of different unrelated fungal species. Other fungi do not have perfect (sexual) stages. The palynologist has an even more difficult task since he or she cannot sprout fossil/fungal palynomorphs to observe the other states in their life cycle. Fungi are not homospores. A single fungal species may be represented by a number of different palynomorphs each representing a different state of development in the organism. These problems only complicate the task of making paleoecological interpretations.

Thirty-two fungal palynomorphs types were recognized from Bug Hill (Table 29). Most of these are ubiquitous types representing yeasts, penicilliums and other cosmopolitan fungi. Other fungal palynomorphs represent more specialized organisms. Three of these potential paleoecological marker types will be considered here. They are: 1) Endogone; 2) Neurospore; and 3) Puccinia types.

TABLE 29. OCCURRENCE OF POLLEN TAXA IN TEST PITS 5 AND 6.

	Test Pit 5 (Central Block)	Test Pit 6 (Depth Below Surface)				
Arboreal	70-80 cm	5-15 cm	25-35 cm	40-50 cm	50-60 cm	70-80 cm
Pinus	*	*	*	*		
TCT Type		*	*		*	
Quercus		*	*	*	*	
Ulmus	*	*	*			
Celtis		*	*			
Liquidambar	*	*	*			*
Carya		*	*			*
Fraxinus			*			
Alnus			*			
Rhus			*	*		
Acer			*			
Salix				*		
Cornus				*		
Non-Arboreal						
Gramineae	*	*	*	*	*	*
Ambrosia	*	*	*	*	*	*
Compositae-	*	*	*	*		
H.S. Type		*	*	*		
Cheno-Am Type		*	*	*		
Liliaceae Type		*	*	*		
Caryophyllaceae		*	*			
Malvaceae			*			
Polygonum			*			
Cyperaceae			*			
Typha			*			
Umbelliferae			*	*		
Leguminosae Type			*	*	*	
Saxifragaceae Type			*	*	*	
Percentage of Indeterminate Pollen	20	22	34	46	6	50
Pollen Sum	10	41	130	92	96	8

The Endogone type resemble Zea pollen in its general appearance. It consists of a large (50 to 100 microns), thick walled, sheriodal mass with a singular aperature (Figure 59). Often a fragment of fungal hyphi is attached to this aperature. The genus-form Endogone is most often associated with symbiotic mycorrhiza fungi which infect the roots of woody plants (Mosse and Bowen 1968; Gerdemann and Trappe 1975). The Endogone spores are produced within the sporocarps formed on the infected roots and dispersed in the soil. This type is, therefore, associated with wooded as opposed to prairie vegetations.

Neurospora is a football-shaped form about 35 microns in length. Aspidcrate spores occur on both ends of this single cell (Figure 59). Rarely does this type display striates or ridges running the length of the spore. Neurospora are known to colonize burnt soil and vegetations (Webster 1980). Their frequency is related to frequency of burning.

The third type of fungal palynomorph identified as potentially important in paleoenvironmental interpretations is the Puccinia type. These are most commonly a triad of cells about 20 microns in diameter. They appear orange rather than brown as most fungal spores. This coloring along with the low echimate sculpting results in a resemblance to ambrosia type pollen (see Figure 59). These are the teliospores of the Pucciniaceae, a family of the Uredinales or rusts. Puccineaceae rusts grow as parasites on forbs and especially grasses (Alexopoulos and Mims 1979). The teliospores are produced and shed from these host plants. The occurrence of these fungal spores as well as the pterotophyte spores and pollen from Bug Hill are reported below.

Test Pit 6

The distribution of fossil palynomorph from Test Pit 6 are shown on Figure 60 and Table 29. Fossil palynomorphs persisted only in the upper five samples of this column. Below this level (80 cm below surface), a significant change in the partical size distribution and percent organic matter occurs (Figure 60), denoting the contact between the Bug Hill midden and older terraces sediments (see Chapter Three).

The distribution of the three major palynomorph classes is also shown in Figure 60. Fungal palynomorphs predominate in all but one of the five samples. This sample (50 to 60 cm below surface) curiously contains a much higher relative frequency of pollen. but a much lower diversity (see discussion below). In the lower most two samples from Test Pit 6, fungal occurrence was so low that quantitative representation may be misleading.

The distribution of the three ecologically significant fungal taxa are shown on the right of Figure 60. The forest indicator, Endogone type, shows a high concentration in the upper and lower samples of the column. Neuospora, the indicator of burning dominates

FIGURE 59. TYPE POLLEN AND SPORE MICROPHOTOGRAPHS.

a: *Endogone* type
b: *Neuospora* type
c: *Puccinia* type
d: *Pinus*
e: Saxifragaceae type
f: *Ambrosia* type
g: Leguminosae type
h: *Helianthus* (H.S. type Compositae) in tetrad form

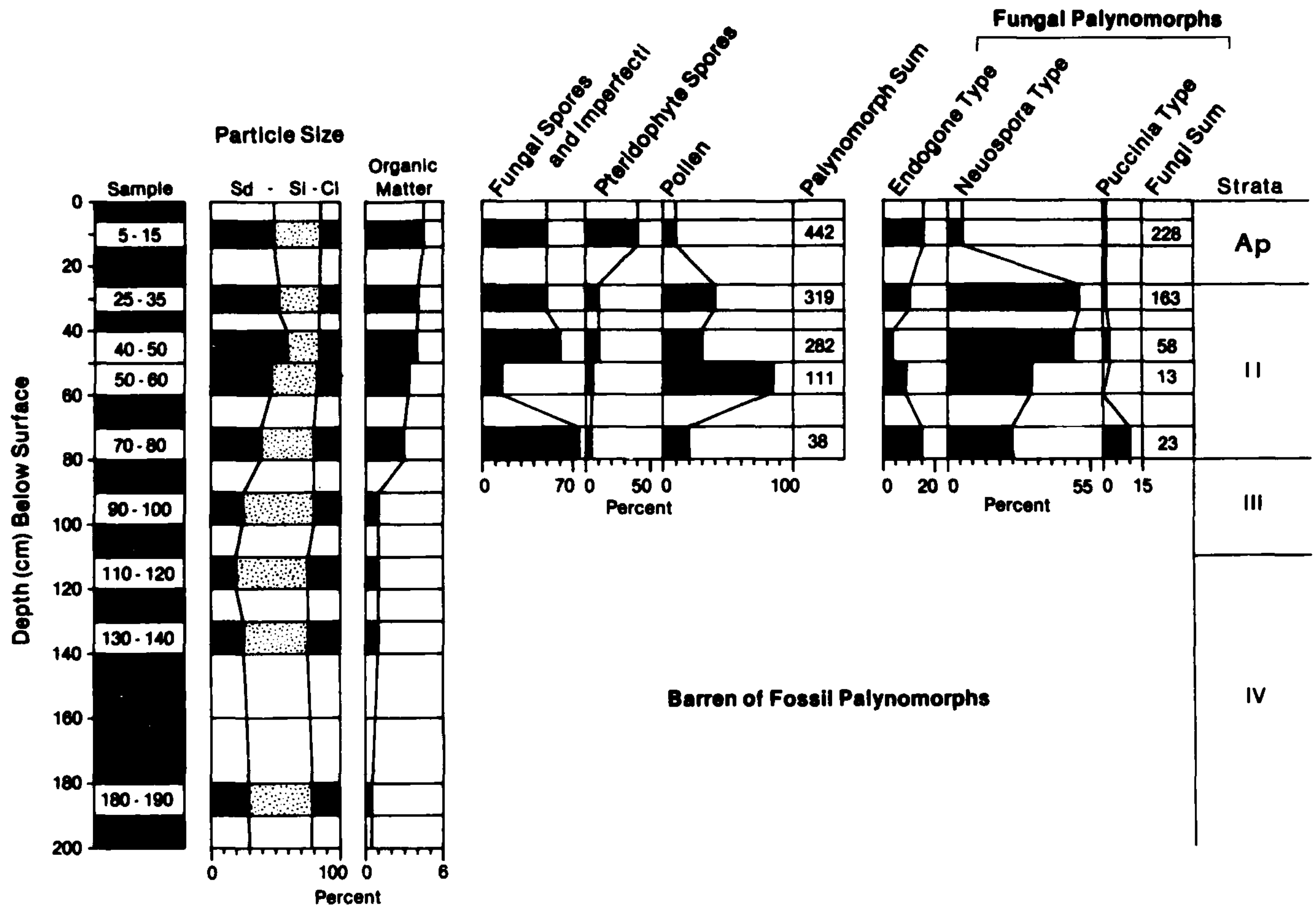


FIGURE 60. TEST PIT 6, DISTRIBUTION OF MAJOR PALYNOMORPH CLASSES AND FUNGAL TYPES.

in the middle of this column (25 to 50 cm below surface). The herbaceous parasite Paccinia is uncommon throughout the column. Even in the lowest sample (70 to 80 cm below surface) the occurrence of ten percent Puccinia actually represents only two spores.

Spores of the Ophioglossaceae family are the only common pteridophytes encountered in the Test Pit 6 column. The rattlesnake fern (Botrychium virginianum) which inhabits humid rich woods and thickets of most of central and eastern North America, is typical of this family. Spores of this type were most abundant in the upper sample five to 15 cm). They occurred only occasionally in lower samples. Fern spores including Osmunda (i.e., the royal fern and cinnamon fern) occurred rarely as did an occasional Bryophyte (moss) spore.

Pollen taxa identified from Test Pit 6 are shown on Table 29. Due to low pollen counts and a high percentage of indeterminate pollen grains, only the presence of the pollen taxa are reported. Biochemical and mechanical damage precluded classification of many pollen grains. This deterioration appears to be progressive as the percentage of indeterminate grains generally increases with depth (Hall 1981). The diversity of pollen taxa through this column is, however, peculiar. The uppermost sample (five to 15 cm) should contain a diverse well-preserved, assemblage representing the modern vegetation, but does not. The next lowest sample (25 to 35 cm) exhibited a more diverse assemblage. This deviation from the expected may be the result of plowing of the central area of the site within historic times. Such plowing could promote oxidation and downward translocation of pollen in this column. Noteworthy is the absence of Zea pollen from the very site which was reported to once have been a cornfield in the historic period.

Both of the upper two samples contained pollen taxa reflecting the regional forest included: Pinus (pine), Quercus (oak), Carya (hickory), Ulmus (elm), Celtis (hackberry), Liguidambar (sweet gum) and TCT type (in this case Taxcdium, bald cypress). The 25 to 35 cm sample contained additional arboreal taxa expected in this regional forest (i.e., Fraxinus, ash; Alnus, alder; and Rhus, sumac). In the samples below 35 cm, the arboreal pollen becomes scarce and inconsistent. Pinus (pine) was represented by a single broken grain (a bladder) in the 40 to 50 cm sample, and was totally absent from other samples. Only two additional pollen taxa were observed: Salix (willow) and Cornus (dogwood). The inconsistencies between the three lower samples and those above are probably an artifact of preservation rather than an indicator of environmental or vegetational differences.

The same distributional discrepancies are also present in the nonarboreal pollen assemblage of Test Pit 6. The upper two samples (five to 15 and 25 to 35 cm) included common herbaceous pollen taxa such as Graminae (grass), Ambrosia (ragweed), high spined (HS type) Compositae (which includes goldenrods and sunflowers), Cheno-Am (Chenopodiaceae and Amaranthaceae; i.e., pigweed and lamb's quarter) and Liliaceae type (here including the lily family as well as other monocot families producing simple monosulcate type pollen). All of these taxa are indicative of the disturbance of the local vegetation at the site by man as well as potential food resources. As was found to be the case with arboreal pollen, the 25 to 35 cm sample was most diverse. Additional non-arboreal pollen taxa occurring in this sample include Caryophyllaceae (scandwort and chickweed), Malvaceae (the mollow family), Polygonom (smartweed), Cyperaceae (sedges), Typha (cat-tail) and Umbelliterae (the parsley family). Below 35 cm, the non-arboreal assemblage was not as diverse. However, two taxa, Leguminosae and Saxifragaceae type were found in especially large numbers in the 50 to 60 cm sample. This sample derived entirely from Stratum II and probably dates to the Fourche Maline phase of the Woodland period. Together, the two taxa comprised about 70 percent of the pollen from the 50 to 60 cm level. Neither taxa is a common windblown type. Both have many look-alikes from which they are indistinguishable due to poor preservation (Figure 59). Both of these taxa occur in tetrads or clusters of grains indicating a local origin of the pollen. They probably represent forbs growing on the site as weeds. However, both taxa also represent potential food plants of the area.

Test Pits 9 and 1 (The Southern Block)

The distributions of the palynomorphs from Test Pit 9 are shown in histogram form on Figures 61 and 62. Samples from this series below 80 cm taken from the contiguous column in Test Pit 1, were barren of fossil palynomorphs. The record from above 80 cm, however, is generally better in terms of preservation and pollen concentration than the samples from Test Pit 6.

The relative distribution of the three major palynomorph classes expressed in percentages is shown on Figure 61. Fungal spores and imperfecti were abundant throughout the column, but became relatively more important towards the middle of the column. The distributions of three individual fungal palynomorphs are also shown on Figure 61. These relative frequencies (percentages) are based on the total number of fungi present in each sample: the "Fungal Sum." The distribution of Endogone type spores resembles that found in Test Pit 6. These forest indicative fungi are relatively more abundant in the upper and lower samples from the Test Pit 9 column. Neuospora type is not distributed in Test Pit 9 as it was in Test Pit 6. In the Test Pit 9 sample series, it becomes most abundant in the upper samples. The Puccinia type is most abundant in the 50 to 60 cm level of this column, but generally increases towards the lower levels. The residual other fungi not included in these three types are distributed with their highest relative frequency generally in the center of the column (Figure 61).

Pteridophyte spores, although present throughout the Test Pit 9 column, remain unimportant (five to ten percent of the palynomorph sum, see Figure 61). Again, Botrychium (i.e., rattlesnake fern) was the most common of these spores. Spores of the Osmunda type (royal

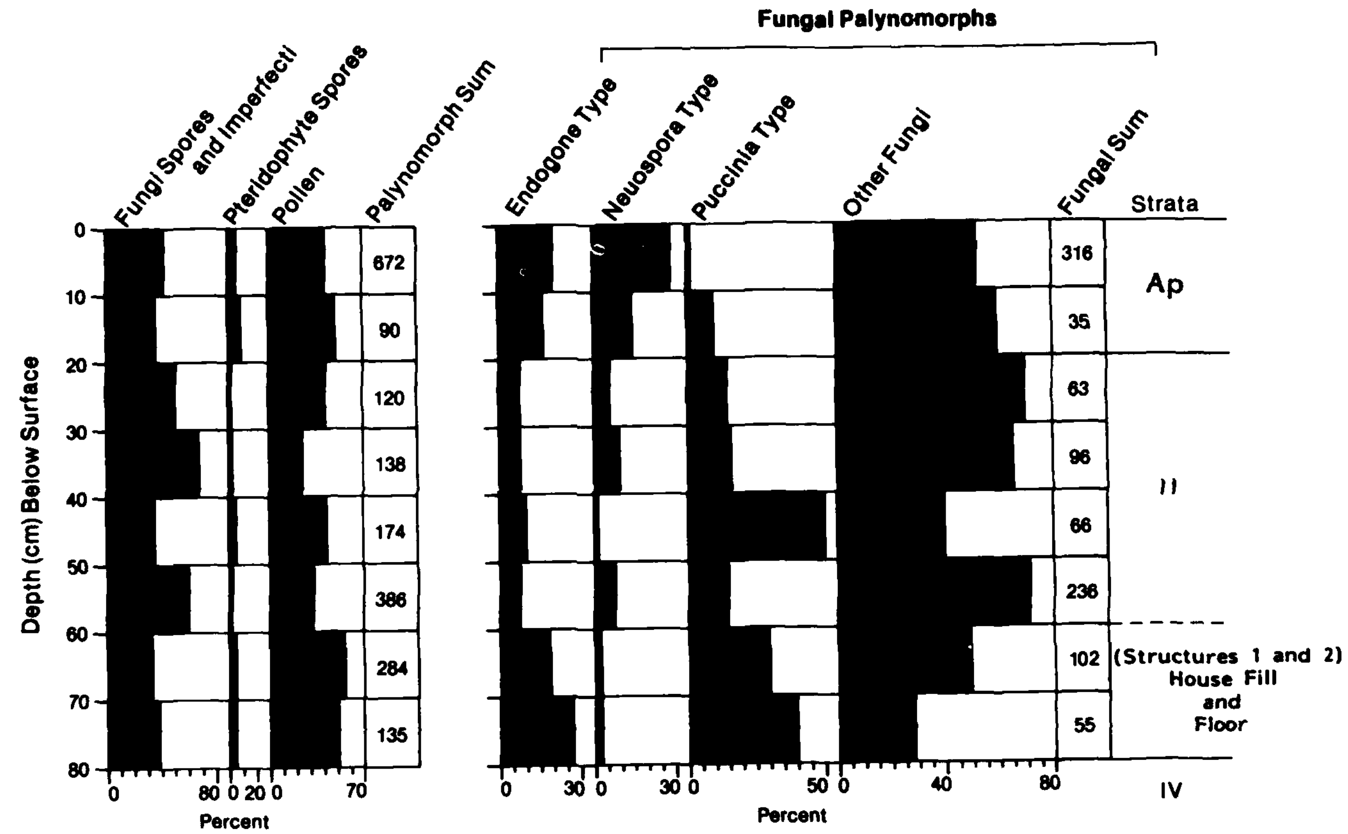


FIGURE 61. TEST PIT 9 (SOUTHERN BLOCK), DISTRIBUTION OF MAJOR PALYNOMORPHS AND FUNGAL TYPES.

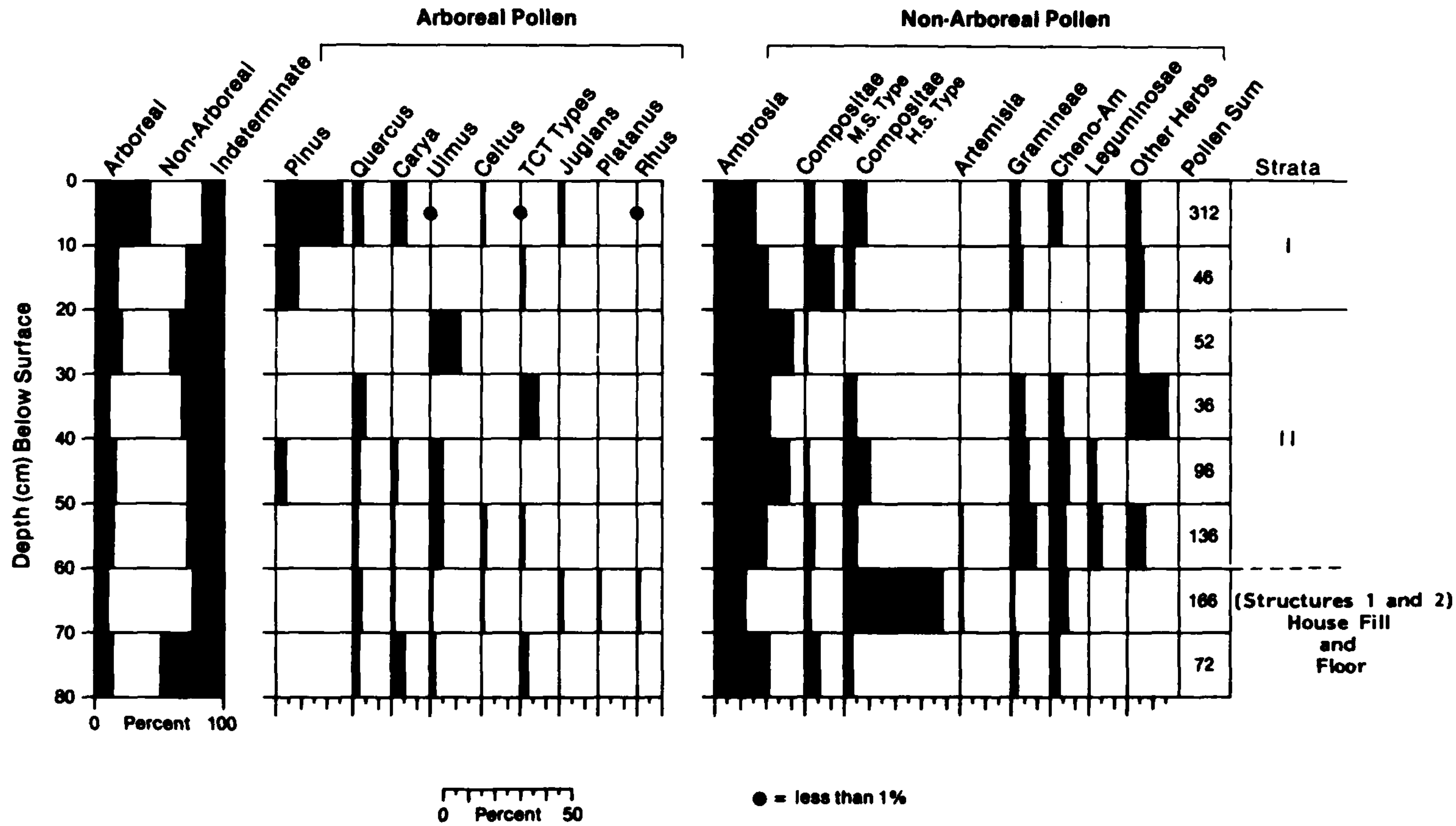


FIGURE 62. TEST PIT 9 (SOUTHERN BLOCK), POLLEN DISTRIBUTION.

fern or cinnamon fern) and Lycopodium (club moss) occurred only rarely. Bryophyte (tree mosses) spores were present only in the upper two samples (0 to 20 cm).

Pollen occurred in all levels of the Test Pit 9 column. The degree of pollen destruction as indicated by relative frequency of indeterminate pollen grains (Figure 62) does not follow the normal pattern of progressive deterioration (Hall 1981). The frequency of indeterminant pollen decreases from 40 to 70 cm rather than exhibiting an increase. It is at this same level, corresponding to fill and floor of Structures 1 and 2 (Early Caddoan period), that the percentage of organic matter also increases. Even so, 25 to 30 percent of the pollen in this zone are so chemically corroded or mechanically damaged that they are unidentifiable. Below this level, 50 percent of the pollen are indeterminate.

Arboreal pollen is relatively most abundant in the upper levels of this column (Figure 62). The surface sample (0 to 10 cm) is dominated by Pinus (pine), Quercus (oak) and Carya (hickory) pollen, but contains numerous other pollen taxa of the regional modern forest. Pinus (pine) pollen is curiously absent below 20 cm except for two grains from the 40 to 50 cm level. This lower pollen zone (including the samples from 40 to 80 cm) does contain Quercus (oak), Carya (hickory), Ulmus (elm), Celtis (hackberry), TCT type (probably Taxodium, bald cypress), Juglans (walnut), Plantanus (water elm) and Rhus (sumac) pollen. The intermediate pollen zone (10 to 40 cm) between the surface sample and the lower pollen zone, is characterized by low pollen frequencies and higher indeterminate pollen percentages. It does not contain as diverse an arboreal assemblage. Ulmus (elm) pollen, which is easily recognized even when badly damaged (Hall 1981), is fairly common in the 20 to 30 cm sample. Quercus (oak) pollen and TCT type pollen also occur in this zone, but not consistently.

A diverse assemblage of non-arboreal pollen taxa occur throughout the Test Pit 9 column (Figure 62). These weedy pollen types are generally more sensitive to disturbance of local vegetation than the arboreal pollen assemblages. Again, their abundance is expected on archaeological sites where man has disrupted the local vegetation. A number of herbaceous plant families are represented in the Test Pit 9 series: Gramineae (grasses), Chenopodiaceae and Amaranthaceae (Cheno-Am type), Leguminosae (the pea family) and "other herbs" including Solanaceae (the night shade family), Onagraceae (the evening primrose family), Polygonaceae (the buckwheat family) and Cyperaceae (the sedges). The composite family is best represented of all the herbs. Four Compositae pollen types are included on Figure 62. These included the low-spined, Ambrosia type (ragweed); the medium-spined (M.S. type), Compositae (thistle and groundsel); the high-spined (H.S. type), Compositae (sunflower); and the Artemisia type (sage) pollen. Fenestrate Compositae type pollen (chicory) was also recovered in the surface sample (0 to 10 cm) and is included with the "H.S. type" in Figure 62. In the 60 to 70 cm sample, an abundance of H.S. type

Compositae pollen was recorded. These were often in "tetrads" or clumps, indicating they were dropped in place rather than transported any distance by wind.

Other Samples

A single sample from the Central Block, Test Pit 5 (70 to 80 cm) was processed for pollen and other fossil palynomorphs. The preservation of the palynomorphs from this sample was disappointingly similar to that found in Test Pit 6. No other samples from the test pit were processed for this reason. The sample contained a diverse fungal assemblage similar to other Bug Hill samples. The pollen taxa present are reported on Table 29. Note that 40 percent of the pollen grains encountered were indeterminately degraded.

A single sample from an outer postmold of Structure 2 was also processed. Although the sample contained cultural materials (bone fragments and flakes), no palynomorphs except for a few fungal spores were recovered by either of the two extractions attempted.

Interpretations

As is often the case in archaeological sediments, palynological preservation at Bug Hill is less than ideal (e.g., Wilson 1977, Hall 1981). A variety of fungal and pteridophyte spores are present and well-preserved. However, these palynomorphs are too micro-environmentally affected at an archaeological site to be of use in problems of a regional nature. They, like the non-arboreal pollen, offer us more information of man's activities than on climatic change at Bug Hill. The regional vegetation record at Bug Hill as indicated by the arboreal pollen reflects the oak/hickory forest of the Ouachita Mountains with one notable exception. During the earlier occupations of Bug Hill, pine is absent. This absence indicates a wetter climatic regimen which likely inhibited forest burning.

Interpretations of the Bug Hill palynological record are, however, offered with reservation. Differential preservation was definitely occurring within the site. It appears that better preservation occurs on the flanks of the midden mound than in the center of the site. The chemical differences in these two soil populations has been documented by D. Johnson (Chapter Three). The most favorable preservation occurred within the fill of Structures 1 and 2 in the Southern Block. This differential preservation accounts for the negative results previously obtained from Bug Hill pollen samples (Vehik 1982a:171-172).

D. Johnson (Chapter Three) also noted that bioturbidity was most intense in the central area of the Bug Hill site, and less so on the flanks. Tree roots, earth worms and other creatures active in soil formation contribute to the vertical translocation of pollen (Walch et al. 1970; Anderson 1979). Man, of course, also plays an active role in churning the soil at archaeological sites. Digging of pits, trenches and other features will mix pollen from different ages.

Although these variables must be avouched, studies have shown that they do not necessarily negate the value of palynological studies in archaeological sediments (Dimbleby 1957; Van Zeist 1967; Schoenwetter 1976).

At Bug Hill, there is a diverse community of fungi. Some 32 different fungal palynomorphs were recognized. Fungi are known to be important in the biochemical degradation of pollen and spores (Goldstein 1960; Elsik 1979; Havinga 1967). Destruction of spores and pollen by fungi is not uniform but selectively more severe on certain taxa (Sangster and Dale 1964; Havinga 1964). For example, Pteridophyte spores have been found to be extremely persistent (Havinga 1967) while coniferous pollen is especially susceptible to digestion by fungus (Goldstein 1960). Typically, biochemical degradation of pollen and spores as induced by fungi is a progressive phenomena (Havinga 1971; Hall 1981).

Fungal palynomorphs are a reflection of more than just a destructive depositional environment. Three fungal types were isolated in this study for their potential in paleoenvironmental interpretation. Their occurrence is too closely linked to the modification of their local environment by man to be of use as regional vegetation or climatic indicators in this situation. The clearing of the woody vegetation from the site itself will determine the abundance of Endogone spores. These spores which are produced on infected roots of woody plants show a marked increase in the upper levels of both Test Pit 6 and 9. This may reflect the forest succession after site abandonment. The Neuospora type is adapted to buried vegetation and soil. It is found in varying abundances throughout the Bug Hill site as a result of man's occupation. The third fungal type, Puccinia, is a parasite typically of grasses and forbs. It is most abundant in the lower levels of Test Pit 9 within the fill of the Early Caddoan houses. These rust spores could have been brought in on building materials (i.e., thatch) or may be related to the weedy vegetation which colonized that location after the destruction of the structure. In other, non-archaeological situations, these fungal types could potentially contribute to paleoenvironmental interpretations (i.e., evidence for prairie versus forest vegetation).

Non-arboreal pollen from Bug Hill is, by and large, the result of weedy plants that thrive in areas where the vegetation has been disrupted. Their abundance at Bug Hill is, for the most part, the result of man's activities at the site. However, most of these non-arboreal pollen taxa also represent potential food resources for the occupants of Bug Hill. Some examples of these potential food plants (Gilmore 1919; King 1976) are listed in Table 30.

In several samples, specific taxa of non-arboreal pollen were found in great abundance and in tetrads or aggregates of pollen grains. Such occurrences exclude the possibilities of wind dispersal and indicates an immediate origin of the pollen. In Test Pit 6, 50 to

TABLE 30. POTENTIAL FOOD PLANTS REPRESENTED IN THE NON-ARBOREAL POLLEN ASSEMBLAGES AT BUG HILL

Plant	Pollen Taxa
Allium (Wild onion)	Liliauae Type
Amaranthus (pig weed)	Cheno-Am Type
Ambrosia (horse weed)	Ambrosia Type
Callirhoe (poppy mallow)	Malvaceae
Chenopodium (goosefoot)	Cheno-Am Type
Helianthus (sunflower)	H.S. Type Compositae
Iva (marsh elder)	Ambrosia Type
Phaseolus (wild bean)	Liguminosae Type
Polygonum (knot weed)	Polygonaceae
Ribes (gooseberry)	Saxifragaceae
Smilax (briar)	Liliaceae Type
Solanum (nightshade)	Sclanaceae
Typha (cat-tail)	Typha

60 cm, large numbers of two pollen types: Leguminosae and Saxifragaceae, occurred in this manner. Both of these taxa could represent food plants (see Table 29). This sample was taken from Stratum II and presumably dates to the Woodland period. In Test Pit 9, 60 to 70 cm, large quantities of H.S. Type compositae pollen occurred (specifically Helianthus, sunflower, in this case; see Figure 65). These pollen aggregates could represent horticulture activities (see Chapter Ten).

The arboreal pollen assemblage is the best palynological indicator of the regional vegetation at Bug Hill. These pollen taxa also represent many potential food resources (Gilmore 1919; King 1976; Shea, Chapter Ten). However, it is unlikely that the gathering of acorns, hickory nuts or hackberry seeds would affect the percentages of Quercus, Carya or Celtus pollen occurring at the site. These arboreal pollen taxa are produced in great numbers and widely dispersed by winds months before the nuts or seeds develop. In general, this regional arboreal pollen record from Bug Hill agrees with other paleoenvironmental studies.

The evidence from Natural Lake indicates that there was a mesic period from about A.D. 250 to A.D. 1200 (Albert 1981). This period of extremely high frequency of oak pollen began its decline at about A.D. 900, but did not really "dry out" until after A.D. 1200. The Natural Lake record is supported by the evidence accured by Hall and others in northeastern Oklahoma (Hall 1977a, 1977b, 1977c, 1978a, 1980, 1982; Henry 1978; Henry et al. 1979). However, the record is more complicated at Ferndale Bog (Albert 1981). The primary difference between the Ferndale Bog and Natural Lake pollen records is the distribution of pine. Although a pine pollen rise has also been observed late in the records of northeastern Oklahoma, its age and correlation has not yet been adequately determined (Hall 1982). Such a rise in the pine pollen frequency does not occur at Natural Lake. It may be that Ferndale Bog, located in a more marginal site in the Ouachitas, was more susceptible to periodic prairie fires which encouraged the colonization by pines.

The earliest pollen samples from Bug Hill with adequate pollen preservation come from the fill of the Early Caddoan houses in the Southern Block (Test Pit 9). Radiometric dates put these samples between A.D. 900 and A.D. 1200. These samples indicate a mesic oak/hickory forest in the region of the site. Pine pollen is conspicuously absent. It is true that pine, as a gymnosperm, is more readily biochemically degraded than many angeosperm pollen taxa (Goldstein 1960). However, as Hall (1981) has pointed out, the distinctive vasiculate shape of pine pollen makes it readily identifiable even when badly corroded and fragmented. Pine is also completely absent even in the lower levels of Test Pit 9 where preservation is somewhat better. This would indicate a more mesic period where fires are inhibited and pine was out competed by oak and hickory. This corresponds with the mesic period in the Natural Lake pollen record.

Above this mesic zone, in the Bug Hill site, is a 20 to 30 cm zone of poor pollen preservation. This could be the result of the general drying trend observed from Natural Lake (about A.D. 1200 to A.D. 1400). The upper samples of the Bug Hill site contain an arboreal pollen assemblage reflecting the pine/oak/hickory forest of the region today.

CHAPTER TEN

PALEOBOTANICAL REMAINS

by

Andrea Shea and Jeffrey H. Altschul

The analysis of carbonized plant remains recovered from the 1981-82 excavations at Bug Hill focused on documenting the floral resources used by the prehistoric inhabitants and determining whether the site was occupied on a seasonal or year-round basis. It was hoped that this information combined with the zooarchaeological and palynological studies would provide a better understanding of subsistence and settlement in the upper Jackfork Valley.

Laboratory Analysis

Flotation samples were taken from all features and from two designated columns in each test pit. All samples were first subjected to water flotation. The materials that floated were then analyzed by sifting each sample through a graduated series of geologic screens (2.00 mm, 1.00 mm and 250 microns). The contents of each screen were examined under magnification ranging from 7x to 30x. Recognizable seed and fruit remains were removed from these screens for identification. The contents of the 2.00 mm screen were sorted and quantified by weight and number. The material remaining in the 1.00 mm and 250 micron screens consisted of fragmented wood charcoal and unidentifiable nutshell types; these were categorized as 'Residual.'

Descriptions and Comments

In general, carbonized materials were sparse from all areas of the site. The only exceptions to this statement were Occupational Surfaces I and III in the Southern Block. These surfaces probably produced better results because of the rapid burnings of Structures 2 and 3. It is quite likely, therefore, that the paleobotanical findings relate primarily to these occupations.

The analyzed plant macrofossils are separated into two general categories: plant food by-products and wood by-products. Each category is discussed below.

PLANT FOOD BY-PRODUCTS

Nut Shell

The 1981-82 nut shell analysis focussed on features from around the site. The emphasis on features derived from Vehik's (1982a:166) note that the incidence of charred nut shell decreased from the top of the mound to the edges of the site. An examination of the 1981-82 flotation columns corroborated Vehik's observation. The decrease in nut shell towards the periphery of the site appears to have more to do with factors of preservation than with cultural practices. In contrast to the general midden, features on the edge of the site that were filled with alkaline soil contained as much carbonized material as their counterparts in the Central Block. In all, over 90 percent of the nut shell was recovered from features. Table 31 presents the distribution of nut shells recovered from all features throughout the site.

Nut shells were probably discarded after processing, though some could have, subsequently, been used for fuel. Nut shells from Bug Hill were divided among three groups: hickory nut shells, walnut shells and acorns. Each of these groups is discussed below.

Hickory Nut shell

The hickory nut husks identified were all thick-shelled except for one fragment. These "semi-woody" husks encase the nut of all species of *Carya*. The husk fragments are carbonized and measure 1/10 in. to 1/4 in. in thickness. The husks of pecan, mockernut, red and bitternut hickories range from 1/10 in. to 1/4 in. thick.

All species of *Carya* are available from September through December (Fowells 1965:111-136). Mockernut hickory (*Carya tomentosa*) and red hickory (*C. ovalis*) are the available thick-shelled species in the area of the site. The present range of shagbark (*C. ovata*) hickory (thick-shelled) reaches the eastern border of Oklahoma. It is possible that this species could have occurred in eastern Oklahoma in the past (Fowells 1965; Harlow and Harrar 1969). Mockernut produces a good crop every two to three years and is one of the heaviest seeded species, averaging 90 seeds (nuts) per pound.

TABLE 31

NUT SHELL RECOVERED FROM FEATURES AT BUG HILL
(all weights in grams)

	Hickory Nutshell	Walnut Shell	Acorn	Total
Southern Block				
Occupational Surface I	.06			.06
Occupational Surface II	.58		.02	.60
Occupational Surface III	8.38	.16	.24	8.78
Central Block				
Stratum I	1.67	.16	.16	1.99
Stratum II	.77	.11		.88
Stratum III	.47			.47
Northern Block				
Stratum III	.03			.03
Peripheries & Stratum II	2.45	.03		2.48
Total	14.41	.46	.42	15.29

The one thin-shelled fragment could not be identified to species. Even so, the two most likely species are either bitternut hickory (C. cordiformis) or pecan (C. illinoensis). Bitternut hickory nuts are characterized by Fowells (1965) as bitter and 'distasteful' to wildlife. In contrast, the nuts of the pecan tree are "sweet and palatable." Mature (30 year-old) bitternut hickory trees produce good seed crops every three to five years. A mature (20 year-old) pecan tree produces a good seed crop every year with a yield of two to three bushels or 100 lb per year (Fowells 1965).

Pecans are probably underrepresented in the sample from Bug Hill. Given the availability of the tree and abundance of nut yield, it should have been heavily exploited by the aboriginals.

Walnut

Remains of walnuts were extremely rare, mostly occurring in very small quantities on the floors of Structures 1 and 2 and in Strata I and II of the Central Block. Walnut trees (Juglans nigra) occur on deep moist, fertile soils and produce good seed crops every two to five years. The fruit ripens in September and October and drops from the tree soon after.

Acorns

Acorn remains are either fragments of shell, meat or cap. The fragmented remains cannot be identified to species. The following oaks were found in the area of the site in the recent past (Fowells 1965; Harlow and Harrar 1969; Bobalik 1977).

White Oaks	Red Oaks
Post Oak (*Quercus stellata*)	Black Oak (*Q. velutina*)
White Oak (*Q. alba*)	Shumard (*Q. shumardii*)
Bur Oak (*Q. macrocarpa*)	Northern Red (*Q. rubra*)
Swamp Chestnut (*Q. michauxii*)	Southern Red (*Q. falcata*)
Chinquapin (*Q. muehlenbergii*)	Water Oak (*Q. nigra*)
	Willow (*Q. phellos*)

The white oaks have a sweet, edible nut that can be eaten with little processing. However, the nuts of the red oaks are bitter and must be boiled or leached to remove the tannic acid (Swanton 1946). Hudson (1976:301) states that the Southeastern Indians used acorns as a source of oil and as a staple in the diet. He states that the Choctaw "relied heavily on acorn meal in years when their corn crop was poor, suggesting, perhaps, that before the cultivation of corn began in earnest, acorns may have been the staple food" (Hudson 1976:308).

In general, the white and red oaks produce good seed crops every two to three years. One notable exception is the species *Q. alba* (White Oaks) which has good crops every four to ten years. Most acorns mature and are available in September and October, although Bur Oaks drop acorns as early as August and continue to do so through November (Fowells 1965:558-638).

Oaks dominate both the upland and lowland forests in the Jackfork Valley. Although no tree density figures are available, Bobalik (1977) characterized the upland forest stands of oak as "fairly dense." In these forests, oaks account for seven of the seventeen species represented (Bobalik 1977). In contrast, the lowland forest is much more diverse, containing many moisture-preferring species (e.g. elm, ash, and hickory). A study of individual tree yield showed a wide range of variation within the oak family, with one mature tree yielding 7,700 acorns per year while another produced only 2,000 acorns (Fowells 1965).

Discussion: Nut shell

Nut shell fragments were primarily recovered from Woodland or Early Caddoan period contexts. In part, this may be a result of differential preservation. However, comparison of the dentition of Late Archaic burials with those from Woodland and Caddoan period contexts showed the absence of any evidence for any nut consumption in the former period and substantial evidence in the later two periods (see

Chapter Thirteen and Appendix III). The paleobotanical evidence, therefore, is supported by the osteological remains and the possibility that the use of nuts increased over time must be given serious consideration.

For the Woodland period, hickory nut shell accounts for 92 percent of the nut shell recovered. A total of 4.47 g was recovered from these deposits which are represented by the features in Stratum I of the Central Block and Burials 3 and 4 in Test Pit 7 from the site peripheries (these were the only features in the peripheries to contain any nut shell).

Most nut shell recovered at Bug Hill was obtained from Early Caddoan period features associated with Structures 1 and 2 (Occupational Surface III). Of the 8.78 g of nut shell recovered from features in the structure, hickory nut shell represents 95 percent of the collection.

The results of the analysis of nut shells from Woodland and Caddoan period contexts are not surprising. The large amount of hickory nut shell relative to walnut shell and acorn is mirrored in the collections of other midden mounds, especially those in the Wister Valley (Galm 1981). While hickory nuts were undoubtedly important to the subsistence of the inhabitants of Bug Hill, it is probably misleading to use the quantity recovered alone as a judge of relative importance. Carbonized acorns and walnut shells are much more fragile than hickory nut shells; a factor which probably accounts for their poor representation.

Another factor which may account for the predominance of hickory nut shell relates to the ways the nuts were processed. Holly (1981) argues that the processing of hickory nuts requires regular exposure to heat, whereas acorns and walnuts do not. The finding of large numbers of small fragments of hickory shell may indicate that the nuts were being cracked, the large shell fragments removed and the remaining small fragments boiled (and possibly carbonized) with the rest of the nut meal. At the Little Egypt site and on the Archaic levels at the Koster site the mean weight of the hickory nut shell was about .008 g (Holly 1981). At Bug Hill, the mean weight of the hickory nut shell from the floor and features of Early Caddoan Period Structures 1 and 2 was .021 g (5.73 g/269 fragments). The nut shell fragments from Bug Hill then are roughly two-and-one-half times larger than corresponding figures from Illinois or Georgia. The discrepancy in the mean weight figures may indicate that the small sample of nut shell recovered from Bug Hill is not representative of the site as a whole. However, it is also possible that the Early Caddo occupants practiced different processing methods than the Archaic residents of Koster or Little Egypt. From their analysis of the dentition from Woodland and Caddoan burials, Rose et al. (Chapter Thirteen) conclude that the Woodland and Caddoan residents of Bug Hill were repeatedly using their own teeth to crack nuts. If correct, then it is quite possible that the Woodland and Caddoan populations of the Ouachitas were processing nut shell quite differently than their counterparts in the Eastern Woodlands.

Carbonized Seeds

A total of 57 carbonized seeds were recovered from the flotation of features and four flotation columns. The four flotation columns were located in the Southern Block (Test Pit 9, northwest corner; Test Pit 1, southeast corner), the Central Block (Unit 5B), and the site peripheries (Test Pit 6, southeast corner). Of the total, eight seeds were recovered from the columns with the remainder from features. The distribution and identification of carbonized sees is presented by strata or occupational surface in Table 32. The distribution of seeds by feature is presented in the feature tables (Tables 1, 4, and 6) in Chapter Four.

Persimmon

A total of 12 persimmon seed fragments were recovered, 10 of which were found in Occupational Surface III (Table 32). The remains are probably from *Diospyros virginiana*, though Steyermark (1977) states that *D. pubescens* also occurs in Oklahoma.

Persimmon trees occur on poorly drained upland sites, terraces and abandoned fields. The fruits ripen after the first frost, and are available from November through late winter. Good crops are produced every two years (Fowells 1965). Hudson (1976) claims that the persimmon was valued above all others by the Southeastern Indians. The fruits were used to make breads, puddings, and pies as well as eaten fresh.

Sumac

Sumac seeds were recovered in small numbers from Occupational Surface I (Late Caddoan), III (Early Caddoan), and Stratum I of the Central Block (Woodland). All seeds recovered are from the woody species of *Rhus*. According to Steyermark (1977) the following species may occur in the area of the site:

R. aromatica (Fragrant sumac)
R. aromatica var. *illinoensis*
var. *serotina*
R. glabra (Smooth sumac)
R. copallina (Dwarf sumac)

Sumac grows in a variety of habitats; open woods, dry soils, along streams, uplands and disturbed areas. The fruits are available from June through December. The fruits can be used to make a beverage ("lemonade"). In addition, the Indians used the fruits for dye and medicinal purposes, smoked the leaves with tobacco and used them for tanning leather (Coon 1974).

TABLE 32. FLORAL REMAINS

OCCUPATIONAL SURFACE (O.S.) OR STRATA

	Southern Block			Central Block	Site Periphery		Totals
	O.S. I	Stratum II	O.S. III	Stratum I	Stratum II	Stratum III	
Amaranthus (pigweed)			1				1
Asteraceae (daisy family)	1		1				2
Chenopodium (goosefoot)	8		6				14
Diospyros virg. (persimmon)			10	2			12
Eleocharis sp. (spikerush)	1						1
Euphorbiaceae (spurge family)					1		1
Galium sp. (bedstraw)			1				1
Gleditsia tri. (honey locust)				1			1
Helianthus annus (common sunflower)		1[a]	1[a]				2
Phytolacca amer. (pokeweed)			1	2			3
Poaceae (grass family)			1				1
Polygonum sp. (smartweed)			2				2
Rhus sp. (sumac)	1		2	2			5
Vitis sp. (grape)			2	5[a]	2[b]	1	10
Xanthium sp. (cocklebur)			1				1
TOTALS	11	1	29	12	3	1	57

[a] recovered from flotation columns

[b] one seed recovered from flotation column

Honey Locust

One fragment of a seed resembling a honey locust seed was recovered from Stratum I of the Central Block. It is eroded, so a positive identification cannot be made. It should be noted, however, that honey locust wood charcoal was identified from the site. Honey locust is a bottomland species and probably grew near the site. The fruit (pod) contains a pulp which has a sweet flavor and ripens in September and October. The fruits can remain on the trees through the winter.

Grape

A total of five fragments and five whole grape seeds were recovered. The following are the species that could occur near the site:

Vitis aestivalis (Summer Grape) - grows in upland woods; available July through October.
V. palmata (Red Grape) - grows in low, wetland woods; available September through October.
V. vulpina (Winter Grape) - grows on alluvial soils; available after frost [November].
V. rotundifolia (Muscadine) - grows in low, wet woods, swamps, bottomlands; available September through October.

Smartweed, Goosefoot, Pigweed

Two achenes of smartweed or knotweed (*Polygonum* sp.) were recovered from Occupational Surface III. These are trigonous in shape and measure 2.5 mm. There are several members of this genus with trigonous achene shapes, and they occur in a variety of habitats such as wet sites, stream banks and disturbed areas (Steyermark 1977).

A total of one fragment and 13 whole seeds of goosefoot (*Chenopodium* sp.) were recovered. All seeds were found either in Structures 1 and 2 (Early Caddo) or Structure 3 (Late Caddo). The seeds measure 1.0 - 1.5 mm and exhibit strong beaking and a slightly pitted pericarp. The specie(s) was not determined due to a lack of comparative specimens. Goosefoot grows in open woods and disturbed habitats. The seeds are available from August through November (Steyermark 1977).

Pigweed (*Amaranthus* sp.) is very similar to goosefoot except for smaller seeds (less than 1.0 mm in size) and a smooth, glossy seed coat. The habitats and availability are the same.

The recovery of these seeds is not conclusive proof of the exploitation of the plants for a food source. However, Yarnell (1976:269) refers to smartweed, goosefoot and pigweed as important food sources since the Archaic. He suggests these plants were probably 'protected' as volunteers in garden plots. Hudson (1976:294) states, "To some extent, the Southeastern Indians continued cultivating or utilizing the plants of the old Eastern Agricultural

Complex, namely sunflower, sumpweed, chenopodium, pigweed, knotweed, giant ragweed and canary grass."

Sunflowers

Two fragments of sunflower seeds were recovered from the flotation column in the Southern Block. One fragment, from level 5 (Stratum II), was a tip section. The second (achene attached) was recovered from level 8, clearly with the fill of Structures 1 and 2.

The length of the medial section of the second fragment is 6.0 mm and the width is 4.0 mm. We would estimate this achene, if complete, to measure 7.5 by 4.0 mm. The wild form of the common sunflower (Helianthus annuus) and several varieties are native to the Colorado Plateau. It is conceivable that this seed is from a wild population. Heiser (1954) estimates the achene size of the original wild ancestral sunflower to have been 4.5 to 5.0 mm. The achene size of modern ruderal sunflowers ranges from 4.0 to 7.0 mm. Heiser (1951) notes that the achenes of Helianthus annuus var. lenticularis were gathered for food by tribes of Indians.

It is more likely, however, that the achene is from a domesticated population. Domesticated sunflower has been recovered from several archaeological sites in Tennessee. Achenes from the Higgs site (900 B.C.) in eastern Tennessee (Brewer 1973) measure 7.8 mm x 3.1 mm (reconstructed to actual size before carbonization). Shrinkage of a sunflower achene is approximately 11 percent during carbonization. Dr. Richard Yarnell (personal communication) uses the factor of 1.11 x 1.27 to determine the original size. The estimated reconstructed size of the achene from Bug Hill is 8.3 x 5.0 = 41.5 (LxW).

Cocklebur

One cocklebur seed was recovered from inside Structures 1 and 2. Xanthium has a spiny fruit (achene) and grows in disturbed habitats. It is suggested that this achene may have been transported to the site accidentally; attached to clothing or to an animal.

Asteraceae

Two fragments of the fruit or seed heads were recovered, one each from Occupational Surfaces I and III. These could be from a member of the Daisy family with a small head (1 - 2 cm). The plants grow in disturbed habitats. The fruits ripen from July through November. Coon (1974) indicates that members of this family have medicinal value.

Euphorbiaceae

One spurge family seed was recovered from the site periphery. Plants of the spurge family have a milky exudate that is sometimes poisonous. Some of the plants have medicinal value if used properly (Coon 1974). The seeds are dispersed from July through November.

Pokeweed

Three pokeweed seeds were recovered, one from Occupational Surface III and two from Stratum I of the Central Block. The berries of pokeweed are slightly toxic, but have medicinal properties. The shoots are edible in the spring as greens and the berries used for a dye (Coon 1974). This plant grows in disturbed habitats. The fruits mature from July through November.

Poaceae

Several members of the grass family have edible grains. The seeds can be parched or ground into meal or cooked in soups. The aboriginals could have used grass plants for a variety of purposes such as mats, screens, arrow shafts, thatching, etc. (Coon 1974). The plants grow in all habitats including disturbed areas and the one seed recovered (Occupational Surface III) could certainly be an accidental inclusion. This one seed (caryopsis) recovered cannot be identified to species level. The grains are available from June through December.

Discussion: Carbonized Seeds

Carbonized seeds were recovered primarily form three contexts; the fill and floors of the burned structures in the Southern Block (Occupational Surfaces I and III) and Stratum I of the Central Block. These contexts all date to the Woodland and Caddoan periods. Only one grape seed was found in a feature (Feature 6, Test Pit 4) that could be clearly associated with Late Archaic deposits.

All five plants represented in Stratum I of the Central Block, (persimmon, honey locust, pokeweed, sumac, and grape) have medicinal or dietary potential. With the exception of pokeweed, the seeds represent woody plants which are not likely to be found in disturbed contexts such as the edges of the site. These seeds then probably do not represent accidental inclusions but instead reflect cultural practices related to subsistence or other cultural events.

It should be noted that all five grape seed fragments from the Central Block were recovered from a flotation sample from arbitrary level 3 (20 to 30 cm below surface). This sample lies at the boundary between Stratum I and the plowzone. While we are confident this sample was taken from intact midden deposits, we cannot entirely rule out the possibility that it had been disturbed by historic plowing activity. [The same statement applies to the one grape seed fragment recovered from the column in Test Pit 6, also from level 3].

Most of the carbonized seeds were recovered from the features and floor of Structures 1 and 2 (Occupational Surface III). In part, this result reflects the large number of features associated with these structures and the fact that 25 percent of the floor itself was also floated. The collection from Occupational Surface III (ca. A.D. 900 -

1050) can be divided into two nearly equal groups. The first represents woody plants whose fruits were probably used in the diet. For the Early Caddo period at Bug Hill this group is composed of persimmon, sumac and grape. These woody plants are from the same families that were recovered from Woodland period deposits (Stratum I) of the Central Block. The similarity between the Woodland and Early Caddo deposits may reflect a continued utilization of many of the same resources.

The second group consists of herbaceous plants, all of which thrive in disturbed contexts. In Structures 1 and 2 this group is represented by one or two seeds of the following plant families: pigweed, daisy, bedstraw, sunflower, pokeweed, grass, smartweed, and cocklebur. One additional herbaceous plant, goosefoot, was better represented than the rest, with six seeds recovered.

Some of the herbaceous plants were probably used by the inhabitants as food or medicines. However, all these plants would have been found near the site in areas altered by human occupation. Their inclusion in the collection then may be accidental with seeds brought into Structures 1 and 2 by the wind or attached to people's clothing.

This interpretation is supported by the distribution of seeds found in Occupational Surface III (see Table 33). Of the woody plants 11 of the 14 seeds were found in trash or storage pits associated with Structures 1 and 2. In contrast, 11 of the 15 herbaceous plant seeds were recovered from the floor or fill of the houses (nine actually came from the floor itself). This distribution is highly non-random ($X^2 = 7.99$, df = 1, $p < .01$). The implication we draw from this study is that fruits of woody plants were brought into the houses, eaten or used, and then deposited in trash pits. Many weed and grass seeds, however, were probably brought into the house unintentionally and therefore are found stamped into the floor. If we are correct, this suggests that unless a substantial percentage of a living surface is floated, seeds of herbaceous plants that make up the site's immediate environment will be underrepresented in the collection.

TABLE 33

DISTRIBUTION OF SEEDS FROM OCCUPATIONAL SURFACE III

	Trash/Storage Pits	House Fill and Floor	Total
Woody plants	11	3	14
Herbaceous plants	4	11	15
Total	15	14	29

$X^2 = 7.99$; $p < .01$; df = 1

The main difference between the carbonized seed collections from the Woodland and Caddoan period deposits at Bug Hill is the presence in the latter of possibly domesticated sunflower. Both sunflower seeds found in the Southern Block were recovered from the flotation column in Test Pit 9. The seed identified as possibly domesticated came from the fill of Structures 1 and 2 (level 8). The second one was recovered from Stratum II (level 5) and may or may not be associated with the Early Caddo occupation.

The interpretation of the role of sunflower in the subsistence practices of the Early Caddoan occupants of Bug Hill is complicated by the small number of seeds and the placement of only one in the housefill. If the only evidence of domestication was the one seed from the fill then the conclusion that horticulture was practiced would be unjustified. However, the combination of the ethnobotanical evidence and the palynological results that showed a high concentration of sunflower pollen (found in tetrads) in the housefill makes the case for horticultural practices somewhat stronger.

Whether or not horticulture was practiced, the ethnobotanical results suggest that the Early Caddo probably "encouraged" the growth of several types of volunteer plants. This "encouragement" may also have included "protecting" these plants through the growing season. All told, the practice of encouraging wild plants may be more important in understanding Early Caddo subsistence than determining whether one type of volunteer plant was or was not domesticated.

WOOD BY-PRODUCTS

Wood by-products are the remains of structural elements, utensils, matting, thatching, or fire wood. The wood charcoal sample from the site represents cane, grape vine, shrub and 18 general types of trees (see Tables 34 and 35). This sample was obtained by identifying to genus a maximum of 30 wood charcoal fragments from each feature. Four flotation columns (the same analyzed for carbonized seeds) were also studied. A total of 158 wood charcoal fragments were recovered from column samples processed from 59 arbitrary levels. The low recovery rate made further study of these columns meaningless and the analysis concentrated on the specimens recovered from features. A total of 1,696 wood charcoal fragments were recovered from features throughout the site. Over 87 percent of these fragments came from the Southern Block with most associated with Occupational Surface III (Structures 1 and 2).

Before discussing the results a brief note is necessary on certain laboratory procedures. As mentioned before, the white oaks and red oaks can be separated on the basis of anatomy. The anatomical structure of carbonized black locust and Osage orange, however, is very similar, making it difficult to distinguish between these two genera. Techniques using scanning electron microscopy have proven successful

TABLE 34. WOOD BY-PRODUCTS FROM THE OCCUPATIONAL SURFACES OF THE SOUTHERN BLOCK.
(COUNTS OF FRAGMENTS)

				O.S.III					
Common Name	Genus/Specie	O.S.I	O.S.II	Floor	Central Posts	Outer Wall Posts	House Burning	Features	Total O.S.III
Cane	Arundinaria gigantea	5	2	272	46	80	164	117	679
Maple	Acer sp.	1	1	---	2	1	3	1	7
Hickory	Carya sp.	9	10	37	16	7	10	16	86
Persimmon	Diospyros virginiana	---	---	---	2	---	---	---	2
Ash	Fraxinus americana	2	1	8	13	2	5	12	40
Honey Locus.	Gleditsia triacanthos	1	2	1	1	---	1	4	7
Black Walnut	Juglans nigra	---	---	---	---	---	1	---	1
Cedar	Juniperus virginiana	---	6	6	1	1	13	6	27
Red Mulberry	Morus rubra	---	---	2	---	1	---	---	3
Pine	Pinus sp.	---	---	---	---	2	1	1	4
Sycamore	Platanus Occidentalis	---	1	4	---	1	---	---	5
Cottonwood	Populus deltoides	---	---	---	---	1	---	---	1
Black Cherry	Prunus serotina	1	5	2	---	1	33	4	40
Red Oak Gr.	Quercus sp.	87	12	44	16	15	27	27	129
White Oak Gr.	Quercus sp.	21	33	26	35	18	19	39	137
Oak	Quercus sp.	---	---	---	---	1	---	---	1
Black Locust/ Osage Orange	Robinia pseudoacacia	---	1	4	4	---	---	1	12
Willow	Salix sp.	---	4	---	---	5	1	2	8
Elm	Ulmus sp.	---	1	16	32	1	17	13	79
Bark		---	---	---	---	2	---	---	2
Diffuse Porous		1	---	1	---	---	---	---	2
Shrub Wood		3	---	---	---	---	---	---	3
Unidentifiable Hardwood		---	---	2	---	2	---	---	4
TOTALS		131	79	425	168	141	295	246	1275

TABLE 35. WOOD BY-PRODUCTS FROM THE CENTRAL BLOCK, NORTHERN BLOCK AND SITE PERIPHERIES. (Counts of Fragments)

		CENTRAL BLOCK			NORTHERN BLOCK AND SITE PERIPHERIES	
COMMON NAME	GENUS/SPECIE	STRATUM I	STRATUM II	STRATUM III	STRATUM II	STRATUM III
Cane	*Arundinaria gigantea*	1			2	1
Maple	*Acer* sp.		5			
Hickory	*Carya* sp.	4	8	1	2	3
Persimmon	*Diospyros virginiana*					
Ash	*Fraxinus americana*	4	3	1	5	
Honey Locust	*Gleditsia triacanthos*			1	4	
Black Walnut	*Juglans nigra*		1			
Cedar	*Juniperus virginiana*	1	5		1	
Sweetgum	*Liquidambar styraciflua*					
Red Mulberry	*Morus rubra*	4		3		
Pine	*Pinus* sp.				4	
Sycamore	*Platanus Occidentalis*		6			
Cottonwood	*Populus deltoides*					
Black Cherry	*Prunus serotina*	1			2	
Red Oak Gr.	*Quercus* sp.	13	23	14	19	
White Oak Gr.	*Quercus* sp.	11	8	2	3	
Oak	*Quercus* sp.	1				
Black Locust/ Osage Orange	*Robinia pseudoacacia*	5	5		4	
Willow	*Salix* sp.					
Elm	*Ulmus* sp.	13			8	
Bark		3				
Diffuse Porous					2	
Shrub Wood			1*			
Conifer				1		
Unidentifiable/ Hardwood				2		
TOTALS		61	65	25	56	4

* grape vine

in showing differences in inter-vessel pitting. But this is a very costly and time consuming process. We have decided to combine the two genera as one wood type because of their common range and availability in the area of the site. The "original" range of Osage orange is southern Arkansas, Oklahoma and northeastern Texas (Harlow and Harrar 1969). The range of black locust extends into southeastern Oklahoma (Fowells 1965). It must be remembered that this decision was made on the basis of laboratory expediency and does not indicate that the two trees necessarily have similar cultural functions.

Discussion: Wood By-Products

Outside the Southern Block, fragments of wood charcoal were recovered in very small numbers. Much like nut shell, the recovery rate decreased with depth. In general, the only conclusion that seems to be warranted in these areas of the site is that the use of oak (especially red oak) was a standard practice throughout the accretional formation of the midden. Whether the scarcity of other types of trees represents a real absence or simply a function of preservation and recovery techniques is unknown.

In the Southern Block substantial wood charcoal remains were recovered from features associated with Structures 1 and 2 (Occupational Surface III) and Structure 3 (Occupational Surface I). Not surprisingly, houses associated with both surfaces (Structures 2 and 3) were interpreted as having burned. The wood charcoal recovered from each leads to certain conclusions about their construction.

The most frequent type of wood charcoal identified for Occupational Surface III is cane (53.2 percent of the total charcoal sample). Cane is especially frequent in samples from the house floor (64 percent of identified charcoal from the floor), the outer wall postmolds (56.7 percent), and the features associated with the house burning (55.6 percent). It is identified in smaller percentages among the features in the house (47.5 percent) and especially from features interpreted as central posts (27.3 percent). The number of and distribution of cane charcoal fragments strongly suggests that the roof of Structure 2 was made of cane (presumably thatched). As Structure 2 burned, fragments of cane fell onto the floor and along the sides of the house. The pits holding central posts and those covered by the floor were "protected" and therefore have little cane represented in their fill.

Oaks were the second most common wood type identified for Occupational Surface III. White oaks appear to be used as frequently as red oaks, a trait peculiar to this occupational surface. Oaks were probably used as firewood and structural supports. At least one central post (Feature 81) appears to be from the white oak group (65 percent of the charcoal specimens from this feature were identified as white oak).

Other wood types common on Occupational Surface III are hickory, ash, cedar, black cherry, and elm. The function of these wood types is unknown, although one central post (Feature 9) was almost assuredly elm (71 percent of the wood charcoal from this feature were identified as elm). All these genera, as well as the others represented by only a few fragments, could occur in various habitats within the 'lowland forest zone' as identified by Bobalik (1977). This forest zone is made up of predominantly oak/elm/hickory/ash forests on floodplains and terraces. Other common constituents are pine, walnut, sycamore, dogwood, black gum, maple, hackberry and mulberry. Most of these genera are represented in the archaeological sample. The results indicate that the Early Caddoan inhabitants of Bug Hill did not travel far to obtain the wood supplies necessary for their houses, fires, and other activities.

The most striking aspect of the wood charcoal collection from Occupational Surface I is the scarcity of cane. On this surface cane represents only 3.8 percent of the collection. In contrast oaks dominate the collection, constituting over 80 percent of the wood charcoal recovered. These results are consistent with archaeological interpretation of Structure 3 as a bee-hive structure supported by a wood frame. This frame (presumably oak) was smothered with mud which then baked and became daub. Some cane was probably mixed in with the mud as indicated by impressions in the daub and the very small number of cane charcoal fragments recovered.

CONCLUSIONS

The paleobotanical analysis was aimed at documenting the floral resources used by the inhabitants of Bug Hill and discerning the season(s) of occupation. The first goal has been largely met with the results presented in the preceding sections. The second goal, however, is more difficult to reach based solely on the paleobotanical results. In general, the seasonal availability of nuts, seeds and fruits recovered from the 1981-82 Bug Hill samples extend from late summer to early winter, with maximum availability occurring from September to November (see Table 36). In this respect, Bug Hill differs little from most sites in the Ouachitas or, for that matter, in the Eastern Woodlands. To say that the site was only occupied in the late summer through early winter because many of the wild plants represented are available at this time is highly misleading. The site probably was occupied at this time of the year but does not necessarily mean it was not occupied during other seasons as well.

If horticulture was practiced then it is quite likely that the site would have been occupied or at least visited during the spring and summer. Use of domesticated sunflower is a possibility during the Early Caddoan occupation. The paleobotanical evidence for domestication is extremely weak, based on one seed. Corroborative palynological evidence, however, strengthens the case for domestication. If sunflower horticulture was practiced it probably took place in

TABLE 36. SEASONAL AVAILABILITY OF PLANT RESOURCES RECOVERED AT BUG HILL

	Period of Seed or Fruit Dispersal						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Woody Plants							
Hickory (nuts)				X	X	X	X
Walnut (nuts)					X	X	X
Acorn (nuts)				X	X		
Persimmon (fruit)				X	X	X	X
Sumac (fruit)	X	X	X	X	X	X	X
Grape (fruit)		X	X	X	X	X	
Herbaceous Plants							
Asteraceae (fruit heads)		X	X	X	X	X	X
Euphorbiaceae (seeds)		X	X	X	X	X	
Pokeweed (fruit)		X	X	X	X	X	
Grass (grain)	X	X	X	X	X	X	X
Smartweed (achene)	X	X	X	X	X	X	
Goosefoot (seed)			X	X	X	X	
Pigweed (seed)			X	X	X	X	
Sunflower (achene)			X	X	X	X	

disturbed soil on or near the site. In addition to sunflower, other volunteer plants may have been "encouraged" by the Early Caddoan occupants and formed an important part of the diet.

Most of the flora represented in the Bug Hill collection prefer habitats that are predominantly scattered throughout the lowland forest zones. A heavy dependence on nuts, however, may have led to forays into the denser stands of oaks in the upland forests. The primary use of the prairie appears to have been for cane and grasses which were probably used mostly for thatch on roofs. In sum, the paleobotanical evidence suggests a heavy emphasis on the lowland forest for obtaining wood and wood by-products. Subsistence data focus on wild plant foods mostly gathered in the fall and volunteer plants and possible domesticated sunflower taken on or near the site.

CHAPTER ELEVEN

ZOOARCHAEOLOGICAL ANALYSES

By

Kathleen Mary Byrd

Introduction

It is estimated that over a million bones were recovered from the 1981-82 Bug Hill excavations. Although bone was collected in large numbers from each excavation unit, the overall distribution of bone was heavily skewed. More bones were found per level near the center of the site than were found on the slopes or the edges of the mound. Moreover, across the site more bones were found in the upper levels of excavation units than were recovered from the lower ones. Both these trends relate to the chemistry of the soil and its affect on the preservation of faunal material. Bones were not only better preserved near the center of the site but were found in much greater diversity. Some types of bones, such as fish ribs, were restricted to the center of the mound and it is quite possible that the remains of some small animal species can only be recovered from this area of the site.

Overall Objectives and Sampling Strategy

The size of the collection and the variation in bone preservation necessitated that we restrict the faunal analysis to goals that could be addressed through the study of appropriate samples of material. Our first goal was to study changes in the patterns of faunal exploitation over the time Bug Hill was occupied as an accretional mound. To this end, the first identification efforts were focused on complete vertical samples of four 1 m by 1 m units spread throughout the Southern Block (N17E12, N14E10, N11E12, N10E10). From these squares, it was clear that a study of the faunal remains based on arbitrary levels was of limited value. The tremendous mixing and churning endemic at Bug Hill has introduced so much "noise" into the levels that ferreting out patterns at a 10 cm level of resolution was impossible. We realized that any conclusions of a study of long-term faunal patterns (i.e., from Late Archaic through Caddoan periods) would have to be couched in such qualified terms that the endeavor was hardly worthwhile.

Attention was then shifted to a second, more limited goal of studying faunal exploitation patterns for the three isolated occupations of the Southern Block. While not as encompassing as the first goal, our second study had the distinct advantage of analyzing material that could be definitely associated with specific occupations and which all came from the same portion and stratum of the site; thereby eliminating variation in bone preservation as a factor.

Three analytical units corresponding to the three occupational surfaces isolated in the Southern Block were thus chosen for the zooarchaeological analysis. Initially we expected the results to bear on subsistence practices from the Woodland through the Late Caddoan periods. Radiocarbon essays, however, showed that Occupational Surface III was occupied later than anticipated, dating to the Early Caddoan period. Unfortunately, by this time it was impractical to alter the zooarchaeological sample. Consequently, the results of this analysis pertain solely to the Caddoan period.

Faunal Materials

Faunal remains were recovered from water screened material and flotation samples. Bones recovered at the water screen were usually larger than one-fourth inch in size. Flotation, on the other hand, recovered bones of all sizes. Often bones from small animals, such as shad, which due to their small size would be lost if only water and/or dry screening is used, can be recovered through analysis of the flotation samples. Such analyses, however, are labor intensive with considerable time spent in initial preparation, sorting, and finally, identification. Therefore, prior to analyzing large numbers of flotation samples an evaluation was undertaken to test the relevancy of such an effort.

For Bug Hill, ten flotation samples from the Central Block and 11 samples from the Southern Block (Test Pit 9, northwest column) were examined. Most of the bones were small unidentifiable fragments. The few bones identified were from animals whose large bones would be retrieved by standard screening methods. For this reason we decided to restrict the analysis of flotation samples to those from features and to focus the analysis of midden levels on screened material. Faunal material from all features at the site were examined and are presented in Table 21 (see Chapter Four). Features and midden levels associated with the three analytic units chosen for the zooarchaeological analysis form the bulk of the data discussed in this chapter.

Analytical Techniques

Many quantifying techniques are used in zooarchaeological studies. The three main types are the minimum number of individuals method (MNI), the weight method, and the fragment method (Chaplin 1971). Each of these has certain advantages and disadvantages.

The MNI method counts the most often reoccurring bone or bone fragment to calculate the abundance of a particular species. For example, seven right distal humeri of deer represent at least seven deer. Then by using the average body weight of a species and determining the butchered weight it is possible to estimate the amount of edible meat.

This method should not be used uncritically, however. Several major points should be considered, one of which is sample size. For small samples using the MNI method distorts the results in favor of the larger animals. For example, one deer phalange could represent a deer with a dressed weight of 50 to 100 lbs. The sample size could increase by several hundred bones and still the MNI for deer could be one (although the number of deer bones could increase considerably). In this larger sample more fish and/or small mammals might well be identified. With these additional animals the relative amount of meat represented by the deer could decrease. The uncritical use of the MNI method can result in a false feeling of exactness.

The weight method is based on the premise that there is a correlation between bone weight and body weight and that it is possible by multiplying the bone weight by a factor to get the amount of meat represented per species. The problem with this method revolves around archaeological bone weight. For the bone weights to be accurate the archaeological bone must be clean (dirt weights) and in a good state of preservation. Eroded weathered bone, burned bone, and fossilized bone do not give reliable weights and, therefore, affect the validity of the estimates. This is especially a problem where some bone has been subjected to weathering over a period of time.

The fragment method, as with the two methods just described, has inherent strengths and weaknesses. The fragment method counts the number of bones and compares the relative abundance of various animals based on these bone counts. Sample size is not as great a problem with this method. Therefore, it is possible to compare and contrast the relative number of a species' bones from level to level and area to area. This method, however, assumes that all bones are treated in more or less the same manner during butchering, cooking and disposal. This is probably not the case. Also this method cannot be used to estimate edible meat.

Although the total number of bones from the Bug Hill collection was large, the need to disregard some units due to possible mixing resulted in a smaller sample size. Therefore, it was felt that the MNI method should not be used. Due to differential bone preservation which was noted in the field during excavation and is evident from examining the collection, it was decided that the weight method in this case was also not worthwhile. Therefore, the fragment method was chosen for the purposes of this study. Using this method it was possible to make some pertinent comparisons among the three components and to examine the differential bone deposition in the collection.

For identification purposes the zooarchaeological collection at Louisiana State University, Museum of GeoScience, was used for most of the identifications. Some of the mammalogy collections at the LSU Museum of Natural Sciences were also utilized. The identification technique involved the comparison of the archaeological material with the bones of the known animals and then the tabulation for each lot of the number of fragments for each species present.

Slightly more than 26,000 bones were examined. Every effort was made to be as exact as possible and the lowest taxon to which a bone could be reliably referred was used. For example, *Canis familiaris*, the dog, and *Canis latrans*, the coyote, interbreed. The resulting hybridization makes it difficult to assign a bone to a particular species when the bones are within the range of both animals. In these cases only the genus or family was used. A large number of bones were assigned to the large mammal category. Most of these bones were fragments and based on the high incidences of deer in the final tabulations these large bones probably belong to this species, although some could belong to elk.

Results

Occupational Surface I

Only the southern part of a Late Caddoan structure (Structure 3) floor extended into the Southern Block. This floor was found in Test Pit 11, levels 2 and 3. In total, 1,462 bones were identified in this unit (Table 37). Species included gar, common snapping turtle, members of the mud-musk turtle family, a box turtle, members of the box and water turtle family, soft-shell turtle, snake, bird, opossum, a probable raccoon, dog/wolf/coyote (all the same genus), squirrel, pocket gopher, beaver, rabbit, a probable elk, and white-tailed deer. Of these, all but the snake and pocket gopher were most likely used as food. Both the snake and gopher are discounted because of their small size, and therefore minimal food value. Both these species would be expected to occur around villages and camps, especially after the site was abandoned. Their occurrence in the sample is very likely due to their natural presence in the area and their subsequent deaths there.

In all but three cases the species and/or families identified were represented by less then 10 bones. The exceptions are the mud-musk

TABLE 37. SOUTHERN BLOCK FAUNAL REMAINS -- OCCUPATIONAL SURFACE I

	NUMBER OF FRAGMENTS			
	Floor	Features	Total	Percent
Lepisosteus sp. (gar)	1	---	1	.07
Unid. Ostelchthyes (unid. fishes)	4	---	4	.27
TOTAL Ostelchtyes (fishes)	5	---	5	.34
Chelydra serpentina (snapping turtle)	7	---	7	.48
Chelydridae (snapping turtles)	3	---	3	.20
cf. Chelydridae (cf. snapping turtles)	2	---	2	.14
Kinosternidae (mud-musk turtles)	20	1	21	1.43
Terrapene sp. (box turtle)	1	---	1	.07
Emydidae (box and water turtle)	57	1	58	3.94
Trionyx sp. (soft-shell turtle)	3	---	3	.20
Unid. Testudines (unid. turtles)	523	12	535	36.62
Unid. Serpents (unid. snakes)	5	---	5	.34
TOTAL Reptilia (reptiles)			635	43.42
Unid. Aves (unid. birds)	3	---	3	.20
cf. Aves (cf. birds)	4	---	4	.27
TOTAL Aves (birds)			7	.48
Didelphis marsupialis (opossum)	1	---	1	.07
cf. Procyon lotor (raccoon)	1	---	1	.07
Canis sp. (dogs and wolfs)	1	---	1	.07
cf. Canis sp. (dogs and wolfs)	1	---	1	.07
Sciurus sp. (squirrels)	2	---	2	.14
cf. Sciurus sp. (cf. squirrels)	1	---	1	.07
Geomys bursarius (pocket gopher)	2	---	2	.14
Castor canadersis (beaver)	1	---	1	.07
Sylvilagus sp. (rabbits)	4	---	4	.27
Small Mammalia (small mammals)	17	1	18	1.22
cf. Cervus canadensis (elk)	1	---	1	.07
Odocoileus virginianus (deer)	81	1	82	5.61
Large Mammalia (large mammals)	676	23	699	47.84
TOTAL Mammalia (mammals)			814	55.71
Unid. Bone	1107	70	1177	
TOTAL IDENTIFIED			1461	99.95

turtles, the water turtles, and the deer. In fact, turtle and large mammals (including deer and elk) make up over 96 percent of all the bone identified. Large mammal alone accounts for 53 percent of the total.

Occupational Surface II

Below the remnants of Structure 3 were a series of features interpreted as the remains of intermittent camps. These features were separated by midden deposits without associated evidence of floors. For this analysis samples from levels 4-6 were examined as well as Feature 30, a faunal and floral processing area. Table 38 lists the results. A total of 2,322 bones were identified from this component. Species include gar, sucker, catfish, common snapping turtle, mud-musk turtles, box turtle, map turtle, members of the box and water turtle family, soft shell turtle, snake, frog/toad, turkey, small bird, opossum, raccoon, dog/wolf/coyote, fox squirrel, pocket gopher, probable beaver, muskrat, rabbit, and deer.

Of these, all except the snake, frog/toad, and pocket gopher were probably used as food. These three are discounted because of their small size making them unlikely sources of food; even if these animals were used as food, their value would have been low. Of the animals identified all but the mud-musk turtles, box and water turtles, large birds (probably all turkeys), and deer were represented in concentrations of less than one percent. Turtle, deer, and unidentified large mammal (probably deer) made up over 91.7 percent of the matrix sample and over 93.7 percent of the Feature 30 sample. Differences between Feature 30 and the midden were the relatively higher proportion of turtles in the feature (54.3 percent) as opposed to large mammals which dominated the midden matrix (46.4 percent).

Occupational Surface III: Structures 1 and 2 and Vicinity

Underneath the camp levels was found a series of Early Caddoan house floors and associated features (Structures 1 and 2). At least one house burned and the floor was overlain by about 20 cm of fill (levels 8 and 9). This component was analyzed in three segments: the house floors and fill, outside the houses, and the features. The associated features include all assigned to this occupational surface (refer to Table 1, Chapter Four). The house floors and fill were confined to Test Pit 1 (levels 8-10), Test Pit 9 (levels 8-10 top), and Test Pit 8 (N14E12, levels 8-10 top). The area outside of the houses was defined as Test Pit 11 (levels 8-10), and Test Pit 10 (N10-N15 E13, levels 8-10). It should be noted that these "outside" areas lie within both Strata II and III; some of the faunal material may relate to earlier Late Archaic occupations of the site. Most of the material, however, is interpreted as being contemporaneous with Occupational Surface III and should be associated with the occupation of Structures 1 and 2. Table 39 lists the zooarchaeological remains.

In all, 6,636 bones were identified from this component. Species include gar, bowfin, catfish, alligator snapping turtle, common

TABLE 38. SOUTHERN BLOCK FAUNAL REMAINS -- OCCUPATIONAL SURFACE II

	NUMBER OF FRAGMENTS			
	Matrix	Percent	Feat. 30	Percent
Lepisosteus sp. (gar)	---	---	1	.15
Catostomidae (suckers)	1	.06	---	---
Ictaluridae (catfishes)	3	.18	---	---
Unid. Osteichthyes (unid. fishes)	7	.42	---	---
TOTAL Osteichtyes (fishes)	11	.56	1	.15
Chelydra serpentina (snapping turtle)	---	---	2	.30
Chelydridae (snapping turtles)	4	.24	---	---
cf. Chelydridae (cf. snapping turtles)	3	.18	---	---
Kinosternidae (mud-musk turtles)	19	1.14	16	2.40
Terrapene sp. (box turtle)	2	.12	1	.15
Graptemys sp. (map turtle)	1	.06	---	---
Emydidae (box and water turtle)	49	2.94	16	2.40
Trionyx sp. (soft-shell turtle)	6	.36	1	.15
Unid. Testudines (unid. turtles)	672	40.48	326	49.24
Unid. Serpents (unid. snakes)	12	.72	4	.60
TOTAL Reptilia (reptiles)	768	46.24	366	55.09
Unid. Anura (frog/toad)	1	.06	1	.15
TOTAL Amphibia (Amphibians)	1	.06	1	.15
Meleagris gallopavo (turkey)	2	.12	---	---
Large Aves (large birds)	42	2.52	---	---
[illegible]ll Aves (small birds)	1	.06	---	---
[illegible] Aves (cf. bird)	---	---	3	.45
Unid. Aves (unid. birds)	3	.18	---	---
TOTAL Aves (birds)	48	2.88	3	.45
Didelphis marsupialis (opossum)	2	.12	1	.15
cf. Didelphis marsupialis (cf. opossum)	---	---	1	.15
Procyon lotor (raccoon)	3	.18	2	.30
Canis sp. (dogs and wolfs)	---	---	1	.15
cf. *Canis* sp. (cf. dogs and wolfs)	1	.06	---	---
Unid. Carnivora (unid. Carnivora)	1	.06	2	.30
Sciurus niger (fox squirrel)	1	.06	---	---
Sciurus sp. (squirrels)	6	.36	3	.45
Geomys bursarius (pocket gopher)	---	---	1	.15
cf. *Castor canadensis* (beaver)	2	.12	---	---
Ondatra zibethicus (muskrat)	1	.06	---	---
Sylvilagus sp. (rabbits)	12	.72	8	1.20
Small Mammalia (small mammals)	30	1.80	9	1.35
Odocoileus virginianus (deer)	135	8.13	51	7.70
Large Mammalia (large mammals)	638	38.43	212	32.02
TOTAL Mammalia (mammals)	832	50.10	291	43.92
Unid. Bone	2040	---	850	---
TOTAL IDENTIFIED	1660	99.84	662	99.76

TABLE 39. SOUTHERN BLOCK FAUNAL REMAINS -- OCCUPATIONAL SURFACE III

	NUMBER OF FRAGMENTS					
	Inside House	Percent	Outside House	Percent	Features	Percent
Lepisosteus sp. (gar)	4	.08	1	.22	1	.08
Amia. calva (bowfin)	1	.02	---	---		
Ictaluridae (catfish)	1	.02	1	.22	1	.08
cf. Osteichthyes	2	.04	---	---		
unid. Osteichthyes (unid. fishes)	1	.02	---	---	4	.32
TOTAL Osteichtyes (fishes)	9	.18	2	.44	6	.48
Macroclemys temmincki (alligator snapping turtle)	1	.02	---	---		
Chelydra serpentina (snapping turtle)	---	---	1	.22	3	.24
cf. Chelydridae (cf. snapping turtles)	6	.12	1	.22		
Kinosternidae (mud-musk turtles)	103	2.09	8	1.80	20	1.60
cf. Kinosternidae (mud-musk turtles)	---	---	1	.22		
cf. *Chrysemys* sp. (slider turtles)	---	---	2	.44		
Terrapene sp. (box turtle)	5	.10	---	---	3	.24
Graptemys sp. (map turtle)	3	.06	---	---		
Emydidae (box and water turtle)	146	2.96	10	2.25	39	3.12
Trionyx sp. (soft-shell turtle)	19	.38	3	.66	2	.16
Unid. Testudines (unid. turtles)	2141	43.36	143	32.21	561	45.32
Unid. Serpentes (unid. snakes)	9	.18	3	.66	10	.80
TOTAL Reptilia (reptiles)	2433	49.27	172	38.68	635	51.48
cf. Aves (cf. bird)					6	.48
Small Aves (small birds)	2	.04	---	---		
Meleagris gallapavo (turkey)	1	.02	1	.22		
Large Aves (large (birds)	14	.28	1	.22		
Unid. Aves (unid. birds)	24	.48	5	1.12	9	.72
TOTAL Aves (birds)	41	.82	7	1.56	15	1.20

TABLE 39. SOUTHERN BLOCK FAUNAL REMAINS -- OCCUPATIONAL SURFACE III (CONTINUATION)

	NUMBER OF FRAGMENTS					
	Inside House	Percent	Outside House	Percent	Features	Percent
Didelphis marsupialis (opossum)	5	.10	---	---		
Scalopus aquaticus (mole)	2	.04	2	.44	1	.08
Procyon lotor (raccoon)	3	.06	3	.66	2	.16
Canis sp. (dogs and wolfs)	1	.02	---	---		
Canis cf. *familarus* (dog)					1	.08
Vulpes fulva (red fox)	1	.02	---	---		
Unid. Carnlovora (unid. Carnivores)	2	.04	---	---	1	.08
cf. Carnivora (cf. (carnivore)					1	.08
Sciurus sp. (squirrels)	12	.24	1	.22	3	.24
Geomys bursarius (pocket gopher)	7	.14	---	---		
Sigmodon hispidus (cotton rat)	---	---	1	.22		
Castor canadersis (beaver)	3	.06	---	---	1	.08
cf. Rodentia (cf. rodents)	2	.04	---	---		
unid. Rodentia (unid. rodents)	---	---	1	.22		
Sylvilagus sp. (rabbits)	36	.72	9	2.02	11	.88
cf. *Sylvilagus* sp. (cf. rabbits)	1	.02	---	---		
Small Mammalia (small mammals)	168	3.40	22	4.95	18	1.44
Odocolleus virginianus (deer)	336	6.81	25	5.63	61	4.92
Large Mammalia (large mammals)	1875	37.98	198	44.59	479	38.69
TOTAL Mammalia (mammals)	2454	49.69	263	58.95	579	46.73
Unid. Bone	4068		368		1254	
TOTAL IDENTIFIED	4937	99.96	444	99.63	1238	99.89

snapping turtle, mud-musk turtle, box turtle, a probable slider turtle, map turtle, soft shell turtle, snake, a small bird, turkey, opossum, eastern mole, raccoon, a probable dog, red fox, squirrel, pocket gopher, cotton rat, beaver, rabbit, and deer. Of these, all but the snake, mole, pocket gopher, and cotton rat were probably used as food. These latter four may not represent food items because of their small size. Of all the species and/or families identified, only the mud-musk turtle, the box and water turtle families, and the deer occur in concentrations greater than one percent. Turtles and deer represented 92.7 percent of the house floor collections and 93.4 percent of the feature material. Large mammal bone alone represented 44.22 percent and 43.20 percent respectively.

Table 40 compares the results for the three sections of the component summarized by class. The larger percentage of large mammal bone deposited outside the house is noted. This result does not appear to be due to changes in hunting practices between the Late Archaic and Early Caddo. Instead, the relative changes in large mammal bones noted probably reflect cultural practices associated with the Early Caddo. Whether the outside area represents a deer butchering locality or activity area, or is the result of a "semi-neat" housewife collecting and redepositing the larger food bone outside the houses, is unclear.

TABLE 40. FAUNAL REMAINS BY CLASS -- OCCUPATIONAL SURFACE III

	House Floor N = 4952	Non-House N = 445	Features N = 1239
Osteichthyes (fishes)	.18	.44	.48
Reptilia (reptiles)	49.27	38.68	51.48
Aves (birds)	.82	1.56	1.20
Mammalia (mammals)	49.69	58.95	46.73

Conclusion of the Southern Block Faunal Components

Animals neither have the same habits or are evenly distributed across the landscape. Each species has certain habitat preferences and behavioral traits which make them easier or harder to catch using a certain procurement technique. These factors are considered below.

Only those species presumably used as food are discussed here. Other species are viewed as commensals due to their small size and natural likelihood of occurring in the area. The commensals include snake, frog/toad, mole, pocket gopher, and cotton rat.

Only four families of fishes; gar, bowfin, catfishes, and suckers, were identified and listed in the tables. A fifth fish, the freshwater drum (Aplodinotus grunniens), was noted in the collection but not from units under consideration here. Of the four families within the example, all could have been caught in Jackfork Creek. Gar and bowfin prefer areas of abundant aquatic vegetation with bowfin also favoring sluggish waters. The suckers and catfishes are both bottom feeders. Bowfin and suckers exhibit schooling tendencies during certain times of the year (Jordan and Everman 1969). All individuals from the collections were fairly small.

These fish are carnivores and can be taken with a hook and line. One bone fishhook was recovered from the 1981-82 excavations and several hook fragments were found in the 1979 season. Net, traps, and poisons could also have been used but all these activities require either a greater initial input of time and energy or are more labor intensive than the hook and line method. Since fish were apparently only an occasionally utilized resource, it is unlikely that these more intensive methods were used.

Turtles, the second most abundant class of animals in the collection, are represented by four families: the snappers; the soft shell turtles; the mud-musk turtles; the box and water turtles including box turtle, map turtle, and sliders. With the exception of the box turtle who are land dwellers, all the families' members are aquatic.

Both species of snappers were present. The alligator snapper is an extremely large turtle with average weights ranging from 35 to 50 lbs and with a recorded weight of 219 lbs. It is carnivorous and is generally found lying on the bottom of the lakes or rivers with its mouth open. The common snapping turtle is smaller (10 to 15 lbs average) and is found in permanent bodies of water. The soft shell turtles are highly aquatic. Neither the snappers nor the soft shell bask on stream banks to any great extent. The mud-musk turtles are also aquatic with the musk turtles rarely leaving the water though mud turtles spend some time on dry land. The members of the family are small, generally well under five inches in length. The water turtles (Emydidae) are found in lakes and rivers. They are aquatic but can be found more often basking on logs and and on banks than the other aquatic types. The map turtles range in size from seven to 10.75 in while the sliders range from five to 13 in. The Emydidae family also includes the box turtle. This turtle is terrestrial and can be found in woods and meadows. It ranges in size from 4.5 to six inches (Conant 1975).

To catch and/or collect these species different techniques could be used. The box turtle can simply be picked up in wooded areas and carried back to camp. Certain times of the year a similar practice could be used for the mud turtles. The others would have to be caught at a river or pond. Some of these could take a hook, especially the musk turtles, but the majority would be easier to catch using a passive technique like a trap. The difficulty of catching these animals and the large number recovered from the site suggest that techniques such as traps were probably used.

Only one species of bird was identified in the collection, the turkey. Mainly an upland bird, the turkey is large, non-migratory, and usually found in groups.

Ten mammals (opossum, raccoon, beaver, muskrat, squirrel, rabbit, dog/wolf/coyote, red fox, elk, deer) usually are assumed to have been used as food. Of these the opossum, raccoon, beaver, and muskrat are generally found along streams or within a short distance of a stream. The first three are chiefly nocturnal. Their size ranges are: muskrat, two to four pounds; opossum, nine to 13 lbs; raccoon 12 to 15 lbs, and beaver 30 to 60 lbs.

The squirrels prefer an arboreal existence, although the fox squirrel does spend some time on the ground. Squirrels are found in both hardwood (gray) and hardwood and pine (fox) forests and along the river bottoms. They are active during the day. The gray squirrel ranges in size of .75 to 1.75 lbs with the fox squirrel from 1.20 to three pounds.

The genus of rabbits identified (*Sylvilagus* sp.) are heavy brush, forest edge or wetland animals. They are active from early evening to late morning. Species range from two to four pounds (*S. floridanus*) to 3.5 to six pounds (*S. aquaticus*) (Burt and Grossenheider 1964).

The predators, the dog/wolf/coyote and the red fox, are chiefly nocturnal. They frequent prairies, open woodlands and mixtures of forests and open areas. Sizes range from the red fox (10 to 15 lbs) to the red wolf (30 to 80 lbs).

Both the elk and deer are large herbivores and are found in forests, forest edges, swamps, and meadows. They elk can weigh up to 1000 lbs. The deer can range anywhere from 50 to 400 lbs. The elk is sometimes seen in groups of 25 or more. The deer, while is has been reported in groups of 25 in the winter, is generally seen the rest of the year singly or in twos and threes.

It is probably likely that a variety of procurement methods were used by Bug Hill people to obtain the mammals found in the midden. Hunting was probably the method used to kill the larger animals, especially the elk and deer, and could have been used on some of the other animals as well. Most animals are more active during early morning or toward dusk; therefore, probably the hunting was done at one of those two times of day. Other species, especially squirrel, are active throughout the day so these could have been caught during the daylight hours. Some nocturnal and aquatic types, especially the opossum, would be easier to catch if traps were used. Dogs could have been kept in the village and killed and butchered there.

Conclusions

Although the relative percentages vary somewhat from unit to unit for all three components, mammals, especially deer, were the most important vertebrate food source. Deer was most likely the single most important animal in the diet. Turtle collecting was a reoccurring activity but did not result in as much food as was obtained by deer hunting. Hunting and/or trapping of other mammals, although minor, resulted in a varied diet. Fishes and birds were occasionally caught, but did not contribute a significant amount to the overall diet and were supplementary in nature.

The results of this analysis indicate that no major shift in faunal subsistence patterns occurred during the three Caddoan occupations of the Southern Block. Comparing these results with those of Vehik's (1982a) indicates little change throughout the entire occupational history of the site. The residents of Bug Hill then, practiced the same overall pattern, deer hunting was emphasized as the most important activity with turtle collecting as a standard practice, and hunting and trapping of other mammals also taking place.

The pattern described above does not appear to be peculiar to Bug Hill but fairly typical of Ouachita Mountain midden mounds in general. Galm (1981) found nearly identical patterns of faunal exploitation at the Sam, Wann, and Curtis Lake sites in the Wister Valley. The consistency in the faunal collections from these mounds indicates that their position in the settlement system changed little over time. This point will be discussed again in Chapters Fourteen and Fifteen.

CHAPTER TWELVE

MOLLUSCAN REMAINS FROM THE BUG HILL SITE (34PU116), PUSHMATAHA COUNTY, OKLAHOMA

By

Arthur E. Bogan and Cynthia M. Bogan

The molluscan fauna of Oklahoma has received considerable attention. The terrestrial and aquatic gastropods of the state have been described, listed and discussed in over 40 papers. This literature is summarized in a series of papers by Branson (1959, 1961a, 1961b, 1963, 1964a, 1973a) and the work of Hubricht (1966, 1967, 1972). This body of literature is supported by literature on the terrestrial mollusk fauna from surrounding states (Leonard 1959; Cheatum and Fullington 1971a, 1971b, 1973; Fullington and Pratt 1974; Franzen and Leonard 1947; and Pratt 1981). The fresh-water bivalve faunas (Unionidae and Pisidiidae) are documented in the early work of Isely (1914, 1924) and later by Branson (1964b, 1973b). The unionid data can be supplemented by the reports of Call (1895), Parmalee (1967) and Murray and Leonard (1962).

The identification, analysis and interpretation of archaeological molluscan assemblages is still relatively undeveloped. The identification of land snails in archaeological sites had been rather infrequent in the first half of the 20th century (e.g., Morrison 1942) and it is really only within the last 20 years that the importance of the terrestrial gastropod remains has been realized (Evans 1972). The faunas reported mostly deal with species present and their interpretation (Matteson 1953, 1959; Clench 1974; Hall 1978a; Baerreis 1969, 1971, 1974, 1978; Neck 1979). Discussions on methodology and constraints on interpretations are however limited (Jaehnig 1971; Baerreis 1973; Cheatum and Allen 1964). Recently, Baerreis (1980) has presented an analysis of an archaeological land snail assemblage using an innovative approach by coupling modern climatic data, data on modern local molluscan morphometrics and a proposed reconstruction of past local climate.

The role of the freshwater bivalves (Unionidae) has been more progressive. The identification of unionids is useful in the reconstruction of local aquatic resources used by the site's inhabitants. Examples include the work of Ortmann (1909), Matteson (1953, 1960), Morrison (1942), Parmalee et al. (1980), and White (1977). The work of Klippel et al. (1978) presents evidence for a change in the water quality of a river through time. Parmalee et al. (1980) provide an example of the zoological importance of the archaeological record in interpreting the past unionid fauna of a river.

Methods

The molluscan sample consists of 742 unionid valves, 8 aquatic gastropods and 5756 terrestrial gastropods from 13 test pits. This sample includes all unionids found at the site. However, due to the number of gastropods recovered, a sampling strategy was developed for these remains. Five flotation columns were analyzed completely. Two of these were from the Southern Block (Test Pits 1 and 9). The rest came from one column each from the Central Block (Unit 5B), the Northern Block (Test Pit 4) and the peripheral units (Test Pit 6). In addition, all gastropods from one 100 cm by 12.5 cm column screened through 1/16 in hardware mesh from the Central Block (Unit 5C) were also examined. Finally, all gastropods recovered from features and burials were analyzed. The results have been combined by excavation unit and stratum and are presented in Table 41.

Identification of the archaeological molluscan remains was accomplished by using field guides (Burch 1962, 1975; Pilsbry 1939-1948) and the Malacology Collections at the Academy of Natural Sciences of Philadelphia. The order of the taxa follows Burch (1962, 1975). The taxa are alphabetical within family and genus.

Discussion

Two species of aquatic gastropods were identified in the Bug Hill collection. The identification of the *Campeloma* follows the logic presented by Branson (1961a:34), i.e., the close resemblance of the shells to *C. decisum*. This animal is typically found on soft mud, silt and/or sand bottoms with or without local current (Branson 1961a:34-35). Branson (1961A:62) and Leonard (1959:58-59) observed that *Helisoma trivolvis* generally inhabits quiet to semi-stagnant water. Thus, these two snails could have been collected or washed on to the site from pool or slack water portions of Jackfork Creek or from standing water of swampy areas adjacent to the site.

TABLE 41. SUMMARY OF MOLLUSCAN REMAINS FROM THE 1981-82 FIELDSEASON.

	Southern Block					Central Block							Northern Block				Site Peripheries				Locality A			
	Ap	II	III	O.S.III	IV	Ap	I	IIa	IIb	III	IV	Burial 6	Ap	II	III	IV	Ap	II	III	IV	Ap	II	IV	TOTALS
Terrestrial Gastropods																								
Gastrocopta armifera		4	11	11	2	2	9	146	217	793	30	974		1	16				1					2217
Gastrocopta contracta				1	1		109	105	129	311	12	285			11									964
Gastrocopta cristata								4	3	2	1	12												22
Gastrocopta pentodon										2														2
Gastrocopta procera							6	7	3	3		4												23
Gastrocopta procera/ cristata							1	3				5												9
Gastrocopta sp.				1				3		5		31												40
Pupilla sp.								2		1														3
cf. *Pupisoma* sp.								1	1															2
Pupoides albilabris								1	1	4		9												15
Vertigo ovata												3												3
Vertigo tridentata									2	1														3
Vertigo ventricosus										3														3
Vertigo sp.							2		1															3
Pupillidae			2																					2
Strobilops labyrinthica				2		1		12	8	4		58						1						86
Anguispira alternata		12	12	30	2	3	37	54	13	11		152			2		1							329
cf. *Anguispira alternata*																								
Helicodiscus parallelus		1	2	4	1		2	62	54	69	6	86			10									297
cf. *Euconulus* sp.											2													2
Hawaiia miniscula		1		3			33	126	147	219	5	175			8					2				719
Mesomphix friabilis			1	3	1	3	16	17	14	9		7			2									73
cf. *Mesomphix friabilis*								1																1
Nesovitrea indentata						3		4		10	1	29					1							48
cf. *Nesovitrea identata*										3														3
Nesovitrea sp.								1	1			137						1						140
Zonitoides arboreus				2			2	39	13	43	4				5			1						109
cf. *Zonitoides arboreus*					1			8	22	26	1													58
Zonitidae		1						1											1					3
Daedalochila auriformis					1																			1
Daedalochila leporina			1							1		2												4
Daedalochila cf. *texasiana*																1								1
Mesodon inflectus		1	1	2		5	5	10	14			7			2	1								48
Mesodon thyroides									1															1
Mesodon sp.								1	2															3
Polygra cereolus		1		2	1																			4
Stenotrema leaf aliciae							5	15	14	1		12			6									53
Polygyridae			1			1	5	2	1						3									13
Indet. terrestrial gastropods		4	4	15	5	4	12	45	72	209	6	63		1	6			1	2					449
TOTALS	0	25	35	76	15	16	235	657	729	1761	69	2051	0	2	71	2	2	4	4	2	0	0	0	5756

TABLE 41. SUMMARY OF MOLLUSCAN REMAINS FROM THE 1981-82 FIELDSEASON. (CONTINUATION)

	Southern Block					Central Block							Northern Block				Site Peripheries				Locality A			
	Ap	II	III	O.S.III	IV	Ap	I	IIa	IIb	III	IV	Burial 6	Ap	II	III	IV	Ap	II	III	IV	Ap	II	IV	TOTALS
Aquatic Gastropods																								
Campeloma decisum								3	2	2														7
Helisoma cf. trivolvis										1														1
TOTALS	0	0	0	0	0	0	0	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Bivalves																								
Amblema plicata	1	14	11	5	1		9	11	9	10				1	9			2	4					87
cf. Amblema plicata		4	2	2			1							1			1	1						12
cf. Fusconaia ebena				1		1																		2
Fusconaia flava		3	4				4	7	5	3					1									27
cf. Fusconaia flava	1	3	1	1			1							1										8
Fusconaia sp.				1																				1
cf. Plectomerus dombeyanus									1															1
cf. Quadrula nodulata								2																2
Quadrula pustulosa		1		1			2		1	5		1												11
cf. Quadrula putulosa		1								2														3
Tritogonia verrucosa		4	1	2			7	3	5	6			1					1	2					32
cf. Tritogonia verrucosa	1						1	2		1			1											6
Elliptio dilatata	1								2															3
Arkansia wheeleri															1									1
Strophitus undulatus								1	1	1														3
Lampsilis cf. ovata			1												1									2
Lampsilis radiata			1				2	12	1	7					2									25
Lampsilis cf. radiata							1		1						1									3
Lampsilis sp.		1					3	1	4	13								2						24
cf. Lamsilis sp.				1			1			4					1									7
Ligumia recta								1	1	1														3
Ligumia subrostrata								1																1
cf. Ligumia sp.									1															1
Potamilus purpurata										1														1
Ideterminate bivalves	10	77	32	64	5	16	38	30	35	72		5	6	11	32	1	8	17	15					474
TOTALS	12	110	53	78	6	17	70	71	67	125	0	6	7	15	48	1	9	23	21	0	0	0	0	740

The large collection of terrestrial pulmonate gastropods comes primarily from the Central Block. In part this is a result of our sampling strategy which emphasized this part of the site. However, a high incidence of land snails was expected in this area, the center of the mound, due to the high soil pH. The basic nature of the soil is conducive to molluscan shell preservation. The test pits located on the mound periphery or off the mound proper show a marked decrease in molluscan abundance.

The terrestrial gastropod assemblage from the site is dominated by the small pupillid snails which account for 57 percent of the assemblage. The Zonitid snails comprise 19.99 percent, the discidae 10.8 percent, and the Polygyrids only 2.2 percent, while the indeterminate snails account for 7.8 percent of the sample.

Publications with listed habitat preferences for the taxa listed in Table 41 were surveyed and will only be summarized here (Pilsbry 1939-1948; Franzen and Leonard 1947; Leonard 1959; Cheatum and Fullington 1971b, 1973; Fullington and Pratt 1974). The reconstructed picture which emerges is a terrestrial molluscan fauna living in a forested situation close to water. Many of the snails are found under rotting logs, leaf litter or under rocks. The situation is similar to the wooded area samples discussed by Basch et al. (1961). The terrestrial taxa identified in this sample of mollusks include those reported by Vehik (1982a:159-166). The 1981-82 sample differs from that reported by Vehik, by the absence in this sample of *Triodopsis cragini*, *Succinea* sp., *Carychium exile* and the marine snail *Olivella*. Conversely, the 1981-82 sample contained a number of taxa not identified by Vehik (1982a) including the *Daedalochila* sp., *Vertigo ovata*, and *Vertigo ventricosus*. These differences probably only represent sample differences and the problems of rare species in the molluscan community. The ecological interpretations for both samples are comparable.

The highest concentration of terrestrial mollusks was in the Central Block. The total number of gastropods per level was calculated to examine the excavation for evidence of climatic change. Figure 63 has a marked plateau at the transition between Strata I and IIa (level 6) and three main peaks; one in Stratum IIb (level 9), one at the transition between Strata IIb and III (level 11) and one in Stratum III (level 15). Vehik (1981:166) noted a peak of *Anguispira alternata* in level 6. There is a corresponding peak in the Central Block, level 6 for this species and only one specimen was found below level 12.

The vertical distribution of the pupillids mirrors Figure 63. Vehik (1982a:166) noted that the species abundance increased about level 9 or 10, probably near the base of Stratum II. This is replicated in the data from the Central Block. The peaks observed in Figure 63 may be evidence for shifts in climate or abrupt ecological changes. A more parsimonious explanation might be that these peaks represent the snail community's response to human occupation and the

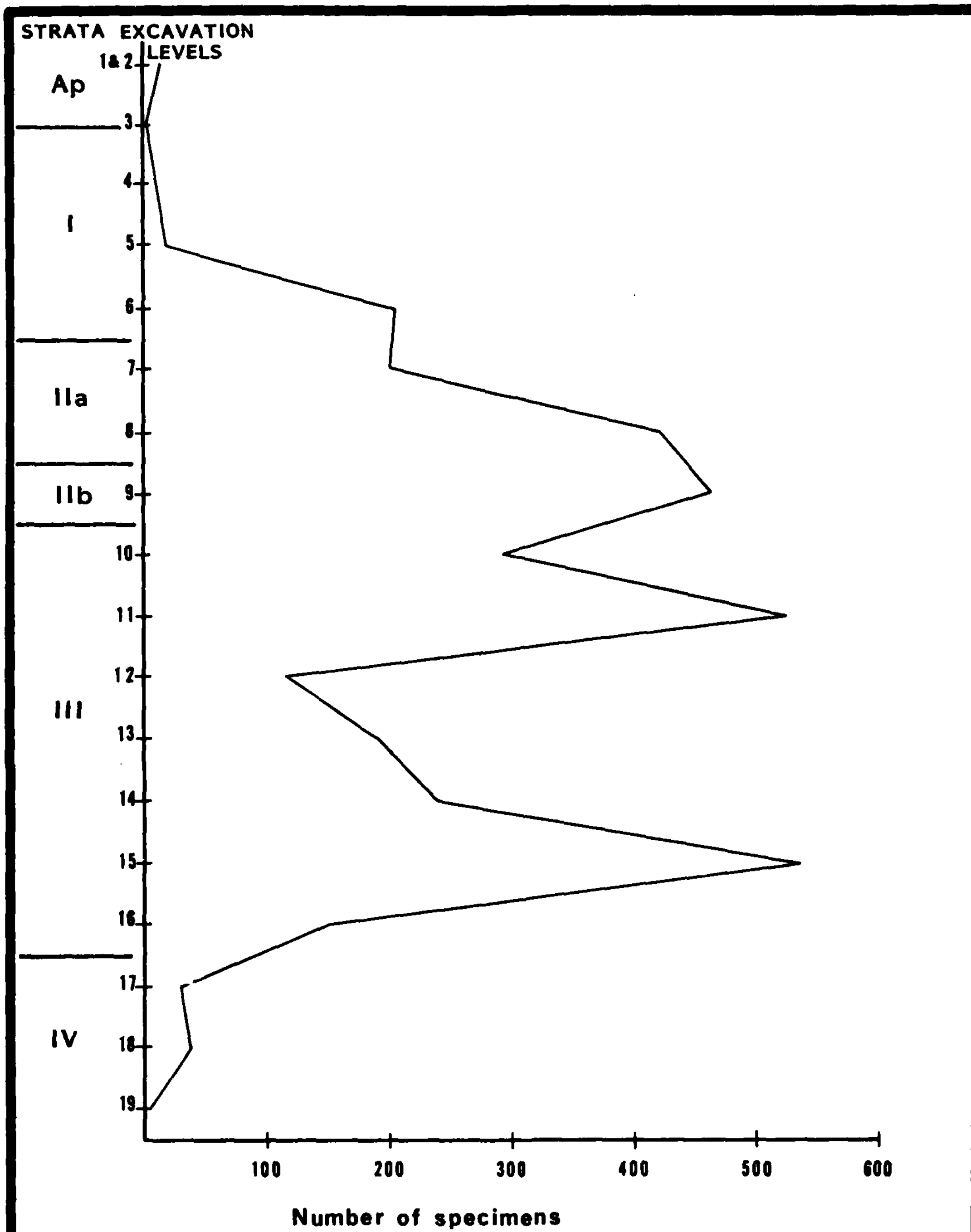


FIGURE 63. GRAPH OF NUMBER OF GASTROPODS PER 10 CM LEVEL FOR THE CENTRAL BLOCK.

concomitant disturbance and enrichment of the local area. All four peaks correspond to the onset of periods of intense occupation: the beginning of midden development during the Late Archaic period - Stratum III (level 15); the periods of intense Late Archaic occupations (level 11 - Stratum IIb and level 8-9 - Stratum IIa); and the start of Woodland period (level 6 - Stratum I). The overall pattern of vertical distribution in the Central Block looks similar to the tabulation presented by Hall (1978).

A very large terrestrial snail assemblage was associated with Burial 6 of the Central Block (Table 41). The occurrence of such a large quantity of snails in this confined space suggests that there were pin spaces around the body after burial and the snails moved into to take advantage of the moisture, space, calcium and, probably, the fungus or other plant foods on the burial.

Fifteen species of unionids were identified in the Bug Hill mollusk sample (Table 41). The requisite habitats for the identified bivalves indicates use of several different habitats. Eleven of the 15 taxa may be found in varying substrates with some current: sand, gravel, but not shifting sand (Murray and Leonard 1962, Parmalee 1967). The other taxa, *Ligumia subrostrata*, *Strophitus undulatus*, *Arkansia wheeleri* and *Potamilus purpurata*, all prefer soft sand and substrates, pool or in some cases ponded habitats in deeper water (Murray and Leonard 1962). The habitats reconstructed from the species requirements document a medium-sized stream with annual floods, riffles and pools, and, possibly, permanent ponded situations (e.g., oxbow or abandoned old stream channels).

The bivalve fauna identified in this sample corresponds very closely to that recovered by Vehik (1982a:165). The mucket, yellow sandshell, fawns-foot and deertoe were not identified in this sample. Combining the two Bug Hill samples illustrates the diverse unionid fauna being exploited, primarily from a riffle and run habitat. Bobalik and Galm (1976) and White (1977) have reported on archaeological unionid assemblages from eastern Oklahoma. The important point to be seen is that the aboriginal inhabitants of these sites were collecting freshwater bivalves for food. Based on the modern fauna, compared with the archaeological fauna, the aborigines were harvesting all species available. Further, they were not being very selective, possibly only taking size and visibility of the animal into consideration. This food resource was probably only a minor supplement to the diet; as Parmalee and Klippel (1974) have demonstrated, unionids are very deficient nutritionally. In general, the quantity of bivalve remains usually overstates the suspected importance of these resources in the prehistoric diet.

Summary

The archaeological molluscan remains recovered from the excavations at the Bug Hill site are useful in reconstructing the local environment. The molluscan remains are consistent with the alluvial history based on geomorphological evidence. That is, a site situated in a floodplain forest, bordered on one side by a relict lake and located either adjacent to Jackfork Creek (Caddoan period) or not far from the active stream (Late Archaic and Woodland periods). All species of bivalves inhabiting these two differing riverine situations were exploited to a modest extent as a supplement to the prehistoric diet. Evidence of climatic ecological change was not found. Instead shifts in the relative frequency of gastropods can more easily be explained as the snail community's response to changes in the intensity of occupation. The picture which emerges from the analysis of the molluscan remains is very similar to the setting today, although possibly slightly moister.

CHAPTER THIRTEEN

BIOARCHAEOLOGY OF THE BUG HILL SITE

By

Jerome C. Rose, Murray K. Marks and Earl B. Kiddick

Introduction

Bioarchaeologists interested in the biological impact of cultural and environmental changes upon the biology of the pre-Caddoan peoples of eastern Oklahoma have been stymied by the inability of archaeologists to assign midden mound burials to specific cultural phases. Undefinable burial pits, the virtual absence of burial goods, a variable mortuary program, and unreliable radiocarbon dates are just several of the reasons why all analyzed human skeletal series from such sites as Sam, Wann (McWilliams 1970), McCutchan-McLaughlin (Powell and Rogers 1980), and Mahaffey (Perino and Bennett 1978) have been analyzed as single burial samples, despite the fact that they probably include individuals from the Late Archaic, Woodland, and Caddoan periods. The excavation and analysis of the Bug Hill site burials presents the first opportunity to compare skeletal data from all three phases within a single site.

The primary purpose of the Bug Hill bioarchaeology project was to provide a comprehensive analysis of the prehistoric human skeletal remains from this site which will provide a data base for future analysis and synthesis. This report is the product of applying an extensive range of methodological and analytical resources to achieving three specific objectives. The first objective is to assess the adaptive efficiency of the Bug Hill inhabitants by comparison to other pre-Caddo and Caddo skeletal series. Adaptive efficiency is estimated by comparing frequencies of pathological lesions, such as periostitis and arthritis, as well as indicators of childhood stress, such as enamel microdefects, between skeletal series from diverse cultural and ecological settings. The second objective is to define the variation in adaptive efficiency and reconstructed diets that occurs between three eastern Oklahoma areas that have been the focus of large-scale archaeological investigations: Wister Lake, Jackfork Valley, and Hugo Lake. The third objective is to test the archaeologically derived temporal sequence of cultural and subsistence changes at the Bug Hill site with the skeletal data.

Methodology

All skeletal material recovered during the 1979 and 1981-82 field seasons was analyzed. The 1979 collection was made available by the U. S. Army Corps of Engineers, Tulsa District and the Archaeological Research and Management Center, University of Oklahoma. This material, which was previously been described, arrived cleaned and processed (Vehik 1982a).

Skeletal material recovered during the 1981-82 field season was delivered to the Osteology Laboratory of the University of Arkansas where it was cleaned, inventoried, and laid out in anatomical position for analysis. Sex was determined using a modification of the procedure developed by Acsadi and Nemeskeri (1970). Age determination for subadults relied on dental development (Schour and Massler 1945; Sundick 1972) and epiphyseal closure (Brothwell 1972; Krogman 1962), while that of adults employed degenerative changes of the pubic symphysis (Gilbert and McKern 1973; McKern and Stewart 1957; Todd 1920) and auricular surfaces (Lovejoy, personal communication). All bones were examined macroscopically and with the aid of a stereomicroscope for the presence of pathological lesions. All lesions were described, photographed, radiographed, and diagnosed by concordance of both clinical and paleopathological interpretations.

The dentitions were inventoried and scored for caries, dental attrition, abscessing, calculus deposits, agenesis, antemortem exfoliation and dental morphology. Five mandibular molars and one deciduous second molar were extracted, cleaned, and examined with a Scanning Electron Microscope for microwear patterns (Rose et al. 1981; Rose 1982; Ryan 1979). Four mandibular canines and five maxillary central incisors were extracted, mounted in epoxy, thin sectioned, and examined with an optical microscope for enamel microdefects (Rose 1977, 1979; Rose et al. 1978). Additional indicators of childhood stress were collected. The frequency of macroscopic hypoplasias were obtained from incisors and canines (Goodman et al. 1980) and growth arrest lines were counted on five tibia radiographs (Clarke 1982). Genetic variation data included the recording of 31 cranial and nine postcranial nonmetric traits and 20 dental morphology traits (Turner

1970; Turner and Swindler 1978). A total of five samples were submitted to the Institute of Physics and Planetary Physics, University of California, Riverside for determination of the carbon 12/13 ratio from the bone collagen fraction. The resulting ratio is compared to the standard and the difference in the relative carbon 13 content or Sigma valve (Vogel and Van Der Merwe 1977; Van Der Merwe 1982). This value indicates maize consumption when less than -16 and no maize at greater than -16. The reader is referred to Appendix III for a more detailed description of the methods employed.

Results

The discussion of the collected data is preceded by a detailed description of each burial recovered during the 1981-82 field season. Detailed inventory, metric and other specialized data are presented in Appendix III. The reader is referred to Vehik (1982a) for descriptions of burials recovered during the 1979 field season. A horizontal plan of Bug Hill is presented in Figure 64 showing the location of all burials recovered during the two field seasons, while Tables 42 and 43 provide pertinent field information.

The dating of these burials is a complicated, yet crucial issue. The burials have been placed into archaeological phases using radiocarbon dates and stratigraphic positions of the skeletons and burial pits when definable. All 11 of the 1979 burials have been assigned to the Late Archaic Wister phase, although the exact chronological positions of Burials 1 and 8 remain in doubt. Of the 1981-82 burials four have been assigned to the Wister phase of the Late Archaic (Burials 1, 7, 8, and 12), five to the Fourche Maline phase of the Woodland Period (Burials 2, 3, 4, 6a, and 6b), and two to the Early Caddoan Period (Burials 10 and 11).

Burial Descriptions

Burial 1 (Northern Block, N54E16-17 and N55E16-17), Strata III - IV: This 46 - 50 year old male was interred as a primary flexed burial lying on his right side (Figure 65). Bone preservation is good and the individual is represented by a nearly complete, although partially fragmented, cranial and postcranial skeleton. [See Appendix III for complete inventory.] A projectile point was present in the burial matrix two centimeters from the right occipital. Osteoarthritis is the dominant pathological lesion which includes the following specific joint surfaces: osteoarthritic lipping of the distal humeri, radii, ulnae, right lateral clavicle and first metacarpal; extensive eburnation of both right and left greater multangulars (Figure 66); eburnation of the patellar surface of both femora, degeneration of the corresponding patellar surfaces (Figure 67), and osteoarthritic lipping of the medial femoral condyles. The right first metatarsal and corresponding phalange show evidence of a healed fracture (Figure 68). A dislocation of the right shoulder may have been responsible for the degeneration and porosity of the distal margin of the glenoid fossa. Osteophytosis is found on four cervical

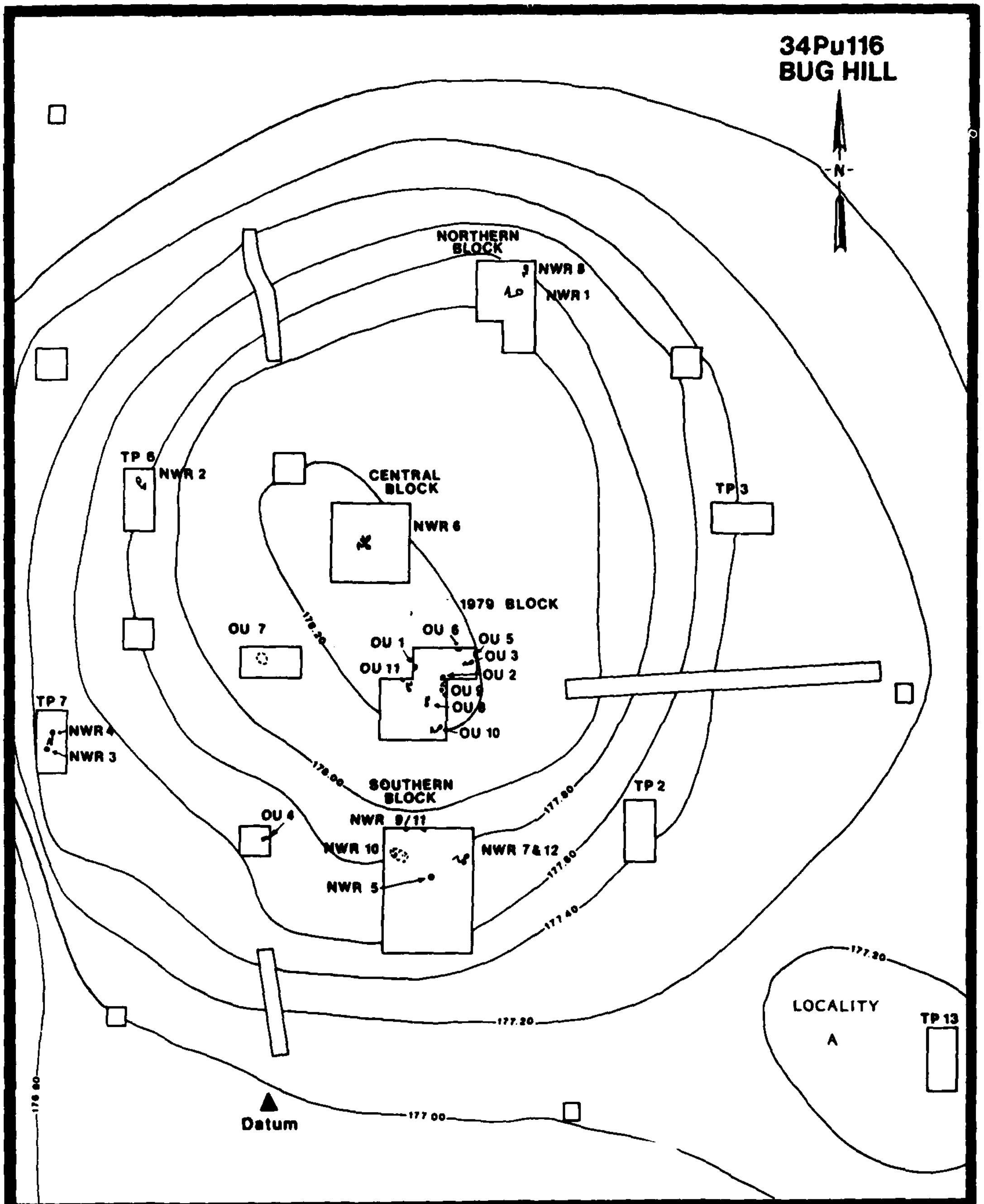


FIGURE 64. LOCATION OF 1979 AND 1981-82 BURIALS AT THE BUG HILL SITE.

TABLE 42. 1979 BURIAL DATA.

Burial Number	Square(s)	Depth Below Surface in cm	Strata	Dimensions Length x Width x Depth	Composition	Body/Skull Orientation	Number of Individuals	Age/Sex	Burial Pit Noted	Grave Goods	C14	Cultural Period Assignment	Comments
1	N28E12	45-77.	II	? x 33 x 32	fragmentary	east-west/ east	1	infant/ ?	yes (?)	none		Late Archaic/ Woodland	found in west wall of unit
2	N28E12	74	III	?	fragmentary	?	1	infant or juvenile/ ?	no	none			
3	N28E14	67	II-III	20 x 25 x ?	primary and flexed	north-south/ north	1	prenatal infant/?	no	two shell pendants (or conch)	1384± 105 B.C.	Late Archaic	C14 date rejected as too early by Vehik (1982:49)
4	N16W0	92-105	III	73 x 89 x 13	primary and flexed (?)	east-west/ east	1	infant/?	yes	none	880± 70 B.C.	Late Archaic	C14 date accepted by Vehik (1982:46)
5	N28E14	77-80	III	35 x ? x 3	flexed (?)	?	1	infant/?	?	none			
6	N28E14	97	III	?	fragmentary	?	1	adult/?	no	none		Late Archaic	4 projectile points and 1 gastropod bead may be associated
7	N28W0	110	III-IV	72 x 84 x ca. 20	cremation	northwest-southeast	1	adult/?	yes	1 projectile point, canine pendant, antler fragments, split deer metapodial, 2 antler billets, 3 bone tubes	288± 70 B.C.	Late Archaic	C14 date acceptable if burial pit originated higher in the midden (Vehik 1982: 53)
8	N23E12	46	II	42 x 50 x ?	primary and flexed	north-south/ south	1	infant/?	no	none			
9	N24E12	65	II	80 x 100 x ?	primary and flexed	northeast-southeast/ northeast	1	31-35/ female	no	none(?)	854± 85 B.C.	Late Archaic/ Woodland	a number of artifacts were noted nearby, but no clear association between them and the burial exists; C14 date rejected as too early by Vehik (1982:59)
10	N26E12	87-98	III	60 x 90 x 11	multiple	?/?	3	2.5-3/? infant/? infant-child/?	yes(?)	2 biface fragments(?), 1 pitted stone(?), 1 mano(?), 3 bone beads		Late Archaic	
11	N26E10	9-100	III	69 x 40 x 9	primary and flexed	upper torso north-south, lower torso east-west/ east	1	7-7.5/?	no	turtle carapace(?)		Late Archaic	

TABLE 43. 1981-82 BURIAL DATA.

Burial Number	T.P.	Square(s)	Depth Below Datum	Dimensions Length x Width x Depth	Strata	Composition	Body/Skull Orientation	Number of Individuals	Age/Sex	Burial Pit	Grave Goods	C14 and Sigma Values	Cultural Period Assignment	Comments
1	4,12	N54E16-17 N53E16-17	176.68-176.83	60 x 99 x 15	III-IV	primary and flexed	east-west/ east	1	46-50/ male	yes	none in the burial pit	1430 ± 110 B.C. -21.22	Late Archaic	point cache (Feature 56) found at same level ca. 2 m to the east and 1 point similar to those in cache found just south of burial
2	6	N41W8 N40W8	177.23-177.40	50 x 50 x 17	II	fragmentary, probably flexed	northeast-southwest	1	4/?	no	1 Gary point found in matrix near burial		Woodland	preservation extremely poor
3	7	N23W15	? - 177.25	?	II	fragmentary	?	1	1 adult/ ?	no	none		Woodland	consists only of several cranial fragments; a few associated long bone fragments
4	7	N23W14-15 N24W14-15	177.09 - 177.22	100 x 50 x 13	II	primary and flexed	north-south/ north	1	40-44/ female	no	Gary (1), metate (1), hammerstone (1), worked slate (1), roughout (1), biface fragments (2), cores (2) found in matrix, near burials		Woodland	1 grape seed and 1 spurge family seed found with skeleton; Burials 3 and 4 probably represent a multiple interment
5	8	N15E10	177.68	N/A	Ip	cranium fragments	n/a	1	adult/?	no	none		?	1 goosefoot seed found nearby
6	5	Unit A and baulk	177.19-177.58	80 x 90 x 31	I-II	multiple interment; primary and flexed	east-west/ east	2	16-17/ male 15-16/ male	yes	hackberry seeds (177), boatstone (1), flaker (1)	A.D. 460 ± 90 -20.92	Woodland	the burial may be intrusive from a late occupation; the skeletons were found covered with small hackberry seeds

TABLE 43. 1981-82 BURIAL DATA.
(Continuation)

Burial Number	T.P.	Square(s)	Depth Below Datum	Dimensions Length x Width x Depth	Strata	Composition	Body/Skull Orientation	Number of Individuals	Age/Sex	Burial Pit	Grave Goods	C14 and Sigma Values	Cultural Period Assignment	Comments
7	10,11	N16E13-14 N15E13-14	176.93-177.16	54 x 81 x 25	II	primary and flexed	east-west east	1	55/female	no	Gary (1), whole biface (1), unidentified contracting stemmed point (1), Ellis point (1), drill (1)	510 ± 130 B.C. -22.13	Late Archaic	baby burial (b.12) found directly beneath the pelvis
8	12	N55E17-18 N54E17-18	176.88-177.06	91 x 65 x 18	III	primary and flexed	north-south/ north	1	35+/male	no	worked antler (1), blocky debris in matrix is found near burial	75 ± 170 B.C. -22.51	Late Archaic	point cache (fea. 56) found 20 cm directly below burial; also 1 piece of blocky debris and 1 piece of unmodified hematite found in matrix near burial
9/11	11	N17E10-11	77.18-177.40	70 x ? x 22	II	primary (?) and flexed	east-west/ west	1	40-44/ male	yes	?	1430 ± 110 B.C. -22.39	Early Caddo	the burial was found directly under a large metate in the north profile of the Southern Bloc. Whether the metate represents grave furniture or a grave marker is unclear
10	8	N16E9-10	77.00-177.05	60 x 110 x 5	II	disturbed burial	N/A	2(?)	8/?	no	one		Early Caddo	burial 10 was found lying over several outer postmolds of structure 2; probably disturbed by house construction; 1 whole biface found in matrix near skeletal fragments
12	10,11	N16E13 N15E13	76.88-176.93	20 x 15 x 5	II	fragmentary	?	1	Infant/?	no	one		Late Archaic	bones were baby burial lying under pelvis of Burial 7; poorly preserved and badly damaged by roots

FIGURE 65. FIELD PHOTOGRAPH OF BURIAL 1.

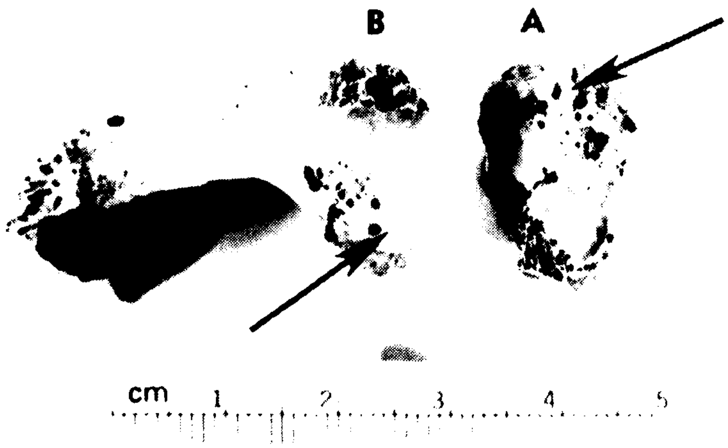


FIGURE 66. GREATER MULTANGULAR (A) AND FIRST METACARPAL (B) OF THE THUMB SHOWING EBURNATION (ARROW) AND DESTRUCTION OF THE ARTICULAR SURFACES OF BURIAL 1.

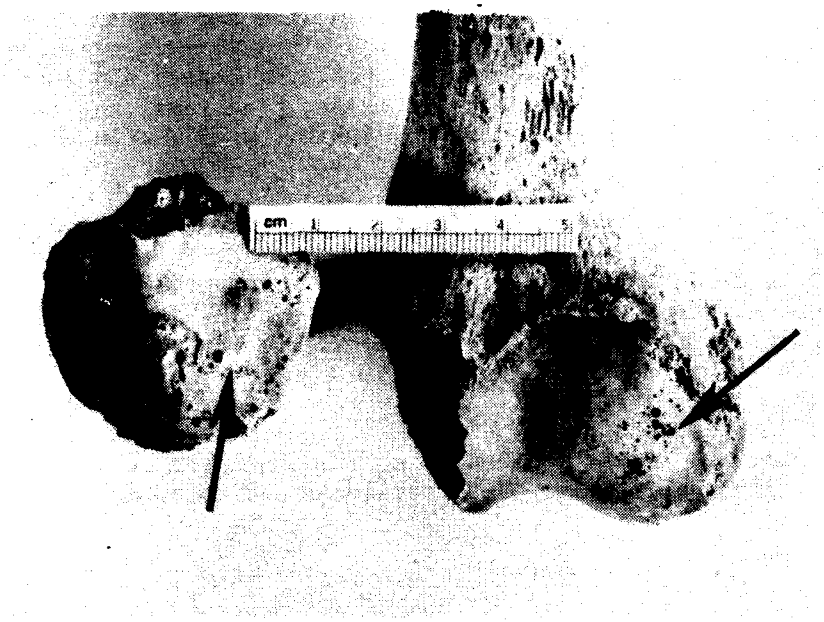


FIGURE 67. DISTAL FEMUR AND PATELLA SHOWING EBURNATION (ARROW) AND DESTRUCTION OF THE ARTICULAR SURFACES OF BURIAL 1.

FIGURE 68. THE RIGHT FIRST METATARSEL (CIRCLE) AND CORRESPONDING PHALANGE SHOWING EVIDENCE OF HEALED FRACTURE AND SUBSEQUENT OSTEOARTHRITIC DEGENERATION FROM BURIAL 1.

vertebrae and all of the lumber vertebrae. Dental attrition and antemortem tooth loss is very pronounced. The mandibular incisors display a 45° labio-lingual wear plane which extends from the enamel of the labial to the root of the lingual surfaces. The two left maxillary and two right mandibular molars have no remaining enamel and exposed pulp chambers with three associated abscesses. The remaining teeth, with the exception of the three canines, exhibit a 45° occlusal plane and no remaining enamel.

Burial 2 (Test Pit 6,N40-41W8, Stratum III): This four year old child was interred as a partially articulated single burial. Bone preservation is good with the skeleton being represented by the following components: left half of cranium, face, mandible, left scapula, left clavicle, two lumbar vertebrae, 24 rib fragments, right radius and ulna, left femur and both tibiae. Active periostitis is present on the distal clavicle, right scapular spine and both tibial shafts. The distribution of this lesion indicates a generalized bacterial infection. Dental attrition is extreme with the cuspal enamel worn smooth and frequent compression fractures and chipping of the occlusal margins.

Burial 3 (Test Pit 7, N22W15, Stratum III): This adult of unknown sex is represented by 40 cranial fragments and possibly six associated long bone fragments. Bone preservation is poor with only portions of the superior occipital and left parietal being identifiable.

Burial 4 (Test Pit 7, N23W14-15, N24W14-15, Stratum III): This 40 - 44 year old female was interred as a primary single articulated burial (Figure 69). Bone preservation is poor and the skeleton is represented by portions of the cranium and fragments of all major long bone shafts. Dental attrition is marked with a pronounced cupping of the occlusal surfaces of the molars (Figure 70).

Burial 5 (Southern Block, N15E10, Stratum I): This adult individual is represented by three left occipital fragments.

Burial 6A (Central Block, Unit 5A and baulk, Stratum I-IIa): This 16 - 17 year old male was interred as a flexed multiple burial with Burial 6B situated slightly beneath Burial 6A (Figure 71). Bone preservation is excellent with nearly complete cranial (Figure 72) and postcranial skeleton. The only missing bones are the left foot and all but the calcaneus of the right foot. Periosteal pitting is found on the following skeletal elements: right parietal, five ribs, the spine of the right scapula and the chin and horizontal ramus of the mandible. Although suggestive, these lesions are not indicative of infectious disease. All vertebral bodies exhibit hypervasularization caused by some unknown etiology (Figure 73). Dental anomalies include: agenesis of both maxillary third molars; retention of a deciduous maxillary canine; and a maxillary supernumery tooth located superior to the left frontal incisor (Figure 74).

Burial 6B (Central Block, Unit 5A and baulk, Stratum I-IIa): This 15 - 16 year old male was interred as a flexed burial just prior to

FIGURE 69. VIEW OF BURIAL 4.

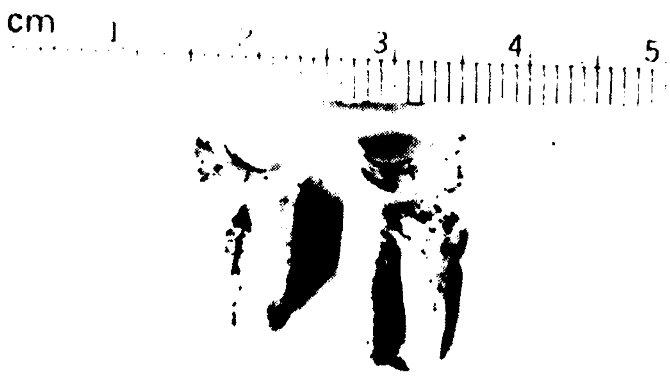


FIGURE 70. TWO MOLARS FROM BURIAL 4 SHOWING THE CUPPED TOOTH WEAR PATTERN.

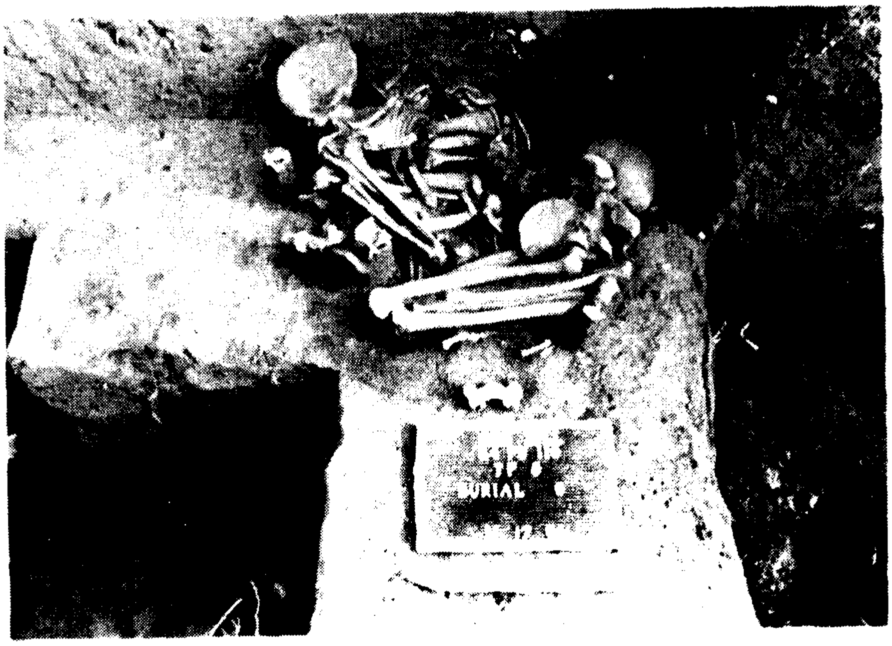


FIGURE 71. FIELD PHOTOGRAPH OF BURIALS 6a AND 6b.

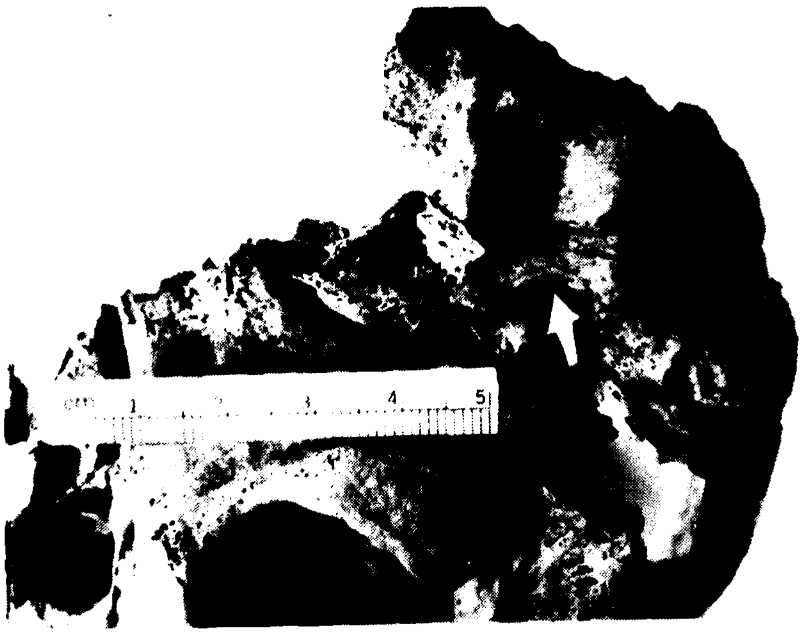


FIGURE 72. BASAL VIEW OF CRANIUM FROM BURIAL 6a SHOWING TYMPANIC DEHISCENCE, A NON-METRIC GENETIC TRAIT (ARROW).

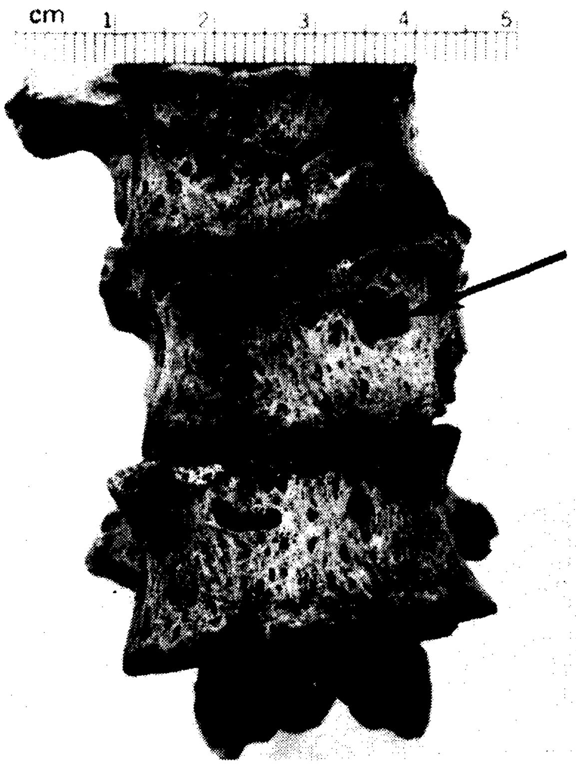


FIGURE 73. THORACIC VERTEBRAE FROM BURIAL 6a SHOWING HYPER-VASCULARIZATION (ARROW) OF THE BODIES.

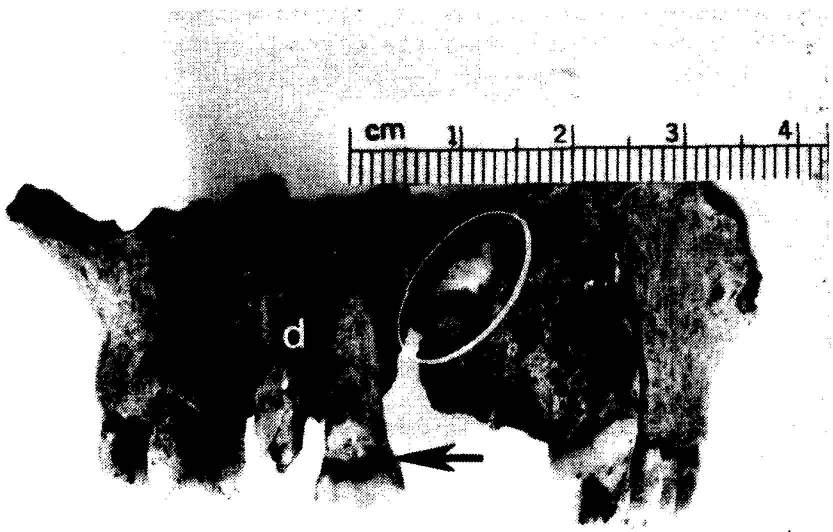


FIGURE 74. MAXILLARY DENTITION OF BURIAL 6a SHOWING RETAINED DECIDUOUS INCISOR (d), AND IMPACTED SUPERNUMERY INCISOR (CIRCLE) AND CARIOUS HYPOPLASIA (ARROW).

Burial 6A. The preservation is excellent with a complete skull (Figures 75 and 76) and complete postcranial skeleton with the exceptions of all lumbar vertebrae but two, both hands, right foot and left patella. Generalized periosteal pitting is present in the following locations: right zygomatic; superior third of the right humerus; scattered areas of the left humerus shaft; superior one-half of the right ulnar shaft; superior one-third of both femoral linea aspera; and both tibial shafts. This pitting is identical, although more extensive, to that observed on Burial 6A. The proximal and distal epiphesial ends of both fibulae exhibit extensive periosteal reactions and initial osteomyelistis (Figure 85). The association of these infectious lesions with the generalized periosteal pitting may suggest that the pitting is the initial stages of generalized infections. If this is the case, then Burial 6A may also be interpreted as displaying the initial stages of bacterial infection.

Burial 7 (Southern Block, N15-16E13-14, Stratum III): This female, 55 years of age or older, was interred as a flexed burial with a neonate (Burial 12) located directly beneath the pelvis. Bone preservation is fair with a nearly complete skull and mandible while the postcranial skeleton is fragmented and 80 percent complete. Two cervical vertebrae exhibit both inferior and superior porosity and degeneration of the bodies, while two lumbar vertebrae exhibit extensive degeneration of the superior bodies surfaces and moderate marginal lipping. The thoracic vertebrae are unremarkable making the pattern of vertebral involvement identical to Burial 1. The sacroiliac articulations show extensive osteoarthritic degeneration. The medial condyle of the left femur and associated articular surface of the tibia show extensive eburnation and flattening of the articular surfaces. Both femora and tibiae also display extensive marginal osteoarthritic lipping. One anomaly is the asymmetry of the humeri and femora. The right femur is slightly larger by 0.1 to 0.2 cm, while the left humerus is larger.

Burial 8 (Northern Block, N54-55E17-18, Stratum III): This male is over 35 years of age and was interred as a single flexed burial. Bone preservation is poor and this individual is represented by a fragmentary cranium and mandible (75 percent complete) and a very fragmentary (60 percent complete) postcranial skeleton lacking vertebrae, ribs, hand, pelvis, sacrum, patellae and feet. The right tibial shaft is swollen with the characteristic schlerotic bone formation (observed in radiograph) indicative of healed infection. The distal right clavicle shows a possibly healing osteomyelitic lesion (Figure 77). Dental attrition is extreme and shows the cupped occlusal surfaces noted in Burial 4.

Burial 10 (Southern Block, N17E10-11, Occupational Surface III): This burial of an eight year old juvenile either represents a secondary burial or a disturbed primary burial with missing and scattered skeletal elements. The cranium is represented by portions of the frontal, right parietal, both petrous portions of the temporal bone, maxillae and mandible. The postcranial skeleton is represented by two

FIGURE 75. FRONTAL VIEW OF SKULL FROM BURIAL 6b.

FIGURE 76. LATERAL VIEW OF SKULL FROM BURIAL 6b.

FIGURE 77. RIGHT CLAVICLE OF BURIAL 8 SHOWING HEALING OSTEOMYELITIS OF THE DISTAL END.

cervical, three thoracic and three lumbar vertebrae; 13 rib fragments; proximal humeral epiphysis; left radius and ulna; six left carpals; five left meta-carpals; right pelvis; sacrum; and three quarters of the distal right femur shaft. Dental attrition is extreme even in this young individual. The first molars have been erupted for only two years and yet the buccal cusps are worn flat while the second dediduous molar is worn to the root. Large compression fractures and marginal chipping are common on all teeth. There are three burned hand phalange fragments from another individual associated with this burial.

Burial 9/11 (Southern Block, N17E10-11, Occupational Surface III): This 40 to 44 year old male is a single burial positioned on his left side beneath a large metate. Burial 9 (five left parietal fragments) is the skull of Burial 11. This burial was located in the north profile of the Southern Block and was only partially removed. Bone preservation is fair and the individual is represented by the following skeletal elements: two thoracic vertebrae; six rib fragments; right and left ilium and ischial fragments; first sacral body; proximal half of the right femur; left femur head; distal epiphyses of both tibiae; and distal one quarter of the left fibula.

Burial 12 (Southern Block, N15-16E13, Stratum III): This neonate (birth ± 2 months) was interred directly beneath the pelvis of Burial 7. Bone preservation is good and the individual is represented by the following skeletal elements: 67 cranial fragments; right clavicle; right scapula; five vertebral bodies and 12 neural arches; 22 rib fragments; left humerus shaft; and one deciduous first molar. Unassociated adult bone fragments include: anterior margin of vertebral body; and long bone fragments. Extensive periostitis of the left humerus, all rib fragments, and 28 skull fragments indicates active bacterial infection.

Table 44 lists the description of miscellaneous human bone recovered in various excavation units during the 1981-82 field season. Assuming that bones from different proveniences represent different individuals and that adult and sub-adult bones within a provenience represent different people, we estimate that an additional 20 sub-adults, 13 adults and five unidentifiable individuals are represented in the midden. Even consolidating adjoining proveniences does not greatly diminish this estimate, leaving 18 sub-adults, 13 adults and five unidentifiables. Most of the isolated human bones probably represent disturbed burials. The clearest example of this process is Burial 10, which was most likely interred as a fully articulated skeleton. Upon construction of Structure 2, this burial was disturbed and scattered over several square meters. Other miscellaneous human bones are probably the result of natural churning and mixing within the midden.

Demography

Demographic analysis is the ideal method for the evaluation of the adaptive efficiency of any population (see Swedlund and Armelagos 1976). Although the demographic literature contains many critical and cautionary statements concerning the application of demographic analysis to prehistoric skeletal series (Howell 1973; Weiss 1972), it has been demonstrated that paleodemography can be a very productive technique (Lallo et al. 1980; Lovejoy et al. 1977; Moore et al. 1975; Weiss 1973). Unfortunately the Bug Hill sample size is not large enough for demographic analysis, but before any comparisons, such as paleopathology, are made, the representativeness of the skeletal series must be established. If the skeletal series is not a realistic sample of a biological population, then the observations obtained from the series cannot be generalized to the entire population of the archaeological community.

Table 45 shows the distribution by age and sex of all the individuals excavated from the Bug Hill site, but does not include the isolated human material. Examination of the spacial distribution of excavation units and the pattern of recovered burials suggests that only 20 to 50 percent of the possible burials were recovered. This conclusion is also supported by the high frequency of random human skeletal elements. There is no indication of a systematic bias in the

TABLE 44. MISCELLANEOUS HUMAN BONE FROM THE 1981-82 FIELD SEASON.

Southern Block

Test Pit 1

N11E11/Level 10
- One vertebral body (infant lumber)
- Two halves of a neural arch, both with periostitis (infant)
- One sital half of terminal phalange (adult)
- One distal tip of ulna (infant)
- One right zygomatic bone (infant)
- One unidentifiable human fragment
  - Total - 5 infant, 1 adult, 1 unidentifiable bone

N12E11/Level 10
- One vertebr.l body (infant)

N10E11/Level 4
- One deciduous maxillary right central incisor (between birth and six months of age)

N11E11/Level 9
- One vertebral body (infant)

Feature 12/Level 12
- One right half superior half occipital portion (adult)

Test Pit 8

N15E10/Level 8
- Four unidentifiable long bone fragments with epiphyseal exposed surface (child)
- One tibial proximal epiphysis (child)
- One unidentifiable epiphysis (child)
- Seven unidentifiable bone fragments
- One left central incisor (adult)

N15E10/Level 9B
- One left clacaneous (child)
- One left first metatarsal (child)
- One left fifth metatarsal (child)
- One unidentifiable human metatarsal (child)
- Two unidentifiable human bones

N15E9/Level 9B
- One vertebral body ephiphyseal superior and inferior surfaces (lumbar-child)
- One ilium fragment with epiphyseal surface (child)
- One tarsal bone (child)

TABLE 44. MISCELLANEOUS HUMAN BONE FROM THE 1981-82 FIELD SEASON.
(Continuation)

Southern Block - Continued

N14E9/Level 9B
One second premolar (adult)

N14E12/Level 0
One mandibular second molar (4 years of age)

Test Pit 9

N12E10/Level 9
One deciduous first molar (6 months of age)

N13E9/Level 8
One permanent pre-molar (6-7 years of age)

N11E9/Level 10 top
Human bone from flotation sample:
One permanent (adult) mandibular incisor

N15E13/Level 5
One proximal phalange (adult-hand)
One distal half middle phalange (adult-hand)

N12E14/Level 7
One canine (partial root as occlusal surface)

Test Pit 11

N17E10/Level 7
One thoracic vertebral body (adult)

N16E10/Level 7
one portion lumbar vertebral body (child)
One unidentifiable cranial fragment
One unfused left pedicle portion (child)

N16E11/Level 9B
One proximal quarter left femur (child - no epiphysis)

N16E14/Level 3
One left greater multangular

N17E11/Level 6
Two fragments either humeral or femoral heads (adult)

N16E9/Level 10
One sternal end of rib

N17E9/Level 7
One mandibular second molar (adult)

TABLE 44. MISCELLANEOUS HUMAN BONE FROM THE 1981-82 FIELD SEASON. (Continuation)

Central Block

Test Pit 5A

SW1/4/Level 5
One mandibular incisor (adult)

SW1/4/Level 3
One terminal phalange (adult-hand)

SE1/4/Level 8
Two sections of manubrium (adult)
One middle hand phalange (adult)
One carpal bone

SE1/4/Level 7
One portion vertebral body with hypervascularization (sub-adult with epephyseal surfaces)

NE1/4/Level 6
One premolar with compression fracture and hypoplasias

Test Pit 5B

NW1/4/Level 11
One right humeral epiphyseal proximal portion (child)

Test Pit 5D

SW1/4/Level 4
One distal phalange

NE1/4/Level 12
One vertebral body (child)

SE1/4/Level 9
One left spenoid greater wing portion (sub-adult)

SE1/4/Level 6
One left maxillary half of arch with two deciduous molars fully erupted and unerrupted first permanent molar (3 years of age)
One right sphenoid greater wing portion (child)

SW1/4/Level 13
One lateral right clavicular portion (child)
One medial two thirds clavicular shaft (child - similar to previous mentioned distal portion)

SW1/4/Level 11
One vertebral body (child lumbar)

SE1/4/Level 10
One talus (infant-child)

TABLE 45. DEMOGRAPHY OF THE BUG HILL SITE.
(All Excavations Combined)

	1979 Excavations			1981-82 Excavations			Combined Excavations			
		Sex			Sex			Sex		
AGE	Unknown	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Total
0 - 0.9	4			1			5			5
1 - 2	3						3			3
3 - 4	1			1			2			2
5 - 9	1			1			2			2
10 -14										0
15 -19					2			2		2
20 -24										0
25 -34										0
35 -44			1		2	1		2	2	4
45 -54					1			1		1
55+	1					1	1		1	2
Unaged Subadults	1						1			1
Unaged Adults	1			2			3			3
Total	12	0	1	5	5	2	17	5	3	25

placement of the excavation units nor in differential rates of prehistoric disturbance, cultural or natural. Thus, the Bug Hill skeletal series appears to be representative of the potential burial population. It must be kept in mind that these individuals have been interred over the course of a long period of time and, thus, represent small samples of several populations.

The Bug Hill skeletal series is not typical of pre-Caddo skeletal series in several respects. First, Bug Hill has the highest proportion (40 percent) of individuals less than five years of age. The two other analyzed skeletal populations from midden mounds traditionally assigned to the pre-Caddo produced only 9.7 percent (Sam and Wann; McWilliams 1970) and 17 percent (McCutchan-McLaughlin; Powell and Rogers 1980) children despite the large sample size from the Sam and Wann sites (i.e., 103 individuals). There are two possible explanations, either Bug Hill experienced a high infant mortality rate or the high proportion of children is due to sampling error.

Secondly, the absence of young females less than 35 years of age is also anomalous, especially when compared to the greater than 50 percent rate in the other two pre-Caddo samples. This finding is most likely due to sampling error.

Third, the large male/female ratio of 1.67 is much greater than the other two pre-Caddo sample sites, again, this ratio must be attributed to small sample size.

Although the Bug Hill skeletal series is not an ideal demographic sample, it is not outside the range of variation observed in the other pre-Caddo samples. The mortality data from three pre-Caddo sites are converted into age-specific probabilities of dying for comparative purposes (Figure 78). The erratic fluctuations of the Bug Hill curve is indicative of sampling error and small sample size. The similarity of peaks and troughs between the Bug Hill and McCutchan-McLaughlin curves suggests that the two samples were drawn from similar demographic populations and neither are radically different from the Sam and Wann series. Thus, Bug Hill differs only in the possibility of a higher childhood mortality rate (although sampling error cannot be ruled out as an explanation) and can realistically be compared to the other pre-Caddo skeletal series.

Discussion

The Bug Hill osteological data can make valuable contributions to bioarchaeology at the regional (i.e., Caddo cultural region), subregional (i.e., eastern Oklahoma), and local (i.e., Jackfork Valley) levels. Combined with other pre-Caddo skeletal series, the Bug Hill data can contribute to a better understanding of the Woodland/Caddo transition. At the subregional level, the adaptive efficiency of pre-Caddo cultures can be compared between three ecological zones: the Wister Valley to the north represented by the Sam, Wann, and McCutchan-McLaughlin sites; the Jackfork Valley represented by Bug

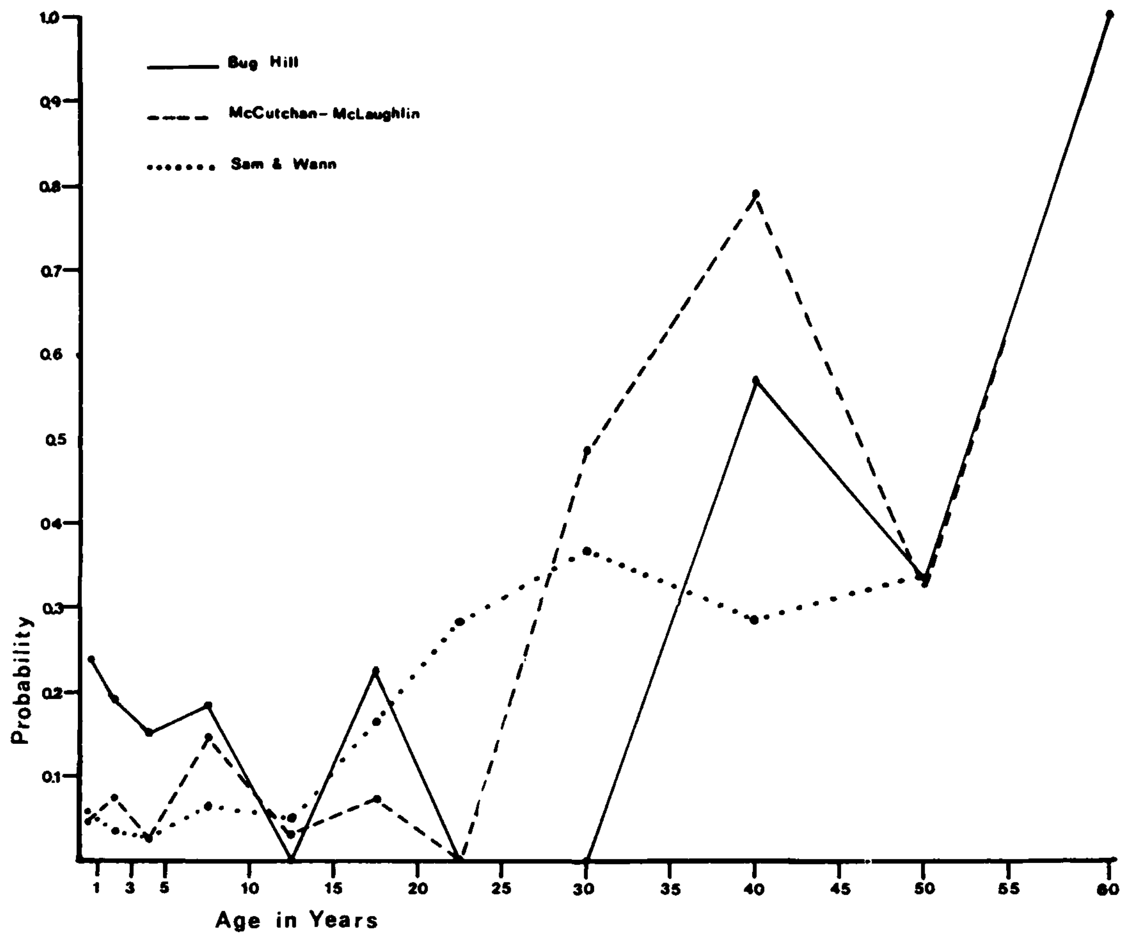
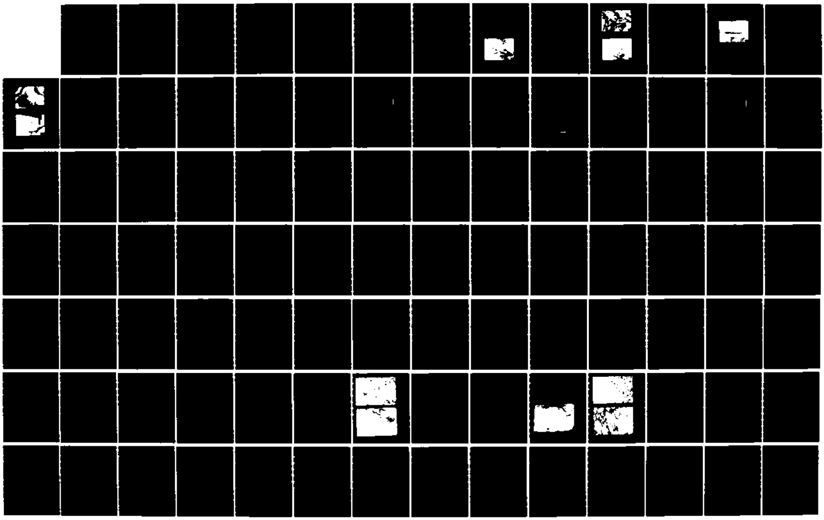


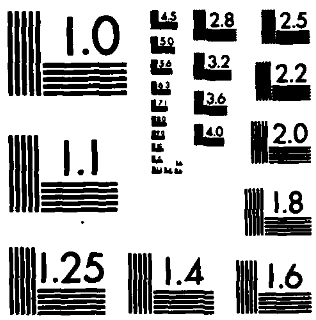
FIGURE 78. PROBABILITY OF DYING FOR THE BUG HILL, McCUTCHAN-McLAUGHLIN AND SAM & WANN SITES.

AD-A144 104 BUG HILL: EXCAVATION OF A MULTICOMPONENT MIDDEN MOUND IN THE JACKFORK VAL..(U) NEW WORLD RESEARCH INC POLLOCK LA J H ALTSCHUL ET AL. 25 NOV 83 DACW56-81-C-0144

4/5

UNCLASSIFIED F/G 5/6 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Hill; and the Hugo Lake area to the south represented by the Mahaffey site. Finally, at the local level, the chronological control established for the Bug Hill burials presents a rare opportunity to examine temporal trends within a single midden mound site. The Bug Hill osteological data and their contributions to bioarchaeology at all three analytical levels are discussed below.

The Woodland/Caddo Transition

The analysis of dental caries has been shown to be invaluable in the reconstruction of prehistoric diets (Hardwick 1960; Moore and Corbett 1971; Turner 1979). Dental caries are the result of slow decalcification of the enamel by the acidic waste products of oral bacteria. The frequency of dental caries is determined by a complex interaction of five major variables: tooth morphology; age; microbiology of the mouth; physical consistency of the diet; and sugar/carbohydrate consumption. Moore and Corbett (1971) have demonstrated that proper data analysis can hold all variables constant leaving sugar/carbohydrate consumption as the independent variable. Turner (1979), using a large sample of prehistoric and historic dentitions, has shown that the proportion of the diet derived from agricultural carbohydrates can be reliably estimated by the frequency of dental caries. Processed agricultural carbohydrates (i.e., maize) provide the ideal environment for cariogenic bacteria, and any increase in the amount consumed will result in an increase in caries.

Other indicators of carbohydrate consumption include base element and stable carbon isotope analyses. To date, these types of analyses have not been conducted on a region wide basis for the Caddo area. Indeed, the stable carbon isotope analyses conducted for Bug Hill (reported later in this chapter) represents one of the first attempts to use this technique in the region., Thus, lacking as yet other widely reported skeletal indicators of maize consumption, the prevalence of caries is used herein to indicate significant quantities of maize in the diet with the stable carbon isotope results used as corroborative evidence for Bug Hill.

Examination of Table 46 reveals that the Bug Hill caries rate per person (0.2) is lower than all other sites except Mahaffey (0.1). In fact, the only carie present is located within a labial hypotplastic lesion of an incisor (see Figure 82). Statistically, the Bug Hill rate clusters best with Mahaffey, Sam, Wann, and McCutchan-McLaughlin, which are all sites with no evidence of maize agriculture.

At the present time, 2.0 caries per person in the most realistic cutoff between no maize consumption and at least some maize consumption. Thus, old Martin Place could represent a transitional diet which included some maize, while there is no question that the Fourche Maline phase (Woodland Period) residents at Ferguson were dependent upon maize agriculture. These data indicate that outside the Great Bend area of the Red River, most pre-Caddo peoples, including those occupying Bug Hill, did not consume maize in any significant quantities. During the Fourche Maline phase of the Woodland Period,

TABLE 46. PROPORTION OF DENTAL CARIES PER PERSON BY ARCHAEOLOGICAL SITE.

Culture	Site	Caries/Person
Pre-Caddo (Pre A.D. 900)	Sam & Wann (McWilliams 1970)	0.8 (45)
	McCutchan-McLaughlin (Powell and Rogers 1980)	1.6 (24)
	Bug Hill	0.2 (6)
	Mahaffey (unpublished data)	0.1 (56)
	Ferguson (unpublished data	4.3 (7)
	Old Martin Place (Stark 1973)	2.1 (8)
Caddo I Red River (A.D. 900-1200)	Crenshaw (Powell 1977)	5.6 (8)
	Cooper Lake (Westbury 1978)	6.3 (15)
	Hanna (Thomas et al. 1980)	1.7 (6)
Caddo II Red River (A.D. 1200-1400)	Belcher I (Webb 1944, 1959)	8.0 (5)
	Benston-Clark (Buikstra and Fowler 1975)	1.7 (31)
	Ferguson (unpublished data)	4.4 (7)
	Sam Kaufman (Butler 1969)	3.0 (19)
	Roden I (Rose et al. 1981)	2.4 (7)
Caddo II Arkansas River (A.D. 1200-1400)	Lundy (Buikstra et al. 1973)	1.3 (6)
	Morris (Brues 1959)	0.9 (19)
	Nagle (Brues 1957	0.4 (5)
	Horton (Brues 1958)	0.6 (21)

however, some groups, especially those residing in the Great Bend area began incorporating maize into their diet. Most, but not all (i.e., Hanna), Early Caddo groups (Caddo I) along the Red River were dependent on maize agriculture. The situation remains the same for Caddo II (A.D. 1200-1400) along the Red River, while, in contrast, the Arkansas River Caddo II caries rates show no evidence consumption.

In summary, these data suggest that maize agriculture began during the Fourche Maline phase of the Woodland Period in the Great Bend area and moved slowly throughout the Caddoan area, but not as yet arriving in the Arkansas River area by Caddo II times. Trace element and stable carbon isotope analyses of all this material is desperately needed to confirm or refute this hypothesized sequence.

Analysis of skeletal pathological lesions can be difficult because specific diagnosis is seldom possible. It has been demonstrated that grouping skeletal lesions into broad etiological categories (i.e., infections) can provide an excellent evaluation of the health status and, subsequently, the adaptive efficiency of prehistoric populations (Armelagos 1969; Lallo and Rose 1979). For example, the transition from hunting and gathering to maize agriculture at Dickson Mounds (Illinois) is associated with dramatic increases in infections, degenerative diseases and mortality (Lallo and Rose 1979). In this particular case, a change in subsistence, settlement density and social organization decreased the adaptive efficiency of the Dickson Mounds population. Cook and Buikstra (1979) suggest that adaptive efficiency is most dramatically reduced during the actual transition between two subsistence strategies. They specifically observe an increase in pathology and stress during the terminal Late Woodland in the Lower Illinois Valley, which coincides with a significant increase in the consumption of maize. Skeletal data observed from a world perspective suggest the hypothesis that stress increases during the period of transition and, then, declines as the new subsistence/social system makes the necessary adjustments to provide maximum adaptive efficiency. Testing this hypothesis within the context of the Woodland/Caddo transition is of general theoretical interest.

Examination of Table 47 shows that the subsistence change from hunting and gathering to maize agriculture along the Red River is associated with large increases in the infectious disease rates for both sub-adults and adults indicating a lowering of adaptive efficiency during the Caddo I period. By Caddo II times the adult rates have declined indicating cultural adjustment to the subsistence change which is completed by Caddo IV (in A.D. 1500-1700), when both the adult and sub-adult rates have returned to pre-Caddo levels. These data lend support to the hypothesis, at least along the Red River, that adaptive efficiency is reduced during major subsistence-cultural transitions and increases after a period of adjustment. What is of importance here is that the Arkansas River Caddo II groups show elevated adult infection rates at a time when the Red River rates have already declined. When these data are viewed in light of the caries data, they suggest that major differences in Caddoan bio-cultural processes existed between the Arkansas and Red River drainages.

TABLE 47. PALEOPATHOLOGY BY CULTURAL PERIOD IN TRANS-MISSISSIPPI SOUTH.

	Infections		Osteophytosis	Osteoarthritis	Trauma
	Sub-adult	Adult	Adult	Adult	Adult
Pre-Caddo					
Eastern Oklahoma (Pre A.D. 900)	12.0 (57)	11.1 (169)	15.4 (169)	8.3 (169)	6.5 (169)
Caddo I					
Red River (A.D. 900-1200)	28.6 (7)	30.0 (20)	11.1 (18)	5.6 (18)	5.6 (18)
Caddo II					
Red River	33.3 (9)	9.8 (41)	16.7 (36)	0.0 (36)	2.8 (36)
Arkansas River (A.D. 1200-1400)	8.9 (45)	23.5 (85)	4.7 (85)	7.0 (85)	4.7 (85)
Caddo IV					
Red River (A.D. 1500-1700)	15.1 (53)	11.9 (84)	33.3 (69)	16.4 (61)	6.6 (61)

Examination of the osteophytosis (i.e., degenerative joint disease of the vertebrae) and osteoarthritis (i.e., degenerative joint disease of the movable joints) rates in Table 47 indicates that physical stress upon the spine and limbs was reduced between the pre-Caddo and Caddo I peoples along the Red River. Thus, this transition between subsistence patterns resulted in a less arduous lifestyle, which ultimately increased for the mature agriculturalists of the Caddo IV period.

Pre-Caddoan Sub-regional Variation

The above described comparisons suggest that major changes in disease patterns and cultural adaptation took place over time at the regional level. However, ecological variation in adaptive efficiency among the pre-Caddo groups of eastern Oklahoma need to be examined. The three ecological areas of interest are: the Wister Valley, which lies in the Arkansas River drainage (to the north of Bug Hill), represented by the Sam, Wann (McWilliams 1970), and McCutchan-McLaughlin

(Powell and Rogers 1980) sites; the Jackfork Valley represented by Bug Hill; and the Hugo Lake area, located along the lower Kiamichi River (to the south of Bug Hill), represented by the Mahaffey site (Perino and Bennett 1978; unpublished data).

Reference to Table 48 reveals considerable variation in the infection rates. Sub-adult and adult infection rates are low at the Sam and Wann sites and slightly higher at the nearby McCutchan-McLaughlin site. Because of the absence of temporal control (Powell and Rogers 1980), a slightly higher proportion of unrecognized Caddo burials at McCutchan-McLaughlin could explain this difference. Alternatively, the adaptive efficiency of the McCutchan-McLaughlin group could have been lower than the residents of the Sam and Wann sites. However, the fact that these differences are maintained throughout the degenerative diseases lends support to the first alternative. The Mahaffey skeletal series most closely resembles Sam and Wann for infections, but McCutchan-McLaughlin for degenerative lesions. The higher degenerative disease rates at Mahaffey can be accounted for by the large proportion of old adults in the skeletal series.

TABLE 48. PALEOPATHOLOGY OF PRE-CADDO SKELETAL SERIES BY SITE.

	Infections		Osteophytosis	Osteoarthritis	Trauma	
	Sub-adult	Adult	Adult	Adult	Sub-adult	Adult
Sam & Wann	0.0 (19)	9.4 (85)	10.6 (85)	1.2 (85)	0.0 (19)	2.4 (85)
McCutchan-McLaughlin	8.3 (12)	20.0 (30)	20.0 (30)	10.0 (30)	0.0 (12)	3.2 (30)
Bug Hill	50.0 (10)	42.8 (7)	28.6 (7)	28.6 (7)	0.0 (10)	28.6 (7)
Mahaffey	0.0 (3)	4.9 (41)	22.0 (41)	22.0 (41)	0.0 (3)	0.0 (41)
Combined	12.0 (44)	11.1 (163)	16.0 (163)	9.2 (163)	0.0 (44)	3.1 (163)

Bug Hill stands out from the others by having the highest infections and degenerative disease rates. The validity of the high degenerative disease rates and their association with an arduous lifestyle are supported by the higher than normal trauma rate, that is healed fractures, at Bug Hill. There are three possible explanations for the high Bug Hill skeletal lesion rates: the Jackfork Valley was an unhealthy place to live; the adaptive efficiency of the Bug Hill cultures was lower than the other pre-Caddo groups; or the Bug Hill skeletal series contained a different proportion of skeletons from the three temporal periods. The validity of these three alternatives can be examined using the stratigraphically segregated skeletal data.

Temporal Variation at Bug Hill

The temporal-stratigraphic control established for the Bug Hill burials presents a rare opportunity to examine temporal trends in pathologies and diet within a single midden mound site. This situation enables the skeletal data to be used for testing the subsistence-cultural reconstructions derived from the artifactual, floral and faunal analyses. All of the 1979 burials and Burials 1, 7, 8, and 12 from the 1981-82 excavations have been assigned to the Wister phase of the Late Archaic period; Burials 2, 3, 4, 6a, and 6b to the Fourche Maline phase of the Woodland period; and Burials 10 and 11 have been assigned to the Caddo I phase of the Caddoan period. Since a major component of the dietary reconstruction data is derived from Scanning Electron Microscopy of enamel attrition, for which there is little published information, this section begins with a review of the comparative material.

Observation of the occlusal surfaces of molars with the scanning electron microscope has made significant contributions to the reconstruction of prehistoric diets (Moore-Jansen et al. 1980; Rose et al. 1979; Ryan 1979; Walker 1976; Walker et al. 1978). Moore-Jansen and co-workers (1980) have been able to demonstrate that subjective comparisons of molar surface topography between prehistoric skeletal series can differentiate between certain dietary and food processing patterns. A short summary of the analysis of two Fourche Maline phase and one Caddo I site follows.

The first Fourche Maline phase site to be considered is the Mahaffey site of eastern Oklahoma. The Mahaffey site produced the following subsistence items: deer; smaller game; waterfowl; freshwater mussels; hickory nuts; walnuts; persimmons; and plums (Perino and Bennett 1978). Moore-Jansen (Rose et al. 1981) describes the Mahaffey molar surfaces as having frequent large striations which have rounded margins and show evidence of extensive polishing along with frequent flat featureless areas (Figure 79). Some molar surfaces are so heavily polished that all striations are obliterated and the enamel prisms are brought into raised relief. The frequent large striations are attributed to the use of stone grinding implements and possibly to grit derived from the consumption of shellfish. The extensive polish, which rapidly obliterates the striations, and produces the raised enamel prism cross-sections, is attributed to the consumption of large quantities of vegetable fiber.

The McCutchan-McLaughlin site (Powell and Rogers 1980) produced a similar pattern. The enamel surface can be characterized as moderately rough with large striations, numerous small striations and moderately frequent compression fractures (Figure 80). The striation margins vary from sharp to well-rounded and there are frequent areas

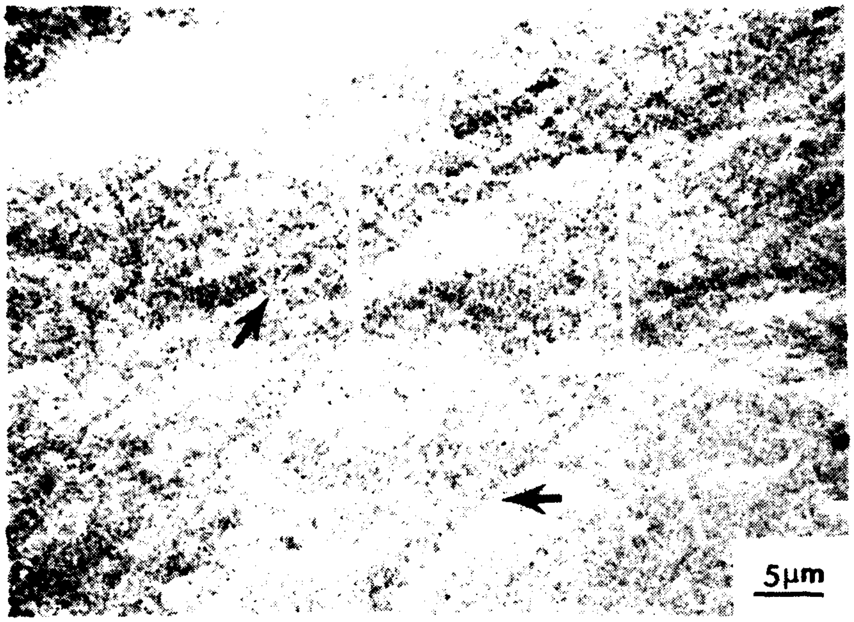


FIGURE 79. S.E.M. MICROGRAPH OF MAHAFFEY MOLAR SHOWING LARGE STRIATIONS WITH ROUNDED MARGINS (BOX) AND AREAS OF FEATURELESS ENAMEL.

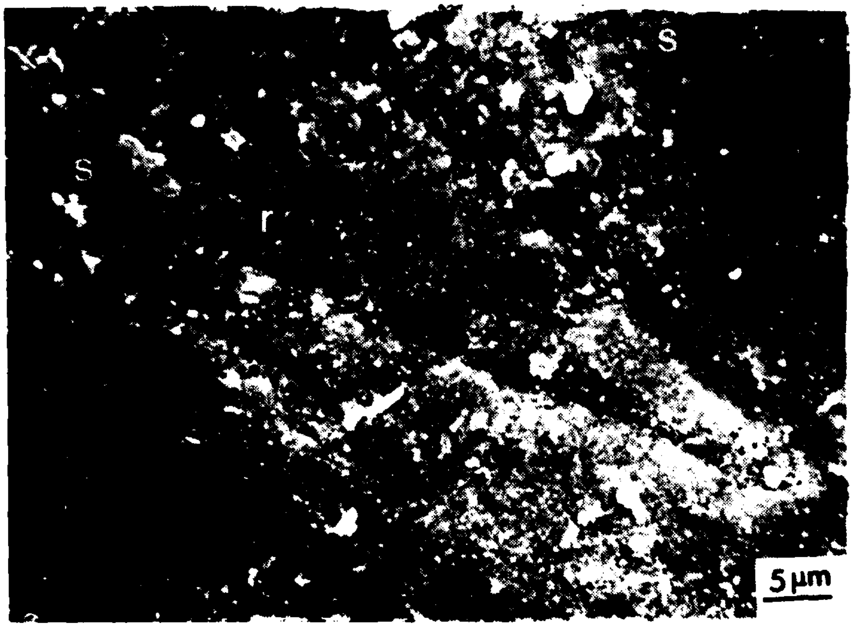


FIGURE 80. S.E.M. MICROGRAPH OF McCUTCHAN-McLAUGHLIN MOLAR SHOWING BOTH SHARP (S) AND WELL-ROUNDED STRIATIONS (R) (1500X).

of flat featureless enamel. In addition, there are moderately frequent compression fractures located on the central cusp areas. These features suggest the following interpretations. The striations are attributed to the use of stone grinding implements, accidental food contamination and the possible consumption of shellfish. The compression fractures are attributed to pulverized nut hulls being included within the diet. The rounded striation margins and flat enamel areas are attributed to the consumption of vegetable fiber. Since polishing is less intense than on the Mahaffey molars, it can be inferred that vegetable fiber consumption was less at McCutchan-McLaughlin.

The Roden site represents the Caddo I population from the Red River Region (Rose et al. 1981). The subsistence remains from Roden indicate the use of deer, small to medium sized mammals, turkey, fish, shellfish, persimmon, hickory nuts, maize and beans (Perino 1981). The enamel surfaces, as described by Moore-Jansen (Rose et al. 1981), are characterized as uneven with a high frequency of wear striations (Figure 81). Compression fractures are moderately frequent in the intercuspal basins. The older striations are obliterated by more recent striations and not by polishing as in the Fourche Maline phase molars. In a sense, the Roden striations appear to be old and ragged due to their long life-span resulting from the low enamel attrition rate. The Roden enamel surfaces appear to be produced by a low to moderate concentration of large, hard particles within a relatively non-abrasive media. The soft non-abrasive diet is attributed to horticultural foods processed using wooden mortars and pestles (Schambach 1980). The striations result from accidental contamination of the foods by dirt and possibly the consumption of shellfish. The total absence of polishing suggests either the absence of vegetable fiber or extensive processing prior to consumption. The compression fractures are attributed to the inclusion of nut hulls in the diet.

The archaeological analysis indicates that the Late Archaic Wister phase occupation of Bug Hill was an intensive seasonal or permanent base camp. The paleoecological analyses suggests an emphasis upon hunting, especially deer, with only a minor utilization of collected plant material (as indicated by the low number of grinding implements). Analysis of the Wister phase dentitions supports this subsistence reconstruction. The absence of dental caries and the rapid dental attrition (see Appendix III) indicate a diet low in processed carbohydrates and the use of stone food processing tools.

Two Late Archaic Wister phase mandibular second molars were examined with the Scanning Electron Microscope. Burial 1 (46-50 year old male) enamel exhibits frequent large striations and a rough surface texture which indicates the use of stone utensils, while the absence of polishing and compression fractures indicate little or no vegetable fiber or nuts in the diet. Burial 7 (55+ year old female) enamel exhibits frequent large striations (Figure 82) and a somewhat smoother surface texture than Burial 1. Again the use of stone utensils are indicated, but the smoother surface texture suggests some vegetal

FIGURE 81. S.E.M. MICROGRAPH OF RODEN MOLAR SHOWING HIGH FREQUENCY OF SHARP WELL-DEFINED STRIATIONS (1500X).

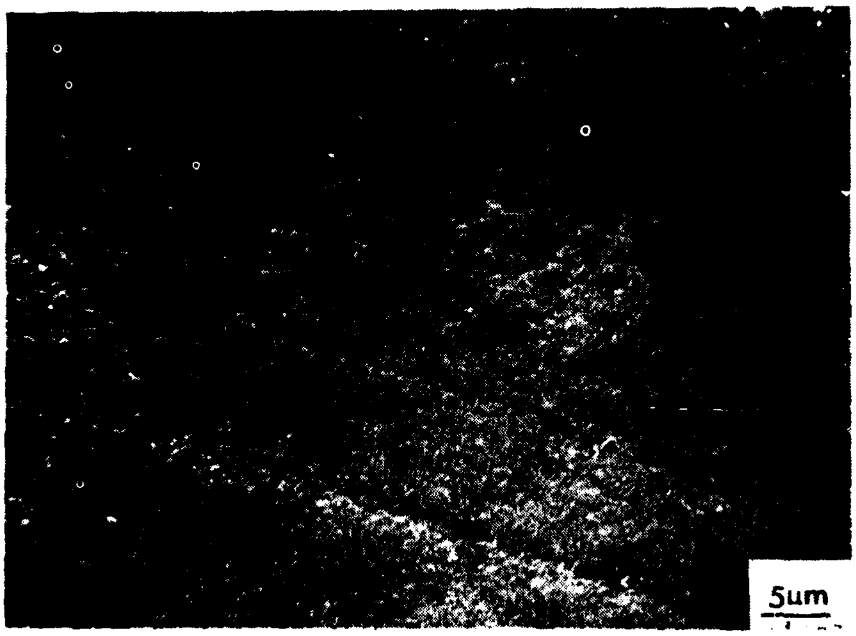


FIGURE 82. S.E.M. MICROGRAPH OF BURIAL 7 SHOWING STRIATIONS AND VARIABLE SURFACE TEXTURE.

fiber and absence of compression fractures indicates no nut utilization. These enamel surfaces show the greatest resemblances to some Caddo teeth (i.e., absence of polishing) and some McCutchan-McLaughlin teeth (i.e., stone utensils and slight polishing). On the whole the Late Archaic dentition of Bug Hill indicate a coarse diet, little or no processed carbohydrates, small to moderate quantities of vegetable fiber, and no nuts. Finally, the Sigma B stable carbon isotope values from the three Wister phase burials (B1, UCR 1538, -21.22; 137, UCR 1540, -22.13; B8, UCR 1541, -22.51) are all within the range of non-maize eating peoples and supports the dietary reconstruction from the caries and microwear data (Vogel and Van Der Merwe 1977; Van Der Merwe 1982).

The Late Archaic Wister phase burials are characterized by high rates of infections, osteophytosis, osteoarthritis, and healed fractures (Table 49). Both the sub-adult and adult infection rates are as high as the Caddo I rates, where people along the Red River were undergoing the stress of culture change (see Table 47). An arduous physical work load is indicated by the high osteophytosis, osteoarthritis and trauma rates. These rates not only exceed all other pre-Caddo and Caddo groups, but also represent the most severe cases of degenerative joint disease.

TABLE 49. PALEOPATHOLOGY BY ARCHAEOLOGICAL PHASE ASSIGNMENT AT BUG HILL.

	Infections		Osteophytosis	Osteoarthritis	Trauma	
	Sub-adult	Adult	Adult	Adult	Sub-adult	Adult
Wister Phase	18.2 (11)	33.3 (6)	33.3 (6)	33.3 (6)	0.0 (11)	16.7 (6)
Fourche Maline Phase	100.0 (3)	50.0 (2)	0.0 (2)	0.0 (2)	0.0 (3)	0.0 (2)
Caddo I	0.0 (1)	0.0 (1)	0.0 (1)	0.0 (1)	0.0 (1)	0.0 (1)

The general character of the Bug Hill occupation changed little between the Late Archaic and Woodland periods. Although deer are still the primary focus of hunting, the proportional distribution of artifact types indicate a reduction in emphasis upon hunting and an increased emphasis upon the preparation of vegetable foods. Carbonized seeds indicate the use of hickory nut, persimmon, honey locust, pokeweed, sumac, and grape, while pollen indicates the availability of wild onion, pigweed, goosefoot, sunflower, horseweed, marsh elder, wild bean, knotweed, and gooseberry. Again the absence of dental caries and rapid dental attrition indicate a diet low in processed carbohydrates and the use of stone food processing utensils.

Two mandibular second molars and one deciduous second molar were examined with the Scanning Electron Microscope. Burial 6a (16-17 year old male) shows extensive marginal chipping, numerous large and small striations (Figure 83), and evidence of polishing on the occlusal surface and crown margins. Burial 6b (15-16 year old male) shows numerous large striations, low frequency of compression fractures, and polishing of the striations and crown margins. Burial 2 (four year old) shows extensive large striations, numerous compression fractures, but no evidence of polishing.

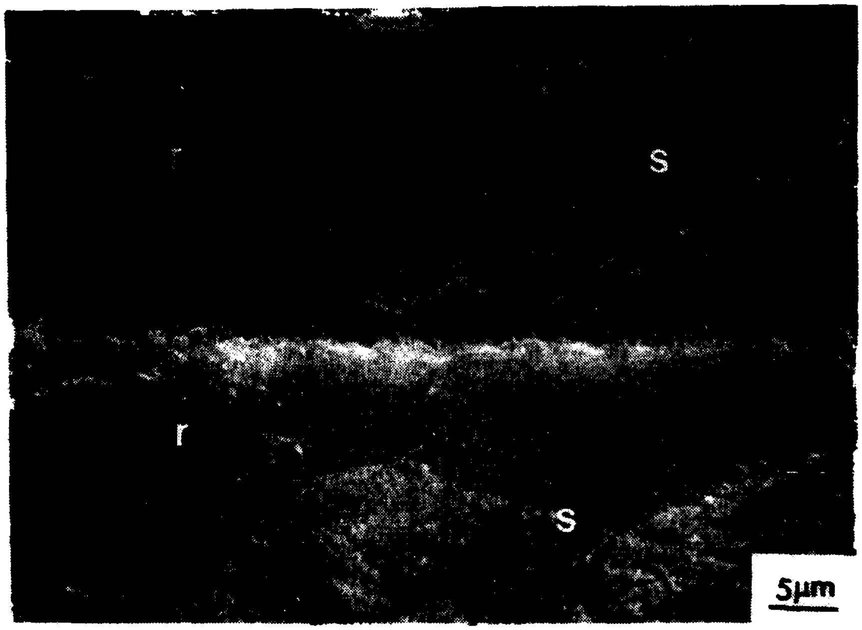


FIGURE 83. S.E.M. MICROGRAPH OF BURIAL 6a SHOWING NUMEROUS STRIATIONS WITH BOTH SHARP (S) AND ROUNDED (R) MARGINS (1500X).

Taken as a group the large number of striations and the rapid dental attrition (especially when the young ages of these individuals are considered) indicates a greater use of stone grinding utensils than during the preceding Late Archaic period. The marginal chipping attest to the presence of large pieces of debris in the diet. In all previous studies conducted at the University of Arkansas compression fractures are always associated with the presence of hickory nuts. Their presence at Bug Hill again is consistent with the hypothesized consumption of hickory nuts. The presence of polishing found on the striation margins and crown margins indicates an increased consumption of vegetable fiber from the Late Archaic period. As a group these enamel surfaces most closely resemble the McCutchan-McLaughlin molars although there are resemblances to some Mahaffey molars. All the dental evidence corroborates the archaeological evidence for increased utilization of plant foods during the Fourche Maline phase occupation of Bug Hill. Further, the Sigma B stable carbon isotope values from the Fourche Maline phase burial (B6, UCR 1540, -20.92) again is within the range of nonmaize eating peoples.

Examination of Table 49 shows that the high sub-adult and adult infection rates continues from the Wister phase. The possibility of an increase exists, but cannot be proven because of small sample sizes. The continuity of high physical stress levels cannot be established because of the young ages of the well preserved skeletons and the absence of joint surfaces in the older adults. This continuity of high infection rates over time establishes the validity of the comparison to the other eastern Oklahoma pre-Caddo skeletal series. It was previously suggested that the uniqueness of Bug Hill is due to differing proportions of individuals from the two phases, but the continuity over time makes this improbable.

The appearance of diagnostic Caddoan culture traits at Bug Hill is associated with only minor subsistence changes from the preceding occupations. The Early Caddo occupation appears to be limited to fall and early winter where deer hunting and riverine exploitation (i.e., fish and turtles) occurred in conjunction with the collection of wild seeds and fruits. Exploitation of the following floral resources are indicated: sunflower; wild bean; goosefoot; gooseberry; persimmon; wild grape; hickory nut; walnut; and acorn. The sunflower may have been domesticated, but there is no evidence of maize. Again the dental data support this subsistence reconstruction.

The dentition of Burial 10 is heavily worn and indicates the continued use of stone grinding implements such as the metate found with Burial 11. This heavy wear is in distinct contrast to the Red River Caddo where the presumed use of wooden utensils produced only light dental attrition. The molar surface of Burial 10 (eight years old) exhibits numerous large striations, frequent compression fractures (Figure 84), marginal chipping (Figure 85), and no evidence of polishing. These observations corroborate the use of grinding implements, the consumption of a coarse diet, and the presence of hickory nuts. The total pattern reflects a continuity of the dietary pattern from the pre-Caddo occupations with the possible exception of reduced plant fiber and increased consumption of starchy seeds. The enamel surface features from Burial 10 are most similar to McCutchan-McLaughlin and show no resemblance to any Red River Caddo molars. Comparison of the Caddoan caries rates from the Arkansas River and Red River areas (see Table 46) presents the possibility that this continuity of subsistence pattern across the Woodland/Caddo transition may not be unique to Bug Hill. The Sigma 13 stable carbon isotope value for this Caddo burial (B 11, UCR 1542, -22.39) indicates no maize consumption and supports the continuity of the subsistence pattern.

The skeletal sample of one child and one poorly preserved adult is not sufficient to make any statement concerning the adaptive efficiency of the Bug Hill Caddo occupation.

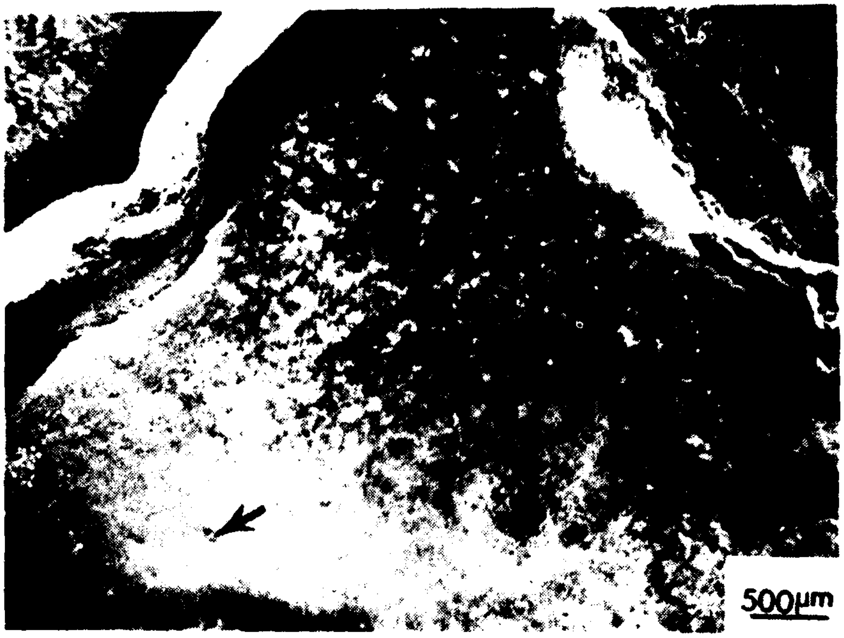


FIGURE 84. S.E.M. MICROGRAPH OF BURIAL 10 SHOWING COMPRESSION FRACTURES (ARROW) WITHIN THE CUSPAL BASIN (14X).

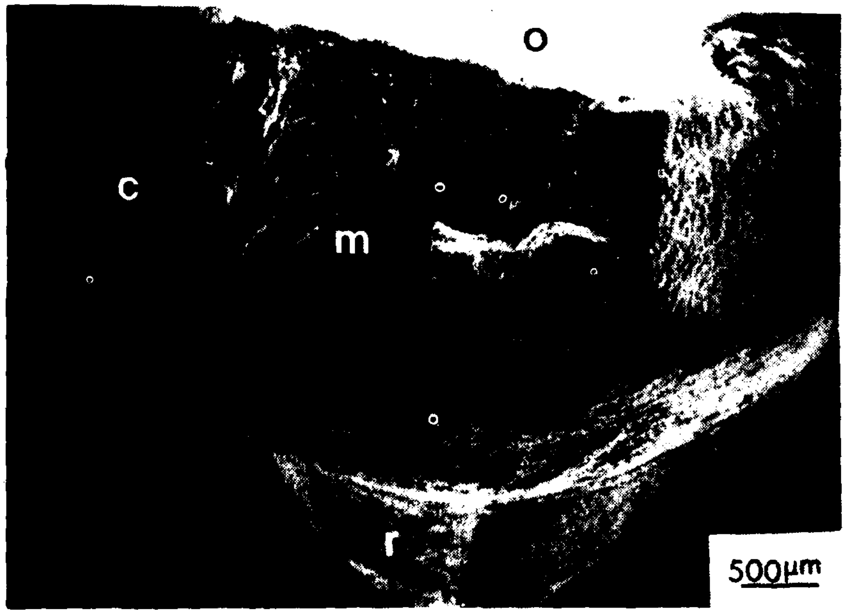


FIGURE 85. S.E.M. MICROGRAPH OF BURIAL 10 SHOWING OCCLUSAL SURFACE (O), CROWN OF TOOTH (C) AND ROOT (R) WITH A LARGE MARGINAL FRACTURE (M) (11X).

Summary and Conclusions

All 11 burials, containing 13 individuals, from the 1979 University of Oklahoma excavations and all 11 individuals from the 1981-82 NWR excavations of the Bug Hill site were analyzed in the University of Arkansas Osteology Laboratory. The skeletal datas obtained from this analysis are compared with other extant skeletal data at three cultural-temporal levels: the Caddoan culture region, the pre-Caddoan subregion of eastern Oklahoma, and the local level of the Jackfork Valley.

At the regional level, the Bug Hill data are combined with other pre-Caddo skeletal data for comparison of adaptive efficiency levels within the pre-Caddo - Caddo cultural sequence. These data (see Table 47) suggest that the pre-Caddo adaptive efficiency was high, but rapidly fell along the Red River with the initial transition to the Caddo culture and maize agriculture. This decline in adaptive efficiency is indicated by increased infectious disease and mortality rates (Rose et al. 1982). It was not until the Caddo IV period that the adaptive efficiency along the Red River returned to the high levels of the pre-Caddo populations. Comparison of the paleopathology and caries rates between the Caddo of the Arkansas River drainage and the Red River drainage suggests that the adoption of the Caddo culture involved different cultural-subsistence mechanisms than along the Red River.

Comparison of the high infectious and degenerative disease rates, found at Bug Hill with the other pre-Caddo skeletal series from eastern Oklahoma, indicates a low level of adaptive efficiency in the Jackfork Valley (see Table 48). In fact, the infectious disease rates are as high as the Red River Caddo I, who are undergoing the stress of cultural transformation. Although this low level of adaptive efficiency at Bug Hill could be due to sampling error, it is supported by other lines of evidence. The extremely high proportion of sub-adults at Bug Hill, when compared to the other pre-Caddo skeletal series, suggests a much higher sub-adult mortality rate.

The frequency of childhood stress indicators (i.e., enamel hypoplasias and Wilson bands, Appendix III) are two to three times higher than the comparative samples (Dickson Mounds, Libben, Roden, and McCutchan-McLaughlin). Both the high sub-adult mortality rate and high frequency of childhood stress support the infectious disease rates in suggesting a low level of adaptive efficiency at Bug Hill. At present, the only reasonable explanation (lacking any evidence for rapid culture changes) is that the pre-Caddo cultures of eastern Oklahoma were not well adapted to the ecological conditions of the Jackfork Valley. Further analysis of pre-Caddo skeletal series from eastern Oklahoma is needed to test this hypothesis.

At the local level both the skeletal and archaeological evidence indicate cultural stability over time at the Bug Hill site. The archaeological evidence suggests that the only change in subsistence was a greater emphasis upon vegetable foods beginning with the

Woodland Period Fourche Maline phase occupation. This hypothesis is supported by the dental evidence which shows an increase in the consumption of vegetal fiber and nuts in association with increased utilization of stone food preparation utensils during the Fourche Maline phase. The continuity of infection rates (Table 49) and indicators of childhood stress indicate that the low level of adaptive efficiency remained unchanged from the Wister to Fourche Maline phase occupations.

Although the skeletal data from the Early Caddoan occupation of Bug Hill are meager, they do suggest a continuity in the subsistence pattern. The lack of skeletal and archaeological evidence for maize agriculture leads one to suspect that maize may not have been an important component of the Caddo adaptation in east-central Oklahoma. When this hypothesis is viewed in light of the non-maize caries rates of the Arkansas River Caddo, the possibility of distinct differences between these people and the Red River Caddo increases. This hypothesis deserves extensive testing with the extant skeletal data.

CHAPTER FOURTEEN

CHANGING COMMUNITIES: THE OCCUPATIONAL HISTORY OF BUG HILL

Throughout its history, Bug Hill served as the loci of a variety of different settlements. Each of these probably reflected a different position in the settlement system and, perhaps, a different type of social community. Various factors, no doubt including both internal cultural processes and external environmental conditions, led to these social forms. In this chapter, we will examine these factors, as well as the various settlement types, their technologies and tool-kits, their subsistence focuses, their social organizations, and their populations.

The following discussion is focussed on the results of the 1981-82 field season. Whenever possible, data from the 1979 excavation are included and these instances are explicitly noted (Vehik 1982a).

THE PALEOENVIRONMENTAL SETTING

There are two major factors that must be controlled in order to reconstruct the environmental context in and around Bug Hill. The first is the fluvial history of upper Jackfork and North Jackfork Creeks. Meander scars and old sloughs presently border the site to the west and southeast while Jackfork Creek occupies a channel 200 m to the south. To interpret the archaeological remains correctly, the histories of these geomorphic features as well as their changing relationships to each other and the Jackfork itself must be understood.

The second factor to control is the changing nature of the vegetative communities indigenous to the Jackfork Valley. In short, we need to determine the number and location of the various vegetative communities for any one period and determine any changes in the position of these communities between periods.

Both factors of this study are discussed in the following sections.

Geomorphology

The Jackfork Valley is composed of folded, steeply dipping and truncated sandstones and shales. The shales are less resistant to erosion and form the river valleys, while the sandstones underlie the mountain ridges. Stanley Shales, the least resistant of the shale formations in the area, form the bedrock material along the southern margin of the valley. These shales are presently supporting the channel of Jackfork Creek. The geologic relationships of the area are fairly stable and have led Johnson (Chapter Three) to conclude that the position of Jackfork Creek and its ancestral streams has remained fairly constant for the entire Holocene (i.e. the last 10,000 years).

The Holocene Terrace on which Bug Hill lies probably stabilized between 2000 and 3000 B.C. These dates are based on radiocarbon assays from Bug Hill and the nearby Wheeler Lee site which indicate that Late Archaic occupation of the area began around 1700 B.C. These components were the first intense occupations of the terrace and judging from the stratigraphy at Bug Hill, took place sometime after the terrace had stabilized.

While the terrace was forming, the present day intermittent slough that adjoins the site to the west held the main channel of North Jackfork Creek (refer to Figure 10 in Chapter Three). During this time (early to mid-Holocene), the confluence of Jackfork and North Jackfork Creeks was immediately adjacent to and south of Bug Hill. This channel of North Jackfork was abandoned by 1000 B.C. with the creek migrating west to its present stream bed (D. Johnson, personal communication; see also Chapter Three). As soil development took place throughout the upper Jackfork Valley, the meandering power of North Jackfork Creek gradually diminished. The relict channel adjacent to Bug Hill became an intermittent slough, fed occasionally by overbank flooding of Jackfork Creek and by slow moving streams to the north.

At some point during the very late Holocene, Jackfork Creek created and occupied the cut-off meander scar, southeast of the site (refer back to Figure 10). This channel was probably active until very recently with the present course of the Jackfork having only been occupied since sometime during the Protohistoric Period.

Paleoenvironment

Two approaches have been previously used to reconstruct paleoenvironmental conditions in the Jackfork Valley. Bobalik (1977:8-16) amassed the available field notes and plots of the original 1895-96 land surveys of the regions and produced a hypothetical vegetative map of the valley as it probably looked prior to Euro-American settlement (Figure 86). Three vegetative zone were recognized, all of which occurred within two kilometers of Bug Hill. Prairies were confined predominantly to wider portions of the floodplain and were characterized by a wide variety of grasses, shrubs and forbs (see Albert 1981, for a complete listing). Upland forests, consisting of an oak/pine/hickory association, were restricted to linear strips along mountain summits and slopes. Plant diversity was low in this zone, but stands of oak and pines were probably fairly dense. Lowland forests of an oak/elm/hickory/ash association were found on the floodplains and terraces of the valley. These forests were the most diverse, supporting other mesic species including hackberry, mulberry, walnut, sycamore, maple and dogwood.

The critical question concerning Bobalik's reconstruction is how far back in time is it applicable. Pollen cores taken throughout the Ouachita Mountains and the adjoining Great Plains indicate that the major plant associations were in existence by the beginning of the Holocene (ca. 8000 B.C.) (see Chapter Nine for a more detailed review). While these groups have persisted, the relationship between them has not remained constant. Two major factors are primarily responsible for disrupting the balance: changes in precipitation and variation in the frequency of widespread burning.

Between 8000 B.C. and 3000 B.C. the vegetation in the region was primarily prairie savannah (Albert 1971). This period roughly corresponds to the Altithermal, the major Holocene dry period. As climatic conditions ameliorated, the savannah retreated, replaced first by oak forests (ca. 2000 B.C.) and then by forests including pine and hickory (ca. 700 B.C.). While these general trends probably occurred in the Jackfork Valley as well, the exact timing and concomittant topographic and ecological shifts have yet to be delineated.

Recent cores taken at Natural Lake, about 6 kilometers east of Bug Hill, have established a pollen record for the Jackfork Valley extending from around 500 B.C. to the present (Albert 1981). For most of this period, the three vegetative zones appear to have co-existed in much the same manner as they were found in 1895-96. However, beginning around A.D. 300, the region gradually experienced moister conditions. These conditions seem to have led to expansion of the woodlands around A.D. 900-1000. This period was followed by a quick retreat around A.D. 1100 and a return to drier conditions (see Chapter Nine). Wyckoff (1981:106) has suggested that this brief mesic interval may have lured Early Caddoan peoples to establish more permanent settlements in the Jackfork Valley. Remains of houses have so far been found in the valley at three sites: the Blessingame site

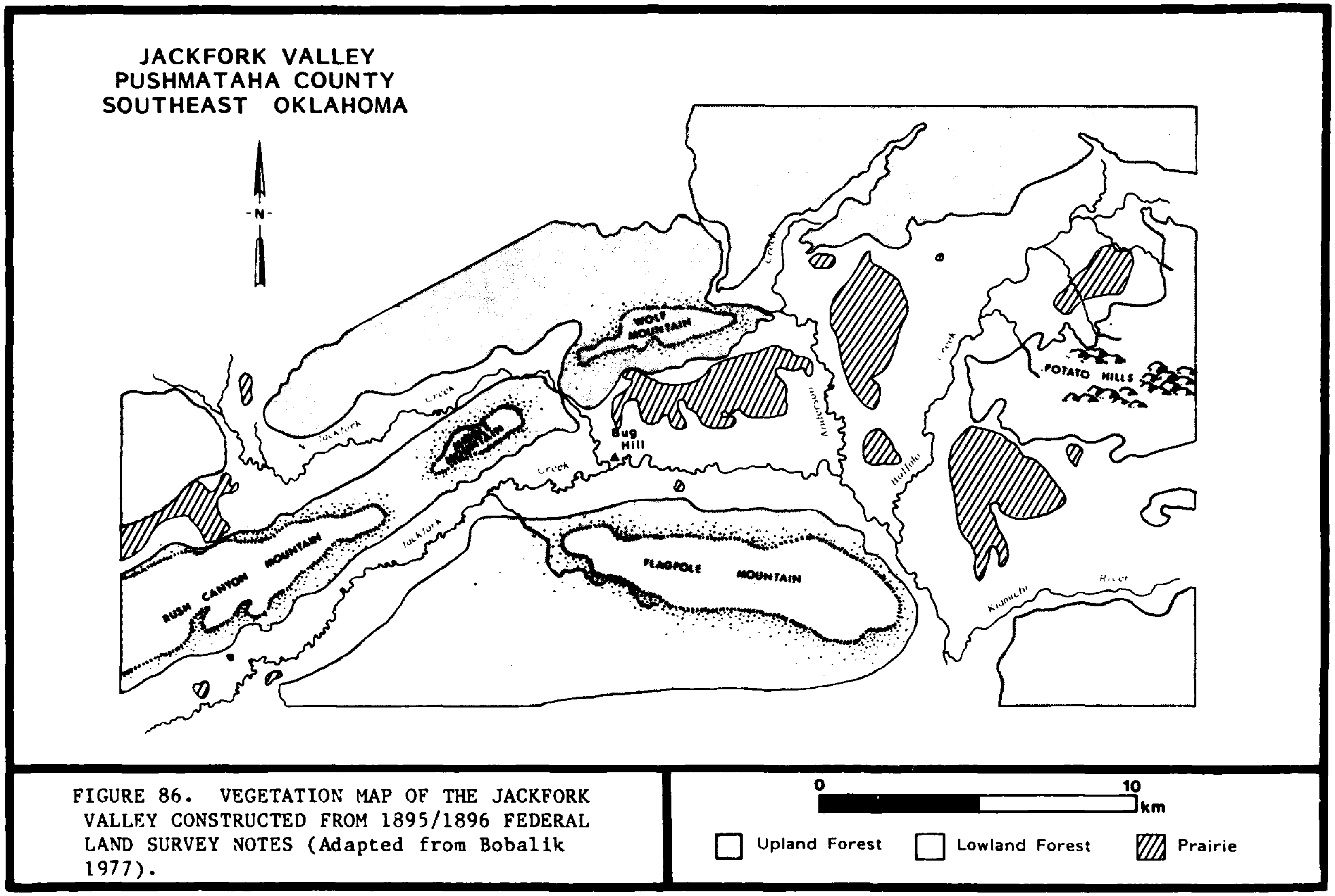


FIGURE 86. VEGETATION MAP OF THE JACKFORK VALLEY CONSTRUCTED FROM 1895/1896 FEDERAL LAND SURVEY NOTES (Adapted from Bobalik 1977).

(34Pu74), the Arrowhead Hill site (34Pu105) and Bug Hill (34Pu116). All houses have been radio-metrically dated to the period between ca. A.D. 900 and 1200.

The Changing Environments of Bug Hill

Using the palynological and geomorphological findings described above as a base, we have developed a paleoenvironmental scenario specific to Bug Hill. Results from all specialized studies have been incorporated wherever appropriate.

At the time of initial occupation, during the Middle Archaic, Bug Hill was situated on a still developing terrace, near the confluence of North Jackfork and Jackfork Creeks. The site, while perhaps optimally located in relation to riverine resources, was prone to periodic floods and probably inhabited only intermittently.

Between 3000 and 1000 B.C., the active channel of North Jackfork Creek moved to its present position west of the site. The Jackfork Terrace on which Bug Hill rests stabilized and floods became less frequent. During this time climatic conditions ameliorated and by the onset of intense occupation at Bug Hill (ca. 1600 B.C.) the prairie savannah, which had dominated the area since the Altithermal, had probably been replaced in the site vicinity by oak forests.

This scenario, with the site adjoined by a relict channel lake to the west and located about 200 m north of the active Jackfork, probably characterized occupation at Bug Hill from around ca. 1600 B.C. to sometime prior to A.D. 900. The only major environmental change during this period was the gradual advance of the lowland oak/elm/hickory/ash forest as the climate slowly continued to ameliorate. By 500 B.C. the Jackfork Valley probably resembled the way it was mapped in 1895-96. Much like today, the area was probably characterized by long, hot summers, high transpiration rates, and moderately slow permeability (Wyckoff 1981:106).

Around A.D. 300 moister, cooler conditions began to prevail. These conditions peaked about A.D. 900-1000, a time which also marks the farthest extent of the woodlands advance. The probable increase in effective moisture may have also led to an increase in the meandering activity of Jackfork Creek. During this same period the Jackfork cut and occupied the meander scar bordering the site to the southeast (Cut-off A in Figure 10). The exact timing of this event is unknown. However it is quite likely that the occupation of locality A, which is composed predominantly of alluvial deposits, corresponds to the period when this channel was active. From the archaeological remains, Locality A appears to date from the Early Caddoan period (ca. A.D. 900-1200). It is quite plausible, then, that the establishment of a more permanent occupation at Bug Hill, as indicated in Structures 1 and 2, was, in part, a response to the site's newly enhanced geomorphic and environmental situation.

By around A.D. 1200 the moister, cooler conditions had run out. The hot, dry summers quickly returned and the forest zones retreated to their 1895-96 boundaries. Bug Hill, however, probably remained a desirable location for brief intermittent camps. By this time the mound had reached its full height and extent. Jackfork Creek still adjoined the site to the southeast. Thus, the site provided a well-drained, elevated location on the Jackfork within easy reach of all three vegetation zones. These attributes probably remained fairly constant at least until the Early Choctaw period, at which time Jackfork Creek migrated to its present location and the site was finally abandoned.

OCCUPATIONAL HISTORY

Initial Occupation

The original occupation of Bug Hill occurred while Jackfork Terrace, on which the midden rests, was being formed. Little evidence remains of the initial occupation(s) beyond a small number of diagnostic projectile points and a series of enigmatic rock concentrations, all of which were found in Stratum IV (Figure 87). Rock concentrations are restricted to a small area near the center of the present-day mound and consist of Features 90 (5C) and 92 (5D) in the Central Block and Feature 79-20 in Square N41E2, about 2.5 m northwest of the Central Block (all features excavated by ARMC in 1979 are prefixed by the designation '79-'). These concentrations are all rather similar. Each feature is composed of small numbers of angular sandstone, few of which appear to be thermally altered. Feature 92 contained a number of very large rocks, several of which had ground surfaces. Bone was associated with Features 92 and 79-20, but with the exception of one deer tooth (79-20), all pieces were extremely fragmentary and could not be identified.

Only one broken biface (79-20) and a small number of flakes were associated with the rock concentrations. Diagnostic projectile points, however, were recovered during the 1981-82 field season from Stratum IV throughout the site. Most of these artifacts were found in either the Southern Block, the Central Block or Test Pit 6. Those from the Southern Block are almost assuredly intrusive from the occupational surfaces above. Features from these surfaces extend into the Jackfork Terrace and it was often impossible to determine whether an artifact was associated with a feature or the surrounding matrix.

Some of the artifacts in Stratum IV from the Central Block and Test Pit 6 may be intrusive, but the majority appear to result from actual occupation and discard practices. The diagnostics include a variety of straight-stemmed and corner-notched points representing types such as Williams, Pedernales, Bulverde, Big Creek and Carrollton. These types indicate that the initial occupation of Bug Hill probably took place sometime during Middle Archaic times. Unfortunately, material was not found in sufficient quantities to

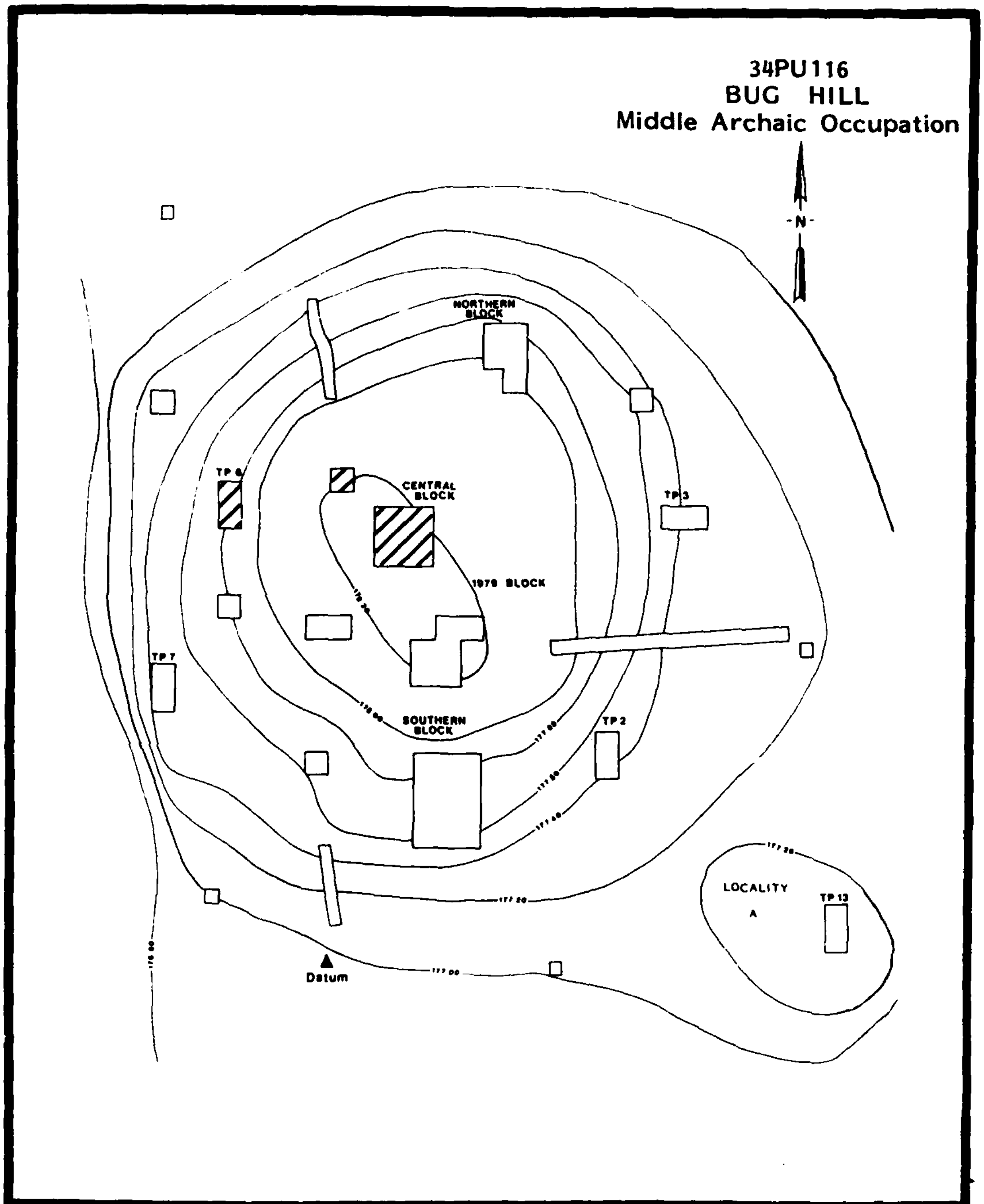


FIGURE 87. AREAS OF INITIAL OCCUPATION (MIDDLE ARCHAIC).

0 25 m

Presence of Middle Archaic occupation

obtain a radiocarbon data for Stratum IV. Consequently, we can only conclude that the early occupation(s) at Bug Hill occurred sometime prior to 1600 B.C., the earliest date for the midden.

The geomorphic evidence summarized in the previous section indicates that the terrace formed during early to mid-Holocene times (ca. 2000 - 3000 B.C.). During this period, North Jackfork Creek probably occupied the intermittent slough bordering the site to the west and the confluence of Jackfork and North Jackfork Creeks bordered the site to the south. Given the position of the rock features within the Jackfork Terrace, it is clear that the site was prone to flooding at this time.

The nature and function of the rock concentrations located near the center of the site are unknown. It is possible that these concentrations represent some type of processing areas. Alternatively, some may have served as hearths. Baked clay was noted near Feature 79-20 and some of the rocks in Feature 90 had been thermally altered. Of course, both types of functions are possible, if not probable.

All diagnostic artifacts from Stratum IV were produced from cherts of the Johns Valley Shale formation (see Chapter Seven). Banks has found a number of outcrops of this chert nearby and it is highly probable that many of the points were knapped out of locally derived material: a pattern that would be followed throughout the site's history.

Late Archaic

Pre-ceramic occupations corresponding to the Late Archaic Period encompass all of Stratum III, and probably the lower portions of Stratum II in most sections of the site. [The only parts of the site in which Stratum II clearly is not associated with a pre-ceramic occupation is in the Southern Block and Locality A.] Fifteen radiocarbon assays (five from 1981-82 and ten from 1979) date these related occupations to between ca. 1600 B.C. and 300 B.C. (see Chapter Five).

The lithic assemblage recovered from Stratum III is very similar to what Galm (1978a, 1978b, 1981; Galm and Flynn 1978) and Bell (1980) have defined as the Wister phase of the Late Archaic. Projectile points are dominated by contracting and expanding stemmed points. Gary points are the most popular, comprising 40.6 percent of the collection. Somewhat surprisingly, Marshall is the second most popular style while Lange points are poorly represented. In the Wister Valley, where the Wister phase was defined, the reverse situation has been found.

Morphologically, the lithic assemblage from Stratum III was the most diverse recovered at Bug Hill. Scrapers were the most prevalent tool type followed closely by whole projectile points. These categories accounted for approximately 60 to 65 percent of all tools in the Central and Northern Blocks, the areas with the largest collections.

Grinding implements were found in roughly the same proportion in both the Central and Northern Blocks, accounting for about 15 percent of the lithic tools. In the Northern Block, the rest of the assemblage was composed primarily of notches and denticulates, which were probably used for cutting and sawing. In the Central Block, the remaining 25 percent was split between three categories: hoes and axes (wood-working tools - ten percent); burins, scaled pieces and gravers (bone/antler/wood working and incising - ten percent); and drills, awls and punches (piercing - five percent).

In general, chipped and groundstone tools of the Late Archaic appear to have been designed for a wide range of activities. Many of these activities were probably focused around hunting or related activities, such as butchering, tanning, bone/antler working and piercing and sewing. Some vegetable processing is taking place, but it does not seem to be a dominant activity.

Besides lithics, a small number of bone artifacts were recovered from Stratum III. Most of these represented awls or flakers. The 1979 excavations recovered a wider variety of bone artifacts from this stratum, including fishhooks, beamers and spatulates (Vehik 1982a). Non-utilitarian artifacts were also found such as bone beads, decorated bone and canine and incisor pendants. Vehik (1982a) also reports a small number of shell artifacts in the form of beads and pendants.

Deposits dated to the Late Archaic are primarily accretional in nature. Occupation took place on top of former occupation. The result is that it is impossible to separate individual occupations, much less define the range of site types which utilized the mound.

The deposits, however, are not entirely homogenous. For instance, we can discern that some occupations were more intense than others. By intense occupation, we mean the use of the site as either a seasonal or permanent base camp. Houses or other structures are often used as one measure of occupational intensity. However, in an accretional midden mound, it is rare that entire structures are discerned. At Bug Hill, we found lines of postmolds that did not connect and often criss-cross each other. While we could not separate individual occupations, we could analyze this type of occupation by examining these features as a unit. For purposes of analysis, we ended up lumping together various postmold patterns, isolated storage/trash pits, hearths and other features which imply some notion of permanency, knowing full well that the various features probably represent a number of different occupations.

For the Late Archaic, we defined two areas of intense occupation (Figure 88). Both areas were excavated in 1979 and the reader is referred to Vehik (1982a) for a more detailed description.

The first area is restricted to the 1979 block excavation and consists of a series of postmolds, ash/clay concentrations and, perhaps,

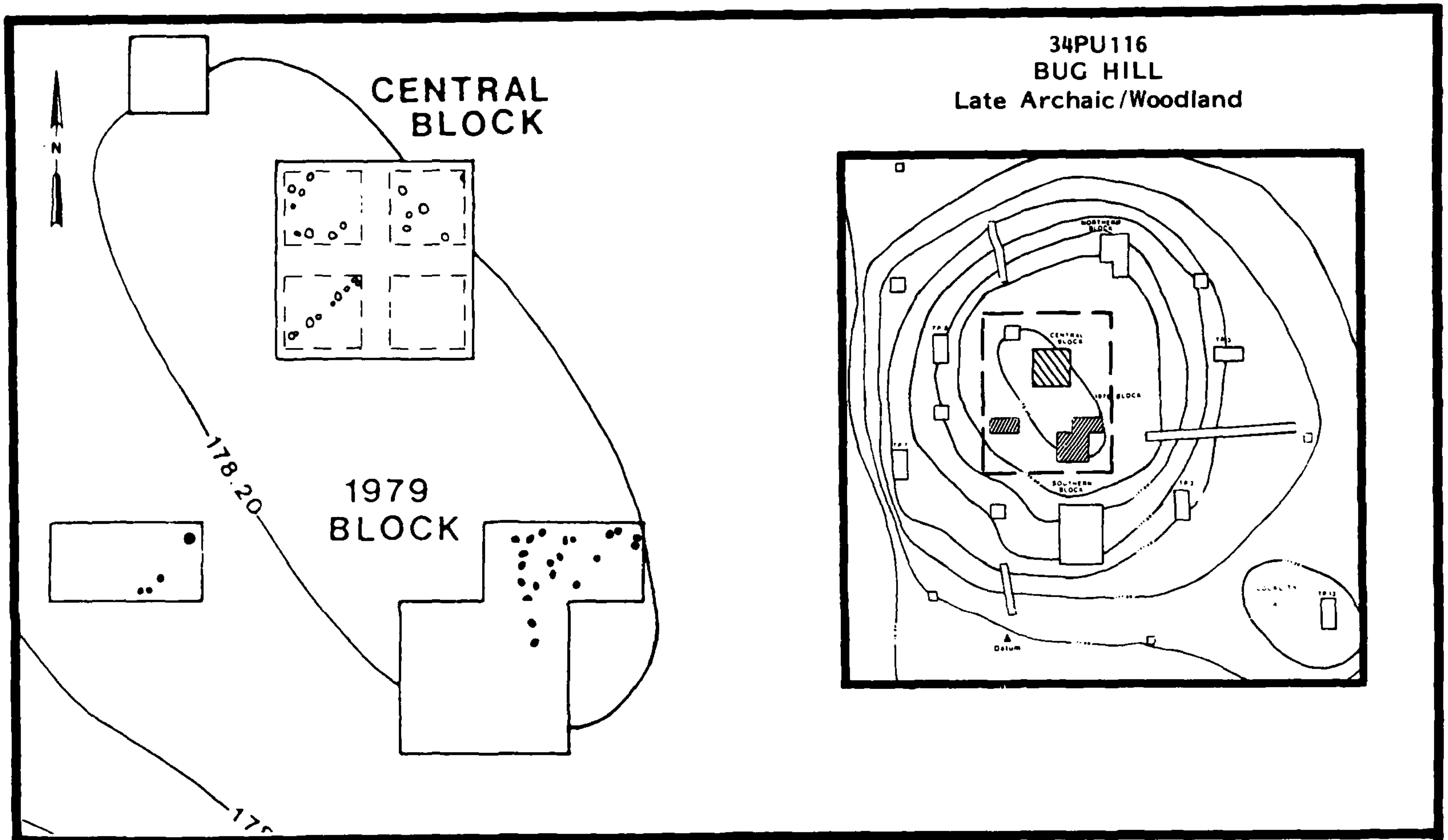


FIGURE 88. AREAS OF INTENSE LATE ARCHAIC PERIOD AND WOOLDAND PERIOD OCCUPATION.

a number of burials. There are several problems in defining the nature of, or providing a precise date for this occupation. First, while several postmold patterns were observed, no complete structure was detected. Indeed, several of the patterns cross-cut each other. Second, postmolds were primarily found at the base of Stratum III, where soil color becomes appreciably lighter. The posts, then, may actually have been higher up in the midden and relate to structures dating to a later time. In fact, three postmolds (Feature 79-5 and 79-37) were found in the mid-levels of Stratum III.

A final problem with interpreting this occupation concerns non-postmold features: the ash/clay concentrations and the burials. Burials and ash/clay concentrations were found at nearly every level between 50 and 120 cm below the surface. Several of these, such as Features 79-34, 79-35 and 1979 Burial 8 were found around 50 cm below the surface and probably reflect a later occupation. Most of the remaining features, however, cluster in Stratum III, between 60 and 100 cm below the surface. These features and burials were not clearly associated with a single occupation as evidenced by a living floor or structural fill. Indeed, judging by the number of separate postmold patterns observed, and the fact that several of the burials (e.g. 1979 Burial 1) appear to have been disturbed, it seems that the area hosted repeated occupations over a period of time. Charcoal samples obtained in a nearby square (N24E10) date these levels between ca. 350 and 1500 B.C.

The second area of intense Late Archaic occupation was also excavated in 1979 in square N28E2. Four postmolds and a storage/trash pit were found 80 cm below the surface in an arc running from the southwest to the northwest corners of the 2 m x 2 m excavation unit. These features were found within a larger area of ash/clay which followed the same general orientation. Unfortunately, these features could not be traced to the adjoining 2 m x 2 m unit (N28W0) and, so, our knowledge of this occupation is limited. Charcoal taken from the general level between 70 and 80 cm below the surface was radiometrically dated to 612 $\pm$ 70 B.C.

The areas of intense occupation excavated in 1979 strongly suggest that at least during some of the Late Archaic period, Bug Hill functioned as a base camp. That is, the site served as a center from which forays into the surrounding were initiated and at which all types of social and economic activities took place (i.e. a diffuse settlement/subsistence pattern). It must be noted, however, that during the 1300 hundred years that the Late Archaic period is represented at Bug Hill, the site probably also served as the locus for many other types of sites. Indeed as Binford (1982) points, the position of a site in the settlement system can change seasonally. For instance, Bug Hill may have served as a base camp during the winter, a fishing camp in the spring, a hunting bivovac in the summer and a lithic procurement station during the fall.

While specialized and impermanent use of Bug Hill probably took place during the Late Archaic, all evidence of these occupations as individual phenomenon has been destroyed. The result is that the remains from these deposits need to be conceived of as some type of "composite" assemblage. Of course, the importance of each occupation to the composition of the overall assemb'age, differs according to the length and nature of the associated activities. Thus, while it is important to recognize the potentially "mixed" nature of the assemblage, it is probably safe to conclude that most of the remains reflect the longer, more-permanent occupations associated with the use of Bug Hill as a residential, base camp.

At present, little insight can be shed on the nature of the Late Archaic occupation. We have no idea what types of houses, if any, were used; whether the site was occupied seasonally or permanently; or the nature of the social order. What little we do know about the Late Archaic residents of Bug Hill is derived from burials. Five burials (Burials 4 and 7 from 1979 and Burials 1, 7 and 8 from 1981-82) from Stratum III have been dated radiometrically to the Wister phase on the basis of wood charcoal found in burial pits or actual portions of the long bones (see Chapter Five). Ten additional burials were found in Stratum III or at the base of Stratum II. Given the difficulty of discerning burial pits and the frequent practice of placing burials beneath living floors, it is possible that some of these burials date to later periods. However, we feel strongly that most date to the Late Archaic.

These 15 burials represent 17 individuals, of which six were adults and 11 were children or infants (Tables 43 and 44, Chapter Thirteen). In all, nearly 70 percent of the individuals buried at Bug Hill were interred during the Late Archaic period. Of the adults skeletons, two represent males and two represent females (the two remaining adult skeletons could not be sexed). Although no burial goods were found with the male burials, a cache of eight Dickson dart points was located between them with another Dickson point found just to the south of 1981-82 Burial 1. All the points were well-made with no indication of use. The points had been knapped out of chert from the Johns Valley Shale formation, which probably was locally derived. A third adult (unsexed) appears to have been cremated (Burial 7-1979). This burial, located in Square N28W0, was associated with a number of grave goods including a canine pendant and several bone tubes.

Of the six infants and children, at least two, and possibly three, were associated with grave goods. These goods ranged from shell pendants to bone tubes. Most of the grave goods were made from local materials, although at least one of the shell pendants was made from marine conch, suggestive of long distance trade.

Most burials were of individuals found in a flexed position (eight cases). There were two cases of multiple burials, one involving an adult female found flexed (1981-1982 - Burial 7) with a neonate beneath the pelvis (1981-1982 - Burial 12) and a second consisting of a badly disturbed burial of three children (1979 - Burial 10). Finally, as mentioned above, one adult was cremated.

Although weak, the data are tantalizing. Adult males were buried on the site, a practice which does not seem as prevalent in later times. Most of the adults and some of the children appear to have associated grave goods or artifact caches. A variety of burial practices from cremation to multiple internment seem to have prevailed, with single, flexed internments being the most popular burial style. In short, the burial data suggest that all inhabitants, regardless of age, sex, and status, were buried on the site.

While our knowledge of the social order is weak, our understanding of the environmental setting is relatively strong. By the Late Archaic, the environmental situation at Bug Hill appears to have stabilized. By the start of this period (ca. 1600 - 1500 B.C.), North Jackfork Creek had probably moved to its present channel with the confluence of Jackfork and North Jackfork Creeks most likely making a corresponding shift to its present position, about 400 m southwest of the site. The site was now less prone to flooding, but it was also several hundred meters away from the closest permanent water source (Jackfork Creek). The abandoned channel of North Jackfork was transformed into an intermittent relict lake draining a number of small creeks to the north and occasionally receiving overflow from the Jackfork.

By at least 500 B.C., the modern vegetative communities were in place. Bug Hill was probably located in an oak/elm/hickory/ash forest near to prairie and upland resources. Paleobotanical or palynological data recovered from Stratum III are insufficient to indicate the types of resources utilized. Substantial faunal remains were recovered (see also Vehik 1982a) indicating that deer was the prime focus of Late Archaic hunting strategies, followed by several species of turtle. Much less emphasis was placed on a wide variety of small mammals, birds (primarily turkey), fish and molluscs.

Woodland Period

Woodland Period occupations correspond fairly well with Stratum II in all areas of the site outside the Southern Block and Locality A and most of Stratum I in the Central Block. Three radiocarbon dates have been accepted for the period and range between A.D. 278 ± 70 and A.D. 617 ± 80 (The A.D. 278 date is correct and was misprinted as 288 in the original report [R. Vehik 1982a:28, Table 3; personal communication, 1983]). A fourth date of 36 ± 80 B.C. is consistent with the depth of the sample but was rejected by Vehik (1982a:30) due to possible contamination.

The apparent 600 year hiatus between the end of the Late Archaic (ca. 300 B.C.) and the onset of the Woodland Period (ca. A.D. 300) is difficult to accept. Deposits dated to this period remain accretional in nature and there are no clear stratigraphic breaks to distinguish Woodland period deposits from earlier ones. Indeed, in the 1981-82 excavation of the Central Block, Stratum II was divided into two analytic substrata, IIa (Levels 7 and 8) and IIb (Levels 9 and 10). This division was made primarily on the basis of postmold patterns and associated features. Stratum IIa was characterized by a line of postmolds running from the southwest corner of Unit 5C to the northeast corner of Unit 5B. Southeast of this line was a variety of features, including a series of ash/clay concentrations focused around a large postmold and possible pit (Feature 25) in Unit 5C and a cluster of mussel shell (Feature 16) in Unit 5D (Figure 26). These spatial associations suggested that the postmolds formed the outer wall of some type of structure. Stratum IIb was also characterized by a large number of postmolds, but few clear patterns were discerned. At the base of Stratum IIb, three large storage/trash pits were detected in Units 5B (Feature 71), 5C (Feature 83) and 5D (Feature 80). These pits were primarily filled with faunal remains. No carbonized seeds and only a few artifacts were recovered from these pits. The top of the features could not be discerned, so it is impossible to determine with which occupation they were associated. It should be noted, however, that all three are located southeast of the line of postmolds observed in Stratum IIa (Figure 27).

In general, the evidence from Stratum II in the Central Block is indicative of a series of repeated, intense occupations. Unfortunately, charcoal was not found in sufficient quantities for dating purposes anywhere from Stratum II in the Central Block. A carbonized log, located 13 cm below the base of Stratum II, was radiometrically dated to 420 $\pm$ 125 B.C. and brackets the lower end of this occupation. Intensive use of the Central Block, then, post-dates ca. 400 B.C., but it is unclear by how much or for how long.

There are minor differences in the assemblages of Strata IIa and IIb that give some hints to their relative date. Only 11 ceramic sherds were found throughout Stratum II in the Central Block. Of these, 10 were recovered from Stratum IIa and only one from Stratum IIb. While the number of ceramics in Stratum IIa is small, there is no evidence that the location of these ceramics is the result of bioturbation. It is quite likely, therefore, that Stratum IIb dates to the end of the Late Archaic and that Stratum IIa dates to at least the early Woodland Period. It must be remembered, however, that the substrata are analytic units and that the deposits drive from the same stratigraphic zones. Thus, it would appear that no major occupational break occurred between the Late Archaic and Woodland periods.

The hallmark of the Woodland Period is the introduction of ceramics. A total of 107 sherds were found in Stratum II throughout the site (excluding Locality A and the Southern Block). Of these, 66, or 61.6 percent, were recovered from peripheral units (Test Pits 2, 3, 6 and 7). Plainwares dominate the collection from Stratum II, comprising 93.5 percent of the total. Williams Plain is the most popular type with grit being the favored tempering agent. A small number of sherds classified as Williams Plain were found with bone and shale temper as were a number of unidentified plainware sherds.

The culture-historic diagnostics found in Strata I and II were again dominated by points of the Gary style. The popularity of this tool type appears to have remained virtually constant over time, comprising 40.6 percent of both the Stratum III collection and the Strata I and II collection. In addition to Gary points, Strata I and II deposits were characterized by a wide variety of mainly expanding stemmed (especially Lange, Edgewood and Ellis) and corner notched (primarily Marcos and Marshall) dart points. A small number of arrow points, primarily Scallorn and Rockwell types, were also found in Strata I and II.

Besides ceramics, the major additions to the Woodland cultural assemblage are double-bitted axes and gorgets. A wide range of modified bone and antler was also recovered in both the 1979 and the 1981-82 field seasons from Strata I and II including awls, flakes, beamers, spatulates, fishhooks, and a number of cut and engraved bones.

Three burials representing five individuals were found in Strata I and II. One burial, Burial 6, was dated radiometrically to A.D. 460 ± 90. If we assume that burials in Stratum II also relate to Woodland period occupations, the following observations can be made. Only women, children and infants are represented in the Woodland period burial population. At this time it is not clear whether adult male burials were not found because of changes in burial practices (i.e. adult males buried off the site) or because of the small sample size. It should be noted, however, that the small number of Woodland Period burials does not necessarily reflect either a change in population or in the nature of occupation. If we use the radiocarbon dates as guides to the length of the culture periods then it follows that for the approximately 400 year Woodland Period we recovered five individuals while for the 1200 year Late Archaic 17 individuals were recovered; or, proportionately, roughly the same number of individuals for each period.

Of the three Woodland burials, only one (Burial 6) had associated grave goods. These goods included a boatstone, a polished flaker, and 179 seed beads. Two of the burials contained two individuals each. Finally, all Woodland period skeletons were found in a flexed position.

The cultural assemblage from Strata I and II is consistent with what Bell (1979) and others have identified as the Fourche Maline phase of the Woodland Period. Throughout the Ouachitas, the nature of Fourche Maline phase occupation is an unresolved and widely debated issue (see Galm 1978a; 1978b;1981; Galm and Flynn 1978a; 1978b; Bell 1953;1979; Bell and Baerreis 1951; Vehik 1982a; Wyckoff 1970; and Schambach 1970; 1982). At Bug Hill, evidence of intense occupation during this period is restricted to the Central Block (Figure 88). As noted above, Stratum II in this unit was associated with a large number of postmolds, a possible structure, numerous storage/trash pits and other associated features. The soil matrix, while relatively homogeneous, was characterized by greater amounts of charcoal and ash flecks than was noted in this stratum in other parts of the site.

This occupation probably represents a base camp situation similar to that described for the Late Archaic. Other types of occupations are possible, of course, but no clear evidence for them exists.

Abrupt cultural change does not appear to have characterized the transition from Late Archaic to Woodland. Evidence from the Central Block indicates that occupation continued from one period to the next with no suggestion of a cultural hiatus. But while the nature of occupation and the overall range of artifact types do not greatly differ between the two periods, differences were noted in the functional focus of the lithic assemblages.

During the Late Archaic, the lithic assemblage was characterized by its diversity of tool types and emphasis on activities associated with hunting or processing faunal remains. In contrast, the most salient characteristics of the Woodland period lithic assemblage is the decrease in the proportion of tools associated with hunting or working faunal remains and the increase in those involved with grinding.

Over 45 percent of all lithic tools from Stratum II (again excluding the Southern Block and Locality A) were either manos, metates, or nutting stones. In Stratum III, these tool types represent less than 20 percent of the assemblage. Correlated with this increase in grinding tools is a marked decrease in the relative frequency of tools associated with hunting or processing faunal remains. Thus, even though nearly all the tool types represented in Stratum III were also found in Stratum II, the Woodland period assemblage appears much more specialized.

The changing proportions of lithic categories is presented in Table 50. This relationship was further explored through a series of student t-tests performed on the three most numerous categories; scrapers, whole points, and grinding implements. The results show that scrapers and grinding tools have mean proportions which differ enough between Strata II and III, relative to their standard deviation, to suggest that the number of tools in these categories also really differ between strata. In contrast, the proportion of whole points remains virtually constant between strata.

The t-tests are instructive, but should not be taken as definitive. Perhaps the most important problem in using t-tests in this situation is that since our variables are percentages, which necessarily must add up to 100% for each provenience, it is a mathematical necessity that the categories in Table 51 cannot be independent but must be completely interrelated (Cowgill et al. n.d.). For example, a decrease in the proportion of scrapers from Stratum III to Stratum II could either be produced by a real decrease in the number of scrapers, an increase in the number of groundstone tools, or some combination of the two.

To determine what the shifts in proportions actually reflected, we computed the actual frequencies of scrapers and groundstone for Strata

TABLE 50. PERCENTAGES OF LITHIC CATEGORIES IN STRATA II AND III.

Provenience	Notches, Denticulates	Burins, Scaled Pieces, Gravers	Scrapers	Whole Points	Ground-stone	Drills, Awls, Punches	Axes, Hoes	N
Stratum II								
Northern Block	7.5	0.0	12.5	25.0	32.5	10.0	2.5	40
Central Block	8.3	8.3	16.7	16.7	41.7	8.3	0.0	24
TP 2	3.7	3.7	25.7	11.1	48.1	7.4	0.0	27
TP 3	0.0	4.9	9.8	22.0	58.5	2.4	2.4	41
TP 6	0.0	5.0	10.0	40.0	30.0	10.0	5.0	20
TP 7	8.0	3.6	10.7	17.9	67.9	3.6	3.6	28
Mean			14.2	22.1	46.5			
Standard Deviation			5.9	6.1	13.5			
Stratum III								
Northern Block	20.5	2.6	35.9	23.1	12.8	2.6	2.6	39
Central Block	0.0	10.0	30.0	30.0	15.0	15.0	0.0	20
Southern Block	0.0	9.1	45.5	18.2	27.3	0.0	8.3	11
Mean			37.1	23.8	18.4			
Standard Deviation			6.6	4.7	6.3			

T-Tests

scrapers: t=4.19	whole points: t=0.26	ground-stone: t=2.13
df=1	df=1	df=1
p> .001	p< .20	p>.05

II and III. These frequencies are presented in Table 51, which shows that the number of scrapers remained virtually constant from Stratum II to Stratum III while the number of groundstone tools increased over five-fold.

TABLE 51. FREQUENCIES OF SCRAPERS AND GROUNDSTONES RECOVERED FROM STRATA II AND III.

	Scrapers	Groundstone
Stratum II		
Central Block	5	12
Northern Block	6	12
Site Peripheries	15	63
TOTAL	26	87
Stratum III		
Central Block	6	3
Northern Block	14	11
Southern Block	4	3
TOTAL	24	17

Besides exhibiting vertical differences between strata, groundstone tools also show a marked horizontal distribution within Stratum III. Nearly 73 percent of all metates, manos, and nutting stones found in Stratum II were recovered from peripheral units (mostly Test Pits 2, 3 and 7). Peripheral excavation units also contained over 60 percent of the ceramics from the same stratum.

Thus, the differences in cultural assemblage between Strata II and III appear to be two-fold: first, a sharp increase in the number of groundstone tools associated with the introduction of ceramics; and second, a marked spatial preference of these two categories away from the center of the mound.

Some of these changes may be related to shifts in subsistence practices. Samples from Stratum II of Test Pit 6 yielded pollen of gooseberry and wild beans often found clumped in tetrads (see Chapter Nine). These results imply that the pollen was not blown in but was actually dropped in place. The co-association of tetrads of pollen, ceramics, and groundstone is certainly suggestive of an increasing economic emphasis on the intensive collection of wild plant foods.

The extent to which the increased emphasis on wild plant changed overall subsistence practices is unclear. The regional environment around Bug Hill probably remained relatively stable between the end of the Late Archaic and the early portion of the Woodland period with the climate similar to that which prevails today. Faunal remains from the storage/trash pits in the Central Block indicate a continuation of the Late Archaic emphasis on deer hunting. Carbonized seeds recovered from Stratum II of the Central Block indicate use of a wide variety of plants including hickory nut, persimmon, honey locust, pokeweed, sumac and grape (see Chapter Ten). Many plant species of the lowland oak/hickory/elm/ash forest were represented in pollen collected from Stratum II in Test Pit 6. Also recorded from this unit was non-aboreal pollen from a number of potential food resources including wild onion, gooseberry, pigweed, goosefoot, sunflower, horseweed, marsh elder, wild bean and knotweed.

In sum, during the Fourche Maline phase of the Woodland period, occupation continued to result in accretional midden deposits. The site remained situated away from the active Jackfork, bordered only by an intermittent relict lake. Subsistence continued to rely heavily on deer hunting and turtle collecting but perhaps with a growing emphasis being placed on plant foods. Ceramics were introduced and shifts in the importance of existing lithic categories took place.

Culturally, Bug Hill continues to serve as a base camp during at least part of the Woodland period. Whether the site was occupied seasonally or permanently is unknown. It is certainly possible, however, that in addition to serving as a base camp for part of the year, Bug Hill was the locus of other site types at other times of the year. While the overall subsistence focus appears to remain relatively stable, significant shifts took place in the emphasis of individual components. At least at Bug Hill, hunting activities appear to be de-emphasized, while collecting activities are intensified. These changes may reflect an increasing amount of experimentation in scheduling decisions. The long-term results were shifts in emphasis within the same general subsistence focus.

Early Caddoan Occupation

Remnants of Early Caddoan Period occupations are restricted primarily to deposits of Stratum II in the Southern Block and Locality A. The upper portion of Stratum I in the Central Block may also date to this period. Diagnostic Caddoan artifacts were found over most of the site, but these were mostly confined to the plowzone. Twelve radiocarbon dates were obtained for this occupation. Of the twelve dates, eight fall within the period from A.D. 859 ± 60 to A.D. 1110 ± 125.

Technologically, the Early Caddo period at Bug Hill is characterized neither by major changes nor innovations in tool types. Use of ceramics probably increased (211 sherds were recovered from deposits of this period); but there does not appear to be a corresponding increase in the diversity of the collection. Over 98 percent of all Caddoan period ceramics are plainwares and Williams Plain remains the dominant type. Other plainwares represented include Leflore Plain and a variety of unnamed thin bone tempered, thin grit tempered, and dense, fine sand tempered ceramic types. Decorative techniques are restricted to incising, punctations and, perhaps, cord impressions. No established decorated types were identified in the 1981-82 collection. Several small sherds however, had fine line incising indicative of either Crockett Curvilinear Incised or Pennington Incised-Punctate.

Modified bone dating to this period was recovered from the Southern Block and possibly from Stratum I of the Central Block. Most worked bone represented awls or flakers, although a number of antler smoothers and handles and bone spatulates were also recovered.

Overall, the lithic assemblage is very similar to that of the preceding Woodland period. There are, however, changes in the proportions of various culture-historic diagnostics. For example, Gary style points climb from around 40 percent of Woodland period points to nearly 60 percent of the Early Caddoan diagnostics. There is also an increase in the number of small arrow points. Arrow points account for around 10 percent of the Early Caddoan point collection with Scallorns being the most popular type.

Bifacial thinning was the predominant stage of lithic manufacture conducted at the site during the Early Caddo occupation. About 90 percent of the debitage found in the house floor consisted of tertiary or bifacial thinning flakes. Almost all of these flakes derived from chert nodules taken from the Johns Valley Shale formation. River cobbles were found in Structures 1 and 2 but the vast majority of these had been tested and few had been modified into cores. The most plausible explanation for these findings is that lithic procurement and initial reduction took place at the source of the materials; presumably, the band of Johns Valley Shale north of the site. Cores and preforms were then brought back to the site, where finished tools were produced. River cobbles were also utilized, but in much smaller amounts than the Johns Valley material.

Perhaps the most striking aspect of the Early Caddoan lithic assemblage is not the range or diversity of tool types, but the marked horizontal differences in the distribution of tool classes. The lower levels of Stratum II in the Southern Block are characterized by a large proportion of whole points and only minor amounts (less than 17 percent) of all other tool classes. In contrast, the lithic assemblage from Stratum II in Locality A is extremely similar to those described for the Late Archaic. The collection from this area contained a high proportion of tools used in hunting and processing faunal remains (i.e., scrapers, notches, denticulates and whole points). Groundstone tools were present in Locality A, but constituted only a small proportion of the total assemblage.

The cultural implications of the marked spatial distribution of artifacts is best understood in relation to the nature of Caddoan occupation. Evidence for intense occupation dating to this period was recovered from the Southern Block. This occupation consisted of two superimposed houses and, perhaps, several outside activity areas.

Around A.D. 900, the occupants of Bug Hill cut into the existing mound in the vicinity of the Southern Block and removed about 30 cm of deposits. A level floor was created on the Jackfork Terrace and a roughly square 6 m x 6 m house constructed. The house, oriented approximately 15° east of north, was supported by four central posts and was focused around a central hearth. Charcoal collected from the central posts, some of the outer posts and the floor indicates that the structural supports of the house were either elm or species of the red oak or white oak groups (Chapter Ten). Other trees used in house construction include ash, hickory, cedar and cherry. The roof of the house was presumably thatched cane, which was found in abundance throughout the house, but especially on the floor.

The exact reason behind placing the house about 30 cm below the then existing ground surface is unknown. It is possible that this action follows a cultural pattern. (This line of inquiry will be examined in the next chapter). It is also possible, however, that this action was a response to the setting of the site. At the Blessingame site (34Pu74), about 9 km east of Bug Hill, earthen berms were built against the sides of two Early Caddoan houses. At Bug Hill no evidence of earthen berms were found. Instead, the residents may have built their house in a depression, thereby providing themselves with extra protection against the elements.

The initial Caddoan house (Structure 1) at Bug Hill appears to have been fairly long lived. The entire length of the outer walls exposed during excavation had been strengthened and refurbished at least once. At some point, however, the house was replaced by a larger and perhaps better constructed one. This second Caddoan house, designated Structure 2, retained the basic orientation of Structure 1 as well as the four post plan. Structure 2 was approximately 20 percent larger than Structure 1 and in contrast to Structure 1 had its walls set at nearly perfect right angles.

The internal organization of the Caddoan houses is difficult to determine. Numerous features were found on the house floor, but in only a few cases was it possible to determine the particular house in which a specific feature was used. However, by looking only at the house floor, a few observations can be made (see Figure 20). The east half of the floor is characterized by a large number of poorly made storage/trash pits and small, unprepared hearths. In contrast, the west half, such as it can be defined on the basis of the exposed portions of the house, is focused around three well-made storage/trash pits, namely Features 62, 63 and 64.

The east-west distinction in feature types was mirrored in the non-random distribution of groundstone implements and scraping tools. The former class of tools was found almost exclusively in the west half of the house while the reverse was true for scrapers. A chi-square test, with 1 degree of freedom, showed that this distribution deviated significantly from what would be expected if the tools were distributed randomly ($x^2 = 4.62$, $p > .05$). The high incidence of groundstone tools in the west half of the house was in sharp contrast not only to the rest of the house floor, but also to Stratum II of the Southern Block in general. The results of the spatial analysis indicate that sections of the house had proportions of groundstone tools similar to those exhibited in Stratum II from other parts of the site. The implication is that activity areas using groundstone implements occurred in the Southern Block and were restricted to the west half of Structures 1 and/or 2. This conclusion is supported by the results of palynological and paleobotanical studies. A possibly domesticated sunflower seed and large quantities of sunflower pollen (often found in tetrads) were found in the southwest corner of the Southern Block in deposits corresponding to house floor and fill. These finds strongly suggest that this portion of the house was the locus of vegetable grinding activities.

The correlation of scrapers with the east half of the house is difficult to interpret. Some scraping activities may have taken place in the houses, though it is much more likely based on the amount of debitage in the floor, that scrapers and other tools were made in or near the houses than actually used there. High proportions of scrapers and other wood, bone, antler and hide working tools were also found at Locality A. This area appears to be ideally suited for the working of these materials; close to water and away from the habitation zones. Further, debitage frequency at Locality A was exceedingly low, indicating that manufacture of lithic tools was not taking place in this area.

While different activities appear to have been segregated in different portions of the house, the "common area" around the central hearth was kept remarkably clean. Two projectile points constitute the total artifact assemblage recovered from the house fill and floor in this area. No evidence was found to indicate that the absence of artifacts in this area was a function of post-depositional processes. Thus, it is possible that this absence is a reliable indicator of the area's cultural position and use.

The differential use of space does not appear to end at the walls of Structure 2. Byrd (Appendix V) noted a much higher percentage of large mammal bone (mostly deer) outside the house (58 percent) than on the house floor (49 percent). Two interpretations appear to be plausible: (1) either the area immediately outside the house represents a deer butchering or processing locality or (2) the larger percentage of large mammal bone is the result of "semi-neat" cleaning activities involving the collection and redeposition of these bones outside the house. At present, we simply cannot determine which, if either, interpretation is correct.

The area immediately north of the house had a special function; it served as a burial ground. Three individuals, placed in two burials, were found along the northern wall. Two of the individuals (Burial 10) were probably associated with Structure 1. Remains of these individuals were concentrated over three postmolds associated with the outer wall of Structure 2. These remains were badly disturbed with skeletal fragments scattered over several meters (Chapter Thirteen). These individuals, then, were probably interred directly outside Structure 1. When Structure 2 was constructed, the burial was disturbed with no attempt apparently made to re-bury the remains.

The second burial, Burial 9/11, consisted of a flexed, adult male placed under a large metate. A sample of the long bone from this burial was radiometrically dated to 1090 $\pm$ 180 B.C. This date, of course, is inconsistent with the interpretation of this burial as Early Caddo. We feel that either the radiocarbon date is incorrect or the burial represents an Late Archaic burial encountered during the building of either Structures 1 or 2 that was then reburied outside the house.

The occupation of Structures 1 and 2 dates to a period of climatic amelioration. Moist, cool conditions began to prevail in the Jackfork Valley around A.D. 300. These conditions reached a peak around A.D. 900-1000 with the drier, warmer climate returning slowly thereafter (present conditions stabilized around A.D. 1200). This period between A.D. 900 and 1200 marks the farthest advance of the woodlands. Around this time, Jackfork Creek cut and occupied the meander scar bordering Locality A, southeast of Bug Hill.

During this period, Bug Hill was bordered by a relict channel lake to the west and the Jackfork to the southeast. Both water sources appear to have been utilized extensively. Unionids exclusive to moving streams as well as those found only in stagnent ponds were recovered from components dated to this period. Fish remains indicate an active interest in the resources of the river. Perhaps the best indicators of extensive riverine exploitation are aquatic turtles; the second most abundant class of animals found in the entire collection. Turtles from four families were recovered, ranging from the large alligator snappers (ca. 35-50 lbs) to small, mud turtles. Some of these turtles, like the large alligator snappers, were undoubtedly collected from the Jackfork itself while others may have been taken in shallower ponds. The large number of turtle remains led Byrd (Chapter Eleven) to suggest that some type of passive technique, such as a trap, was probably used.

The Early Caddoan residents of Bug Hill were situated in the relatively lush lowland in close proximity to both the prairie and the uplands. Wood by-products recovered predominantly from house fill show that numerous types of trees were brought to the site, many probably used as structural supports. Carbonized seeds and pollen also recovered from the house fills indicate that diverse floral resources were being utilized as food stuffs. Predominant among these were sunflower, wild bean, goosefoot, gooseberry, persimmon, wild grape, hickory nut, walnut, and acorn (see Chapters Nine and Ten for complete listings). Many of these resources were no doubt found in nearby forests or prairies. However, some probably grew on or near the site in soil disturbed by human activities. These latter species include grapes, gooseberry, smartweed, pigweed, wild bean, and sunflower. Sunflower pollen was found in such large quantities and with the grains often in tetrads, that it simply is not possible that the pollen was blown into the house. These plants were probably gathered or in the case of sunflower planted on or near the site.

Although the evidence is less than definitive, sunflower appears to have been domesticated. While only one carbonized seed was recovered from the house fill, the size of the achene clearly falls within the range of a domesticated population. Little can be concluded from one seed. However, the fact that nearly 40 percent of the pollen recovered from level 8 of the house fill was H.S. type composite (specifically Helianthus) and that the pollen grains were found in tetrads or aggregates, supports the case of domesticated sunflower use.

Regardless of whether sunflower was actually domesticated it does appear that the Early Caddo at Bug Hill "encouraged" various types of "volunteer" plants growing on the edges of the site. These plants were probably actively collected. How important these plants were in the overall subsistence picture and whether their encouragement required a major re-allocation of time and scheduling decisions remain topics for future research.

In addition to nearby floral resources, the forests and prairies surrounding Bug Hill supported a diverse animal population. Preeminent among these in terms of importance as a food source for the residents of Bug Hill were deer and elk. These large herbivores (elk can weigh up to 1000 lbs, while deer range between 50 and 400 lbs) are found throughout the forest, forest edge, and meadow. Though these animals are sometimes found in large groups, they spend most of their time alone or with one or two others. Hunting in small parties was most likely the method used to obtain these animals.

Smaller mammals, including opossum, raccoon, beaver, muskrat, rabbit, and squirrel, were also taken. Several of these species (beaver, opossum, and raccoon) are nocturnal or highly aquatic and may have been taken in traps. The remainder, active at various times of the day, were probably hunted.

Dog (a general class including dog, coyote, and wolf) and red fox are found throughout the area. These predators are primarily nocturnal and would have been obtained through hunting techniques. Some dogs, however, may have been kept in the village. Dog burials, while not common, have been found at a number of midden mound sites (Bell and Baerreis 1951; Bell 1980).

The only bird represented in the collection was turkey. This large, non-migratory bird prefers the upland forests. Turkeys are often found in groups and can be hunted or trapped.

In sum, Early Caddoan subsistence practices at Bug Hill appear to have focused on late fall-early winter gathering of fruits, seeds, and nuts combined with a strong emphasis on deer hunting and turtle collecting. While deer hunting and turtle collecting may also have been a fall activity, no evidence of molting or other seasonal indicators were observed in the collection, and these animals are available at other times of the year. Sunflower horticulture may have been practiced and if so indicates some use of the site during the spring or early summer.

The overall picture which emerges is of a group intensively collecting seeds, fruits and nuts as they ripen in the fall. This group may also have harvested a limited sunflower crop and actively collected several species of volunteer plants growing in disturbed areas on or near the site. These food sources were presumably stored and, together with deer and small animals taken intermittently, kept the group through the winter. In the spring or early summer, the residents may have planted sunflower on the margins of the site and collected and hunted a variety of plants and animals. Whether the site was occupied permanently throughout the summer is unknown, but it may have served as a base for hunting and gathering forays into the surrounding uplands.

The Destruction of Structure 2

At some point, a fire started in the northern section of Structure 2, engulfing and destroying the entire house as it fanned to the northwest. The burned rubble filled the depression created for the house with about 20 cm of ash, clay and charcoal debris.

The nature of the destruction of Structure 2 is open to debate. One possibility is that the fire was simply an accident. Alternatively, the fire may have been set, possibly as part of a ritualistic ceremony. Several lines of evidence exist, which tend to support the second explanation. These lines will be discussed individually below.

The first line of evidence involves the types of projectile points found in the fill and floor of Structures 1 and 2. Banks (Appendix IV) was the first to note that most of the dart points found in these deposits were not made in typical Caddoan styles, but rather are more characteristic of the Archaic period. By itself, this line of evidence is not very convincing. While the Early Caddoan collection from Structures 1 and 2 seemed more characteristic of a Woodland period assemblage than a Caddoan period one, it still was not that different from other Early Caddoan sites in the Jackfork Valley (Vehik and Galm 1979; Vehik 1982b). Rather than viewing this assemblage as untypical, we thought it more likely that the nature of the artifacts accurately reflect the overall conservative nature of the culture.

Our perception of this assemblage began to change with the second line of evidence. In Chapter Six we noted that unlike scrapers and groundstone tools, the points found in Structures 1 and 2 were distributed in a more-or-less random pattern. Intrigued by the distribution and the sheer size of the collection, Banks (Appendix IV) examined all the whole and broken points and noted that 24 percent had been burned. In contrast, only 13 percent of other bifacial tools from the fill and floor of the structures exhibited direct evidence of burning. By way of comparison with other deposits, six percent of the bifaces in Stratum II of the Southern Block had been burned while only five percent of the points in the entire Central Block exhibited burning, and most of these were confined to the upper five levels. While the higher proportion of burned tools in the structure fill is expected, we still cannot explain why points were nearly twice as likely to be burned as opposed to other types of bifacial tools.

Finally, as noted in Chapter Six, the proportion of whole points to broken points in the fill and floor of Structures 1 and 2 was 1:1.3, whereas elsewhere at the site the proportion averaged around 1:3. The implication is that the Early Caddoan occupants broke about three times fewer points than any other residents in the sites' then 2500 year history. Combined with the high proportion of whole points is the fact that the Early Caddoan structures have the highest proportion of broken bifaces at the site (56 percent of the total assemblage for Occupational Surface III) and the largest density of flakes and cores. While it is possible that some of these broken pieces represent point fragments, there is no reason to believe that the proportion of point fragments in the biface category is substantially higher for Occupational Surface III than for any other deposit at Bug Hill.

To interpret the evidence, we have to reconcile a large proportion of whole, burned points which are more characteristic of an earlier culture period in the same deposit as a large percentage of unburned, broken tools and flakes. While several possible explanations exist, we feel the following is the most plausible.

The high proportion of burned points indicates that many of these tools were in the house at the time of the fire. The large amount of whole points can be interpreted in two ways. First, tool making was performed elsewhere at the site and only whole points were brought into the house. Alternatively, the points, most of which are "Archaic" style dart points were brought into the house deliberately prior to burning the house. While, we cannot demonstrate or refute either hypothesis, we do feel that the later hypothesis warrants serious attention. The stratigraphic evidence indicates that the fire started in the north end of the house, away from the central hearths. The fire, apparently burned rapidly and intensely with the burned clay underlying the fire restricted to an area less than two meters in diameter. The stratigraphic evidence combined with the large number of "Archaic" style, randomly distributed points does suggest some unusual type of behavior. Although not conclusive, the fire seems hardly accidental.

After Structure 2 burned it left a depression of burned rubble and debris. This depression may have served as a convenient waste disposal area for later lithic manufacturing areas. This interpretation would nicely account for the large number of exhausted cores, core fragments, blocky debris, flakers and broken bifaces encountered in Stratum II and the fill of Structures 1 and 2. The lower percentage of burned bifaces than points in the house fill, then, could be explained as the result of later disposal practices depositing large numbers of unburned broken bifaces, thereby significantly decreasing the proportion of burned to unburned tools.

Intermittent Camps

After the destruction of Structure 2, Bug Hill served as the locus for a number of intermittent occupations. Evidence for these occupations was restricted to levels 4 through 7 of Stratum II in the Southern Block and the upper portion of Stratum I in the Central Block. No radiocarbon dates were obtained for this period.

Remains of these occupations from the Southern Block are in the form of rock-lined pits (Features 3 and 31), bell-shaped hearths (Features 16 and 32) and floral and faunal processing areas (Features 30 and 53). A clay-lined pit (Feature 93) from the Central Block may date from this period, though it is more likely associated with the succeeding occupation. These features were all spatially distinct, separated by each other by midden deposits. We could not determine which features were associated with a single occupation or how many occupations were represented.

Few culture-historic diagnostics or tools of any type were recovered from these features. Bell-shaped hearths, however, are fairly sensitive time indicators dating almost exclusively to post A.D. 1400 (Briscoe 1977; Wyckoff 1980). The hearths at Bug Hill appear to have been re-used as trash pits; both were filled with consolidated ash and fire-cracked rock.

The rock-lined pits were filled with the same soil matrix as the surrounding middens. No artifacts, animal bones or carbonized seeds were found inside these pits. The final set of features, the processing areas, consisted of little more than amorphous concentrations of floral and faunal remains. Neither area appeared to have been prepared in any special manner, nor did they seem to have been used repeatedly.

These features probably represent the remains of intermittent camps. By A.D. 1200, climatic conditions seem to have stabilized and the environment surrounding Bug Hill was probably similar to that of today. Jackfork Creek most likely continued to occupy the meander scar southeast of the site. Faunal remains, from the features and surrounding midden, indicate little change in subsistence practices from the preceding occupation. Hunting practices were still focused on deer and turtle collecting remained an important activity. Intermittent occupation of the site, then, probably reflects the continued availability of riverine and lowland forest resources close to Bug Hill.

Late Caddoan Occupation

Remains of a Late Caddoan structure were uncovered in the northern section of the Southern Block. The structure was restricted to levels 2 and 3 of Stratum II in Test Pit 11. Three radiocarbon samples (one dated separately by two different laboratories) yielded four dates ranging from A.D. 950 $\pm$ 150 to A.D. 1860 $\pm$ 80. The extreme dates appear to be too old and too recent respectively. The middle date of A.D. 1500 $\pm$ 55 seems to be a better reflection of the actual date of occupation.

Only a small number of artifacts were recovered from this occupation. The few lithic and ceramic culture-historic markers collected definitely suggest a Caddoan Period occupation. The one decorated sherd recovered was identified as a Pennington Incised-Punctate. All remaining ceramics were plainwares with Williams Plain being the dominate type. Both grit and bone tempered varieties (Varieties A and B) of Williams Plain were recovered. Of the three remaining sherds, two were identified as thin grit/grog and one as thin grit.

The lithic collection was equally as sparse. Over half the diagnostics were points of either the Gary or Scallorn style. The balance of the collection was composed of a number of various expanding stemmed dart points, an unidentified straight stemmed dart point and a Bonham style arrow point. Other than points, which account for 40 percent of the entire lithic collection, the assemblage consisted of small numbers of cores, scrapers, bifaces and a hammerstone.

A circular structure, approximately 3 m in diameter, was the focus of the Late Caddoan occupation. The structure, designated Structure 3, extended into the north wall of the block and only slightly over half of the structure was excavated. Nearly three times the amount of daub per square meter level was recovered from the fill of Structure 3, than from the fill of Structures 1 and 2. No postmolds or burned posts were recovered, although several carbonized logs were dispersed throughout the structure and the immediately surrounding area. Identified wood by-products indicate that these logs were probably from trees of either the red oak or white oak groups. Surprisingly, only small amounts of cane were recovered.

The picture of Structure 3 which emerges, then, is that of a small circular, perhaps bee-hive shaped, structure. The structure consisted of a wood frame which supported an outer protective covering of daub. Internally, the structure appears to have been focused around a number of small hearths, three of which were noted in the portion of Structure 3 that was excavated. All three hearths were similar in size and shape. In each case, a shallow, basin-shaped pit appears to have been dug into the floor and used as a hearth. It is not clear how often each hearth was used or if they were used simultaneously.

Structure 3 burned down leaving a 20 cm deposit of charcoal, ash, baked clay and daub inside the confines of the structure and a thin lens of ash extending several meters to the west. As the structure burned, large chunks of daub, probably from the roof and walls, fell onto the floor leaving pock marks and depressions throughout.

By the Late Caddoan occupation, climatic conditions had almost certainly stabilized, resembling those of today. Jackfork Creek probably still occupied the meander scar southeast of the site. The subsistence focus of the Late Caddoan occupation appears to be similar to those of at least the preceding Caddoan occupations. Deer and turtle remains comprise over 96 percent of all bone identified in the fill of Structure 3, whereas bones of the same animals accounted for about 93 percent of the faunal collection from the fill of Structures 1 and 2. Late Caddoan residents appear to have concentrated somewhat more on deer than their predecessors. Large mammal bones account for 53 percent of the total from Structure 3, but only 44 percent from Structures 1 and 2. Small mammals, such as raccoon, squirrel, beaver and rabbit, as well as dogs and birds were also hunted, but in no case were more than 10 bones of each species or genus represented in the collection. Carbonized seeds and nut shell indicate a continued use of surrounding plant resources, especially goosefoot and hickory nut.

The Late Caddoan occupation appears to have been a seasonal hunting and collecting camp. No storage/trash pits or other features indicative of a more permanent settlement were found.

Historic Occupation

A scattering of historic material was recovered from the plowzone throughout the mound and Locality A. The remains date from the late nineteenth and early twentieth centuries. Vehik (1982a:195) suggests that the artifacts relate to an early Choctaw occupation. Cultural material collected during the 1981-82 field season and interviews with local residents corroborate this conclusion.

The nature of this occupation is unclear. No structural evidence was found and it is uncertain whether a historic structure was built on the site. Local informants claim that the site was occupied early in the twentieth century for a relatively short period of time. The resident (name unknown) then supposedly moved to an area just east of the present bridge embankment.

STABILITY AND CHANGE ALONG THE UPPER JACKFORK

The preceding discussion summarized perhaps 4000 years of occupation at Bug Hill. Throughout its history, the site lay witness to some of the most dramatic events to shape the Jackfork Valley: the introduction of domesticates, the first use of ceramics and the changing course of the river itself. But in the midst of flux, there were elements of continuity. Some of these elements characterized all the occupations and, to a certain extent, continue to characterize the area today.

Perhaps the most basic element of stability was the focus on deer hunting. From around 1600 B.C. onward, deer remained the cornerstone of prehistoric subsistence. At no time during the Early Caddoan Period did large mammal bone (most of which are deer) constitute less than 40 percent of the faunal collection. Even today, the Choctaw residents of the narrows in the Upper Jackfork Valley rely on deer for a significant portion of their diet, especially during the winter (Ruby Burns, personal communication).

Even beyond deer, many subsistence practices seem to have remained fairly stable. Riverine exploitation focused on turtle and shellfish with much less emphasis placed on fish and small aquatic mammals. Small mammals, dogs and turkeys were also pursued throughout the forests and prairies. In addition, seeds, fruits and nuts from a wide variety of wild trees and plants were collected.

The stability of the overall subsistence focus is perhaps best reflected in the remains of the residents of Bug Hill. Even though these remains cover approximately 3000 years of occupation (ca. 1600 B.C. to A.D. 1500), there are remarkable similarities not only in the physical and genetic make-ups, but also in the diseases and traumas which plagued them.

Bug Hill was never a place for children. The site's burial population exhibits the highest childhood probability of dying known for any midden mound in the Ouachitas. The high probability could be attributed to vagaries of sample size if it were not for other indications of tremendous childhood stress. The childhood infection rate at Bug Hill is 50 percent, whereas the combined rate for all midden mounds in the Ouachitas is only 1.9 percent (see Chapter Thirteen). Overall, the osteological evidence indicates that it is not the type or chronological patterns of childhood stress that make Bug Hill unique, but simply the intensity of the stress.

Besides childhood disease, the residents of Bug Hill were afflicted by two major pathologies: high dental attrition and *osteoarthritis*. Both pathologies probably relate to subsistence practices. High dental attrition is typical of most burial populations in the western Ouachitas and is indicative of the use of grinding implements in food preparation, the consumption of shellfish and nuts with hull fragments, and the ingestion of a moderate to high amount of plant fiber. Extreme osteoarthritis is also typical of Late Archaic and Woodland populations, a reflection perhaps of a physically strenuous lifestyle.

Stability in diet and disease contrast sharply with changes in other aspects of culture. From the impermanent camps of the Middle Archaic to the "Harlan" style houses of the Early Caddoan period, Bug Hill hosted a wide variety of architectural styles and differing patterns of spatial use. Remains of most Archaic occupations appear to be uniformly distributed over the area used. This pattern appears to change during the Woodland period, at which time grinding implements are found on the slopes of the mound while evidence of intense occupation is restricted to the summit. The trend toward spatial segregation reaches a peak during the succeeding Early Caddoan period. During this occupation, specialized activity areas are distributed not only throughout the site, but within individual houses as well.

Specialization in the use of space appears to be correlated with changes in technology and, perhaps, minor shifts in subsistence practices. The Woodland period distribution of grinding implements corresponds to an increase in the proportion of these tools and the introduction of ceramics. Though little paleobotanical or palynological data pertaining to this period were obtained, it is clear that at least gooseberry and wild beans were intensively collected. Whether this makes a dramatic shift in subsistence patterns is uncertain, but it seems quite plausible that these changes either indicate an increased use of vegetable resources and/or signal the introduction of domesticated plants. Data from the succeeding Early Caddoan suggest that by this time at least sunflower horticulture was being practiced with the intensive collection of "volunteer" plants also emphasized. It is important to remember that while these practices represent specific additions or shifts in emphasis, the overall subsistence focus does not appear to have changed.

Changes in the social order probably occurred along with the shifts in subsistence practices and architectural styles. What little evidence we have on this aspect of cultural life is derived from burials. In general, burial practices appear more varied and more elaborate during the Late Archaic than any succeeding period. Marine shell beads and pendants, bone tubes and large unused Dickson dart points represent a few of the grave goods found among Late Archaic burials. Grave goods were found with infants as well as adults; males as well as females.

Perhaps Late Archaic burials appear more elaborate because all members of the group seem to have been buried on the site. Adult males are conspicuously absent or extremely rare in the later occupations, especially the Early Caddo. It is possible that adult males from these periods were buried at special sites; a practice indicative of greater social complexity, not less. Our present confusion indicates how really little we know.

CHAPTER FIFTEEN

WIDER IMPLICATIONS

The occupational history of Bug Hill is rich and complex, providing evidence of continuity and change over 4000 years. Yet, Bug Hill was more than a location that was frequently occupied. To understand Bug Hill, we must be able to look beyond the site boundaries and examine its position in the different settlement systems that occupied the Jackfork Valley. The first part of this chapter is devoted to such a study.

The second part of this chapter returns to the issues outlined in the research design. Some of these issues were dealt with rather successfully; others, however, were not. In part both success and failure reflect on our orientation and approach. In this concluding section, we reflect on our shortcomings and contributions and offer suggestions for future research.

BUG HILL'S PLACE IN THE JACKFORK VALLEY

Widely disparate types of settlements and settlement patterns have characterized the Jackfork Valley for thousands of years. Delineating these patterns has been the subject of intense archaeological interest. Over the last decade, the Oklahoma Archeological Survey and the University of Oklahoma's Archaeological Research and Management Center (ARMC) have conducted a series of investigations to help unravel these patterns. From this work, we now have some idea of the overall pattern of site distribution and fairly in depth knowledge of 12 individual sites (Neal 1972; Bobalik 1977, 1978a; Vehik and Galm 1979; Vehik 1982a, 1982b).

These data, however, are not without their limitations. First, all archaeological work in the Jackfork Valley (including the present project) has been conducted in conjunction with the construction of Sardis Lake and has been strictly focused on areas within the proposed flood pool. Consequently, our knowledge of utilization of the surrounding areas, such as the upland forests, the mountains or the confluence of Jackfork Creek and the Kiamichi River is extremely limited. Second, even with the flood pool, our knowledge of site distribution is strictly judgemental and somewhat biased. The entire decade of work in the Jackfork Valley has been based on a one month survey by Larry Neal (1972; personal communication) and a one week follow up survey by Richard Drass (1977). While these surveys covered much of the valley, they were neither systematic nor complete. These surveys focussed on areas near the major streams and probably located many of the larger sites (although not one of the four midden mounds were found during these surveys). At the time these surveys were conducted the Jackfork Valley was covered by dense forest and surface visibility was far from ideal. Yet, these surveys did not include provisions for regular subsurface tests (e.g., shovel pits) at systematic intervals. The result is that while we may know the location of some of the larger residential sites in the valley, we do not know very much about the smaller specialized camps. The point is not that these surveys were conducted poorly. Indeed, given the constraint of time and money, Neal and Drass did superb work. However, without either 100 percent coverage or some type of probabilistic sampling approach combined with a subsurface testing program, we simply cannot predict with any confidence site density, site probability, the range of site types or attributes of site location.

What we can do with the available data, however, is look very closely at the relationship between the types of occupations represented at Bug Hill and those observed elsewhere in the valley. The following section is not a culture history of the Jackfork Valley. Vehik (1982a; Vehik and Galm 1979) and Bobalik (1977) have already presented such overviews. Instead in what follows, we have focused on three issues in the culture history of Jackfork Valley which specifically relate to the occupations at Bug Hill.

Initial Occupation of the Valley

The earliest evidence of occupation at Bug Hill dates to the Middle Archaic Period. At present, this represents the earliest occupation of the Jackfork Valley for which we have clear evidence from appropriate stratigraphic contexts. Bobalik (1977:560) found materials on the surface at eight sites suggestive of Paleo-Indian or Early Archaic occupations. But in no case were these corroborated with artifacts recovered during the testing phase of these sites. In fact, Lintz (1979d) conducted intensive excavations at one of these sites, the Jeff Brown #1 site (34Pu72) and still found no evidence of an Early Archaic occupation. He did find a number of large contracting stemmed points (Gary style) which he was tempted to assign to Middle Archaic occupation, but which could just as easily relate to any occupation between Middle Archaic and Caddoan times.

After nearly a decade of work, we still do not have any evidence beyond surface finds for occupation of the Jackfork Valley prior to the Middle Archaic period. Is it possible then that the valley was not occupied prior to this time? We doubt very strongly that this is the case. Many of the sites which have been intensively investigated have by-and-large been those least likely to contain evidence of early occupation. These sites, like Bug Hill, lie on recent Holocene flood terraces or in the present floodplain. Evidence of early occupations in these areas probably is buried under meters of recent deposits. At Bug Hill, for instance, materials from Middle Archaic occupations were found within the Jackfork Terrace, as much as 50 cm below the base of the midden. Evidence of earlier occupations may exist in the area, but there is no way to determine how much deeper they lie. Instead of guessing how deep we need to excavate to find Paleo-Indian, Early Archaic, or Middle Archaic occupation, our search for evidence of this period should concentrate on geomorphic surfaces of the appropriate age.

In the Jackfork Valley, Nials (1979:523-25) has tentatively identified three such surfaces which date to the Pleistocene or earlier. One of these surfaces is the 6-9 m terrace, one of the most consistently recognizable features in the valley. Near Bug Hill, this terrace is found bordering the south bank of Jackfork Creek from at least the bridge embankment in the east up into the narrows between Jackfork and the Middle Mountains (Don Johnson, personal communication; Chapter Three). Local collectors have found numerous lithic scatters on this surface, though none have been systematically investigated (Donna Addington, personal communication).

The Jackfork Valley would have been a prime locale for obtaining cherts of the Johns Valley shale formation. While there are other areas containing outcrops of the Johns Valley formation, there is no reason that the Jackfork Valley should have been overlooked. If early residents of this area were ranging into the Ouachitas to obtain knappable cherts, then we might expect to find a variety of special purpose camps dating to these periods. The exact nature of this exploitation and how it fits into a larger subsistence pattern remains for the future to be answered.

The Late Archaic/Woodland Period: Discerning Change in a Conservative Culture

One of the least understood periods in the prehistory of the Ouachitas and surrounding regions is the interval stretching from the Late Archaic to the rise of the Caddoan culture. Most investigators divide this interval into two periods: the Late Archaic and the Woodland. In the Jackfork Valley, Late Archaic occupations are affiliated with the Wister phase; a regional expression defined for the Wister Valley, but extending south at least as far as the Jackfork Mountains (Bell 1979; Galm 1978a, 1978b, 1981; Galm and Flynn 1978b; Vehik 1982a, 1982b). Similarly, Woodland occupations are associated with the Fourche Maline Phase. Combined, the two phases span roughly from 1600 B.C. to A.D. 700 - 800 in the Jackfork Valley (Vehik 1982a, 1982b).

What has been puzzling archaeologists working in the Ouachitas for the past 40 years is whether the differences between the Late Archaic and Woodland occupations actually denote cultural change or simply reflect arbitrary archaeological distinctions. Traditionally, this cultural distinction has turned on the absence of pottery in the Late Archaic and its presence, albeit in small numbers, in the Woodland. Beyond ceramics, however, components of the two periods are remarkably similar in terms of the range and diversity of artifact types and cultural features. Almost all dart point styles and other culture-historic artifacts fit into one period as easily as the other. What we need to resolve, then, is whether the addition of pottery was accompanied by other changes in cultural behavior and, if so, determine whether we can discern these changes archaeologically.

Viewing this problem from the Jackfork Valley provides some idea about why it is so difficult to resolve. Over the last decade, 23 Late Archaic and 19 Woodland components have been tentatively identified in the valley. Of the 19 sites reported to contain Woodland components, 18 of them also have been reported to contain components assigned to the Late Archaic (Bobalik 1977; Vehik 1982b). Indeed, for the most part, it is a misnomer to speak of separate components. Bobalik (1979:567-70), for instance, was unable to separate Woodland components at all, preferring to designate sites as either 'Late Archaic/Woodland' or 'problematic Woodland/Early Caddoan'.

In a concerted effort to unravel this problem, a major portion of ARMC's research in the valley was devoted to sites that were believed to date to the Woodland Period (Vehik 1982b:407). Of the 11 sites, besides Bug Hill, intensively excavated in the valley, nine were reported as containing Woodland components. Unfortunately, none of these were single component sites. Six of these sites also reportedly contained Late Archaic components while seven are reported as remnants of Early Caddoan occupations (Table 52).

Without clear stratigraphic breaks, it has been virtually impossible to determine in what ways Late Archaic assemblages differ from Woodland ones. Thus, in the Jackfork Valley, as elsewhere, isolating Late Archaic from Woodland components has really meant determining whether pottery is present or not.

In the face of continual confusion, archaeologists have doggedly kept to the notion of the Fourche Maline as an important and useful way to conceptualize Woodland Period occupations. In the past, some archaeologists used the introduction of ceramics as indirect evidence of the beginnings of domesticated plant use. To date, however, no evidence has been found in the western Ouachitas of horticulture during the Fourche Maline phase nor any evidence of major shifts in subsistence practices from the preceding Late Archaic.

TABLE 52. SITES OTHER THAN BUG HILL EXCAVATED IN THE JACKFORK VALLEY IN CONJUNCTION WITH THE CONSTRUCTION OF SARDIS LAKE.

Site Number	Site Name	Institution Responsible	Late Archaic	Woodland	Early Caddoan
34Pu71	Natural Lake Site	ARMC	X	X	X
34Pu72	Jeff Brown # 1	ARMC	X(?)	X(?)	
34Pu73	Vanderwagen	ARMC	X	X	X
34Pu74	Blessingame	ARMC	X		X
34Pu79	Jock Standefer	ARMC	X(?)	X(?)	
34Pu99	Sallee G	OAS	X	X	X
34Pu100	Turtleluck	ARMC		X	X
34Pu102	Wheeler Lee	ARMC	X	X	
34Pu105	Arrowhead Hill	ARMC		X	X
34Pu111	Buffalo Bend	ARMC		X	X

ARMC - Archaeological Research and Management Center, University of Oklahoma
OAS - Oklahoma Archeological Survey

The excavations at Bug Hill provided two lines of evidence which may shed light on the differences between Late Archaic and Woodland Period occupations. The first concerned differences in the proportion of various tool classes between Stratum III (Late Archaic) and Stratum II (Woodland). As noted in the previous chapter, the lithic assemblage of Stratum III was characterized by a wide variety of tool classes. Overall, the assemblage reflects a strong emphasis on working and processing faunal remains. Between Strata III and II, there is a marked change in emphasis of the collection, though the range of tools represented remains about the same. Stratum II is characterized by a much higher proportion of grinding implements and substantial reductions in the percentages of most of the antler/bone working tool classes.

Attempts to replicate the analysis with data from the other eleven excavated sites in the Jackfork Valley have been stymied. In part, this situation simply reflects the inability of some sites to separate components vertically. But a more fundamental reason concerns the differences between the lithic analysis conducted by ARMC and that conducted by NWR at Bug Hill.

Our analysis was directed at discerning horizontal and vertical patterns of presumed functional categories while ARMC was basically concerned with investigating site function and manufacturing processes through use of a general model of lithic reduction (see Bobalik 1977;

Vehik 1979c, 1982a, 1982b). Practically speaking, the major difference revolves around the classification of chipped stone tools other than points. Both analyses made fine distinctions between tool types based on morphological criteria. Our analysis emphasized the placement of attributes on finished pieces (such as side, backed and end scrapers), while ARMC emphasized the presence or absence of attributes on unfinished or refinished pieces (e.g., percent of cortex, presence or absence of a haft element or the size of flake scars). Thus, while both analyses contain similar general categories, such as scraper, burin or biface, it is not at all clear that comparable criteria were used in their definition.

We hasten to point out that one system is not inherently better than the other. Each was designed to address a different set of issues. The point being made, however, is that at Bug Hill, differences attributed to function were noted between the Late Archaic and the Woodland Periods assemblages. These differences were interpreted as being indicative of a shift in emphasis away from hunting and towards intensive collecting. On the basis of one site, we simply cannot determine whether this change reflects a shift in Bug Hill's position in an otherwise stable subsistence/settlement system or indicative of a fundamental shift in scheduling decisions which affected the overall cultural system in the Jackfork Valley.

The second dimension which differentiated Late Archaic and Woodland occupations at Bug Hill was burial practices. Powell and Rodgers (1980), among others, have quite correctly pointed out the pit falls of associating burials with the stratigraphic context in which they are found. At Bug Hill, we have tried to circumvent these problems through 1) absolute dating and 2) careful examination of the stratigraphic situation. Even so, some of the burials associated with the Late Archaic may date to the Woodland Period. The reverse, however, will almost assuredly not be true (that is, a burial which does not extend into Stratum III will not date to the Late Archaic).

Late Archaic burials at Bug Hill differ from those of the Woodland Period primarily in three areas. First, adult males were buried on the site during the Late Archaic and apparently not the succeeding period. Second, burial styles were more varied in the Late Archaic ranging from cremation to multiple internments, while Woodland burials were predominately flexed internments. Finally, grave goods of all types accompanied Late Archaic burials and were conspicuously absent from most dated to the Woodland Period.

Interpreting these patterns is complicated by several factors. Only a small proportion of the burials out of the total potential burial populations of Bug Hill were actually excavated. Moreover, extremely few burials have been reported from other sites in the Jackfork Valley. A multiple burial of three or four individuals was excavated at the Wheeler Lee site, 800 m east of Bug Hill (Lintz 1982a). These skeletons, associated with a Late Archaic component, were found in a burial pit which contained three projectile points, a grinding slab and a fragment of green paint or copper. Lintz (1982a) was unable to determine whether these artifacts represented intentional grave goods or incidental inclusions. While the multiple burial and possible grave goods at the Wheeler Lee site are consistent with the Late Archaic pattern at Bug Hill, it hardly represents conclusive corroborative evidence.

To determine whether the patterns at Bug Hill are representative of widespread change in burial mores studies of burial practices from the Wister Valley and surrounding areas to the north and the lower Kiamichi River Valley to the south were undertaken (Powell and Rodgers 1980; McWilliams 1970; Perino and Bennett 1978). In neither area were patterns found that were similar to those observed at Bug Hill. In part, this situation reflects an inability to associate burials with specific components. For instance, the McCutchan-McLauglin site (34Lt11) is a midden mound similar to Bug Hill which lies on Fourche Maline Creek 15 to 20 mi west of present Wister Lake. At this site, Powell and Rodgers (1980:5-9) carefully examined the stratigraphic context of each burial. In some cases, they were able to assign a burial to the lower (non-ceramic) or upper (ceramic) components. But for the most part, burials were not associated with a component and the entire burial sample was treated as a single population.

As a consequence, it is very difficult to tell whether the patterns observed at midden mounds in the Wister Valley and surrounding region bear any relation to those at Bug Hill. If we treat this area as a whole, we find a wide variety of burial customs (Galm 1978, 1981; Powell and Rodgers 1980; Wyckoff 1976; Wyckoff and Woody 1977). At the McCutchan-McLaughlin site, six multiple burials accounted for 45 percent of the total burial population. One of the burials (Burial 6) contained nine individuals and one dog, some of which suffered violent deaths. Other mass burials have been found in the midden mounds of Wister Valley and evidence of violent death has been noted at the Wann and Redwine sites (Sharrock 1960:22; Galm 1978:240).

Overall, however, of the 1185 burials representing 1405 individuals excavated at Wister Valley sites by the WPA and Bell during the 1950s (Bell 1953; Williams 1953), over 95 percent were single full-flexed burials (Galm 1978:235). About 39 percent contained 'probable' grave goods, which in most cases consisted of a few associated artifacts (mostly projectile points). In general, the evidence from the Wister Valley shows burial practices remaining fairly stable. Cases of possible violent death appear to exist but whether these represent valley-wide processes or merely reflect site-specific events is unknown.

To the south, along the lower Kiamichi River, Perino and Bennett (1978) recovered 47 Woodland Period burials at the Mahaffey site (34Ch1). Surprisingly, most of these were "old adults," over 35 years old (52.5 percent: this percentage is from a total of 59 burials, 12 of which are Caddoan in date). Moreover, of these skeletons which could be sexed, over 50 percent were males. Perhaps most surprising of all, only two burials contained grave goods.

Perino and Bennett (1978:28) argue that this situation indicates that some type or types of status requirements were mandatory for burial in this particular cemetery. Whether or not they are correct, the Mahaffey results point out differences in burial practices may have less to do with changes over time than with differences in function and/or status between sites of the same period. Burials placed at base camps may follow a very different pattern than those forced to take place at hunting camps or those "high status" burials reserved for valley-wide cemeteries. Combining these results with those from the Wister Valley strongly suggests that factors such as violent death and status differential may be responsible for variations in burial practices within, as well as between, cultural periods.

As far as Bug Hill is concerned, there are three plausible ways to account for differences in burial practices between Strata III and II. First, the observed differences could simply be an artifact of small sample size. Although possible, we feel this stance may be overly conservative. While only a small proportion of the site was excavated, all portions were tested and burials were found from all parts of the site.

A second explanation is that the differences in the burial practices are site-specific. That is, these changes reflect a shift in the place of the Bug Hill in the settlement system of the Jackfork Valley. Following this scenario, during the Late Archaic, Bug Hill served as a major settlement and, thereby, a major burial ground as well. In the following Woodland Period, the site no longer served as valley-wide base camp. One result might have been that the site now only served as a burial ground for women and children with men being buried elsewhere. The shift in burial practices, then, while providing insight on Bug Hill, sheds little information on the difference between Late Archaic and Woodland occupations of the valley.

A third alternative is that the shift in burial practices at Bug Hill actually reflects culture change experienced throughout the Jackfork Valley and, perhaps, beyond. At the moment, it is extremely difficult to evaluate these explanations. Basically, to distinguish between the second and third hypotheses, we need to determine whether the patterns noted in burial practices and cultural assemblage at Bug Hill hold beyond the site itself. If these patterns are found no where else in the Jackfork Valley, then it would appear that valley-wide, little change occurred between the Late Archaic and the Woodland periods. The changes noted at Bug Hill, then, would appear to be site-specific. Changes in the lithic assemblages from a relatively homogenous generalized assemblage during the Late Archaic Period to a more specialized one during the subsequent Woodland Period may suggest a shift from use as a highly intense base camp settlement to either a less intensely occupied base camp and/or a series of special purpose camps.

If, on the other hand, the patterns of change noted at Bug Hill are found endemic at all site types throughout the Jackfork Valley, a case could be made for slight, but significant, change between the Late Archaic and the Woodland periods. Overall, however, the trend remains one of cultural continuity. Bug Hill is, after all, an accretional midden mound, built up over generations of repetitive deposition of organic remains, most of which took place during these two periods.

Early Caddoan Occupation: Cultural Backwater or Intrusive Settlement

At most midden mounds, the archaeological problems described in the previous section plague our understanding of Early Caddoan occupations as well. That is, the fuzziness that surrounds the separation of Later Archaic from Woodland deposits also surrounds the distinction between Woodland and Early Caddo deposits.

This was not the case at Bug Hill. Here we found the homogenous accretional deposits that had characterized the mound for thousands of years replaced by sharp changes in depositional processes. The sharpness of the stratigraphic break was surprising in-and-of itself. But what was more surprising was the nature of the cultural features and assemblage.

Structures 1 and 2 at Bug Hill could have been found at Harlan or Spiro or any one of the major Caddoan centers along the Red River without any special notice being taken. Yet while the size and shape of these structures are typical of early Caddoan houses, the associated cultural assemblage is not. Taken together, the lithic and ceramic assemblages recovered from the houses are more typical of a Late Archaic or Woodland Period occupation than these are of a Caddoan one. Indeed, until over 10 radiocarbon samples returned with consistent dates between A.D. 900 and 1200, we strongly believed that the houses dated to the Woodland Period (Altschul 1982a, 1982b).

There appear to be two alternative scenarios which best account for this situation. First, the developments at Bug Hill could be viewed as simply reflecting a local population differentially acquiring cultural traits from the outside. In particular, two traits appear to be non-local developments of major consequence, house forms and the use of plant domesticates, particularly sunflower. An alternative view conceives of these changes as induced by outside groups either in the form of actual settlement or by persuading local groups to enter into a larger interaction network.

While these scenarios are not mutually exclusive, the greater importance given to one series of cultural processes has vast implications for interpreting the overall cultural development of the Jackfork Valley. For instance, if the first scenario is a more accurate representation than the second, then we can view the groups of the Jackfork Valley as primarily outside observers of events taking place at various times around them. These people borrowed a set of traits from their neighbors, but really exerted no influence on events occurring outside the valley. Archaeologically, we would expect little change in settlement or subsistence patterns.

The implications of the second scenario are quite different. In this case, groups from outside the valley actually came into the Jackfork. These groups either (1) moved into an unihabited valley, (2) supplanted the indigenous population, (3) co-existed with the indigenous population but as a separate system, or (4) merged with the indigenous population. In the first three instances we would expect to perceive a marked break in the archaeological record between the Woodland and Caddoan occupations both in the content of assemblages and settlement patterns. In the last case, we would expect some changes in the assemblage (especially in artifact styles) but not necessarily any shift in settlement or subsistence patterns (very similar to the first scenario).

As was the case before, to resolve these issues we need to look beyond Bug Hill. Bobalik (1977:574) tentatively identified 15 Early Caddoan components in the Jackfork Valley, nine of which were thought to be base camps. These base camps appeared to cluster in two areas; one along the middle reaches of Anderson Creek and a second near the confluence of Anderson, Buffalo and Jackfork Creeks. Because of the limited nature of the survey on which these clusters are based, they are perhaps better viewed as suggestive of potential early Caddoan site density rather than a true indication of actual settlement patterns.

During the subsequent mitigation programs (Vehik and Galm 1979; Vehik 1982b) Early Caddoan components were identified at eight sites (four of which were not identified among Bobalik's components, including Bug Hill). Two of these are of particular importance because they contained evidence of Early Caddoan houses. At the Blessingame site (34Pu74) Lintz (1982b) excavated two rather similar Early Caddoan houses. Both structures were subrectangular and oriented between 11° and 13° west of north, respectively. While interior features of Structure 2 were obscured by soil conditions, Structure 1 was supported by four central posts and had an extended entryway to the east. The outer walls of each structure were probably supported by earthen berms. Finally, hearths occupied a conspicuous space in the center of each structure.

The houses averaged slightly over 25 m^2 in area, just over half the size of Structure 2 at Bug Hill. Internally, the houses were divided along an east-west axis (unlike the north-south division at Bug Hill). Artifacts, including ceramics, groundstone implements, and a variety of chipped stone tools, were concentrated in the southeast and southwest quarters, suggesting areas of intense lithic and organic tool manufacturing, processing and storage. In the northeast quarter large dart points were associated with burned bones. Lintz (1982b) argued that this pattern was indicative of a processing and cooking activity area. Little material was found along the west wall and northwest quarter of either structure. This negative evidence was used to support the notion that these areas served as sleeping or storage quarters.

Seven radiocarbon dates were obtained from Structures 1 and 2 at the Blessingame site. After correcting the dates with MASCA procedures, Lintz (1982b) obtained an average of A.D. 1221 ± 34 for Structure 1 and A.D. 1166 ± 39 for Structure 2. Based on stratigraphic evidence, however, Lintz postulated that the structure had been sequentially occupied with Structure 1 having been occupied prior to Structure 2.

At the Arrowhead Hill site, a series of related features were found that are believed to relate to a single structure. Unfortunately, the only remnants of this structure are seven dispersed postmolds, two carbonized logs, a series of dispersed baked clay and a large amount of charcoal (Bobalik 1982). Based on the exposed postmolds, Bobalik estimated the north-south extent of the structure at 4.2 m. No entryway, living floor or internal features were noted. Bobalik did note, however, that most cultural remains were in the northeast or southwest portions of the "house" area. This distribution suggested that these areas hosted lithic manufacturing and maintenance activities. The northeast quarter was further distinguished by large amounts of ceramics and unburned bone. The Early Caddoan component at Arrowhead Hill is distinguished from both Bug Hill and Blessingame by higher numbers, although still a very low percentage of decorated ceramics. Three radiocarbon dates from Structure 1 at Arrowhead Hill place the Early Caddoan occupation somewhere between A.D. 1000 and 1200.

There are some obvious differences which distinguish the occupations of the Arrowhead Hill, Bug Hill, and Blessingame sites. But, while the differences are noteworthy, it is important not to lose sight of the underlying similarities characterizing all Early Caddoan occupations in the Jackfork Valley. Perhaps the most striking of these is the appearance of structures. While it is true that postmold patterns were recovered from Archaic/Woodland deposits at Bug Hill and the Buffalo Bend Site (34Pu111), no clear evidence of house-like structures has been found which date prior to the Early Caddoan Period (Vehik 1982b; Flynn, Earman and Vehik 1979). This situation is true not only for the Jackfork Valley but the Wister Valley as well (Galm 1978a).

Although the appearance of house-like structures in the archaeological record is interesting in-and-of itself, the basic importance of this fact is that the structural remains reflect a very different set of behaviors relating to the occupation of sites. Late Archaic and Woodland deposits are accretional in nature. Despite all possible changes that could have occurred during these periods, the behaviors responsible for building the middens throughout the valley remained relatively stable. This is simply not the case for the Early Caddoan Period. The basic question here is whether the Early Caddoan structures reflect a change in the type of intensity of occupation of the Jackfork Valley or signify a shift in cultural practices that resulted in different depositional processes.

All four Early Caddoan structures in the Jackfork Valley had been burned. As mentioned in the previous chapter, there is some evidence to suggest that Structure 2 at Bug Hill was purposely burned. If so, this event would not have been unique. Burned Early Caddoan structures have been found throughout the Arkansas and Red River drainages (Bell 1972; Rogers 1982; Brown 1966, 1973; Finkelstein 1940; Muto 1978; Newell and Kreiger 1949; Harrington 1920). At the major ceremonial centers, such as Harlan or Spiro, the burning of specialized structures has been associated with ceremonial or mortuary practices. However, this practice is not confined to centers, nor to specialized structures. As early as 1920 Harrington noted the proclivity of finding burned "earth lodges" (similar to Structures 1 and 2 at Bug Hill) in earthen mounds in the Little River drainage of southwest Arkansas. Harrington's (1920:258-259) comments on this situation are worth repeating.

> The fact that so many of the earth-lodges had been destroyed by fire, and so many fragments of burned waddle-and-daub walls of thatched houses were encountered, finds a possible explanation in Joustel's statement that, "When the [Caddo] remove their dwellings they generally burn the cottages they leave and build new on the ground they design to inhabit."

It is possible, then, that the appearance of houses in the Jackfork Valley during the Early Caddoan Period may have little to do with changes the intensity or type of settlement. Instead, they are probably better interpreted as a reflection of changing cultural practices (i.e. the purposeful burning of abandoned structures) which "accidentally" resulted in the greater visibility of certain cultural features in the archaeological record.

Other cultural practices were changing as well. Early Caddoan sites in the Jackfork Valley are marked by the very different way space was utilized by their inhabitants. Specialized activity areas appear within structures as well as in different parts of the site. Indeed, one of the more intriguing aspects of the Early Caddoan structures in the Jackfork Valley is the fact that structures at no two sites are alike. While the houses at Bug Hill may have fit in at Spiro or Harlan, those from Blessingame or Arrowhead Hill would have seemed peculiar (Bell 1972; Rogers 1982). Not only are the houses at Bug Hill nearly twice as large as any other Caddoan structure in the valley, but their internal organization in the form of features and artifactual distribution appears to be somewhat more complex as well.

As noted in the previous chapter, Structures 1 and 2 at Bug Hill were placed in a depression. The exact reasons for placing the houses 30 cm below the then existing ground surface are unknown; but the action was certainly not unprecedented for the Caddo region. Muto (1978) found a similar situation at Parris Mound in the Arkansas River drainage while Newell (Newell and Krieger 1949:29, Feature 9) encountered a structure "built in a shallow pit" at the George C. Davis site along the Neches River in east Texas. Both the Parris Mound structure and Feature 9 at the Davis site were interpreted as specialized structures, not domiciles. While Banks (Appendix IV) believes this may also be the case at Bug Hill (i.e., a "chief's house") we feel that at present evidence is less than convincing.

The differences in form and size of the Early Caddoan structures in the Jackfork Valley are mirrored in their cultural assemblages. At the Arrowhead Hill site, small arrow points constitute 41 percent of the points assigned to Component 2 (Early Caddoan -- see Bobalik 1982). This figure is similar to the 48 percent found in Structure 1 at the Blessingame site. In Structure 2 at the Blessingame site, however, less than 14 percent of the points were small arrow points, while at Bug Hill this figure drops to less than 8 percent points from the fill and features from Structures 1 and 2. In terms of ceramics the Caddoan assemblage at Arrowhead Hill was characterized by relatively large numbers of decorated (19 percent) and shell tempered (17 percent) pottery (Bobalik 1982). In contrast only three decorated sherds (out of 61) were found in either Structure 1 or 2 at the Blessingame site and no decorated sherds were found in the fill of Structures 1 and 2 at Bug Hill.

It is possible that these differences in cultural assemblages reflect differences in the time of occupation. Most of the radiocarbon dates from Structures 1 and 2 at Bug Hill cluster between A.D. 950 and 1025. The three dates from Arrowhead Hill range from between around A.D. 1000 to 1100 (Bobalik 1982). The radiocarbon dates from the Blessingame site range so widely that it is difficult to assign a precise date of occupation. It should be noted, however, that of the seven dates, five range between A.D. 970 and 1210 (Lintz 1982b).

In short, the absolute dates do not provide clear evidence of differences in the times of occupation. Instead, all three sites appear to have been occupied sometime between A.D. 900 and 1200. While they may not have been contemporaneous, the residents of the three sites certainly lived during the same culture period.

While differences exist between the assemblages, it is important that they not be overemphasized. For example, none of the ceramic collections in the Jackfork Valley display the quality in design or form that would indicate major influence from either centers of the Arkansas or Red River drainage. Most of the ceramics at Arrowhead Hill, Bug Hill and Blessingame appear to be variations of either Williams or Leflore Plain with decorative techniques primarily restricted to some form of incising or punctation. Although the proportion of arrow to dart points differs, the range of point types by-and-large does not. In fact, one of the more interesting aspects of the collections from the three sites is that the dart points appear to be more diagnostic of the Late Archaic or Woodland Periods with styles such as Gary, Marcos, Ellis and Marshall being the most popular.

While the proportions of arrow points to dart points may indicate slight temporal differences, overall the lithic orientation of the three sites is very similar. At each site a heavy investment was made in the procurement of lithic raw materials and the production of stone tools. Most archaeologists working in the area have argued that these raw materials were collected in the form of cobbles from nearby rivers and streams (see Vehik and Galm 1979; Vehik 1982a, 1982b). Banks, however, (Chapter Seven) has argued convincingly that this is not the case at Bug Hill. Little evidence of stream cobbles or water action was found in the collection. Instead, the weathering that appears on the artifacts almost assuredly occurred in the natural formation. Further, available stream cobbles are simply not sufficiently large to produce tools such as the Dickson bifaces found in the Northern Block or the large expanding stem points found in the fill of Structures 1 and 2. Finally, good, easily available chert outcrops of the Johns Valley Shale formation occur within four kilometers of the site.

Although he has not examined the collections from other sites in the Jackfork Basin, Banks (personal communication) is extremely skeptical that river cobbles were used to any extent in the valley. Simply put, river cobbles in the Jackfork drainage are too small to be of much use in manufacturing lithics and therefore it is hard to understand why people would have used them as a substitute when excellent quality cherts can be quarried easily nearby.

Understanding the Early Caddoan Period in the Jackfork Valley revolves around articulating three factors: the environment, external influence, and internal cultural processes. Of the three, we have the best control (which is not saying very much) over the environment. As noted in the previous chapter (see also Chapter Nine), the climate of the Jackfork Valley has been characterized by hot, dry summers since the Altithermal. The only exception to this pattern was a brief interval of cooler, moister conditions prevailing between ca. A.D. 900 to 1200. This interval was characterized by the farthest advance of the lowland forest (which provided most of the floral and faunal resources at Bug Hill). This is precisely the period of Early Caddoan occupation.

Explaining the expansion of Early Caddoan settlements into the western Ouachitas as a response to climatic amelioration has received support in recent years. Galm (1978b:74-76, 1981:143; Galm and Flynn 1978a) has suggested that there may have been a cultural hiatus or at least a reduction in the overall population between around A.D. 200 and 600 in the Wister Valley.

Vehik (1982b) combining radiocarbon dates from the Turtle Luck site (34Pu100), the Arrowhead Hill site (34Pu105), the Buffalo Bend site (34Pu111), and the Bug Hill site with stratigraphic and archaeological features from other sites, has convincingly argued against such a hiatus or reduction for the Jackfork Valley. In particular 11 radiocarbon dates from these four sites range from A.D. 243 ± 54 to A.D. 683 ± 65 (Vehik 1982b).

The Early Caddo of the Jackfork Valley, then, did not move into an unoccupied region. Indeed, there is no compelling reason to believe there was any substantial movement of people at all. Genetically, Caddoan skeletons could pass for those dated to the Late Archaic or Woodland periods. Similar disease and trauma appear to have been common throughout time. At Bug Hill, populations of all culture periods were characterized by infectious disease rates uncommonly high even for non-industrialized societies.

Yet the Early Caddo residents of the Jackfork Valley were different than their predecessors. Changes in diet (domesticated sunflower and volunteer plants) and custom (house building and burning) link the residents with events outside the Valley. Whether these changes really signal the participation of the Early Caddo residents in wider cultural events or are merely a cultural veneer placed over a conservative and semi-closed mountain valley cultural system is difficult to determine.

In the past archaeologists have tried to explain Early Caddoan occupation of the Jackfork Valley by associating it with major cultural spheres to the north and south. Comments like "the cultural assemblage [of the Jackfork Valley] is similar to the Late Hochatown and early Sanders Foci in the Red River Basin and to the Harlan and Spiro phases in the Arkansas River Valley (Vehik 1982b:411)" are rampant throughout the literature. One of the problems with trying to view the developments in the Jackfork from the outside is that one loses sight of internal cultural processes.

Three general observations can be made about Early Caddo settlement of the Jackfork Valley. First, no major shift in settlement pattern occurred between the Woodland and Early Caddoan periods. Base camps are still located in the floodplain with special purpose camps presumably located throughout the Valley (it must be remembered that most of these latter type of sites have not been located). Second, unlike the Wister Valley, there is no evidence in the Jackfork Valley of any type of hierarchial settlement system (see Galm 1981; Brown, Bell and Wyckoff 1978). Structures 1 and 2 at Bug Hill are certainly larger than any other structure in the Valley and are quite comparable to similar structures at the major centers of the Arkansas River drainage. Banks (Appendix IV) views the size and complexity of these structures as evidence of the occupants elevated status. However, using size and form alone, as indicative of elevated status, seems somewhat problematic.

The third and final point is that during the Early Caddoan Period the Jackfork Valley was initially influenced more by developments in the Arkansas River drainage than the Red River drainage. This is the conclusion reached by Vehik (1982b:416-417) on the basis of Phase I and Phase II work in the Valley and we strongly concur. This influence, however, does not appear to be either intensed or sustained. Ties to the groups in the Red River drainage became much more important slightly later in time. Banks (personal communication) believes the Gahagan bifaces in a shaft burial at the Bentsen-Clark site on the Red River and identified at the time as "Woodford chert" (Banks and Winters 1975) most likely derive from the Johns Valley formation. Similarly, the large biface recovered at the Sam Kaufman site was knapped out of a nodule of "nova-chert," probably originating somewhere in the John Valley shale (Banks, personal communication; Skinner et al. 1969).

With these considerations in mind, we have put together the following hypothetical development sequence to account for Early Caddoan occupation in the Jackfork Valley. No claims are made about the scenario's validity, only that it represents our best guess at this time.

Early Caddoan influence probably moved into the Jackfork Valley from the north. Evidence from the Wister Valley (Galm 1981) indicates that minor ceremonial centers may have been established as early as A.D. 800, though an integrated settlement pattern was probably not defined until around A.D. 1000. It is quite possible that the Wister area was being influenced by the centers of the Arkansas drainage. Following this view, it is not unreasonable to hypothesize that the same type of influence or settlement may have entered the Jackfork Basin about the same time.

No evidence exists in the Jackfork Valley of a hierarchial Caddoan settlement system. Instead, Early Caddoan expansion into the valley seems to have been largely one way; with influence in the form of trade, social customs and perhaps religious beliefs entering the valley and little leaving it. Thus, the occupants at Bug Hill appear to have adopted the Caddoan lifestyle without ever having been integrated into the sociopolitical systems to the north.

But while they may not have participated in the cultural systems to the north, they may have been extremely important to the incipient centers to the south. Along the lower Kiamichi River, in the vicinity of the Hugo Reservoir, a number of sites were excavated in conjunction with the construction of the Hugo Reservoir (Lawton 1960; Burton 1970; Rohrbaugh et al 1971; Rohrbaugh 1972; 1973; Perino and Bennett 1978) At the Mahaffey site (34Ch1) Perino and Bennett (1978) noted that most of the lithic tools were knapped out of cherts from outcrops located in the upper Kiamichi drainage. In particular, three of the identified cherts, Big Fork, Woodford, and Green are derived from the Johns Valley shale formation.

Perino and Bennett (1978), along with most archaeologists working in the area, claimed that the prehistoric occupants of the Hugo Lake area obtained their lithic raw materials from river gravels. For the most part, these investigators are probably correct. The bulk of "everyday" utilitarian lithic tools are knapped from river cobbles; but the five ceremonial items, such as the Gahagan bifaces and Caddoan knives, certainly were not. Although no systematic study has been conducted, at least some of these ceremonial items from Red River Caddoan sites consist of chert from the Johns Valley formation. These artifacts, then, may have originated in the Jackfork or Brushy Creek valleys.

If chert or nodules were being traded out of the Jackfork Valley what was being traded in? At present, we simply cannot answer this question. The archaeological record indicates that trade in finished artifacts was not occurring. It also appears that popular Caddoan styles of pottery designs and arrow points were either not being transferred or being ignored. At the moment, the only items that appear to have been transferred were certain rituals (house burning) and domesticates.

From these conclusions we can only speculate. Were the house burning rituals part of a larger belief system? Were the Early Caddo residents of the Jackfork Valley brought into this system? Did these people "trade" chert to the elite of the Red River Valley centers? If so, what were the mechanism and nature of the "trade?" Did the residents of the Jackfork Valley receive material or spiritual goods in return? What were the social effects of this trade? The list of questions could be extended indefinitely, but for now all must remain unanswered.

REFLECTIONS

The excavations at Bug Hill represent the final stage of archaeological research funded by the CE prior to the impoundment of Sardis Lake. Over the past ten years, the Oklahoma Archeological Survey, the University of Oklahoma's Archaeological Research and Management Center and New World Research have been involved in a concerted effort to learn as much as we could about the prehistory of the Jackfork Valley.

There is a tendency to believe that now that the fieldwork and laboratory analyses are over that research in the Jackfork Valley is complete. In truth, as with all major projects, we are only now beginning to understand the nature of occupation in the Jackfork Valley and to realize the complexities and idiosyncracies unique to the area. In the previous sections, we have outlined hypotheses on a select number of issues which we feel best account for the present data. Most of these can be tested by re-evaluating portions of collections already obtained from excavations and testing programs in the Valley. These hypotheses will not be repeated here. Instead in the following sections we will reflect on a number of broader issues concerning Bug Hill and the Jackfork Valley.

Bug Hill

The excavation of every midden mound in southeast Oklahoma has been plagued by the same basic problem, the inability to discern meaningful stratigraphic breaks. At Bug Hill we struggled with the same problem with similar results. In the field it was impossible to separate Late Archaic from Woodland deposits. Galm (1978a, 1978b; Galm and Flynn 1978a, 1978b) among others has suggested that this situation reflects an extremely stable and conservative way of life. To a certain extent, we agree. Faunal, malacological, osteological, and artifactual data are consistent with this interpretation. Yet upon closer examination patterns emerged in the data which suggested that a number of important changes took place during the cultural continuum represented by the accretional build-up.

Searching for patterns in the artifactual data recovered from midden mounds is not new (see Bell 1953; Procter 1957; Sharrock 1960). Usually, however, the exercise has been performed to separate components. Emphasis is placed more on the absence of certain traits than on changes in the proportion of certain functionally related parts of the assemblage (see Galm 1978b, 1981; Galm and Flynn 1978b; Vehik 1982a).

If the Fourche Maline phase relates to a significant cultural change, rather than simply denoting the time interval between the introduction of ceramics and the development of the Caddo, then we have to be able to document these changes in the material remains. At Bug Hill, there were indications of changes in functional orientation away from an extreme emphasis on faunal resources to a more even balance between floral and faunal ones. Determining whether these patterns relate to culture change or site specific shifts is really less important than the type of study that led to asking the question. If we are to dig in midden mounds we must develop the means to discern culture change and the rate of that change in the absence of clean stratigraphic breaks. The lesson of Bug Hill is that we still have far to go.

Jackfork Valley

Many archaeologists have considered the river valleys in the Ouachita Mountains to be little more than cultural cul-de-sacs. To the extent that the well-known and elaborate Caddoan centers are located in the floodplains of the major rivers to the north and south they are correct. However, the notion that the Jackfork Valley (and probably most of the mountain valleys) was of little importance to the crystallization of Fourche Maline phase societies or the development of the lower Kiamachi and Red River Caddoan centers is clearly overstated.

The archaeological research of the last decade in the Jackfork Valley has revealed a long and complex occupational sequence. Yet while the rudiments of the culture history have been outlined we still have little knowledge on some of the more basic issues. In particular, we have no way of estimating site diversity, site density or site probability. As such, we are in an extremely weak position to discuss settlement patterns, resource exploitation, or subsistence practices. We are even in a weak position to discuss the relationship between already excavated components in the valley.

Given the amount of work already completed we feel that a small amount of additional work would greatly enhance our knowledge of the area. In particular, three rather small scale projects are outlined below:

1. A probablistic stratified survey

The valley could be stratified along the vegetative zones established by Bobalik (1977) or by other factors, such as soil and drainage system (Anderson Creek, Buffalo Creek, etc.) and an appropriate number of quarter sections (or any other size unit) for each stratum selected through a simple random sampling technique. Because Sardis Lake is already in place, the area below the dam site and the confluence of Jackfork Creek and the Kiamachi River could be surveyed as a substitute for the floodplain. The basic goal of the survey would be to provide relatively unbiased estimates of site density and site diversity from all regions of the valley. Due to the dense ground cover in this area, we strongly recommend that any such survey include provisions for systematic subsurface tests and adequate means to screen the resulting soil.

2. Intensive survey of the Johns Valley shale formation.

Banks' (Chapter Seven, Appendix III) has pointed out the importance of this formation in the lithic assemblage at Bug Hill. We suspect the same is true at other sites. What we need to do is establish the exact location of all the outcrops, the types of activities that took place at them, the relation between specific outcrops and particular sites in the Jackfork Valley, the possible use of these cherts along the Lower Kiamichi, and the routes used to transport these cherts.

3. Re-analysis of lithic collections from sites reported to contain Late Archaic and/or Woodland components.

At Bug Hill, our lithic analysis indicated that deposits affiliated with Fourche Maline occupation could be distinguished from those containing Late Archaic occupations on the basis of changes in the preparation of certain tool categories. One expeditious way to determine whether these changes are site specific or indicative of a more general cultural shift would be to re-analyze some of the collections recovered by ARMC at other sites throughout the valley.

There are, of course, other studies that could be proposed. However we feel that these in particular are the most pressing at this point in time. Future researchers must build on the base we have already established. We have learned a tremendous amount about the Jackfork Valley in the last 10 years, but are now only realizing how much more there is to know.

APPENDIX I

SOIL DESCRIPTIONS

Eleven soil cores were taken and analyzed in an attempt to understand site formational processes. These eleven samples fell rather neatly into three soil populations. Rather than presenting the results for all eleven cores, we have chosen to present a representative core from each population. The complete results can be found in Johnson's (1981) original report.

Population:	A
Classification:	Cumulic (anthropic) Hapludoll
Identifier:	Bug Hill No. 2, 34Pu116
Location:	400 meters northeast of junction of Jackfork Creek and North Jackfork Creek, Pushmataha County, Oklahoma
Geographic Coordinates:	SE 1/4, SE 1/4, NW 1/4, SE 1/4, Sec. 7, T2N, R18E, Pushmataha County, Oklahoma
Geomorphic Surface:	Jackfork Terrace
Landform:	Near center of anthropic mound on river terrace
Parent Material:	Midden debris over alluvium
Slope:	0 - 2° (0 - 3%)
Elevation:	Approximately 586 ft (178 m)
Vegetation:	Deciduous oak/hickory/ash forest
Collected By:	D.L. Johnson and W.P. White, June 29, 1981
Described By:	D.L. Johnson and W.P. White, June 29, 1981
Exposure:	Hydraulic core, 2 1/4 in (5.7 cm) dia.

Horizon	Depth (cm)	Description
Ap	0 - 25	Black (10YR4/1m; 4/2d) silt loam; massive breaking to very weak medium crumb structure; friable; non-calcareous, pH 7.7; lithic flakes at 10 and 18 cm; few fine pores; few to common fine roots; clear smooth boundary.
A_{12}	25 - 85	Very dark brown (10YR2/2m; 4/2d) silt loam; massive breaking to weak medium subangular blocky structure; friable; strongly effervescent in 10% HCl, pH 8.35; oxidized granules at 35, 42, 50, 69 and 85 cm; charcoal at 68 cm; lithic flake at 77 cm; few to common fine pores; few to common fine roots; clear gradual boundary.
A_{13}	85 - 138	Very dark grayish brown (10YR3/2m; 5/2d) silt loam; massive, breaking to weak medium subangular blocky structure; friable; violently effervescent in 10% HCl, flecks of charcoal at 100 cm; pH 8.3; common fine pores; few to common fine roots; clear gradual boundary.
II-A_{1b}	138 - 165	Dark brown (10YR3/3m; 5/3d) silt loam; massive, breaking down to weak course subangular block structure; friable; violently effervescent in 10% HCl, pH 8.3; oxidized earth at 112, 122 and 130 cm; charcoal at 112 and 157 cm; common to many very fine pores; few very fine roots; clear gradual boundary.
IIB_{2tb}	165 - 230+	Dark yellowish brown (10YR4/4m; 5/4d) silt loam; very weak medium prismatic structure breaking to moderate strong subangular block structure; friable; violently effervescent in 10% HCl with filamentous carbonates filling pores beginning at 180 cm, pH 8.2; few to common very fine and fine pores; very few very fine roots.

Population:	B
Classification:	Mollicludalf
Identifier:	Bug Hill No. 10, 34Pu116
Location:	400 meters northeast of junction of Jackfork Creek and North Jackfork Creek, Pushmataha County, Oklahoma
Geographic Coordinates:	SE 1/4, Se 1/4, NW 1/4, SE 1/4, Sec. 7, T2N, R18E, Pushmataha County, Oklahoma
Geomorphic Surface:	Jackfork Terrace
Landform:	On side of anthropic mound on river terrace
Parent Material:	Midden debris over alluvium
Slope:	4 - 6° (7 - 10%)
Elevation:	Approximately 582 ft (177.5 m)
Vegetation:	Deciduous oak/hickory/ash forest
Collected By:	D.L. Johnson and W.P. White, June 31, 1981
Described By:	D.L. Johnson and W.P. White, June 31, 1981
Exposure:	Hydaulic core, 2 1/4 in (5.7 cm) dia.

Horizon	Depth (cm)	Description
Ap	0 - 20	Very dark brown (10YR2/2m; 4/2d) silt loam; massive, breaking to weak medium subangular block structure; friable; non-calcareous, pH 6.7; lithic flake at 18 cm; common very fine and fine pores, common fine roots; clear smooth boundary.
A_{12}	20 - 59	Very dark grayish brown (10YR3/2m; 5/2d) silt loam; massive breaking to moderate medium subangular blocky structure; friable; non-calcareous, pH 6.2; stone (artifact?) at 22 cm; fire oxidized sandstone at 45 cm; few silt coating (silans); many very fine and medium pores; few fine roots; clear smooth boundary.
II-A_{1b}	59 - 74	Dark grayish brown (10YR4/2m; 5/3d) silt loam; very weak course prismatic breaking to moderate medium subangular blocky structure; friable; non-calcareous, pH 6.1; common silt coatings (silans); few thin and moderately thick clay skins; common very fine and fine pores; few fine roots; clear, smooth boundary.

Horizon	Depth (cm)	Description
IIA_{2b}	74 - 90	Brown to dark brown (10YR4/3m; 5/3d) silt loam; very weak coarse prismatic breaking to moderate medium subangular blocky structure; friable; non-calcareous, pH 5.6; few thin clay skins; common fine and medium pores; few fine roots; clear smooth boundary.
IIB_{1b}	90 - 108	Brown to dark yellowish brown (10YR4/3.5m; 5/4d) silty clay loam; moderate medium prismatic structure; friable; non-calcareous, pH 5.5; few to common silt coatings (silans); many moderately thick clay skins; common fine and medium pores; few fine roots; abrupt smooth boundary.
IIB_{2tb}	108 - 160	Dark yellowish brown (10YR4/4m; 5/4d) silty clay loam; moderate to strong medium prismatic structure; friable; non-calcareous, pH 5.4; few silt coatings (silans); many moderately thick clay skins; many fine pores; few fine roots; gradual smooth boundary.
IIB_{3b}	160 - 210	Dark yellowish brown (10YR4/4m; 5/4d) fine sandy loam; weak coarse prismatic structure; friable; non-calcareous, pH 5.8; many thin clay skins (a few moderately thick ones); charcoal at 170 cm; many very fine and fine pores; few fine and medium roots; clear smooth boundary.
IIC_{1b}	210 - 238+	Yellowish brown (10YR5/4.5m; 5/4d) fine sandy loam; massive; very friable; non-calcareous, pH 6.0; many very fine and fine pores; few fine and medium roots.

Comment: The subsoil horizons in this pedon are very slightly gleyed.

Population:	C
Classification:	Aquic Hapludalf
Identifier:	Bug Hill No. 11, 34Pu116
Location:	400 meters northeast of junction of Jackfork Creek and North Jackfork Creek, Pushmataha County, Oklahoma
Geographic Coordinates:	SE 1/4, SE 1/4, NW 1/4, SE 1/4, Sec. 7, T2N, R18E, Pushmataha County, Oklahoma
Geomorphic Surface:	Jackfork Terrace
Landform:	River terrace adjacent to Bug Hill midden mound
Parent Material:	Alluvium
Slope:	0 - 2° (0 - 3%)
Elevation:	Approximately 581 ft (177.2 m)
Vegetation:	Deciduous oak/hickory/ash forest
Collected By:	D.L. Johnson and W.P. White, June 31, 1981
Described By:	D.L. Johnson and W.P. White, June 31, 1981
Exposure:	Hydraulic core, 2 1/4 inches (5.7 cm) dia.

Horizon	Depth (cm)	Description
A_1	0 - 14	Dark grayish brown (10YR4/2m; 5.5/2d) silt loam; massive to weak medium crumb structure; friable; non-calcareous, pH 5.3; common fecal pellets; common very fine pores; common fine and course roots; clear smooth boundary.
A_2	14 - 42	Yellowish brown (10YR5/4m; 5/6d) silt loam; weak fine to medium subangular blocky structure; friable; non-calcareous, pH 5.0; few to common fecal pellets; many fine and fine pores; few fine and medium roots; clear smooth boundary.
B_1	42 - 48	Yellowish brown (10YR5/4m; 6/3d) silt loam; moderate medium subangular block structure; friable; non-calcareous, pH 4.8; many silt coatings (silans); few thin clay skins; few fecal pellets; many fine pores; few fine roots; clear smooth boundary.

Horizon	Depth (cm)	Description
B_{2t}	48 - 170	Dark yellowish brown (10YR4/4m; 6/3d) silty clay loam; moderate medium subangular blocky structure; non-calcareous, pH 4.9; many moderately thick clay skins (some with 5YR4/3m colors); few to common silt coatings (silans); few fecal pellets; common mottles; matrix color is 7.5YR4.5/4m, slightly gleyed along root channelways; many fine and medium pores; few fine and medium roots; gradual smooth boundary.
B_3	170 - 180	Yellowish brown (10YR5/4m; 6/4d) silt loam; weak medium subangular blocky structure; friable; non-calcareous, pH 5.3; few very thin clay skins; root channelways gleyed and silty; few to common mottles; few fine and medium pores; few fine roots; diffuse clear boundary.
C_1	180 - 220	Yellowish brown (10YR5/4m; 6/4d) silt loam; massive to weak medium subangular blocky structure; friable; non-calcareous, pH 5.2; few very thin clay skins; common mottles; root channelways gleyed (silty); few to common fine and medium pores; few fine and medium roots; abrupt clear boundary.
C_2	220 - 230+	Light yellowish brown to brownish yellow (10YR6/4.5m; 7/4d) silt loam; massive to weak medium subangular blocky structure; friable; non-calcareous, pH 5.3; few very thin clay skins; common fine and medium pores; few fine roots.

Comment: This pedon is well off the anthropic mound and, except for the gleying, is close to being the 'normal' soil on this terrace.

APPENDIX II

MAJOR CHERT SOURCES IN THE JACKFORK AND BRUSHY CREEK BASINS

by

Larry D. Banks

The following appendix describes the chert sources available in the Jackfork and Brushy Creek basins. These descriptions are based on both a literature search and fieldwork conducted by the author. The location of each formation and each sampling station is presented in Figure 51 (Chapter Seven).

Jackfork and Stanley Groups

Although the Jackfork and Stanley groups comprise the largest total acreage of any geological units in the study area they and the Atoka Formation are not shown on the map of lithic resources (Figure 51) for three reasons. First, the exact location of chert stringers in the formations are not accurately mapped. Second, inclusion would tend to congest the map even more than it is, thereby detracting from the more important formations (that is, those more important in prehistoric utilization of the region). Third, because these three units essentially comprise the bedrock of all the remaining unmapped geography shown in the map of the area, they are as beneficially defined by narrative as by graphic representation.

The valley floor of the Jackfork Basin is underlain by the Stanley group and the southern flanks of the Winding Stair Range, the Jackfork, and the Flagpole Mountains are all composed primarily of the

Jackfork group. The Jackfork group is also interbedded with the southernmost outcrops of the Johns Valley Shale flanking the north side of the valley. From the eastward-trending zone of the Johns Valley outcrops northward, the Winding Stair Range consists primarily of the Atoka Formation.

The Atoka Formation, the Markham Hill and the Wesley Formations of the Jackfork group, and the Ten Mile Creek and Chickasaw Creek Formations of the Stanley group as noted in Table 16, all contain beds of siliceous (chert-like) shale. The cherts in these units all tend to be gray to black with blocky fracture patterns. In general, the siliceous shales are brittle and tend to weather more rapidly than most of the area cherts resulting in light gray or even dirty-white artifacts which would not ordinarily be identified as readily as would their original lithic material type.

The Stanley group consists of thick alternating beds of shale and quartzitic sandstone. Though the basic lithology is similar to the Stanley, the Jackfork group has a predominant ratio of quartzitic sandstone to shale in contrast to the units of the Stanley group. The siliceous shales in both the Stanley and Jackfork also produce gray, dark gray and black chert stringers or lenses. In general, these black cherts are difficult to distinguish from each other. The spicular cherts from the Wesley Formation of the Jackfork and from the Chickasaw Creek Formation of the Stanley are especially similar. Occasional beds of the black cherts exhibit a better than normal conchoidal fracture due to a higher silica content, but the cherts are all typically brittle. Artifacts of most of the black cherts often appear as light to medium gray cherts, but fresh flakes or recent breaks reveal the black colors of the original rock.

The most distinctive of the thin bedded black cherts, as mentioned previously, is the Battiest chert from a zone in the Ten Mile Creek Formation of the Middle Stanley. This particular chert was called the Smithville Lentil by Honess (1923:192) and the name Battiest was suggested by Shelburne (1960:18). In comparison to the other black cherts, the Battiest is distinctive because of its higher luster, better conchoidal fracture and by the hairline veins of white quartz which commonly occur throughout the chert. The Battiest chert seems to be slightly more resistant to effects of weathering than the others, although this is purely an educated guess and is unquantified. This seemingly unique chert in the Stanley group, however, has not been recorded as being present in the Jackfork Creek deposits. The cherts are most distinguishable by the white spicules which are most common to the Chickasaw Creek and by the waxy luster and hairline quartz veins in the Battiest chert. The Battiest chert is clearly the best quality and consequently most widely used chert from the Stanley groups. Also it does not weather as rapidly and result in a film-covered surface as frequently as the sicileous shales. The Battiest chert has a higher silica content in comparison to the cherty shales.

Seely (1955:67) used megascopic and petrographic examinations attempting to distinguish between the silicious shales of the Ten Mile

Creek and Moyers members of the Stanley group. He had some success over a short distance, but based solely on megascopic identification, distinction between the members could not positively be made. However, he does say that the Chickasaw Creek shale is distinctive from the others. It should be noted that although Seely was not specifically examining cherts in the units, it is quite likely that similar results for the chert beds will also occur.

The quartzites in both the Stanley and Jackfork groups vary widely in texture, color, and knappability. Iron staining frequently produces alterations along fractures and bedding planes in shades of brown and red colors. Weathering also may produce changes in color like that described for the cherts. The quantity of quartzite in the Ouachita Mountains is limitless as far as lithic resources for prehistoric exploitation were concerned.

Big Fork Chert

In the study area the Big Fork formation crops out only in the Potato Hills, but the outcrops to the west and southwest of the study area may be more relevant to this report than those in the Potato Hills. The Big Fork crops out in the extreme southwestern edge of the Ouachita Mountains (Black Knob Ridge) southeast of Atoka and from that point extends northward for the entire length of the Ridge. The Big Fork formation along with the Arkansas Novaculite extends for another 2.4 km (1.5 mi) northeast of Stringtown. It does not crop out again along the eastward trending Ouachita ridges for some 69 km (41 mi) to the vicinity of the Potato Hills. In Black Knob Ridge the Big Fork outcrop is about 15 km (9.3 mi) in length with a maximum width slightly in excess of 182 m (200 yd). The formation dips almost vertically (Figure II-1) and the strata are fractured and very brittle. In the Potato Hills the outcrops are more massively concentrated as the core of the geological fenster. Even in the Potato Hills, however, the dip is still steeply dipping and the rock is highly fractured and folded (see Miller 1955: Figure 19). The chert beds vary in thickness from a few to as much as 38 cm. In this lower portion of the formation the chert is dense and massive. Internal fracturing is relatively minimal. The chert as observed and collected at Black Knob Ridge east of Atoka includes two distinct varieties.

Type 1: This rock is massive and in hand specimens appears to be very competent, however, upon being struck with a hammerstone it is revealed to be brittle and the fractures tend to be uneven. The rock is opaque even on thin edges and is a medium gray (N5) color. It has a dull luster, and weathers to a light gray (N7), brownish gray (5YR4/1) and a moderate brown (5YR5/4).

Type 2: This type is also opaque, has poor conchoidal to uneven fracture. It is a medium gray (N6) to light gray (N7) with tiny (pinpoint size) dots of moderate red (5R4/4) sprinkled uniformly over the rock. This dotted surface gives the rock an illusion of being pinkish gray. It, too, has a dull luster.

FIGURE II-1. BIG FORK CHERT, BLACK KNOB RIDGE. Note: vertical dip.

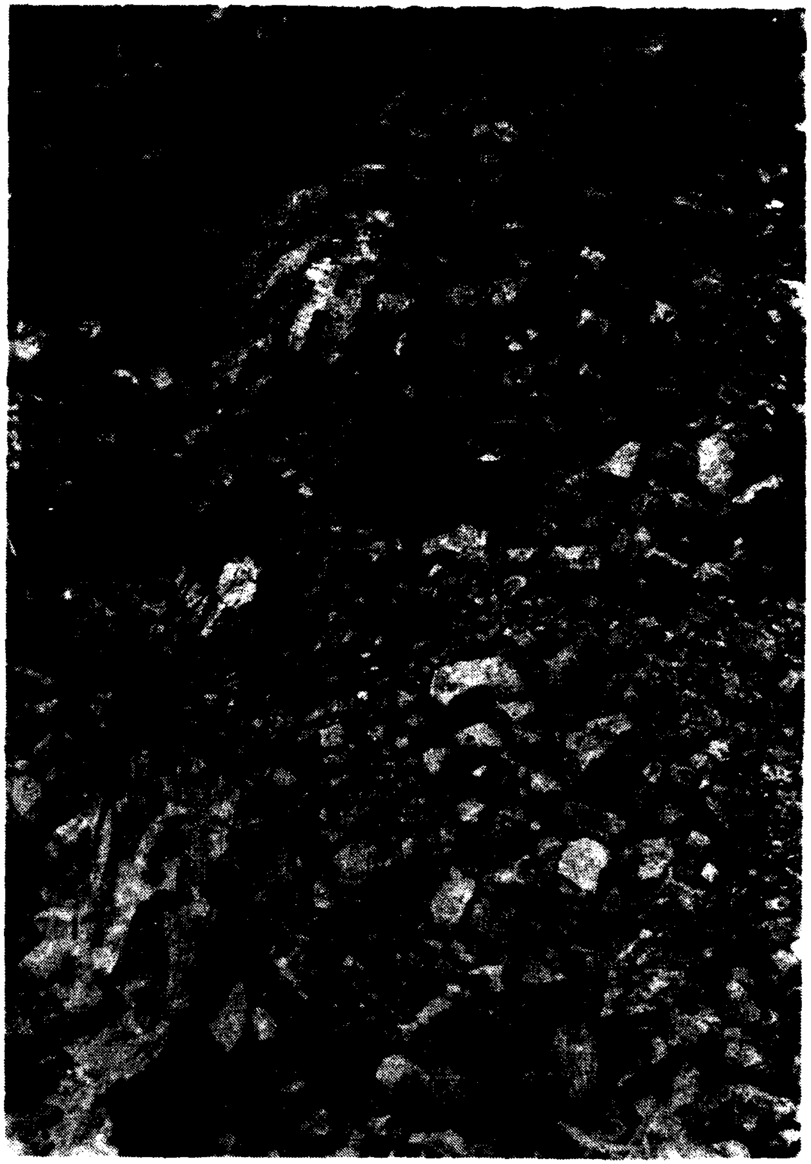


FIGURE II-2. PINETOP CHERT, PINETOP LOCALITY NO. 3. Note: chert inclusions (dark areas) in the limestone lense.

Northward from the Atoka locality, the Big Fork becomes more highly fractured and exhibits more pronounced laminae in thin bedding planes. At Stringtown the chert is brownish gray (5YR4/1) and grayish brown (5YR3/2) with thin (3-4 mm) laminae of a grayish red (5R4/2) color. This rock weathers to varying shades of light blue gray (5B7/1) to medium light gray (N6) and medium dark gray (N4). It gives an impression of being banded because of the laminated planes which stand out as a result of differential weathering. The weathered surface is slightly vitreous and often appears to be crazed. Some of the contacts between laminae weather to a very pale orange (10YR8/2).

Even though this chert is highly fractured, it appears infrequently as artifacts dating from late PaleoIndian to Caddoan cultures in southeastern Oklahoma, southwest Arkansas, and northeast Texas. The artifacts exhibit the typically fine fracture patterns as the bedded lenses. Obviously, some of the materials could be effectively utilized by prehistoric knappers in spite of the fracturing. Although the materials at the Atoka locality are not as highly fractured, the vertical dip of bedding here and even northward through Stringtown as exposed by modern alteration would have caused limited use of the beds for quarrying activities under natural and primitive conditions.

In the Potato Hills, Miller (1955) describes the Big Fork beds as

> "normally black on the fresh surface.....[and the chert] weathers light brown to buff and is white, light blue, or brown on a fresh surface."

He does not discuss fracture patterns but based on the photographs shown in his Figures 11 and 12 (Miller 1955: 30, 34, respectively) the beds are typically fractured in small rectangular blocks. He does comment that "....although good exposures are difficult to locate, some were observed where streams cut across beds with steep dips" (Miller 1955: 12). He also references and confirms Goldstein and Hendricks' (1933) statements that the Big Fork contains spicules, radiolaria, and the upper shales contain graptolites (Miller 1955: 14). In several localities (such as the Potato Hills) it is often difficult to define a distinct contact zone between the Big Fork and similar chert beds of the Arkansas Novaculite (Mark Sholes, personal communication).

Pinetop Chert

The study area includes a single outcrop of the Pinetop chert in the northern portions of Sections 3 and 4, T2N, R15E. Hendricks et al. (1947) describe this locality as "....40 ft of chert that is mostly white and light gray and contains some lenses of very fine grained, sparingly fossiliferous limestone. Much of the chert weathers brown and very porous."

Today this exposure parallels the gravel road west of the Pinetop Cemetery and extends westward across the Indian Nation Turnpike. On both sides of the road chert drift is common, and the hilltop in the north center of Section 4 has been altered by construction equipment apparently for use as road metal. The backslope of the west side of the turnpike provides a relatively good exposure of both the Pinetop and Woodford formations. The *in situ* materials of the Pinetop occur in: (1) jointed and fractured beds; (2) nodular lenses tightly embedded in limestone strata (Figure II-2); and (3) as indistinctly defined areas of silification in the limestone beds.

From this outcrop, four basic varieties were collected as described below:

Type 1: Large tabular pieces which are relatively free of fractures. The rock is opaque but tends to be more translucent in thin flakes. The color is basically a medium light gray (N6) to medium gray (N5), but mottling of both darker and lighter shades of gray are common. The rock has a dull to slightly vitreous luster and is aphanitic in texture. Fracture is conchoidal and smooth. This specimen could easily be confused with one or more varieties of Keokuk (Boone) chert and especially so if the artifacts were small. The gray chert grades imperceptibly into a pale yellowish brown opaque material.

Type 2: The original matrix of this rock is an excellent quality of chert. It is aphanitic in texture with a uniform grayish blue (5PB5/2) color. Well-healed hairline fractures transecting the rock exhibit thin (0.5 mm) moderate yellowish brown (10YR5/4) staining which gives the rock a goldish tint. The outer portion of the rock has weathered to a light yellowish brown (10YR6/6). A vitreous luster occurs on both the weathered and unweathered freshly flaked surfaces. The rock is opaque, and the unweathered portion, if found separately, would most likely be classified as jasper. According to Don Wyckoff (personal communication) the unweathered original rock type is identical to the chert type referenced to Zipper by Bobalik (1977:687-689), Lintz (1979a:28-37) and in a number of reports by other authors.

Type 3: This type is also aphanitic in texture. It is multicolored and mottled. The color ranges from very light gray (N8), moderate pink (5R7/4), moderate red (5R5/4), moderate reddish brown (10R4/6) to light red (5R6/6), dark yellowish orange (10YR6/6) and moderate yellowish brown (10YR5/4). The lighter shades of gray give the rock an illusion of chalcedonic translucency. However, it is all opaque. The variegated coloring possibly results from weathering because none of the *in situ* material was comparable. Some of the *in situ* chert of a highly fractured nature and generally of a whitish pink suggests color change of a more subtle extent. This rock is relatively small. It is unlike any other chert type normally associated with the Ouachita Mountain sources. In most archaeological contexts it would probably be classified as an exotic.

Type 4: This specimen exhibits excellent conchoidal fracture, is aphanitic in texture, and more uniform in color than other types. It is an opaque grayish brown (5YR3/2) to black (N1). It weathers to yellowish gray (5Y7/2), light olive gray (5Y6/1) to vivid moderate red (5R4/6). Thin flakes of this type would be easily confused with novaculite.

Even though the rocks are highly fractured at Pinetop, the overall quality of chert appears to be better than at most chert formations examined during this study. Also, a bifacially flaked preform of quartzite from the Stanley or Jackfork found on the Pinetop outcrop suggests use of this locality for chert exploitation to some unknown extent. The nearby terraces of the unnamed tributaries of Elm Creek to the northeast of the area could possible produce an associated workshop site. The 40 ft of "white or light gray chert" described by Hendricks et al. (1947) was not observed. Apparently, the lighter colors were simply lumped together as being white.

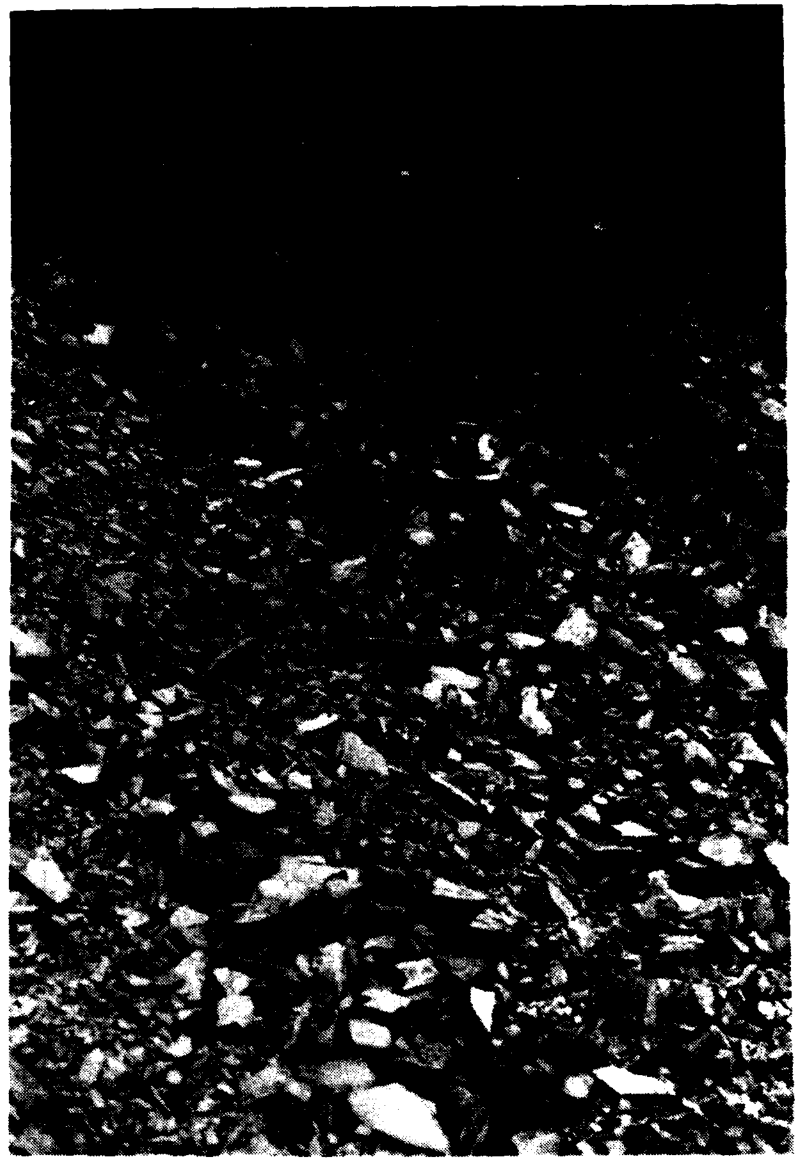
Arkansas Novaculite - Woodford Chert

The Arkansas Novaculite crops out in three distinct areas of the Ouachita Mountains. Although all three areas (central McCurtain County, Black Knob Ridge, and the Potato Hills) possess a potential relationship to the lithic industry as reflected in the archaeological sites of the Jackfork Basin, and to the Bug Hill site specifically, only two of the three, are discussed herein.

The Arkansas Novaculite at Black Knob Ridge (Figures II-3 to II-5) varies "from 234 to 340 ft thick" (Hendricks et al. 1947) and ranges in color from light gray to apple green and black. In many cases, a

FIGURE II-3. ARKANSAS NOVACULITE FORMATION, BLACK KNOB RIDGE.
Note: Rock hammer, left corner.

II-4. CLOSE UP OF ARKANSAS NOVACULITE.
Note: fractured beds.



II-5. ARKANSAS NOVACULITE, POTATO HILLS LOCALITY NO. 1.

single lense of some 10 cm thick exhibits all three colors. The material is highly fractured and brittle. The novaculite lenses are frequently interbedded with hard siliceous shales could be effectively utilized as ground stone celts or similar tools but none are specifically known to exist anywhere in the area. The green chert, which occurs in nodular form as well as the more typical lenticular lenses weathers to a light yellow brown to moderate brown color.

In the Potato Hills the westernmost exposures of the Arkansas Novaculite (Figure II-5) are identical in character and color to those at Black Knob Ridge. The colors range from gray, apple green, to black and even the brownish-gold staining from weathering is the same. The beds are also highly fractured like those at Black Knob Ridge. Miller (1955:18) states that:

> "....this formation consists of beds of chert that range in color from a brilliant white to black, and in thickness from less than an inch to as much as 18 inches. In the lower beds the lighter or pastel colors predominate with white, light green, blue, and tan appearing in abundance in the order stated."

In 1947, Hendricks et al. divided the Arkansas Novaculite into four lithologic units from the exposure in Black Knob Ridge and additionally mapped the Woodford chert along the eastern flank of the ridge. Later investigators such as Hart (1947) considered the Woodford of Hendricks et al. (1947) to be the upper novaculite. Sholes (1972:iv) divides the Arkansas Novaculite into five members on the basis of exposures near Hot Springs and Caddo Gap, Arkansas, and McCurtain County, the Potato Hills, and Black Knob Ridge in Oklahoma. He states:

> "The Arkansas novaculite is predominantly interbedded chert, shale, and novaculite, with minor chert-clast conglomerate and sandstone. It varies from 100 to 275 m thick, and over most of its outcrop area can be divided into five members which are, with maximum thicknesses, in ascending order: lower chert and shale, 20 m; lower novaculite, 135 m; middle chert and shale, 105 m; upper novaculite 55 m; and upper chert and shale, 30 m. Novaculite disappears toward the north and west by thinning and increase in shale content. Members are not differentiated where novaculite is absent. Conglomerate beds are locally present throughout the formation."

Shole's distinction between chert and novaculite is based on petrographic analyses, examination with a scanning electron microscope, and x-ray diffraction which indicates that:

"Novaculite is a siliceous rock composed of microquartz which contains almost no chalcedony and which can usually be distinguished from chert by its gritty rather than smooth fracture surface. Metamorphism of novaculite alters an original bimodal grain size distribution consisting of 0.01 to 0.1 micron clusters of grains less than 2 microns in size separated by grains 2 to 5 microns in size by increasing the size of all grains but retaining the bimodal texture and finally by eliminating the bimodal texture and yielding an extremely even-grained rock with polyhedral grains 5 to 20 microns in size. Spicules, probably from sponges, are the predominant fossil in novaculite

Chert [in the Novaculite Formation] consists of a heterogenous mixture of elongate to equant grains of microquartz up to 25 microns in size, and generally contains chalcedony. Radiolaria, palynomorphs, sparse condonts, and locally, sponge spicules are present in chert but rarely comprise as much as 20 percent of the rock."

In the study area, the Arkansas Novaculite crops out not only in Potato Hills area (see Figure 51), but it also occurs immediately to the southwest of the area as a relatively thin exposure along the east side of Black Knob Ridge, east of Atoka, Oklahoma (SE1/4 SE1/4 Sec 35, T2S, R11E and SW1/4 SW1/4 Sec 36, T2S, R11E). At the Black Knob Ridge the novaculite is from "234 to 340 ft thick" (Hendricks et al. 1947: Sheet 1) but it thins northward until it pinches out about 4 km (2.5 mi) northeast of Stringtown where the Big Fork chert also pinches out. Hendricks et al. (1947) refer to "slices" of the novaculite occurring along the Winding Stair fault, but it is likely that these are exposures indicated on their map and on the map for this report (refer to Figure 51) as the Woodford chert. Hendricks et al. (1947) describe the novaculite at Black Knob Ridge as follows:

"The lowest member constitutes about half of the formation; it is made up of thin-bedded, light-colored novaculite, much of which is apple-green in color, interbedded, with hard green shale. The second lithologic member constitutes about half of the upper part of the formation. It is made up of beds of novaculite of variable thickness that are light gray to almost black, and are separated by thin partings and beds of black and paper shales. The basal beds of this member are generally conglomeratic. The two uppermost members are about equal to thickness and together constitute about one-fourth of the formation. The lower of these two members consists of red and green, gritty, micaceous, and flaky shale that weathers to a soft clay; this shale contains some thin beds of novaculite, particularly in the lower part, and some local beds of blocky black shale. The upper member consists of green, brown, and gray novaculite in beds ranging from 1-inch to 1-foot thick."

Specimens collected from this same locality of the novaculite during the study can be described as four basic types.

Type 1: The color varies from light bluish-gray (5B7/1), greenish-gray (5G6/1), to dusky-blue (5PB3/2). The luster varies from dull to vitreous. It is opaque and has an uneven though conchoidal fracture.

Type 2: The color varies from a grayish-blue-green (5BG6/2) to light greenish-gray (5GY8/1).

Type 3: The color from *in situ* formations is light brownish-gray (5YR6/1) with tinging of pale red-purple (5RP6/2). It weathers to a light greenish-gray (5GY8/1).

Type 4: In color, the type varies from black (N1) to dusky-brown (5YR2/2). It is fine-grained to aphanitic in texture and opaque and generally dull in luster. This type is brittle but has relatively good conchoidal fracture in comparison to other types at this locality.

All four types described are in beds from a centimeter or so of thin plates to beds about 30 cm thick. All of the beds are brittle and highly fractured (see Figures II-3 to II-5). On the surface of Black Knob Ridge south of Highways 3 and 7, where the novaculite blocks have weathered out, the green-yellow-brown banded pieces appear to be more cohesive but even here they are still too brittle for effective conversion to tool types. This locality is not shown on Figure 51 because of its distance from the Jackfork Basin, but a geologic knowledge of Black Knob Ridge is critical in any discussion of chert resources in the western Ouachita Mountains.

In the western flanks of the Potato Hills (see Figure II-5) the description of the novaculite can essentially be duplicated from that described above. The beds do not appear to be as finely fractured as at Black Knob Ridge, but the beds are still brittle and highly fractured. The physical properties of the chert at Locality 11 are the same as those at Black Knob Ridge. However, in regard to other localities in the Potato Hills, Miller (1955:18) states:

> "This formation consists of beds of chert that range in color from a brilliant white to black and in thickness from less than an inch to as much as 18 inches. In the lower beds the lighter or pastel colors predominate with white, light green, blue, and tan appearing in abundance in the order stated.

Thin black shales and slates appear occasionally, separating beds of chert and becoming more noticeable in thickness and occurrence towards the top of the formation. The light colored chert beds change little with weathering; however, the black chert beds, which are numerous in the middle and upper parts of the formation, weather to a white or light gray. The shales in the transitional unit near the top of the formation become less fissile and the color changes to an olive drab from the black color of the lower shales."

The "brilliant white to black" variety described by Miller (1955) was not observed during this study. It is likely that the materials described by Miller were not of sufficient quality for tool production; relatively small quantities of the material have been recovered from archaeological sites in the Jackfork Basin as either finished tools or debitage. In all likelihood, the poor exposures and the fractured nature of the chert precluded extensive use of these in-place cherts by prehistoric knappers. The best exposures of the novaculite (such as those referenced herein) are only visible as a result of modern roadcuts. Good natural exposures in this area are rare.

Woodford Chert

At the Pinetop locality (Locality 3, Figure 51) the Woodford chert crops out along the southern margins and parallel to the Pinetop chert in the northern portions of sections 3 and 4, T2N, R15E. Like the Pinetop, the Woodford is poorly exposed under natural conditions and only slightly better in modern roadcuts. At this locality four different specimens were collected but very slight distinctions occur.

Specimen 1: This roughly rectangular block (13 cm x 17 cm x 8.5 cm) is a black (N1) to grayish black (N2) chert with a dull to earthy luster as seen on a fresh break. It has a gritty appearance identical to most of the black chert in the Arkansas Novaculite at Black Knob Ridge. It is totally opaque, and thinly laminated. Iron pyrite is observable in some of the laminae. The fracture tends to be more brittle than conchoidal.

The weathered surfaces of the thin laminae alternate between medium dark gray (N4) to medium gray (N5). The weathered surface exhibits a slight luster.

Specimen 2: This single specimen which was 8 cm x 10 cm x 5.3 cm before being flaked exhibits two different basic qualities. One portion is identical to the first specimen in texture, luster, and diaphaniety but is brownish black (5YR2/1) to olive black(5Y2/1). An embedded concretion-like nodule (2 cm x 3 cm) of brownish gray (5YR4/1) brittle chert is thinly encircled with yellowish-white iron pyrite. Laminae are not observable. The color of the nodule is the same as most of the Big Fork chert at Stringtown, Oklahoma.

The other half of the rock exhibits aphaniety with a vitreous luster and excellent conchoidal fracture. It too is totally opaque even on thin edges, and exhibits iron pyrite growth along healed fractures and some of the laminae. The weathered surface varies from dark gray (N3), dark greenish gray (5GY4/1) to a rusty reddish brown.

Specimen 3: This is a small 5 cm x 4 cm nodule of chert, the outermost edge of which would be best described as a very fine-grained medium gray quartzite. It has a dull luster. The unweathered rock however is a black (N1), aphanitic chert. It has excellent conchoidal fracture with a vitreous or waxy luster. A thin (3 mm) laminae of medium gray runs through the specimen. Except for the white crinoidal fragments in the Bayou Manard chert of northeast Oklahoma, small flakes of this rock could be easily mistaken for Bayou Manard.

Specimen 4: This is a tabular (11 cm x 10 cm x 4 cm) specimen of a uniformly colored medium light gray (N6) very fine grained and well indurated sandstone, or a highly siliceous shale. Laminae are faintly visible. The interesting feature of this rock is an embedded concretion of dark gray (N3) chert (1.2 cm x 2.3 cm) with concretionary bands of weathering surrounding the nodule. This rock is of more geologic than archaeologic interest because of its possible indications for a nodular origin for some of the Woodford cherts.

In 1972, some large chert boulders of unusually high-quality material types were found in a road cut of the newly constructed Indian Nation Turnpike south of Blanco. The boulders were sporadically embedded but roughly aligned with the bedding planes of a dark gray shale deposit. The boulders were attributed to having been derived primarily from the Woodford chert before redeposition in the shale because:

a) the only known description of the Pinetop chert at the time was that it was white. The boulders were primarily light to dark gray, dark brown, and medium blue-gray;

b) the Woodford-Pinetop formations were the only chert formations shown to be in the vicinity on the state Geologic Map of Oklahoma; and

c) the scale of the map was too small to provide more precise positioning.

This locality was referenced in the Bentsen-Clark site report (Banks and Winters 1975:28 and 32) and the large chert bifaces found in Feature 3 of the Bentsen-Clark site were attributed to the same type materials as those in the outcrop.

When this current study was begun, a re-examination of the Arkansas Novaculite exposure at Black Knob Ridge produced tantalizing but small and highly fractured chert types reminiscent of some of the previously found boulders. At that time, 20-21 May 1982, a definite connection between the novaculite and the blue-gray boulders was still not made. In September 1982, a copy of Sholes' 1978 dissertation was obtained and subsequent personal communications with Sholes revealed the relationship between some of the chert boulders and the Arkansas Novaculite. The updated geologic mapping (Hart 1974) of Black Knob Ridge confirmed that the easternmost edge of the Highway 3 and 7 exposure was the Arkansas Novaculite and not the Woodford chert.

The past confusion between the Novaculite and the Woodford chert is understandable because the two units are lateral equivalents and at some point northeast of Atoka the Woodford grades into the upper Novaculite. The black chert beds in the Arkansas Novaculite interbedded with thin shale lenses at Black Knob Ridge are comparable in appearance to the Woodford deposits exposed at the Pinetop locality, however. Also, some of the Woodford chert at the Pinetop locality exhibits better conchoidal fracture, is aphanitic in appearance rather than the more gritty texture common at Black Knob Ridge, and has a more vitreous luster. However, as Sholes pointed out, the chert in the Novaculite contains chalcedony. It is probably the chalcedony that gives the chert its vitreous luster.

The light gray, dark gray, and blue-gray materials found in the Johns Valley Shale outcrops which were previously reported (Banks and Winters 1975:37) as Caney Shale have not been observed even in small amounts in the Woodford deposits. Amsden and Fay (personal communication) also say that all the Woodford chert they have seen is dark gray to black, opaque, and with a generally dull luster. The chert boulders from the Johns Valley Shale on the Indian Nations Turnpike are discussed next.

<u>Johns Valley Shale</u>

The Johns Valley Shale overlies the Jackfork group and is considered equivalent to the Wapanucka Limestone by Hendricks et al. (1947:Sheet 1) as well as later investigators. The formation crops out in a southwest to northeastward trending series of disjointed and discontinuous sinuous exposures throughout the Winding Stair Range. At a distance of approximately 9.6 km (6 mi) south of the headwaters of the Jackfork Creek and across Flagpole Mountain, the most concentrated single exposure, about 23.2 sq km (9 sq mi), of the Johns Valley formation occurs. This type locality of the formation is centered between T1N and T1S in the center of R16E. Except for this particular area (which was not examined during this study) the other Johns Valley exposures range from about 70 m (200 ft) to as much as 304.8 m (1000 ft) in width or thickness. The dip of the formation into the subsurface probably averages about 50 degrees.

The formation occurs on and parallel to ridge tops in the Winding Stair Mountains as well as on the flanks of the ridges and in the valleys. Hendricks et al. (1947: Sheet 1) describe the lithology of the formation as:

"clay, shale and clay, thin beds of sandstone, a few lenses of limestone, abundant erratic boulders, and large erratic masses of different kinds of sedimentary rocks. Near the base the shale is generally dark gray, but throughout the remainder of the formation it is light gray to tan."

In the exposures examined during this study, the formation weathers to a tan-yellow clay, within which the erratic boulders occur with a great deal of consistency. In a couple of locations, pits excavated into the formation suggest that concentrated gravels and boulders occurred in enough quantity to be used for gravel road fill.

For purposes of this study, the chert materials from seven separate localities of the Johns Valley formation (numbered 4-10) spaced across the entire length of the study area are used as supporting documentation. The localities were selected on the basis of intervening distances and on proximity to the Jackfork Basin and to the Bug Hill site in particular. A major objective of the examination was to determine whether chert cobbles and boulders were present in all localities and whether there were distinctions between the chert type present. All of the localities except No. 9 are accessible by vehicle.

Locality No. 4

This outcrop is in the center of a ridge crest located in the middle of Section [Sec] 9 Township [T] 2N Range [R] 15E. The outcrop is cut by the Indian Nation Turnpike. This is the same locality mentioned previously in describing what was once thought of as a Woodford chert or Caney shale exposure in the Bentsen-Clark site report (Banks and Winters 1975). Under natural conditions this exposure would not have been amenable to chert extraction. The chert boulders, up to maximum size of nearly a meter in length, did not occur in the upper elevations of the almost vertically dipping dark gray shale. On top of the ridge there was no evidence of lithic debitage. However, the ridge top was not examined beyond the edges of the backslopes. About midway up the steep backslope a lenticular mass of chert breccia a couple of meters in length and 7 cm by 12 cm in cross section occurs. This silica cemented breccia is composed of fine angular chert fragments of white, black, gray, and olive colors up to a maximum of 3 mm in length. The weathered surface is a matrix of medium light gray N6, with bluish-white 5B9/1 brecciated fragments. The rock is opaque, has an uneven conchoidal fracture, and is very dense. It has the general appearance of a diorite because of the elongate chert fragments.

At this locality, the chert types are as follows:

Type 1: Six centimeters thick, 17 cm long, 16 cm width outermost cortex. It is light gray (N7) to light olive gray (5Y6/1) to medium dark gray (N4) and contains light brown (5YR5/6) iron staining. Staining on edge is dark greenish-gray (5GY4/1). The cortex gives the appearance of the rock being a claystone. The surface is striated. A broken corner of the cobble shows the rock is an aphanic chert with multi-colored banding differentiated by laminated (bedding?) planes. The coloration ranges from light gray (N7), light olive gray (5GY6/1) to brownish-gray (5GY4/1) and moderate yellowish-brown (10YR5/4). The moderate yellowish-brown gives the overall rock an appearance of being goldish-brown. A fresh break transverse to the bedding indicates that the parent rock is quite different from the weathered break and from the cortex. The rock is best described as an aphanic and opaque flint with an excellent conchoidal fracture. The banding varies in color from grayish-black (N2), to brownish-gray (5YR4/1) and a medium light gray (N6). The luster is slightly vitreous. It is most likely derived from the chert in the Arkansas Novaculite.

Type 2: This specimen is similar to Type 1 except the hues are more bluish ranging from a medium dark gray (N4) to medium bluish-gray (5B5/1) and light bluish-gray (5B7/1). Thin flakes of this material are bluish-white (5B9/1) and contain small splotches of light gray. This rock is identical to one found as road gravel on the Sardis Road west of Yanush. It is also similar to some of the bluish-gray minor types located in the Arkansas Novaculite at Black Knob Ridge of the same color or colors. Tiny pinpoint vugs stained with moderate yellowish-brown (10YR5/4) give an overall impression of the rock being a high quality bluish-gray flint flecked with gold. Cortex is unlike Type 1 but is probably novaculite with a medium dark gray (N4) and rough grainy sandstone appearance.

Type 3: This is a large spall of a boulder. The cortex is like Type 1. The dimensions of this specimen are 12 cm by 16 cm by 3 cm. The fractured plane is an aphanic, opaque chert with large patterned splotches ranging from pale yellowish-brown (10YR6/2), grayish-orange pink (5YR7/2) to medium dark gray (N4). This rock has a dull luster. The original source of origin is suggested as the Pinetop Formation.

Type 4: This specimen has a chalky, dull, dirty gray (N7) to a very light gray (N8) cortex. Bedding planes or laminae are evident even in the cortex. In a fresh break the rock is evenly textured, is aphanic and dusky brown (5YR2/2) in color. Iron pyrite filling occurs in the bands of concentric weathering. The presence of iron pyrite may be a diagnostic distinction of the Woodford in comparison to the brown cherts of the Big Fork formation. However, similar types of iron pyrite have not been observed in the Big Fork deposits. Whether or not the iron pyrite results from weathering in the Johns Valley shale in both types is undetermined. Thin flakes of this material appear as grayish brown (5YR3/2). This "chocolate" colored chert is more typical of the Woodford but because of its coloration is possibly from the Big Fork.

Type 5: This piece is identical to Type 4 in texture, luster and observable bedding planes. However, this specimen is olive black (5Y2/1) and is probably from the Woodford Formation.

Type 6: Similar to Types 1 and 2 but the banding on this specimen is more prominent and some of the intervening bands are fine to medium grained rather than being aphanitic. These grainy bands are more of a pale brown (5YR5/2) rather than the more vivid lighter browns on the other specimens. This rock is identical to one collected from the Woodford outcrop at the Pinetop locality.

Type 7: A dense opaque white (bluish-white 5B9/1) chert which can best be described as a novaculite. It has a porcelain-like texture and appearance with very slight mottling of very light gray. It is highly fractured and probably derived from the Pinetop. It would easily be confused with the Tahlequah or "Peoria" chert.

Type 8: This piece is a well-healed and cemented boulder (30 cm by 28 cm by 17 cm) of chert breccia. Colors range from white (N9) to light gray (N3). The grain varies from aphanitic in the dark gray to a fine grained quartzite-like in the light gray area. Mottling and veining in the basic colors are common. The cortex on one side is a mottled yellowish-gray (5Y7/2) in addition to the dark grays and whites.

Type 9: Identical to Type 5 except this specimen is a much larger piece and the banding is more noticeable. The weathering on this rock is interesting; it follows the banding as well as well-healed fractures producing geometric mottling. The weathered surface is generally a light yellowish-gray (5Y7/2; lighter than the color chart) with some iron oxide staining. The base color varies from an olive gray (5Y4/1) to olive black (5Y2/1) and brownish-black (5YR2/1), but slight splotching on the weathering surface is a brownish-gray (5YR4/1). The greater percentage of weathering on this rock is identical to the largest biface at the Bentson-Clark site (Banks and Winters 1975). A boulder with the dimensions of 43 cm by 43 cm by 17 cm of this material was found in an adjacent exposure of the Johns Valley Shale. The boulder is very dense and unfractured. Bedding laminae from 2 mm to 1 cm thick are observable but the laminae are so tightly cemented that the rock can be flaked by percussion without splitting along the laminae. The boulder is slickensided and weathered to a sandstone-like surface. This is the best quality of the Woodford chert. The weathered surface is multi-colored in very pale orange (10YR8/2), pale yellowish-orange (10YR8/6), grayish-orange (10YR7/4), pale yellowish-brown (10YR6/2) to light (5YR5/6) and moderate brown (5YR4/4). The boulder is interesting geologically because the observable bedding planes are aligned with the narrow axis of the boulder rather than the length or width as would be expected. The original boulder obviously resulted from a vertical fracture at right angles to the bedding.

Locality No. 5

[Legal Description: NE 1/4 of the SW 1/4 of the NW 1/4 of Sec 26 T3N R16E].

This exposure is slightly south (1.5 km [.93 mi]) of the crest of the divide (1060 ft elevation above MSL) between the headwaters of the unnamed but northwest fork of the Cedar Creek tributary of the Jackfork Basin and the South Fork of the Elm Creek tributary of the Brushy Creek Basin. Brushy Creek is a South Canadian tributary. This locality is 6.4 km (4 mi) west of Ti and is crossed from north to south by the road between Sardis and Haileyville. The outcrop has an exposed width of less than 200 m (656.2 ft) and a length of about 6 km (3.75 mi).

On the west side of the road the area had recently been burned over. Also, what appears to be a clearing for a new road more or less paralleling the Haileyville-Sardis Road but a couple of hundred meters to the west, cuts across the outcrop from north to south. Lithic debris resulting from primary reduction, as well as chert cobbles and boulders, occur throughout the burned and cleared areas.

In the dry arroyo, which is the extreme upper drainage of the Cedar Creek tributary, the banks appear to have been modified by excavation. Lithic debris consisting of everything from pressure flakes to "tested" boulders and cobbles still exist in the "excavated(?)" area. The physical evidence does suggest that the creek bank was widened as a result of digging chert cobbles and boulders out of the yellowish-tan clay. On the east side of the road where the native vegetation has not been removed it would be almost impossible to determine that raw chert materials were present; upon close examination, "tested" cobbles and lithic debris can be found by removal of the humus.

Twenty-one individual specimens were collected from this locality on the basis of distinctiveness as observed in the field. When the hand specimens were later being described it was discovered that most of the specimens were identical in type to the chert specimens collected from Locality 4. To avoid repetition, only those specimens which are atypical in whole or in part of those from Locality 4, are described.

Type 1: This type is nearly identical to Type 1, Locality No. 4, is more highly fractured and does not exhibit a cortex. This specimen has sharp angular edges in contrast to the rounded cobble form of the type from Locality No. 4.

Type 2: Fractured boulder. Similar to Type 8, Locality No. 4, but this specimen has no dark gray matrix. The fresh rock exhibits a yellowish tinge which was not observed in Type 8, Locality No. 4. It also exhibits megaquartz cavity filling.

Type 3: Breccia. Chert breccia occurs in two distinctly different types. The first basic type is represented by two specimens, both of which have a pale greenish-gray cast. The two specimens are made up of high quality novaculite and Woodford materials but are so uniformly cemented that conchoidal fracture is not drastically impeded. One specimen contains angular fragments that vary from dusky yellowish-brown (10YR2/2) to a lighter golden brown (moderate yellowish-brown 10YR5/4) in a matrix of yellowish-gray (5Y8/1). Small 5 mm or less) rounded particles of grayish-orange (10YR7/4) and pale olive (10Y6/2) are interspersed in the otherwise angular matrices. The second specimen of this same basic type is composed of long narrow rectangular fragments of moderate brown (5YR4/4), light greenish-gray (5GY8/1) and dark gray (N3). Small areas of a purplish tinge (light brownish-gray 5YR6/1) also occur. The specimen is opaque and is aphanic in texture. It has good conchoidal fracture.

The third breccia is medium light gray matrix with angular and subrounded fragments of a very light gray (N8). The fracture is conchoidal but has a tendency to be uneven. This rock is also opaque but it has an earthy or dull luster. The reverse side of the rock does not exhibit the brecciated character because of weathering. The breccia features are more pronounced on the old surface.

Type 4: This specimen is a dark yellowish-brown (10YR4/2) with medium dark gray (N4) splotches sprinkled throughout. The rock is aphanic, opaque and has a dull luster.

Type 5: This specimen is novaculite. It is light gray (N6) to grayish-blue (5PB5/2) with some elongated splotches 1 mm thick up to 1 cm in length. It weathers along the edges to moderate yellowish-brown and semi-translucent. Some white crenulated streaks are interspersed throughout this rock. It is opaque even on thin edges.

Type 6: The exterior of this piece is bluish-white (5B9/1) to very light gray (N8) and white (N9). It is porcelain-like with slight luster and has a 1-2 mm thick cortex. Beneath the white exterior the rock is pale yellowish-brown (10YR6/2) to pale brown (10YR2/2). A reshaped dart point from Bug Hill is an exact match for this rock. The interior has a vitreous luster and is opaque. The interior has a bluish-black cast but matches the rock color chart as dusky yellow brown. This specimen was examined by Don Wyckoff (personal communication) who stated that this was a classic variety of what others had been calling Zipper chert, derived from the Pinetop Formation.

A second, large piece is the same as the above with pale yellowish brown to pale brown weathering. Its exterior, however, is grayish-orange pink (5YR7/2). A fresh flake produced a moderate yellowish-brown (10YR5/4) scar. Pale blue gray streaking was noted across the surface of grayish-orange and pink background. Weathering along one edge is grayish red (5R4/2) and light brown (5YR5/6). Outermost weathering of original cortex is very pale orange (10YR8/2) to pale yellowish orange (10YR8/6) - chalky.

Locality No. 6

[Legal Description: NE 1/4 Sec 4 T2N R17E].

This locality is parallel to the Sardis-Counts Road and is still covered in native vegetation (oak-hickory-pine forest). Flaked debris and chert cobbles can be found in the humus but no collection of type materials was attempted. Without question, however, the outcrop had been subjected to some degree of chert extraction in the past as evidenced by the lithic debris present.

Locality No. 7

[Legal Description: SE 1/4 Sec 34 and the SW 1/4 of Sec 35 T3N R17E (about 1.6 km (.99 mi) east-northeast of Locality No. 6)].

Like Locality No. 6, this exposure occurs along the lower flanks of the ridge lying to the north of North Jackfork Creek. The southern edge of the outcrop is exposed along the recently cut backslope of the road between Sardis and Counts. Unaltered cobbles and boulders of high quality quartzite and chert are common throughout the subsurface of the exposure. In the uppermost edges of the backslope, flaked debris is present. In the wooded area north of the road cut, lithic debris can be located with a little difficulty like the exposures mentioned previously. At this locality the quartzites seemed to be more common and generally of a better quality than quartzites in other exposures. Of course, in all cases only miniscule examination has been made in comparison to the total extent of all the Johns Valley outcrops.

The cherts are identical to those at Locality No. 5. However, the quartzites either appeared to be different here in number and quality or they were simply not observed at Locality No. 5. Without question, chert and quartzite types should occur in the Johns Valley deposits which were not necessarily observed or collected. Regardless of comparison between the two localities, the quartzites at Locality No. 7 warrant special recognition. One boulder appeared to be a very pale yellowish-white fine-grained and well-indurated siltstone. It is totally opaque, has an earthy luster and yet exhibit a conchoidal fracture. When broken, however, the interior stone is a very fine to ultra fine medium dark gray N4 quartzite. Between the interior unaltered rock and the cortex a thin (2 mm) concretion-like crust of grayish-brown (5YR3/2) to moderate brown (5YR3/4) fine grained quartzite occurs. The very pale orange (10YR8/2) outermost patina which looks like a yellowish-white siltstone is approximately 0.5 mm thick. The stone has excellent conchoidal fracture. Another quartzite which also exhibits concretion-like banding as a result of weathering exhibits a moderate brown (5YR3/4) exterior and dusky brown (5YR2/2) unaltered interior. It too has excellent conchoidal fracture.

Locality No. 8

[Legal Description: western center of Sec 36 T3N R17E].

This outcrop is simply an eastern extension of those mentioned as Localities 5 and 6. These three (Localities 5, 6, and 8) are individually off-set by lateral displacement along fault lines. Locality 8 also occurs along the lower southern flanks of the ridge north of North Jackfork Creek. Although a major portion of this exposure has been cleared, it was not examined because permission from an absent homeowner could not be obtained. However, flake debris and chert cobbles are observable in the private drive up to the house.

The outcrop is 1.6 km (.99 mi) northwest of the "Narrows" (Figure 51 in Chapter Seven) on North Jackfork Creek and only 4 km (2.5 mi) from the Bug Hill site. The outcrop expands in width to the northwest for a distance of about three kilometers before pinching out near the West Fork of Anderson Creek. This is the closest, most easily accessible, and most extensive outcrop of the Johns Valley Shale in the area of the Bug Hill site. According to Cheryl Smith (personal communication, September 1982) the landowner at this locality has observed lithic debris all along the ridge extending to the northeast.

Locality No. 9

[Legal Description: NE 1/4 NW 1/4 SW 1/4 and NW 1/4 NE 1/4 SW 1/4, Sec 9 T3N R18E].

This is the area which was visited on April 19, 1975, as discussed in the introduction of Chapter Seven. At that time the locality was considered a workshop but could not be related to any particular chert resource. During preparation of this study it became apparent that the locality was a workshop site, on a terrace and near a clear flowing spring, located a short distance to the north of an outcrop of the Johns Valley Shale. The materials observed at the site are the same typical types as those described for other Johns Valley outcrops but collections from this area have not been made. There did seem to be an unquantified predominance of blue-gray and brown cherts and fine-grained gray quartzitic sandstone debitage.

For purposes of this report the location of the workshop in the mountains is of greater significance than is a physical description of chert types present. Because of the limitations imposed by project boundaries none of the previous investigators looked for sites so far outside the project area, but the site fits well into the special activity type site proposed in the model by Sheila Bobalik and supported by others. The distance of this site from the valley floor of the Jackfork Basin is not great. Even though the outcrop could be considered local to a base camp in the lower valley, it would seem more logical that a few days would be spent at the "mountain" site to extract chert and produce preforms. A site of this nature should be examined in detail for supporting documentation of the proposed settlement pattern. This was the most likely location of La Harpe's campsite the night of 24 August 1719. The description of the terrain, the marcassite (which is common in the Johns Valley deposits), and the flint with white metallic flecks (iron pyrite) all fit La Harpe's journal description.

Locality No. 10

[Legal Description: West center SE 1/4 and east center SW 1/4 Sec 3 T3N R19E].

This locality is situated in a narrow valley cut by a short northeastward flowing tributary of Boggs Hollow Creek, a tributary of Buffalo Creek. The Johns Valley outcrop in which the short unnamed tributary and the southeastward flowing Long Boggs Hollow is entrenched extends to the southwest for a distance in excess of 20 km (12 mi). The extreme southwestern exposure of the outcrop pinches out where the Winding Stair fault crosses Anderson Creek in Sec 23 T3N R18E.

The outcrop closely parallels the crest of the rugged divide separating the Anderson and Buffalo Creek valleys. In this locality the Johns Valley outcrop is poorly exposed except for the steep clay (weathered shale) banks which exhibit the typical erratic boulders. Most of the outcrop is covered by dense vegetation on the steep lower slopes of the mountain valley. No evidence of prehistoric chert extraction was observed here, but because of the vegetation and poor exposures the outcrop was not examined on the slopes. Four chert cobbles of two basic material types were collected in an eroded gully leading into the creek bed. The chert types observed and collected were typical, but not as abundant, of the same types observed in other localities.

Type 1: This specimen was 21 cm by 19 cm by 7 cm in dimension. It had a knobby, rounded flow-like structure exhibited on one side and a lower valve of a brachiopod (1.7 cm) on the other side. In color this rock is pale yellowish-brown (10YR6/2) with splotches up to 4 mm diameter of dark yellowish-brown (10YR4/2) with a thin ring of very light gray (N8). The weathered surface is light olive brown (5Y5/6), moderate yellowish-brown (10YR4/2) to grayish-black (N2). Basic rock is between light olive gray (5Y6/1) and olive gray (5Y4/1). It has a high gloss on a slightly weathered but flaked edge. In a fresh break the chert is shown to be the typical dusky blue (5PB3/2) to medium (N4) and dark (N3) gray chert from the Arkansas Novaculite. Toward the outer edge, the chert becomes more translucent and grades into the yellowish-gray and brown colors exhibited externally. From the exterior, it would be difficult to recognize the rock as one of the nova-cherts.

Type 2: This piece was 15 cm by 15 cm by 8 cm. It had a claystone-looking cortex of a dull, aphanic, pale yellowish-gray (5Y7/2) and lighter color. The interior exhibited high deepening of conchoidal fracture and brownish-black, semi-translucent, pinpoint iron pyrite in weathered area underneath luster. The cortex was weathered to blackish-red (5R2/2) and dusky brown (5YR2/2). Laminations were noticeable. A concretion of marcassite is cemented on one side of the rock. Three other large cobbles identical to Type 2 were observed at this locality but were not collected.

Wapanucka Limestone - Chickachoc Chert

These two closely related formations have not figured prominently in archaeologically related studies for several reasons. First, is a lack of familiarity with the chert types on the part of the archaeological community. Second, and perhaps more importantly, the materials also appear to have been of limited use to prehistoric peoples.

The Wapanucka-Chickachoc units are two of the dominant formations of the northwesternmost edge of the Ouachita Mountains. In combination with outcrops of the Atoka and Springer formations, the Wapanucka-Chickachoc formations form the scenic ridge extending northeastward from a point north of Stringtown and arcing eastward from Reynolds as the northern perimeter of the Ouachita Mountains. Both formations dip steeply and often expose bare rock faces along the edges of the ridges which they form. Hendricks et al. (1947:Sheet 1), note the separation of the two laterally equivalent formations by the Katy Club Fault; the Wapanucka occurs on the west and northern side of the fault and the Chickachoc occurs to the east and south. The two narrow sinuous outcrops parallel each other at an average distance of less than 3/4 of a mile.

These investigators describe the Wapanucka as alternating sequences of four separable units which, when combined, vary from 270 ft to 720 ft (82.2 m to 219.4 m) thick. As they (Hendricks et al. 1974: Sheet 1) state:

> "The lowest unit is a sequence of alternating shale and spicular limestone beds which range in thickness from 60 to 320 feet. The shale is gray, clayey and calcareous, and weathers tan. The limestone beds are dark gray, fine-grained and very siliceous, contain abundant sponge spicules, and weather light gray to buff. The overlying unit is absent locally, but generally is present as a ledge-forming unit as much as 120 feet thick. It consists of (a) limestone that is dark gray, fine-grained, and platy; (b) calcareous, medium-grained sandstone; and (c) dark gray, dense, spicular and locally oolitic limestone, all of which are interbedded with gray calcareous shale that weathers tan. The third unit is 60 to 250 feet thick and

consists of gray, calcareous, clay shale that weathers tan and locally contains thin lenses of brown conglomeratic and glauconitic limestone. The fourth or uppermost unit is the principal ridge-forming member. It ranges in thickness from 60 to 170 feet. The lithology of the beds composing it varies greatly, but at most places there is a lower, dark-gray, siliceous and oolitic limestone which grades laterally into coarse-grained, calcareous, and brown to buff sandstone. Above this siliceous limestone is a limestone that is light gray, non-siliceous, dense to fine-grained, pseudo-brecciated, and very irregularly bedded. At the top of the fourth unit a bed of hard, black, spicular chert from 2 to 10 feet thick is generally present.

All parts of the Wapanucka limestone are fossiliferous. The formation is of lower Pennsylvanian (Morrow) age and is correlated with the Wapanucka limestone of the Arbuckle Mountain region, the Chickachoc chert, and the Johns Valley shale."

The Chickachoc chert is described as overlying

"the Springer formation in this belt, but the nature of the contact *could not* be determined. The formation is generally poorly exposed with only the most resistant beds cropping out. Its thickness is estimated to be 600 feet. The formation consists of greenish-gray to tan clay shale that weathers to a tan clay and contains beds and lenses of spiculite. The spiculite consists of a mass of sponge spicules cemented by siliceous limestone. Where is is fresh, the spiculite is dark bluish-gray and very hard. Where it is weathered, it resembles a coarse-grained sandstone or porous chert, but each is a sponge spicule. As many as 10 beds of spiculite, each more than 5 feet thick, are present locally. In general, the base of a bed of spiculite, about 10 feet thick, is assumed to be the base of the formation; a bed of spiculite 20 to 50 feet thick is present in the middle part; and a very massive bed of spiculite, 30 to 120 feet thick, constitutes the top member. Locally, the Chickachoc chert contains abundant brachiopods, a few cephalopods, and other fossils of lower Pennsylvanian age that are identical to those of the Wapanucka limestone, with which it is correlated."

During the Bug Hill study chert was collected from one locality of each formation south of Pittsburgh. A second locality of the Chickachoc was also examined, but the exposure was so poor that suitable hand specimens could not be found. In addition, Wapanucka strata located south of Blanco and exposed in road cuts of the Indian Nation Turnpike were examined. The nature and types of chert were no different from those described south of Pittsburg. The chert in the formation south of Blanco did not seem to be as much of a major lithologic component as at Pittsburg, however.

The Wapanucka outcrop examined 2.4 km (1.5 mi) southwest of Pittsburg is exposed by a county road cut through the narrow limestone ridge. The limestone bedding dips about 65 degrees to the south and contains chert inclusions. The chert zones of silicification grade into the limestone and unlike separable nodular lenses of chert, it is difficult to extract chert hand samples with a rock hammer.

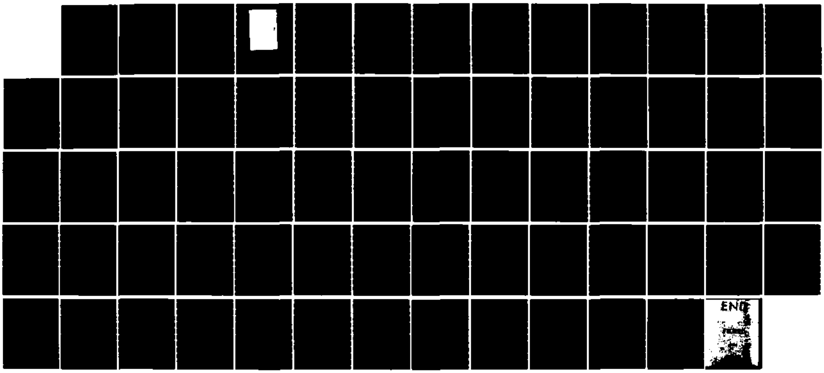
Two types of chert were found. One is opaque and has a dull luster; a distinguishing feature apparently is the incompletely silicified or chertified carbonate rhombs which occasionally occur in concentrated splotches producing sparkles. The rhombs also occur sporadically and individually. The chert is primarily a medium gray N5 matrix with elongated splotches of darker (medium gray N4 to dark gray N3) colors. These spicular features often occur at interposing angles but in roughly lenticular alignment. Combined with identical coloration this mottling causes this type of the Wapanucka to closely resemble some of the Keokuk (Grand Falls) chert varieties from northeast Oklahoma. The fracture in the Wapanucka tends to be a little more uneven than most of the Keokuk varieties and the Wapanucka lacks the common virtreous to waxy luster of the Keokuk cherts. If the Wapanucka was heat treated, however, the similarities of the two chert types would make differentiation difficult. It is possible that the more frequent presence of spicules and tiny crinoid clasts of the Wapanucka could possibly serve as a distinction. The Wapanucka also gives an impression of being tougher than a Keokuk--possibly a slight difference in grain size. The Wapanucka weathers to a light gray N7 color and exhibits tiny pinpoint dots of a darker gray. This weathered rock also resembles the Sallisaw chert of northeast Oklahoma.

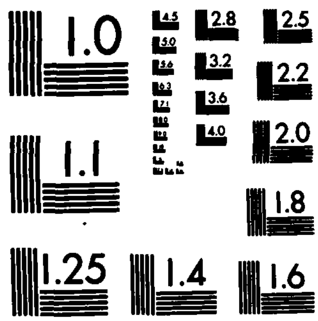
The second Wapanucka variety collected is the same type as that described above by Hendricks et al. (1947). This chert is black, dense, tough, opaque, aphanitic, and highly fractured. Small flakes and artifacts could be confused with the Bayou Manard (variety of Moorefield chert from the flanks of the Ozarks). The difficulty in obtaining unfractured pieces of any appreciable size from the outcrop seems to preclude widespread use of this material. Its occurrence in stream gravels, however, is unknown at this time.

The Chickachoc chert collected from Locality No. 2 (NE 1/4 of SE 1/4 Section 6 T2N R14E) consists of four varieties:

AD-A144 104 BUG HILL: EXCAVATION OF A MULTICOMPONENT MIDDEN MOUND IN THE JACKFORK VAL..(U) NEW WORLD RESEARCH INC POLLOCK LA J H ALTSCHUL ET AL. 25 NOV 83 DACW56-81-C-0144 5/5

UNCLASSIFIED F/G 5/6 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Type 1: This type is from a 6 cm thick lens of which 2 cm are tripolitically weathered. The weathered surface is a yellowish-gray (5Y7/2) and resembles siltstone. The interior 4 cm is a brittle chert with a dull luster, is opaque, and is a uniform pale yellowish-brown (10YR6/2). It is riddled with tiny light gray spicules. The brittleness and high degree of fracturing renders the in situ material almost useless for tool production.

Type 2: The specimen is from a lense 9 cm thick. It is opaque and has a slight luster. Its color is pale yellowish-brown (10YR6/2) in a fresh break. It is not quite as brittle as the first type, and though it still contains spicules, they are less concentrated. Except for the spicules the material would be easily confused with the brownish variety of Keokuk chert located (among other places) near Lake Spavinaw in northeast Oklahoma; the mottled banding is even similar. This chert weathers to a uniformly colored very light gray (N8), which like the weathered Wapanucka resembles weathered pieces of the Sallisaw chert.

Type 3: This type is also from a 9 cm thick lense, half of which is tripolitically weathered. The innermost material also appears to be partially weathered. The weathered surface has a slight luster and is grayish-orange (10YR7/4), but the fresh interior is the same color and luster. Unlike the previous types this one has good conchoidal fracture and does not appear to contain the spicules so characteristic of the other types. It is also opaque even on thin edges. The grayish-orange color is mottled with dusky yellowish-brown (10YR2/2) rectangular splotches which coincide with the natural lamellar structure and the darker color may indicate the original matrix. The more predominant grayish-orange color may result from more advanced weathering. This type is the "typical" Chickachoc chert most commonly recognized in artifact form.

Type 4: The variety appears to be a very minor type in occurrence. The basic matrix is a dense, tough, medium dark gray (N4), and a medium gray siliceous limestone which subtly grades into an evenly colored, fine grained, grayish-black (N2) spicular chert. The spicules are recognizable with a 10x hand lense but not readily observable with natural vision. There is no clear separation between the siliceous limestone-chert matrix such as is common in nodular chert. Extraction of this in situ material for tool production would appear to be an impossibility with primitive tools.

Another exposure 1/2 mi to the north was examined. The only chert type observed was in a 10 cm thick lense. The chert is laminated, brittle, and has the same basic color of pale yellowish-brown (10YR6/2) like Type 1 above.

The poor surface exposures of both the Wapanucka and the Chickachoc formations and the difficulty in extracting the better grades of chert seem to lessen the value of these outcrops for lithic procurements. Area streams should be examined for the possibility of obtaining more easily accessible raw materials.

Stream Gravels

All previous investigators in the project area considered the chert gravels in the alluvial terraces and gravel bars of existing streams to be the principal sources of raw material origin. These hypotheses were based on the facts that: (1) chert cobbles of the same material as the artifacts were obtainable in local streams; (2) the debitage and portion of some artifacts exhibited weathered cortex typical of stream gravels; and (3) cobbles are perhaps one of the most commonly accepted (by archaeologists) sources of chert for tool production by cultures of all time periods.

In sites on the lower Kiamichi River, of which the Jackfork is a principal tributary, and below the Kiamichi on the Red River, "tested" cobbles and cobble cores, many of which are quite small, are commonly found on Caddoan sites. A cobble type of particular interest found in the lower Kiamichi and Red River gravel sources warrants some discussion here. The cobbles exhibit a yellow brown waxy cortex and a progressively altering coloration from the cortex to the center of the cobble. From the exterior inward the colors change from brown to yellow to green. Flakes from the outer portions of the pebble would normally be classified as jasper (brown or yellow chert), but the original pebble as reflected by the innermost and unaltered portion of the cobble is apple-green chert from the Potato Hills area.

Some cobbles exhibit extremely small unaltered surfaces and some are simply yellow-brown "jasper" cobbles. Detailed research is being initiated to determine whether analytical techniques (trace elements, scanning, electron microscopic, etc.) are valid lines of inquiry to determine the possible identification of the cherts of origin for such cobbles. The specimens of "Messer flint" described as "highly translucent in colors of light yellow, light brown, and light gray" by Perino and Bennett (1978:32) and referenced as a chert type by Lintz for the Jackfork Basin (Lintz 1979a:30) were examined prior to this study at the Museum of the Red River. They are actually a yellow variety of cryptocrystalline and translucent silicified wood. This variety is distinguishable from a sedimentary chert by the microscopic woodgrain.

In the Jackfork basin stream cobbles were examined at the "Narrows" of North Jackfork Creek, above the Bug Hill site, and on Buffalo Creek immediately below (south of) the bridge in the NW1/4 of Sec 12 T2N R18E.

The two areas were selected because they are strategically placed, geomorphologically, in relationship to the basic chert outcrops from which most of the stream gravels could have been derived. At the Narrows (Figure II-6) there were a few chert pebbles which were less than 5 cm in length but only three of a large enough size and quality to produce even small bifacial dart points. Those materials, however, fractured upon initial impact with a small hammerstone. The smaller pebbles seemed to be, and logically so, more competent and flawless,

FIGURE II-6. THE "NARROWS" STREAM GRAVELS.

but they were too small for utility except perhaps for bi-polar flaking such as that discussed by Mallouf (1976:57-162). It has not been demonstrated, however, that bi-polar flaking as a technique used in the Jackfork Basin. Given the availability of larger lithic materials for use, it is not surprising that bi-polar flaking is extremely rare at Bug Hill (see Chapter Six).

The largest and most common chert type in the active gravel bars at the "Narrows" is the gray-black spicular chert from the siliceous shales from the Jackfork or possible the Stanley group. None of the materials observed were comparable to the Battiest chert of the Ten Mile Creek formation and although the cherts were spicular like the Chickasaw member, the lighter shades of gray and the more commonly uniform spattering of spiculae through the Chickasaw Creek materials were absent. All of the black cherts were identical and probably came from the Wesley formation of the Jackfork group although the Chickasaw Creek chert is also of a similar type.

Weathering appears to occur rather rapidly in these black cherts from the Jackfork and Stanley groups and quite likely in the black chert reported in the Atoka formation (Shelbourne 1960:41-43) although the Atoka chert is not well known nor described. The Wesley and Chickasaw Creek cherts most often appear in artifact form as a light to medium light gray siltstone-appearing rock with a dull or earthy luster. The differential effects of weathering on most of the black cherts are most easily recognized than they are on other specimens of chert. The effects in general are poorly understood at this time, but the pH of the soil within which the artifacts are deposited and the varying degree of surface exposure through time, are probably the most critical factors to be considered.

Four different specimens of the black chert were collected on the basis of possible minor differences resulting from the weathering film being developed. The four specimens are all the same, with only the minor distinctions in weathering and conchoidal fracture. In fresh breaks the rocks are dark gray N3 as indexed to the rock color chart. Thinly laminated bedding planes are present, but there are only slight, if any, changes in color between bands. All four specimens were too brittle to be effectively flaked.

The surprisingly negative data derived from the gravels at the "Narrows" is the apparent absence of chert cobbles from the Johns Valley Shale deposits located immediately to the north of the Narrows as well as most of the North Jackfork drainage in general.

The gravel bar at the Buffalo Creek locality is immediately downstream from the bridge on road. The gravels exposed range upward in size to large cobbles (20.6 cm). At the time of this visit, a film of silt resulting from previous high water obscured some of the hard-gloss patina so common to chert gravels. Cobbles and pebbles suspected of being chert were tested with a quartzite hammerstone and in some cases with a rock hammer. This locality was expected to produce chert and novaculite from the eastern and northern edges of the Potato Hills, where both the Big Fork and Arkansas novaculite formations crop out. It was also anticipated that secondarily deposited gravels from chert in the Johns Valley shale might occur. The results were less than expected. Out of an unquantified but substantial number of cobbles tested only four were chert and only one of these was of sufficient quality to produce lithic tools.

<u>Specimen No. 1</u>: This cobble is roughly rectangular (8 cm x 8 cm x 5.5 cm). The outermost flat surfaces (bedding planes) were a glossy

moderate yellowish brown (10YR5/4) and the surrounding edges a medium (N5) to dark gray (N3). Thin laminae were observable. Upon being struck with a hammerstone the cobble split in two along an old fracture. The fractured surfaces were also weathered. A transversely struck flake produced a black (N1), brittle but vitreous chert. The chert is opaque and does not exhibit laminae on a fresh surface. The appearance of the weathered surface is more typical of the Big Fork, but the fresh interior is more comparable to either the Woodford or a black novaculite with a high percentage of chalcedony present. Because of the highly fractured nature of the rock it would be difficult to produce even a small biface and perhaps unifacial arrowpoint.

Specimen No. 2: This rectangular cobble (10 cm x 7 cm x 5.5 cm) has a weathered moderate yellowish brown (10YR5/4) to light brown (5YR5/6) glossy cortex. The interior exhibits a very pale greenish yellow core increasing to a more brownish color toward the outer margins. Thin flakes are translucent and light brown (5YR6/4) in color. The rock is brittle and as highly fractured as specimen 1.

Specimen No. 3: The original dimensions of this pebble prior to fracturing were 6 cm x 3 cm x 1 cm. It has a hard glossy moderate yellowish brown cortex. It is opaque. On a fresh break this specimen exhibits a pale light olive (5Y5/2) interior grading into a moderate yellowish brown. Unlike specimen 2, this pebble did not exhibit internal fractures and it has a dull luster and is opaque. Both are from the same original chert type, however, having been derived from the greenish chert beds of the Arkansas Novaculite. The size of this pebble would be restrictive for tool production. An interesting observation concerning the green chert pebbles in the Kiamichi basin is that the better quality materials, though still restricted in size, seem to increase with distance from the source of origin. Also, the green chert cobbles are conspicuous by their absence in the Johns Valley deposits.

Specimen No. 4: This cobble is shaped in a parallelogram whose maximum dimensions at acute angles to the bedding laminae are 12 cm x 5 cm x 8 cm x 9 cm. The exterior surface is not completely covered by gravel cortex and in places the interior of the black rock is exposed, but in general the high gloss cortex is banded in alternating shades of pale yellowish brown (10YR6/2), dark yellowish brown (10YR4/2), dusky yellowish brown (10YR2/2), olive dark yellowish brown (10YR4/2), olive black (5Y2/1) and pinkish gray (5YR8/1). The interior is a more single and uniform color of olive to brownish black (5Y2/1 and 5YR2/1 respectively). The thinly laminated bedding planes vary from 2 to 10 mm separated by thin hairline bands of light gray. The conchoidal fracture is excellent at right angles to the laminae. The rock is aphanitic and opaque even on thin edges. It has a dull to vitreous luster, and pinpoint reflections of quartz sparkle in natural light. The rock is internally fractured but not to the same extent as the other gravels. The cobble is identical to boulders found in the Johns Valley shale deposits and could have been derived from upstream deposits of the Johns Valley shale or from the black novaculite deposits from the Potato Hills. The cortex is quite comparable to cobbles in the Johns Valley shale. The greatest distinction between the Johns Valley cobbles and this one is the presence of "chatter" marks on the stream cobble.

The general impression derived from examination of the modern stream gravels is that most of the larger chert gravels and cobbles are so brittle and so highly fractured that systematic reliance on gravel bars for use as sources of stone tool production would have been negligible in comparison to use of the easily accessible and more productive outcrops of the Johns Valley shale. This would be especially true if production of chert raw materials in an appreciable quantity and quality was a primary objective of any given culture as it would be if chert resources were a factor in the determination of settlement patterns.

It is difficult to distinguish artifacts produced from stream or terrace gravels as opposed to being produced from the cobbles obtained directly from the Johns Valley shale for two basic reasons. In the first place most of the chert gravels existing in stream or terrace deposits of all Jackfork tributaries except Buffalo Creek are derived from the Johns Valley formation anyway. Secondly, since cortex exists on both the Johns Valley cobbles as well as the stream gravels, the cortex development is measured in degrees rather than merely being present or absent. The stream and terrace gravels are likely to have a "harder" and more polished cortex in addition to a greater likelihood of "chater" marks, but these attributes can also, though less commonly, be observed on some of the Johns Valley cobbles. For archaeological purposes, development of a better method of differentiation could be worthwhile in that slightly different technological skills are required to obtain raw materials from the two source types. However, the ability to distinguish between those differences may or may not be anthropologically significant.

APPENDIX III

SPECIALIZED BIOARCHAEOLOGICAL ANALYSES

Jerome C. Rose, Murray K. Marks and Earl B. Riddick

The basic Bug Hill skeletal data have been presented in Chapter Thirteen along with a discussion of their relevance to pre-Caddo bioarchaeology in eastern Oklahoma. As is frequently the case in bioarchaeology, specialized analyses are conducted which for lack of comparative data cannot be included in the general discussion. These specialized analyses, conducted on the Bug Hill burials, are presented in this appendix for the use of future researchers. A detailed skeletal inventory may be found in Table III-1, while all skeletal measurements are listed in Table III-2. A detailed description of the methodologies employed is provided to complement the abbreviated version presented in Chapter Thirteen. This is followed by data presentation and discussion of dental pathology and antemortem loss, dental attrition, childhood stress, and genetic analysis.

METHODOLOGY

All skeletal material recovered during the 1981-82 field season was received at the Osteology Laboratory of the University of Arkansas directly from the field without any processing. Each of these burials was washed in a 50/50 solution of alcohol and water without immersion. The dentition and delicate skeletal features (i.e., pubic symphyses) were cleaned with 95 percent alcohol. All the dirt removed from the bones was waterscreened (3.2 mm hardware cloth) and examined for small skeletal elements as well as floral and faunal remains, which were separated for analysis by appropriate investigators. All skeletal elements were labeled with the appropriate accession numbers and all broken pieces were reconstructed.

TABLE III-1. BUG HILL BURIAL INVENTORY.

Bone	Frontal	Parietal	Occipital	Temporal	Maxilla	Mandible	Teeth: Maxillary	Teeth: Mandibular	Clavicle	Scapula	Sternum	Vertebrae: Cervical	Vertebrae: Thoracic	Vertebrae: Lumbar	Ribs	Humerus	Radius	Ulna	Hands	Pelvis	Femur	Patella	Tibia	Fibula	Foot
Side	R L	R L	R L	R L	R L	R L			R L	R L					R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
Burial 1	P P	P P	P P	C C	P P	P P	P	P	P P	P P		P	P	P	P P	P P	C F	P C	P C	P F	F P	C C	F C	F A	P F
Burial 2	A P	A C	A C	A C	C C	C C	C	C	A C	C A	A	F	F	F	P P	A A	P A	P A	A A	A A	A P	A A	P C	A A	A A
Burial 3	A A	P F	P F	A A	A A	A A	A	A	A A	A A	A	A	A	A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A
Burial 4	C C	P C	P P	P P	A A	A A	F	A	A F	F F	A	A	P	A	F F	P P	P F	F P	A A	F F	C C	A A	C P	F A	F F
Burial 5	C C	P F	C C	P P	P F	C C	C	C	C A	C A	A	P	C	C	C C	C C	C C	C C	P P	C C	C C	A C	C C	C C	P A
Burial 6A	C C	C C	C C	C C	C C	C C	C	C	C C	C P	A	A	P	P	P C	C C	C C	C C	A A	C C	C C	C A	C C	C C	C A
Burial 6B	C P	P P	P P	C C	C F	C P	F	P	A A	P F	F	F	P	C	P P	C C	P C	C P	F A	P P	F F	P P	F F	A F	F A
Burial 7	P F	F F	F P	C C	A F	P P	P	P	F A	F F	A	A	A	A	A	P P	F F	F F	A A	A A	P F	A A	P A	P A	A A
Burial 8	A A	A A	A P	A A	A A	A A	A	A	A A	A A	A	A	A	A	A A	A A	A	A A	A A	A A	A A	A A	A A	A A	A A
Burial 11	A A	P A	A A	A A	A A	A A	A	A	A A	A A	A	A	A	A	A F	A A	A A	A A	A	F P	F F	A A	A A	A A	A A
Burial 12	F F	F F	F F	F F	F F	A A	P	A	A C	A A	A	F	F	F	P P	A A	A A	A A	A A	A A	A A	A A	P A	A A	A A
Burial 10	F C	P A	A A	F A	P P	C C	C	C	C A	A F	P	F	F	F	F P	A A	A C	A P	P A	F P	A P	A A	A A	A A	A A

Key:

C = Complete bone 90-100%
P = Partial bone 50-90%
F = Fragmentary bone 50% or less
42= Absent

TABLE III-2. POSTCRANIAL METRICS FROM BUG HILL.

	Scapula Max. Length	Scapula Max. Breadth	Clavicle Maximum Length	Clavicle Midshaft Circumference	Humerus Max. Length	Humerus Minimum Head Diameter	Humerus Midshaft Circumference	Radius Maximum Length	Sacrum Maximum Height	Sacrum Max. Breadth	Innominate Maximum Height	Innominate Maximum Breadth	Innominate Ischial Length	Innominate Pubis Length	Femur Maximum Length	Femur Physiological Length	Femur Maximum Head Diameter	Femur Midshaft Circumference	Femur Subtrochanteric A-P Diameter	Femur Subtrochantric M-L Diameter	Tibia Maximum Length	Tibia A-P Diameter	Tibia M-L Diameter
Male Adults -																							
B.1	-	-	-	3.50	-	-	6.20	-	-	-	-	-	-	-	-	-	4.70	9.50	2.85	2.85	-	4.30	2.50
B.11	-	-	-	-	-	-	6.50	-	-	-	-	-	-	-	-	-	4.85	8.70	3.35	2.55	-	-	-
B.8	-	-	-	-	-	-	6.80	-	-	-	-	-	-	-	-	-	-	8.30	2.70	2.50	-	3.00	2.10
B.6A	-	8.0	13.70	3.30	30.40	3.75	5.72	-	[illegible].32	-	-	13.53	6.90	-	42.60	42.25	4.05	8.00	2.15	2.85	-	2.92	2.27
B.6B	-	-	14.80	3.31	30.31	4.01	6.42	2[illegible].10	-	-	19.4	13.55	7.87	7.55	40.00	39.70	4.40	7.50	2.30	2.75	34.3	3.30	2.30
Female Adults -																							
B.4	-	-	-	-	-	-	5.00	-	-	-	-	-	-	-	-	-	-	7.80	2.00	3.00	-	2.85	1.85
B.7	-	-	-	-	-	-	5.30	-	-	-	-	-	-	-	-	-	-	7.50	2.00	2.70	-	2.90	1.60
Sub-Adults -																							
B.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.80	1.35	1.40	-	1.40	1.62
B.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

The burials were arranged in anatomical position for analysis. The burials were inventoried and all observations and measurements (after Bass 1971) were, then, made while material necessary for specialized analysis (i.e., molars for microscopic observations; canines and incisors for histological analysis; and pathologies for photography and radiography) were separated out. Sex was determined using a modification of the procedures developed by Acsadi and Nemeskeri (1970).

Each morphological and metric feature useful in sex determination was scored on a scale of +2 (hypermasculine) to -2 (hyperfeminine) and a weighted mean score was calculated to assign sex. All criteria used for scoring were derived from the published literature (Acsadi and Nemeskeri 1970; Bass 1971; Brothwell 1972; Krogman 1962; Ubelaker 1978) and standardized by seriation of all Caddo and Fourche Maline skeletal material available in the University of Arkansas Osteology Laboratory. After matching the morphological traits (i.e., mastoid, linea aspera, etc.) to the sexing standards, the Bug Hill skeletal material was seriated for each trait to assure internal consistency and to check for idiosyncratic variation. Reliability of each sex determination was assessed by grouping all recorded observations from each burial into four categories: 1) size and robusticity; 2) muscle attachments; 3) non-pelvic shape; and 4) pelvic morphology. Sex determination was considered reliable if two or more observations could be made from the pelvis and other categories. Sex determination was considered less reliable if two or more observations were made from only one or two non-pelvic categories. No sex determination was attempted on individuals younger than 15 years of age.

Age determination of children employed dental development standards (Demirjian and Levesque 1980; Moorrees et al. 1963a, 1963b; Schour and Massler 1945; Sundick 1972). Juveniles were aged by epiphyseal closure using published standards (Bass 1971; Brothwell 1972; Krogman 1962). Adults were aged by degenerative changes of the pubic symphysis using models for both males (McKern and Stewart 1957) and females (Gilbert and McKern 1973). Because these two techniques are most reliable in the younger age categories, the Todd technique, which consists of both photographs and written descriptions of the pubic standards, was also employed to prevent systematic underestimation of age (Todd 1920). In addition, a technique based on the degenerative changes of the sacral surface of the ilium was also employed (Lovejoy, personal communication). The technique consists of a description and photograph for each five year adult age category. An age assignment was made only after all the above techniques were reconciled.

All bones were examined macroscopically and with the aid of a stereomicroscope for identifications of pathological lesions. Each lesion was diagnosed using comparative collections and the published paleopathology literature (e.g., Brothwell and Sandison 1967; Buikstra 1981; Ortner and Putschar 1981; Steinbock 1976). Each lesion was described and photographed, prior to being radiographed and independently diagnosed using clinical radiographic interpretation. Final diagnosis resulted from mutual concordance of both the clinical and paleopathological interpretations. Periosteal reactions and porotic hyperostosis were classified as either active or healing using the criteria established by Mensforth et al. (1978).

All pathological lesions were grouped into etiological categories (i.e., infections, porotic hyperostosis, developmental anomalies, osteophytosis, osteoarthritis and trauma) for epidemiological analysis and comparison with the published information from other skeletal collections. The published literature was carefully reviewed to ensure that all pathology data conformed with the procedures employed in the Bug Hill analysis.

The dentitions were inventoried and scored for caries, dental attrition, abscessing, calculus deposits, agenesis, antemortem exfoliation and dental morphology. Each tooth was examined with a sharp dental explorer under good illumination, using a stereomicroscope where necessary. Caries were identified by penetration of the enamal surface by the dental explorer and recorded by tooth surface (i.e., occlusal, smooth surface, cervical, interproximal and root) following the procedures of Moore and Corbett (1971). Adult caries rates were calculated by tooth type (e.g., molars), total observed teeth and mean caries per individual. Quantification of dental attrition employed the Scott (1979a) system which scores each molar occlusal surface quadrant from one to ten on the basis of the proportional area of enamel wear facets and remaining enamel when the dentin is exposed. The total score for each molar (which can range between 0 and 40) was determined by summing the scores of the four quadrants. Because there is, as yet, little comparative data using the Scott method, molar attrition was also scored using the Murphy (1959) system. This method requires matching the amount of dentin exposure to standardized drawings which have been assigned scores between zero and nine. Mean scores for each molar type (i.e., first, second and third) were calculated for comparison with other skeletal series.

Abscesses were scored by the presence of observable drainage passages in the mandible and maxilla. Rates were caluculated by abscesses per observable bone. Antemortem tooth loss was differentiated from postmortem loss by the presence of remodeling activity within the surface of the tooth sockets.

As a complement to the attrition analysis used in dietary reconstruction, the molar surfaces were observed with the scanning electron microscope (Rose et al. 1981; Rose 1981; Ryan 1979; Walker 1976; Walker et al. 1978). Five mandibular molars and one deciduous second molar were selected for examination and cleaned in a sonic cleaner with alcohol. The crowns were removed from their roots, mounted on aluminum stubs and coated with 17.3 nanometers of gold (P.I.I. sputtering system). The mesio-lingual cusp was marked and the specimen mounted in an I.S.I. 60 scanning electron microscope set at a beam angle of 15 degrees and a voltage of 30 KV. Each mesio-lingual cusp was photographed (Polaroid type 55+/-film) at low magnifications (i.e., 15 - 20 x). The surface of each cusp was examined at 500 magnifications and two to four micrographs were taken at 1500 magnifications to represent the surface topography of the cusp. The procedures employed were standardized for comparability to the other skeletal populations previously studied in the University of Arkansas Osteology Laboratory. The enamel surface topography was described and compared to similar micrographs from other skeletal series.

It has been demonstrated that histological defects observed in the enamel of adults can be used to reconstruct childhood morbidity patterns (Rose 1977, 1979; Rose et al. 1978; Rose and Lallo 1979). Four mandibular canines and five maxillary central incisors representing five individuals were selected for histological analysis. The teeth were placed upon an epoxy (Beuhler Epo-Mix Epoxide) platform within a disposable mold. The teeth were covered with epoxy and placed under vacuum until all bubbles were eliminated. The molds were placed in a pressure chamber at 50 psi nitrogen and maintained at 60 degrees centigrade for twelve hours. A longitudinal bucco-lingual slice was, then, made through the central axis of each tooth with a low speed diamond saw. The slice was mounted with epoxy onto a frosted petrographic slide. The sections were thinned with 600 grit silicon carbide papers on a motorized grinder. Each section was polished with six micrometer diamond paste on a nylon cloth for 10 minutes, and then 0.25 micrometer diamond paste on texmet for 10 minutes using automated Buehler low speed polishers. Final polishing employed 0.05 micrometer alumina on a microcloth for one to three minutes. Each section was etched for 15 seconds in a one normal dilution of hydrochloric acid and rinsed in tap water prior to dehydration in 95 percent alcohol. Each section was examined for Wilson bands and hypoplasias at 160 magnifications using a Zeiss Standard 18 microscope equipped with both transmitted light and reflected light Nomarski optics. The criteria for defining Wilson bands and hypoplasias, as well as the data for caluclating the age of incidence, are derived from Condon (1980).

In addition, the frequency of macroscopic hypoplasias were collected from the canines and incisors using the criteria and procedures of Goodman et al. (1980). The distance of each hypoplasia from the cemento-enamel junction was measured with Helios dial calipers and converted to the age of incidence using a dental growth chart (Goodman et al. 1980).

Radiographs of five tibiae were obtained using standard clinical procedures. The incidence of growth arrest lines (i.e., Harris lines) was recorded and the age of incidence calculated using the procedures established by Clarke (1982).

Genetic variation both within the Bug Hill sample and between Bug Hill and both Fourche Maline and Caddoan skeletal series can be calculated using non-metric (i.e., epigenetic) data. Although preservation of the skeletal series was not ideal, all observable traits were scored. A total of 31 cranial and nine postcranial non-metric traits were scored using the system developed by Buikstra (1976, personal communication). This system scores each trait as not observable, absent or present in one to four possible variants. The Bug Hill dentitions were scored for 20 morphological traits using the methodology and standard dental casts developed by Turner (1970; Turner and Hanihara 1977; Turner and Swindler 1978). Each trait was scored as not observable, absent or present in one to nine possible variants.

RESULTS OF ANALYSES

Dental Pathology and Antemortem Loss

Additional data were collected for calculus deposits, abscessed teeth, and antemortem tooth loss (Table III-3). Calculus is a calcified deposit along the gumline of the tooth formed by the interaction of saliva, food and oral microorganisms. Excessive deposits can result in periodontal disease, alveolar resorption and subsequent tooth loss. Apical abscessing is the consequence of the inflammation of the dental pulp resulting from bacterial invasion by means of caries or pulp exposure due to rapid attrition. Abscessing invariably results in antemortem tooth loss.

Calculus deposits are common at Bug Hill with 60.7 percent of the teeth affected. This rate is slightly below that reported for Caddo sites such as Cooper Lake (86.7 percent, Westbury 1978) and Ferguson (71.4 percent, unpublished data). There is, as yet, not enough comparative data for an interpretation of calculus rates. The rate of dental abscessing at Bug Hill is 3.5 per individual which is much higher than Caddoan skeletal series: Morris, 1.0 (Brues 1959); Nagel, 0.4 (Brues 1957); Cooper Lake, 2.6 (Westbury 1978); Sam Kaufman, 1.2 (Butler 1969); and Kaufman-Williams, 0.4 (Loveland 1980). There are no comparative Fourche Maline phase data. Because of the absence of dental caries, this high abscess rate must be attributed to the rapid dental attrition which exposes the pulp chambers to bacterial invasion. Figure III-1 shows the positive relationship by tooth type between abscessing and antemortem tooth loss. Although abscessing cannot explain all antemortem loss both phenomenon are directly correlated with rapid dental attrition (Powell and Rogers 1980). In contrast, most abscessing and antemortem tooth loss observed in Caddoan dentitions can be attributed to dental caries (Rose 1982).

Dental Attrition

The amount of dental attrition or gradual removal of enamel is an excellent indicator of the abrasive quality of prehistoric diets. Comparison of attrition rates is useful in isolating particular food preparation techniques such as the use of stone food grinding implements. In addition, attrition rates can be used to characterize the overall subsistence strategies of prehistoric groups. For example, hunter/gatherers tend to have much higher attrition rates than agriculturalists.

TABLE III-3. PERCENTAGE OF TEETH WITH CARIES, CALCULUS, ABSCESSES, LOST ANTEMORTEM, AND AGENESIS FOR BUG HILL ADULTS.

	Total Possible Teeth	Total Teeth Present	Caries	Calculus	Abscessed*	Lost Anti-Mortem	Agenesis
Molars	76	36	0.0 (36)	55.6 (36)	12.7 (55)	35.5 (76)	5.3 (76)
Pemolars	49	23	0.0 (23)	56.5 (23)	14.6 (41)	42.8 (40)	0.0 (49)
Canines	24	12	0.0 (12)	58.3 (12)	0.0 (19)	20.8 (24)	0.0 (24)
Incisors	48	13	7.7 (13)	84.6 (13)	22.2 (36)	45.8 (48)	6.2 (48)
Total	197	84	1.2 (84)	60.7 (84)	13.9 (151)	38.1 (197)	3.6 (197)

*This rate is determined using observable alveolar bone.

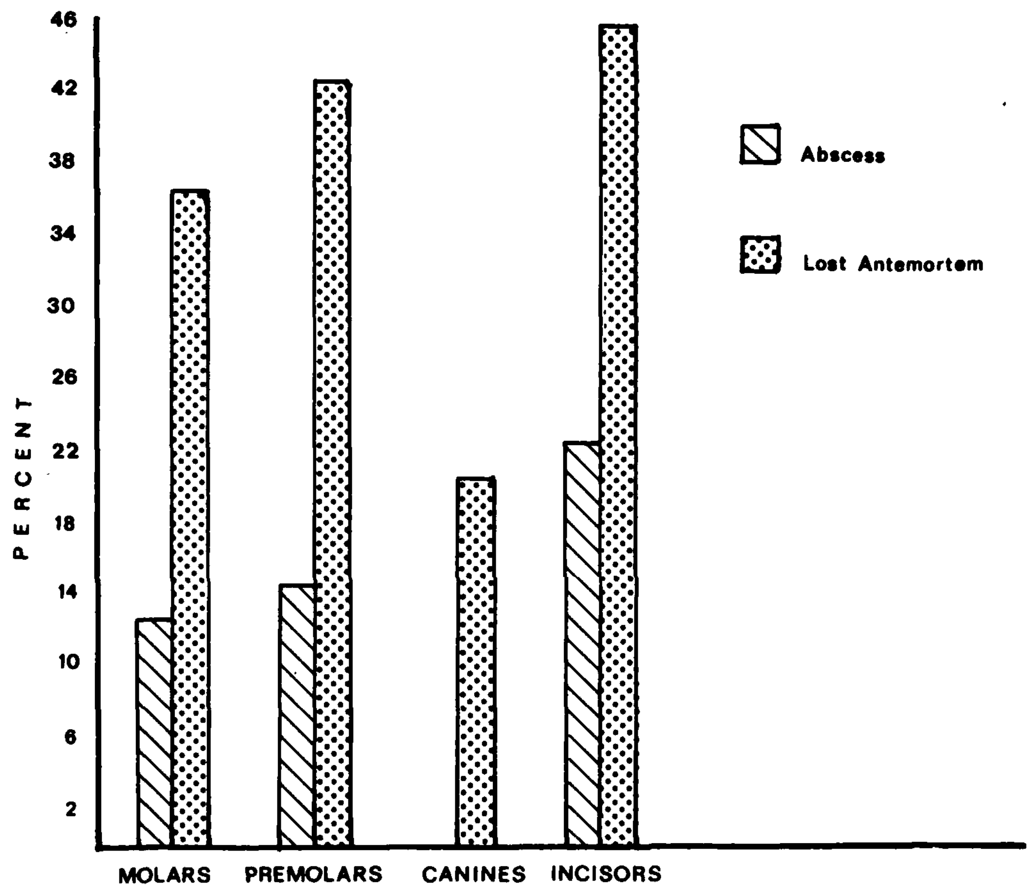


FIGURE III-1. PERCENT OF TEETH WITH ABSCESS AND ANTEMORTEM TOOTH LOSS.

Table III-4 lists the mean Scott attrition scores by dental arch (i.e., maxillary) and molar sequence number (i.e., first molar). The means are compared using all available maxillary second molars regardless of the number of individuals represented. Although this is not the preferred method, the small sample size makes it necessary. Since attrition increases with age, the demographic sample must be controlled, which in this case, was done by dividing the sample into those younger and those older than 35 years of age.

Comparison of the Bug Hill mean Scott scores with other available data show that Bug Hill has very high attrition scores. Both the young and old Bug Hill scores are higher than the Mississippian Campbell site (Scott 1976b) (Max M_1 - 19.3, M_2 - 15.1, M_3 - 4.2; Man M_1 - 17.6, M_2 - 14.6, M_3 - 3.0).

The mean Murphy attrition scores follow the same pattern (Tables III-5 and III-6). In Table III-6, the McCutchan-McLaughlin, Sam and Wann scores are reported only for those individuals aged between 18 and 30 years. Unfortunately, there are no Bug Hill teeth which fit within this age range; thus, the Bug Hill means for the young and old groups must be used as brackets for a hypothetical mean score for 18 - 30 year olds. As can be seen in Table III-6, the Bug Hill Murphy scores are quite similar to those from other Ouachita Mountain midden mound sites and considerably higher than those typical of Caddoan skeletal series. Comparison of both the Murphy and Scott attrition scores to other skeletal series indicates that the Bug Hill people consumed a very abrasive diet, which is typical of hunting and gathering peoples who prepare their foods with stone grinding implements.

Childhood Stress

Recent research has demonstrated the utility of enamel defect analysis for the reconstruction of childhood stress patterns (Cook 1981; Goodman et al. 1980; Huss-Ashmore et al. 1982; Lallo and Rose 1979; Rose et al. 1978; Rudney 1981). Dental enamel is a non-vital tissue that once formed is not remodeled and, thus, like tree rings, contains a "memory" of its metabolic experience. Enamel hypoplasias are deficiencies in enamel thickness caused by a metabolic disturbance of amelogenesis (i.e. enamel formation). Although the exact cause of the hypoplasias has not been established, they are considered to be excellent indicators of stress episodes such as infectious disease or malnutrition (Giro 1947; Kreshover 1960; Sarnat and Schour 1941; Schour and Massler 1945). Since each tooth crown is formed during a specific chronological period in the individual's life (i.e., mandibular canines between one and five years), any enamel disturbance can be assigned to a specific age (i.e., 2.5 - 3.0 years). This technique has the advantage of using the teeth of adults to reconstruct childhood metabolism and, thus, overcoming the problem of underrepresentation of children in archaeologically-derived skeletal samples.

The frequency of enamel hypoplasias were collected from five individuals, all but one of whom were under 18 years of age. Each

TABLE III-4. MEAN SCOTT ATTRITION SCORES BY MOLAR TYPE FOR THE BUG HILL SITE.

	Entire Sample			35 Years and Older			15-17 Years		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Maxillary M_1	6	27.2	6.11	2	35.0	0.0	4	23.2	0.96
M_2	7	17.8	12.10	3	29.3	8.39	4	9.2	3.95
M_3	1	38.0	0.00	1	38.0	0.00	-	-	-
Mandibular M_1	8	28.2	6.52	4	33.0	6.00	4	23.5	1.73
M_2	8	22.5	14.6	4	35.8	5.19	4	9.2	1.50
M_3	5	32.6	9.53	5	32.6	9.53	-	-	-

TABLE III-5. MEAN MURPHY ATTRITION SCORES BY MOLAR POSITION FOR THE BUG HILL SITE.

	Entire Sample			35 years and older			15-17 years		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
M_1	13	5.8	1.74	5	7.8	0.45	8	4.5	0.53
M_2	15	3.7	3.71	7	7.4	0.98	8	4.0	0.52
M_3	5	7.2	1.79	5	7.2	1.79	-	-	-

TABLE III-6. COMPARATIVE MEAN MURPHY ATTRITION SCORES FOR ADULTS.

Period and Site	M_1	M_2	M_3
Fourche Maline			
Mahaffey[1]	8.4	6.7	5.0
Sam and Wann[2]	6.9	5.4	1.9
McCutchan-McLaughlin[2]	7.5	5.9	2.3
Bug Hill young	4.5	4.0	-
Bug Hill old	7.8	7.4	7.2
Caddo IV			
Cepeland/Hedges[2]	2.5	1.5	0.4

1 unpublished data

2 Powell and Rogers 1980

hypoplastic episode was converted into an age of incidence using the conversion chart published by Goodman et al. (1980). Table III-7 lists the number of examined enamel one-half year units as well as the number of hypoplasias for the Bug Hill skeletal series. The Bug Hill hypoplasia rates are 0.4 per one-half year enamel unit and 4.8 per individual. The rate per individual is three times as high as that reported (1.6) for the highly-stressed Mississippians from Dickson Mounds (Goodman et al. 1980). The high rate at Bug Hill is due, in part, to small sample size and partly to the use of sub-adults. It has been repeatedly demonstrated that the frequency of hypoplasias decrease with increased age at death as the most stress-susceptable individuals are removed from the population (Goodman et al. 1980). Thus, hypoplasias were recorded on the most stress-susceptable individuals from the Bug Hill population.

Powell and Rogers (1980) report that 73 percent of the McCutchan-McLaughlin skeletal series had at least one hypoplasia. In contrast, all five Bug Hill individuals (100 percent) had at least one hypoplasia. Figure III-2 shows the distribution of hypoplasias by age for the Bug Hill and McCutchan-McLaughlin sites. When small sample sizes are taken into consideration, there is no difference in the pattern with both sites showing maximum hypopolasias between 2.5 and 5.0 years. They do differ in absolute frequency with Bug Hill expressing greater childhood stress. These data are compatible with the higher childhood probability of dying and higher infection rate at Bug Hill. Thus, the hypoplasia data support the hypothesis that the Bug Hill population experienced a higher level of stress than McCutchan-McLaughlin and, thus, a lower level of adaptive efficiency.

Histologically, enamel is composed of enamel prisms which are laid down through the width of the crown by ameloblasts. The crystalline structure of the prisms reflect the metabolism of the ameloblasts at the time they were formed. Thus, metabolic disturbances are recorded in the enamel prism structures, which, like hypoplasias, can be assigned to a specific period in the individual's life. Rose (1977; 1979) defines a group of structural enamel prism defects (labeled Wilson bands) which are characterized by abnormal enamel prism structure along the striae of Retzius.

Rose et al. (1978) using mandibular canines demonstrate an increase in Wilson bands at Dickson Mounds as the population experienced the transition from hunting and gathering to maize agriculture. Rose and Boyd (1978) showed that the chronological patterning of Wilson bands observed in adult teeth corresponded closely with the chronological distribution of unremodeled periostitis (i.e., active infection) among the large number of children from the Libben site, Ohio. The present interpretation of Wilson bands is that they are indicators of childhood infectious diseases. The frequency of childhood infections is determined by nutritional adequacy and overall childhood stress. Thus, the pattern of Wilson bands will estimate the chronological pattern of childhood infections and the frequency of Wilson bands will estimate nutritional adequacy and childhood stress

TABLE III-7. DISTRIBUTION OF HYPOPLASIAS AT THE BUG HILL SITE.

One-half year units	Number enamel units	Number hypoplasias	% hypoplasias per enamel unit	% of total hypoplasias
0.0 - 0.5	3	0	0.0	0.0
0.5 - 1.0	3	0	0.0	0.0
1.0 - 1.5	4	0	0.0	0.0
1.5 - 2.0	4	0	0.0	0.0
2.0 - 2.5	5	0	0.0	0.0
2.5 - 3.0	5	4	80.0	16.7
3.0 - 3.5	5	3	60.0	12.5
3.5 - 4.0	5	4	80.0	16.7
4.0 - 4.5	5	5	100.0	20.8
4.5 - 5.0	5	5	100.0	20.8
5.0 - 5.5	5	2	40.0	8.3
5.5 - 6.0	5	0	0.0	0.0
6.0 - 6.5	5	1	20.0	4.2
Total	59	24		

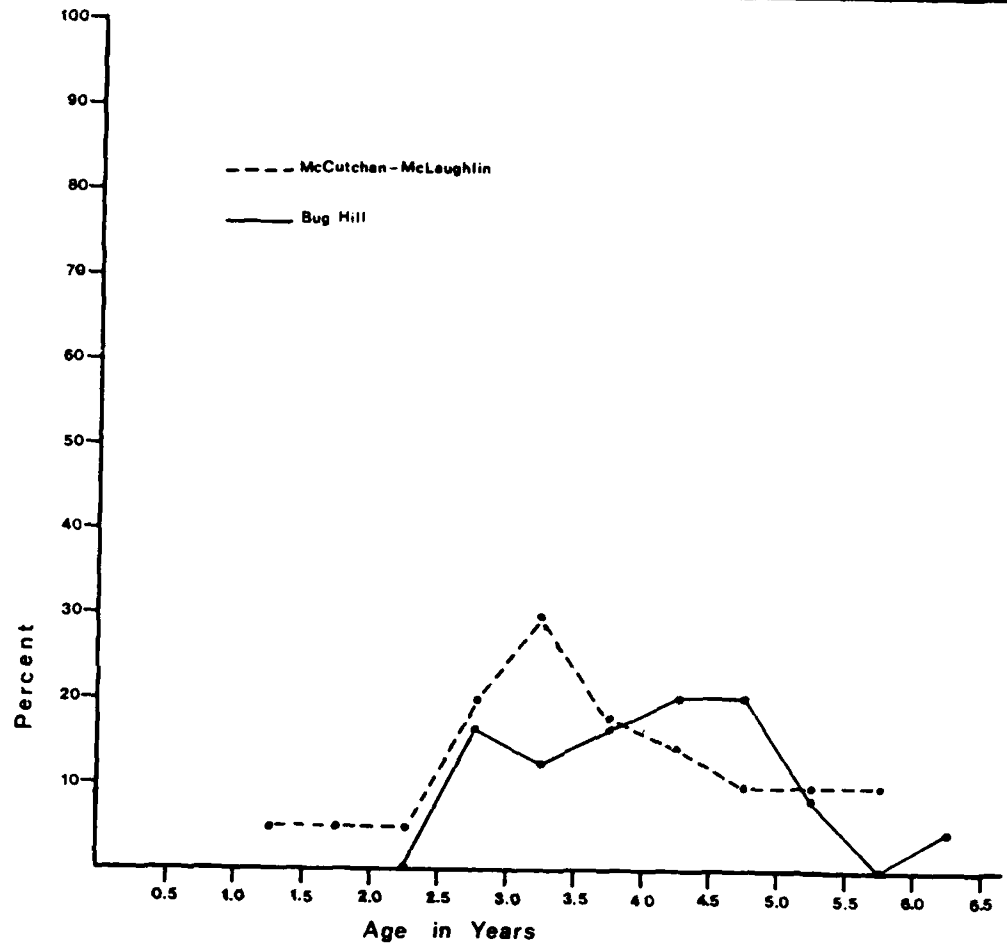


FIGURE III-2. PERCENTAGE DISTRIBUTION OF HYPOPLASIAS BY ONE-HALF YEAR ENAMEL UNITS.

load. The major problem of Wilson band analysis has been their low frequencies making large samples necessary for pattern reliability. Both Condon (1980) and Rudney (1981) demonstrates that less severe enamel disturbances follow the same distribution as Wilson bands and can be used to solve the problem of low frequencies. Wilson bands have been redefined for this study using the definition of Condon (1980).

A total of four permanent mandibular canines and five permanent maxillary incisors from Bug Hill were examined for Wilson bands. The percentages of Wilson bands per one-half year enamel unit are tabulated for canines in Table III-8 and for incisors in Table III-9. The incisor data will not be discussed further because there is as yet little comparative data and the chronological conversion chart is still tentative.

The Libben site is the largest and most extensive study of Wilson bands using the new definition employed in the Bug Hill analysis. A total of 112 canines produced 83 Wilson bands. The Libben site represents a well-adapted Late Woodland subsistence/economic system from Ohio (A.D. 800 - 1100) with evidence of adequate nutrition, a low infection rate and a low probability of dying for all ages (Boyd 1978; Lovejoy et al. 1977). The Roden site is a Caddo site with evidence of maize agriculture and fairly extensive hunting and gathering (Perino 1981). A total of seven mandibular canines produced eight Wilson bands. At the present time, these two sites have produced the only Wilson band data using the Condon redefinition.

The Wilson band frequency data indicate that, as expected, the Libben children were subjected to the lowest stress load (0.74 Wilson bands per individual), while the Roden children experienced almost twice as much stress (1.33 Wilson bands per individual). This greater childhood stress at Roden is attributed to the use of maize, especially as a major component of the weaning diet. The Bug Hill children experienced over twice the stress load (3.50 Wilson bands per individual) as the Roden children and almost five times the stress load as the Libben children. This high level of childhood stress observed in the Wilson band frequency corroborates the high Bug Hill childhood probability of dying and infectious disease rate.

Long bone growth can also be disrupted by stress episodes such as infectious disease and malnutrition. Bone growth ceases for the duration of the insult and if the individual recovers, bone growth will resume. When growth begins, there remains a plate of transversely-oriented trabecular bone, which can be observed on radiographs as transverse opaque lines known as Harris lines (Steinbock 1976). Age of incidence is assigned to each Harris line using the proposition of the distance between the line and bone end to total bone length (Clarke 1982). Since Harris lines are found in decreasing frequency in the distal tibia, proximal tibia, distal radius and metacarpals, the tibia is, thus, the best single bone to use for analysis (Clarke 1982; Steinbock 1976). The frequency and age of incidence of Harris

TABLE III-8. PERCENTAGES OF WILSON BANDS PER ENAMEL ONE-HALF YEAR UNITS FOR CANINES.

	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5
Roden	50.0 (2)	0.0 (3)	0.0 (4)	16.7 (6)	0.0 (7)	50.0 (6)	50.0 (6)	0.0 (6)
Libben	0.0 (37)	9.1 (55)	14.0 (86)	10.1 (99)	15.3 (111)	14.4 (111)	14.3 (112)	6.2 (112)
Bug Hill	0.0 (2)	33.3 (3)	50.0 (4)	50.0 (4)	25.0 (4)	100.0 (4)	133.0 (3)	0.0 (3)

TABLE III-9. PERCENTAGES OF WILSON BANDS PER ENAMEL ONE-HALF YEAR UNITS FOR INCISORS.

	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5
[illegible]	0.0 (3)	0.0 (4)	16.7 (6)	66.7 (6)	16.7 (6)	40.0 (5)
Bug Hill	50.0 (2)	0.0 (4)	60.0 (5)	60.0 (5)	100.0 (5)	125.0 (4)

lines, though non-specific as to cause, can be used to reconstruct the patterns of childhood stress from adult skeletal material (Clarke 1982). However, unlike teeth, these stress markers are obliterated with age as the bone remodels. The best results are, thus, obtained by using the youngest individuals.

A total of three tibiae were suitable for radiography and Harris line analysis. Burial 6B (male, 15 - 16 years old) has one line which occurred at slightly less than one year of age. Burial 6A (male, 16 - 17 years old) also had one line which occurred at slightly less than one year of age. Burial 11 (University of Oklahoma series; 7 - 7.5 years of age) has four lines which can be assigned to the previous year of life (i.e., 6-7 years). This produces a total subadult rate of 1.0 lines per individual. Powell and Rogers (1980) report a subadult Harris line rate of 3.9 per individual and an adult rate of 1.6 per individual. A subadult Harris line rate of 0.4 per individual is reported for the Caddoan Kaufman-Williams site (Loveland 1980). The small sample size from Bug Hill makes the Harris line rate somewhat unreliable, but it does appear to be within the range of the McCutchan-McLaughlin rate.

Genetic Analysis

Since Laughlin and Jorgenson (1956) first used non-metric traits to analyze regional population variation, non-metric trait analysis has been frequently employed in bioarchaeology (Berry 1968; Buikstra 1976; Finnegan 1974; Lane and Sublett 1972; Rightmire 1972; among others). In addition, analysis of the variation in dental morphology has been frequently used in bioarchaeology to assess population affinities and origins (Turner 1970; Turner and Hanihara 1977; Turner and Swindler 1978; among others). Both skeletal and dental non-metric traits are reported for the Bug Hill skeletal series. Although the sample sizes for the skeletal non-metric traits are small (see Table III-10) there are sufficient comparative data for a preliminary interpretation. The sample sizes for the dental morphology data are too small for comparison and are reported for future reference (Table III-11).

The single most important genetic problem within the Caddoan area is the question of the biological origins of the Caddo. Although previous researchers have postulated an external origin, current theory places their origin within the indigenous Fourche Maline phase populations. The present state-of-the-art for Fourche Maline/Caddo bioarchaeology makes a comprehensive examination of Caddoan origins premature, but there are sufficient data for preliminary hypothesis testing. Nonmetric skeletal traits are reported for two Caddo sites and three midden mound sites both (with Fourche Maline and Caddo components) within the Oklahoma Arkansas River area. The data from the literature are transformed into simple positive/negative contrasts where the unilateral appearance of a bilateral trait is recorded as positive. The 19 most frequently reported traits are included as percentages in Table III-12.

TABLE III-10. NONMETRIC TRAIT SCORES FOR BUG HILL BURIALS.

CRANIAL NON-METRIC VARIANTS

Trait	B.1		B.4		B.6A		B.6B		B.7		B.8		B.8*		B.9*		B.11*	
	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
Epipteric Bone	1	1	9	9	9	9	1	1	9	9	9	9	1	9	9	9	9	9
Asterionic Bone	1	1	9	1	1	1	1	2	9	9	9	9	9	1	9	9	9	9
Parietal Notch Bone	1	1	1	1	1	9	1	1	1	9	2	9	1	2	9	9	9	9
OS Lambdoid Suture	1	1	1	1	1	1	2	1	9	9	9	9	9	9	9	9	1	9
OS Coronal Suture	9	1	9	9	9	9	1	1	9	9	9	9	9	9	9	9	1	1
OS japonium	1	1	9	9	9	9	1	1	9	9	9	9	9	9	1	9	9	9
Infra-orbital Suture	9	9	9	9	9	1	9	1	1	9	9	9	9	9	2	9	9	9
Parietal Notch	9	9	2	2	9	9	2	1	2	2	2	2	9	1	2	9	2	2
Supra-orbital Notch	2	2	9	2	2	2	2	9	2	9	9	2	9	9	1	9	2	2
Supra-orbital foramina	2	2	9	9	2	1	1	2	1	9	2	2	9	9	2	9	2	1
Accessory Supra-orbital foramina	1	1	9	9	1	1	1	9	1	9	2	1	9	9	2	9	1	1
Multiple Mental foramina	2	2	9	9	1	1	1	1	1	1	1	1	1	1	9	1	9	9
Mylo-hyoid Arch	1	9	9	9	1	1	1	1	1	9	9	9	1	9	9	9	9	9
Accessory Infra-orbital foramina	9	9	9	9	9	9	9	1	1	9	9	9	9	9	1	9	9	9
Tympanic Dihiscence	1	1	2	9	2	2	1	1	1	1	9	9	9	9	9	9	9	9
Auditory Exostoses	1	1	1	1	1	1	1	1	1	1	1	1	9	9	9	9	9	9
Divided Hypoglossal Canal	9	9	9	9	2	2	9	1	9	9	9	9	9	9	9	9	9	9
Post-Condylar Canal <u>not</u> Patent	9	9	9	9	1	1	9	9	9	9	9	9	9	9	9	9	9	9
Foramen Ovale incomplete	9	9	9	9	1	9	1	1	1	1	9	9	9	9	9	9	9	9
Foramen spinosum open to F. lacerum	9	9	9	9	9	9	1	1	9	9	9	9	9	9	9	9	9	9
Multiple Zygomatico-facial foramina	1	2	9	9	9	2	2	2	1	9	1	9	9	9	2	9	9	9
Pertygo-alar spurs	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Pterygo-spinous spurs	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Metopic Suture open	1		1		1		1		1		1		9		1		1	
Bregmatic Bone	1		1		9		1		1		9		9		9		1	
Inca Bone	1		1		1		1		1		9		1		2		1	
Apical Bone	1		1		9		2		9		9		9		1		1	
OS sagittal Suture	1		1		9		1		9		9		9		9		1	
Mandibular Torus	1	2	9	9	1	1	1	1	9	1	2	2	1	1	9	2	9	9
Palatine Torus	2		9		2		9		1		9		9		2		9	
Obelionic foramina	1	1	1	1	2	9	1	2	9	9	9	9	9	9	9	1	1	1

TABLE III-1G. NONMETRIC TRAIT SCORES FOR BUG HILL BURIALS. (Continuation)

POST-CRANIAL NON-METRIC VARIANTS

Trait	B.1		B.4		B.6A		B.6B		B.7		B.8		B.8*		B.9*		B.11*	
	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
Atlas: Lateral Bridging	1	9	9	9	1	1	9	9	9	9	9	9	1	1	9	9	9	9
Atlas: Posterior Bridging	1	1	9	9	1	1	9	9	9	9	9	9	1	1	9	9	9	9
C3: Accessory Foramina	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	9	1	1
C4: Accessory Foramina	9	9	9	9	1	2	9	9	2	2	9	9	1	1	9	9	2	2
C5: Accessory Foramina	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	9	2	9
C6: Accessory Foramina	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	9	9	9
C7: Accessory Foramina	9	9	9	9	9	9	9	9	9	9	9	9	1	1	9	9	9	9
Humerus: Septal Apeture	1	1	1	1	1	2	9	9	9	9	9	9	1	1	9	9	9	9
L5: Spondylysis	9	9	9	9	1	1	9	9	1	1	9	9	1	1	9	9	9	9

* Burials from 1979 excavation by University of Oklahoma

TABLE III-11. MAXILLARY AND MANDIBULAR DENTAL MORPHOLOGY.

Maxillary Dental Morphology

		Burial 6A	Burial 6B	Burial 10
Winging	I1	9	9	9
	I1	9	9	9
Shoveling	C	9	9	9
	2I	9	1	9
	1I	1	9	9
	I1	9	9	9
	I2	9	1	9
	C	0	9	9
Double Shoveling	C	9	1	9
	2I	9	4	9
	1I	9	9	9
	I1	9	9	9
	I2	9	4	9
	C	9	4	9
Tuberculum dentale	C	9	0	9
	2I	9	0	9
	1I	0	9	9
	I1	9	9	9
	I2	9	0	9
	C	2	0	9
Incisor Interruption Grooves	2I	9	4	9
	1I	4	9	9
	I1	9	9	9
	I2	9	2	9
Canine Distal Accessory Ridge	C	9	9	9
	C	9	9	9
Premolar Cusp Number	2PM	1	1	9
	1PM	1	1	9
	PM1	1	9	9
	PM2	9	9	9
Cusp 5	3M	9	1	9
	2M	9	9	1
	1M	9	9	1
	M1	9	9	1
	M2	9	9	1
	M3	9	9	9
Carabelli's Cusp	3M	9	1	9
	2M	1	1	1
	1M	1	1	1
	M1	1	1	1
	M2	1	1	1
	M3	9	9	9
Hypocone	3M	9	3	9
	2M	0	4	0
	1M	0	4	0
	M1	0	4	0
	M2	0	4	0
	M3	9	9	0
Third Molar	3M	2	1	9
	M3	2	1	9

TABLE III-11. MAXILLARY AND MANDIBULAR DENTAL MORPHOLOGY.
(Continuation)

Mandibular Dental Morphology

		Burial 6A	Burial 6B	Burial 10
Lower Incisor Shoveling	2I	9	0	9
	1I	0	0	9
	I1	0	0	9
	I2	0	0	9
Canine Distal Accessory Ridge	C	9	0	9
	C	9	9	9
Premolar Lingual Cusps	2PM	1	1	9
	1PM	1	1	9
	PM1	1	1	9
	PM2	1	9	9
Molar Groove Pattern	3M	2	3	9
	2M	2	2	9
	1M	2	2	1
	M1	2	2	1
	M2	2	2	1
	M3	9	3	9
Protostylid	3M	2	1	9
	2M	1	1	9
	1M	1	1	2
	M1	1	1	2
	M2	1	1	2
	M3	9	1	9
Cusp 6	3M	2	1	9
	2M	1	1	9
	1M	1	1	1
	M1	1	1	1
	M2	1	1	1
	M3	9	1	9
Cusp 7	3M	1	1	9
	2M	1	1	9
	1M	1	1	0
	M1	1	1	0
	M2	1	1	0
	M3	9	1	9
Cusp 5	3M	2	1	9
	2M	1	1	9
	1M	1	1	2
	M1	1	1	2
	M2	1	1	2
	M3	9	1	9
Third Molar	3M	1	1	9
	M3	1	1	9

TABLE III-12. PERCENTAGE OF POSITIVE NONMETRIC TRAITS FOR FOURCHE MALINE AND CADDO SITES.

	Bug Hill	McCutchan-McLaughlin[1]	Sam[1]	Wann[1]	Bentsen Clark[2]	Kaufman Williams[3]
Epiteric Bone	0.0	0.0	7.7	0.0	66.7	-
Asteriaonic Bone	20.0	0.0	4.0	18.8	0.0	29.4
Parietal Notch Bone	28.6	15.4	0.0	0.0	-	16.7
Os Lambdoid Suture	20.0	20.0	8.8	85.0	66.7	23.5
Os Coronal Suture	0.0	16.7	9.7	16.7	-	2.3
Supra-Orbital Foramen	85.7	33.3	35.1	36.8	57.1	-
Multiple Mental Foramen	14.3	-	-	-	10.7	3.7
Mylohyoid Arch	0.0	-	-	-	33.3	3.7
Accessory Infra-Orbital Foramina	0.0	33.3	0.0	0.0	-	-
Auditory Exostosis	0.0	0.0	15.0	19.0	17.6	5.7
Post Condylar Canal Not Patent	0.0	0.0	33.3	100.0	16.7	-
Foramen Ovale Incomplete	0.0	0.0	0.0	0.0	0.0	-
Foramen Spinosum Open	0.0	0.0	25.0	66.7	-	-
Metopic Suture Open	0.0	0.0	0.0	0.0	0.0	-
Bregmatic Bone	0.0	0.0	0.0	0.0	0.0	-
Inca Bone	12.5	-	-	-	0.0	0.0
Mandibular Torus	42.8	33.3	5.9	22.2	-	9.2
Palatine Torus	75.0	12.5	18.8	0.0	-	6.1
Tympanic Dihiscence	40.0	-	-	-	11.1	15.2

1 Powell and Rogers 1980

2 Buikstra and Fowler 1975

3 Loveland 1980

McWilliams (1970) concludes that non-metric analysis of the Sam and Wann Fourche Maline skeletal series indicates a common genetic heritage for these two sites. Powell and Rogers (1980) conclude that when sample size is taken into consideration that the McCutchan-McLaughlin skeletal series cannot be differentiated from the Sam and Wann series. These authors suggest (implicit in their analysis) a common genetic heritage for the Oklahoma Fourche Maline with variation due to temporal and geographic distance. Small sample size (maximum of seven individuals) precludes a statistical comparison of Bug Hill and the other three midden mound sites. Visual comparison of the percentages in Table III-12 indicates that when traits have a high frequency (i.e., Supra-Orbital Foramen) at Bug Hill, they are also high in the other three Fourche Maline skeletal series, while traits with low frequencies (i.e., Epipteric Bone) at Bug Hill are also low at the other sites. These data suggest a common gene pool for the Oklahoma Fourche Maline populations. Comparison of the Fourche Maline and Caddo (i.e., Bentsen Clark and Kaufman-Williams) frequencies does not suggest any major genetic difference between the two populations. Although the data are still not sufficiently numerous for a comprehensive test, they do not support Caddoan origins outside the indigenous Fourche Maline populations.

APPENDIX IV

AN INTERPRETATION OF THE ROLE OF LITHIC RAW MATERIALS AT BUG HILL

by

Larry D. Banks

During the chert identifications some observations were made that are perhaps of equal, if not more, significance than the relationship of the artifacts to the chert boulders in the Johns Valley deposits. Since the chert identifications were being made purely from a material identification and the artifact typology was not a factor, particular awareness of typology was only incidental. After examining most of the selected artifacts, however, it became apparent that a number of the dart points from the Early Caddoan house (Structure 2) were of typical Archaic period styles. Some of the longer stemmed "Garys" appear to be resharpened Dicksons. This was revealing, though not surprising, because Lintz (1979c) suggested such recycling as a practice to explain phenomena at the Blessingame site. The stems of both the Gary's and the smaller Dixon's fall well within the same size ranges. The differences mostly occur in the lengths and widths of the blades. The obviously resharpened Gary type specimens could very well have been produced from the older and larger Dixons.

Also, Shafer (1973:233-235) suggests the use of recycling Archaic bifaces by the Caddo at the George C. Davis site to explain the obviously more recent flaking on the Archaic preforms found by Newell and Kreiger (1949). The hematite plummet (Story 1972:34) from Feature 119 of Mound C at the Davis site is, of course, a different type of artifact from those being discussed here, but the presence of this "Poverty Point" type of artifact in a Caddoan ceremonial context is certainly indicative of a Caddoan attitude of respect, reverence, or some other sort of veneration of "relics" from an earlier people. In specific relationship to the Bug Hill site and in particular to the one individual associated with the cache of Dickson points (Feature 56), there is a strong implication that stone tool production (and possibly lithic industry in general) and ceremonialism were closely related at least as early as Late Archaic time and possibly carried over into Caddoan customs.

The number of projectile points examined was presumably only a portion of the numbers represented because only slightly over three quarters of the structure had been excavated. The Archaic and Caddoan artifacts combined exhibited effects resulting from burning and charring by the same fire. Why would the floor of a Caddoan structure be littered with chipped lithic artifacts of both Caddoan and Archaic origin? Was the burning of the structure intentional or accidental? Can such an unusual accumulation of typologically mixed artifacts be used as an indication of determining whether a structure was burned intentionally? If not, what other criteria are required to archaeologically determine the cause of a fire in specialized type of site?

Although a number of artifacts exhibited heat crazing, fire spalls, and discolorations, few of the materials appeared to have represented intentional heat treatment which normally produces more uniform color change, glossy luster, and absence of actual crazing, fracturing, and pot lidding. The specimens exhibiting the effects of heat can best be explained by accidental and direct association with fire.

The more unexplainable aspect associated with this burned "house" was the number of artifacts involved. Even if all the artifacts had been of Caddoan origin, the structure should not have been literally covered with artifacts.

In contrast to the materials in the Caddoan structure, the artifacts from the other strata did not exhibit burning or charring, although a few of them do exhibit possible heat treatment. Is the 3500 year old ritualistically placed cache of the "Dickson" blades indicative that later Woodland and Caddoan people learned of the Johns Valley sources from the terminal Archaic occupants of the valley? Were Caddoan settlement patterns in the Jackfork basin influenced strongly, if not primarily, by the Johns Valley outcrops? The four known "black mounds" in the Jackfork basin appear to be rather uniformly spaced; in at least three of those cases the proximity to outcrops of the Johns Valley shale suggests that the site locations were, in part, a response to the provenience of lithic resources.

Explanations for the presence of recycled Archaic artifacts of the same lithic types, occurring in significant numbers in the floor of a burned structure pose complex questions to be answered. Given the fact that the Johns Valley deposits represent what can be considered some of the most significant chert resources in the western Ouachita Mountains, it would be quite likely that a high economic value would be placed upon the area as well as upon the raw materials. In turn, this recognition would certainly play a major role in settlement patterns not only for the systems manifested in the Jackfork basin related direct to chert procurement, but in a larger regional system, especially during the Caddoan periods. It would also follow that the value of the materials and the area would be accompanied by ceremonialism. If the occurrence of the raw materials was viewed as a "divine" gift in a view similar to those reflected in such ethnographic literature as that of the Pawnee and Arikara (Dorsey 1904-1906), then it would be more difficult to understand why ceremonialism would not be involved rather than having to explain why it was.

Several questions come to mind. Was the Bug Hill site only one component of a system designed primarily to produce chert for wider distribution in a Caddoan "chiefdom"? Were the other "midden mounds" in the Jackfork basin strategically placed for "local" exploitation or control of chert resources? Were the "mound" site occupied contemporaneous with other sites in the basin at any given point in time, or were they occupied essentially by skilled specialists within each culture who relocated from time to time? Are similar patterns expressed in other basins of the Ouachitas with Johns Valley exposures such as those of Buck Creek and Johns Valley itself? Did the early Caddoan inhabitants learn of the Johns Valley raw materials from other people, or did they manage to locate such obscure geologic deposits during their own explorations? The evidence at Bug Hill seems to suggest a continuum of knowledge of natural resources spanning Archaic, Woodland, and Caddoan periods. There is no question that the previously referenced large chert bifaces found in a ceremonial context at the Bentsen-Clark site are from the Johns Valley shale deposits in the Jackfork basin.

If the Jackfork basin was used as a "factory" locale, then the unexplained relationships between "reduction" and habitation sites found by all the previous investigators would be logically explained. The "better" or more "highly valued" products would more logically be found in sites outside the Jackfork basin. It would follow that only debitage would be expressed in high percentages of material remaining near the source of origin. Also, if the value of the Jackfork area resources was what it seems to have been, abandonment of the area by ritually attuned Caddoan inhabitants could have been accompanied by ritualistic burning of a temple or the local "chiefs" house containing the most highly valued economic products in the area - chert, representing not only Caddoan artifacts but objects representing human antiquity.

BIBLIOGRAPHY

Acsadi, G. and J. Nemeskeri
1970 History of human life span and mortality. Akademiai Kiado, Budapest.

Albert, Lois E.
1981 Ferndale Bog and Natural Lake: five thousand years of environmental change in southeastern Oklahoma. Oklahoma Archeological Survey, Studies in Oklahoma's Past No. 7. University of Oklahoma, Norman.

Alexopoulous, C.J. and C.W. Mims
1979 Introductory mycology. John Wiley and Sons, New York.

Altschul, Jeffrey H.
1982a A progress report on the Bug Hill site (34Pu116), Pushmataha County, Oklahoma. Paper presented at the Fourth Annual Flint Hills Archaeological Conference, Tulsa.

1982b Bug Hill: excavation of a multi-component midden mound, Clayton (Sardis) Lake, southeast Oklahoma. Paper presented at the 47th annual meeting of the Society for American Archaeology, Minneapolis.

Anderson, S.
1979 Brown earth and podzol: soil genesis illuminated by microfossil analysis. Boreas 8:59-73.

Armelagos, G.J.
1969 Disease in ancient Nubia. Science 163:225-259.

Baerreis, D.A.
1969 A preliminary analysis of gastropods from the Mill Creek sites. Journal of the Iowa Archeological Society 16:333-343.

1971 Environmental reconstruction through molluscan remains: a preliminary report on the A.C. Banks site. In Prehistoric investigations, edited by Marshall McKusick, pp. 95-108. Office of Iowa State Archaeologist, Report 3.

1973 Gastropods and archaeology. In Variation in anthropology, edited by Donald W. Lathrap and Jody Douglas, pp. 43-53. Illinois Archaeological Survey, Urbana.

1974 Molluscan remains from 13Ck405. Journal of the Iowa Archeological Society 21:131-143.

1978 Armstrong: gastropod analysis, Appendix B. In The Armstrong Site: a Silvernale phase Oneota village in Wisconsin by W.M. Hunley. The Wisconsin Archaeologist 59(1):106-107.

Baerreis, D.A.
1980 Habitat and climatic interpretation from terrestrial gastropods at the Cherokee Site. In The Cherokee excavations, Holocene ecology and human adaptations in northwest Iowa, edited by Duane C. Anderson and Holmes A. Semken, Jr., pp. 101-122.

Banks, Larry D.
1975 Field report on retracing the 1719 route of Jean Baptiste Benard Sieur de la Harpe through the Winding Stair Range. Ms. on file at the U.S. Army Corps of Engineers, Fort Worth District.

Banks, Larry D. and Joe B. Winters
1975 The Bentsen-Clark site: a preliminary report. Texas Archeological Society Special Memoir 2, San Antonio.

Barr, T.P.
1966 The Pruitt site: a Late Plains Woodland manifestation in Murray County, Oklahoma. Oklahoma River Basin Survey, Archeological Site Report 5. University of Oklahoma Research Institute, Norman.

Basch, Paul F., Philip Bainer and Jerry Wilhm
1961 Some ecological characteristics of the molluscan fauna of a typical grassland situation in east central Kansas. The American Midland Naturalist 66(1):178-199.

Bass, William M.
1971 Human osteology: a laboratory and field manual of the human skeleton. Missouri Archaeological Society, Columbia.

Bell, R.E.
1953 The Scott Site, LeFlore County, Oklahoma. American Antiquity 18(4):314-331

1958 Guide to the identification of certain American Indian projectile points. Oklahoma Anthropological Society, Special Bulletin No. 1. Norman.

1960 Guide to the identification of certain American Indian projectile points. Oklahoma Anthropological Society, Special Bulletin No. 2. Norman.

1972 The Harlan site, CK-6, a prehistoric mound center in Cherokee County, eastern Oklahoma. Oklahoma Anthropological Society, Memoir 2. Norman.

1980 Fourche Maline: an archaeological manifestation in eastern Oklahoma. In Caddoan and Poverty Point archaeology: essays in honor of C.H. Webb, edited by Jon L. Gibson, pp. 83-125. Louisiana Archaeological Society Bulletin 6.

Bell, R.E. and D.A. Baerreis
1951 A survey of Oklahoma archaeology. Bulletin of the Texas Archeological and Paleontological Society 22:7-100.

Berg, Richard
1982 Paleopathology of the Gold Mine site. Ms. on file at Anthropology Department, University of Arkansas.

Bernabo, J.C. and T. Webb III
1977 Changing patterns in the Holocene pollen record of northeastern North America: a mapped summary. Quaternary Research 8:64-96.

Berry, R.J.
1968 The biology of non-metrical variation in mice and men. In The skeletal biology of earlier human populations, edited by N. Brothwell. Pergamon, London.

Binford, Lewis R.
1981 The archaeology of phase. Journal of Anthropological Archaeology 1(1):5-31.

Bjorck, S., T. Persson and I. Kristersson
1978 Comparison of two concentration methods for pollen in minerogenic sediments. Geol. Foren. Stockh. Forh. 46:76-82.

Blair, W.F. and T.H. Hubbell
1938 The biotic districts of Oklahoma. The American Midland Naturalist 20:425-455.

Bobalik, Sheila J.
1982 The Arrowhead hill site (34Pu-105). In Phase II archaeological investigations at Clayton Lake, southeast Oklahoma, edited by Rain Vehik. Archaeological Research and Management Center Research Series No. 8. University of Oklahoma, Norman.

1977 Archaeological investigations at proposed Clayton Reservoir, 1976: Latimer, Pittsburg and Pushmataha counties, Oklahoma. Oklahoma Archeological Survey, Archeological Resource Survey Report 5. University of Oklahoma.

1978a The Viper Marsh site (Mc-205) McCurtain County, Oklahoma. Oklahoma Archeological Survey Occasional Publication 3. University of Oklahoma, Norman.

1978b Archaeological investigations at the Sallee G. site, 34Pu-99, Pushmataha County, Oklahoma. Oklahoma Archaeological Survey Studies in Oklahoma's Past 3. University of Oklahoma, Norman.

Bobalik, Sheila J.
1979 The Vanderwagen Site (34Pu73). In Prehistory of the proposed Clayton Lake area, southeast Oklahoma: phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center, Research Series No. 6. University of Oklahoma.

Bobalik, Sheila J. and Jerry R. Galm
1976 Faunal remains from the Scott (34Lf-11) and Wann (34Lf-27) sites, Oklahoma, Appendix C. In Cultural sequences at the Scott (34Lf-11) and Wann (34Lf-27) sites and prehistory of the Wister Valley, by Jerry R. Galm and Peggy Flynn, pp. 299-332. Archaeological Research and Management Center, Research Series No. 3. University of Oklahoma.

Bowers, Roger L.
1975 Petrography and petrogenesis of the Alibates dolomite and chert (Permian) northern panhandle of Texas. M.A. Thesis, Department of Geology, University of Texas at Arlington.

Boyd, Lynn F.
1978 Evaluation of Wilson Bands as an indicator of childhood stress: a case study of developmental enamel defects in the Libben skeletal population. M.A. Thesis, University of Arkansas, Fayetteville.

Brackenridge, G.R.
1981 Late Quaternary floodplain sedimentation along the Pomme de Terre River, southern Missouri. Quaternary Research 15.

Branson, B.A.
1959 The recent gastropods of Oklahoma. Part I, Historical Review, general comments and higher taxonomic categories. Proceedings of the Oklahoma Academy of Science 39:21-37.

1961a Recent Gastropoda of Oklahoma, Part II. Distribution, ecology and taxonomy of fresh-water species, with description of Helisoma travertina sp. nov. Oklahoma State University Publication Biological Studies Series No. 6, pp. 1-72.

1961b The recent Gastropoda of Oklahoma, III. Terrestrial species: Pupillidae, Carychiidae, Strobilopsidae and Oligyridae. Proceedings of the Oklahoma Academy of Science 41:45-69.

1962a The slugs (Gastropoda: Pulmonata) of Oklahoma and Kansas with new records. Transactions of the Kansas Academy of Science [illegible](2):110-119.

1962b The recent Gastropoda of Oklahoma, Part IV. Terrestrial species, families Polygyridae and Bulimulidae. Proceedings of the Oklahoma Academy of Science 42:60-80.

Branson, B.A.
1963 The recent Gastropoda of Oklahoma, V. Terrestrial species, Valloniidae, Achatinidae and Succineidae. Proceedings of the Oklahoma Academy of Science 43:73-87.

1964a List of the Sphaeriidae known from Oklahoma. Sterkiana 13:19-21.

1964b The recent Gastropoda of Oklahoma, VI. Terrestrial families, Endodontidae and Haplotrematidae. Revisions and Retinella Zikmundi sp. nov. Proceedings of the Oklahoma Academy of Sciences 44:25-41.

1973a The recent Gastropoda of Oklahoma, Part VII. The Zonitidae. Sterkiana 52:28-44.

1973b Significant pelecypod records from Oklahoma. The Nautilus 87(1):8-10.

Braun, E.L.
1950 Deciduous forests of eastern North America. The Free Press, New York.

Brewer, Andrea J.
1973 Analysis of floral remains from the Higgs site (40Ld45). In Excavation of the Higgs and Doughty Sites, I-75 salvage archaeology, edited by M.C.R. McCollough and C.H. Faulkner. Tennessee Archaeological Society Miscellaneous Paper 12:141-144.

Briscoe, J.
1977 The Plantation Site (Mi-63), an early Caddoan settlement in eastern Oklahoma. Oklahoma Department of Transportation, Oklahoma Highway Archaeological Survey, Papers in Highway Archaeology 3.

Brothwell, Don R.
1972 Digging up bones. Trustees of the British Museum, London.

Brothwell, Don R. and A.T. Sandison (editors)
1967 Disease in antiquity. Charles C. Thomas, Springfield.

Brown, James A.
1966 Description of the mound groups. University of Oklahoma Research Institute Spiro Studies 1. Norman

1971 Pottery vessels. University of Oklahoma Research Institute Spiro Studies III. Norman.

1973 Spiro art and its mortuary contexts. In Death and the afterlife in Pre-Columbian America, edited by Elizabeth P. Benson, pp. 1-32. Dunbarton Oaks Research Library and Collection, Washington D.C.

Brown, James A., R.E. Bell, and D.G. Wyckoff
1978 Caddoan settlement patterns in the Arkansas River drainage. In Mississippian settlement patterns, edited by B. Smith, pp. 169-200. Academic Press, New York.

Brues, A.M.
1957 Skeletal remains from the Nagle Site. Bulletin of the Oklahoma Anthropology Society 5:101-106.

1958 Skeletal material from the Horton Site. Bulletin of the Oklahoma Anthropology Society 6:27-32.

1959 Skeletal material from the Morris Site (CK-39). Bulletin of the Oklahoma Anthropological Society 7:63-70.

Bryson, R.A., D.A. Baerreis and W.M. Wendland
1970 The character of late-glacial and post-glacial climatic changes. In Pleistocene and Recent environment of the central Great Plains, edited by W. Dort and J.N. Jones. Department of Geology, University of Kansas, Special Publication 3:53-74.

Burch, J.B.
1962 The eastern land snails. How To Know Series, p. 214. Wm. C. Brown Company, New York.

1975 Freshwater Unionacean clams (Mollusca: Pelecypoda) of North America. Revised Edition, p. 204. Malacological Publications, Hamburg, Michigan.

Burton, S.S.
1970 The Hugo Dam Site, Ch112, Choctaw County, southeast Oklahoma. Oklahoma River Basin Survey. University of Oklahoma Research Institute, Norman. Archaeological Site Report 16.

Buikstra, Jane E. (editor)
1981 Prehistoric tuberculosis in the Americas. Northwestern University Archaeological Program, Evanston.

Buikstra, J.E. and D. Fowler
1975 An osteological study of the human skeletal materials from the Bensten-Clark Site. In The Bentsen-Clark site, Red River County, Texas: a preliminary report, by L.D. Banks and J. Winters, pp. 79-97. Texas Archeological Society, San Antonio.

Buikstra, J.E., M. Vadeboncower, and G. Behrend
1975 An osteological study of the human skeletal materials from the Bensten-Clark Site. In The Bensten-Clark site, Red River County, Texas: preliminary report, by L. Banks and J. Winters, pp. 79-97. Texas Archeological Society, Austin.

Butler, B.H.
1969 Analysis of the human skeleton remains (Appendix I). In Investigations at the Sam Kaufman Site, Red River County, Texas, edited by S.A. Skinner, R.K. Harris and K.M. Anderson, pp. 115-136. Southern Methodist University Contributions in Anthropology 5. Dallas.

Burton, Susan S. and William L. Neal
1970 The Dickson-Haraway site, SQ-40, Sequoyah County, Oklahoma. Oklahoma River Basin Survey, Archaeological Site Report 20:1-51.

Call, R.E.
1895 A study of the Unionidae of Arkansas, with incidental reference to their distribution in the Mississippi Valley. Transactions of the Academy of Sciences of St. Louis 7:1-65.

Chaplin, Raymond E.
1971 The study of animal bones from archaeological sites. Seminar Press, London.

Cheatum, E.P. and D. Allen
1964 Limitations in paleoecological reconstruction utilizing data from fossil non-marine molluscs. In The reconstruction of past environments, assembled by James J. Hester and James Schoenwetter, pp. 31-33. Fort Burgwin Research Center No. 3. New Mexico.

Cheatum, E.P. and R.W. Fullington
1971a The Recent and Pleistocene members of the Gastropod family Polygyridae in Texas, Part I. Dallas Museum of Natural History Bulletin 1:1-74.

1971b Keys to the families of the recent land and fresh-water snails of Texas, supplement. Dallas Museum of Natural History Bulletin 1:1-18.

1973 The Recent and Pleistocene members of the Pupillidae and Urocoptidae (Gastropoda) in Texas, Part II. Dallas Museum of Natural History Bulletin 1:1-67.

Christensen, Martha
1981 Species diversity and dominance in fungal communities. In The Fungal Community, edited by D.T. Wicklow and George C. Carroll. Marcel Dekker, New York.

Clarke, Steven K.
1982 The association of early childhood enamel hypoplasias and radiopaque transverse lines in a culturally diverse prehistoric skeletal sample. Human Biology 54:77-84.

Clench, William J.
1974 Mollusca From Russell Cave. In Investigations in Russell Cave, Russel. Cave National Monument, Alabama, by John W. Griffin, pp. 86-90. National Park Service Publications in Archaeology 13. Washington, D.C.

Conant, Alban J.
1975 A field guide to reptiles and amphibians of eastern and central North America. Houghton McMillan Company, Boston.

Condon, Keith W.
1980 Correspondence of developmental enamel defects between the mandibular canine and first premolar. M.A. Thesis, Department of Anthropology, University of Arkansas. Fayetteville.

Cook, Della C.
1981 Mortality, age-structure and status in the interpretation of stress indicators in prehistoric skeletons: A dental example from the Lower Illinois Valley. In The Archaeology of Death, edited by R. Chapman, I. Kinnes, K. Randsborg, pp. 133-55. Cambridge University Press, London.

Cook, Della C. and J.E. Buikstra
1979 Health and differential survival in prehistoric populations: prenatal dental defects. American Journal of Physical Anthropology 51:649-664.

Coon, Nelson
1974 The Dictionary of useful plants. Rodale Press, Pa.

Corps of Engineers
1981 Baseline bedrock and geologic coring data. Unpublished data on file U.S. Army Corps of Engineers, Tulsa District, Tulsa.

Cowgill, George L., Jeffrey H. Altschul, and Rebecca S. Sload
n.d. Spatial analysis of Teotihuacan: a Mesoamerican metropolis. In Intrasite spatial analysis in archaeology, edited by H. Hietala and P. Larson. Cambridge University Press, London.

Crabtree, Don E.
1972 An introduction to flintworking. Occasional Papers of the Idaho State University Museum 28.

Crane, Cathy J.
1982 Plant utilization at Spoonbill, an early Caddo site in northeast Texas. Midcontinental Journal of Archeology 7:81-97.

Crook, Wilson W. and R. King Harris
1952 The Trinity Aspect of the Archaic Horizon: the Carrollton and Elam Foci. Bulletin of the Texas Archeological and Paleontological Society 23:7-38.

Cook, Wilson W. and R. King Harris
1959 C-14 date for the Late Carrollton focus Archaic level: 6000 Years B.P. Newsletter of the Oklahoma Anthropological Society 8(3):1-2. Norman.

Cutler, Hugh C. and Leonard W. Blake
1973 Plants from archeological sites east of the Rockies. Missouri Botanical Gardens, St. Louis.

Davis, E.M.
1970 Archeological and historical assessment of the Red River basin in Texas. Arkansas Archeological Survey, Research Series 1:25-65.

Delcourt, P.A. and H.R. Delcourt
1981 Vegetation maps for eastern North America: 40,000 B.P. to the Present. In Geobotony II, edited by R.C. Romans. Plenum Press, New York.

Dellinger, S.E. and S.D. Dickinson
1941 Excavation of the Means Place, a Caddo-Coles Creek site in Hot Springs County, Arkansas. Ms. on file at the University of Arkansas Museum, Fayetteville.

Demirgian, A. and G.Y. Levesque
1980 Sexual differences in dental development and prediction of emergence. Journal of Dental Research 59:1110-1122.

Dickinson, S.D. and S.E. Dellinger
1941 Excavation of the Cooper Place, a Marksville site in Hot Springs County, Arkansas. Final report on W.P.A. Project No. 665-63-3-170. Ms. on file at the University of Arkansas Museum, Fayetteville.

Dimbleby, G.W.
1957 Pollen analysis of terrestrial soils. New Phytologist 56:12-28.

Dorsey, George A.
1904a Traditions of the Skidi Pawnee. Published for the American Folk-Lore Society by Houghton-Mifflin and Company, Boston and New York, London: David Nutt, 270, 271 Strand. Leipzig: Otto Harrassowitz, Querstrasse 14.

1904b Traditions of the Arikara. Published for the American Folk-Lore Society by Houghton-Mifflin and Company, Boston and New York, London: David Nutt, 270, 271 Strand. Leipzig: Otto Harrassowitz, Querstrasse 14.

1906 The Pawnee, Mythology (Part 1). Carnegie Institution of Washington, Washington, D.C.

Drass, Richard
1977 Resurvey and testing of selected locales in the Clayton Reservoir area, Appendix A. In Archaeological investigations at the proposed Clayton Reservoir 1976: Latimer, Pittsburg, and Pushmataha counties, Oklahoma, by Sheila J. Bobalik, pp. 595-657. Oklahoma Archaeological Survey Archaeological Survey Report 5. University of Oklahoma, Norman.

Driver, H.E. and W.C. Massey
1951 Comparative studies of North American Indians. Transactions of the American Philosophical Society, New Series 47 (Part 2).

Elsik, W.C.
1966 Biologic degradation of fossil pollen grains and spores. Micro-Paleontology 12(4):515-18.

1971 Microbiological degradation of sporopollenin. In Sporopollenim, edited by I. Brooks, pp. 480-509. Academic Press, London.

England, C.M. and E.L. Rice
1957 A comparison of the soil fungi of a tall-grass prairie and an abandoned field in central Oklahoma. Botonical Gazette 118:186-190.

Evans, J.G.
1972 Land snails in archaeology. Seminar Press, London.

Faegri, K. and J. Iversen
1975 Textbook of pollen analysis. (Third Revised Edition). Hufner Press, New York.

Fay, R.O.
1980 Geological and historic notes on the La Harpe Expedition into Oklahoma in 1719. Oklahoma Geology Notes 40(6):254-261.

Finkelstein, J.J.
1940 The Norman Site excavations near Wagoner, Oklahoma. The Oklahoma Prehistorian 3(3):2-15.

Finnegan, M.
1974 A migration model for northwest North American. In International Conference on the Prehistory and Paleoecology of Western North American Arctic and Subarctic, edited by Raymond Schlederman. University of Calgary Press.

Flynn, Peggy, M.H. Earman, and R. Vehik
1979 Test excavations at the Buffalo Bend Site (34Pu-111). In The prehistory of the proposed Clayton Lake area, southeast Oklahoma: Phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center Research Series 6. University of Oklahoma, Norman.

Folk, Robert L.
1965 Petrology of sedimentary rocks. (Fourth Edition). Hemphills, Austin, Texas.

Folk, Robert L. and C.E. Weaver
1952 A study of the texture and composition of chert. American Journal of Science 250: 498-510.

Fowells, H.A.
1965 Silvics of forest trees of the United States. Agriculture Handbook No. 271. USDA Forest Service, Washington, D.C.

Franzen, D.S. and A.B. Leonard
1947 Fossil and living Pupillidae (Gastropoda = Pulmonata) in Kansas. University of Kansas Science Bulletin 31(2):313-411.

Freeman, J.E. and A. Dewey Buck, Jr.
1960 Woodward Plain and Neosho Punctate, two shell tempered pottery types in northeastern Oklahoma. Oklahoma Anthropological Society Bulletin 8:3-16.

Fullington, R.W. and W.L. Pratt, Jr.
1974 The Helicinidae, Carychiidae, Achatiniade, Bradybvaenidae, Bulimulidae, Cionellidae, Haplotrematidae, Helicidae, Oreohelicidae, Spriaxidae, Streptaxidae, Strobilopsidae, Thysanophoridae, Valloniidae (Gastropoda) in Texas, Part III. Dallas Museum of Natural History Bulletin 1:1-48.

Galm, Jerry
1978a Archaeological investigations at Wister Lake, LeFlore County, Oklahoma. Archaeological Research and Management Center, Research Series 1. University of Oklahoma, Norman.

1978b The archeology of the Curis Lake site (34Lf-5A), LeFlore County, Oklahoma. Archaeological Research and Management Center, Research Series 2. University of Oklahoma, Norman.

1981 Prehistoric cultural adaptations in the Wister Valley, east-central Oklahoma. Ph.D. dissertation, Washington State University, University Microfilm, Ann Arbor.

Galm, Jerry and Peggy Flynn
1978a New radiocarbon dates for sites in the Wister Valley, eastern Oklahoma. Oklahoma Anthropological Society Newsletter 26(5):2-5.

1978b The cultural sequences at the Scott (34Lf-11) and Wann (34Lf-27) sites and prehistory of the Wister Valley. Archaeological Research and Management Center Research Series No. 3. University of Oklahoma, Norman.

Geological Society of America
1970 Rock color chart. Geological Society of America, Boulder.

Gerdemann, J.W. and J.M. Trappe
1975 Taxonomy of the Endogonoceae. In Endomycorrhizas, edited by F.E. Sanders, B. Mosse and P.B. Tinker, pp. 35-51. Academic Press, New York.

Gilbert, B. Miles and T.W. McKern
1973 A method for aging the female Os Pubis. American Journal of Physical Anthropology 38:31-38.

Gilmore, M.R.
1919 Uses of plants by the Indians of Missouri River region. Bureau of American Ethnology Annual Report 33:43-154.

Giro, C.M.
1947 Enamel hypoplasia in human teeth: an examination of its causes. Journal of the American Dental Association 34:310-317.

Gleason, Henry A.
1952 New Britton and brown illustrated flora. Volumes 1, 2, and 3. Hafner Press, New York.

Goldstein, S.
1960 Degradation of pollen by Phycomycetes. Ecology 41:543-545.

Goodman, Alan, G.J. Armelagos and J.C. Rose
1980 Enamel hypoplasias as indicators of stress in three prehistoric populations from Illinois. Human Biology 52:515-28.

Goodyear, Albert C.
1974 The Brand Site: a techno-functional study of a Dalton site in northeast Arkansas. Arkansas Archaeological Survey Research Series 7. Fayetteville.

Graham, R.W., C.V. Haynes, D.L. Johnson, and M. Kay
1981 Kimmswick: a Clovis-mastodon association in eastern Missouri. Science (in press).

Gruger, J.
1973 Studies on the Late Quaternary vegetation history of northeastern Kansas. Geological Society of American Bulletin 84:239-250.

Guilinger, Edwin L.
1971 Archaeological situation at the Copeland site, a Fourche 'Maline site in LeFlore County. M.A. Thesis, University of Oklahoma, Norman.

Hall, S.A.
1977a A Holocene geology and paleoenvironmental history of the Hominy Creek Valley. In The prehistory and paleo-environment of Hominy Creek Valley, edited by D.O. Henry, pp. 12-43. Laboratory of Archaeology, University of Tulsa, Oklahoma.

Hall, S.A.
1977b Geological and paleoenvironmental studies. In _The prehistory and paleoenvironment of Birch Creek Valley_, edited by D.O. Henry, pp. 11-31. Laboratory of Archaeology, University of Tulsa, Oklahoma.

1977c Geology and palynology of archaeological sites and associated sediments. In _The prehistory of the Little Caney River, 1976 Field Season_, edited by D.O. Henry, pp. 13-42. Laboratory of Archaeology, University of Tulsa, Oklahoma.

1978a Late Holocene alluvial chronology from northeastern Oklahoma. _Fifth Biennial Meeting, American Quaternary Association, Abstracts_ 1978:207.

1978b Snails from archaeological sites in Hominy Creek Valley. In _The prehistory and paleoenvironment of Hominy Creek Valley 1977 field season_, by Donald O. Henry, pp. 79-86. Laboratory of Archaeology, University of Tulsa, Oklahoma.

1980 Paleoenvironmental synthesis of Hominy Creek Valley: pollen and land snail evidence. In _The prehistory and paleoenvironment of Hominy Creek Valley, 1978 field season_. Laboratory of Archaeology, University of Tulsa Contributions in Archaeology 6:44-55.

1981 Deteriorated pollen grains and the interpretation of quaternary pollen diagrams. _Reviews of Palaeobotany and Palynology_ 32:193-206.

1982 Late Holocene paleoecology of the Southern Plains. _Quaternary Research_ 17(2):in press.

Hally, David J.
1981 Plant preservation and the context of paleobotanical samples. American Antiquity 46(4):723-742.

Hamilton, M.
1977 Testing a model for the prediction of variation in human sexual dimorphism. Paper presented at the 46th annual meeting of the American Association of Physical Anthropology, Seattle.

Hardin, Patrick and D. Robinson
1975 A descriptive report of the Vanderpool site, CK-32, Cherokee County, Oklahoma. _Oklahoma Anthropological Society Bulletin_ 23:91-168.

Hardwick, J.L.
1960 The incidence and distribution of caries throughout the ages in relation to the Englishman's diet. _British Dental Journal_ 108:9-17.

Harlow, William M. and Ellwood S. Harrar
1969 _Textbook of dendrology_. McGraw-Hill Book Company, New York.

Harrington, M.R.
1920 Certain Caddo sites in Arkansas. Indian Notes and Monographs. Museum of the American Indian, Heye Foundation, New York.

Hart, Donald, Jr.
1974 Reconnaissance of the water resources of the Arbuckle and Sherman quadrangles, southern Oklahoma. Oklahoma Hydrologic Atlas No. 3, Oklahoma Geological Survey and United States Geological Survey. University of Oklahoma, Norman.

Hatcher, M.A.
1927 Descriptions of the Tejas or Asinai Indians, 1691-1722. Southwestern Historical Quarterly 30(2):150-80.

Havinga, A.J.
1964 Investigation into the differential corrosion susceptibility of pollen and spores. Pollen et Spores 6(2):621-635.

1967 Palynology and pollen preservation. Review of Paleobotany and Palynology 2:81-98.

1971 An experimental investigation into the decay of pollen and spores in various soil types. In Sporopollenin, edited by J. Brooks, pp. 446-479. Academic Press, London.

Haynes, C. Vance
1976 Late Quaternary geology of the lower Pomme de Terre River valley. In Prehistoric man and his environment: a case study in the Ozark Highland, edited by W.R. Wood and R.B. McMillan, pp. 47-61. Academic Press, New York.

1981 Late Quaternary geology of the lower Pomme de Terre River, Missouri. Final contract report for the H.S. Truman Reservoir Project, Osage River Basin (for the University of Missouri, Columbia).

Heiser, Charles B., Jr.
1951 The sunflower among the North American Indians. Proceedings of the American Philosophical Society 95:432-448.

1954 Variation and subspeciation in the common sunflower, Helianthus annuus. American Midland Naturalist 51:287-305.

Hemmings, E. Thomas
1980 Spirit Lake (3LA83): test excavation in a Late Caddo site of the Red River, southwest Arkansas. In Contributions to the archaeology of the Great Bend Region in south Arkansas, edited by Frank F. Schambach. Arkansas Archeological Survey Research Series, in press.

Hendricks, Thomas A., L.S. Gardner, and M.M. Knechtal
1947 Geology of the western part of the Ouachita Mountains of Oklahoma. United States Geological Survey Oil and Gas Explorations, Preliminary Map 66 (in three sheets). Oklahoma City.

Henry, D.O.
1978 Big Hawk Shelter in northeastern Oklahoma: environmental, economic and cultural changes. Journal of Field Archaeology 5:269-87.

Henry, D.O., B.H. Butler and S.A. Hall
1979 The Late prehistoric human ecology of Birch Creek Valley, northeastern Oklahoma. Plains Anthropologist 24(85):207-38.

Hoffman, Michael P.
1968 Archaeological investigations in the Millers Crossing, Hutt, and White Cliff sites, Millwood Reservoir, southwestern Arkansas. Research conducted under cooperative agreement between the National Park Service, Southeast Region, and the University of Arkansas Museum, Contract No. 14-10-0131-1525.

1969 Prehistoric developments in southwestern Arkansas. The Arkansas Archaeologist 10(1-3):37-49.

1970a Three sites in Millwood Reservoir: The Hutt site, the Stark site, and the Beard Lake site. Arkansas Archaeological Survey Research Series 2. Fayetteville, Arkansas.

1970b Archaeological and historical assessment of the Red River Basin in Arkansas. Arkansas Archaeological Survey Research Series 1. Fayetteville, Arkansas.

Honess, C.W.
1923 Mountains of Oklahoma. Oklahoma Geological Survey Bulletin 32(1). Norman.

House, John H. and James W. Smith
1975 Experiments in replication of fire-cracked rock. In The Cache River archaeological project, edited by Michael B. Schiffer and John H. House. Arkansas Archeological Survey Research Series 8. Fayetteville, Arkansas.

Howell, Nancy
1973 The feasibility of demographic studies in 'anthropological' populations. In Methods and theories of anthropological genetics, edited by W.H. Crawford and P.L. Workman. University of New Mexico Press, Albuquerque.

Hubricht, L.
1966 Some land snail records from Arkansas and Oklahoma. Nautilus 79(4):117-118.

Hubricht, L.
1967 Some land snail records from Oklahoma and Arkansas. Nautilus 81(2):65-67.

1972 Some river drift land snails from Oklahoma. Sterkiana No. 45:36.

Hudson, Charles
1976 The Southeastern Indians. University of Tennessee Press, Knoxville.

Huss-Ashmore, R., Alan H. Goodman and George J. Armelegos
1982 Nutritional inference from paleopathology. Advances in Archaeological Method and Theory 5:395-473.

Isely, F.B.
1914 Mussel streams of eastern Oklahoma. Department of Commerce, Bureau of Fisheries, Economic Circular 9, pp. 1-4.

1924 The fresh-water mussel faunal of eastern Oklahoma. Proceedings of the Oklahoma Academy of Sciences 4:43-118.

Irvine, Marilee
1980 Ceramic analysis from the Williams I site, 34Lf-24, Leflore County, Oklahoma. M.A. Thesis submitted to the Department of Anthropology, University of Oklahoma, Norman.

Jaehnig, M.E.W.
1971 The study of gastropods: methodology. Plains Anthropologist 16(54, Pt. I):289-297.

Johnson, D.L.
1977a Soils and soil-geomorphic investigations in the lower Pomme de Terre River Valley. In Contract report for H.S. Truman Reservoir Project, Osage River Basin, Missouri, Part IV, pp. 59-139. University of Missouri, Columbia.

1977b Soil-geomorphic and soil-archaeologic relationships at the Sohn site, Jackson County, Missouri. Contract report for the University of Missouri, Columbia.

1981a Soil geomorphological and alluvial stratigraphical overview of the Feeler site (23Ms12), central Gasconade River, Missouri. Final contract report for the University of Missouri, Columbia.

1981b Soil geomorphic investigations at the Bug Hill site (34PU116) Clayton Lake, Oklahoma. Ms. on file at the Tulsa District Corps of Engineers, Tulsa, Oklahoma.

Johnson, D.L. and C.S. Alexander
1976 A portable coring device for rapid site-sampling and for collecting undisturbed reference monoliths. Plains Anthropologist 20:135-137.

1977 An improved hydraulic sampler for obtaining undisturbed cores. Journal of Sedimentary Petrology 46:259-271.

Johnson, Leroy, Jr.
1962 The Yarbrough and Miller sites in northeastern Texas, with a preliminary definition of the La Harpe Aspect. Bulletin of the Texas Archeological Society 32:141-284.

Jones, V.H.
1949 Appendix, Maize from the Davis Site: its nature and interpretation. Society for American Archeology, Memoir 5:239-49.

Kapp, R.O.
1969 How to know pollen and spores. William C. Brown Company, Dubuque, Iowa.

King, Frances B.
1976 Potential food plants of the western Missouri Ozarks. In prehistoric man and his environments: a case study in the Ozark Highland, edited by W.R. Wood and R.B. McMillan, pp. 249-260. Academic Press, New York.

King, J.E.
1973 Late Pleistocene palynology and biogeography of the western Missouri Ozarks. Ecological Monographs 43:539-69.

King, J.E. and E.H. Lindsay
1976 Late Quaternary biotic records from spring deposits in western Missouri. In prehistoric man and his environments: a case study in the Ozark highland, edited by W.R. Woods and R.B. McMillan, pp. 63-78. Academic Press, New York.

Klippel, W.E., G. Celmer, J.R. Purdue
1978 The Holocene Naiad record at Rodgers Shelter in the western Ozark highland of Missouri. Plains Anthropologist 23(82, Pt. I): 257-271.

Kolb, C.R. and G. Fredlund
1981 Palynological studies, Vocherie and Raybum's Domes, North Louisiana Salt Dome Basin. U.S. Department of Energy, Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Kreiger, Alex
1947 The first symposium on the Caddoan archaeological area. American Antiquity 12(3): 198-207.

Kreshover, S.
1960 Metabolic disturbances in tooth formation. Annals of the New York Academy of Science 85:161-67.

Krogman, Wilton M.
1962 The human skeleton in forensic medicine. Charles C. Thomas, Springfield.

Lallo, J., J.C. Rose and G.J. Armelagos
1980 An ecological interpretation of variation in mortality within three prehistoric American Indian populations from Dickson mounds. In Early Native Americans: Prehistoric Demography, Economy and Technology, edited by D.L. Browman. Mouton Publishers, The Hauge.

Lallo, John W. and J.C. Rose
1979 Patterns of stress, disease and mortality in the two prehistoric populations from North America. Journal of Human Evolution 8:323-35.

Lane, K.A. and A. Sublett
1972 The osteology of social organization: residence pattern. American Antiquity 37:186-201.

Laughlin, W.S. and J.B. Jorgensen
1956 Isolate variation in Greenland Eskimo crania. Acta Genetica et Statistica Medica 6:3-12.

Lawton, S.P.
1960 Archaeological survey of the Hugo Reservoir. Unpublished ms. on file at the Oklahoma River Basin Survey Project, Norman.

Leonard, A.B.
1959 Handbook of gastropods in Kansas. University of Kansas Department of Zoology, State Biological Survey, Miscellaneous Publication 20:1-224.

Leopold, E.B.
1967 Late-Cenozoic patterns of plant extinction. In Pleistocene extinctions, the search for a cause, edited by P.S. Martin and H.E. Wright, pp. 203-246. Yale University Press, New Haven, Connecticut.

Lieux, Meredith H.
1980 An atlas of pollen of trees, shrubs and woody vines of Louisiana and other southeastern states. Pollen et Spores 22:17-57.

Lintz, Christopher
1979a Lithic resources in the proposed Clayton Lake area. In The prehistory of the proposed Clayton Lake area, southeast Oklahoma: phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center Research Series No. 6. University of Oklahoma, Norman.

Lintz, Christopher

1979b The Natural Lake site (34Pu-71). In The prehistory of the proposed Clayton Lake area, southeast Oklahoma: phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center, Research Series No. 6. University of Oklahoma, Norman.

1979c The Blessingame site (34Pu-74). In The prehistory of the proposed Clayton Lake area, southeast Oklahoma: phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center, Research Series No. 6. University of Oklahoma, Norman.

1979d Jeff Brown site (34Pu-72). In The prehistory of the proposed Clayton Lake area, southeast Oklahoma: phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center, Research Series No. 6. University of Oklahoma, Norman.

1982a The Wheeler Lee site (34Pu-102). In Phase II archaeological investigations at Clayton Lake, southeast Oklahoma, edited by Rain Vehik. Archaeological Research and Management Center, Research Series 8. University of Oklahoma, Norman.

1982b The Blessingame Site (34Pu-74). In phase II archaeological investigations at Clayton Lake, southeast Oklahoma, edited by Rain Vehik. Archaeological Research and Management Center, Research Series 8. University of Oklahoma, Norman.

Little, Silas, Jr.

1953 Prescribed burning as a tool in forest management in the northeastern States. Journal of Forestry 51:496-500.

Lorrain, Dessamae

1968 An archaeologist's guide to nineteenth century American glass. Historical Archaeology 2:35-44.

Lovejoy, C.O., R.S. Meindle, T.R. Pryzbeck, T.S. Barton, K.G. Heiple and D. Knotting

1977 Paleodemography of the Libben site, Ottawa County, Ohio. Science 198:291-293.

Loveland, Carol J.

1980 The skeletal biology of the Caddo Indians of the Kaufman-Williams site, Red River County, Texas. Unpublished Ph.D. Dissertation, Department of Anthropology, University of Tennessee.

Lyell, Sir Charles

1849 A second visit to the United States of North America. Harper and Row, New York.

MacNeish, Richard S.
1958 Archaeology of Tamaulipas, Mexico. Transactions of the American Philosophical Society 48(6).

Mallik, M.A. and E.L. Rice
1966 Relation between soil fungi and seed plants in three successional forest communities in Oklahoma. Botanical Gazette 127:120-27.

Mallouf, Robert J.
1976 Archaeological investigations at proposed Big Pine Lake, 1974-1975, Lamar and Red River counties, Texas. Historical Commission Archeological Survey Report 18. Austin.

Matteson, M.R.
1953 Land-snail shells found in a kitchen midden of Illinoian Indians of the Hopewell culture. Nautilus 66(4):130-138, 67(1):25-26.

1959 Snails in archaeological sites. American Anthropologist 61(6):1094-1096.

1960 The reconstruction of prehistoric environments through the analysis of molluscan collections from shell middens. American Antiquity 26(1):117-120.

Mayo, M.E.
1975 A resurvey and assessment of the prehistoric resources of Wister Lake, LeFlore County, Oklahoma. University of Oklahoma Research Institute. Oklahoma River Basin Survey, General Survey Report 15. Norman.

McBride, Earle F. and A. Thomson
1970 Novaculite, Marathon Region, Texas. Geological Society of America Special Paper 122.

McKern, R.W. and T.D. Stewart
1957 Skeletal age changes in young American males, analyzed from the standpoint of identification. Technical Report EP-45. Headquarters Quarter Master Research and Development Command. Natick, Massachusetts.

McWilliams, Dick
1970 Physical anthropology of Wann and Sam, two Fourche Maline focus Archaic sites in eastern Oklahoma. Bulletin of the Oklahoma Anthropological Society 19:101-136.

Mehringer, P.J., Jr., C.E. Schweger, W.R. Wood and B.R. McMillian
1968 Late-Pleistocene boreal forest in the western Ozark highlands. Ecology 49(3):568-69.

Mensforth, Robert P., C. Owen Lovejoy, John W. Lallo and George J. Armelagos
1978 The role of constitutional factors, diet and infectious disease in the etiology of porotic hyperostosis and periosteal reactions in prehistoric infants and children. Medical Anthropology 2(1).

Miller, B.W.
1955 The geology of the western Potato Hills, Pushmataha and Latimer counties, Oklahoma. M.A. Thesis, University of Oklahoma, Norman.

Moore, James A., A.C. Swedland and G.J. Armelagos
1975 The use of life tables in paleodemography. Society of American Archaeology Memoir 30:57-70.

Moore, P.D. and J.A. Webb
1978 An illustrated guide to pollen analysis. Halstead Press, New York.

Moore, W.J. and M.E. Corbett
1971 The distribution of dental caries in ancient British populations. I. Anglo-Saxon Period. Caries Research 5:151-168.

Moore-Jansen, P.H., J.C. Rose, J.C. Stewart-Abernathy and M.L. Powell
1980 Dietary reconstruction from observations of enamel wear striations on Caddo and Fourche Maline molars. Paper presented at the 22nd Caddo Conference, Texarkana Community College, Texarkana, Texas.

Moorrees, Coenraad F., E.A. Fanning and E.E. Hunt
1963a Formation and resorption of three deciduous teeth in children. American Journal of Physical Anthropology 21:205-213.

1963b Age variation of formation stages for ten permanent teeth. Journal Dental Research 42:1496-1502.

Morrison, Joseph P.E.
1942 Preliminary report on mollusks found in the shell mounds of the Pickwick Landing basin in Tennessee River valley. In An archaeological survey of Pickwick Basin in the adjacent portions of the states of Alabama, Mississippi and Tennessee, by William S. Webb and David L. DeJarnette, pp. 337-392. Smithsonian Institute, Bureau of American Ethnology Bulletin 129. Washington, D.C.

Mosse, B. and G.D. Bowen
1968 A key to the recognition of some Endogone spore types. Transactions of British Mycological Society 51:469-83.

Munsell
1970 Book of color. Munsell Color Company, Inc., Baltimore, Maryland.

Murphy, T.
1959 Gradients of dentine exposure in human molar teeth attrition. American Journal of Physical Anthropology 17:179-86.

Murray, H.D. and A.B. Leonard
1962 Handbook of unionid mussels in Kansas. University of Kansas, Department of Zoology and State Biological Survey, Miscellaneous Publication 28:1-184.

Muto, G.R.
1978 Paris Mound archaeology project: phase I. Oklahoma Historical Society, Series in Anthropology. Oklahoma City.

Neal, Larry
1972 Assessment of the cultural-historical resources of Clayton Lake. Oklahoma River Basin Survey, University of Oklahoma. Norman.

Neck, R.W.
1979 An analysis of the molluscan fauna from F193-1, Unit 62. Appendix II. In Report on the Fall 1978 investigations at the George C. Davis Site, Caddoan Mounds State Historic Site, Cherokee County, Texas, by J.P. Thurmond and U. Kleinschmidt, pp. 98-103. University of Texas, Austin.

Newkumet, P.
1940a Preliminary report on excavations of the Williams Mound, LeFlore County, Oklahoma. The Oklahoma Prehistorian 3(2):2-6.

1940b Excavation of "Black Mound" reveals ornate "hair pins." The Oklahoma Prehistorian 3(2):8-9.

1940c Report on the Williams I site, LeFlore County, Oklahoma. Ms. on file, Western History Collection, University of Oklahoma.

1940d Report on the Sam site, LeFlore County, Oklahoma. Ms. on file, Western History Collection, University of Oklahoma.

1940e Report on the Mackay site, LeFlore County, Oklahoma. Quarterly field report (third quarter 1940), LeFlore County Archaeological Project. Ms. on file, Archaeological Research and Management Center, University of Oklahoma.

Neumann, H.W.
1967 The paleopathology of the Archaic Modoc Rock Shelter inhabitants. Illinois Museum Reports of Investigations 11. Springfield.

Newell, H. Perry and Alex Kreiger
1949 The George C. Davis site, Cherokee County, Texas. Memoirs of the Society of American Archaeology 5.

Newman, T. Stell
1970 A dating key for post-eighteenth century bottles. Historical Archaeology 4:70-5.

Nials, F.L.
1979 Report of geological investigations at Clayton Lake, Appendix C. In Prehistory of the proposed Clayton Lake area, southeast Oklahoma: Phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center, Research Series No. 6, University of Oklahoma, Norman.

Noel Hume, Ivor
1980 A guide to artifacts of colonial America. Alfred A. Knopf, New York.

Nuttal, T.
1980 A journal of travels into the Arkansas territory during the year 1819, edited by Savoie Loffinville. University of Oklahoma Press, Norman.

Ortmann, A.E.
1909 Unionidae from an Indian garbage heap. Nautilus 23(1):11-15.

Ortner, Donald J. and Walter G.J. Putschar
1981 Identification of pathological conditions in human skeletal remains. Smithsonian Contributions to Anthropology 28. Washington, D.C.

Parmalee, P.W.
1967 The freshwater mussels of Illinois. Popular Science Series 8:108.

Parmalee, P.W. and W.E. Klippel
1974 Freshwater mussels as a prehistoric food resource. American Antiquity 39(3):421-434.

Parmalee, P.W., W.E. Klippel and A.E. Bogan
1980 Notes on the prehistoric and present status of the Naiad fauna of the Middle Cumberland River, Smith County, Tennessee. Nautilus 94(3):93-105.

Penfound, W.T.
1962 The Savanna concept in Oklahoma. Ecology 43(4):774-75.

Perino, Gregory
1968 Guide to the identification of certain American Indian projectile points. Oklahoma Anthropological Society, Special Bulletin, No. 3. Norman, Oklahoma.

1971 Guide to the identification of certain American Indian projectile Points. Oklahoma Anthropological Society, Special Bulletin, No. 4. Norman, Oklahoma.

Perino, Gregory
1981 Archaeological investigations at the Roden Site (MC-215) McCurtain County, Oklahoma. Museum of the Red River, Idabel, Oklahoma.

Perino, Gregory and W.J. Bennett, Jr.
1978 Archaeological investigations at the Mahaffey Site, CH-1 Hugo Reservoir Choctaw County, Oklahoma. Contract Report, Museum of the Red River, Idabel, Oklahoma.

Pilsbry, Henry A.
1939 Land mollusca of North America (north of Mexico). The Academy of Natural Sciences of Philadelphia, Monographs 1(1):1-573.

1940 Land mollusca of North America (north of Mexico). The Academy of Natural Sciences of Philadelphia, Monographs 1(2):575-594.

1947 Land mollusca of North America (north of Mexico). The Academy of Natural Sciences of Philadelphia, Monographs 2(1):1-520.

1948 Land mollusca of North America (north of Mexico). The Academy of Natural Sciences of Philadelphia, Monographs 2(2):521-1113.

Phillips, P.
1970 Archaeological survey of the Lower Yazoo Basin, Mississippi, 1949-1955. Papers of the Peabody Museum of Archaeology and Ethnology 60.

Powell, Mary, Lucas and J. Daniel Rogers
1980 Bio-archaeology of the McCutchan-McLaughlin site. Oklahoma Archaeological Survey No. 5. Norman, Oklahoma.

Powell, Mary L.
1977 Prehistoric ritual skull burials at the Crenshaw site (3MI6), southwest Arkansas. Bulletin of the Texas Archeological Society 48:111-118.

Pratt, W.L., Jr.
1981 A revision of the land snail genus Polygyra in Texas. Ph.D. Dissertation, University of Arizona, Tucson.

Prewitt, Terry
1974 Report on test excavations at Lt-38 and Lt-39. In Reports of the Arkla Salvage Project, pp. 158-190. Oklahoma Archaeological Survey Contract Archaeology Series 1. Norman, Oklahoma.

Proctor, Charles
1957 The Sam site, Lf-28, of LeFlore County, Oklahoma. Bulletin of the Oklahoma Anthropological Society 5:45-91. Oklahoma City.

Rice, E.L. and W.T. Penfound
1959 The upland forests of Oklahoma. Ecology 40(4):593-608.

Rightmire, G.P.
1972 Cranial measurements and discrete traits compared in distance studies of African Negro skulls. Human Biology 44:263-276.

Rogers, J. Daniel
1980 Spiro archaeology: 1979 excavations. Oklahoma Archaeological Survey, Studies in Oklahoma's Past No. 6. Norman.

1982 Spiro Archaeology: 1980 research. Oklahoma Archaeological Survey, Studies in Oklahoma's Past No. 9. Norman.

Rohrbaugh, Charles
1972 Hugo reservoir II. Oklahoma River Basin Survey, University of Oklahoma Research Institute, Archaeological Site Report 23. Norman.

1973 Hugo Reservoir III. Oklahoma River Basin Survey, University of Oklahoma Research Institute, Archaeological Site Report 24. Norman.

Rohrbaugh, C.L. et al.
1971 Hugo Reservoir I. Oklahoma River Basin Survey, University of Oklahoma Research Institute, Archaeological Site Report 22. Norman.

Rose, J.C.
1977 Defective enamel histology of prehistoric teeth from Illinois. American Journal of Physical Anthropology 46:439-46.

1979 Morphological variations of enamel prisms within abnormal Striae of Retziius. Human Biology 51:139-51.

1981 Bio-archaeology of two Late Woodland sites 22IT537, 22LO530 from the Tombigbee River. In Tennessee - Tombigbee Waterway Alabama and Mississippi Tombigbee River Multi-Resource District Quarterly Report January-March 1981, Appendix I, pp. 1-82.

1982 Bioarchaeology of the Cedar Grove Site. In Cedar Grove: An interdisciplinary investigation of a Late Caddo farmstead in the Red River valley, edited by Neil Trubowitz.

Rose, J.C., G.J. Armelagos and J.W. Lallo
1978 Histological enamel indicator of childhood stress in prehistoric skeletal samples. American Journal of Physical Anthropology 49:511-16.

Rose, J.C., M.W. Blaeuer, B.A. Burnett and M.S. Nassaney
1982 Paleopathology and the origins of agriculture in the Lower Mississippi valley and Caddoan regions. Paper presented at the Paleopathology and Origins of Agriculture Conference, State University of New York, Plattsburg.

Rose, J.C. and L.F. Boyd
1978 Dietary reconstruction utilizing histological observation of the enamel and dentine. American Journal of Physical Anthropology 48:431.

Rose, J.C., P.M. Clancy, P.H. Moore-Jansen
1981 Bio-archaeology of the Roden site. In Archaeological investigations at the Roden site (MD-215) McCurtain County, Oklahoma, by G. Perino. Museum of the Red River, Idabel, Oklahoma.

Rose, J.C., P. Moore-Jansen, J.C. Stewart and M.L. Powell
1979 Determination of grit size of archeological diets by observation of human enamel with the light microscope. Paper presented at the 48th Annual Meeting of the American Association of Physical Anthropologists, San Francisco.

Rudney, Joel D.
1981 The paleoepidemiology of early childhood stress in two ancient Nubian populations. Ph.D. Dissertation, Department of Anthropology, University of Colorado, Boulder.

Ryan, Allen
1979 Dental attrition. American Journal of Physical Anthropology 50:155-68.

Sangster, A.G. and H.M. Dale
1961 A preliminary study of differential pollen grains preservation. Canadian Journal of Botany 39:35-43.

1964 Pollen grain preservation of underrepresented species in fossil spectra. Canadian Journal of Botany 42:437-49.

Sarnat, B.G. and I. Schour
1941 Enamel hypoplasia (chronic enamel aplasia) in relationship to systematic diseases: a chronological, morphologic and etiologic classification. Journal of the American Dental Association 28:1989-2000.

Schambach, Frank F.
1970 Pre-Caddoan cultures in the Trans-Mississippi South: a beginning sequence. Ph.D. Dissertation, Department of Anthropology, Harvard University.

1982 An outline of Fourche Maline culture in southwest Arkansas. In Arkansas archaeology interview, edited by Neal L. Trubowitz and Marvin D. Jeter. Arkansas Archaeological Survey Research Series No. 15. Fayetteville.

Schoenwetter, James
1976 A test of the Colorado Plateau pollen chronology Scherrer Formation, southeastern Arizona. Journal of the Arizona Academy of Science 11:89-96.

Schoolcraft, Henry R.
1819 A review of the lead mines in Missouri, including some observations on the mineralogy, geology, geography, antiquities, soil, climate, population and production of Missouri, Arkansas, and other sections of the Western Country. Wilson and Company, New York.

Schour, I. and M. Massler
1945 The effects of dietary deficiencies upon the oral structures, parts I, II and III. Journal of American Dental Association 32:714-727, 871-879, 1022-1030.

Scott, E.C.
1979a Dental wear scoring techniques. American Journal of Physical Anthropology 51:213-18.

1979b Principal axis analysis of dental attrition data. American Journal of Physical Anthropology 51:203-212.

Seely, Donald
1955 Pushmataha and LeFlore counties, Oklahoma. M.A. Thesis, University of Oklahoma.

Shaeffer, James
1965 Salvage archaeology in Oklahoma, Volume 1. Papers of the Oklahoma Archaeological Salvage Project, Nos. 8-15. Oklahoma Anthropological Society 13:77-151.

Shafer, Harry J.
1978 Lithic technology at the George C. Davis site, Cherokee County, Texas. Ph.D. dissertation, Department of Anthropology, University of Texas at Austin. Published by the Anthropology Laboratory, Texas A&M University, College Station.

Sharrock, F.W.
1960 The Wann site, Lf-27, of the Fourche Maline focus. Bulletin of the Oklahoma Anthropological Society 8:17-47.

Shelburne, Orville B., Jr.
1960 Geology of the Boktukola syncline, southeastern Oklahoma. Oklahoma Geological Survey Bulletin 58. Norman.

Sholes, Mark Allen
1978 Stratigraphy and petrography of the Arkansas Novaculite of Arkansas and Oklahoma. Ph.D. Dissertation, University of Texas at Austin.

Skinner, S. Alan, R.K. Harris, and Keith Anderson (editors)
1969 Archaeological investigations at the Sam Kaufman site, Red River County, Texas. Southern Methodist University Contribution in Anthropology 5. Dallas.

Stark, M.J.
1973 The osteological analysis of the skeletal remains from the old Martin Place (3LR49). Senior honors thesis on file, Department of Anthropology, University of Arkansas. Fayetteville.

Steinbock, R.T.
1976 Paleopathological diagnosis and interpretation: bone diseases in ancient human populations. Charles C. Thomas, Springfield.

Steyermark, J.A.
1963 Flora of Missouri. Iowa State University Press, Ames.

Stini, W.A.
1969 Nutritional stress and growth: sex differences in adaptive response. American Journal of Physical Anthropology 31:417-26.

Story, D.A.
1972 Excavations at the George C. Davis site, 1968, 1969, 1970, Cherokee County, Texas. University of Texas at Austin.

Styles, Bonnie W.
1981 Faunal exploitation and resource selection: early Late Woodland subsistence in the lower Illinois Valley. Northwestern University Archeological Program, Scientific Papers No. 3. Evanston.

Suhm, Dee Ann, Alex D. Krieger and Edward B. Jelks
1954 An introductory handbook of Texas archaeology. Texas Archeology Society, Bulletin 25. Austin.

Suhm, Dee Ann and E.B. Jelks
1962 Handboo Texas archaeology: type descriptions. The Texas Archeological Society and the Texas Memorial Museum. Austin.

Sundick, R.I.
1972 A method for assigning ages to immature skeletons. American Journal of Physical Anthropology 37:452.

Swanson, Earl (editor)
1973 Lithic technology: making and using stone tools. Aldine, Chicago.

Swanton, John R.
1942 Source material on the history and ethnology of the Caddo Indians. Bureau of American Ethnology Bulletin 132. Washington, D.C.

1946 The Indians of the southeastern United States. Bureau of American Ethnology Bulletin 137. Washington, D.C.

Swedlund, A.C. and G.J. Armelegos
1976 Demographic anthropology. William C. Brown, Dubuque.

Taylor, R.J.
1965 Short Leaf Pine (Pinus echinata) in Bryan County, Oklahoma. The Southwestern Naturalist 10(1):42-7.

Thomas, P.M., L.J. Campbell and S.R. Ahler
1980 The Hanna site: An Alto village in Red River Parish. Louisiana Archeologist 5.

Tixier, Jacques
1974 Glossary for the description of stone tools with special reference to the Epipaleolithic of the Merfredls. Newsletter of Lithic Technology, Special Publications 1. [Translated by M.H. Newcomer.]

Todd, T. Wingate
1920 Age changes in the pubic bone I. The White male pubis. American Journal of Physical Anthropology 3:285-34.

Turner, C.G. II
1970 New classification of non-metrical dental variation. American Journal of Physical Anthropology 33:144-45.

1979 Dental anthropological indications of agriculture among the Joman People of central Japan. American Journal of Physical Anthropology 51:619-36.

Turner, C.G. II and K. Hanihara
1977 Additional features of Ainu dentition. American Journal of Physical Anthropology 46:13-24.

Turner, C.G. II and D. Swindler
1978 The dentition of New Britain West Nakanai Melanesions. American Journal of Physical Anthropology 49:361-72.

Ubelaker, Douglas H.
1978 Human skeletal remains, excavations, analysis, interpretation. Aldine Manuals on Archeology. Aldine Publishing Company, Chicago.

Udden, Johann August
1898 Mechanical composition of wind deposits. Published by the Authority of the Board of Directors, Augustana College and Theological Seminary, Rock Island, Illinois.

Van Der Merwe, J. Nickolaas
1982 Carbon isotopes, photosynthesis, and archaeology. American Scientist 70:596-606.

Van Geel, B.
1965 A paleoecological study of Holocene peat bog sections in Germany and the Netherlands. Review of Palaeobotany and Palynology 25:1-120.

Van Zeist, W.
1967 Archaeology and palynology in the Netherlands. Review of Palaeobotony and Palynology 4:45-65.

Vehik, R.
1979a Summary and interpretations of Phase I investigations in the proposed Clayton Lake area. In The prehistory of the proposed Clayton Lake area, southeast Oklahoma: Phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center, Research Series No. 6. University of Oklahoma, Norman.

1979b Phase I excavations at the Arrowhead Hill site (34Pu-105). In The prehistory of the proposed Clayton Lake area, southeast Oklahoma: Phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center, Research Series No. 6. University of Oklahoma, Norman.

1979c Research design and investigative strategies. In The prehistory of the proposed Clayton Lake area, southeast Oklahoma: phase I investigations, edited by Rain Vehik and Jerry R. Galm. Archaeological Research and Management Center, Research Series No. 6. University of Oklahoma, Norman.

1982a The Archaeology of the Bug Hill Site (34Pu116): Pushmataha County, Oklahoma. Archaeological Research and Management Center, Research Series No. 7. University of Oklahoma, Norman.

1982b Phase II archaeological investigations at Clayton Lake, southeast Oklahoma. Archaeological Research and Management Center, Research Series No. 8. University of Oklahoma, Norman.

Vehik, Rain and Jerry R. Galm (editors)
1979 The prehistory of the proposed Clayton Lake area, southeast Oklahoma: Phase I investigations. Archaeological Research and Management Center, Research Series No. 6. University of Oklahoma, Norman.

Vogal, J.C. and Nikolaas J. Van Der Merwe
1977 Isotopic evidence for early maize cultivation in New York State. American Antiquity 42:238-242.

Walch, K.M., J.R. Rowley, and N.J. Norton
1970 Displacement of pollen grains by earthworms. Pollen et Spores 12: 39-44.

Walker, A., H.N. Hoeck and L. Perez
1978 Microwear on mammalian teeth as a diet indicator. Science 201:908-10.

Walker, Phillip L.
1976 Wear striations on the incisors of Cercopithecoid monkeys as an index of diet and habitat preference. American Journal of Physical Anthropology 45:299-307.

Walker, Robert A.
1980 Dental pathologies, wear and sexual dimorphism of the Gold Mine site. Honors Thesis, Department of Anthropology, University of Arkansas.

Webb, Clarence H.
1944 Dental abnormalities as found in the American Indian. American Journal of Orthodontics and Oral Surgery 30(9):474-486.

1959 The Belcher Mound: a stratified Caddoan site in Caddo Parish, Louisiana. Society for American Archaeology, Memoir 16.

1963 The Smithport Landing site: an Alto Focus campout in De Soto Parish, Louisiana. Bulletin of the Texas Archeological Society 34:143-187.

Webster, John
1980 Introduction to fungi. Cambridge University Press, Cambridge.

Wedel, Mildred Mott (translator)
In Press Benard de La Harpe, Jean Baptiste, 1718-1720 Journal du voyage de la Louissianne fait par le Sr Bernard [sic] de La Harpe et des decouvertes qu'il a fait dans la party de l'ouest de cette colonie. Mss. francais 8989, folios 1-36, Bibliotheque Nationale, Paris.

Weiss, Kenneth M.
1972 On the systematic bias in skeletal sexing. American Journal of Physical Anthropology 37:239-50.

1973 Demographic disturbance and the use of life tables in anthropology. Society for American Archaeology, Memoir 30:46-56.

Westbury, Marilyn S.
1978 Osteological analysis (Appendix III). In Archaeological research at the proposed Cooper Lake, northeast Texas 1974-75, by K. Doehner and R.E. Larson, pp. 159-86. Southern Methodist University, Dallas.

White, D.S.
1977 Changes in the freshwater mussel populations of the Poteau River system, LeFlore County, Oklahoma. Proceedings of the Oklahoma Academy of Science 57:103-105.

Wilson, L.R.
1966 Palynology of the Domebo site. In Domebo: a Paleoindian mammoth kill site in the Prairie-Plains, edited by F.C. Leonhardy, pp. 44-50. Contributions of the Museum of the Great Plains 1. Lautor, Oklahoma.

1977 Palynological study of Feature 4, MI-63, from an Early Caddoan village in eastern Oklahoma. Oklahoma Highway Archaeological Survey, Papers in Highway Archaeology 3. Oklahoma City, Oklahoma.

Williams, B.
1953 The Ward site, LeFlore County, Oklahoma. Oklahoma Anthropological Society Newsletter 1(9):2-9.

Wood, W.R.
1963 The Poole site: components for the Fourche Maline and Mid-Ouachita foci in Garland County, Arkansas. Ms. on file Archaeological Research and Management Center, University of Oklahoma.

Wright, H.E., Jr.
1968 History of the Prairie Peninsula. In The Quaternary of Illinois, edited by R.E. Bergstrom, pp. 78-88. College of Agriculture, University of Illinois, Urbana, Special Report 14.

Wyckoff, Don G.
1965 Biggham Creek site, McCurtain County, Oklahoma. Oklahoma River Basin Survey Project, Archaeological Site Report 3. Norman, Oklahoma.

1966 The Hughes, Lamas Branch. and Callaham sites, McCurtain County, southeast Oklahoma. Oklahoma River Basin Survey, University of Oklahoma Research Institute, Archaeological Site Report 4. Norman.

1967a The E. Johnson site and prehistory in southeast Oklahoma. Oklahoma River Basin Survey Project, University of Oklahoma Research Institute, Archaeological Site Report 6. Norman.

1967b Woods Mound group: a prehistoric mound complex in McCurtain County, Oklahoma. Oklahoma Anthropological Society Bulletin 15:1-76.

1967c The archaeological sequence in the Broken Bow Reservoir area. Stovall Museum of Natural History and Oklahoma River Basin Survey Project, University of Oklahoma Research Institute. Norman.

1968a The Beaver site and archaeology of the Broken Bow Reservoir area, McCurtain County, Oklahoma. Oklahoma River Basin Survey Project, University of Oklahoma Research Institute, Archaeological Site Report 9. Norman.

Wyckoff, Don G.

1968b The Bell and Gregory sites: archaeological chronicles of prehistory in the Pine Creek Reservoir area, southeast Oklahoma. Oklahoma River Basin Survey, University of Oklahoma Research Institute, Archaeological Site Report 11. Norman.

1970a Archaeological and historical assessment of the Red River Basin in Oklahoma. Arkansas Archaeological Survey, Publications in Archeology, Research Series 1. Fayetteville.

1970b The Horton site revisited, 1967 excavations at SQ-11, Sequoyah County, Oklahoma. Oklahoma Archaeological Survey, Studies in Oklahoma's Past 1.

1974 The Caddoan area: an archaeological perspective. Caddoan Indians (1):25-279. Garland Publishing, Inc., New York.

1976 1976 Archaeological field work at the McCutchan-McLaughlin site, Latimer County, Oklahoma. Oklahoma Anthropological Society Newsletter 24(8): 1-9.

1980 Caddoan adaptive strategies in the Arkansas Basin of eastern Oklahoma. Ph.D. Dissertation, Department of Anthropology, Washington State University, Pullman.

1981 Pollen, plants and people: some archeology perspectives on eastern Oklahoma prehistory. In Ferndale Bog and Natural Lake: five thousand years of environmental change in southeastern Oklahoma, by Lois E. Albert. Oklahoma Archeological Survey, Studies in Oklahoma's Past 7. Norman.

Wyckoff, Don G. and T.V. Woody

1977 1977 field work at Lt-11: the OAS spring dig and the university field school. Oklahoma Anthropological Society Newsletter 25(8):1-13.

Yarnell, Richard A.

1974 Plant food and cultivation of the Salts Cavers. In Archaeology of the Mammoth Cave area, edited by Patty Jo Watson, pp. 113-122. Academic Press, New York.

1976 Early plant husbandry in eastern North America. In Cultural change and continuity, edited by Charles Cleland, pp. 265-74. Academic Press, New York.

FILMED