To the Graduate Council:

I am submitting herewith a thesis written by Sarah C. Sherwood entitled "Microartifact Analysis of A Dallas Phase House Floor". I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the Masters of Arts, with a major in Anthropology.

Dr. Jan F. Šimek, Major Professor

We have read this thesis and recommend its acceptance:

Walter E. Klippel

John T. Ammons

Accepted for the Council:

C. W. Minkel

Associate Vice Chancellor
and Dean of The Graduate School

MICROARTIFACT ANALYSIS
OF A DALLAS PHASE HOUSE FLOOR

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Sarah C. Sherwood

December 1991

ACKNOWLEDGEMENTS

This thesis would not have been possible without the support and assistance of faculty, colleagues, and friends. First I would like to acknowledge Richard R. Polhemus, both colleague and friend. This research would not have been possible without his dedication to the Loy Site and his commitment to consistent and careful fieldwork.

I would like to thank the members of my committee. I am indebted to my major professor, Dr. Jan F. Simek, for his support, friendship, time and endurance through many drafts of this work. Both Dr. Walter E. Klippel and Dr. John T. Ammons were patient and helpful.

I am grateful to Dr. Julie K. Stein for her work with microartifacts and for sharing her geological approach to the archaeological record. She has helped me and continues to help me fit the pieces together.

To my friends and colleagues I owe many thanks. To those at the University of Washington, Steve B.H. Cole, Kim Kornbacher, Pat McCutcheon, Angie Linse, Chris and Felice Pierce, and Kris Wilhelmsen, for their different perspectives, microartifact brain-storming resulting in a successful poster symposium, and finally for making me feel welcome in Seattle. To those at the University of Tennessee, to name just a few, Susan Andrews, Phil Carr, Maureen Hays, Rachel Power, Lynn Snyder, Mike Timpson, and

Amy Young, thank you for your help, encouragement, and the best comraderie to be found.

Steven Ousley and Terry Dishghon provided invaluable services and patience with their computer wizardry. I would also like to acknowledge the University of Washington Laboratory of Archaeological Sediments for its role in the initial phases of this project. The remainder of the work was conducted in the fledgling Laboratory of Analytical Archaeology at the University of Tennessee.

Finally, I acknowledge my family. First Dad, Dr. W. Cullen Sherwood, for his dedication to science and history, and his respect for academics. And to the rest of the gang, Mom, Grandma, Stuart, Aaron and Sam for their support and good humor.

ABSTRACT

This thesis examines microartifacts from a late Mississippian Dallas Phase house floor at the Loy Site (40JE10). This examination was undertaken to learn whether the organization of interior space can be better defined with the addition of microartifacts to the more traditional macroartifact analysis. First, the potential of microartifacts to enhance our knowledge of the prehistoric use of space is suggested in a review of previous actualistic, experimental, and ethnoarchaeological research. Then, macro- and microartifact spatial distributions are analyzed. Results of the analysis offer a more dynamic view of the use of space than would have been possible looking at only the macro scale material. Three areas of activity are proposed; a central area focusing on the hearth, a refuse disposal area beneath the benches lining the walls, and a lithic manufacturing area in the southern corner behind a door partition. The techniques needed to collect, process, and analyze microartifacts are developed through refined field sampling, conventional sedimentological protocol, and the development of a computer program to operationalize a basic statistic to produce a representative microartifact sample.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

MICROARTIFACT ANALYSIS

INTRODUCTION

Microartifacts have long been an untapped resource in the archaeological record. Microartifacts are defined as any artifact measuring less than 2 mm, the size of coarse sand (Dunnell and Stein 1989). Initial studies have illustrated the potential for these small scale artifacts to enhance our knowledge of activity areas and formation processes, providing vital information to reconstruct the history of an archaeological deposit (Fladmark 1982; Hull 1987; Madsen and Dunnell 1989; Rosen 1986, 1989; Stein and Teltser 1989; Vance 1989).

Microartifact analyses are not however without limitations. With the decrease in object size comes a decrease in our abilities to observe and identify the object (Dunnell and Stein 1989). We are forced to rely on microscopic techniques for analysis. These techniques normally involve incident light and a binocular stereomicroscope utilizing relatively low magnification, 10 to 40 x. This allows for greater depth of field and increased three dimensional information. In addition to the problem of the change from traditional techniques of observation, there is a reduction in the number of artifact attributes that can be reliably identified. This means that microartifacts contain less information in terms of artifact classification but compensate for this limitation in the information they contain relating to the history of the deposit.

Because of their size microartifacts are affected differently in comparison to macro scale material by both natural (e.g., wind, water), and cultural processes (e.g., sweeping, raking, sorting) (Dunnell 1986; Dunnell and Stein 1989; Fladmark 1982; Hull 1983; Nicholson 1983; Schiffer 1987). An additional advantage of microartifacts resulting from their size is their abundance. This abundance can provide the archaeologist with large sample sizes for strengthened quantitative analyses even in the sparsest of sites (Dunnell and Stein 1989, Vance 1989).

Horizontal artifact distributions will be the focus of this study. An essential part of understanding archaeological patterns, and something that microartifacts can contribute towards, is the ability to distinguish between actual activity areas versus an area of discard (i.e. primary versus secondary deposits). This distinction is a primary focus in this study.

The research undertaken here has three main objectives. First, the potential of small scale artifact analysis to address questions concerning the prehistoric use of space is explored. This potential is clearly shown in research dealing with small scale artifacts in experimental archaeology and ethnoarchaeology.

The second objective is to understand the patterns recognized across an enclosed Late Mississippian house "floor" through microartifact analysis. Microartifact analysis enhances the interpretative potential of an associated macroartifact assemblage. The exclusion of macro scale material in the interpretation of microartifacts is a repeated problem in past analyses.

The third and final objective is to contribute to the development of the methods and techniques used to sample, process and quantify microartifacts. Methods and techniques remain in the developmental stages. Earlier studies, experiments in particular, included a number of size divisions and sampling schemes making it difficult to objectively compare among them. A conventional system for processing and counting the micro-scale material is however finally becoming a reality using standard sedimentological nomenclature. Yet a variety of sampling and quantifying techniques continue to be applied. Overall, the greatest need lies in improving the techniques required to access the information efficiently in terms of time and expense. The amount of time necessary for processing and counting is consistently the argument used against integrating microartifact analysis into archaeological research designs. In this thesis, a new approach to microartifact sampling through applications in statistics and field protocol is undertaken in an effort to increase the validity and cost effectiveness of microartifact analysis.

The site used in this study is the Loy Site (40JE10), a Late Mississippian, Dallas Phase town. The deposits sampled were located within a house referred to as Structure 3. The texture of these deposits offered little potential for vertical movement of sand-size particles; therefore they were considered suitable to reliably examine horizontal artifact distributions. Current Mississippian research trajectories are aimed at better understanding the sociopolitical variability of these complex societies. Microartifact analysis as it addresses intrasite spatial patterns can offer data towards answering these ultimate questions.

STATEMENT OF PROBLEM

Based on the assumption that human behavior is patterned and therefore creates patterns in the material culture, archaeologists describe and analyze artifact spatial organization to reconstruct the behavior of prehistoric people. These analyses focus on the identification of patterns across past living surfaces, both within site boundaries (intrasite) and among sites within a region (intersite). This study focuses on intrasite patterning, specifically in a household of a predominantly sedentary group. The household is a unit of observation representing the minimal basic social and domestic unit of a community (Laslett 1972, Nass 1989). Archaeologically the household appears as a series of empirical elements, identified in this study by post hole patterns, basin shaped floor, central hearth, and artifact concentrations. These are the elements which may allow the archaeologist to identify and interpret a discrete social group (i.e. the household) within its environment (Polhemus 1987).

The interpretation of spatial organization within a household relies on the recognition of structurally restricted space and the nonrandom clustered arrangement of artifact types and material class. Artifact material classes imply specific functions, e.g. ceramics functioned as cooking and storage vessels, lithic material functioned as tools or byproducts of the manufacture and use of tools. Typological classes can go a step further attempting to relate specific attributes of an artifact to identify function. Spatial organization of artifact classes implies the arrangement of particular areas for particular activities. These areas are referred to as activity areas, places where deposition occurred in a structurally restricted place resulting in a concentration of artifacts (Yellen 1977). This definition excludes dumping areas, (locations where refuse or undesirable byproducts, removed from the original activity location, are deposited in a separate, often designated area) from consideration as activity areas.

Archaeologically we seek to identify activity areas through pattern recognition. When patterns are sought within an archaeological household the data gathered are traditionally based on macro-scale artifacts. Pattern recognition can be done intuitively or through the use of computerized mathematical and statistical analyses of artifact classes and their location (see Clark 1968; Hodder and Orton 1976; Simek 1984, 1989). From the groups of artifacts in the assemblage and their locations, the archaeologist searches for clusters. The interpreted activity or activities that are represented by a cluster are generally based on the relative proportions of the types present.

The primary units of analyses in activity area research are usually defined at the intrasite scale. At this scale the focus is on archaeological deposits, three dimensional lithostratigraphic units made up of sedimentary particles defined by their physical properties and boundaries (Stein 1987:339). The sedimentary particles that make up an archaeological deposit include artifacts. In order to describe and interpret the history of a deposit, the source, transport agent(s), environment of deposition and post-depositional alteration(s) must be determined. Data must be collected observing attributes and parameters of composition, size, structure, shape, etc., of the deposit as a whole and the particles that compose it.

Due to the diagenetic nature of the archaeological record, the original artifact patterns (those created by human behavior) are subject to change by any number and degree of post-depositional processes. There is an abundance of research seeking to identify and decipher the signatures of these formation processes (see Schiffer 1987; Wood and Johnson 1978). The identification of formation processes relies on data spanning the regional scale, through that of the deposit, down to the ionic scale. An understanding of the processes present and how they may collectively affect the archaeological record, potentially altering the original behavioral patterns, is vital to the interpretation of archaeological patterns we observe today. In theory, microartifacts that enter the archaeological record already small offer information on cultural formation processes and those that break down in the record inform on post-depositional, usually non-cultural processes (Dunnell and Stein 1989:34).

BACKGROUND REVIEW

The following is a brief review of microartifact studies, highlighting the type of archaeological questions being asked and the general methodology applied. Microartifact terminology and definitions vary throughout the studies. The size ranges generally lie within course to medium sand (2 mm to .25 mm) unless otherwise noted.

Microarchaeology, the study of the "minute remains of a variety of culturally derived materials" was first suggested by Hassan (1978:208). Prior to this time small size artifacts had only been acknowledged during sedimentological studies of archaeological deposits as being a result of human activity (Dincauze 1976; Farrand 1975). In his 1978 article Hassan identified the promising applicability of archaeological sediments to the identification of activity areas. He states, "these microarchaeological remains are not likely to suffer from the problems of intentional removal by man or other agents which may obfuscate any indications of the kind of activity" (Hassan 1978:208).

Early studies, like those already mentioned above, noted the potential for unique information with the recovery of small-scale material, but attention to the microartifact data source appears to have been successfully stimulated with the study by Fladmark (1982). This study focused on microdebitage and its potential for identifying cultural deposits and lithic reduction strategies. Fladmark stated that "...microdebitage presence and location might be useful to answer spatial and behavioral questions." (Fladmark 1982:216-217). This observation prompted others to apply microdebitage to questions of the spatial distribution of artifacts and interpretation of activity areas.

The concept of microdebitage was soon expanded to incorporate nearly all artifact material classes, resulting in these sand-size artifacts addressing a wide array of archaeological questions over the last eight years. For example, Nicholson (1983) collected microartifacts from survey auger tests and used them to identify site locations. Straight (1986) used a series of seismic and sedimentary analyses, among them the identification of small size artifacts, to discriminate between archaeological deposits and natural deposits along submerged and buried former land surfaces on the Gulf of Mexico continental shelf.

Current trends in microartifact research are directed toward problems concerning formation processes and the identification of activity areas. Rosen (1986, 1989) has identified formation processes and interpreted room function based on percentages and correlations of compositional artifact types in the context of rooms and courtyards at Tell sites in Israel. In addition to bulk sediment samples Rosen looked at microartifacts in bricks and floor deposits to aid in the identification of formation processes. Artifacts were quantified by visually estimating percentage. Analysis of horizontal samples provides information for the spatial distribution of activities. The composition of structural material compared to floor material can help differentiate between refuse produced from activities and refuse resulting from the collapse and disintegration of building material.

Reese (1986) sought to identify activity areas in a historic Chinese worker's area combining historic sources, informants, and microartifacts. Hull (1983, 1987) applied microdebitage analysis to the identification of activity areas within three tipi-rings from the Northern Plains in Calgary, Alberta. She collected from concentric grid units within the rings and counted 10,000 particles measuring .5 mm to .25 mm per sample. The microdebitage (chert, chalcedony and quartzite) counts ranged from 100 to 0 within the sample units with 20 defining a cluster. Hull observed correspondences and non-correspondences in the micro and macro distributions. She interpreted the presence/absence of clusters based on the following model:

> "(1) Primary [activity area] refuse is identified by a cluster of macrodebitage corresponding to a cluster of microdebitage.
> (2) Secondary [discard area] refuse consists of macrodebitage with no corresponding cluster of microdebitage.
> (3) De facto refuse, although difficult to distinguish from primary refuse, should correspond to a microdebitage high density area while containing relatively large macroflakes and possibly more tools or tool fragments." (Hull 1987:773)

Vance (1986, 1989) has compared micro and macro artifacts at two different sites. The first was a northwest coast protohistoric Duwamish longhouse at 45KI51 in Renton, Washington. In the longhouse Vance was attempting to test activity area interpretations that had been made based on macroartifact distributions. Vance collected bulk samples that were to represent each activity area. She examined the 1.0 mm to .5 mm fraction (1.0 ϕ), counting 2000 particles to identify lithics (cryptocrystalline and basalt), ocher and rust. She excluded bone and shell based on its abundance within the matrix of the sediment. Her analysis showed concordance between some original activity area assignments and discordance on others. The discordance, based on the absence of microdebitage, were in areas that had been interpreted as knapping activity areas based on the macro lithic material. Vance's second study (1989) looked at microartifacts from Robards Farm, in southeastern Missouri. Surface collections from the plowed site have produced Late Archaic through Early Mississippian material. Vance collected samples from the surface in an effort to compare micro and macro plow zone assemblages. Her stratified random sampling design represented 20 m blocks, her grain-size analyzed was 1 ϕ. The microartifacts counted were lithics, ceramics and rust fragments. The rust was interpreted as representing historic farming activity. The presence of lithic and ceramic microartifacts was interpreted as activity areas present but provided no information beyond what had already been gathered from macro artifacts. Vance reports two primary limitations in the interpretive potential of the results. The sampling interval was coarse, probably greater than the circumference

of an activity area. It was also impossible, using that sampling frame in a plow zone situation, to discern between the multiple occupations at the micro-scale.
Microartifact data have been incorporated by others in southeastern Missouri into the surficial data from low density plowed sites (Madsen and Dunnell 1989; Stein and Teltser 1989). Stein and Teltser (1989) looked at grain-size distributions of artifacts within the plow zone to test the interpretations of site depositional history as interpreted by other site data. Their results shed light on formation processes, such as the mechanical weathering of lithics and ceramics producing relatively abundant sand-size particles. Madsen and Dunnell (1989) use microartifacts, specifically their abundance, to compensate for the low density macroartifact distributions typical of plow zone assemblages. With the increase in sample size provided by microartifacts they were better able to assess land use patterns.

Two of the most recent published studies look at intrasite structure using microartifacts. The first is Metcalf and Heath (1990) who examine the spatial distribution of microrefuse on the floors of a Nawthis Village structure in central Utah. The purpose of their study was to determine the character of variation in microrefuse between and within rooms, hopefully allowing for inferences to be made concerning the inhabitants and the structure of their activities (Metcalf and Heath 1990:791). Bulk samples were collected at 1 m intervals across the floor. One liter of material, < 4.75 mm to > 2.38 mm, was floated and analyzed by removing and tabulating microrefuse (lithics, bone, and seeds). The results of the study identified potential activity areas and their associations to the hearth. Unfortunately the exclusion of the remainder of the artifact assemblage (macroartifacts and artifacts less than 2 mm) did not allow for a more comprehensive approach to assemblage variation. To address future questions of microrefuse, Metcalf and Heath advise further development of ethnoarchaeological studies developing a theoretical framework for "why do people clean" and the effects of different cleaning technologies (Metcalf and Heath 1990:794).

Simms and Heath (1990), address not only site structure, but also use of space, season and duration of occupation, assemblage composition and site function as it is interpreted and supported by ethnoarchaeology. Their work took place at a fifteenth century hunter and gatherer site in Utah. Bulk sediment samples were collected for microartifact analysis representing interpreted deposits (secondary refuse, hearths, activity areas). The laboratory protocol was the same as used by Metcalf and Heath (1990). The authors had difficulty using microrefuse to identify activity areas due to its fairly consistent distribution across the site. Microrefuse was however useful in interpreting formation processes. For example they concluded that the secondary deposits appear to be the result of "batch" dumping and individual discard (evidenced in the relative absence of microrefuse) rather than sweeping (Simms and Heath 1990:805). The identification of variscite and calcite at the micro-scale (it was absent at the macro-scale) provide more information as to assemblage composition. Micro-scale variscite morphology indicates ornament manufacture and the calcite (not natural to the local sediments) supplies the only evidence of possible ceramic manufacture.

In summary, the majority of the literature reviewed above confirms the potential of micro-scale artifact analysis to address a number of pertinent archaeological questions of spatial analysis, formation processes, and assemblage composition. These studies have used varying sampling techniques and laboratory protocols designed for individual research circumstances. Three primary deficiencies in microartifact analysis stand out in a number of the studies. These are the exclusion of macroartifacts, sampling problems, and the time required to analyze the microartifacts.

Data generated by microartifacts are a compliment to conventional macroartifact data and should not stand alone (Rosen 1986). They are not considered a replacement or a test of interpretations based on macroartifacts. Consequently only in the most unusual formation conditions would different size classes of artifacts be expected to exhibit identical distributions (Dunnell and Stein 1989:39). Sand-size artifacts have been shown to undergo transport, deposition, and post- depositional processes different from their larger counterparts. The potential variability in distributions, resulting in different patterns due to distinct causes, offers microartifacts as a unique source of information. In this study, the traditional macroartifact assemblage (everything greater than .75 cm recovered in a quarter inch screen) is compared to the microartifact assemblage recovered from Structure 3 at the Loy Site.

Recovery of microartifacts in the field should be systematic and as representative of the macro sample as possible. The excavation unit and the macroartifacts recovered within it must be considered carefully. Does the traditional bulk sediment sample adequately represent the same area supposedly associated with the macro sample? In an attempt to bypass the potential problems of the bulk sample a scheme was developed for the Loy Site that homogenizes a sample to represent the horizontal area represented by the macro material. Previously cited research dealing with plowed deposits are based on the same concept of homogenization of the sediments as a result of the plowing process.

Probably the biggest deterrent to microartifact analysis, and the repeated concern related by researchers engaged in the study, is its cost in time. Even though the information gathered from microartifact analysis is unique and insightful, the significant amount of time it traditionally requires to process and quantify these abundant particles makes the analysis costly. Simms and Heath (1990) report the time out of the field needed to recover, sort and identify microartifacts "ranged from as little as 2 hours per sample to several that required 80 hours each" (1990:805). Others have reported excessive time involved in microartifact quantification. This thesis shows that through the use of a basic probability statistic and a computer, the element of time can be reduced substantially while still acquiring a representative microartifact sample.

In this study, 79 samples were collected from the Loy Site, processed and analyzed. Material classes of micro- and macro-size artifacts were quantified and their distributions compared. The results indicate unique processes affecting artifacts based on their difference in size and material type. These new data shed light on the understanding of the formation processes creating the archaeological record of a Dallas Phase household. This study provides insights into the application of microartifact analysis to spatial questions, and as with all new data sources this study produces new questions and attempts to encourage new avenues of inquiry.

CHAPTER II

ARTIFACT SIZE

Artifact patterns are associations of artifacts ranging in size from meters to microns. Size variability can be the result of cultural and natural formation processes. As an attribute, size can be effected in two ways: 1) reduction; and 2) the sorting or "winnowing" of artifacts (Schiffer 1987:267). The sorting of artifacts by size and their reduction can occur at any stage in the depositional history. Analysis of artifacts in different size classes can be used to reconstruct the depositional history of archaeological deposits.

The size distribution of sedimentary particles (grain-size data), is used by sedimentologists to reconstruct geologic depositional histories. More specifically sedimentologists see the size of the grains as an indicator of "the energy of the depositing medium and the energy of the basin of deposition" (Reineck and Singh 1986:132). In archaeological deposits this translates to the size of artifacts as indicators of a range of human activities. As a result of those activities the artifacts were transported into a depositional environment where diagenesis occurs (the degree depending on the nature of the environment and post-depositional processes) creating the archaeological record. Analysis of post-depositional alteration may indicate whether the deposit has undergone significant disturbance distorting initial artifact patterns, or has remained fairly undisturbed. Microartifact analysis must consider the size range of the source, the affect of subsequent transport, the environment of deposition, and post-depositional alteration of artifact size. A new cycle of deposition resulting from an erosional event, where the archaeological deposit itself becomes the source, must be considered as well. This too influences the range of artifact sizes in an archaeological deposit.

This chapter discusses factors which affect the size of artifacts observed in the archaeological record. First source and transport agents are discussed. Then post-depositional processes, particularly those which may bias the archaeological record in favor of microartifacts, are addressed. Finally, it is demonstrated that it is necessary to use both micro- and macroartifacts in the reconstruction of processes which produce and obscure patterning of archaeological materials.

Source

In sedimentology a limiting factor in the use of grain-size is the knowledge of the source or the original availability of various sizes of grains (Reineck and Singh 1986). In an archaeological context this can be translated into the original artifact size distribution as it is deposited. Unfortunately, artifact size has the potential to be affected at any stage in the history of a deposit. Archaeologists have a slight advantage over sedimentologists however in that they can safely estimate the physical parameters (specifically size) possible for the original source of the artifact. For example, when a ceramic sherd is recovered from an archaeological deposit there are certain assumptions that can be made about the original source and its size, that the sedimentologist can not assume about a quartz gravel. The range of sizes of a ceramic vessel (the source) has known parameters based on knowledge of a ceramic assemblage from a specific ethnostratigraphic unit (for more information on ethnostratigraphic units see Stein 1990). Ceramic vessels from a certain time period, with particular temper usually had rather limited size ranges.

Our knowledge of the physical properties of a material type, based on results of scientific studies, can provide additional information about the potential for size reduction and sorting. The majority of experimental, ethnoarchaeological, and archaeological studies of artifact grain-size distributions and their interpretation have focused on lithic material and observations made on stone technology. This is primarily due to the preservation of lithic material at all size scales in the archaeological record and its physical structure which results in limited size reduction due to mechanical and physical weathering.

The existing studies are in no way exhaustive. For example, how microartifacts in particular are generated, in all material classes throughout the depositional history, is an area of much needed study.

Transport

Within the prehistoric household context, the artifact is created and becomes part of the record through manufacture, use and discard. These three activities essentially act to both create and transport microartifacts. Manufacturing techniques of lithics and bone tools are reductive or subtractive. The only additive technique is ceramic manufacture.

In reductive strategies, manufacture, use and discard can result in a range of sizes. When considering lithic material, the literature is fairly abundant. Similar studies of bone tool reduction however, are nearly nonexistent in the literature. This is probably due to how bone tools are manufactured. Bone tools are manufactured through abrasive techniques which produce bone byproducts measurable only in microns. In addition, being organic small bone fragments will survive only a short time in the archaeological record unless burnt. As a result there is little for the archaeologist to examine from the manufacturing process - often only a preform or the tool itself. Studies have shown, however, that the grain-size range among lithic debitage produced during manufacture is broad with high percentages of micro-sized debitage relative to the larger sizes (Baumler and Downum 1989, Behm 1983, Fladmark 1982).

Like in manufacturing, the use of lithic tools produce small flakes in edge damage and retouch. Lithic microwear studies using low power microscopic techniques focus on the attributes of scars representing edge damage from use and retouch. This edge damage is then used to interpret the functional use of a tool (Keeley 1980; Odell 1977). The smallest unit of analysis in low power study, other than polish, is the individual damage scar on a working edge. These scars are classified by general appearance, depth, and size (Keeley 1980:24). The sizes are in the range of small-scale debitage or microdebitage, 2 mm to .5 mm (Keely 1980). Thus, lithic manufacture and use activities both generate microartifacts.

Activity Area versus Discard Area

The knowledge of the source and transport of an artifact or artifact assemblage may help to understand the processes responsible for the size(s) present in the archaeological record. The distinction between activity areas and areas of discard - also referred to as primary and secondary deposition (Schiffer 1987) - has long been a question of interest (for example see DeBoer and Lathrap 1979; Hayden and Cannon 1983; Schiffer 1983). Addressing this question to the archaeological record can allow us to better understand site structure, its changes through time, and help us better identify the composition of such assemblages. This question is usually approached through examination of distribution and composition of macroartifacts. Recently however, studies widened the breadth of their size distribution to include microartifacts. The studies have operated under the assumption that the grain-size distribution may help to identify whether an archaeological deposit was a specific activity repeated in the same location, or created by discard (Rosen 1989). These studies have stated that micro scale grain-sizes and their provenience have a high probability of recording the location of the activity that produced them (Behm 1983; Hull 1983, 1987; Reese 1986; Rosen 1986; Vance 1989). This is based on the assumption that the micro material is all that remains following clean up in a repeatedly used area such as a structure. The area of discard, on the other hand, will contain what is collected from the activity area, assumably by hand, and will consist of larger grain-sizes. This phenomena has been observed in several contexts - experimental, ethnoarchaeolgical, and archaeological. The studies mentioned here are not all microartifact studies per se, but studies that allow us to assess the value of the attribute of artifact size, particularly addressing activity areas versus discard areas.

Experimental studies, focusing on stone tool technology, in particular biface manufacture, have yielded information on variation in byproduct size. These studies have attempted to correlate attributes observed from replication of different percussion techniques against attributes displayed by artifacts (Henry et al. 1976:57), and in so doing have made some important observations on size and the effect of size.

Several studies have focused on the ability of experimental grain-size distribution to be correlated with the lithic manufacturing techniques. Such a relationship would ideally allow the archaeologist to infer the technique used to create a recovered archaeological assemblage. Henry et al. (1976) published the results of a replicative experiment where Clovis points were manufactured using a variety of percussion techniques. The objective was to associate debitage characteristics with knapping techniques. Although this association was not viable, some interesting observations were made concerning the smaller debitage sizes. Debitage "is less likely to be disturbed during the occupation of a prehistoric site and thus should be a more valid indicator of certain activities." (Henry et al. 1976:61).

Fladmark conducted one of the most complete experiments to date. His 1982 study focused on the knapping of obsidian and the grain-size distribution that resulted. Numerically, greater than 99.5% of the debitage counted fell between 1.0 mm and .063 mm (Fladmark 1982:207), illustrating the relative abundance of micro-sized debitage created during manufacture.

Behm (1983) employed "mass analysis" to sort flake sizes produced during biface manufacturing experiments. Mass analysis, proposed by Ahler (1975), partitions lithic material by sieve mesh size. Behm uses two of those sizes, grade 3 (1.4 mm) and grade 4 (3.3 mm) to produce a ratio he believes distinguishes between primary and secondary deposits. His experimental distribution for primary deposits was created by collecting everything from a knapping area. The secondary distribution was produced by leaving a knapping area untouched then later sweeping and cleaning it by hand. The result in the secondary deposit was the absence of the smallest flake sizes, evidently overlooked and/or ignored during cleaning.

Schiffer (1987) coined the term the "McKellar Principle" based on observations made during a study by McKellar (1983 cited in Schiffer [1987:62]) of modern discard practices on the University of Arizona campus. The "McKellar Principle" encourages the archaeologist to recover small artifacts left behind in "regularly maintained activity areas" as it represents primary residual material (Schiffer 1987:62). This phenomenon has been noted in the context of ethnoarchaeology research as well.

Ethnoarchaeology studies have been fairly rigorous in their observation of modern populations and small-size artifacts. Gallagher (1977) observed Ethiopian obsidian workers practicing "cultural sorting" through the deposition of lithic debris away from the activity area. "Cultural sorting" refers to the selection of certain larger grain-sizes to be removed from the activity area and deposited at a discard location. Removal is primarily done to avoid the danger of stepping on these sharp fragments and the need to keep an area clear.

Binford (1978) identified different zones of deposition implying areas of activity versus areas of discard among the Alaskan Nunamuit. The "toss zone" refers to the area peripheral to an activity area where large debris are tossed. Small debris was dropped and left in the activity area (drop zone). Additionally, Binford observed as occupation intensified reuse of activity areas resulted in the tossing of large debris, thereby leaving small-sized objects. Hence, these activity areas became rich with small material while the larger material ended up in the areas of low use or the toss zone.

O'Connell (1987) has worked extensively among the Alyawara hunters and gatherers of central Australia, looking at intrasite structure. One of the major implications his data offers archaeological research is the observed "primary" locations of "very small refuse items" (O'Connell

1987:104). O'Connell suggests that the larger items are less informative as they are subject to cultural sorting. This size sorting was also observed among the highland Maya by Hayden and Cannon (1983). Following bipolar reduction of glass bottles to produce tools, great care is taken to remove debitage from "high to moderate use areas" to discard locations away from the living areas, such as specially dug pits, streams or public dumps (Hayden and Cannon 1983:159).

Clark (1986) examined ethnographic evidence of chert arrowhead manufacturing and refuse discard by contemporary Lacandon Maya. The Lacandon reportedly rely on a cloth to collect most of the refuse during knapping. However, microdebitage (no size given) can pass through and/or miss the cloth (Clark 1986). This microdebitage is not retrieved as it is trampled into the floor and does little harm. Following knapping, the contents of the cloth are removed to a "special trash gourd" (Clark 1986:24). When the gourd is full the contents are deposited far from the living area. As a result the actual work area is potentially only identifiable by microdebitage, as the larger material has been removed.

Discard location was the focus of Murray's review of ethnographic data from sedentary and migratory groups (Murray 1980). In that study, the practices of 79 cultural groups were reviewed. The findings suggest that with increasing sedentism, especially in conjunction with enclosed activity areas, there is a decreasing correspondence between location of use and discard (Murray 1980:497). While these ethnographic studies were not exhaustive, other such studies of modern populations have noted the same phenomena concerning artifact size. Size decreases in repeatedly used, potentially enclosed activity areas implying the removal of the larger sizes to other areas.

The size of discard material, the result of what Gallagher (1977) called "cultural sorting", is limited by the means of collection before disposal. In a household context this may be only large items, perhaps gathered by hand from the use or manufacture area and then discarded elsewhere in an area of little foot traffic. Artifacts at the micro-scale would in theory be too small to retrieve by hand. The amount of disturbance by sweeping or raking on an earthen floor has only been recently considered (Metcalf and Heath 1990; Neilsen 1991). Some speculate that foot traffic causing an increase in soil compaction in enclosed structures will increase the preservation of microartifact patterns (Hull 1987; Villa 1982).

Overall, based on the studies reviewed in experimental archaeology, ethnoarchaeology, and archaeology it would appear safe to assume that micro-scale grain-sizes and their provenience have a high probability of predicting the location of the activity that produced them. This assumption must however take into consideration formation processes, in particular those that affect a deposit post-depositionally. Such processes may significantly alter the observed patterns in the archaeological record.

Post-Depositional Alteration

Once an artifact has entered the archaeological record, either through loss or discard, at the time of manufacture or use, it can undergo post-depositional alteration. This includes any change that occurs to alter the original form or content of the deposit. Post-depositional alteration can affect the grain-size of the archaeological deposit through chemical and physical processes resulting in both size reduction and sorting. The degree of change in size or the distribution in sizes from the time an artifact enters the archaeological record depends partly on the type of material (e.g., chert, bone, clay). Artifact material classes discussed below focus on those recovered in a southeastern prehistoric context. No effort is made to discuss size of historic artifacts or obscure trade items that occasionally appear.

Weathering Artifact size can be affected by chemical and mechanical weathering causing reduction in size and sorting. Weathering can be defined as the process by which a source material is reduced in size through a variety of causes related to water, air, or living matter.

Archaeological sediments can come under the attack of any form of weathering.

Mechanical weathering is the reduction of a material by physical processes into smaller fragments "but without significant change in chemical or mineralogical composition" (Boggs 1987:27). Agents of mechanical weathering in an archaeological context include but are not limited to trampling, plowing, fire, and freeze-thaw. These agents weaken the material through some form of physical force causing ultimate fragmentation, often into micro-sizes. All artifact material classes can be affected by these processes, some more than others depending on their ability to endure physical force before breaking.

Chemical weathering is the change that can be inflicted upon a material when it is attacked by water, oxygen and carbon dioxide from the atmosphere causing dissolution of some components and recombination of others to form new components (Boggs 1987). Archaeologists are primarily concerned with chemical weathering of bone, and shell due to the hydrogen ion activity (pH) in the soil (Cook and Heizer 1965; Gordon and Buikstra 1981).

Durable artifacts, ceramic, and lithics in particular, must undergo extremes in mechanical weathering for size reduction to occur, compared to less resistant organic artifacts, such as bone, shell, and charcoal. These more vulnerable materials can be easily reduced by both mechanical and chemical weathering. Weathering of lithics, on the other hand, depend on the type of resource material. Different rocks are made of different minerals arranged in different structures. Porous rocks can be reduced more easily as water can enter the material weakening the structure. All rock undergoes chemical weathering. The degree is based not only on the chemical structure but the environment, surface exposure and time.

Ceramic and shell can be prone to both chemical and mechanical weathering. Shell tempered ceramics are weathered chemically by the leaching of the shell from exposed surfaces leaving voids in the clay matrix. The leaching reduces the ability of the ceramic to resist mechanical weathering hence promoting fracture and a reduction in size. A recent series of experiments conducted by Neilson (1991) indicate trampling (a form of mechanical weathering) as a significant agent in the generation of micro-scale ceramics.

Size has been used as a tool to decipher formation process of plow zone ceramic assemblages. Dunnell and Simek (1989) suggest all other things being equal that the smaller the sherd the more time it has been under the plow until it reaches a stable size. A similar study is currently underway by Pierce (1991) using ceramics that have reached that stable size where they are no longer being reduced by the plow. The goal is to use ceramic microartifacts and the degree of weathering as a relative dating tool in plow zones. The degree of rounding as opposed to angularity is directly related to the length of time the object has been exposed to chemical and mechanical weathering. The higher the index of roundness the older the sherd.

Shells, composed of calcium carbonate, can be reduced by chemical and mechanical weathering. Acidic environments will return the carbonate into solution while basic environments (high pH) will act to preserve the chemical structure. Shell is not strong structurally, and many of the gastropods (due to their thin-walled chambers) will fragment easily under most mechanical weathering processes.

Bone is 33% organic and 66% inorganic. Both the organic and inorganic contents of bone make it vulnerable to chemical weathering. Under the ravages of carnivores (mechanical weathering) bone can be gnawed, reduced to smaller fragments, and ingested (Binford 1981). Smaller sized bone fragments can then enter the record from the gnawing or in the scat of these carnivores. Digested bone can be distinguished from undigested fragments by distinctive pitting and polishing signatures that remain on the surface of the digested bone (Klippel et al. 1987; Snyder and Klippel 1990). The attribute of polish was not considered in the microartifact analysis but has been observed during preliminary analysis of the macro bone assemblage at the Loy Site.

Post-depositional processes such as weathering can induce the sorting of grain-sizes that create associations having nothing to do with human behavior (Schiffer 1987). Sorting by natural agents can result in the removal or displacement of size classes.

In the context of soil genesis within soil horizons, sorting is referred to as translocation, the downward movement of sand size particles. This process occurs mainly in porous soils. In such contexts microartifacts could conceivably migrate downward from their original location. Microartifacts having undergone such processes however, can still be invaluable sources of information to unravel the complex digenesis of an archaeological deposit (Stein and Teltser 1989).

An example of the movement or absence of an artifact due to weathering could be the following. Within a hypothetical archaeological deposit, bone artifacts might be reduced by leaching or might not survive at all. This absence or reduction in size may be the result of chemical weathering, not human behavior. In such environments, post-depositional alterations can greatly influence the artifact grain-size distributions observed, actually producing or moving microartifacts. As a result the assemblage in the example above should be analyzed as a signature of bone <u>macro</u> artifacts. In the hypothetical deposit, sand-sized bone fragments or trace elements have been reduced and sorted by post-depositional processes and may be all that remain of what was originally whole bones and large fragments deposited by people.

Grain-size distribution Depending on the competency of the transport agent, conditions and availability within the source area, the transport medium can move different sizes from the existing environment of deposition and deposit them elsewhere acting theoretically as a post-depositional alteration (Stein and Teltser 1989:2-3). Sedimentologists identify different sorting mediums by different modal peaks in the grain-size distribution. Bioturbation such as earthworms and burrowing animals will sort sediments resulting in displacement of small artifacts; the size depends on animal body size (Stein 1980). Such sorting would create a distribution with a peak in the small size fractions. Larger burrowing animals will displace larger objects, often bringing them to the surface causing a skew towards smaller sizes in the grain-size distribution. Cryoturbation (freeze-thaw) has been shown to sort sediments with the coarser fraction being pushed upward and the finer material downward (Wood and Johnson 1978). Wind will move the smaller particles (depending on its velocity and the exposure of the ground surface) leaving larger particles behind producing a modal peak in the larger particle sizes. These natural processes could cause the sorting of an artifact assemblage by size resulting in the removal of microartifacts to a new environment of deposition or microartifacts being left behind as the larger objects are selected for and removed.

An archaeological example of such post-depositional processes affecting small-scale artifacts was observed by Behm (1985) during analysis of a lithic assemblage from a site at Death Valley National Monument, California. Within the assemblage, Behm noted the relative absence of small size debitage. He concluded, based on his knowledge of the slight gradient present and local sheet water erosional processes active today, that the assemblage had undergone fluvial processes acting to "winnow out" the small size material leaving the large material in situ (Baumler 1986:123; Behm 1985:127). Had the post-depositional processes gone unrecognized, a totally different interpretation may have been formulated. Similar observations have been made of other exposed deposits vulnerable to fluvial and eolian sorting (Behm 1985; Fladmark 1982; Schiffer 1987; Wood and Johnson 1978).

By definition humans, as biological agents, are a solid transport agent (Stein 1987). Solid transport agents, such as ice, do not consistently sort certain size ranges but have the capability of moving any size distribution. Herein lies a major contribution of ethnoarchaeological observations. These studies have consistently observed specific human behaviors as a sorting mechanism ("cultural sorting"). This behavior includes the use of an activity area, cleaning, and the disposal of collected refuse. As a result, humans must continue to be considered as solid transport agents but in inquiries concerning activity areas versus refuse disposal - the potential exists for modal peaks or the selection, resulting in the greater representation of specific sizes. These distributions among the different size classes could offer vital information towards the depositional history. A modal peak among the small fractions may indicate a location functioned as an activity area while a model peak among the large fractions may indicate a discard area.

In conclusion, these experimental, ethnoarchaeology and archaeological studies have shown that artifact patterns are indeed composed of different sizes of artifacts. Different reduction and sorting processes can affect different material types. Great attention must be given to material class when analyzing the grain-size distribution of an archaeological deposit. This consideration governs the kinds of questions that can be posed using different materials at the micro-scale. Approaching artifact distributions from the sedimentological framework of source, transport, environmental depositional and post-depositional alteration can assist the archaeologist in sorting out the depositional history, potentially identifying the processes responsible for the grain-size distribution(s) present.

CHAPTER III

THE LOY SITE

The Mississippian period, A.D. 800-1700, is generally defined as the period in Southeastern prehistory when maize agriculture became the primary product and food source. The period is characterized by shell tempered ceramics, wall trench houses, the arrangement of mounds and household structures around open plazas, and mortuary practices indicating centralized leadership in a ranked sociopolitical structure (Chapman 1985; Smith 1986; Steponaitus 1986). The structure analyzed in this study is from the Loy Site and dates to the Late Mississippian Period, Dallas Phase circa A.D. 1400.

The Loy site is located in southern Jefferson County in the Ridge and Valley physiographic region of East Tennessee. The site is situated on a first terrace on the east bank of the Holston River (Figure 1). A coring and magnetometer program conducted across the terrace by R. Polhemus has defined a town covering an area approximately 120 by 210 m. The site includes three separate episodes of palisade wall construction and expansion, a platform mound, central plaza, and an estimated 60 structures.

Local Soil Description

The soil genesis that has occurred across the first terrace directly affects the depositional history of the

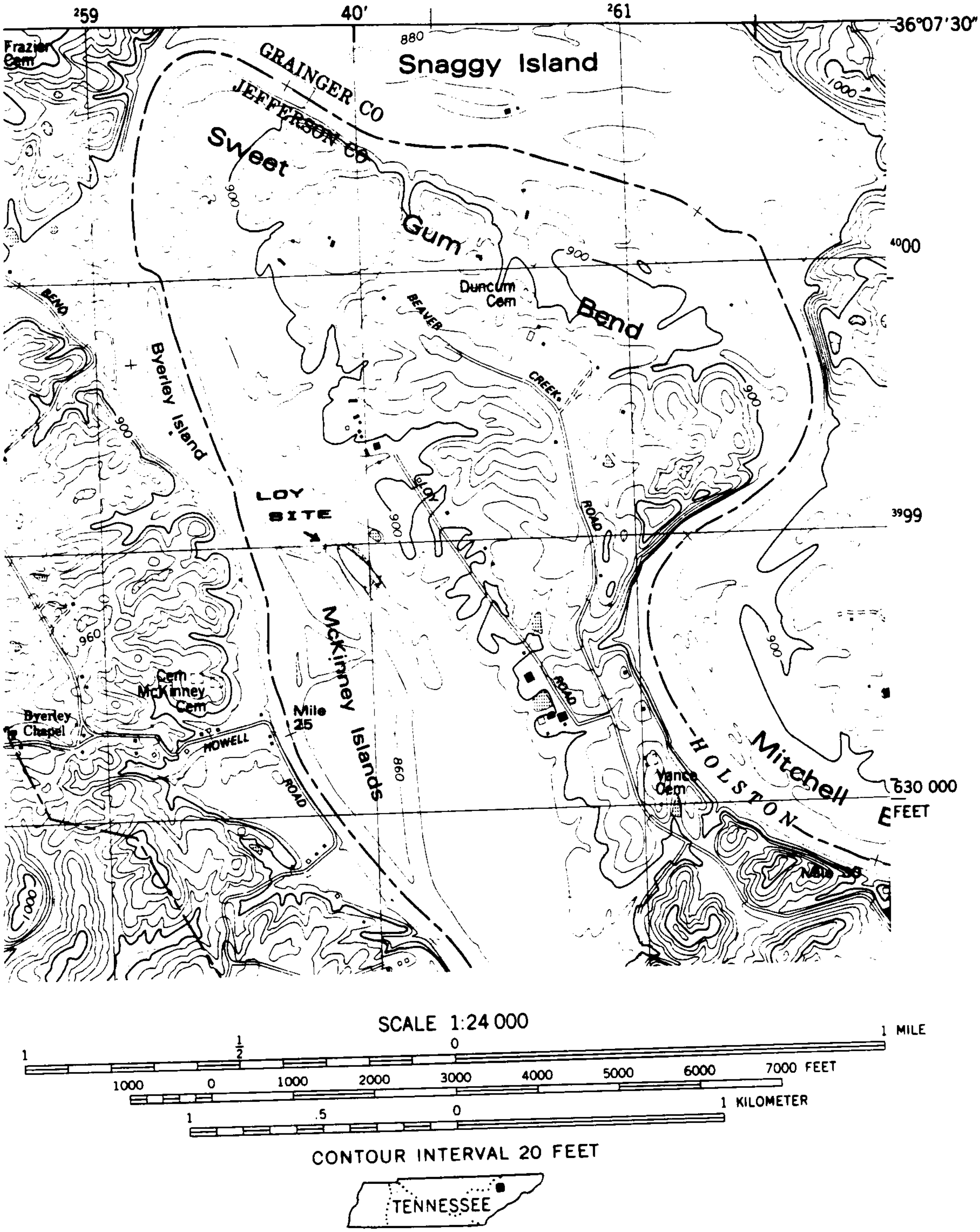
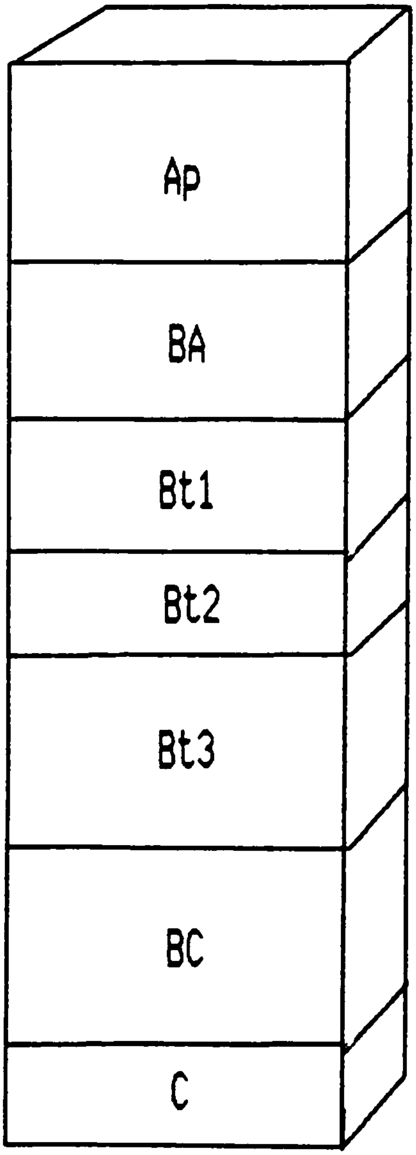


Figure 1: Location of the Loy Site (Mascot Quadrangle, Tennessee, 7.5 minute series)

archaeological sediments. The following is a brief discussion of the soils in the vicinity of the site. Several sources of information are utilized: recent data from preliminary characterization of Jefferson County soils conducted by the United States Department of Agriculture (USDA) and the Soil Conservation Service (SCS) (Soil Survey Staff 1988), augering data from across the terrace (Polhemus 1991 personal communication), and profile information from a control profile just south of the site limits examined by the author. The stratigraphic sequence associated directly with Structure 3 is discussed later in this chapter. The sediments associated with Structure 3 indicate the depositional settings applicability to microartfiact analysis.

The soil survey data (Soil Survey Staff 1988) come from two pedons analyzed down river, south of the Loy Site, on the same first terrace at approximately the same topographic and geomorphic location. Their general description in profile is illustrated in Figure 2. Parent material is mixed alluvium, and the slope is approximately one percent. The soil is classified as a fine-loamy, mixed, thermic Typic Argiudoll. The Ap is defined as a very fine sandy loam with a sand content of over 50% grading into a loam. The Bt horizons below the Ap (three in all) are all described as loam. Comments from the preliminary descriptions identify an alluvial overlay at 0-28 cm (0-11 in). This observation

Pedon Description - SND S86TN-89-1
(based on preliminary data)



(not to scale)

Ap - 0 to 35 cm; very dark grayish brown (10YR3/2); loam (53% sand); moderate medium granular structure parting to weak medium subangular blocky; Ap considered surficial alluvial deposit.

BA - 35 to 50 cm; dark brown (10YR3/3); silt loam (36% sand); moderate fine subangular blocky structure.

Bt1 - 50 to 68 cm; dark grayish brown (10YR4/2); silt loam (37 % sand); weak medium subangular blocky structure.

Bt2 - 68 to 93 cm; brown to dark brown (7.5 YR4/4) silt loam (38% sand); moderate coarse prismatic structure parting to weak medium subangular blocky.

Bt3 - 93 to 124 cm; brown to dark brown (7.5YR4/4); silty clay loam (42% sand); moderate coarse prismatic structure parting to weak medium subangular blocky; many patchy distinct black (10YR2/1) manganese or iron-manganese coats on faces of peds.

BC - 125 to 150 cm; strong brown (7.5YR4/6); loam (49% sand); moderate coarse prismatic structure parting to weak medium subangular blocky.

C - 150 to 163 cm; strong brown (7.5YR4/6); loam (63% sand); weak coarse prismatic structure.

Figure 2: General Description of Soil Profile based on Soil Survey Preliminary Data, Jefferson County

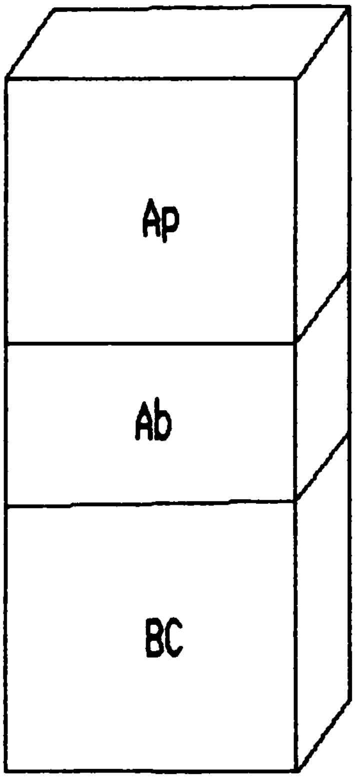
closely corresponds with the identification of a buried A at a similar depth described at the Loy Site in association with Structure 3.

The coring data collected by Polhemus produced similar observations and also provides data on site size, site structure, and geomorphic history. There was one localized major non-archaeological stratum present, not encountered in the soil survey data. This is a white quartz coarse sand mixed with yellow clay that appears to lie at the east end of the site, extending beneath Structure 3. This sediment was identified at ca 64 cm below the current surface in the vicinity of Structure 3. This deposit is interpreted as associated with an abandoned channel. The east side of the site is bounded by an intermittent stream which flows northward, paralleling the river until it reaches the northern limit of the site and turns at a right angle to meet the river. At one time, prior to the Archaic Period, this stream must have been located where the site is today, and it meandered eastward to its present path. This sandy clay loam (56% sand - predominantly quartz) has contributed to the archaeological deposits identified across the site, especially within the structures. When pits were excavated by prehistoric people to depths of 90 cm or more into the structure floor the excavated sediment was incorporated into the floor and into the posthole and pit deposits. A number of different sizes and morphologies were observed among the quartz grains in the archaeological deposits identifying more than one source in the alluvial parent material. This is typical for a first terrace, which can and does sustain erosional and depositional episodes of flooding. The differing quartz grains are attributed to the deep deposits below the Loy Site and the mixed alluvial parent material.

The control profile described by the author varied somewhat from the soil profile described by the soil survey (Figure 3). The control profile was located just beyond the south extension of the site and was in a slightly lower topographic location. The Ap lay at a depth of 0-47 cm compared to 0-35 cm of the soil survey pit. An AB was recorded from 47-61 cm, the boundary was not abrupt but the horizon remained evident suggesting an eroded then buried AB. The color was dark and clay cutans increased with depth. Toward the base of the AB and into the horizon below, gleying (lower chromas) increased with depth. This type of clay accumulation is not evident in any of the coring within the occupied area of the site and may be due to increased surface water related to poor drainage at a slightly lower surface elevation.

Soil descriptions across the area are in general agreement. Soil data from the area have been compared to information gathered during site excavation, although comparisons are very limited at this point. One thing that is clear from comparison is that the site has a sedimentary

Control Profile
Loy Site (40JE10)



Ap - 0 to 47 cm; very dark grayish brown (10YR3/2); silt loam (22% sand); granular structure at the surface parting to subangular blocky.

Ab - 47 to 61 cm; very dark brown (10YR2/2); silt loam (12% sand); subangular blocky.

BC - 61 - 109 cm; dark yellowish brown (10YR4/4); sandy loam (69% sand); subangular blocky; distinct black (10YR2/1) manganese or iron-manganese coats on faces of peds; sparse gleying light yellowish brown (10YR6/4).

Figure 3: General Description of the Loy Site Control Profile

sequence greatly affected by human occupation. For example, large "borrow pits" have been identified along the southeastern site edge. They were probably excavated as sources for mound construction and daub preparation. These are identified by slightly lower surface elevations resulting in a slight basin shape, and a change in vegetation covering the area. The coring program identified large poorly developed deposits with distinct boundaries, irregular in shape (horizontally), and relatively few artifacts. One of the borrow pits measure ca 7.5 by 24 m with a depth of 61 cm.

A 10 cm thick humus was preserved beneath or between Dallas deposits; this contained a consistent small amount of early Archaic through Woodland Period artifacts indicating that the portion of the terrace occupied by the Dallas people has remained at a relatively stable elevation for the last ca 7,000 to 8,000 years. Late eighteenth - early nineteenth century depositional changes are evident in an alluvial overlay that covers the terrace appearing in each of the profiles described.

The overlay observed in the soil survey data and noted at the site, evidently occurred long after the Loy Site occupants abandoned the area. The overlay appears to make up the majority of the Ap. This has served to protect much of the archaeological sediments at the site since only portions of the existing structure floors examined have been disturbed by plowing. Unfortunately of the stable surface surrounding the structure only portions remain.

The Mississippian Period Dallas Phase

The Mississippian is divided into three periods. These periods are delineated by trait lists identifying variations in artifact styles and types, architecture, and settlement structure. Based on the Loy Site location and distinct traits, the site has been assigned to the Mississippian II period. This period is known within the Ridge and Valley physiographic province as the Dallas and Mouse Creek Phases, A.D. 1300 - 1600. The Loy Site is specifically ascribed to the Dallas phase. This phase has been observed extending south from the lower French Broad and Holston drainage through the Tennessee River Valley, and southwest into portions of Georgia and Alabama (Polhemus 1987).

Lewis and Kneberg (1946) were the first to define the Dallas phase and created a detailed trait list based on observations from sites in the Chickamauga Basin including the Hiwassee Island Site. In general, the ceramics are distinctively shell tempered including cord marked, modeled, incised decoration, fillet applique, and a limited amount of incised grit tempered wares. Other distinct traits include predominantly flexed human burial commonly found within and in the immediate vicinity of the household, and rectangular structures built with interior support systems and single set posts (Polhemus 1987).

A Model of a Dallas Phase Structure

The household unit is archaeologically represented in the Dallas phase by a primary structure (winter house), a secondary structure (summer house) and an outside activity area associated with processing facilities (Polhemus 1985). An architectural typology has been constructed by Polhemus (1987) for Mississippian structures based on archaeological evidence and ethnographic descriptions. The primary structure used in this study is identified by Polhemus as "type 4a", a rectangular domestic structure with a rigid single set post construction and four main roof supports. The main roof supports are centered on a prepared clay hearth. The secondary structure normally found associated with 4a is typed 5a, a rectangular, rigid single set post construction, small in relative size, typically identified with 30.5 cm diameter postholes and surface fired areas (Polhemus 1985). These 5a structures are interpreted as partially open sheds for cooking and food processing. Structure types 4a and 5a are consistently found associated as primary and secondary structures respectively, composing a household unit.

Polhemus' model for the use of space within a primary structure is based fundamentally on data from the Toqua Site (40MR6), also a Mississippian Period, Dallas Phase town (see Polhemus 1985). The model divides the structure into two principal parts:

...a central `public' floor area around the hearth, and an outer `private' floor area situated between the roof supports and the exterior wall. The public area is centered on the prepared clay hearth and frequently includes surface fired areas probably utilized in food preparation. The private floor area is usually divided into segments through the use of interior posthole alignments or prepared clay daub partitions. Segments situated between main roof supports along the central portion of each wall appear to have functioned as beds or benches as well as serving as loci for activities such as flintknapping and bone tool manufacturing. Burials are most frequently placed beneath or immediately in front of the beds or benches. The corners of the structure, making up the remaining portions of the private floor area, were utilized for storage. (Polhemus 1985:57)

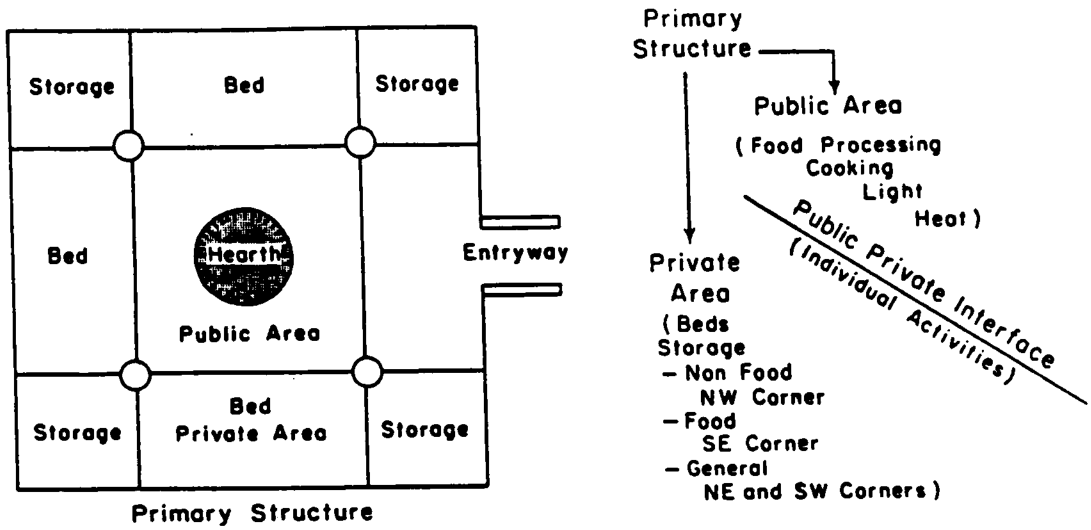


Figure 4. Polhemus' model for the interpreted use of space in the Dallas Phase of the minimal settlement unit (after Polhemus 1985:Figure 3.6).

This model is based on ethnographic accounts of similar structures in the southeast (see Williams 1973), archaeological structure remains, and the patterning of macro artifacts across the "floor". A similar model focusing on floor space usage has been constructed for late Mississippian, Barnett Phase structures from northwestern Georgia (Hally 1983). The organization of the structural elements are nearly identical to that of Type 4a.

As was noted above, the majority of the assemblages used to develop the Type 4a model were collected from structures excavated at Toqua. Within these assemblages artifact classes or combinations of classes were identified in clusters and interpreted as activity areas reflecting organization of space. These clusters consisted of chipped stone or bone debris, and material for working shell, concentrated in front of the remains of benches that once lined the structure walls (Polhemus 1987). These clusters were identified in both the "public" and "private" areas. The central "public" area is usually relatively clear of macro debris except for the immediate area of the hearth. The corners of the structures are interpreted within the 4a model as storage areas, and were either clear of debris, or contained ceramic vessels and/or food remains (e.g. charred corn). The interpretation of the corners, located within the private area, was based on artifact clusters, their orientation, and the absence of artifacts. In the case of Toqua Structure 14, one corner contained concentrations of corn, squash, and various seeds and nuts recovered in association with microfauna (small rodent) (Polhemus

1987:285). Incidently this was the only micro fauna recovered from within the structure. This association was interpreted as a food storage area where microfauna would have had access to these food stuffs. The majority of the ceramic vessels found in the corners of structures at Toqua and at Loy are recovered inverted. The inverted placement is interpreted as a vessel storage position.

Structure 3

The general stratigraphic sequence observed across the area of Structure 3 includes five lithostratigraphic units: plow zone, sub-plow zone, level 1, level 2, and the floor (Figure 5). A 27 cm plow zone covers the entire first terrace and is characterized as a very dark greyish brown (10YR 2/3) silt loam (29% sand). The first lithostratigraphic unit encountered beneath the plow zone is called the sub-plow zone. It includes a remnant of Mississippian sheet midden overlying an earlier humus. These two layers were combined in the field and measured approximately 8 cm thick. The apparent humus indicates a stable surface nearly 30.5 cm below the current surface. The unit is identified in the field by organically rich very dark brown (10YR2/2) silt loam (29% sand). In the midden portion the artifacts are oriented horizontally with the "humus" below generally artifactually sterile and friable. The midden and old humus are truncated towards the east. This phenomena is not illustrated in Figure 5. The eastern

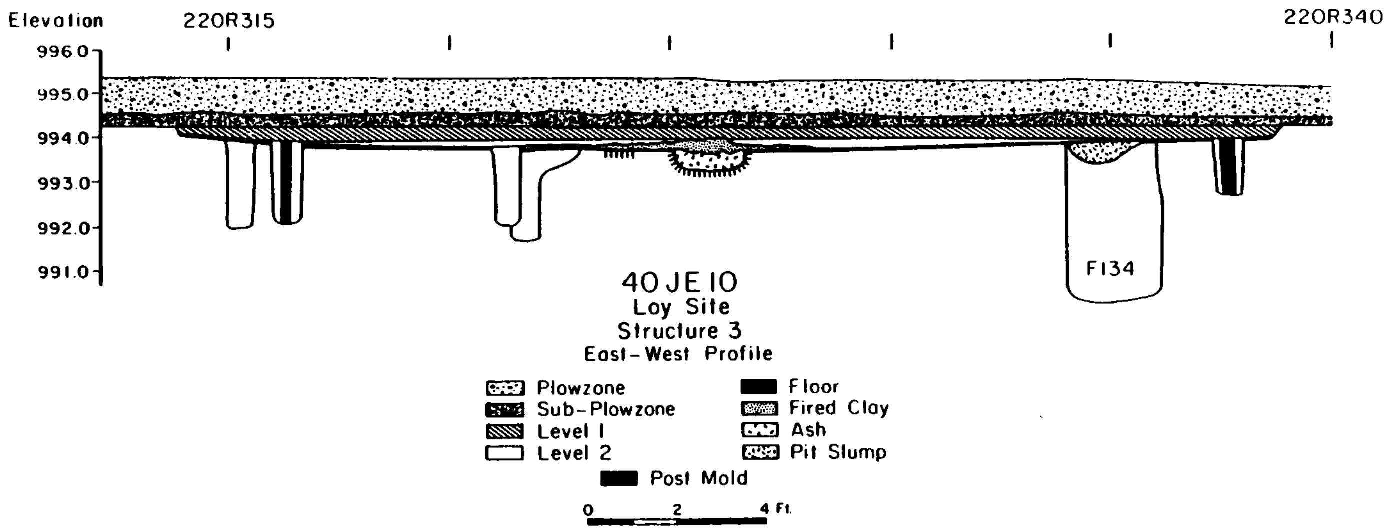


Figure 5: General Stratigraphic Sequence of Structure 3 at the Loy Site

truncation has removed portions of the original stable surface from beyond the limits of the basin shape deposits composing the structure.

The next three units, which compose Structure 3, intrude through the midden and humus. These deposits form a basin measuring 24 cm deep at its center. The bottom unit is interpreted as a floor based on attributes of texture - silt loam (26% sand), lighter in color (dark yellowish brown (10YR3/4), and more compact than the deposits above, and on the association of artifacts in a horizontal orientation (Figure 5). In addition, subfloor deposits such as postholes, entry way trenches, and pits become visible at this level (illustrated in Figure 6). The floor varies in thickness between 3 cm to 9 cm. Samples for microartifact analysis were collected from the floor. The vertical placement of the microartifact sample was between the actual compact "floor" surface and the "floor" sediments, or area of accumulations above.

The unit above the floor, level 2, is characterized as a very dark brown (10YR2/2) silt loam (25-30% sand). The deposit is interpreted as a destruction zone, where the sediments are the result of the structure burning and collapsing. The destruction zone is primarily composed of fired clay daub and charred architectural material mixed with sediments from above and below.

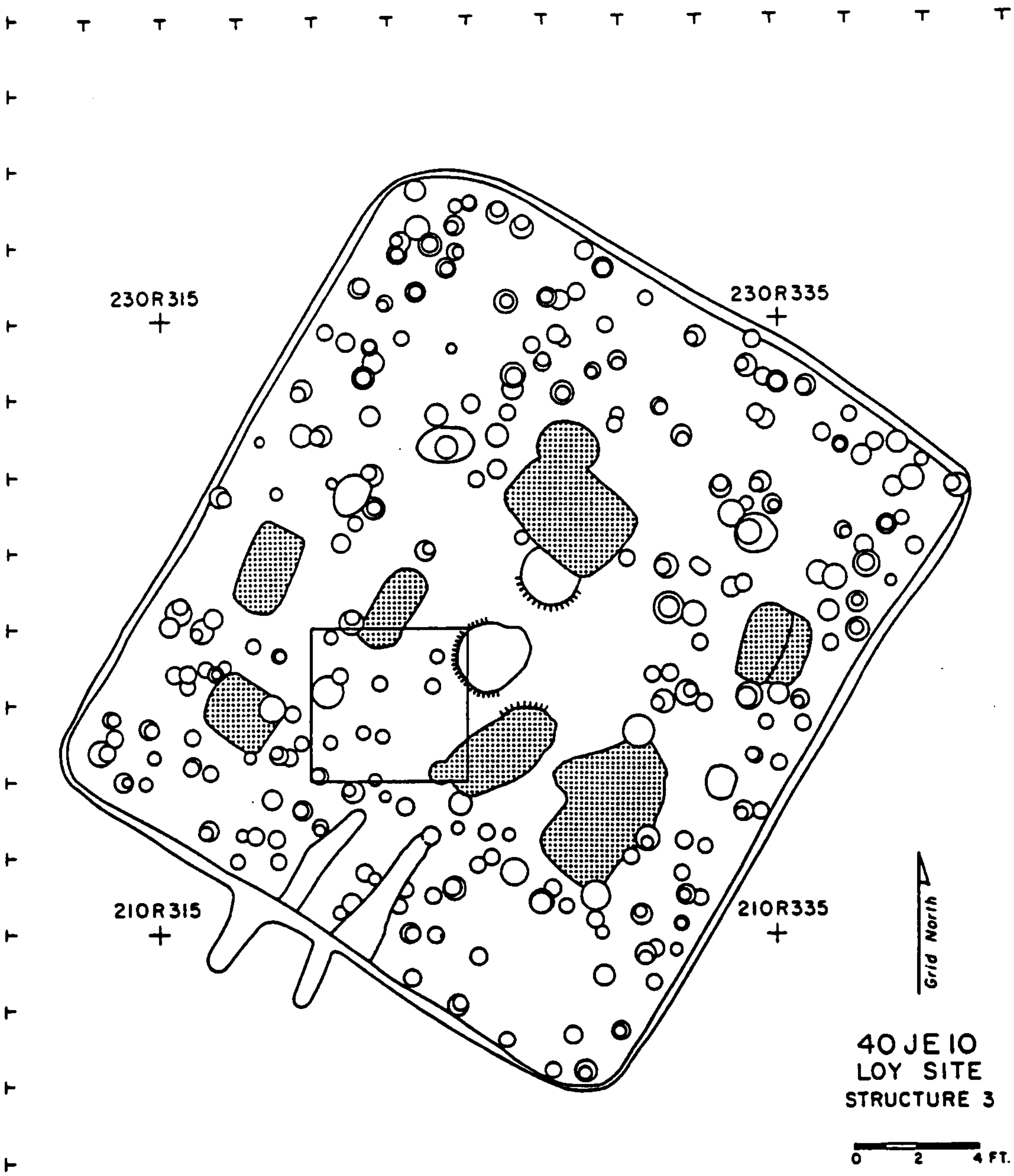


Figure 6: Plan Map of Structure 3 and the Location of Floor Deposits

Level 1, the upper most unit composing Structure 3 is characterized as a very dark brown (10YR2/2) silt loam (27% sand). It is interpreted as overburden or post-destruction. The dark brown friable sediment is characteristic of an A horizon, with inclusions of small artifact material brought up through bioturbation from the underlying cultural deposits and moved downward from the plow zone.

The excavation protocol as it relates to the current general excavation of Structure 3 is outlined in Appendix A. A 1.5 m square area in the center of the southwest quadrant of the structure was not available for sampling (illustrated in Figure 6). This area was excavated in 1983 during initial testing of the magnetometer survey results.

Structure 3 at the Loy site was chosen to study the application of microartifacts for several reasons. In general, current research questions surrounding the Mississippian Period relate directly to the organization of space and its implications for socio-political organization (Smith 1978; Sullivan 1987). The general research design at the Loy Site focuses on the spatial organization of the town with emphasis on the interiors of the structures. Much of the analysis aimed at answering related questions is based on the macroartifact assemblages. Existing studies reviewed in Chapters I and II indicate the micro assemblage would offer unique complimentary information to the Loy Site macroartifact assemblages.

The nature of the lithostratigraphic units associated with Structure 3 are ideal due to their original formation inside the constraints of an enclosed structure. Microartifacts deposited within an enclosed structure will be less likely to be dispersed during manufacture and use. In addition, trampling resulting in compaction could potentially preserve depositional patterns (Hull 1987; Villa 1982).

Structure 3 appears to have undergone rebuilding or renovation episodes, but without change to the structure orientation. Frequently these structures were rebuilt over time with occasional reorientations correlating with change in the community structure. On the assumption that specific areas within a structure were designated for particular activities, reorientation can result in potential palimpsests of artifact clusters. This close vertical proximity can make pattern delineation difficult if not impossible in such a horizontally restricted area. This does not appear to be a problem for Structure 3. According to Polhemus (personal communication 1991), the last rebuilding episode maintained the Structure's original orientation and excavated a new floor below any that may have existed previously. This is based on a set of relatively shallow postholes located on the interior of the structure which parallel the outside southwest wall perpendicular to the entry trench deposits (see figure 6).

Finally, like many late Mississippian structures recovered archaeologically, Structure 3 was consumed by a fire that completely destroyed the enclosure. Often an event such as total destruction by burning will cause a structure to collapse, sealing in the floor deposits below. This appears to have occurred at Structure 3. Preliminary observations made from the macro assemblage indicate that the Structure 3 assemblage is interpreted as an abandonment assemblage. This interpretation implies that abandonment occurred prior to the fire. This assumption is made based on a comparison of the macro artifacts assemblage and structural remains of other contemporary similar Dallas Phase structures, especially two that have been excavated adjacent to Structure 3 at the Loy site. These macro assemblages were much richer and denser including ceramic vessels on the floors. The macro assemblage being an abandonment assemblage alone offers microartifact analysis as a desirable addition to the analysis. Abandonment assemblages might not necessarily reflect previous occupational depositional regimes (Linse 1991). Microartifacts have a greater probability of reflecting activity as they are assumed less likely removed from surfaces during occupation.

The depositional situation found in relation to Structure 3 offered circumstances ideal for microartifact analysis. Research at the Loy Site is centered on better understanding the organization of space during the Dallas Phase based primarily on artifact patterns. It has been shown that microartifacts are a vital source of information in the deciphering of artifact distributions. In addition, the nature of such a Dallas Phase structure with its sedentary inhabitants, excavated earthen basin floor, and complete enclosure, also offered a prospective secure environment for the deposition of microartifacts. Finally, the living floor had been buried by the relatively rapid destruction of the structure by fire producing stratigraphic protection, hence limiting the post-depositional erosional processes brought on by exposure.

CHAPTER IV

METHODS AND MATERIALS

The primary goal of this research is to examine the spatial distribution of microartifacts, relate them to macro artifact assemblages, and assess their potential contribution to activity area interpretation. To accomplish this, the sampling design used in the field must allow well-grounded comparison between the micro and the macro-scales of data, and given the abundance of the micro-scale particles, the technique of microartifact sampling and quantification must be both statistically representative and time effective.

The 0.0 ϕ (2.0 - 1.0 mm), and 1.0 ϕ (1.0 - .5 mm) size fractions were selected for microartifact analysis. The fired clay material classes (to be discussed later) can only be identified with confidence down to 1.0 ϕ. After .5 mm the particles begin to break down into their constituents, either fired clay fragments, shell fragments, or quartz grains, and can no longer be properly identified. This phenomena was also observed and noted by Madsen and Dunnell (1989) when attempting to point count fired clay microartifacts. Studies that have analyzed microdebitage only, have been able to work with much smaller phi sizes. For instance, Fladmark (1982) identified a lithic size class down to 4.0 ϕ, .063 mm.

Control Samples Control samples were collected to determine the natural background sand-size particles that could be possibly misidentified as artifacts contributing to the microarchaeological assemblage. The location chosen "off site" lies along the same first terrace on which the Loy Site is situated, just south of the site boundary described in Chapter 2. Selected control samples underwent the same lab protocol as the archaeological samples. The resulting data were to be used, if necessary, to correct for the potential nonarchaeological contribution from the natural sediments.

Vertical Samples Vertical bulk samples were collected at 7.6 cm (.25 ft) arbitrary levels from each excavation unit forming two transects across the structure. These levels relate directly to the lithostratigraphic units making up Structure 3. Vertical samples were collected to gather information on the nature of the soils forming within Structure 3, and to assess the grain-size distribution in relation to the stratigraphic units. The collection protocol is detailed in Appendix A. Two sets of these samples were selected, one from the center of the structure, and the other towards the outer wall. Their entire vertical sequence was analyzed to determine grain-size distribution.

The grain-size analysis was conducted using the Hydrometer method, from Day (1956) and Gee and Bauder (1986) for the clay and silt size particles. The sand size fraction was analyzed using the nested US Standard sieves divided by phi sizes (Day 1965). This protocol is detailed in Appendix A as well.

As stated in Chapter II, grain-size data can offer a wealth of information when determining depositional history. Grain-size analysis was performed on these few vertical samples to offer some insight into the sand size distribution throughout the deposits. Since this microartifact study focuses on only the 0 ϕ and 1 ϕ, the protocol used to process the horizontal microartifact samples will not divide the remaining particles represented. Therefore the grain-size analysis of the vertical bulk samples becomes especially important to add additional information useful in understanding microartifacts within Structure 3 and ultimately, interpreting the depositional history.

Material Classes

Seven material classes were designated based on observations made during the preliminary analysis and protocol design. These classes were chosen on the basis of the natural sediment and macroartifact material classes present at the site. Comparative collections were made by reducing large artifacts from past surface collection to 0.0 ϕ and 1.0 ϕ to aid in the proper identification of material class. These comparative samples are now located in the Laboratory of Analytical Archaeology at the University of

Tennessee. The classes in this study are unmodified rock, lithic, charcoal, bone, shell, and fired clay (including daub and ceramics).

Unmodified Rock This class is the "catch all" category for any rock, mineral, or concretion (iron or manganese) that was natural to the alluvial sediment. This included material that could have been altered by people (therefore an artifact) but could not be reliably identified as such at this small scale (e.g., groundstone, fire cracked rock). The majority of the unmodified rock is alluvially transported quartz grains that appear to be from a number of sources. The quartz varies substantially in size, color and morphology. Much of the quartz is rounded with frosted surfaces making it easily distinguishable from lithic artifacts which have a high degree of angularity. Where difficulty arose was in a limited fraction of the quartz grains which are angular with a glassy luster. These could conceivably be microdebitage due to their angularity but were counted in the class of unmodified rocks based on observations made in the control profile samples and the microartifact comparative samples.

Lithic Lithic refers to modified rock or mineral. The modification is assumed to be the result of lithic reduction or wear from use and trampling by people. The material most often identified at the macro level is Knox black chert and a tan chert (Fort Payne ?) with lesser amounts of quartzite, and possibly quartz. Based on observations made of this and other comparative collections, the resource type is not consistently obvious at the micro scale. At least some hint of color will usually be present. Due to the angular alluvial quartz grains composing some of the deposits, lithics were identified using the following combination of attributes: angularity, thinness (often opaque), remnants of conchoidal fracture attributes, and absence of frosting (as on most of the alluvial quartz grains), and at least some hint of color (usually grey, tan, or even oolites).

Charcoal Charcoal is defined as any black carbonized material. Based on general morphology, the majority of the carbonized material appears to be burned wood, seed, or cane fragments. Some burned bone was also identified but since not all charcoal could be reliably identified as to type, it remained as charcoal. It is interesting to note the detail observable at this scale in the structure of the charcoal. Wood charcoal and seed charcoal have been identified to genus when observed by the properly trained analyst. Identification at this scale could have some interesting applications beyond what is visible at the macro scale and in terms of sampling for botanical remains.

Bone Bone fragments are assumed to have been deposited as a result of cultural processes whether from human subsistence, canid gnawing within the structure, or in the case of microfauna, perhaps animals drawn there because of human food stores and refuse. Bone was not difficult to identify with its unique structure and shapes. It was immediately distinguishable from the other material classes even when burned. The samples appeared to contain fragments of fish bone, fish scale, mammal bone (large and small) and microfauna teeth. Bone preservation is variable; fragments can not be further described or identified with the exceptions of some fish bone and rodent teeth due to the original small size of the fragment source.

Shell The shell fragments are also primarily considered to be the result of cultural processes. Shell is identified based on its white to grey color, and morphology. The shell present appears to reflect that of the macro assemblage composition, mostly freshwater mussels and gastropods with an occasional land snail fragment. The macro shell material was extremely decomposed and degraded, breaking apart easily during excavation.

Fired Clay: Daub and Ceramic Fired clay was divided into two separate material classes based on composition or temper. Macro fired clay artifacts at the site contain two distinct classes of material in a clay matrix, sand and shell. Based on ethnographic records, and the location and nature of the macro material, the sand inclusions are indicative of daub. The term daub refers to the local clay that was collected and used in house construction, lining hearths and sections of the roof and walls, to make a structure more secure and fire proof. Very fine quartz sand grains are the most abundant constituents of daub but this clay can also include the imprint or inclusions of material such as charcoal, cane, other plant materials, even debitage and ceramic sherds. Often Mississippian structures such as the one under investigation were burned so the daub is not only dried clay but also essentially fired, giving it a texture and hardness similar to prehistoric low-fired, course ware ceramics.

Mississippian ceramics are most often tempered with crushed shell. Shell tempering is fairly easy to identify, even at the micro scale. The ceramic sherds at Loy occasionally exhibit voids as a result of the shell leaching from the clay matrix. These voids are lenticular and plate shaped, easily identified as leached shell tempered ceramics. Based on these attributes fired clay microartifacts are distinguished based on the type of temper present (sand or shell) or void shape.

There is one type of material that can often be confused with fired clay microartifacts - soil concretions. The Loy site sediments appear to contain concretions composed of manganese or iron-manganese. This observation is reinforced from similar observations made by the county soil survey (Soil Survey Staff 1988). Concretions are variable in color (brown, tan, black, red), always round, and depending on the type "are formed in the presence of fluctuating groundwater, oxygen-rich soil atmosphere, and abundant available iron [carbonate, or manganese]" (Stein and Teltser 1989:22). Fired clay classes were distinguished from concretions based on attributes of temper (presence/ absence), and roundness (both daub and ceramics were never round but usually subangular).

Based on the definitions above, a classification of seven materials was designated. The next issue to address is sampling, both in the field and beneath the microscope.

SAMPLING

The field microartifact sampling scheme designed for the floor had to produce samples that could reliably be compared with the macro-scale samples. It is nearly impossible to study the population of these abundant particles exhaustively, therefore we must sample. Sampling <u>for</u> microartifacts and <u>among</u> micro-scale particles is a challenging methodological issue. It is not difficult to sample for microartifacts because of their abundance. The issue lies in what population a sample actually represents.

In attempting to identify activity areas, as this study endeavors to do, three potential difficulties must be considered. First, the sampling interval should be smaller than the area of an activity, otherwise the area of the activity could occur between samples and remain undetected. This issue is very site specific considering site size, duration of occupation, the nature of the activity one is seeking to identify. The second difficulty is the relationship between macro and micro assemblages. A protocol for field sampling should be designed based on the macroartifact units, representing as much of the same surface area as possible.

Once the sample representation and interval have been determined, the third difficulty, how to quantify the microartifacts within the samples, becomes relevant. Few have opted to count "everything". A more realistic approach is to attempt to reach redundancy in the number within a material class counted. Theoretically, once redundancy is reached a representative sample will have been collected.

Sampling For Microartifacts

At the Loy site, the lithostratigraphic unit most likely to contain activity debris was defined as the floor. It was differentiated from other strata in the field both horizontally and vertically by its shape, relative light color, compactness, its immediate contact with an overlying increase in organic matter and artifacts, and its association with posthole, pit and a hearth deposits. The microartifacts were collected from the immediate floor while the macroartifacts came from this surface and the dark organic rich sediment just above.

As outlined in the excavation protocol (Appendix A), the floor was excavated in 76 by 76 cm square units (Figure

7). Macroartifacts are classified and spatially analyzed both as point plotted artifacts and quadrant data. Here in lies the problem of comparison between the two scales of artifacts, macro and micro. In an archaeological context such as Structure 3, the traditional bulk sediment sample would not truly represent the same "floor" area as macro artifacts recovered across the collection unit. In a plowed context, bulk samples are a reasonable method for collecting a representative microartifact sample from an area as large as 4 by 4 m due to the homogenization of the sediments. However, in a non-tilled context, such a sampling scheme could only represent the area of the bulk sample itself. The sampling scheme designed for this study attempts to homogenize the sediment from the 76 cm square in hopes that the microartifacts recovered are representative of the majority of the unit area. The areas of micro sample collection within the excavation units are illustrated in figure 8. Briefly, a square is laid out in the center of each excavation unit measuring 38 cm (1.25 ft) square covering at least 50 % of the horizontal area of each unit. The sample did not extend to the edges of the 76 cm excavation unit in an effort to represent only the unit area and avoid potential overlap with activities represented in neighboring units.

The sample collection proceeds through several steps. The first step is the cleaning of the designated area,

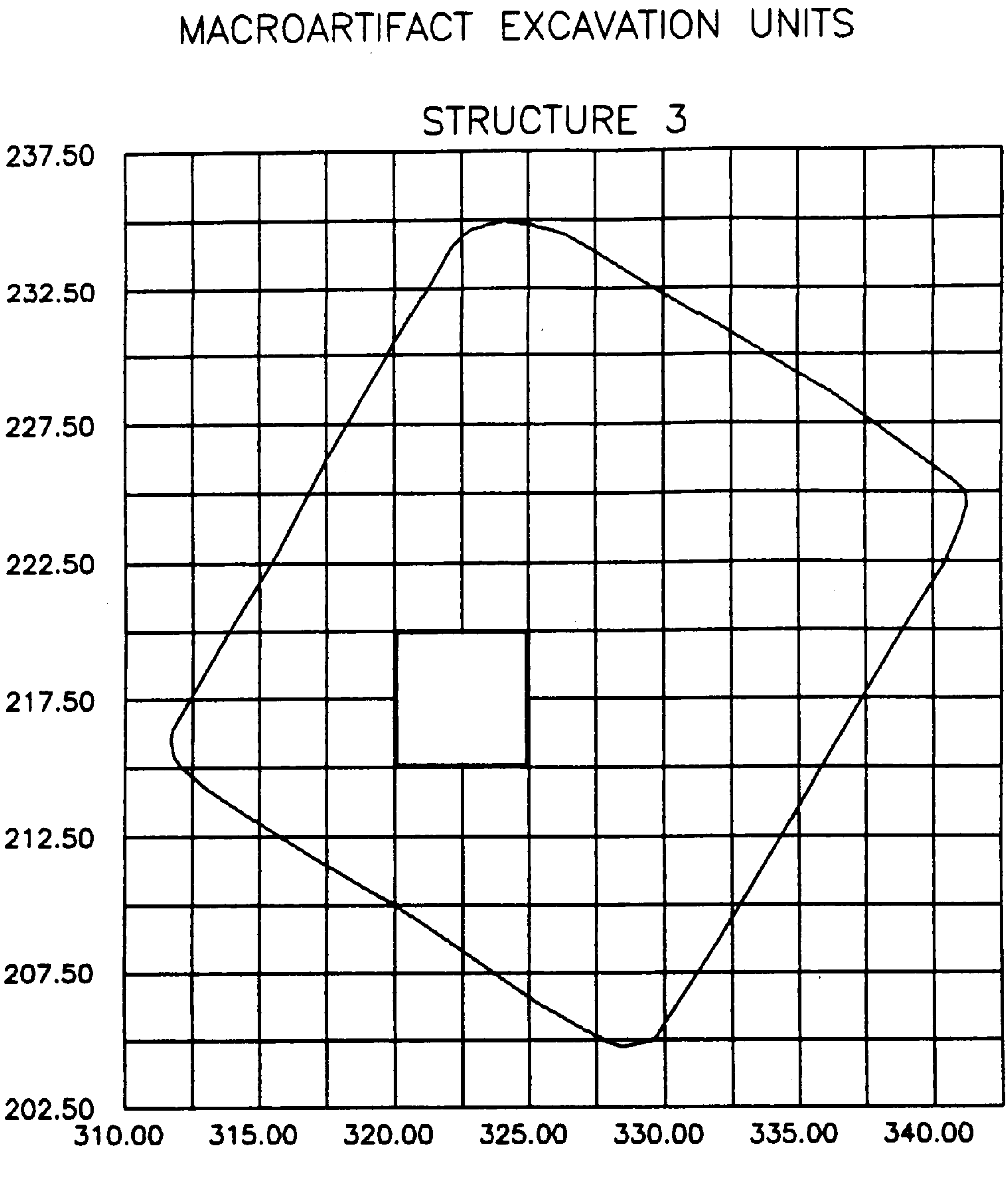


Figure 7: Standard Excavation Units Across Structure 3

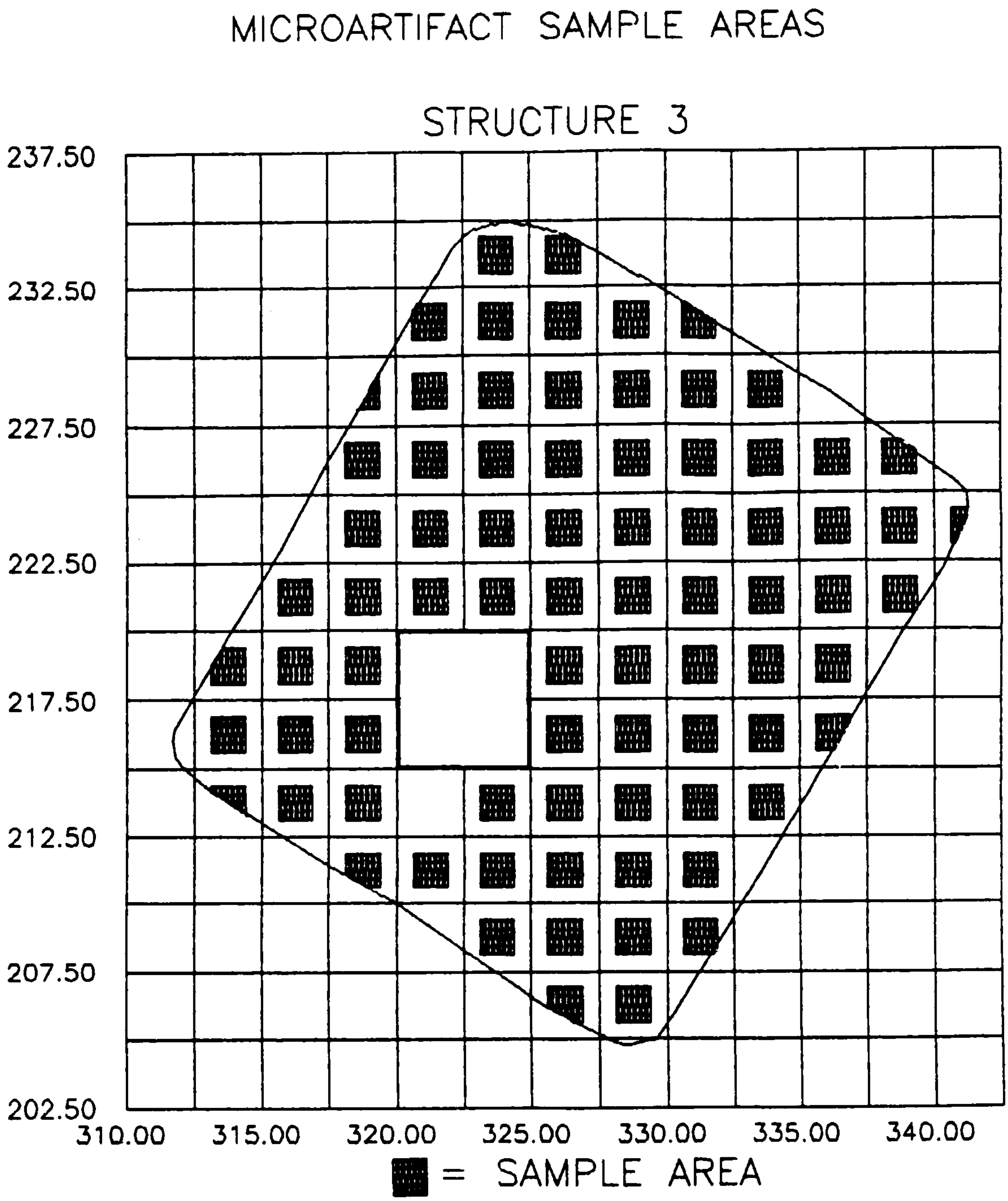


Figure 8: Microartifact Sample Areas within the Standard Excavation Units of Structure 3

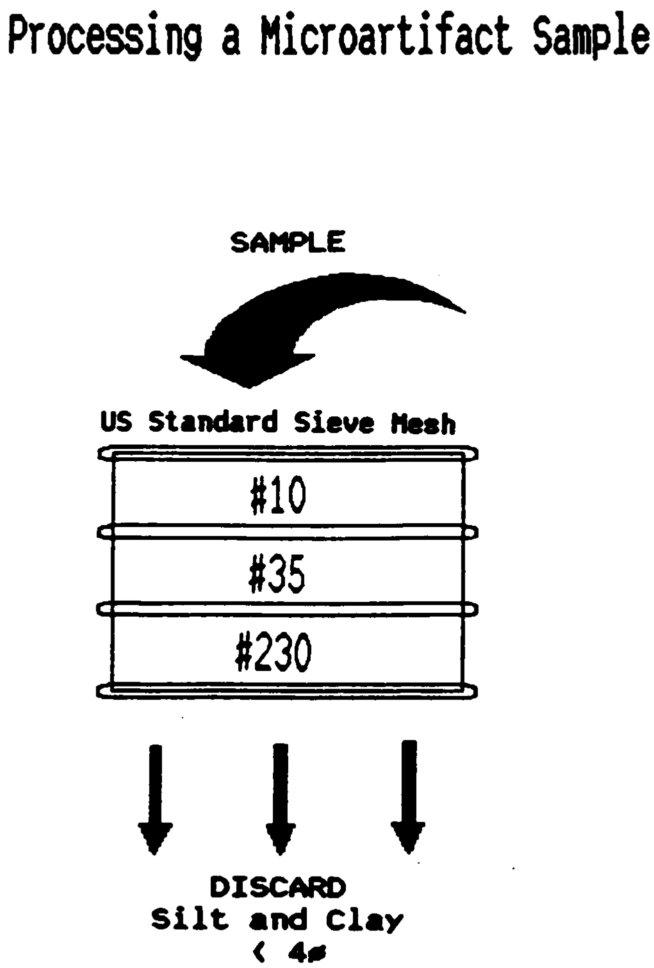
lightly scraping the unit with a clean trowel to remove any material that may have been transported into the square by wind or sediment on clothing following regular excavation. Approximately 600 g of sediment was then collected from the sample unit and bagged directly. A more detailed description of the sampling protocol can be found in Appendix A.

Sampling Among Microartifacts

Processing the field sample The laboratory procedures were designed to reduce the field samples to sand-size particles ready for analysis. These procedures are a variation on basic sedimentological grain-size techniques. The procedure, using nested US Standard sieves to collect the designated phi sizes, is presented at length in Appendix A. The procedure is designed with two specific purposes in mind. The first is the removal of the organic matter. The second is the separation of the phi sizes to be used in the analysis from the other grain-sizes present in the sample.

Removal of the organic matter was necessary as it causes aggregation of fine particles affecting the counts of the fractions to be analyzed. Aggregates result in "dirty" samples, making the grains difficult to identify and count. The aggregates form during the evaporation process. This step in the procedure occurs following sample deflocculation, and the removal of silt and clay from the sand fraction. After washing, the sand-size particles are put in a beaker with the water necessary to remove the grains from the screen, and dried slowly to remove all the water. While the samples dry in an evaporate oven on low heat, the fine organic matter collects on the surface of the water. As the water evaporates, the organic matter forms a dense film over the grains on top causing them to adhere in masses much larger than their actual particle sizes. As a result, these aggregates skew the sample sizes and fall apart with increased handling resulting in difficulties in identification from the "dirty" appearance of the sample.

Pretreatment of the sample to remove organics, and/or carbonates is an undesirable option as bones, charcoal, and shell are a part of the microartifact assemblage. As an alternative to pretreatment, the sample was wet sieved. This method of sieving collects all the organic matter finer than 4.0 ϕ in the fine fractions to be discarded with the silt and clay fractions. This procedure, based on the stacking order of sieves, is designed to wash and separate four different fractions (figure 9). The procedure is designed to discard the silt and clay, and separate the 4.0 ϕ to 2.0 ϕ (fine sand), 1.0 ϕ and 0.0 ϕ (course sand), and > -1.0 ϕ (granule and greater) fractions. In addition wet sieving results in the total removal of aggregates from the sample and the segregation of the 1.0 ϕ and 0.0 ϕ to be analyzed.



#10 Any material >2mm (-1.0ø) that may have remained in the sample.

#35 Collect particles from .5mm up to 2mm, course sand (1.0ø and 0.0ø) for analysis.

#230 Collect particles .0625 mm up to .5 mm, fine to medium sand (4.0ø to 2.0ø), to save for future research.

Figure 9: Illustration of the Wet Sieving Procedure Used to Process Microartifact Samples

Microartifact Quantification Microartifact analysis has been discouraging in the past, primarily because of its expense in time. Traditionally, counting has been a long and tedious process. Techniques of quantification have varied, but that most often applied is point counting. Point counting is the method by which geologists observe, identify, and determine the percentages of various minerals in rock (Galehouse 1971). This technique is most often used with sedimentary rocks in thin section in order to help determine the depositional history of the rock. Microartifact analysis relies on this technique to identify material classes present and quantify them.

Point counting in microartifact studies has involved the counting of a particular weight of a phi fraction or range of phi fractions, or the counting of a set number of grains per sample, usually from 1,000 to 10,000. Often weight determination is based on the number of grains that weight is assumed to represent. Due to variation in grain shape, and specific gravity, this method should be used with caution. On the other hand, counts are clearly documented but the reasoning behind the designated count is sometimes unclear or poorly supported. Determining sample size to achieve a representative sample has generally been an issue of much uncertainty.

How many of these abundant grains should be counted and how do we achieve a reliable sample? Vance, in speaking against arbitrary sample sizes stated:

> A reasonable approach to this [sample size] is to assume an approximately normal distribution of microartifacts and to calculate what size sample must be counted to establish, at a chosen confidence level, that the expected microartifact count is significantly different from zero. Samples of this size can then be expected to yield reliable presence/absence data, and also, in some instances, to support more refined quantification (1989:60-62)

For example, in Vance's Robards study she counted 40,308 grains, identifying 79 flakes, to calculate a population estimate of p = 0.00106 flakes per grain (Vance 1989:62). From this information, using a 95% confidence level and a variation on binomial probability estimates, the required sample size was 1956.25. This method not only takes a significant amount of time (processing and identifying 16 preliminary samples), but also excludes the input of other artifact classes from within a population. In addition, the sample size established from one group of trial samples from a site may not concur with others from the site. For samples from deposits where specific activities are believed to have taken place, there could be a significant increase in a material class from one sample to the next possibly due to the restriction of the activity area or any number of formation processes. These possibilities must be considered.

In an effort to streamline the process by generating a representative sample within a reasonable time frame, a computer program called PARACOUNT was written by Ousley and Sherwood (n.d.) to quantify the point counted grains. This program was inspired by Vance's (1989) sampling work and an earlier GWBASIC program that was designed by geologists to allow spatial relationships in a thin section to be preserved as it was point counted (Foreman et al. 1989). The geologic program determined not only the spatial relationship of grains within the rock but also the volume percentage of grains based on a statistic of reliability.

PARACOUNT, written using PARADOX (a relational database management program) and its Programming Application Language (PAL), has three objectives 1) to operationalize the counting of material classes to produce volume percentages, 2) to provide for a statistically reliable sample, and 3) to do it swiftly and reliably. The first objective was accomplished by designing the program so that as the analyst identifies particles through the microscope they are tallied by class, grain by grain, directly on the keyboard (different numbers on the key pad are assigned to different classes). As the identification is entered the program calculates the frequency, percentage, and reliability statistic and displays the results on the screen. The counting procedure using PARACOUNT is offered in detail in Appendix A.

The second objective relies on a technique first proposed by Van Der Plas and Tobi (1965) for use in the identification of rock in petrographic analysis. Reliability is expressed by the standard deviation of a binomial distribution of discrete variables.

$$\sigma = \sqrt{\frac{p(100-P)}{n}}$$

where: p and P = percent of the material class by volume. (100 - P) = q [in the usual binomial equation]
n = the total number of a material class counted.

The σ can be whatever the analyst determines is a reliable sample. For the purposes of this study a 95% confidence interval was defined as reliable. A σ of 2 indicates a 95% confidence level. This implies that for a 95% confidence level the estimate will lie between p + 2σ and p - 2σ in about 95 out of 100 cases. As sample size increases the σ decreases indicating an increasing estimate of reliability. When the reliability goal is achieved the analyst completes the counting and the results are transferred by the program directly into a PARADOX table file allowing for further manipulation or applications. This eliminates the step of entering the results into a spreadsheet thereby reducing the possibility of errors associated with rekeying.

For their purposes of thin section analysis Van Der Plas and Tobi (1965) consider their population as a homogeneous rock with randomly distributed compositional mineral grains. This assumption is actually better suited for microartifact analysis where the grains are randomly spread across a dish beneath the microscope than a thin section of unknown rock where homogeneity might not be the case at all.

For this study, each sample was identified and counted based on its own distribution to take into consideration the variation in material class. In addition, no more were counted than was absolutely necessary, saving significant amounts of time yet still achieving a reliable sample from each excavation unit population. With seven material classes the reliable sample sizes ranged from approximately 1350 to 1800 grains, the mean being 1704. The average counting time was 20 minutes.

Data Analysis

The volume percents derived from counting the 0.0 ϕ and 1.0 ϕ fractions (Table 1) were used to examine distributions and identify clusters. Using SURFER, a high resolution two and three dimensional graphics package, the data was organized by material class to create isopleth density contour maps. These contour maps are compared between micro and macro distributions and among microartifact classes. The macroartifact data consists of total counts representing the excavation units (Table 2). No partitioning of material types or classes as they may represent specific activities or tool kits was done, only relationships between material class and between micro and macro scales were examined.

Table 1: Microartifact basic statistics by volume percent

Artifact	Min %	Max %	Mean %
Misc. Rock	11.06	80.09	46.02
Charcoal	7.11	48.01	26.20
Ceramic	0	8.48	1.13
Bone	1.23	10.90	5.47
Lithic	.09	7.52	1.99
Daub	.09	79.37	18.09
Shell	0	7.35	.60

Table 2: Macroartifact basic statistics by count

Artifact	Min	Max	Mean
Misc. Rock	0	343	46.80
Charcoal	0	17	1.42
Ceramic	0	459	59.43
Bone	0	200	29.43
Lithic	0	31	7.76
Daub	0	3983	209.66
Shell	0	61	5.80

Artifact clusters and vacant areas are examined in their relation to the structure of the household. For example, in reference to Polhemus' (1985) proposed model "public" versus "private" areas are assessed based on the micro and macro results relating to the use of space within a primary structure. Also to be considered is the association with deposits interpreted as postholes and pits excavated and filled in the floor of the structure. Formation processes that could have created or altered artifact size and material class distributions between the micro and the macro distributions are considered.

In summary, this chapter has defined the material within the study. The methodology has been discussed and the techniques used are outlined step by step. Data analysis involves the comparison of isopleth density contour maps by material class between macro and micro. Several of the techniques were developed specifically for this project, so their applicability to other microartifact studies varies. The program PARACOUNT has the potential to be applied to any microartifact data set significantly increasing the efficiency of the counting process.

CHAPTER V

RESULTS

EXPECTATIONS

Microartifact analysis provides interesting and informative insights into the formation processes of Structure 3. The assumption has been, primarily based on ethnoarchaeological and anthropological observation, that small-scale artifacts generated during human activity are better indicators of activity location than are macro-scale artifacts. This assumption is based on notions of "cultural sorting" and the incorporation of sand-size artifacts into the floor by trampling.

Based on these suppositions some basic expectations exist prior to data analysis. The expectations are as follows. Following the model for the use of space in a primary structure proposed by Polhemus (1985) there is a "private" area reserved for sleeping and individual activities where benches line the walls, and there is the central "public" area where hearth centered activities take place. The "public" area is kept clear of refuse due to the amount of foot traffic and "public" activities that occur there. Based on this model the central "public" area should produce few or no macroartifacts, those that do appear must have been located by natural formation processes, or were deposited just prior to abandonment. This central area should in theory produce microartifacts in abundance, especially along the margins between the "public" and "private" areas where individuals seated on the benches would engage in manufacture or use producing microartifacts that would have been incorporated into the floor where they fell.

This expectation is further supported in a study of Late Mississippian domestic structures by Hally (1983). Hally (1983), at the Little Egypt Site (9MU102) used distributions and analysis of ceramic artifacts to answer questions of use and discard within enclosed structures. The types of data used were artifact size, number and type of vessels present, and sherd cross-mends. From within a house Hally examined the central area versus the exterior area (same as Polhemus's (1985) public and private). The central area included the hearth, and the margins between the central and exterior area. The exterior area included private benches or sleeping areas which lined the wall. Based on the absence of the large size artifacts, it appeared that the central area of the floor had been carefully maintained or swept during use. Rarely then, would enough large material remain on the living floor to be incorporated into the archaeological record to produce artifact patterns revealing activity areas. Under such circumstances, microartifacts would seem to be the only clue remaining from an area where an activity repeatedly occurred. Hally's study does not identify microartifacts *per se*, however the value of micro-scale material is evident through his use of size for the identification of activity areas.

Both models, and the experimental and ethnoarchaeology studies reviewed, lead one to propose microartifacts as potentially the best indicator of activity areas that would have been used in relation to the hearth or at the margins between the central and exterior areas. The private or exterior area beneath the benches and in the "storage" corners are expected to produce macro artifacts as this area is out of the way of foot traffic and convenient for storage and/or disposal.

RESULTS OF ANALYSIS

The actual distributions observed from Structure 3, divided by material classes and micro and macro, were not what the expectations had generally predicted. To discuss the results, figures containing density isopleth maps by material are offered for each general size class, macro and micro. A transparent overlay of the structure map containing posthole, pit hearth and entrance trench deposits was generated at the same scale as the distribution maps. This overlay was used to consider sub-floor deposits as small basins of deposition contributing to the clustering of artifacts. Each distribution is briefly described and then discussed. The raw data are presented in tables in Appendix B.

Lithics

The macro distribution of lithics is focused around the central hearth with a cluster towards the northern limit of the central "public" area (Figure 10). The micro distribution, on the other hand, clusters in the southern corner to the right of the entrance partition (Figure 10). This corner could have been isolated from the rest of the structure, away from the benches and the central hearth and behind the entry way. Anyone who has stood near a flintknapper knows the dangers of flying debitage and the resulting ground accumulations. When the activity had to be performed indoors, an out of the way location such as this may have been ideal.

This is the only material class where the expectations seem to at least partly ring true. If the southern microdebitage cluster was an area of refuse collection or disposal then the macro grain-sizes should also contribute significantly to the artifact assemblage found there. The maps illustrate some limited input but nothing that could be interpreted as significant in terms of clustering.

The majority of the macro distribution appears to cluster around the hearth with a small contribution by microdebitage possibly indicating activity areas just prior to abandonment.

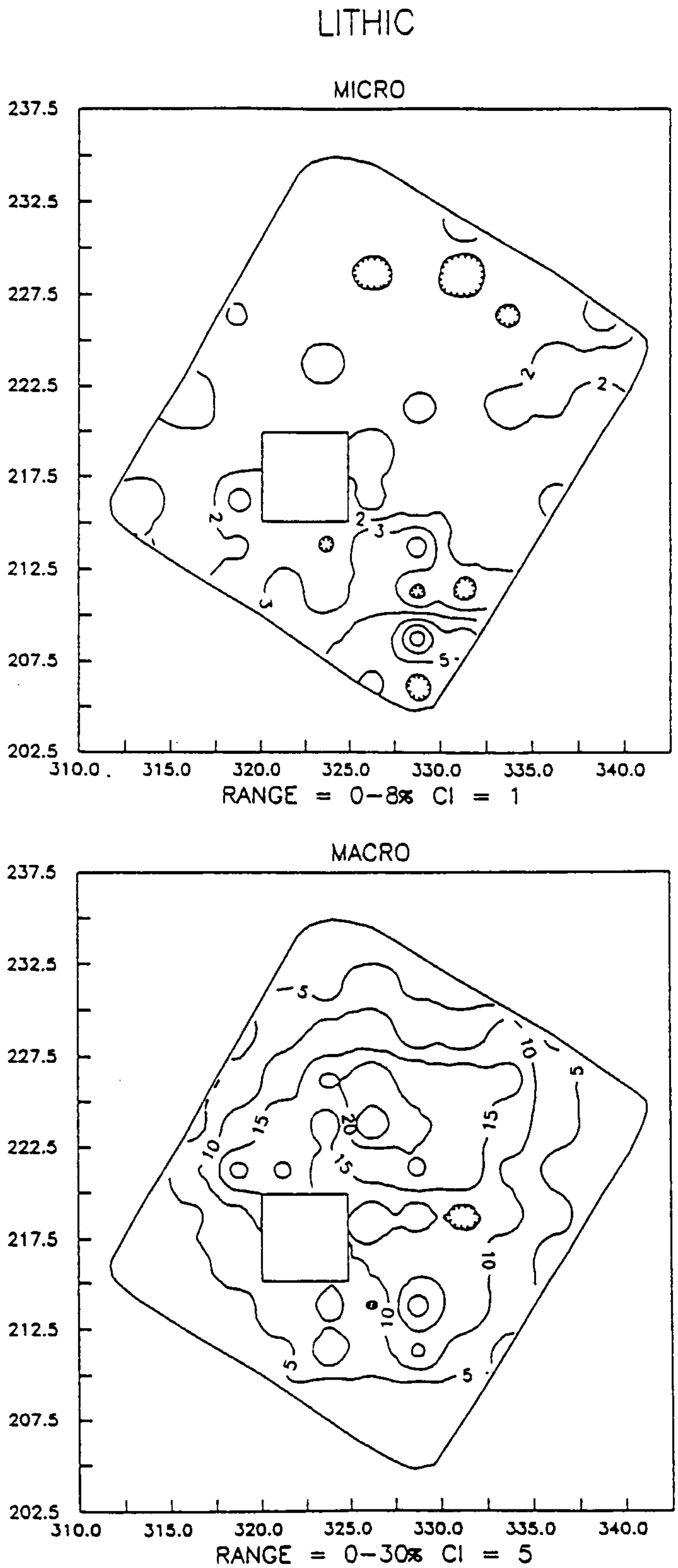


Figure 10: Lithic Distributions in Structure 3

Charcoal

The charcoal distribution between micro and macro varied significantly. The macro distribution was sparse with a concentration just south of the central hearth (Figure 11). The map overlay and field notes indicate its direct association with a pit deposit that intersects what appears to be the base of an earlier shallow hearth deposit.

The micro charcoal is fairly evenly distributed across the house floor decreasing towards the center (Figure 11). Clusters are located beneath the benches, especially in the eastern half of the structure along the northeast and southeast walls. This type of concentration appears in several other material classes and will be discussed later in the chapter.

Bone

The bone distribution also varies significantly between macro and micro scales. The macro bone is clustered away from the walls towards the center with a dense concentration just north of the central hearth (Figure 12). Conversely, the micro distribution focuses away from the central areas beneath the benches (Figure 12). The only exterior area not producing micro bone is within the doorway, between entryway partitions.

Ceramic

Ceramic distributions were very similar to that of bone. The macro ceramics also focused towards the center

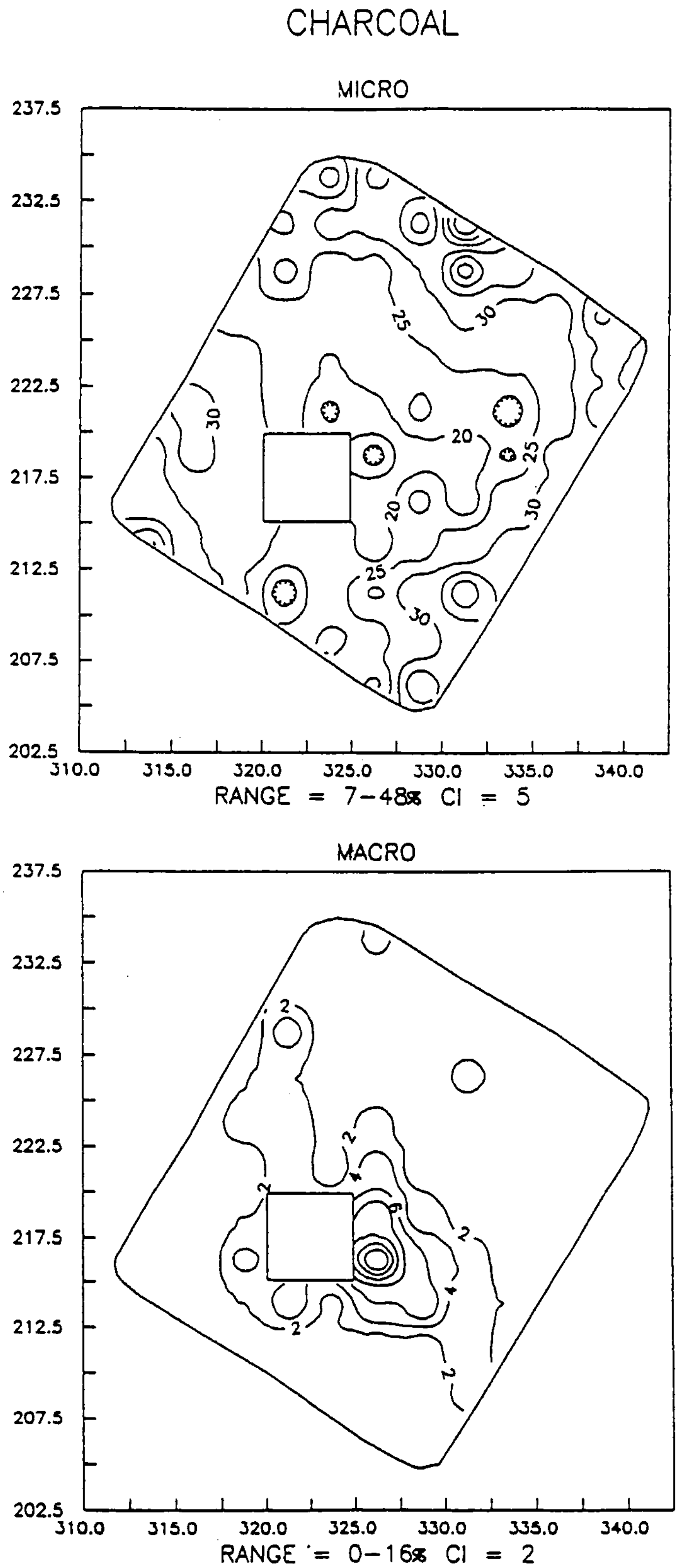


Figure 11: Charcoal Distributions in Structure 3

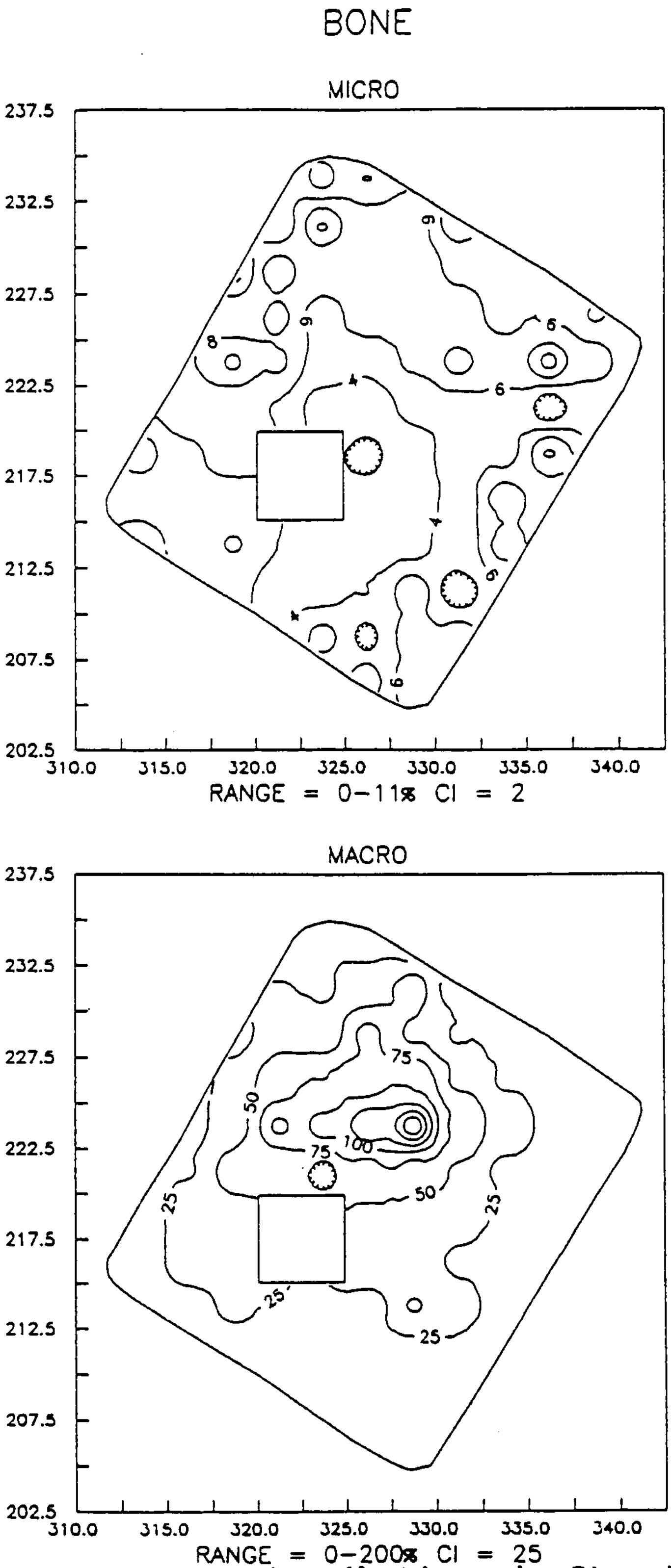


Figure 12: Bone Distributions in Structure 3

with a concentration just north of the hearth while the micro distribution concentrated along the walls with the majority along the western periphery (Figure 13). The densest cluster is along the southwestern wall. The southeast quadrant of the house exhibits few if any ceramics. Interestingly between the entryway trenches along the southwest wall where traffic would have entered and exited the structure, a micro ceramic cluster appears.

Daub

Daub distributions appear to co-occur with architectural features. The macro daub is immediately associated with the hearth deposit at the structures center (Figure 14). During excavation the upper portion of the hearth contained only daub. Not until this daub was removed did the ash and charcoal normally associated with hearths become abundant. The majority of the daub found in association with the hearth was interpreted as roof or smoke hole lining. This interpretation is based on its location within the structure and the morphology of the larger fragments. Many of the fragments had curved and smoothed surfaces which are believe to have lined the smoke hole in the center of the roof.

The micro daub distribution has its greatest cluster also associated with the central hearth (figure 14). Other clusters appearing both in the central area and along the walls are small and isolated. These are interpreted as

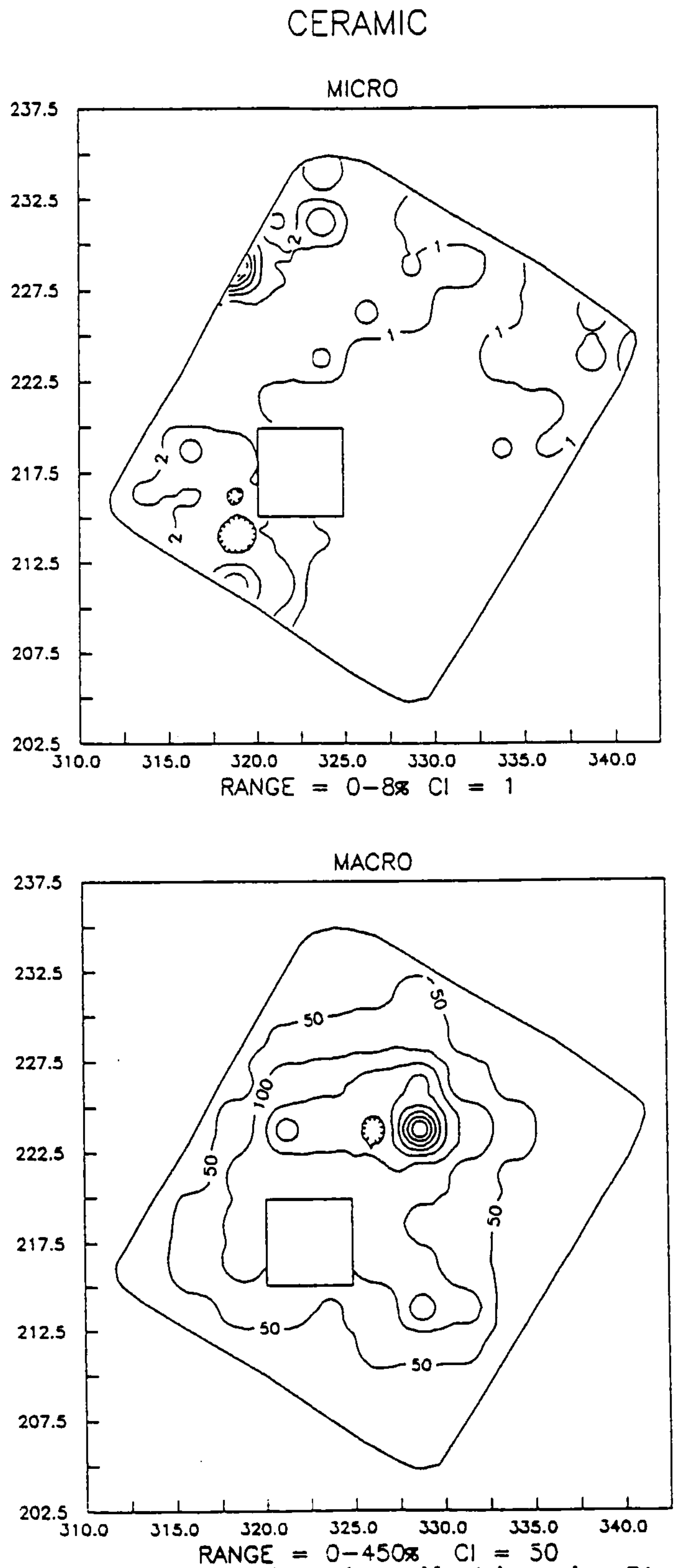


Figure 13: Ceramic Distribution in Structure 3

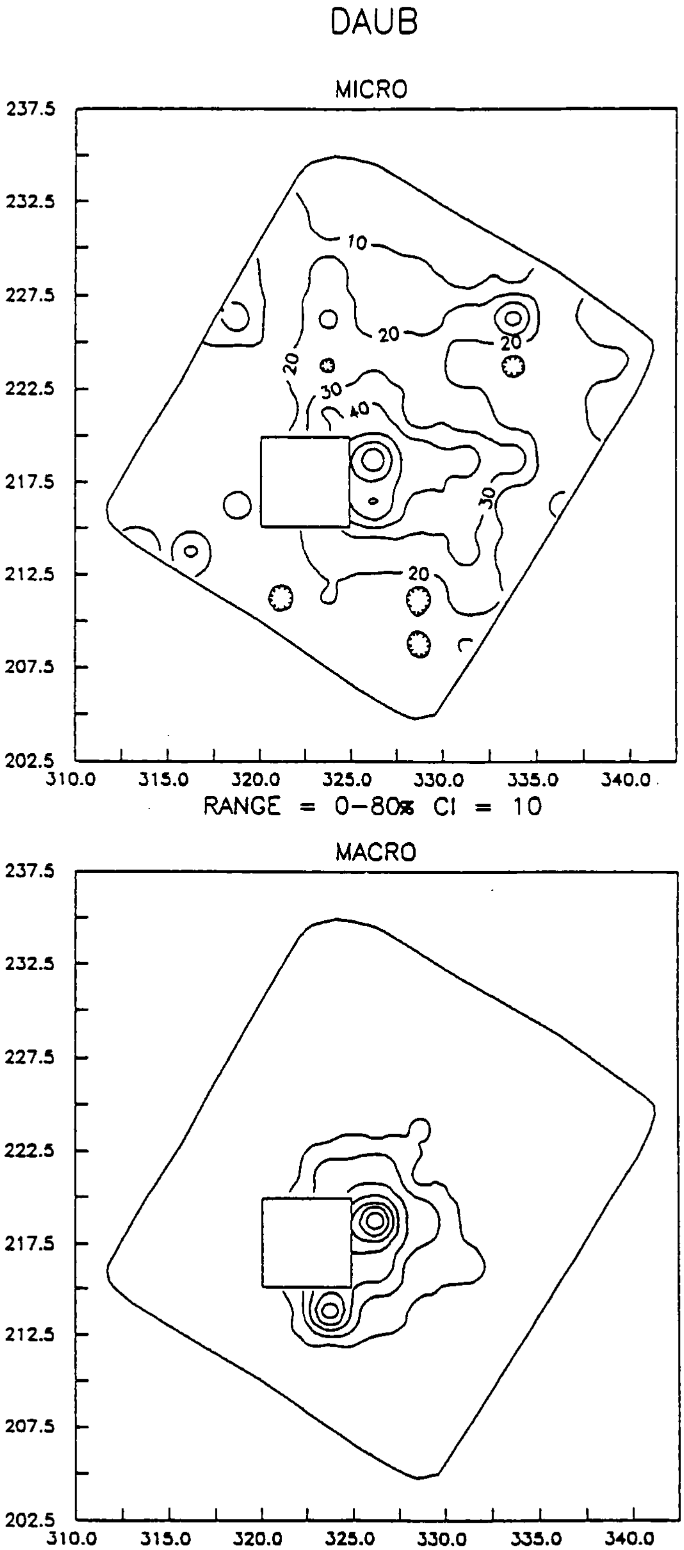


Figure 14: Daub Distributions in Structure 3

potential locations of interior partitions that may have once been associated with the benches and the "private" area. In neighboring contemporary structures excavated at the Loy Site these partitions are partially preserved. They are primarily constructed from daub, and attached perpendicular to the wall.

Shell

The shell distributions between the macro and the micro scales were nearly identical (Figures 15). The two main clusters were in the north and west corners with smaller secondary clusters just inside the northeast wall. The micro shell may reflect post-depositional alteration of the shell rather than manufacture or use.

DISCUSSION

There were three distinct patterns identified among the distribution of the material classes by size. The first is represented only in lithics and is the only set of distributions concerning activity area versus discard area that concurs with the expectations. Here what may be an actual activity area was identified by the concentration of microdebitage and absence of macrodebitage. Perhaps due to "cultural sorting" at least some larger debitage was removed from this work location and disposed of elsewhere.

As an aside, based on the nature of the Dallas Phase lithic technology, debitage dumps should be extremely

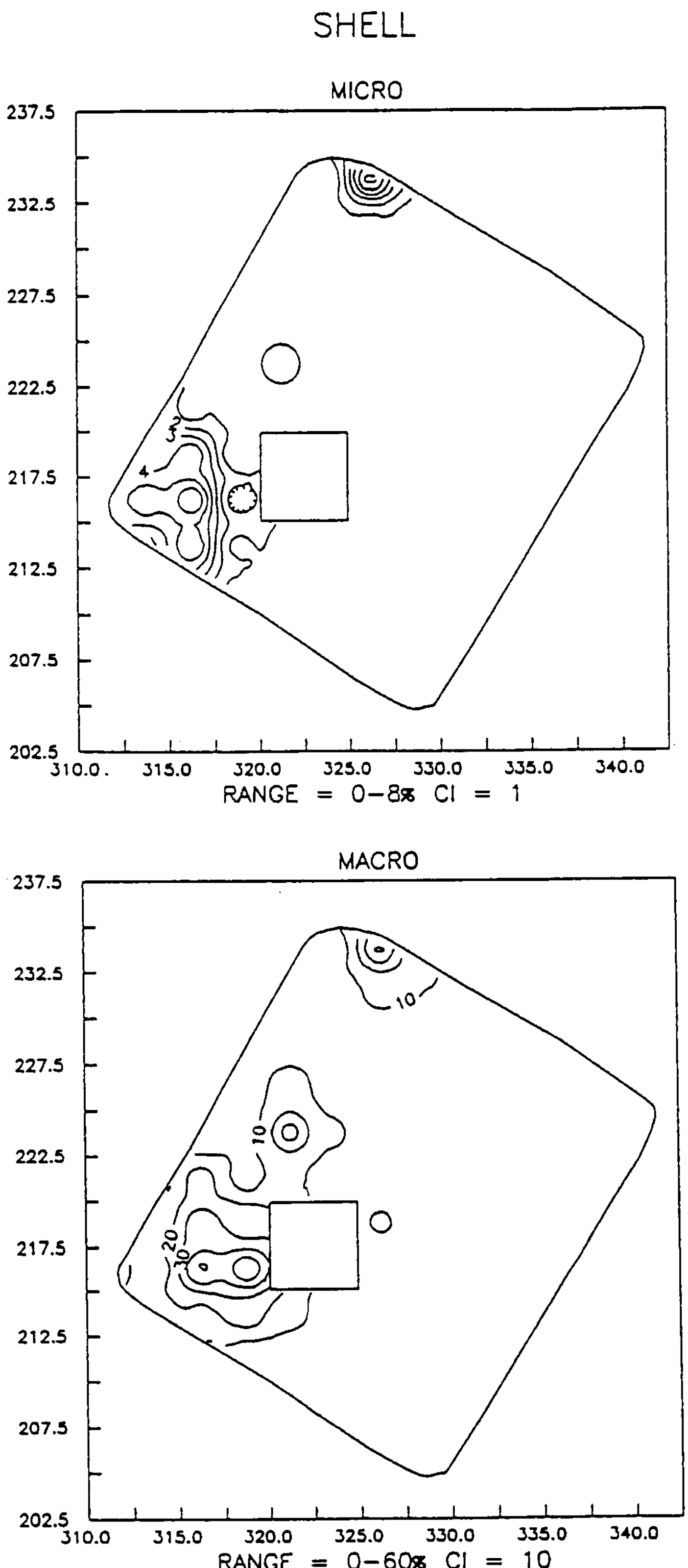


Figure 15: Shell Distributions in Structure 3

difficult to identify. Their projectile points and other tools made using chipped stone technology are small, often produced from what might be considered secondary reduction flakes. Their primary resource (based on the proportion found within the macro assemblage) was Knox Black Chert which occurs locally but in relatively small nodules containing various unconformaties in the rock. This information would indicate that there may have been very little waste to be disposed of as refuse. What macrodebitage there was may have been reserved for use at a later time. Thus, identification of a lithic refuse dump in this context may be difficult.

That macro tool and debitage distribution recovered centers around the hearth. The lack of microdebitage clustering in this area may indicate activities of lithic tool use. Storage is another interpretation that could be considered but at this point there is no additional data to either deny or support this.

The second general pattern was observed among the daub and shell classes. Unlike the others this pattern is based on concordance between size classes. Both the daub and the shell had very similar distributions within their material classes across the range of sizes. The similarity among the distributions are probably a direct result of the nature of the material classes in that both are easily weathered. The chemical makeup of shell makes it especially vulnerable to chemical weathering. Daub, unlike ceramic, is never really fired except by brief structural fire therefore the clay is vulnerable to both chemical weathering (e.g., alteration in the moisture content of the clay) and mechanical weathering (e.g., fracture due to cryoturbation, structure collapse, plowing). The shell and daub distribution could very well represent their deposition due to cultural formation processes. Their size distribution is probably the result of various post-depositional processes.

The third general pattern recognized deviates from the original expectations. Associated patterns illustrate the macro distributions centering on the hearth with the micro distributions concentrated along the walls. These patterns were observed among the charcoal, ceramics and bone. Ceramics, bone, and charcoal are all materials affiliated with food preparation and cooking. Their clustering together, adjacent to the hearth, would lead one to such a domestic interpretation. Support of this interpretation would need to come from a detailed study of the type of bone, ceramic and charcoal recovered and their condition in comparison to the rest of the assemblage. Such an endeavor is not part of this study.

The formation processes for these artifact distributions appear to be primarily cultural. The "floor" was fairly protected from surface processes such as sheet wash, or wind by the "destruction zone" and the overlay deposited across the terrace sometime after Mississippian occupation. Bioturbation probably had some affect but no obvious sorting signatures or substantial related deposits have been identified. The grain-size analysis conducted of the vertical sample sequences produced no significant textural changes. Translocation, the downward migration of sand size particles during soil forming processes, was not identified.

Two explanations are offered here for the microartifact patterns in the third general pattern. The first is the potential that the benches were not substantial, meaning there were places in the construction (cracks and holes) where micro material could filter downward to be deposited beneath the benches. This seems highly unlikely based on ethnographic observations (Swanton 1946) and benches that have been recovered archaeologically in circumstances of exceptional preservation.

The second explanation and the one preferred in this study concerns microartifact movement. Studies have speculated on sweeping as a cleaning method and its effects on artifact size distributions across floors where activities are performed. Most have suggested that on an unprepared earthen floor, such as Structure 3, sweeping would have little effect on the micro material while it would move the macro material (McKellar 1983 cited in Schiffer 1987; Metcalf and Heath 1990; Schiffer 1987; Hull

1989). A recent actualistic experiment conducted by Neilsen (1991) produced some interesting results concerning the maintenance of lithic activity areas. In "pick up" cleaning, where all visible (>16 mm) flakes are removed by hand, a "complete dissociation of macro and micro artifacts" (Neilson 1991:10) (the ethnoarchaeologist's "cultural sorting") was observed.

When Neilson (1991) applied sweeping to a lithic reduction area a different pattern occurred. Some intriguing observations were made including:

> "The smallest flakes [<1 mm] were transported with the loose dirt that covered the surface and ended up uniformly distributed across all samples. The largest microdebitage (1-8 mm in this case), on the other hand, is too small to be intentionally removed with the broom, and heavy enough to stay in its original location." (Nielsen 1991:5)

This has some unsuspected implications for this and other studies that attempt to identify activity areas using microartifact analysis. This actualistic study indicates that the largest microartifacts, (2 mm) as defined by Dunnell and Stein (1989), are subject to movement by sweeping. The next larger phi size, -1.0 ϕ (2 - 4 mm) may be a more reliable indicator due to its relative stability during the sweeping process. This observation is supported by the distributions in Structure 3 among the < 2 mm charcoal, bone, and ceramics, assuming that these refuse materials were swept in a direction away from the "public" center of the house towards the wall, beneath the benches, to avoid foot traffic and remove refuse from sight.

The cluster of ceramic microartifacts along the southwest wall in the entryway has interesting implications considering another actualistic study conducted by Neilsen (1991) reported in the same paper. This study attempts "to assess the amount of microartifacts produced by trampling on different material [ceramics and lithics]" (Neilsen 1991:7). The ceramic results are far more conclusive than those for lithics. Neilson (1991:7) observes:

> "...microsherd of trampling origin are far more numerous than those resulting from any case of vessel breakage, and would obscure any pre-existing trend. Trampling is a more intensive process of ceramic damage than any form of vessel failure that is likely to occur during use."

Based on these observations the ceramics recovered in the micro assemblage probably do not indicate breakage location, especially in their distribution along the walls beneath benches. Instead they are probably the result of sweeping, most likely after trampling reduced larger sherds. The cluster in the entryway could implicate one process with two effects. First, trampling could be the cause for the increase in the microsherds. Second, as trampling generates more micro sherds it also increases the likelihood of their being embedded in the floor, allowing them to elude sweeping processes.

The macro ceramic clusters towards the center of the structure are each associated with a light cluster of micro ceramics. Perhaps these do indeed represent breakage events just prior to abandonment. Such an event might lead to the deposition of a small amount of micro sherds (compared to trampling) and the larger sherds not removed but allowed to remain in their place of impact due to impending abandonment.

The micro bone is also supportive of the experimental sweeping observations. Two other possible formation processes should be suggested here as well - canids and microfauna. Dogs can play a large part in the formation processes that occurred in such sedentary villages (see Binford 1981; Brain 1981). The behavior of the modern domestic dog often leads them to retreat beneath furniture to chew on items. The gnawing of bone could easily produce micro bone distributions depending on the level of preservation. Microfauna have been observed in relatively large numbers in hypothesized storage areas in similar Mississippian structures. If refuse is being swept beneath benches or tossed beneath them in larger sizes then microfauna, small rodents in particular, would be easily attracted to these dark and resource rich areas.

The amount of variability in these three patterns observed offers vital information about formation processes contributing to the archaeological record. Both original depositional and post depositional processes are hypothesized to account for the three patterns. Which ever the process of combination there of, this offers rich information that would not be attainable without microartifact analysis.

Part of the preliminary expectations were based on observations made by Hally (1983) from within a later Mississippian structure and the model proposed by Polhemus (1987). Their observations, based on macro material, identified the central area as being kept clear, relatively empty in terms of ceramics in particular. The deviation between their studies this one is curious. The abandonment sequences may have been different producing different patterns across the floors. When the analysis of the macro material from Structure 3 and other structures at the Loy Site is complete it may shed more light on these differences.

CHAPTER VI

SUMMARY AND CONCLUSIONS

SUMMARY

The results of this study identify microartifacts as a compliment and enhancement to the interpretation of macro artifact assemblages. Microartifacts have produced a more comprehensive look at the archaeological deposits and insights into the identification of activity areas versus discard areas in Structure 3 at the Loy Site. In addition, the processing and analysis was designed to be carried out in a timely, cost-effective manner.

This research set out with three objectives. The first was to assess the potential of small-scale artifact analysis to address questions concerning the prehistoric use of space. A high potential was clearly indicated in a review of previous microartifact studies, ethnoarchaeological studies, and a look at the importance of the attribute of size. The microartifact studies in particular apply basic sedimentological principles and techniques in recognition of the importance of collecting and analyzing sizes beyond traditional macroartifacts. The ethnoarchaeological studies reviewed have observed the generation of small-scale artifacts among modern cultures and the behaviors affecting the sorting of artifacts based on size. These observations can help us to identify possible sorting patterns produced by people. Size was shown to have the potential to reveal information about the source, transport agent, environment of deposition and post-depositional processes of an archaeological deposit.

The second objective was to pursue microartifact analysis to enhance the interpretive potential of the existing macroartifact assemblage. Beginning expectations were based on existing models for use of space in Mississippian Dallas Phase structures, such as Structure 3 at the Loy Site, and the assumption that activity versus discard areas can be differentiated based on the grain-size distribution of the artifacts present. Such an analysis was especially desirable due to the preliminary interpretation of abandonment based on the macroartifacts. The expectations determined that during structure occupation the central "public" area of the house would have been clear of macro-material with clusters of micro-material present representing the activities that were performed there. Clusters of macro material should be located outside the structure, and in the "private" areas representing areas of discard out of the way of foot traffic, or storage. The microartifact analysis revealed unexpected results.

Different distribution patterns between micro and macro scale data imply that different formation processes affect both different material classes and different size scales. Shell and daub have very similar distributions between scales while ceramics, bone and lithics do not. In Structure 3, the greatest concentration of debitage is located in the southeast corner, indicating an activity zone of lithic manufacture. Macro lithics do not appear there at all. The sand size ceramic and bone concentrate along the walls, beneath the benches, at the margin of the "private" area. These distributions of micro and macro bone and ceramic artifacts did not concur with the initial model expectations. If these micro-scale particles were supposedly overlooked by "cultural sorting" then these artifacts are more easily moved than previously expected and some other cleaning technique, or formation process must have transported them to their current location along the structures interior margins out of the realm of activity areas.

The third and final objective of this study was to contribute to the development of the methods and techniques used to sample, process and quantify microartifacts. The horizontal sampling scheme designed to sample the excavation units is thought to produce a fair representation of the horizontal space represented by the macroartifacts. The protocol used to process the samples in the laboratory followed standard sedimentological procedures allowing the data to be standardized. In addition, the procedures involved a reasonable investment in terms of time. Through the development and application of the computer program

PARACOUNT the quantification procedure was streamlined and operationalized. A simple binomial probability statistic was applied allowing concurrent counting and calculations to identify a reliable sample. The result was a counting time of approximately 20 minutes with the entire hands on laboratory procedures averaging approximately one hour per sample. The result is an improved and a cost-effective way to conduct microartifact analysis.

CONCLUSIONS

No study should come to a close without reflecting on the contribution of the research and the paths it indicates for future work. The primary message of this study is that microartifact analysis can be cost effective and must be integrated into archaeological research design. Microartifacts are an important part of the artifact assemblage making up an archaeological deposit. Without attention to the different sizes present and their variation we are sampling a biased fraction of the archaeological record. Like any form of data, microartifacts are not without their limitations. These limitations, including complications in sampling and identification, should be kept in mind as we pose our questions and design field and laboratory protocols.

In retrospect it is unfortunate that this study was able to look at the microartifact patterning of only one structure at the Loy Site. We know that although other

Dallas Phase structures are of similar construction and organization the macroartifact assemblages vary in abundance, material present, and distribution. At this point we do not know how such variation manifests itself in microartifact assemblages. It is assumed this sort of macroartifact variation can be primarily attributed to two possible cultural formation processes. The first is status of the occupants when structures are located in different sections of a town site, and the second is structure abandonment. To address questions of status, microartifact distributions could be compared between structures whose macroartifacts are interpreted as representing different economic statuses. Perhaps higher status households used space differently than lower status households. This could be evident in differences in assemblage compositions and/or abundances among both macro and microartifacts. For example, fewer microartifacts could potentially indicate less activity of manufacture and use within the structure. Variation in grain-size distributions across a floor can indicate different areas being kept clear or different areas used for discard. This variation among structures could have interesting implications.

In questions relating to abandonment the archaeologist must consider how long the structure remained empty before it was destroyed (usually by fire) and if any of the original patterns of occupation exist in the microartifact distribution. Different combinations, distributions and densities of macroartifacts are used to interpret abandonment processes. Microartifacts are considered less likely to be removed from living surfaces by "cultural sorting" and may provide a record different from the abandonment assemblage or an occupation assemblage left behind by catastrophic burning. In the case of Structure 3 the macro assemblage is currently interpreted as an abandonment assemblage. The microartifacts could be partly an abandonment assemblage but appear to also still retain spatial distributions associated with occupation.

Due to time limits in this study, samples could only be collection from the deposit interpreted as the house floor. The archaeological record of a household usually includes potential activity areas outside the primary structure. Ideally, a systematic sampling program would be implemented that collected samples across the excavation area. Sampling deposits based on their field interpretation (e.g., flintknapping area, secondary refuse area) could result, and has resulted in some studies, in a potential bias. The concept of a "floor" has traditionally been one of those mysterious observations that archaeologists "just know". Rarely are floors carefully defined or described, they are normally interpreted in the field. Perhaps the size distribution of artifacts inside versus outside might show a distinct dichotomy related to a floor level. In addition, patterning may vary both in size and composition. The phenomena of trampling and its potential affect on both micro- and macro-assemblages might be interesting to observe, for example inside and outside the structures entryway. Such analyses may also better help us identify actual "floors".

Finally, Structure 3 has only scratched the surface of the Dallas Phase and their use of space. Polhemus' model for the use of space based on macro artifacts and ethnographic observation is supported in its dichotomization between the hearth and central "public" area of the house and the surrounding "private" area. A definite dichotomy was observed between the micro- and macroartifacts and their distribution across the structure floor. The concept of "private" and the use and organization of this space in Polhemus' model should, however, be refined. According to this analysis the "private" area was the focus of micro-size material probably removed from the central area of the structure and deposited along the interior walls, most likely by cleaning techniques (e.g., sweeping, raking). Microartifacts associated with refuse disposal, those larger items that would have been collected by hand, are not associated with the micro distributions. This would imply that larger refuse is being removed from the primary structure to a designated location outside the immediate household. Perhaps the integration of microartifact analysis into the interpretation of macro assemblages with an emphasis on assemblage composition and grain-size distribution will allow for the fine tuning of the public versus private model and its consideration of the use of space.

In regard to quantification procedures, the application of a simple binomial probability statistic is currently providing a reliable sample. There can be difficulties however with the comparison between percentages from different samples. This is a mathematical problem that can be overcome, most likely with the simple application of a statistic that will allow the confident comparison between volume percentages from different sized samples. The percentages in this study are considered sufficient for the identification of concentrations in the microartifact distributions.

Microartifact techniques can be very site specific depending on the nature of the sediment that contains the material classes present, both natural and cultural. For example, at the Loy Site the mixed alluvial parent material including quartz grains of varying size and angularity made it difficult to differentiate lithics and natural quartz grains. Questions concerning assemblage composition can be extremely informative at the micro-scale. Artifacts not present as the larger scales may remain only as sand sized or smaller particles. Studies have been conducted identifying the presence/absence of ceramics based on the remains of their temper (Simms and Heath 1990; Teltser and Kovacik 1991). Obviously, such an approach can only be conducted in areas where the ceramic temper is not native to the area, so that its presence is the result of human input. The point remains however that microartifact analyses must be specifically designed for different depositional situations containing different materials. As a result microartifact analysis can address specific questions of spatial structure, formation processes, and assemblage composition.

FUTURE WORK

Based on this study and others, the critical information needed to continue productive microartifact research is scientific data towards explanations of microartifact generation and movement (source and transport). Ethnoarchaeology and actualistic studies have made significant contributions towards the observation of microartifacts but they cannot provide the information we need to understand <u>why</u> different sizes and different material classes are differentially sorted by size by such processes as sweeping. We need scientific experimentation of their movement and how they are generated. Questions concerning how and why different material types respond to reduction in size and how this affects the archaeological deposits observed today need to be addressed. Perhaps the material sciences can provide insights into the nature of materials and how microartifacts, by the laws of physics, respond or do not respond to various formation processes.

To apply the increasing knowledge concerning microartifacts, samples for microartifacts must be collected in the field and analyzed. Despite the interpretive potential of microartifacts as a compliment to larger artifacts, the scale employed in archaeology remains at the traditional macro level (objects that remain in a ½ in [ca 1.5 cm] or ¼ in [ca .75 cm] screen). This is a consequence of the general belief that with reduced size comes a reduction in information. Relying only on macro size artifacts, and ignoring the spectrum of grain-sizes present, reduces the potential for identifying complete artifact patterns. Without collecting grain-size data, archaeologists are neglecting vital information which leaves them unable to adequately address the questions they pose.

REFERENCES CITED

REFERENCES CITED

Ahler, S.A.
1975 Patterning and Variability in Extended Coalescent Lithic Technology. Unpublished PhD dissertation, Department of Anthropology, University of Missouri, Columbia. University Microfilms, Ann Arbor, Michigan.

Baumler, M.F.
1985 On the Interpretation of Chipping Debris Concentrations in the Archaeological Record. Lithic Technology 14:120-125.

Baumler, M.F., and C.E. Downum
1989 Between Micro and Macro: A Study in the Interpretation of Small-Sized Lithic Debitage. In Experiments in Lithic Technology, edited by D.S. Amick and R.P. Mauldin, pp. 101 - 116. BAR International Series 528.

Behm, J.A.
1983 Flake Concentrations: Distinguishing Between Flint Working Activity Areas and Secondary Deposits. Lithic Technology 12:9-16.

1985 An Examination of the Effects of Slope Wash on Primary Deposits of Chipping Debris: A Reply to Baumler. Lithic Technology 14:126-129.

Binford, L.R.
1978 Dimensional Analysis of Behavior and Site Structure: Learning from an Eskimo Hunting Stand. American Antiquity 43:330-361.

1981 Bones. Academic Press, New York.

Boggs, S. Jr.
1987 Principles of Sedimentology and Stratigraphy. Merrill Publishing Company, Columbus, Ohio.

Brain, C.K.
1981 The Hunters and the Hunted. University of Chicago Press, Chicago.

Chapman, J.
1985 Tellico Archaeology: 12,000 Years of Native American Archaeology. Report of Investigations No. 43, Department of Anthropology, University of Tennessee, Knoxville, Occasional Paper No. 5, Frank H. McClung Museum, The University of Tennessee, Knoxville, Publications in Anthropology No. 41, Tennessee Valley Authority. Published by Tennessee Valley Authority.

Clark, J.E.
1986 Another Look at Small Debitage and Microdebitage. Lithic Technology. 15:21-33.

Clarke, D.L.
1968 Analytical Archaeology. Methuen, London.

Day, P.R.
1956 Report to the Committee on Physical Analysis, 1954-1955. Soil Science Society of America Proceedings 20:167-169.

1965 Particle Fractionation and Particle-Size Analysis. In Methods in Soil Analysis, 1st edition, Agronomy 9, edited by C. A. Black, pp. 545-567.

DeBoer, W.R., and D.W. Lathrap
1979 The Making and Breaking of Shibo-Conibo Ceramics. In Ethnoarchaeology: implications of ethnography for archaeology, edited by C. Kramer, pp. 102-138. Columbia University Press, New York.

Dincauze, D.F.
1976 The Neville Site: 8000 years of Amoskeag, Manchester, New Hampshire. Peabody Museum Monographs 4. Peabody Museum of Archaeology and Ethnology, Cambridge, MA.

Dunnell, R.C.
1986 Five Decades of American Archaeology. In American Archaeology Past and Future, edited by D.J. Meltzer, D.D. Fowler, J.A. Sabloff, pp.23-49. Smithsonian Institution Press, Washington.

Dunnell, R.C., and J.F. Simek
1989 Artifact Density, Sherd Size, and the Plowzone Processes at Robards Farm (Dunklin County, Missouri). Paper Presented at the Fifth Annual Meetings of the Society for American Archaeology, Atlanta, GA.

Dunnell, R.C., and J.K. Stein
1989 Theoretical Issues in the Interpretation of Microartifacts. Geoarchaeology 4:31-42.

Farrand, W.R.
1975 Sediment Analysis of a Prehistoric Rockshelter: the Abri Pataud. Quaternary Research 5(1):1-26.

Fladmark, K.R.
1982 Microdebitage Analysis: Initial Considerations. Journal of Archaeological Science 9:205-220.

Foreman, J.L., D.M. Steinhauff, T. Labotka, and K.R. Walker
1989 Phasecount: Computer Assisted Point Count Program for Thin-Section Spatial Analysis. Geological Society of America Abstracts with Programs, 21.

Galehouse, J.S.
1971 Point Counting. In Procedures in Sedimentary Petrology. edited by R. Carver, pp. 385-407. Wiley, New York.

Gallagher, J.P.
1977 Contemporary Stone Tools in Ethiopia: Implications for Archaeology. Journal of Field Archaeology. 4:407-414.

Gee, G.W., and J.W. Bauder
1979 Particle Size Analysis. In Methods of Soil Analysis Part I Physical and Mineralogical Methods. 2nd edition. Agronomy 9. edited by A. Klute, pp. 383-409. American Society of Agronomy and the Soil Science Survey of America, Madison, Wisconsin.

Hally, D.J.
1983 The Interpretive Potential of Pottery From Domestic Contexts. Midcontinental Journal of Archaeology 8:163-196.

Hayden, B., and A. Cannon
1983 Where the Garbage Goes: Refuse Disposal in the Maya Highlands. Journal of Anthropological Archaeology 2(2):117-163.

Hassan, F.A.
1978 Sediments in Archaeology: Methods and Implications for Paleoenvironmental and Cultural Analysis. Journal of Field Archaeology 5:197-213.

Henry, D.O., C.V. Haynes, and B.Bradley
1976 Quantitative Variations in Flaked Stone Debitage. Plains Anthropologist 21:57-61.

Hodder, I., and C. Orton
1976 Spatial Analysis in Archaeology. Cambridge University Press, New York.

Hull, K.
1983 Application of Microdebitage and Spatial Analysis. Unpublished Master Thesis, Department of Anthropology, University of Calgary, Calgary.

1987 Identification of Cultural Site Formation Processes through Microdebitage Analysis. American Antiquity 524:772-783.

Keeley, L.H.
1980 Experimental Determination of Stone Tool Uses: A Microwear Analysis. University of Chicago Press, Chicago.

Klippel, W.E., L.M. Snyder, and P.W. Parmalee
1987 Taphonomy and Archaeologically Recovered Mammal Bone from Southeast Missouri. Journal of Ethnobiology 7(2):155-169.

Laslett, P.
1972 Household and Family in Past Time. Cambridge University Press, New York.

Lewis, T.M.N., and M. Kneberg
1946 *Hiwassee Island: An Archaeological Account of Four Tennessee Indian Peoples*. University of Tennessee Press, Knoxville.

Linse, A.
1991 The Big, the Little, and the Left Behind: The Story of Macro- and Microartifacts. Poster Presented at the 56th Annual Meeting of the Society for American Archaeology, New Orleans, LA.

Madsen, M.E., and R.C. Dunnell
1989 The Role of Microartifacts in Deducing Land Use From Low Density Records in Plowed Surfaces. Paper Presented at the 54th Annual Meeting of the Society for American Archaeology, Atlanta, GA.

Metcalfe, D., and K.M. Heath
1990 Microrefuse and Site Structure: The Hearths and Floors of the Heartbreak Hotel. *American Antiquity* 55:781-796.

Murray, P.
1980 Discard Location: The Ethnographic Data. *American Antiquity* 45:490-502.

Nass Jr., J.
1989 Household Archaeology and Functional Analysis as Procedures for Studying Fort Ancient Communities in the Ohio Valley. *Pennsylvania Archaeologist* 59:1-13.

Nicholson, B.A.
1983 A Comparative Evaluation of Four Sampling Techniques and of the Reliability of Microdebitage as a Cultural Indicator in Regional Surveys. *Plains Anthropologist* 28:273-281.

Nielsen, A.E.
1991 Where Do Microartifacts Come From. Paper Presented at the 56th Annual Meeting of the Society for American Archaeology, New Orleans, LA.

O'Connell, J.F.
1987 Alyawara Site Structure and Its Archaeological Implications. _American Antiquity_ 52:74-108.

Odell, G.H.
1977 The Application of Microwear Analysis to the Lithic Component of an Entire Prehistoric Settlement: Methods, Problems, and Functional Reconstructions. PhD Dissertation, Department of Anthropology, Harvard University, University Microfilms, Ann Arbor.

Ousley, S.D., and S.C. Sherwood
n.d. Paracount. Computer program on file, Department of Anthropology, University of Tennessee, Knoxville, TN.

Pierce, F.M.
1991 Identifying Occupations: A New Technique based on Ceramic Microartifact Weathering. Poster Presented at the 56th Annual Meeting for the Society of American Archaeology, New Orleans, LA.

Polhemus, R.
1985 _Mississippian Architecture: Temporal, Technological, and Spatial Patterning of Structures at the Toqua Site (40MR6)_. Unpublished MA thesis, University of Tennessee - Knoxville.

1987 _The Toqua Site: A Late Mississippian Dallas Phase Town_. Volumes I and II, University of Tennessee Department of Anthropology Report of Investigations No. 41. Tennessee Valley Authority Publications in Anthropology No. 40.

Reese, Jo Ann
1986 Microarchaeological Analysis of the Chinese Worker's Area at the Warrendale Cannery Site, Oregon. Paper presented at the 51st annual meeting of the Society for American Archaeology, New Orleans, LA.

Reineck, H.E., and I.B. Singh
1986 _Depositional Sedimentary Environments_. Springer-Verlag, New York.

Rosen, A.M.
1986 Microarchaeology at Village and City Sites in the Near East. Paper Presented at the 51st Annual Meeting of the Society for American Archaeology, New Orleans, LA.

1989 Ancient Town and City Sites: A View From the Microscope. American Antiquity 54:564-578.

Schiffer, M.B.
1983 Towards the Identification of Formation Processes. American Antiquity 48:675-706.

1987 Formation Processes of the Archaeological Record. University of New Mexico Press, Albuquerque.

Simek, J.F.
1984 Integrating Pattern and Context in Spatial Archaeology. Journal of Archaeological Science 11:405-420.

1989 Structure and Diversity in Intrasite Spatial Analysis. In Quantifying Diversity in Archaeology, edited by R.D. Leonard and G.T. Jones, pp. 59-68. Cambridge University Press, London.

Simms, S.R., and K.M. Heath
1990 Site Structure of the Orbit Inn: An Application of Ethnoarchaeology. American Antiquity 55:797-813.

Smith, B.D.
1986 The Archaeology of the Southeastern United States: From Dalton to DeSoto, 10,500 - 500 B.P. In Advances in World Archaeology, edited by F. Wendorf, and A.E. Close, pp. 1-92. Academic Press, Orlando, Florida.

Snyder, L.M., and W.E. Klippel
1990 Wild Canid Modification of Ungulate Remains: Implications for Interpretations of the Archaeological Record. Paper Presented at the Sixth International Council for Archaeozoology, Washington, DC.

Soil Survey Staff
1988 Soil Classification Data, Jefferson County, Tennessee. United States Department of Agriculture, Soil Conservation Service, National Soil Survey Laboratory, Lincoln, Nebraska.

Stein, J.K.
1987 Deposits for archaeologists. In Advances in Archaeological Method and Theory, edited by M.B. Schiffer, pp.337-395. Academic Press, NY.

1990 Archaeological Stratigraphy. In Archaeological Geology of North America, edited by N.P. Lasca, and J. Donahue, pp.513-524. Centennial Special Volume no. 4. Geological Society of America, Inc., Boulder, Colorado.

Stein, J.K., and P.A. Teltser
1989 Size Distributions of Artifact Classes: Combining Macro- and Micro-Fractions. Geoarchaeology 4:1-30.

Stephonaitis, V.P.
1986 Prehistoric archaeology in the Southeastern United States, 1970-1985. Annual Review of Anthropology 15:363-404.

Stright, M.J.
1986 Human Occupation of the Continental Shelf During the Late Pleistocene/Early Holocene: Methods for Site Location. Geoarchaeology 1:347-364.

Sullivan, L.P.
1987 The Mousecreek Phase household. Southeastern Archaeology 6:16-29.

Swanton, J.R.
1946 Indians of the Southeastern United States Bureau of American Ethnology, Bulletin 137, Government Printing Office, Washington DC.

Teltser, P., and J.J. Kovacik
1991 Plowzone Structure From a Middle Woodland Settlement from Microartifacts. Poster Presented at the 56th Annual Meeting of the Society for American Archaeology, New Orleans, LA.

Van Der Plas, L., and A.C. Tobi
1965 A Chart For Judging the Reliability of Point Counting Results. American Journal of Science 263:87-90.

Vance, D.E.
1986 Microdebitage Analysis in Activity Analysis: An Application. Northwest Anthropological Research Notes, 20:179-189.

1989 The Role of Microartifacts in Spatial Analysis Unpublished Doctoral Dissertation, University of Washington, Seattle.

Villa, P.
1982 Conjoinable Pieces and Site Formation Processes. American Antiquity 47:276-290.

Williams, S.C. (editor)
1973 Adair's History of the American Indians. Promotory Press, New York.

Wood, W.R., and D.L. Johnson
1978 A Survey of Disturbance Processes in Archaeological Site Formation. In Advances in Archaeological Method and Theory edited by M.B. Schiffer, pp.315-385. Academic Press, New York.

Yellen, J.
1977 Archaeological Approaches to the Present: Models For Reconstructing the Past. Academic Press, New York.

APPENDICES

APPENDIX A

FIELD AND LABORATORY PROTOCOL

THE LOY SITE, STRUCTURE 3 - EXCAVATION PROTOCOL

The excavation strategy was defined based on research goals of collecting three dimensional provenience artifact data to better address questions of spatial organization within Dallas Phase houses. Excavation protocol was designed by R. Polhemus. Excavation techniques associated with Structure 3, following the coring and magnetometer survey, are as follows.

1) A grid of 1.52 m (5 ft) squares was superimposed over the site.

2) Plow zone was removed as a unit in 1.52 ft squares,and screened through half inch mesh. Beneath the plow zone arbitrary excavation levels of ca 7.5 cm were excavated and screened through quarter inch mesh. From each of these levels a 3 L floatation sample and 1.5 L sediment sample were collected.

3) At the base of the plow zone the 1.52 m squares were divided into 4 quadrants. Squares measuring 76 cm were excavated in 7.6 cm arbitrary vertical levels. These levels closely followed the natural boundaries between the lithostratigraphic units identified (Described in Chapter 3).

4) Artifacts within the structures were given three dimensional provenience and removed. All ceramic, lithic, bone, and shell artifacts, greater than approximately 1 cm were given an individual number and X, Y, Z coordinates. Angular rock (fire cracked) was point plotted only when measuring less than 3 cm. The remaining sediment was screened through a quarter inch mesh. All material remaining in the screen was bagged according to the 76 cm excavation unit and level.

MICROARTIFACT FIELD SAMPLING PROTOCOL

Horizontal Sampling

A 38 cm square was laid out in the center of the 76 cm square excavation unit. This area was lightly scraped with a clean trowel to remove any material that may have been recently transported into the excavation area by wind or on clothing. The trowel was then recleaned and the sample area troweled to a depth of approximately 7 mm. This process would remove roughly 600 grams of sediment. The excavation units that extended partially outside the horizontal extent of the floor were collected only within the boundaries of the floor deposit.

The sediment samples are collected in the field in 2 L zip-lock plastic bags, brought back to the lab, and opened to allow for air drying. When the samples are dry they are each weighed to one tenth of a gram. Each sample was split with a Jones Sample splitter and the contents of each pan put into two separate bags - one designated for storage and potential chemical analysis and the other for microartifact analysis.

Vertical Bulk Samples

In the southeast corner of each level a three dimensional bulk sample was marked off measuring 6.1 x 15.2 cm. The sample was measured 3 cm north of the southeast corner along the east wall. The sample was removed as intact as possible in order to maintain its original structure. Sample collection involves a clean trowel to slice out the required dimensions and deposit them in a new zip-lock two liter bag. The sample is broken apart slightly by hand into the bag to assure no macro artifacts are present. The samples are then removed to the lab. These samples were not primarily collected to represent the provenienced 76 cm square as were the horizontal samples. These samples focused on representing the lithostratigraphic units across the structure, the soil above and possible grain-size distributions due to post-depositional alteration of the sediments.

MICROARTIFACT SAMPLE PREPARATION

Preliminary testing and protocol design were conducted at the University of Washington Laboratory for Archaeological Sediments. The Laboratory of Analytical Archaeology at the University of Tennessee - Knoxville supported the reminder of the sample processing and analysis. Each sediment sample designated for microartifact analysis underwent the following procedure:

1) The sample was first divided using the Jones splitter. From one of the pans approximately 100 grams was extracted and weighed to one tenth of a gram. This usually

amounted to the contents of the entire pan. The exact weight is recorded on the data sheet with the sample's provenience designation (representing a 76 cm excavation unit). Any remaining sediment was returned to the zip-lock with that collected in the other pan.

2) The weighed sediment was poured into a numbered flask or fleaker. In order to disperse the individual particles to separate the sediments approximately 180 ml of peptizing agent was added to the sediment in the flask. The containers were sealed tightly and put on a shaker for 1 hour then allowed to sit over night.

The peptizing agent used was Sodium Hexametaphosphate solution. The solution consists of 1 gram of Sodium Hexametaphosphate to 1 liter deionized water.

3) After sitting over night the contents of the flask were briefly shaken by hand to return the contents into suspension and wet sieved through a 4 phi screen. Ultimately the entire procedure included two 4 phi "washings". This was done in an effort to assure the removal of all silt and clay size particles from the sand sized particles. The first wet sieving involved the washing of the material with deionized water for approximately 5 minutes using a spray bottle and washing the material back and forth across the screen. This procedure was performed over a basin. After this preliminary washing the material collected in the basin less than 4 ϕ was discarded and the contents of the 4 phi screen are washed back into the flask using peptizing agent and a funnel. Peptizing agent is used to bring the flask up to a volume of approximately 150 ml. The flask was sealed, and returned to the shaker for five minutes and once again allowed to sit over-night.

4) The second and final wet sieving takes place using three nested sieves. Before this procedure is started three beakers are labeled with the flask numbers representing the contents of sieves -1.0 ϕ, 1.0 ϕ and 4.0 ϕ. These empty beakers are each weighed and their weight recorded on the data sheet.

5) The sediment that had been in solution over-night is then poured into the nested sieves, phi sizes -1.0, 1.0 and 4.0. Deionized water is used to gently rinse the material through the screens. Once the material in the 1.0 ϕ screen -1.0 ϕ is satisfactorily cleaned it is removed from the nest and washed into a filter resting in the corresponding beaker. The 1.0 and 4.0 ϕ sieves continue to be washed until all the material less than 1.0 ϕ is washed

to the 4.0 Φ screen below. The material was washed, using a spray bottle of deionized water into a preweighed beaker and set aside. The material in the 4.0 Φ screen was washed until all the silt and clay was removed. The contents were then rinsed into the corresponding preweighed beaker.

6) The three beakers were then put into a preheated oven at a temperature less than 100° C. The samples remained in the oven until the water was completely evaporated leaving only the grains. The beakers were removed and allowed to cool to room temperature.

7) Once cooled each beaker was weighed with its contents to 1/10,000 of a gram and its weight entered on the data sheet. The contents of the beakers containing -1.0 Φ and 4.0 Φ were stored in labeled envelopes. The contents of the beaker containing the 1.0 and 0.0 Φ were collected into a clear vial with a labeled tag. These grains were used for the actual microartifact analysis.

MICROARTIFACT QUANTIFICATION PROTOCOL

1) The 0.0 Φ and 1.0 Φ grains collected during the microartifact sample preparation are randomly spread across a glass petri dish using a small paint brush. Before the sample is added to the dish the surface is wiped down with lens paper that has been sprayed with commercial Static Guard to avoid static electricity movement of the particles. The petri dish is grooved on the bottom with a grid pattern made up of 1 cm squares. This grid is used to guide the counting by columns and rows. The counting starts in the upper left hand corner, moving down the designated column, carefully counting only those grains within the column. At the end of the column the counting will continue to the right, moving up the column adjacent to that just counted.

2) To facilitate the counting a binocular stereomicroscope, Wild Leitz M3Z, that magnifies up to 80 x is used. The light source used is a double flexed arm fiberoptic incident system. To best identify the grains and view only those within the column a magnification of 40 x is used. On grains of questionable identity the magnification can be increased.

3) The PARACOUNT program assigns the computer keys 1 - 7 to each material type. The identity of each grain is

entered as counting is done while viewing through the microscope, acting much as a manual counter. As each particle is entered the program calculates the frequency, volume percentage, and statistical information for each material class.

4) A statistically representative sample is generally reached between 1500 - 1800 grains. Once that representative sample is reached the data is automatically entered into a spread sheet data management file in PARADOX, were it can be organized and manipulated.

APPENDIX B

DATA TABLES

B.1: Microartifact Data Generated in PARACOUNT

			Total Count								Standard Deviation							Volume Percent						
X	Y	Unit	M.Rx	Charc	Ceram	Bone	Lith	Daub	Shell	Total	M.Rx	Charc	Ceram	Bone	Lith	Daub	Shell	M.Rx%	Charc%	Ceram%	Bone%	Lith%	Daub%	Shell%
327.50	205.00	02G	1065	329	1	52	91	193	3	1734	2.34	1.88	.12	.82	1.07	1.51	.20	61	19	0	3	5	11	0
330.00	205.00	02H	673	715	5	138	67	226	1	1825	2.26	2.29	.24	1.24	.88	1.54	.11	37	39	0	8	4	12	0
325.00	207.50	03F	914	457	0	124	71	204	2	1772	2.37	2.08	0.00	1.21	.93	1.52	.16	52	26	0	7	4	12	0
327.50	207.50	03G	959	384	2	57	79	231	1	1713	2.40	2.02	.17	.87	1.01	1.65	.12	56	22	0	3	5	13	0
330.00	207.50	03H	915	437	1	126	133	155	2	1769	2.38	2.05	.11	1.22	1.25	1.34	.16	52	25	0	7	8	9	0
332.50	207.50	03I	788	569	1	118	96	163	0	1735	2.39	2.25	.12	1.21	1.10	1.40	0.00	45	33	0	7	6	9	0
320.00	210.00	04D	905	460	85	78	35	196	10	1769	2.38	2.09	1.02	.98	.66	1.49	.36	51	26	5	4	2	11	1
322.50	210.00	04E	1102	173	44	40	59	123	2	1543	2.30	1.61	.85	.81	.98	1.38	.18	71	11	3	3	4	8	0
325.00	210.00	04F	876	420	5	58	32	371	0	1762	2.38	2.03	.25	.85	.64	1.94	0.00	50	24	0	3	2	21	0
327.50	210.00	04G	856	558	1	71	59	248	1	1794	2.36	2.19	.11	.92	.84	1.63	.11	48	31	0	4	3	14	0
330.00	210.00	04H	867	605	11	141	28	102	1	1755	2.39	2.27	.38	1.30	.60	1.12	.11	49	34	1	8	2	6	0
332.50	210.00	04I	440	791	4	35	28	455	0	1753	2.07	2.38	.23	.67	.60	2.09	0.00	25	45	0	2	2	26	0
315.00	212.50	05B	906	95	7	34	23	42	29	1136	2.38	1.64	.46	1.01	.84	1.12	.94	80	8	1	3	2	4	3
317.50	212.50	05C	430	386	37	65	26	506	94	1544	2.28	2.20	.78	1.02	.65	2.39	1.22	28	25	2	4	2	33	6
320.00	212.50	05D	857	521	26	110	33	179	11	1737	2.40	2.20	.58	1.17	.66	1.46	.38	49	30	1	6	2	10	1
325.00	212.50	05F	855	453	20	44	34	408	0	1814	2.34	2.03	.49	.72	.64	1.96	0.00	47	25	1	2	2	22	0
327.50	212.50	05G	961	261	0	40	74	394	0	1730	2.39	1.72	0.00	.72	.97	2.02	0.00	56	15	0	2	4	23	0
330.00	212.50	05H	821	391	11	58	80	389	0	1750	2.39	1.99	.38	.86	1.00	1.99	0.00	47	22	1	3	5	22	0
332.50	212.50	05I	510	426	11	72	25	558	3	1605	2.32	2.20	.41	1.03	.62	2.38	.22	32	27	1	4	2	35	0
335.00	212.50	05J	729	543	16	156	28	233	1	1706	2.40	2.26	.47	1.40	.62	1.66	.12	43	32	1	9	2	14	0
315.00	215.00	06B	887	410	37	75	42	208	102	1761	2.38	2.01	.68	.96	.73	1.54	1.11	50	23	2	4	2	12	6
317.50	215.00	06C	902	488	37	110	20	207	140	1904	2.29	2.00	.63	1.07	.47	1.43	1.20	47	26	2	6	1	11	7
320.00	215.00	06D	931	485	34	81	60	142	4	1737	2.39	2.15	.66	1.01	.88	1.31	.23	54	28	2	5	3	8	0
327.50	215.00	06G	292	287	0	38	7	1018	0	1642	1.89	1.87	0.00	.74	.32	2.40	0.00	18	17	0	2	0	62	0
330.00	215.00	06H	522	458	6	36	24	607	1	1654	2.29	2.20	.30	.72	.59	2.37	.12	32	28	0	2	1	37	0
332.50	215.00	06I	649	260	0	73	34	654	2	1672	2.38	1.77	0.00	1.00	.69	2.39	.17	39	16	0	4	2	39	0
335.00	215.00	06J	893	547	7	174	23	167	6	1817	2.35	2.15	.29	1.38	.52	1.36	.27	49	30	0	10	1	9	0
337.50	215.00	06K	860	607	1	133	42	132	3	1778	2.37	2.25	.11	1.25	.72	1.24	.19	48	34	0	7	2	7	0
315.00	217.50	07B	972	374	27	52	31	204	56	1716	2.39	1.99	.60	.83	.64	1.56	.86	57	22	2	3	2	12	3
317.50	217.50	07C	700	603	62	100	14	205	85	1769	2.33	2.25	.87	1.10	.42	1.52	1.02	40	34	4	6	1	12	5
320.00	217.50	07D	869	501	46	143	30	247	0	1836	2.33	2.08	.73	1.25	.59	1.59	0.00	47	27	3	8	2	13	0
327.50	217.50	07G	126	81	5	14	1	904	8	1139	1.86	1.52	.39	.65	.18	2.40	.49	11	7	0	1	0	79	1
330.00	217.50	07H	563	320	0	48	27	764	1	1723	2.26	1.87	0.00	.79	.60	2.39	.12	33	19	0	3	2	44	0
332.50	217.50	07I	528	291	10	89	13	811	1	1743	2.20	1.79	.36	1.05	.41	2.39	.11	30	17	1	5	1	47	0
335.00	217.50	07J	599	325	19	85	31	627	1	1687	2.33	1.92	.51	1.07	.65	2.35	.12	36	19	1	5	2	37	0
337.50	217.50	07K	795	561	19	180	19	150	1	1725	2.40	2.26	.50	1.47	.50	1.36	.12	46	33	1	10	1	9	0
317.50	220.00	08C	770	553	18	131	49	156	8	1685	2.43	2.29	.50	1.30	.82	1.41	.33	46	33	1	8	3	9	0
320.00	220.00	08D	771	489	21	113	23	290	6	1713	2.40	2.18	.53	1.20	.56	1.81	.29	45	29	1	7	1	17	0
322.50	220.00	08E	947	374	9	99	33	238	4	1704	2.41	2.01	.35	1.13	.67	1.68	.23	56	22	1	6	2	14	0
325.00	220.00	08F	676	227	2	34	25	685	3	1652	2.42	1.69	.17	.70	.60	2.42	.21	41	14	0	2	2	41	0
327.50	220.00	08G	580	332	7	43	20	710	3	1695	2.30	1.93	.31	.76	.52	2.40	.20	34	20	0	3	1	42	0
330.00	220.00	08H	759	461	5	73	42	361	1	1702	2.41	2.15	.26	.98	.75	1.98	.12	45	27	0	4	2	21	0
332.50	220.00	08I	769	387	6	87	33	430	5	1717	2.40	2.02	.28	1.06	.66	2.09	.26	45	23	0	5	2	25	0
335.00	220.00	08J	1002	286	9	79	41	251	4	1672	2.40	1.84	.36	1.04	.76	1.75	.24	60	17	1	5	2	15	0
337.50	220.00	08K	940	448	14	31	35	246	4	1718	2.40	2.12	.43	.64	.68	1.69	.23	55	26	1	2	2	14	0
340.00	220.00	08L	836	671	20	70	25	92	8	1722	2.41	2.35	.52	.95	.58	1.08	.33	49	39	1	4	1	5	0
320.00	222.50	09D	782	511	18	185	37	227	1	1761	2.37	2.16	.48	1.46	.68	1.60	.11	44	29	1	11	2	13	0
322.50	222.50	09E	772	372	21	148	32	338	36	1719	2.40	1.99	.53	1.35	.65	1.92	.69	45	22	1	9	2	20	2
325.00	222.50	09F	888	339	41	91	48	327	1	1735	2.40	1.90	.73	1.07	.79	1.88	.12	51	20	2	5	3	19	0
327.50	222.50	09G	733	381	2	67	13	511	0	1707	2.40	2.02	.17	.94	.42	2.22	0.00	43	22	0	4	1	30	0
330.00	222.50	09H	678	420	2	109	28	498	2	1737	2.34	2.05	.16	1.16	.60	2.17	.16	39	24	0	6	2	29	0
332.50	222.50	09I	892	445	4	160	30	227	2	1760	2.38	2.07	.23	1.37	.62	1.60	.16	51	25	0	9	2	13	0
335.00	222.50	09J	968	444	33	130	29	101	0	1705	2.40	2.13	.67	1.29	.63	1.14	0.00	57	26	2	8	2	6	0
337.50	222.50	09K	754	451	23	187	46	254	0	1715	2.40	2.13	.56	1.51	.78	1.72	0.00	44	26	1	11	3	15	0
340.00	222.50	09L	676	610	43	120	39	184	1	1673	2.40	2.35	.77	1.26	.74	1.53	.12	40	36	3	7	2	11	0
342.50	222.50	09M	662	465	0	44	40	122	1	1334	2.74	2.61	0.00	.98	.93	1.58	.15	50	35	0	3	3	9	0
320.00	225.00	10D	520	365	19	108	13	561	2	1588	2.36	2.11	.55	1.26	.45	2.40	.18	33	23	1	7	1	35	0
322.50	225.00	10E	907	417	25	152	38	209	5	1753	2.39	2.03	.57	1.34	.70	1.55	.25	52	24	1	9	2	12	0
325.00	225.00	10F	615	371	4	66	21	545	1	1613	2.40	2.07	.47	.97	.56	2.33	.12	38	23	1	4	1	33	0
327.50	225.00	10G	1055	480	49	156	28	260	5	2033	2.22	1.88	.68	1.18	.52	1.48	.22	52	24	2	8	1	13	0
330.00	225.00	10H	797	442	29	117	19	318	0	1722	2.40	2.11	.62	1.21	.50	1.87	0.00	46	26	2	7	1	18	0

B.1: Microartifact Data Generated in PARACOUNT (cont.)

			Total Count								Standard Deviation													
X	Y	Unit	M.Rx	Charc	Ceram	Bone	Lith	Daub	Shell	Total	M.Rx	Charc	Ceram	Bone	Lith	Daub	Shell	M.Rx%	Charc%	Ceram%	Bone%	Lith%	Daub%	Shell%
332.50	225.00	10I	587	504	3	123	18	395	0	1630	2.38	2.29	.21	1.31	.52	2.12	0.00	36	31	0	8	1	24	0
335.00	225.00	10J	395	449	12	80	14	801	1	1752	2.00	2.09	.39	1.00	.43	2.38	.11	23	26	1	5	1	46	0
337.50	225.00	10K	976	458	17	101	26	163	1	1742	2.38	2.11	.47	1.12	.58	1.40	.11	56	26	1	6	1	9	0
340.00	225.00	10L	841	717	42	64	6	70	0	1740	2.40	2.36	.74	.90	.28	.94	0.00	48	41	2	4	0	4	0
320.00	227.50	11D	590	337	136	44	16	480	1	1604	2.41	2.03	1.39	.82	.50	2.29	.12	37	21	8	3	1	30	0
322.50	227.50	11E	808	572	34	169	16	151	0	1750	2.38	2.24	.66	1.41	.46	1.34	0.00	46	33	2	10	1	9	0
325.00	227.50	11F	777	352	18	109	19	470	1	1746	2.38	1.92	.48	1.16	.50	2.12	.11	45	20	1	6	1	27	0
327.50	227.50	11G	933	358	23	136	11	267	1	1729	2.40	1.95	.55	1.29	.38	1.74	.12	54	21	1	8	1	15	0
330.00	227.50	11H	858	521	16	135	21	191	0	1742	2.40	2.19	.46	1.28	.52	1.50	0.00	49	30	1	8	1	11	0
332.50	227.50	11I	723	833	30	98	4	46	1	1735	2.37	2.40	.63	1.11	.23	.77	.12	42	48	2	6	0	3	0
335.00	227.50	11J	816	681	16	86	27	101	3	1730	2.40	2.35	.46	1.05	.60	1.13	.20	47	39	1	5	2	6	0
322.50	230.00	12E	953	427	13	76	23	257	0	1749	2.38	2.05	.41	.97	.54	1.69	0.00	54	24	1	4	1	15	0
325.00	230.00	12F	760	578	72	180	20	99	1	1710	2.40	2.29	.97	1.48	.52	1.13	.12	44	34	4	11	1	6	0
327.50	230.00	12G	920	546	26	105	27	77	10	1729	2.40	2.24	.59	1.20	.68	.99	.36	53	32	2	7	2	4	1
330.00	230.00	12H	760	738	12	128	21	61	1	1721	2.39	2.39	.40	1.26	.53	.89	.12	44	43	1	7	1	4	0
332.50	230.00	12I	905	164	3	24	33	1	0	1130	2.38	2.10	.31	.86	1.00	.18	0.00	80	15	0	2	3	0	0
325.00	232.50	13F	989	237	5	42	26	38	1	1338	2.40	2.09	.33	.95	.75	.91	.15	74	18	0	3	2	3	0
327.50	232.50	13G	665	579	17	61	28	116	101	1567	2.50	2.44	.52	.98	.67	1.32	1.24	42	37	1	4	2	7	6

B.2: Macroartifact Data, Total Counts

X	Y	Unit	M.Rx	Daub	Ceram	Lith	Bone	Shell	Charc
323.75	206.25	02F	0	0	1	0	1	0	0
326.25	206.25	02G	0	0	1	0	1	2	0
328.75	206.25	02H	3	2	4	1	1	0	0
331.25	206.25	02I	1	0	2	0	0	0	0
321.25	208.75	03E	4	3	6	5	0	1	0
323.75	208.75	03F	1	1	0	1	0	0	0
326.25	208.75	03G	3	0	5	1	5	0	0
328.75	208.75	03H	3	0	5	2	4	2	1
331.25	208.75	03I	9	0	8	0	7	1	3
318.75	211.25	04D	7	10	12	2	6	1	0
321.25	211.25	04E	8	84	24	4	9	1	0
323.75	211.25	04F	24	185	29	14	12	1	1
326.25	211.25	04G	28	47	71	9	19	1	0
328.75	211.25	04H	30	63	57	16	20	0	0
331.25	211.25	04I	36	107	55	8	24	1	4
333.75	211.25	04J	12	2	2	2	2	0	0
313.75	213.75	05B	4	0	12	0	4	16	0
316.25	213.75	05C	8	6	34	3	12	17	1
318.75	213.75	05D	22	27	76	4	35	25	2
321.25	213.75	05E	29	366	72	7	25	13	6
323.75	213.75	05F	42	2876	44	11	22	0	1
326.25	213.75	05G	55	673	52	4	10	1	6
328.75	213.75	05H	117	396	187	23	55	1	8
331.25	213.75	05I	47	82	134	14	36	1	2
333.75	213.75	05J	23	15	28	9	20	2	2
311.25	216.25	06A	0	0	0	0	1	0	0
313.75	216.25	06B	11	3	39	2	10	14	0
316.25	216.25	06C	49	32	97	4	50	53	0
318.75	216.25	06D	52	166	129	9	40	61	5
326.25	216.25	06G	78	1835	127	10	52	2	17
328.75	216.25	06H	83	482	107	15	38	1	6
331.25	216.25	06I	73	762	73	14	18	0	4
333.75	216.25	06J	19	20	23	7	8	1	0
336.25	216.25	06K	9	2	13	1	3	0	1
313.75	218.75	07B	9	0	14	0	7	11	0
316.25	218.75	07C	32	35	101	4	48	37	1
318.75	218.75	07D	30	75	113	9	39	24	2
326.25	218.75	07G	108	3983	146	7	42	12	10
328.75	218.75	07H	73	1303	77	7	31	2	2
331.25	218.75	07I	65	447	60	8	37	0	1
333.75	218.75	07J	45	32	45	12	25	0	0
336.25	218.75	07K	28	8	30	7	12	1	1
338.75	218.75	07L	0	0	2	0	0	0	0
313.75	221.25	08B	1	2	2	0	3	0	0
316.25	221.25	08C	18	3	27	10	23	25	1
318.75	221.25	08D	61	41	127	22	69	4	0
321.25	221.25	08E	71	331	108	21	50	10	4
323.75	221.25	08F	91	1240	94	12	35	1	0
326.25	221.25	08G	112	1453	139	16	62	9	6

X	Y	Unit	M.Rx	Daub	Ceram	Lith	Bone	Shell	Charc
328.75	221.25	08H	97	308	119	21	62	2	0
331.25	221.25	08I	68	76	75	21	46	1	0
333.75	221.25	08J	42	16	39	9	16	1	0
336.25	221.25	08K	28	3	15	3	11	0	0
338.75	221.25	08L	7	4	9	0	2	0	0
316.25	223.75	09C	8	1	15	2	7	0	1
318.75	223.75	09D	67	47	88	11	40	3	3
321.25	223.75	09E	115	239	232	21	108	35	4
323.75	223.75	09F	98	372	200	11	112	11	1
326.25	223.75	09G	117	348	122	31	154	3	3
328.75	223.75	09H	343	572	459	20	200	1	0
331.25	223.75	09I	141	93	146	19	68	5	0
333.75	223.75	09J	104	22	96	12	44	2	0
336.25	223.75	09K	50	11	35	8	23	1	0
338.75	223.75	09L	35	3	21	3	13	0	0
341.25	223.75	09M	7	1	2	0	1	0	0
318.75	226.25	10D	23	9	27	5	32	3	2
321.25	226.25	10E	80	82	139	13	70	18	2
323.75	226.25	10F	131	127	149	21	75	1	0
326.25	226.25	10G	130	115	160	25	84	3	1
328.75	226.25	10H	224	218	219	18	99	1	0
331.25	226.25	10I	73	32	49	18	44	3	3
333.75	226.25	10J	78	14	34	19	22	0	2
336.25	226.25	10K	28	2	19	6	14	2	0
338.75	226.25	10L	26	1	18	2	7	0	0
341.25	226.25	10M	0	0	1	0	0	0	0
318.75	228.75	11D	8	2	22	1	5	2	0
321.25	228.75	11E	70	49	57	9	46	3	6
323.75	228.75	11F	74	55	72	11	28	2	1
326.25	228.75	11G	65	34	87	13	86	1	0
328.75	228.75	11H	93	31	83	7	45	3	1
331.25	228.75	11I	47	3	34	7	21	5	2
333.75	228.75	11J	57	5	23	13	24	2	1
336.25	228.75	11K	12	0	4	3	2	0	0
321.25	231.25	12E	26	2	15	5	26	1	1
323.75	231.25	12F	33	6	19	3	18	1	0
326.25	231.25	12G	36	2	37	10	43	12	0
328.75	231.25	12H	134	10	78	4	70	10	1
331.25	231.25	12I	21	4	7	0	8	3	0
321.25	233.75	13E	3	0	4	0	0	0	0
323.75	233.75	13F	32	7	23	1	24	5	0
326.25	233.75	13G	15	0	27	1	9	42	3
328.75	233.75	13H	13	1	11	1	2	14	0

VITA

Sarah Catherine Sherwood was born at the University of Virginia Hospital on August 12, 1962. She attended public schools in Charlottesville and Harrisonburg, Virginia, and graduated from Harrisonburg High School in June 1980. She earned a Bachelor of Science in Anthropology with a minor in Geology at James Madison University in August 1985. In the fall of 1987 Sarah entered the University of Tennessee, Knoxville and in December 1991 received a Master of Arts degree in Anthropology.

Ms. Sherwood is currently pursuing a Doctorate in Anthropology. She is a member of the Society for American Archaeology, Geological Society of America, and the Southeastern Archaeology Conference.