To the Graduate Council:

I am submitting herewith a dissertation written by Hugh Bryson Matternes entitled "Social and Biological Structures in the Mound C Cemetery, Wickliffe Mound Group (15BA4)." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Anthropology.

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We have read this dissertation and recommend its acceptance:

Accepted for the Council:

Interim Vice Provost and
Dean of the Graduate School.

Social and Biological Structures in the Mound C Cemetery, Wickliffe Mound Group (15BA4).

A Dissertation
Presented for the
Doctor of Philosophy
Degree
University of Tennessee, Knoxville

Hugh Bryson Matternes

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Abstract

Cemeteries are archaeological phenomena that accumulate over time. When formed in socially unstable cultural environments, the messages communicated by mortuary-based material symbols may change over the course of grave accumulation. This dissertation explores whether Mississippian Period mortuary deposits in Mound C, of the Wickliffe Mound Group (15BA4) changed over time.

Cemeteries are places where the dead's social qualities are defined. They help reemphasize important community values and provide a biologically safe repository for the dead. Symbolized mortuary features convey seven general types of social information. This relationship is sensitive to temporal change.

Several analyses placed the cemetery into socio-biological contexts. Radiometric analysis identified that graves accumulation coincided with an unstable socio-political expansion. Health conditions were similar to those in Mississippian communities. Age and sex structures conformed to those in other like assemblages. Evidence of internal structure was also identified. The interments exhibited 34 distinct attributes. For each of 104 interments, these attributes were transformed into Jaccard pseudo-distance measures. Several clustering approaches were used to model the structural organization of these variables. Cophenetic analyses determined that the Average Linkage Approach provided the best fit with the original data's structure.

No less than 71 unique mortuary attribute combinations were deposited in the cemetery. These were arranged into nine distinct clusters. The internal structure of each cluster varied between groups. The cemetery was observed to follow the same low entropy structural arrangement found in other Mississippian Period cemeteries. As a means of controlling for time, each clustered interment was stratigraphically ordered. Graves representing the most ancient and most recent deposits were compared. No strong differences between initial and ending accumulation events were found. Social change during the Mound C Cemetery accumulation period was not strong enough to alter the existing mortuary ritual in an archaeologically definable

manner. Given that village use was longer than Mound C Cemetery use, more than one facility must have been used by the community. Major shifts in community dynamics may discourage interest in established burial areas and promote construction of new facilities.

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VOLUME 1

Chapter 1. Introduction

Most cemeteries represent areas where the dead and residue from mortuary ritual are allowed to accumulate. These facilities are not products of a single death event, rather they are a reflection of many death events. Mortuary accumulations are not single moment phenomena, they occur over time. This introduces the possibility that their form may change during accumulation.

Change in organization over a given accumulation period can have many long reaching ramifications. Social segments may appear or disappear, change status, modify an existing mortuary expression or introduce a new lexicon of symbolic expression. Likewise, organizational instability reflects on the biological data by modifying how age, sex, kinship and health data are represented. Most analyses of non-historic mortuary deposits assume some level of social stability during the cemetery's accumulation period.

To date, mortuary research has worked within a model of past social stability without exploring mortuary expression in clearly unstable cultural settings. One unstable social provenience is the Mississippian culture of the Eastern United States. Most analysts believe that communities following this late prehistoric social pattern were organized into chiefdoms or chiefdom-like social structures. Political instability is a hallmark of these organizations. Anderson (1994:9) has argued that 'cycling', the " ...recurrent process of emergence, expansion and fragmentation of complex chiefdoms amid a regional backdrop of simple chiefdoms" results in periodic re-organization of the regional social order. This phenomenon produces patterns of community size and structure fluctuations that are very reminiscent of the socio-political evolution visible in late prehistoric communities.

One former focus for mortuary rituals is located in the Wickliffe Mound Group (15BA4). This Middle Mississippian mound and village complex is located on the confluence of the Ohio and Mississippi Rivers in Western Kentucky. Archaeological evidence for significant social transitions at this study site includes a pattern of rapid expansion and decline of site usage, the appearance of the Mound C mortuary facility after several generations of domestic habitation and an abrupt

abandonment of the village. Even within the restricted view provided by the archaeological record, there is evidence against stability in this community. Do these events affect how mortuary rituals were accomplished?

Many graves in the Mound C Cemetery are partially stratified and can be ordered as a means of controlling for time within the cemetery. Data from mortuary variables, engendering both biological and social dimensions, are subjected to R and Q mode analysis to learn how mortuary expressions were organized. Applying aspects of Dalland's (1984) key sequence procedure to a Harris matrix of interment stratigraphy helped verify whether differences over time could be detected

There are important ramifications from these results. If change in Mississippian mortuary expression is demonstrated, mortuary data – particularly that from the Mississippian period – must be seen as sensitive to social transition biases. Conversely, negative evidence for perceptible change in mortuary structure indicates that some social expressions are less resilient to change than other aspects of the archaeological record. In light of current anthropological interests in the social and temporally dynamic nature of Mississippian culture, this project can assess the utility of mortuary organizational data for continued social research.

Chapter 2. The Ritual of Death

"Mortuary Practices are produced by a system
and thus can only be understood by reference
to their place in that system."
- Arthur Saxe (1970)

The process of dying is a natural phenomenon. It represents the final phase of the life cycle, culminating with the death event - a physiological transition of the living organism into a non-living corpse. While cellular activity continues after the clinical symptoms of death (Gill-King 1997:94-95), humans tend to recognize death as more of a single biological incident. Most cultures respond to death as an episodic event.

Death entails the permanent removal of a human being from the social environment. In this regard, it acts as an agent of social disintegration. Death prevents individuals from contributing their labor, wisdom and experience, capital or genes to the community's overall well being. Death reduces society's capacity to function efficiently. Over time, death removes community members. Communities, therefore, cannot ignore death events. When death occurs, a culture must minimally acknowledge the event's passage and adjust its organizational structure to compensate for the loss. The examination and interpretation of responses to a death event enable social scientists to identify fundamental aspects of how human social organizations operate (c.f., Chapman et al. 1981; Hertz 1960; O'Shea 1984; Saxe 1970).

The Ritual

A community is faced with two issues after a death event. First, death introduces a potentially dangerous biohazard to the community setting and second, a social void is created by the loss (Binford 1971:16). The range of practices employed by a community to address and overcome those issues is referred to as the mortuary program (Braun 1979:66). Mortuary programs employ practices that remove the dead's physical remains from the environment without eliminating the dead's social persona from the community's social context. They also provide a means of community support for the survivors.

Removing the dead from the living environment is a socially delicate undertaking. Dying represents an important rite of passage, where the dynamic social identities of the living are transformed into permanent social classifications of the dead (Saxe 1970:7). These transactions require considerable planning and reflection on the part of the community. While no two communities respond alike to death, all societies recognize that death requires a collective community response (Hertz 1960:76). Humans have developed rituals that help guide the community through such crises and reaffirm both the dead and the living's membership in the organizational network (Radcliffe-Brown 1964:324). Their responses to death generally fall within the bounds of pre-determined behaviors deemed acceptable by a community for the given situation (Goffman 1959:28). Many of these responses include visual, performance (gestural) and spoken displays or languages. These are designed to communicate information about the death event and its impact on the community. These presentations also review the social provenience of all parties involved. Particularly in non-literate societies, these non-written 'languages' are the foundation of funerary behaviors (Randsborg 1989:85). Behaviors conducted in response to a death event can be classified as mortuary rituals.

Mortuary rituals are performances acted out by members of the surviving community. Individuals assume culturally prescribed social roles; that is, they limit their behaviors to fit within the boundaries of a pre-determined social classification; and act out a display designed to influence how the viewing audience thinks and feels about the dead and the death event. Mortuary rituals provide an interpretation of the death event in a manner supportive of both the dead and the community as a whole (O'Shea 1984:287). This is accomplished by grounding these rituals in the community's larger structure of beliefs and material symbolism (McGuire 1988:440).

Mortuary rituals last as long as community members feel that there are needs to alter day-to-day events. These rituals are by no means literal interpretations, rather they are abstract idealizations of the situation bounded by what the audience's normative cultural belief systems can accept as real (Goffman 1959:35). The purpose of the mortuary ritual is not to portray death in realistic terms, but to utilize death as a means of influencing or reaffirming what the observer thinks

(McGuire 1988:436). In this regard the mortuary ritual is a means of shaping social values (Geertz 1973:97).

A successful mortuary ritual portrays the dead in a manner that is superior to reality, yet not a complete fabrication. Mortuary ritual performances must follow community norms for what is and is not an appropriate representation. These rituals represent final opportunities to classify the dead's place in a community context. The ritual must effectively convey idealized qualities and relationships of the dead to an audience (Pearson 1982:110). This then defines how the dead will be remembered and socially provenienced. Failure to follow the established social guidelines runs the risk of the dead losing their place as a former member of the surviving community (Hall 1980:9-10).

Social Personalities

While mortuary rituals provide recognition of an individual, it is the subject's social characteristics -- not just the social personality – that influences the ritual's form. Mortuary rituals are based on features and qualities attributed to the dead. Throughout life, a community member acquires biological, ascribed and achieved characteristics (Goodenough 1965:4). These are used to classify the individual's place in the social matrix. Features, such as one's age, sex, kinship, health, social rank, economic and political power, are assigned to a particular social role (or social identity) and used to guide each individual through the choice of potential social roles available. The acceptance of one role frequently is conditional on other roles. In order to assume the role of a mother, for example, one must possess the identities of an adult, a female and guardian of a child. The sum of all social roles that society allows an individual to hold is referred to one's social personality or persona (Warner 59:304).

In normal day-to-day life, social personae help narrow the range of behavior choices available to an actor. They are important reference points, clarifying what rights and duties are expected from the individual and the community (Goodenough 1965:4). How individuals define themselves and are defined by those around them indicate behaviors that may or may not be regarded as appropriate. Social personalities exist for as long as the idea of the individual is

perpetuated. Some aspects of these social constructs are present prior to the subject's birth and last well after their death (Figure 2-1). The size of the social personality is largely a function of roles assumed by the individual. It does not remain static, rather a social personality changes with age. In the event of the subject's death, the social personality defines how the living should interact with the dead and provides a template outlining what rituals are and are not appropriate (O'Shea 1984:10). Variations between individual social personalities are the foundation for most mortuary expressions.

Basic Social Roles

Mortuary rituals require participants to act and respond in culturally prescribed ways. Suites of behaviors that are recognizable as components of a social identity or role help to classify participants. The role assumed determines how a ritual participant will interact with other social identities (Goodenough 1965:6).

In order to understand the mortuary ritual, it is first necessary to identify what roles are present in a given cultural setting. There are a wide variety of specific roles available for any given mortuary presentation. Participants in a mortuary ritual, however, are definable as behaving according to one of three generalized role patterns – they may represent the deceased, or be part of the presentation team, or serve as a member of the audience. Accordingly, role interactions follow three fundamental identity relationships –the dead with the audience, the dead with the presentation team, and the presentation team with the audience.

The Deceased

Death events are perhaps the most critical element in a funerary ritual. These events require the loss of a human life. All cultural responses to death require that the role of "Deceased" be attributed to a specific social personality. Since social identities can be ascribed to non-human, inanimate, and imaginary beings, the state of being alive is not a pre-requisite for a community to interact with the identity (Goodenough 1965:5). The role of "Deceased" is defined as the non-living (or soon to be non-living) individual whose impending death event initiated the mortuary ritual.

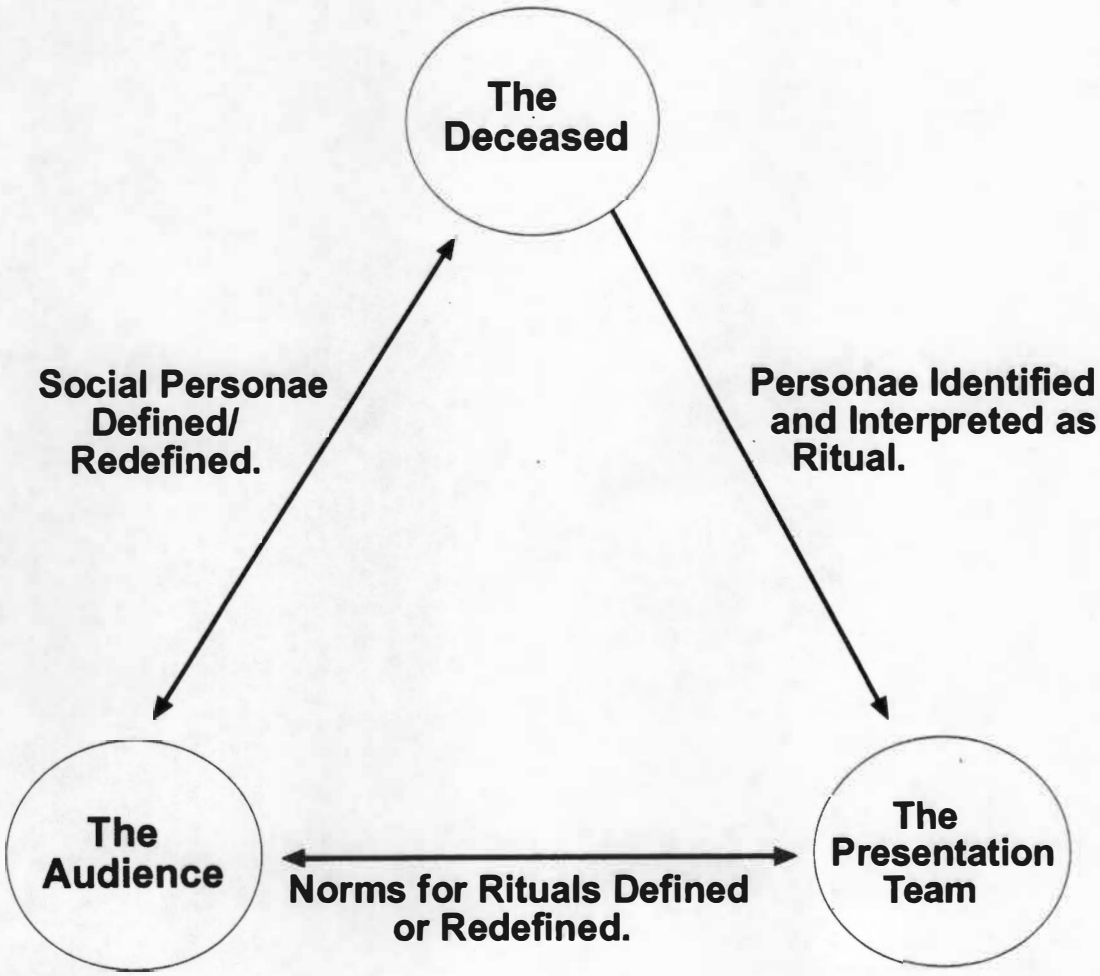


Figure 2-1. A Model of Mortuary Interactions.

Mortuary rituals focus on the deceased. Many aspects of the deceased's place in the community define how mortuary rituals are carried out. Despite their non-living status, the dead are principal figures in a mortuary ritual. The deceased's direct impact on the mortuary ritual form is largely limited to actions occurring prior to the death event. Throughout their lives, the deceased assemble materials and social qualities that are made available to the presenters for interpretation. However, because the deceased are incapable of interacting with the ritual, their role in the ceremony is purely a passive one. The deceased frequently are reduced to little more than objects subject to both physical and symbolic manipulation. In this capacity, the physical remains are modified in order to affirm the dead's place in the community's structure.

The Presentation Team

Since the dead are incapable of manipulating how a surviving community perceives them, post-mortem image control is assigned to a presentation team (Goffman 1959:77; Hall 1980:12). These individuals ensure that the audience has interpreted relevant aspects of the deceased's social persona and that a culturally appropriate mortuary ritual is provided. Presentation teams invariably act as social mediators – they evaluate the dead's social qualities, suppress those that are irrelevant or uncomplimentary and symbolically emphasize important and positive social qualities within the range of acceptable cultural responses (O'Shea 1984:10). They accomplish this transformation through body preparation, through participation in the ritual, and through application of the appropriate post-interment behaviors.

Members of the presentation team are defined as living individuals whose actions influence how the deceased are interpreted. They assume this role until their part of the mortuary ritual is complete. In a modern American funeral, the presentation team would include such figures as pall bearers, clergymen, florists, spouses, children and other family members, seamstresses, eulogizers, and woodworkers, as well as funeral directors and their accompanying staff. Presentation team members provide labor, capital, status or experience to some aspect of the mortuary ritual. They are often identifiable by distinct dress and/or behavior; these features help the audience identify what specific role each participant is playing. Membership in a presentation team is not an exclusive

classification. Frequently, members of the presentation team can also act as audience members, relative to where participation in the mortuary ritual has occurred and what the team member's duties entailed during the course of funerary events.

The Audience

The audience is composed of people who interpret the burial ritual, but do not formally participate in its execution. The duty of an audience member is to observe mortuary displays and judge whether to accept how the dead are presented as part of the surviving community's heritage.

Like the presentation team, distinctive clothing or behavior may identify audience members. While audiences are usually present during a funerary event, they do not have to observe the whole ritual, nor do they have to be present during mortuary performances. Since material aspects may be used to convey meaning, audience members include people interpreting the mortuary setting after the ritual is completed.

Despite their seemingly passive role in the mortuary ritual, audiences actually define how mortuary rituals are accomplished. While presentation teams apply meaning to social qualities, audiences decide whether the rituals successfully portray the deceased in meaningful manners. The adoption of variations in presentation and meaning are largely based on whether the audience accepts or rejects the new form as a reasonable funerary symbol.

Role Interaction

Mortuary rituals are composed of integrated ideas generated by three distinct sets of actors. The interaction of these participants determines the range of presentation given to a particular mortuary ritual. During life, the deceased accumulates social qualities and roles based on the audience's interpretation of the subject's physical and social characteristics. At the time of death, a team of presenters evaluates and interprets the dead's place in the community through a series of presentations, behaviors, and other ritualized activities. There usually are a number of ritual behaviors within each cultural system's repertoire,. However, the norms for what is appropriate are based on what the audience feels is applicable to a given situation. Performances by the presentation team to the audience attempt to apply an idealized view of the deceased that is

complementary to both the dead and the community. Application of these attributes to the dead by the audience enables the deceased to be cognitively transformed from a living to a non-living component of the community's social matrix.

Social personae identify community values. By defining how the dead fit into a social matrix, the community reaffirms its cosmology, identifies important social constructs, and defines where individuals fit into its organizational plan. The dead are largely organized according to how the community views itself. When examining mortuary features, an analyst is essentially examining community perception. What is presented is not a literal portrayal of community structure, instead mortuary features convey a more ideological perspective of the community. Variability in form serves a dual purpose – it informs an audience about both the individual and the community through a veil that enhances important social values.

General Sequence of Events

Human responses to a death event are rarely limited to a single presentation. More often, they form a sequence of events. Death causes a disruption of cultural routines. Loss leaves a social void requiring a period of adjustment within the surviving community. Ritual presentations are not instantaneous, but some aspects do tend to be performed soon after the death event. Reactions to a death event can occur at any time prior to, during or after the actual experience. As a result, the behaviors and parties associated with each phase of the cultural response to death are not the same. Most mortuary rituals follow five phases of mortuary activity (Figure 2-2).

Phase I: Pre-mortem Funerary Events

People can frequently recognize death as the likely outcome to a stress event and can predict the need to perform mortuary rituals. Death events do not have to occur in order for ritualized mortuary behavior to commence. Preparation for death can occur well before the death event's actual transpiration.

Pre-mortem funerary events mostly represent preparatory measures accompanied before the victim is actually faced with a lethal crisis. They may be initiated, directed and accomplished by

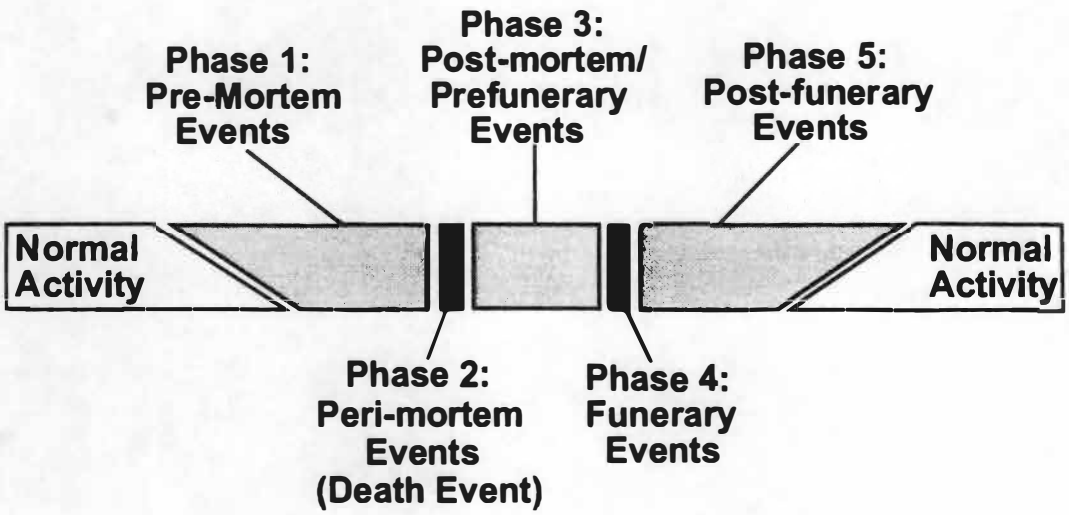


Figure 2-2. General Sequence of Mortuary Related Events.

the (soon-to-be) deceased or members of the presentation team[1]. Preparatory measures may include such activities as choice and construction of a burial facility, appeal to the culture's appropriate supernatural forces, acquisition of a desired burial costume, and clarification of rights and duties among the survivors. During this phase, the victim does not specifically assume the role of the "deceased" and may engage in presentation team-like roles or actions. Involvement of the victim as part of the presentation team is a unique feature of this phase.

Phase II: Peri-mortem Funerary Events

As death nears, many cultures participate in rituals designed to ward off or prepare for the death event. In American mortuary rituals, the application of final absolution, assemblage of the presentation team, and the death vigil are examples of peri-mortem funerary events. This period is highlighted by ritualized behavior and performances aimed predominantly at the (soon to be) victim. In such cases, the role of deceased (instigator of the ritual) and audience (those who interpret the ritual) may be one and the same. Rites would be recognized as performances made by members of the presentation team. Peri-mortem funerary events are differentiated from the pre-mortem events by the victim's clear assumption of a deceased or near deceased social role. During Phase II, certain members of the presentation team assume new or additional roles that may not be part of their normal repertoire.

Phase III: Post-mortem/Prefunerary Events

Most ritualized mortuary activities occur after the death event. Between the time of death and performance of the community presentation, there is a period where the presentation team becomes the primary focus of mortuary related behavior. These activities focus on completing preparations needed to accomplish the appropriate presentations and preparing the dead for final dispensation. Unlike earlier phases, the dead are no longer contributing elements to the presentation team; instead, they are assigned to the more passive "Deceased" role.

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[1] Sometimes victims can initiate preparations, but use of these preparations in the post-mortem ritual is still under the control of the presentation team.

During this phase, members of the presentation team, including the immediate survivors, are expected to shed some of their pre-death event social roles and assume a more mortuary influenced behavior pattern. In the American culture, for example, a "wife" is expected to become a "widow" at the loss of a spouse and behave in a manner fitting for that role. Likewise, survivors and members of the presentation team may be expected to surround their environment with the appropriate symbology. These symbols communicate that a death event has occurred in the community, where the event occurred, and frequently, who died. Occupation of a 'death attired' environment also associates mortuary ideology with the surviving group. In nineteenth century America, environmental alterations included stopping clocks at the time of death, reversing mirrors, tolling bells, drawing shades in the home, and donning black attire (Crissman 1994; Hillerman 1980; Lott 1995; Shields 1977).

During Phase III of the mortuary event, the surviving community arranges the funeral. One important aspect of this is body preparation. The dead's mortal remains act as a communication vehicle capable of physical and symbolic manipulation. Death rarely leaves the human form in a manner acceptable for presentation in a funerary event. If the corpse is used as part of the funerary ritual, it is frequently modified to reduce the impact of morbid disfigurement or deterioration and to aid in the corpse's association with other mortuary symbols. Among modern American funerary customs, body preparation would include arrangement of the limbs and closing the dead's eyes to provide the appearance of sleep, embalming or the application of makeup to mask decomposition.

Phase IV: The Funeral Event

Funerals are more than simple memorial ceremonies, they are designed to symbolically transform the deceased's place among from the world of the living to that of the dead. This transpires in a manner that the community believes will reduce social disruption. From a more functional view, funerals provide a means of reestablishing social networks, emphasizing a community's religious or philosophical doctrine and reaffirming the deceased's place within the community (Haberstein and Lamers 1985).

Funerary presentations are performances conducted by the presentation team for an audience. They require the deceased to play a passive role and the audience to interpret the presentation team's efforts. Unlike changes to the presentation team's environment, which are designed to communicate information about the death event, funerary environments link symbols and ideas with the dead. Size, color, shape, orientation, and location are all aspects of the funerary environment that can be used to convey symbolic meaning. Relative to the culture and circumstances surrounding a given death, rituals occur in specially designated areas or in more commonly used locales. Features within these locales may be emphasized prior to the actual funerary event to ensure effective communication of the presentation team's delivery.

Frequently funerary presentations occur more than once. The dead may be memorialized in one location and a separate ceremony held elsewhere. Among societies practicing some form of inhumation, the burial site tends to be one of these ritual foci. Construction of a grave facility manipulates physical components of the gravesite, providing an opportunity to enhance material symbolism. Features, such as location relative to other interments, orientation of the grave, depth of the facility and choice of burial area are commonly used to symbolically communicate messages to the funerary ritual's audience.

Funerary rituals often present the dead's physical remains to the community. In order to facilitate an audience's ability to associate the dead with appropriate mortuary symbols, dress is an essential component of the body preparation. Hillerman (1980:92) notes that the dead are frequently clothed in specially made or conserved attire, designed to enhance the deceased's appearance and define their role in the funeral ritual.

Associating the dead with material objects can convey additional meaning. Many objects support their own cultural meanings and when placed with the dead, these meanings emphasize the dead's social qualities. Offerings made to the dead frequently emphasize social ties and obligations between the dead and the surviving community. The use of containers to hold the body, such as coffins, caskets, mats or grave liners help hide the natural processes of decay, aid in transport of the

dead, separate the deceased from soil used to fill a grave, as well as provide an additional means of burial display (Gittings 1984; Lang 1984).

Phase V: Post-funerary Events

Obligations to the dead frequently do not end with completion of funerary rituals. Members of the presentation team may maintain funerary roles and the community may recognize those places, objects, names and ideas associated with the dead cannot be utilized in the same manner. These deviations away from pre-death event behavior are multi-factorial. They are designed to allow for periods of community adjustment, reduce the threat of death from contact (both physical and spiritual) with the dead's materials, and serve as a means of emphasizing the messages conveyed in the funeral ritual. The principal figures present during post-funerary events are the presentation team and the audience.

As noted, social affirmations of community ideals are largely expressed during the funeral ritual. However, the audience receiving this information is limited to those who attend the ceremonies. A much larger audience is available if funerary ideology is communicated over a broader period of time. One effective means of accomplishing this is through the implementation of permanent visible symbolic communication tools in the funerary context (Bell 1990:69). Perhaps the most recognizable means of communication across time are objects placed at the grave's location. Such objects, including gravestones, decorations, vegetation and offerings, do more than identify the grave's presence, they serve to perpetuate ideas associated with the deceased's social persona. Their presence on the surface enables audience interpretation for as long as the objects remain present.

Chapter 3. Organizational Properties in Mortuary Ritual

One of Anthropology's concerns is the type of information most commonly conveyed through material symbolism. These vehicles of expression provide the most direct means for understanding how cultural groups perceive their place in the social environment. An historical overview of funerary symbolism investigations reveals what agents are known to affect mortuary variability.

Early Approaches

The association between the dead, aspects of their life, and mortuary variability first appeared as an underlying assumption among mid-nineteenth century writings (O'Shea 1984:3). Most early approaches to the subject generally stem from observations made or discussed by ethnographic researchers (c.f., Bushnell 1920:146-148; Hertz 1960:82; Van Gennep 1960:146; Yarrow 1881:5). These analysts recognized that most cultures employed several different types of mortuary ritual. Individual components or burial traits were rarely unique to a particular community. These analysts treated funerary polymorphism from a single social dimension, namely religious affiliation (Bartel 1982:33-34; Binford 1971:7).

Bartel's (1982) review of the subject recognized the archaeological investigation of mortuary variability as an offshoot from nineteenth century examinations of human religious beliefs. Post-funerary rituals, such as ancestor worship, were also tied solely to a culture's religious doctrine (Maine 1883:116). Sir John Lubbock was one of the first to break from this tradition. He noted that burial treatment was not driven by religious philosophy, rather that it was also affected by the deceased's age, sex, and social status (Lubbock 1882:49-52, 283-286). Lubbock and his contemporaries viewed mortuary variation as single dimension correlations between one of the deceased's social features and some form of mortuary representation (Bartel 1982:36-37). This normative approach to mortuary data prevailed through much of the late nineteenth and early twentieth centuries. While variabilities were recognized and associated with social features,

mortuary data was viewed more as an approach to human philosophies than as a means of studying organizational properties.

Kroeber rejected the concept that mortuary practices were dependent on basic biological and social needs (Kroeber 1927:314). His examination of California Native American mortuary practices found that mortuary traits corresponded very poorly with the distribution of other cultural traits (including other mortuary practices). He suggested that the same agents (namely contact and diffusion) that spurred change in other aspects of these cultures did not drive mortuary variability. This rejection of uniformity in cultural change was one of the first suggestions that mortuary behaviors may be dependent on their own form of social change. Kroeber tended to view mortuary features as 'unstable' cultural traits. He felt that they occurred in the same randomized manners associated with changes in fashion. While Kroeber acknowledged that specific methods of disposal could be related to the deceased's social qualities, this was not an important component of his thesis.

Other twentieth century anthropologists turned to cultural-sociological approaches as a means of inquiry. An examination of mortuary rituals as assemblages of social roles and personalities enabled Radcliffe-Brown to recognize mortuary behavior as an instrument for overcoming the hardships introduced by a death event (Radcliffe-Brown 1964:285, 297). Examinations from the functionalist paradigm stressed that variation in mortuary behavior could not be seen simply as random fluctuation, rather that these differences helped to fulfill some forms of social need.

Radcliffe-Brown's analytical concepts provided the theoretical framework for later anthropologists like W.H. Goodenough (1965) to formalize ritualized behavior and view it in terms of discrete individual human interactions. Goodenough's work suggested that by decomposing activities into distinct roles, sets of rules governing these behaviors could be obtained. Firth's (1967:352) application of role analysis recognized that the ideological concepts imbedded in mortuary ritual actually had their foundations in the culture's organizing principles. Mortuary rituals were seen as a way of coping with death according to a culture's perceived place in the universe.

These ideas implied that basic organizing principles might be deduced from a study of mortuary rituals.

The importance of social variables as a means of explanation in mortuary analysis did not arise until the 1960s and 1970s. One of the most influential contributions of this period was a symposium entitled "The Social Dimensions of Mortuary Practices", sponsored by the American Anthropological Association at its annual meeting in 1966 (Brown 1971:1). Participants recognized that social qualities of the dead were responsible for many variations in mortuary expression. Presentations focussed on mortuary data recovered from a host of different cultural contexts. Evidence was provided indicating that age, sex, and status[1] associations could be established among a number of variations in mortuary facilities. Subsequent publication of the symposium in 1971 emphasized that these variables were not only recorded in the archaeological record, but could also be used to interpret critical aspects of the surviving community's structure. The studies outlined in this book provided the foundation needed to enable many anthropologists to use mortuary data as an avenue towards social reconstruction.

Ethnography and the Binford-Saxe Approaches

Louis Binford's (1971) submission to the 'Social Dimensions' symposium was an important landmark in mortuary analysis. Binford systematically defined the relationship between variability and social structure in a manner conducive to archaeological analysis. Binford felt that the traditional notion of trait list comparison was simply a means of manipulating data without really processing its meaning. He advocated that the structural components generating feature variability needed to be recognized.

Binford turned to the ethnographic record to look for regularities in the way rituals varied. He questioned whether Kroeber's assertion, that mortuary practices did not vary in a predictable

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[1] Several ideas are applied to the term 'status'. Blau's (1977:8) view that status is any social concept where humans are placed in a ranked order was adapted for this study.

manner, was true. His survey of world wide mortuary practices was able identify that several agents were responsible for a considerable number of mortuary variations.

Binford (1971:11) argued that variation in mortuary practices within a single community resulted from three fundamental sources – environmental effects on the death event; replacement of the ritual by other forms, and most importantly, the deceased's relationship with society as reflected in their social personae. Specifically, recovering information on this latter agent was an important means of social reconstruction. Binford (1971:14) identified age, sex, social rank, social affiliation, and death event circumstances as important influences on mortuary representation. While these ideas were certainly not new to Anthropology, Binford's work was a major step towards formalizing the relationships between mortuary influences and mortuary variation.

Establishing patterns in mortuary variability provided grounds for rejecting Kroeber's instability hypothesis. In particular, Binford found evidence that burial form could be understood in terms of community subsistence patterns; among hunter-gatherers, age and sex were determined to be primary agents of mortuary variation, while social position was a more sensitive discriminant among more agriculturally based cultures (Binford 1971:20). In general, Binford recognized that as modern cultures became more complex, mortuary variation would likewise increase.

The prospect of social reconstruction from mortuary data led many analysts to consider the degree of social detail available, particularly if archaeological data was supplemented with ethnographic analogies. The traditional trait list approach to identifying mortuary variability required two assumptions; first, that the meaning behind material symbolism was the same if the expression was similar and second, that the compared sets of data were collected to the same levels of detail. What was not commonly recognized was that ethnographic descriptions were often second hand accounts based on a small number of observations. These accounts frequently lacked the detail needed to determine whether undescribed features were truly absent or simply overlooked (O'Shea 1984:21-22). Additionally, when a polymorphic expression, such as form of body disposal, was found in two different mortuary programs the meanings attached were rarely identical. Without an

examination of the social context, it was difficult to ascertain whether polymorphic expression meanings were the same.

Uko (1969) placed little faith in mortuary based ethnographic comparisons. He felt that at best:

> Careful use of ethnographic data has served to do one major thing -- to represent the possibility of varied and heterogenous reasons or causes for a practice. As far as I am concerned, the use of ethnographic parallels can only in very exceptional cases suggest a one-to-one correlation between the acts of Tribe A and the remains of culture B, but what they can do is to suggest the sort of possible procedures which may result in traits characterizing culture B (Uko 1969:262).

Lack of definitive social, temporal, and cultural relationships between communities with similar mortuary variables reduced the validity of applying one assemblage's social meaning to other groups.

O'Shea's (1984) analysis of six Native American societies from the Central Plains represented one of the few studies able to overcome these hardships. His results indicated that accurate social reconstruction can be obtained from mortuary data. However, some dimensions of variability between organizations were decidedly more visible than others (O'Shea 1984:250). Less visible distinctions known to exist between groups, such as clan affiliation, were believed to be a product of expression through perishable material symbols (O'Shea 1984:252). Ethnographic examination of the mortuary ritual emphasized that accurate, albeit incomplete, interpretations of social perimeters were possible from archaeological data, given that some understanding of the community structure was known.

A refined formalization of the relationship between mortuary variables and social features was outlined by Arthur Saxe (1970). Saxe rejected the perception of a cemetery simply as an assemblage of deceased community members. He argued that burial grounds represented collections of social personae arranged by distinct definable sets of cultural rules (Saxe 1970:4). Saxe shifted focus away from the individual grave or burial practice and centered attention primarily on the cemetery or burial accumulation area.

Saxe decomposed the structural components of a mortuary ritual into its fundamental social interactions as a means of establishing a behavioral foundation for patterned variations in mortuary features. Following the work of Ward Goodenough, Saxe viewed mortuary behaviors as rule bound and thus capable of definition through structural linguistic models.

Saxe generated eight hypotheses which model the manner in which mortuary representations were believed to be distributed (Table 3-1). The first four hypotheses related to the arrangement of social personae within a community and mortuary program, while the final four focussed on how well social organizational properties were represented in mortuary programs. Application of these hypotheses to four ethnographically described populations found overwhelming support for the modelled arrangement between social personae and aspects of the mortuary program. Patterned variation in burial features tended to relate to different aspects of social identity. Each combination of burial features represented distinctly different social personae.

While this clearly is an important contribution, it has limited archaeological value. Tainter (1978:118) observes that when applied to archaeological data, Saxe's formal analysis tends to downplay commonality between burials and emphasize the unique or idiosyncratic features found within the mortuary assemblage. The Saxe approach is capable of defining the range of variables and any associations between them, but the meaning behind each form is not defined, leaving the analyst to subjectively deconstruct patterns within the data and assign meaning based on other information. Empirical methods of attaching specific social personae to a group of features are still lacking.

Cross-cultural analyses of Saxe's social structure-burial program hypotheses have provided minimal or inconclusive support. As noted earlier, Saxe's analysis contained only a few ethnographic cases. His results indicate that these relationships could not be explored conclusively from a population of four cultures and that this form of investigation required a very large sample size.

Despite these issues, Saxe's work provided an important backdrop for organizational reconstruction -- he found evidence that much of the patterned variation found in mortuary data was due to social factors. Analysts uncovering patterned mortuary behavior could thus be assured that,

Table 3-1. Saxe's Mortuary Representation Hypotheses.

Hypothesis No.	Hypothesis
1	"The Components of a Given Disposal Domain Cooperate in a Partitioning of the Universe, the Resultant Combinations Representing Different Social Personae" (p.65).
2	"In a Given Domain, the Principles Organizing the Set of Social Personae (Produced by Cooperative Partitioning of the Universe of Disposal Components) are Congruent with Those Organizing Social Relations in the Society at Large" (p.66).
3	"Within a Given Domain Personae of Lesser Social Significance Tend to Manifest Fewer Positive Components in their Significata Relative to Others, and Conversely" (p.69).
4	"The Greater the Social Significance of the Deceased the Greater Will Be the Tendency for the Social Persona Represented at Death to Contain Social Identities Congruent with that Higher Position at the Expense of Other (and Less Socially Significant Identities) the Deceased May Have Had in Life, and Conversely" (p.71).
5	"The More Paradigmatic the Attributes Evidenced in the Key Structure of the Domain, the Less Complex and More Egalitarian the Social Organization. Conversely, the More Tree-like the Attributes, the More Complex and the Less Egalitarian the Social Organization" (p.75).
6	"The Simpler a Sociocultural System the Greater Will Be the Tendency for There to be a Linear Relationship Between Number of Components in Significata, Number of Contrast Sets Necessary to Define Them, and the Social Significance of the Significata; and Conversely" (p.112).
7	"The Simpler the Sociocultural System the Less Divergence Will Be Evident in the Treatment of Different Kinds of Deviant Social Personae, and Conversely" (p.118).
8	"To the Degree that Corporate Group Rights to Use and/or Control Crucial but Restricted Resources are Attained and/or Legitimized by Means of Lineal Descent from the Dead (ie, Lineal Ties to Ancestors), Such Groups Will Maintain Formal Disposal Areas for the Exclusive Disposal of Their Dead, and Conversely" (p.119).

Source:
Saxe, A.
1970 *Social Dimensions of Mortuary Practice*. Unpublished Ph.D. Dissertation, Department of Anthropology, University of Michigan, Ann Arbor.

barring environmental and circumstantial factors, mortuary variations were related to organizational features in the depositing community. Braun (1981:411) notes that Saxe demonstrated:

> ..that the mortuary ritual program of a society constitutes a system of symbolic communication, serving as a cultural mechanism for affirming and reinforcing the continuity of social orderliness.

While not specifically outlining how mortuary practices are organized, Saxe does provide a foundation for other analysts to explore specific mortuary systems from a firmer theoretical foundation.

While the Binford-Saxe approaches provided the background needed for social interpretation, their examinations did not extend to mortuary data preserved in the archaeological record (Hofman 1986:18). Other analysts established that the archaeological record was generally in agreement with the model of social complexity. Rothschild's (1979) examination of mortuary variability in the mobile communities represented at Indian Knoll and more sedentary groups from Dickson Mounds, not only supported Binford's model, but also demonstrated that pattern variances were detectable archaeologically. Braun's (1979) exploration into Middle Woodland mortuary rituals indicated that age and sex biases favored adult males. His also found evidence of ascribed rank in these mortuary deposits. Pearson et al.'s (1989) consideration of Korean elite burials and Scott's (1983) examination of Mississippian burials at Toqua indicated that segments of the community could be subjected to this form of analysis, too. Mainfort (1985) distinguished patterns of individual wealth and status within a single historic Native American cemetery.

Application of social reconstruction to Mississippian cultural deposits validated that elite and non-elite social divisions were a pan-Southeastern United States social phenomenon. Peeble's (1972) examination of Moundville Phase sites in Alabama indicated that grave location and inclusion of artifact forms communicated rank, age, and sex differences between community members. No less than eleven distinct mortuary variable clusters could be distinguished, suggesting that a complex hierarchial structural arrangement was used by the Moundville chiefdom (Peebles 1972). A similar examination of Dallas Culture mortuary rituals by Hatch (1976) indicated that different assemblages

of mortuary variables (and hence cluster arrangements) created the same general structural configuration as seen in Moundville.

Energy Models

One of the inherent problems associated with the Binford-Saxe approach to mortuary variation was a lack of common denominators. While a variety of features and objects were associated with status in a community, these variables are limited to categorical approaches. In most situations, where status was expressed in a mortuary setting, anthropologists noticed that individuals with greater social rank tended to be endowed with finely crafted goods, specialized burial facilities or both (O'Shea 1984:45; Peebles and Kus 1977). Assuming that the association between mortuary variability and social rank is represented by a single variable, Tainter (1976, 1978, 1981) argued that the amount of energy expended in completion of a mortuary event was reflective of the deceased's rank in a society. This was approximated archaeologically by assuming that durable mortuary variables were a representative sample of variants available to the deceased.

In theory, Tainter offers the analyst the opportunity to cross such analytical barriers as time, location, culture and the artifact's material qualities and then examine grave differences as a common unit of measurement. To date, however, the approach is still more theoretical than applicable. One of the principle problems with the energy model is the ability to recognize energy expenditure and measure it equally. Tainter's hypothesis is as much a physics as an anthropological question. It is based on knowing how much energy it takes to complete a task. At best the quantitative application of Tainter's work applies subjectively defined levels of energy to an ordinal scale on a very limited number of mortuary variants. These results, however,

do suggest that energy expenditure and social rank are likely associated (Tainter 1976:96; 1978:135).

Another problem with this model is energy attribution. In Tainter's model, the energy represented in a mortuary setting is considered a reflection of the deceased's status. Hofman (1986:20) argues that this incompletely represents mortuary energy allocation. In communities

employing mobile lifestyles or long distance task forces, the energy expended to inter the dead may only represent the distance between place of death and that of interment. Energy expenditure is not purely an agent of social rank. Likewise, circumstances of death including death at a distant or unapproachable locale, morbid injury from fire or mutilation by aggressors can produce variations in energy expenditure that have little to no bearing on the deceased's standing in a community. Goldstein (1980:56) ponders whether the energy used to express one rank is proportionately equal to or greater than the energy needed to attain a higher rank. These shortcomings in Tainter's model have not been addressed.

Mobility as a Confounding Factor

Prior to the mid-1980s, most analysts searching for agents of mortuary variation focussed on communities following some form of sedentary lifestyle. Very little attention was paid to mobile groups or populations demonstrating relatively low degrees of social complexity. When applied to mobile populations, Hofman (1986) found that sedentary based models of mortuary variation were incapable of accounting for substantial variation. Minimally, Hofman (1986:54) felt that at least two more agents were responsible for mortuary variation. Organizational variability and resource fixity were needed to correct the model for differences in community mobility.

Hofman noted that there were survival advantages to increasing or decreasing population density with the availability of resources. Sedentary cultures tended to focus on extracting resources that were available at any time or in quantities that enabled populations to remain at one place for long periods of time. This lack of mobility congregated both populations and opportunities for death events around resource nodes in the community's catchment area. Variations in location and distance between mortuary areas reflected a greater degree of the community's structural components.

Among more mobile populations, resource availability is not spatially or temporally constant. As a result, populations and death events are distributed throughout the catchment area according to time, availability, and magnitude of the resources available. When inhumation is practiced, the

distribution of graves and their form is less a function of organizational structure and more a factor of when and how resources are available. Hofman advocates the inclusion of resource fixity, the spatial and temporal distribution of key economic resources, as a key agent of mortuary variation.

Closely linked to resource fixity is a community's organizational variability. Given a sedentary population in a catchment area, community organization remains constant (i.e., will not undergo drastic/periodic change in size and structure). Relative to this feature, ritual morphology is also expected to remain constant. Among mobile populations, however, there are survival advantages to increasing or decreasing population density with the availability of resources. When a death event occurred, the ritual given to the dead would not be equal at all points in the organizational cycle. Individuals received variable burial location, body treatment and social recognition relative group structure at a given moment. While ritually patterned within the given socio-environmental context these variations contrast those observed in rituals performed at other points in the organizational cycle. It is important to recognize that multiple mortuary rituals are likely among groups whose organizational structure fluctuates during burial accumulation periods. To account for this variability, an understanding of the community's organizational structure throughout the accumulation period is needed.

Hofman's additions were designed to make the mortuary model applicable to a wider range of cultural forms. The addition of resource fixity to the model required the identification of critical resources available to a community and that their predictability be ascertained. Likewise, organizational variability was designed to correct for patterned instability in the social structure. Groups whose organizational structure did not remain constant through the accumulation period were likely to utilize different mortuary features, relative to group size and structure available during mortuary events. This variable emphasized that patterned differences in mortuary rituals will not appear patterned until corrections for group structure during the mortuary event are taken into account. In essence, organizational fixity was a means of correcting for variation in a feature that is nearly constant in sedentary populations.

Idiosyncratic Mortuary Variation

Most of the variation discussed relates to patterned forms of mortuary behavior. However there are very few, if any, mortuary rituals where structured diversity accounts for all material differences. Some variations are unique or rarely represented, indicating that mortuary rituals are not wholly standardized.

Keesing (1984:54-57) notes that religious, symbolic and cosmological knowledge is unevenly distributed among community members. Instead, information tends to be circumscribed to discrete groups or individuals within the community. Variations emerge as different ritual specialists interpret performance guidelines. Differences in interpretation can conclude with two or more distinct variants reflecting the same meaning. An example of this variation is seen in the variety of crosses found in a Christian cemetery. Despite their stylistic variations, Christian affiliations are attached to each style.

Among non-specialists less formal and more personalized relationships between the living and the dead are expressed. Fenton (1991:145-148) argues that these manifestations are rarely organized in a cohesive manner, creating an array of unrelated, highly variable mortuary features. An example of this that I am personally familiar with involves my grandmother's insistence that opal jewelry was included with her deceased daughter's burial attire. The choice of this stone by my grandmother (Mrs. Opal P. Porter) was done to symbolize the close relationship between mother and daughter. In Early Woodland assemblages, Fenton (1991:303) argues that the representation of some skeletal elements in burial mounds is a reflection of idiosyncratic variation. These symbol-based variations represent intentional acts designed to provide meaning where meaning is either vague or culturally undefined.

Biology and Organization

Kinship is a feature that commonly influences the distribution of human actions. The incomplete documentation of a culture found in the archaeological record and wide range of cultural manifestations interact to reduce most archaeological interpretations of kinship to highly questionable

opinions (Allen and Richardson 1971:51). Another approach to this question of social organizational properties in mortuary data is to examine genetic associations. These methods are based on the genetic component of morphology. Individuals possessing a common ancestry frequently display common sets of genetic features (Sjovold 1984). Concentrations of these features in a mortuary assemblage indicate the degree of relatedness between individuals. Contrasting relationships between male and female interments can then indicate residence pattern (assuming that residence was a major determinant of burial location), (Konigsberg 1988).

Lane and Sublett (1972) examined the distribution of non-metric skeletal features in an attempt to understand residential aspects of historic Seneca Native Americans. When considered against ethnohistorical data, patrilocal kinship clusters could be defined among five regional cemeteries. More recently, several analysts used lineal descent groups to test Saxe's hypothesis (1970:119) that discrete contemporaneous formal disposal areas for the dead represent a means of resource control. Goldstein (1976:58) noted that this pattern was not universally employed among modern human cultures. Archaeological examinations by Howell and Kintigh (1996:538) confirmed that discrete contemporary burial areas did demonstrate the presence of distinct descent groups. Kinship patterning was probably used to validate ancestral ties to a particular locale (See Botwick 1997; Glazier 1984:111; Morris 1991).

Genetic analysis has proven to be extremely successful when applied to a number of different mortuary contexts and biological variants (Bondioli et al. 1986; Corruccini et al. 1982; Owsley and Jantz 1978; Spence 1974; Stone and Stoneking 1993). These studies demonstrate that minimally, kinship is a feature affecting where certain community members are interred. Genetic studies also emphasize that status encompasses a wider range of social interactions than just community rank. While analysts do not agree on the proper means to statistically manipulate and interpret kinship data, the methods employed are able to obtain information that is frequently unavailable in any other form (c.f., Corruccini 1998; Howell and Kintigh 1996, 1998; Konigsberg 1988; Roesing 1986).

Post-Processual Contributions

Within the last twenty years, many analysts have moved away from arguments over statistical manipulation of mortuary data and focussed on more theoretical questions (Morris 1991:147). In particular, applications of the Binford-Saxe organizational paradigm frequently treat a cemetery's organizational properties as absolute manifestations of social structure and position (O'Shea 1984:3). This view however is not universal. Post-processual examinations of cemeteries reject mortuary organizational properties as literal translations of real world relationships. McGuire (1988:458) argues that ritual symbolism is based on idealized relationships, not actual situations and thus represent a means of political manipulation. Symbolic accentuation of one facet of a personae and de-emphasis of other aspects enable the dead to appear as a more prestigious entity than if both aspects were treated equally (Bell 1990:71). By stressing how the dead are perceived by an audience, a presentation team is capable of using mortuary ritual as a means of maintaining or enhancing power over other community members (Pearson 1982:101). A presentation team can legitimate this change in structure by associating (or disassociating) the dead with previously used mortuary symbols.

At best, these analysts argue that mortuary ritual represent a cultural abstraction of social order. They cannot be translated verbatim. This, however, does not mean that ritual expressions are useless. Organizational properties for the community, not the individual, are still represented. As long as the representation falls within the range accepted by the audience as reasonable, inflation of a persona's social merit occurs within the bounds of community self-perception. These studies of social organization treat mortuary assemblages as collective wholes, able to generate assemblages of structural features, not as detailed descriptions of each social position within a community.

Post-processual studies tend to focus on historic Euro-American mortuary rituals. The richness of detailed information available emphasizes that the relationship between meaning and symbol is not constant. While mortuary symbolism shifts with changes in social ideas (McGuire 1988), the meaning attached to a constantly used symbol is also subject to change. Meaning attached to a form at one time cannot be assumed as equal to another time, particularly if there is

evidence of change elsewhere within the ritual. While not clearly emphasized in the post-processual mortuary literature, control for time is needed to accurately account for differences in ritual meaning.

Despite the potentially complex opportunities for variation to appear in a given funerary event, mortuary programs are patterned behaviors. These expressions do not appear to be random. Rather, they serve as part of a behavioral structure designed to fulfill social needs brought on by a death event. Anthropologists recognize that symbolic expressions have far less to do with the individual's personality or religious-philosophical beliefs than they do with the organization of society and the social personalities that compose it. The expression of social structure is not represented authentically, instead it appears to be more a reflection of how the sees itself (or wishes itself to be seen). Mortuary rituals, therefore, are fundamentally social constructs whose meaning reflects a given cosmology. Variations in form serve as a means of communicating different details about the group's relationship with the world around them.

Schulting (1995:7) recognizes that processualist and post-processualist approaches are not mutually exclusive sub-paradigms. They differ only in terms of the emphasis placed on information content, not whether social information is present at all. Not all aspects of the information content in mortuary expression are presented equally. Some segments of the worldview are clearly more prone to symbolic communication than others. Those agents defining an interaction between the individual and the community or the community with the surrounding physical and social environments appear to be the most susceptible to more detailed forms of symbolic communication. While the relationships are far from adequately understood, it is evident that mortuary variability may be modelled and that some variables probably represent commonly expressed agents.

Pader (1982) has argued against the use of modelling in mortuary analysis because models assume that ritual participants will universally abide by the model's conventions. Humans clearly do not rigidly follow mortuary presentation traditions, but it is equally unrealistic to assume that individual mortuary behaviors do not follow any line of cultural convention. Models serve as analytical constructs, designed to guide and outline how researchers perceive the operation of a phenomenon

that cannot be scientifically controlled. They should never be considered as finished scientific explanations. Schulting notes:

> ...the archaeological record is largely the result of group rather than individual behavior (See Hayden and Cannon 1982), the sum of individual actions are amenable to generalizations which help "explain" these behaviors...they [models] expose underlying rationales that are valid cross culturally (1996:6).

Therefore, models should be used to help define social or group mortuary expressions, not individual mortuary representations.

So what agents appear to be major contributors to variation in mortuary rituals? To date, anthropologists identify no less than seven general agents contributing to differences in funerary presentation (Figure 3-1). There are innumerable, frequently inter-connected types within these agents. For example, the mortuary expressions may define the dead by sex ('a male'); by sex and age ('a man'); by age, sex and status ('an uncle or rich uncle'), or age, sex, status and idiosyncratic variation ('an uncle who always remembers people's birthdays'). These are limited only by the culture's ability to define social aspects in need of expression. In this model, variables are not mathematically associated with one another. This is because the relationship between one particular mortuary feature and its agents are not independent (or the same) as in another feature. Material Expression-Agent Relationships are also not discrete; multiple agents can easily contribute towards a given expression or even several expressions.



Figure 3-1 Agents of Mortuary Variability (Modified from Hofman 1986:54).

Chapter 4. Modelling Mortuary Structure

Discrete social personalities are composed of sets containing individual roles. If sets of contemporaneous roles are expressed identically between two individuals, these assemblages represent the same social personality. They would both share the same material symbols. Likewise, different social personalities express dissimilar material expressions. This pattern is roughly equivalent to that described in the material expression-agent relationship (henceforth referred to as the attribute-agent relationship). More importantly, this pattern defines how information is communicated to the ritual's audience. Shared contemporary social personalities are expected to possess shared attribute-agent relationships. Defining social personalities can be accomplished by defining sets of burials containing homogenous attribute-agent relationships.

Perfect Trees and Paradigms

One means of investigating social dimensions in mortuary assemblages is to systematically define the amount of commonality present in the structure. Analysts begin by defining what variations are present among interments. Features that are common among all mortuary structures are recognized as ritual aspects that are available to all members of a community. Variation in mortuary features is evidence that identical mortuary rituals are not provided to all community members. Determining where these differences exist and how they are structured indicates why rituals varied. Perfect tree and paradigm diagrams represent two distinct mortuary structure models.

Saxe (1970:44) notes that in a perfect paradigm; "...a difference in only one value (component) of one dimension is sufficient to change a significatum...into another significatum; perfect paradigms are absolutely redundant". In other words, there is no overlap between variables. Use of certain mortuary expressions, therefore, is exclusive to one meaning in the mortuary ritual. These expressions are not used in conjunction with other forms and use is reserved for specific social personas. In Figure 4-1 observe that different sets of material symbols are distinctly

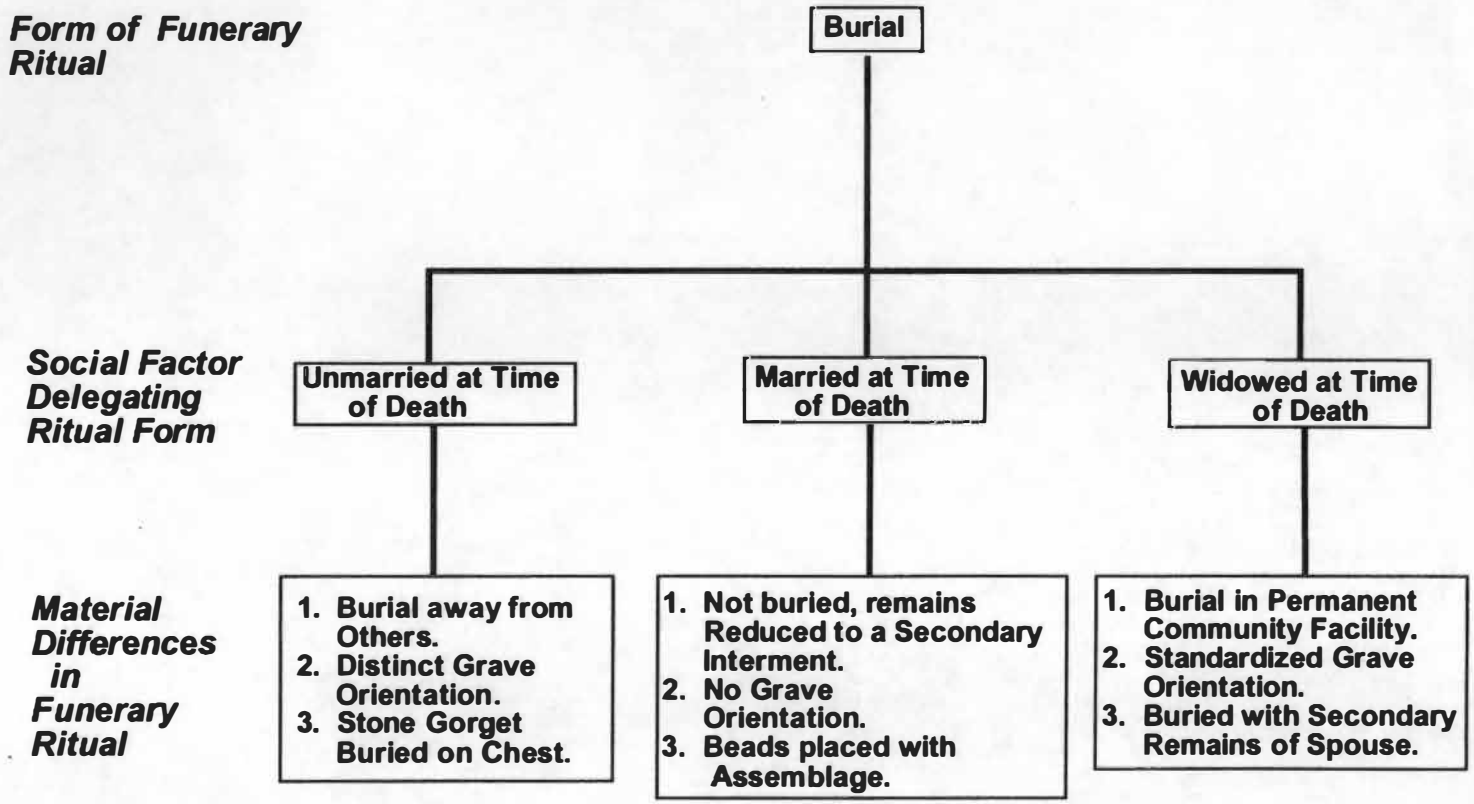


Figure 4-1. A Hypothetical Mortuary Paradigm.

associated with marital status. There is no expression overlap. Paradigmatic symbols are exclusive social indicators; there is only one way to acquire, for example, beads with the dead – be married and die before your spouse. Attributes that indicate differences in funerary practice are described as key features.

Kay (1966:22) notes that perfect paradigms, where exclusive representation results in a complete absence of redundant expressions between significatums, are not common. In many systems there are tendencies towards this empirical construct, but it is rarely achieved. Among human organizations, paradigmatic mortuary expressions emphasize social distinctions that are present within the organization. Goldstein (1980:63) observed that mortuary assemblages showing paradigmatic properties are typical of more egalitarian social structures.

Organizational diagrams that form perfect trees lack exclusive 'sets' of ritual expressions. Attributes in these sets are shared between discrete organizations. What contrasts distinct groups are the unique combinations of expressions against a common background. In terms of mortuary behavior, there are key features in the common ritual whose pooled representation distinguishes social nuances. These nuances discriminate groups from one another. In Figure 4-2, variations in the individual's status and sex are combinable features signifying differences in funerary ritual performed for widows. Interpreting these material differences as a unit communicates real social meaning to the living community.

Differences and similarities in the application of key features indicate that perfect trees are highly repetitive between significatums. Perfect trees utilize only a small pool of potential features to distinguish important social and cultural differences between members of a burial community.

Perfect trees imply highly structured organizations. When a key variable is applied to a tree, there will be a change in one feature that may result in a change in the expression, as well as a retention of existing features. This phenomena enables organizations to use mortuary rituals as a bonding factor by emphasizing social commonality in the material expressions and at the same time express distinction by varying a few features. Like the perfect paradigm, perfect trees are analytical

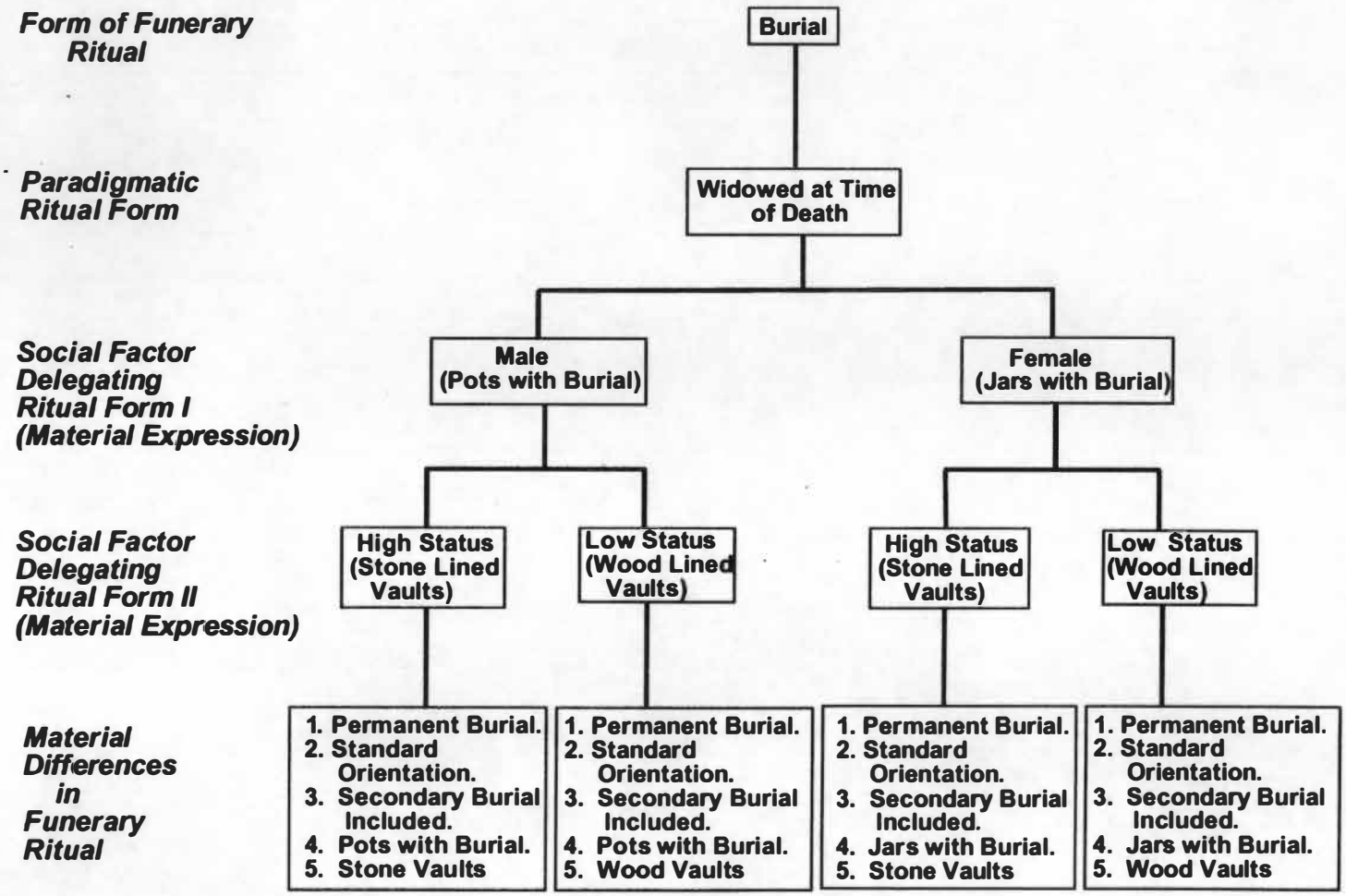


Figure 4-2. A Hypothetical Mortuary Tree.

constructs. Social groups tend towards this expression but probably never actually achieve it. Goldstein (1980:63) associates tree mortuary structures with groups practicing social stratification.

The Single Attribute-Agent Relationship

During a mortuary ritual, the manipulation of material elements serves as an important means of symbolic communication. Mutual understanding is achieved when relationships between the expression and meaning are recognized and then shared by the ritual's actors and audience members. While the precise details outlining each mortuary ritual's expression may not be recovered from archaeological contexts, some rudimentary organizational features can be obtained by a careful examination of the patterning expressed in an assemblage of mortuary rituals. Patterned attribute-agent relationships provide the analyst with an opportunity to recover some of the meaning invested in each symbolic expression.

The attribute-agent relationship is first explored in terms of single attributes. Attributes are defined as the range of values expressed by a variable (Spaulding 1977:4). Mortuary variables are material expressions that possess more than one form and are associated with the funerary ritual. Attributes within mortuary variables would embrace such features as primary and secondary treatments or north and south orientations. Agents refer to factors influencing the expression of variables and attributes. Features such as age, sex, status or circumstances of death represent them. Agents are roughly analogous with statistically independent variables.

Mortuary expressions follow a general model of mortuary variability. In essence, this model defines any form of mortuary expression (or attribute) as an application of specific meaning (or agent). For any given mortuary ritual, material expression is attached to meaning so that:

$$\textit{Expression (Attribute)} = \textit{Meaning (Agent)} \qquad (1).$$

more specifically:

$$V = GASROCI^{1} \quad (2).$$

Without a comprehensive understanding of the culture's mortuary ritual, a thorough interpretation of the meaning behind any single attribute cannot be accomplished. Comparisons between mortuary rituals, however, can provide a means of determining equivalent attributes and agents. Mortuary rituals are considered simultaneous events for this discussion. For meaning to be expressed the same between any two mortuary rituals, then:

$$V_{(GASROCI)1} = V_{(GASROCI)2} \quad (3).$$

In other words, the attribute-agent relationship expressed in one ritual must be the same as expressed in the other. Rituals expressing this association are described as shared, relative to the examined attribute. Shared relationships indicate that similar social circumstances resulted in an expression of similar material forms. An examination of shared relationship groups, each expressing a similar set of meanings and hence similar social personalities, can be used as a means of determining what social personae exist in a depositing community's organizational structure.

Grouping mortuary rituals in terms of shared attribute-agent relationships creates contrasts between like and dissimilar mortuary assemblages. Non-shared relationships are indicative of differences in the input provided by each agent and the manner in which these agents are symbolized.

Differences in contemporary attribute-agent relationships indicate that different social elements are present in the mortuary assemblage. Internally disparate mortuary assemblages can occur in one of three forms; attributes may be different, agents may be different or both may be different.

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[1] Where V=Mortuary Attribute, G=Gender, A=Age, S=Status, R=Resource Fixity, O=Organizational Stability, C=Circumstances of Death and I=Idiosyncratic Agents.

To illustrate this and other attribute-agent relationships, the relationship between high and low status English graves is considered. In general, low status individuals were initially symbolized with building stone gravestones and high status with marble headstones (Figure 4-3), (Cannon 1989; Pearson 1982). With the passage of time, high status is expressed by cremation and low status adopted marble gravestones (See Chapter 5 for a more detailed discussion of these phenomena). The use of cremation among two mortuary rituals to express high status reflects a shared attribute-agent relationship. Dividing this particular mortuary assemblage into groups of shared relationships would succeed in placing both of these rituals into the same group.

Dissimilar Attributes and Agents

If attributes and meanings are not the same within given mortuary expressions, then:

$$V_1 \neq V_2 \quad and \quad (GASROCI)_1 \neq (GASROCI)_2 \qquad (4).$$

In this particular circumstance, separate meanings are conveyed through different material expressions. Among English grave markers, for example, the initial use of building stone to mostly signify low status and white marble to symbolize high status graves resulted in interments with dissimilar sets of attributes and specific agents. Mortuary expressions featuring this type of relationship would be separated into different organizational groups. A similar pattern would also hold true between agents and mortuary variables.

Same Meaning, Different Attribute

Material expression may differ while the meaning is the same. This can be expressed as:

$$V_1 \neq V_2 \quad and \quad (GASROCI)_1 = (GASROCI)_2 \qquad (5).$$

While this phenomenon has not been thoroughly explored, some analysts recognize that variables and attributes have polymorphic relationships with a particular meaning (c.f., Hatch 1976; Mainfort 1985; Ravesloot 1988). Potential candidates for this phenomenon are recognized where the same set of agents makes identical contributions to two different attributes. An example of this can also be illustrated in the English status-gravestone observations. During the transitional period (Phase 2), the definition of low status may be expressed by use of either white marble or by building stone (Figure 4-3). Because material expressions are different, these assemblages are not grouped into

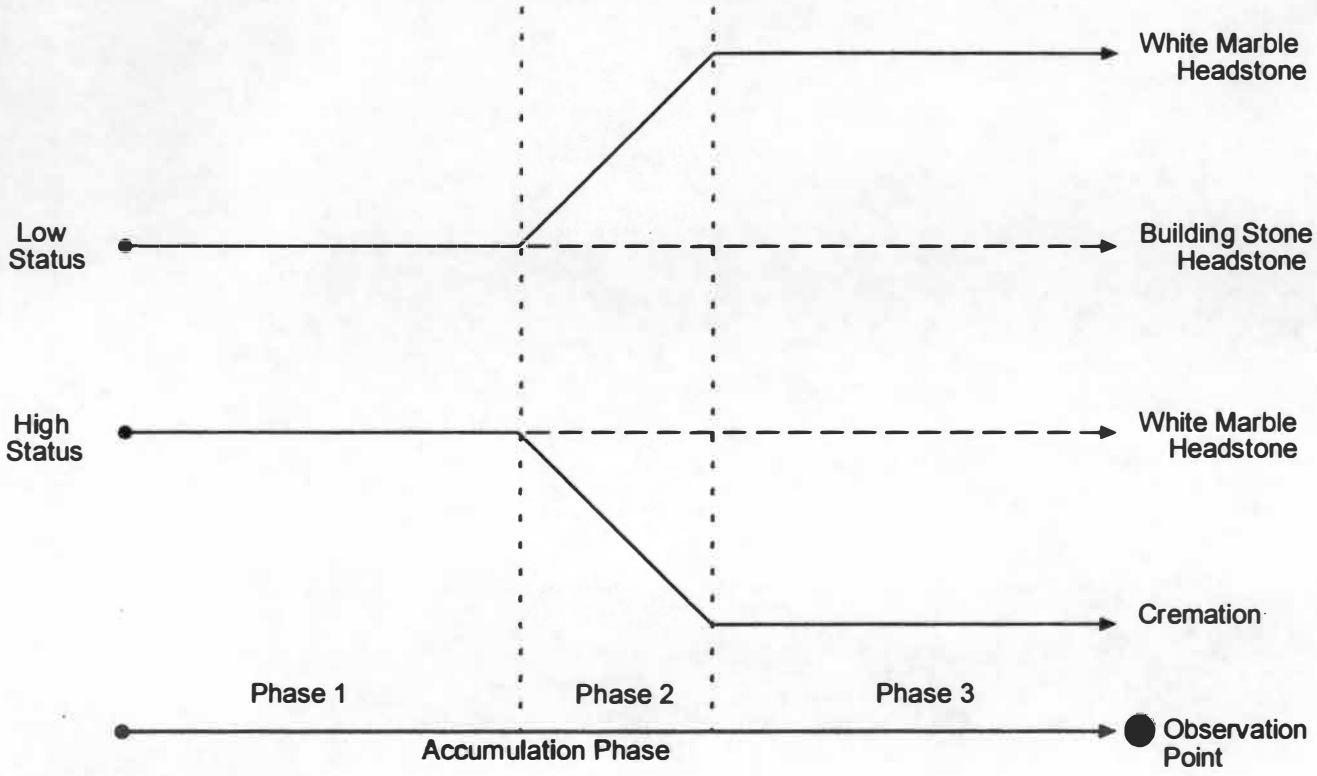


Figure 4-3. The Expression of Status in English Cemeteries.

the exclusive sets. However, their shared meanings link them into a less homogenous, higher order classification (i.e., variable gravestone marker materials = social status). These ritual expressions should not be considered as independent expressions, rather they are components of larger, less precise groups. In this example, White Marble-Low Status and Building Stone-Low Status expressions are grouped under the single classification of low status expressions. In a multiple attribute organizational structure, both attributes would be expected to express comparable levels of similarity.

Same Material Expression, Different Meaning

It is also possible that meaning differs while material expression remains the same. This can be modeled as:

$$V_1 = V_2 \quad and \quad (GASROCI)_1 \neq (GASROCI)_2 \qquad (6).$$

What this case emphasizes is a lack of shared interpretation. Within the community, presentation teams use the same variables to express more than one meaning. Returning to the English example, use of white marble during the transition period may indicate that the deceased was a lower status or a true high status individual -- the material expression relates to how the audience and presentation team chose the rituals to be symbolized. Differences of this nature may be detected as differing agent contributions within the assemblage of like material expressions.

Relationships between Mortuary Rituals

Mortuary attributes do not occur as independent expressions, rather they represent components of a larger, more elaborate composition. Suppose, for example, that a presentation team needs to create a display from a set of social variables that includes being a male, an older adult and having grandchildren. From these three qualities it is possible to interpret the dead as a man, a husband, a father, an in-law, an old man or a grandfather. If single attribute-agent relationships are independently presented to express the dead's social features, the display is too

ambiguous to define what role was being emphasized. How does the audience know which interpretation is the form presented?

Social qualities are discriminated into an interpretable structure by order. Separate attribute-agent relationships are integrated into an understandable unit based on what the presentation team feels are paramount social features. The ideas and meanings attached to mortuary expressions do not all contribute equally to this singular expression, some attributes or sets of attributes define social roles that are more critical to the expression while others define less important social details. By ordering social features, presentation teams specify what aspects of the dead's social qualities are emphasized.

The integration of attribute-agent relationships into a mortuary expression may be modelled as:

$$SP = \{M_{1A}, M_{1B}, M_{1C} \; M_{2D}, M_{2E}, M_{2F} \; M_{3G}, M_{3H}, M_{3I} \; \ldots M_X\}^2 \quad (7)$$

Since these social statements are symbolized by material expressions and meanings are symbolized by material attributes, the tangible correlate to this model is:

$$SP = ME \text{ and } SP = \{V_{(GASROCKI)1A}, V_{(GASROCKI)1B}, V_{(GASROCKI)1C} \; V_{(GASROCKI)2D}, V_{(GASROCKI)2E}, V_{(GASROCKI)2F} \; V_{(GASROCKI)3G}, V_{(GASROCKI)3H}, V_{(GASROCKI)3I} \; \ldots V_{(GASROCKI)X}\}^3 \quad (8)$$

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[2] Where SP = Social Personality;
M_{1A}, M_{1B} and M_{1C} = Most Important Roles (or Concepts);
M_{1D}, M_{2E} and M_{2F} = Second Most Important Roles (or Concepts);
M_{3G}, M_{3H} and M_{3I} = Third Most Important Roles (or Concepts);
and M_X = Least Important Role (or Concept).

[3] Where ME = Mortuary Expression;
$V_{(GASROCI)1A}$, $V_{(GASROCI)1B}$, $V_{(GASROCI)1C}$ = Most Important Roles (and Concepts);
$V_{(GASROCI)2D}$, $V_{(GASROCI)2E}$, $V_{(GASROCI)2F}$ = Second Most Important Roles (and Concepts);
$V_{(GASROCI)3G}$, $V_{(GASROCI)3H}$, $V_{(GASROCI)3I}$ = Third Most Important Roles (and Concepts);
and $V_{(GASROCI)x}$ = Least Important Concept.

Among mortuary rituals, roles and ideas that distinguish fundamental qualities to be emphasized about the dead will be more important to the presentation than others. Minimally, this sorts social roles and concepts into a hierarchical arrangement discriminating ideas into those of greater and lesser importance. Likewise, attributes and sets of attributes symbolizing these paramount ideas will occupy a higher order position with lesser social qualities being relegated to lower order ranks.

One important quality of this structure is its amenability to internal variation. Within a given social personality, there are a number of social qualities and roles that provide details about the dead that do not conflict with the fundamental discriminant. The grandfather, for instance, can be a potter or a farmer, married to Family X or Y, and in poor or good health. None of these roles directly influence his standing as a grandfather. These variations enable differing concepts within a social role to be expressed. Their importance to the overall presentation once again defines where they are positioned in the social personality's structure.

Identical Social Personalities

Just as individual attributes and agents exhibit simple associations between mortuary rituals, sets of attribute-agent relationships are also patterned. When indistinguishable funerary displays are used to communicate the same social information about the dead, the result will be identical sets of attribute-agent combinations. This may be modeled as:

$$SP1=SP2 \quad and \quad \{M_{1A}, M_{1B}, M_{1C}, M_{2D}, M_{2E}, M_{2F}, M_{3G}, M_{3H}, M_{3I} \ldots M_X\} = \{M_{1A}, M_{1B}, M_{1C}, M_{2D}, M_{2E}, M_{2F}, M_{3G}, M_{3H}, M_{3I} \ldots M_X\} \quad (9)$$

These recognize a lack of variation among social qualities and social quality importance between funerary representations. Graves symbolizing identical social personalities will show a common grouping throughout a cemetery's organizational structure.

Different Social Personalities

Conversely, funerary displays may express very different ideas about the dead. When dissimilar social personalities are compared, the resulting mortuary expression may be modeled as:

$$SP_1 \neq SP_2, \quad because \quad \{M_{1A}, M_{1B}, M_{1C}, M_{2D}, M_{2E}, M_{2F}, M_{3G}, M_{3H}, M_{3I} \neq \{M_{1J}, M_{1K}, M_{1L}, M_{2M}, M_{2N}, M_{2O}, M_{3P}, M_{3Q}, M_{3R} \quad (10)$$

$...M_x\}$ $...M_x\}$

Where social discriminants are tied to material features, differences in variants, attributes, groups of attributes and their importance indicate shifts in meaning. While shared lower order ideas and symbols may mark similar details, these features have little impact on more fundamental social qualities. Variations among these higher order features mark prominent social distinctions. Among graves from a military cemetery, for example, the presence of common faith may detail a similar quality in two mortuary displays, but designations of rank or branch of service are dominant features defining the dead's place in military society. These latter representations serve as paramount social discriminants capable of separating the dead into very different groups.

Same Social Personality, Equally Important Social Roles

Flexibility in social personalities means that minor social roles and concepts can be portrayed between individuals, but these details will not change the general meaning applied to the representation. If different concepts within the same general idea are considered equal, they will contribute the same importance to the ritual's presentation. This may be modeled as:

$$SP_1 \cong SP_2, \text{ because } \{M_{1A}, M_{1B}, M_{1C} \cong \{M_{1A}, M_{1B}, M_{1C} \quad (11)$$
$$M_{2D(a)}, M_{2E(a)}, M_{2F(a)} \quad M_{2D(b)}, M_{2E(b)}, M_{2F(b)}$$
$$M_{3G(a)}, M_{3H(a)}, M_{3I(a)} \quad M_{3G(b)}, M_{3H(b)}, M_{3I(b)}$$
$$...M_x\} \quad ...M_x\}^4$$

Note that the general structure remains the same so long as the contribution between agents remains constant. Returning to the military illustration, location may be used to define primary social discriminants, such as rank or branch of service, and gravestone stars and crosses symbolize the dead's faith. If stars and crosses express the same relationship with location (i.e., faiths are mixed within rank or branch of service sections), then the difference in attribute form indicates that the agents behind these forms share a common level of importance (i.e., specific religious affiliations are less important social features than rank or branch of service). Graves expressing this type of

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[4] Where $M_{2D(a)}$, $M_{2E(a)}$, $M_{2F(a)}$ and $M_{2D(b)}$, $M_{2E(b)}$, $M_{2F(b)}$ represent different roles (or concepts) in ideas D, E, and F; and $M_{3G(a)}$, $M_{3H(a)}$, $M_{3I(a)}$ and $M_{3G(b)}$, $M_{3H(b)}$, $M_{3I(b)}$ represent different concepts (or roles) in ideas G, H, and I.

relationship would share common paramount features and exhibit attribute variations at similar organizational levels.

Same Social Personality, Variably Important Social Roles

Alternative concepts within a general idea are not required to express the same degree of importance; presentation teams may manipulate them differently within a common framework. This change in the arrangement of mortuary attributes may be modeled as:

$$SP1 \cong SP2, \text{ because } SP1\ \{M_{1A},\ M_{1B},\ M_{1C},\ M_{2D(a)},\ M_{2E(a)},\ M_{2F(a)},\ M_{3G(a)},\ M_{3H(a)},\ M_{3I(a)},\ \ldots M_x\} \cong SP2\ \{M_{1A},\ M_{1B},\ M_{1C},\ M_{2G(b)},\ M_{2H(b)},\ M_{2I(b)},\ M_{3D(b)},\ M_{3E(b)},\ M_{3F(b)},\ \ldots M_x\} \quad (12)$$

This type of arrangement may be encountered when one idea or variant is more socially desirable than its alternatives. For example, if religious differences in military cemeteries varied in their importance, it would be possible for all ranks sharing one faith to be buried together and all other faiths buried by rank or branch of service. Within the variable religion, one religious concept's relationship with rank or branch of service is much different than that of other religious forms. Graves with this type of relationship would exhibit attributes from the same general agent type, at different points in the organizational structure.

Chapter 5. Modeling Time with Mortuary Structure

"There seems to be a tendency among some anthropologists to expect different cultures when different burial customs are found. They have been following the idea that change in burials probably indicates a change in culture or the presence of another tribe."
James B. Griffin (1930).

Griffin's statement reflects the notion that mortuary rituals are frequently treated as static units of cultural expression. Proponents of this view would argue that the only dateable changes that can occur in the mortuary facility are large-scale socio-cultural transitions. In this chapter, the possibility of much less drastic forms of change are considered, with particular emphasis placed on the individual mortuary feature's stability over time.

Time as a Mortuary Construct

Differences in material expression can be attributed to several social agents. These are manipulated by the ritual's participants. These actions follow a general model of mortuary variability that can account for a substantial number of the differences observed between mortuary rituals. The model is a population-based construct aimed at explaining individual features. Its strength comes from comparison between rituals. This model can be applied to a wide range of cultural responses to death. However, its application is dependent on the analyst's ability to control for time.

Mortuary rituals are usually sampled across an accumulation period -- the span of time that graves enter the mortuary record. In order for the model to be successfully applied the variables examined must express the same relationships between meaning and symbolized expression throughout the accumulation period. Any change in the material expression of meaning introduced during the accumulation period will severely hamper the model's ability to explain variability. The model, therefore, can only provide intelligible output to those circumstances where the material expression relationship remains stable throughout the accumulation phase.

Some analysts are clearly cognizant that the lack of temporal control presents a major shortcoming in mortuary analysis (Chapman and Randsborg 1981:23). This does not mean that they have successfully corrected for time's effect. The data available for examination frequently are

derived from prehistoric and poorly defined historic cemetery contexts. These samples are notorious for their poor temporal control. The application of broad, general temporal divisions provides a minimal degree of control over time (c.f., Mitchell et al. 1989; Pader 1982; Schulting 1995; Steponaitis 1983). Graves frequently are unstratified. They are commonly devoid of sensitive temporal markers, and often have not been comprehensively subjected to relative or absolute dating techniques. In the absence of temporal control, analysts must assume that temporal variability did not occur during the accumulation period (Braun 1981:409; O'Shea 1981:52; Ravesloot 1988:49). There are two consequences of this assumption. First, only those agents expressing a stable relationship with a symbolized expression throughout the accumulation period will provide an accurate portrayal of unexplained variation.

Secondly, unstable variability; that is, relationships where agents or material expressions change during the accumulation phase; confounds an accurate identification of discrete social representations. Consider the situation outlined in Figure 5-1. While temporally stable variations result in an accurate interpretation of the number and form of social categorizations in the depositing community, change in either the meaning or expression results in an incorrect tabulation of the number of social forms, hence, misidentification of their true meaning. Without control over time, it is not possible to identify whether differences between graves arose from heterogeneous social forms or a change in the expression of a common social personality (Goldstein 1980:56-57).

When possible, time should be controlled and form an integral part of the general model of mortuary variability. Applying time to the general model of mortuary variability, however, requires some minor adjustment in how the model is perceived. In its given form, the model references a specific (unnamed) material expression and identifies agents that influence it (See Figure 3-1). As a singular expression, the model refers to only one material form out of a variety used in any given individual ritual. Time, defined as the point when a material form is presented to the audience, is understood to be a single dimension. However, the application of this model for comparative purposes poses the question of whether the attribute-agent relationship observed in one ritual is the same as the attribute-agent relationship observed in another. Unless time is equal in both rituals, the

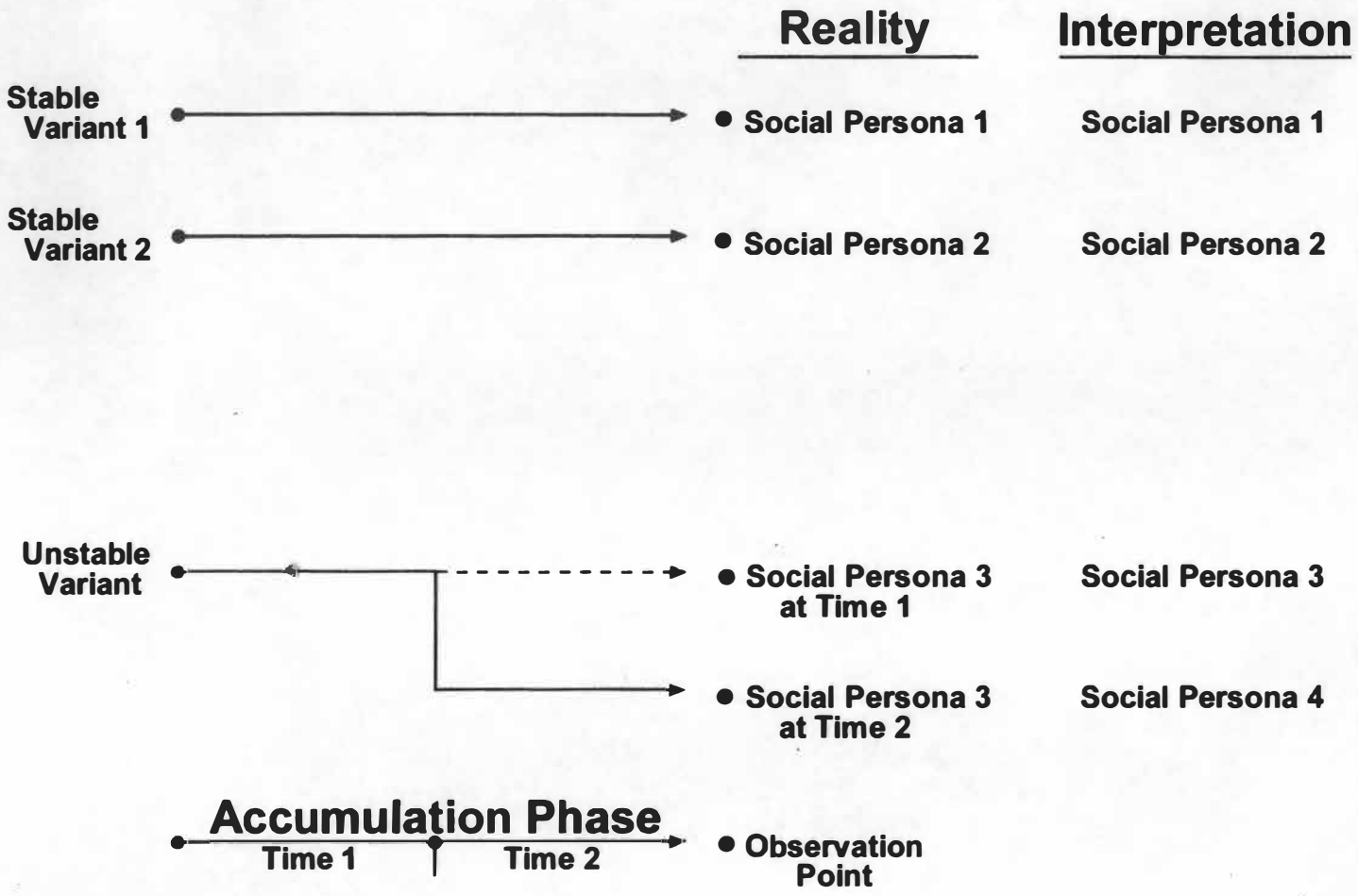


Figure 5-1. Effects of Temporally Stable and Unstable Variations on Mortuary Interpretation.

possibility that temporal variation enters into the attribute-agent relationship cannot be dismissed. Temporal factors, such as addition or subtraction of a ritual component; contrasting interpretations of meaning and expression by the ritual's participants; change in a community's organizational, religio-philosophical or technological structure; or simple replacement of one form with another can alter the contribution each agent makes to the material expression. This change in contribution alters the meaning and requires the application of a different material expression. When comparisons are made between individual rituals, it is necessary to discern the influence of time in each ritual (Figure 5-2)[1]. An accurate interpretation of mortuary structure therefore cannot ignore time's effect.

To illustrate this point, Pearson (1982) and Cannon's (1989) examinations of English cemeteries are again considered. Graves of non-elite/non-high status individuals were typically memorialized with markers made from locally obtained building stones (principally limestone and sandstone) during the nineteenth century (Pearson 1982:107). The use of white marble was originally designed to indicate the deceased's high status (Figure 5-3). As demand for these exotic materials increased, production costs were reduced and white marble became more available for use by lower status presentation teams to accentuate the deceased's social standing. This resulted in a blurring of white marble's ability to communicate true high status as a component of the dead's social persona. Lacking a discriminant feature, English elites gradually dropped use of white marble as a status indicator and adopted the practice of cremation -- a practice that violated most non-elite religious philosophies -- as a form of status communication (Cannon 1989:441; Pearson 1982:108).

Late nineteenth and early twentieth century English cemeteries contain areas where primary interments are marked by both marble and building stones, as well as places containing secondary (cremated) interments. Without a control for time, it is doubtful that the meaning (i.e., status) attached to these three expressions would be recognized as patterned variation. They would simply

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[1] For the purposes of this analysis, the mortuary ritual is treated as a single event, even though time passes between ritual commencement and completion. Since archaeological data cannot accurately discriminate when during a mortuary ritual a particular material expression was implemented (or changed), time is defined as the moment when ritual events influencing the archaeological record are completed.

Individual Mortuary Ritual:

$$(V = G\ A\ S\ R\ O\ C\ I)_{T_1}$$

Multiple Mortuary Rituals:

$$(V = G\ A\ S\ R\ O\ C\ I)_{T_1}$$

$$(V = G\ A\ S\ R\ O\ C\ I)_{T_2}$$

$$(V = G\ A\ S\ R\ O\ C\ I)_{T_3}$$

T_1 = Time at Point 1.
T_2 = Time at Point 2.

Figure 5-2. Application of Time to the General Model of Mortuary Variability.

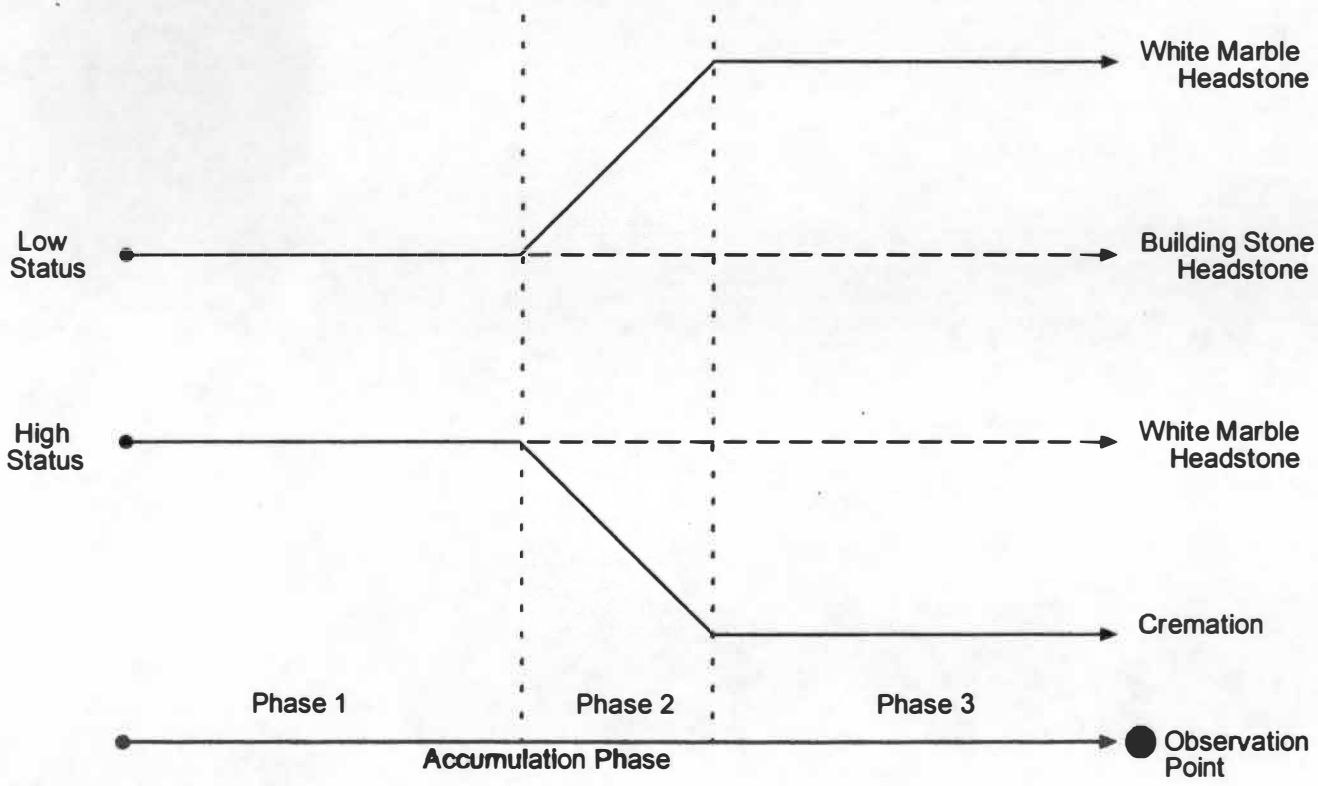


Figure 5-3. Change in the Expression of Status in English Cemeteries.

appear as three distinct social personae (primary rituals with white marble headstones, those with building stone markers, and cremations). The possibility of only two statuses being represented cannot be discerned from this data alone. Note that in the case of high status interments, meaning was largely transferred from an ambiguous form to a previously undefined material representation during Phase 2. This emphasizes that while meanings remain constant, what varied through time was material expression. The reverse situation is also possible. Without controlling for time, the true meaning communicated by white marble is lost as ambiguously patterned variation.

The impact of time on a mortuary assemblage is influenced by several factors, including the death rate, the accumulation period and rate of social change. Communities undergoing high death rate periods are likely to minimize the amount of expression embodied in each mortuary ritual, whereas a long time span between death events enables the presentation team a greater opportunity to invest time and resources into mortuary expressions. Mortuary accumulation periods that are relatively short minimize the opportunity for temporal variation; longer accumulation periods likewise increase the chance that material expressions will display instabilities (O'Shea 1984:14). Goldstein (1980:56-57) has observed that the importance of time in affecting mortuary variability is related to the rate of social change within the community as a whole. Non-mortuary related evidence for social change could be used as a proximate predictor of whether substantial change in mortuary expression is likely to be present. In communities reflecting lots of evidence for social change, it is likely that mortuary expression will undergo some modification, whereas more stable community forms may reflect little to no temporal variability. This does not mean that attribute-agent relationships are stable, only that the rates of change are minimized.

Mortuary displays, particularly those reflecting status or social rank, frequently go through periods of cyclic change that may or may not be associated with other features visible in the archaeological record (Cannon 1989). Questions of social change therefore should not focus on status/rank sensitive features alone. In unstable socio-political organizations, it is unlikely that any assumption of stability in the material expression-agent relationship is a realistic supposition. It is

especially important to address time to account for change that may have ensued during the accumulation period.

Modelling Time

The relationships modeled in Chapter 4 have the advantage of classifing homogenous and heterogeneous sets of mortuary presentations as authentic social distinctions for a given time and place. As constructed, these models ignore the fact that cemeteries accumulate over time and that time enables an opportunity for relationships to change. Variability models only explain variation accurately if the funerary events were simultaneous.

What happens if mortuary rituals took place over time? Consider two hypothetical mortuary rituals for the same social personality that transpire consecutively over a very short period of time. The meaning applied to variables associated with the first ritual would be extremely similar to those employed during the second ritual. This can be modeled as:

$$V_{(GASROCI)T1} = V_{(GASROCI)T2} \text{ and } SP_{T1} = SP_{T2}^{2} \quad (13)$$

The only difference between this model and Model 3 is the addition of the time variable. If mortuary rituals do not occur simultaneously and neither variable nor meanings are the same, then:

$$V_{T1} \neq V_{T2} \text{ and } (GASROCI)_{T1} \neq (GASROCI)_{T2} \quad (14)$$

Likewise, changes in material expression with the meaning remaining the same would be expressed as:

$$V_{T1} \neq V_{T2} \text{ and } (GASROCI)_{T1} = (GASROCI)_{T2} \quad (15)$$

and finally, if meaning changes and material expression remained the same, then:

$$V_{T1} = V_{T2} \text{ and } (GASROCI)_{T1} \neq (GASROCI)_{T2} \quad (16)$$

Time does not change the behavior of independent attribute-agent relationships and mortuary events. Non-shared attribute-agent relationships express the same associations noted in Models 4 through 6 and mortuary events exhibit the patterns outlined in Models 10 through 12. Whether the

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[2] Where T1=Time of Occurrence 1 and T2=Time of Occurrence 2.

features examined were always different or changed between rituals, the pattern remains the same. Time provides an opportunity for change to occur in how like mortuary presentations are interpreted and presented, but time by itself is not a major influence in how ideas are symbolized.

As time passes between mortuary events, the possibility that attribute-agent relationships will shift is greater. Most associations between time and opportunity for change are probably positive -- the greater the passage of time between two mortuary rituals, the greater the chance that mortuary expressions will not be equal. Returning to the English cemetery example, high status mortuary expressions used during Phase 1 stand a greater chance of being alike than if compared to a Phase 2 or 3 expression. Comparisons of mortuary events and expressions express some degree of dissimilarity if the symbols or meanings are unstable over time. These can be modeled as shown in Table 5-1. In this case, rituals from Period 1 will probably be less like rituals from Periods 3 or 4 than from Period 2. Note that this is a probabilistic, not an absolute statement. Sequentially presented mortuary expressions of the same social personality stand a greater chance of expressing common meanings and forms with short periods between presentations than among those separated by more time.

Since cemeteries represent accumulations of mortuary rituals with most not representing simultaneous events, the application of time is critical to understanding mortuary structure. Social issues that are important enough to require expression in the mortuary ritual cannot be assumed to have remained stable instead, stability must be demonstrated.

Table 5-1. Similarity Matrix between Compared Rituals from Different Time Phases.

Time Period	Phase 1	Phase 2	Phase 3	Phase 4
Phase 1	Same	Similar	Less Similar	Least Similar
Phase 2	Similar	Same	Similar	Less Similar
Phase 3	Less Similar	Similar	Same	Similar
Phase 4	Least Similar	Less Similar	Similar	Same

Chapter 6. Western Kentucky and the Mississippian Culture Area

There is no exact definition of what constitutes the Mississippian Culture. Most analysts agree that the Mississippian lifeway includes the development of large sedentary populations, agricultural intensification with a particular emphasis on maize and bean production, and the development of a ranked social structure (Fagan 1991:390-391; Jennings 1989:254-271). Some analysts include the introduction of material-technological changes, namely the use of shell as a ceramic tempering agent (Morse and Morse 1983:208). Beyond these general characteristics, however, Mississippian cultural manifestations are extremely diverse. Unlike previous cultural lifeways, the Mississippian culture displays a greater range of expression, a feature leading Fagan (1991:390) to suggest that cultural diversity may be an important feature distinguishing it from other Southeastern United States Native American cultural adaptations. Defining a cultural representation as "Mississippian", therefore, defines only a general classification.

One of the hallmarks of the Mississippian cultural lifeway was intensive agriculture. As population sizes expanded and remained permanently within the region, the landscape became more broadly developed. There were increases in the number of settlements. Choice of site location stemmed from a combination of several factors, including distance from differing environments (particularly fresh water aquatic resources), elevation above the flood plain, access to reliable fresh water supplies, and the amount of arable cropland available. These factors influenced the carrying capacity for a sedentary population at a given location. Mississippian sites in western Kentucky generally appear as one of several forms: farmsteads, hamlets or villages, and larger towns or regional centers.

1. Farmsteads. In general, most Mississippian habitation areas with a single structure were farmsteads. They were usually delineated by isolated domestic debris scatters in the vicinity of potential agricultural land and characterized by a low density, fairly discrete midden or surface debris scatter. Farmstead sites in the Oscar and Barlow Bottoms were constructed on natural levees,

ridges and terraces (Kreisa 1988a:163). These locations were probably chosen in an effort to avoid areas that were prone to flooding, yet were close to highly fertile land. Matternes' (1995a) analysis of the Curtis-1 (15BA129), Ed's Place (15CE43), and Sissel-4 (15CE49) sites indicated that farmsteads were established as early as the Late Woodland period. The upland location of 15BA129 and 15CE49 implied that farmsteaders probably took advantage of localized patches of highly fertile land. Excavations at 15McN38 indicated that thirteenth century Mississippian farmsteads probably represent short-term occupation areas (Butler et al. 1981:48). Post and wall trench patterns revealed little to no structural repair to farmstead structures. These sites were probably abandoned soon after these structures fell into disrepair.

Relatively independent groups probably formed farmsteads. Their size suggested that nuclear or extended family groups occupied them. Whether they were politically allied with larger communities has not been absolutely demonstrated. Minimally, farmsteaders probably maintained contact with higher order communities in order obtain goods and services that were not available in the immediate environment.

2. Hamlets or Villages. Western Kentucky hamlets or villages deposits contained substantial concentrations of debris and evidence for multiple structures. Villages were generally larger than hamlets and contained greater evidence of small earth works and other reserved spaces. Fairly small populations occupied these sites (Less than 150 people). In the immediate area, sites such as Crawford Lake (15McN18), Running Slough (15FU67), Burcham (15HI15), and the Steam Site (15McN24) would fall into the classification of hamlet/villages. Excavations at the latter of these representations showed that structures were rebuilt several times, indicating a greater occupational time depth than attributed to farmsteads (Butler et al. 1981:89). Examinations of the Reed (15McN51) site established that this Mississippian community originated in the Late Woodland period (Kreisa 1995:169). Variations in artifact and feature scatters at the Steam site indicated that hamlets contained space reserved for specific activities or functions (Butler et al. 1981:120).

Hamlets clearly contained more people than were living at a given farmstead. Extended or multiple extended families are suspected as being the principal organizing components. Hamlets

and villages probably supported economic alliances with higher order communities. Hamlets and villages were at least semi-autonomous and could have been managed as successful small simple chiefdoms or by local bigmen.

3. Towns and Regional Centers. There are numerous representations of these larger structures recorded in western Kentucky. Towns and regional centers consist of sites with at least one mound present, substantial midden or debris deposits, and evidence of relatively long term occupations. They include a range of sites from the single mound site found at Rowlandtown (15McN3) through the large complex multi-mounded sites like Kincaid. They are considerably larger than villages or hamlets. Since these sites form prominent features on the landscape they have been known for considerable periods of time and constitute a major focus of the region's archaeology. Clay (1997:17) has suggested that the smaller versions of this site form are excellent indicators of change in Mississippian Culture.

Space in Mississippian towns is a controlled feature. The presence of mounds, plazas and enclosures indicate that specially designated use areas were present within the community's space and that these areas were reserved for select members of the community or for certain purposes. Towns and regional centers contain relatively large populations, probably consisting of numerous kinship groups. These family networks provided a large enough economic base to draw goods and possibly labor from the surrounding hinterland. Most towns and regional centers were probably controlled by simple or complex chiefdoms.

Western Kentucky

Terminal Late Woodland/Emergent Mississippian (700-1000 AD)

The Late Woodland period was not as strong a cultural presence as the later Mississippian period. It is one of western Kentucky's least understood cultural representations (Table 6-1). Most analysts accept that after about 700 AD, Woodland communities in western Kentucky were probably permanent residents.

Table 6-1. Notable Late Prehistoric Phases in Western Kentucky.

Phase	Cultural Affiliation	Temporal Affiliation
Baytown	Late Woodland	<700-900 AD
James Bayou	Emergent Mississippian	800-1000 AD
Jonathan Creek	Early Mississippian	1000-1100 AD
Dorena	Early Mississippian	1100-1300 AD
Kincaid/Angelly	Middle Mississippian	1200-1300 AD
Medley	Middle Mississippian	1300-1500 AD
Tinsley Hill	Middle Mississippian	1350-1450 AD
Jackson	Middle Mississippian	1500-1700 AD

Habitation sites tended towards strategically locations at environmental interfaces between the flood plain and uplands (Sussenbach and Lewis 1987). The diverse environmental niches available for exploitation reduced the amount of travel needed to take advantage of upland, floodplain or aquatic resources. These populations were at least semi-sedentary. Thick middens, such as those at Indian Camp (15CE19) and Marshall (15CE27), evidenced that some Late Woodland sites were occupied for considerable periods of time (Railey 1996:113).

In the regions surrounding the Mississippi-Ohio Rivers confluence, there are a number of Late Woodland sites that show a transition in material (principally ceramic) forms from Woodland towards a decidedly more Mississippian style (Kreisa and Stout 1991:125). The relatively small size of many of these sites suggests that these communities were autonomous or weakly allied with other settlements. Kreisa and Stout (1991:136) noted that size and content differences in these communities may be early manifestations of a hierarchical relationship but the power structure probably did not develop much higher than a bigman or simple chiefdom.

Most Late Woodland sites tend to be small (<1 Hectare) and probably representing individual farmsteads or small hamlets (Kreisa 1989:26). In the Big Bottoms region of southwestern Kentucky, survey and excavations by Kreisa (1987:85) identified evidence of a more complex arrangement. At the Rice site (15FU18), construction of three mounds and appearance of several

dispersed, presumably allied hamlets indicate that some levels of political complexity may have been established (Kreisa 1988b:146).

The archaeological record does not indicate if the Mississippian representation in western Kentucky replaced the preexisting Late Woodland cultural form, arose from it, or was acculturated from other regions. In all likelihood, indigenous Late Woodland populations were exposed to the Mississippian culture and gradually adopted its form (Muller 1993:131; Schwartz 1962:12). Evidence of Mississippian activities can generally be attributed to the region by about 900 AD (Kreisa and Stout 1991:140). Most analysts would agree that the regional population density increased after the Mississippian culture became established.

Early Mississippian (1000-1250 AD)

Early Mississippian sites are distinguished from the Late Woodland/Emergent Mississippian by a loss or severe reduction in distinctive ceramic forms, including Baytown and Yankeetown Late Woodland forms. Social transitions may have accompanied these material changes.

Along the Tennessee River, excavations at Jonathan Creek (15ML4) revealed a Mississippian town containing no less than three mounds (Webb 1952). Clay's (1997:23) examination of the ceramics indicate that a high concentration of early (Jonathan Creek Phase, 1000-1100 AD) Mississippian materials and a scatter of later ceramic forms are present. This early representation has prompted use of Jonathan Creek as the 'Type Site' for early Mississippian material culture in west-central Kentucky. Changes in the stockade line evidence several size changes in the village. Clay (1997:24) suggests that the late occupation ceramic under-representations may indicate a population decline during the latter aspects of the site's occupation[1]. Since no comparable sites have been found in its vicinity, Jonathan Creek may have served as a small regional center.

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[1] This pattern might also be a sampling bias. Clay (1997:24) notes that Jonathan Creek was not uniformly examined. Since the village shows evidence of size and shape change over time, it is also possible that the village focus shifted to another unexcavated locale (See also Clay's (1997) comments on Twin Mound).

Early Mississippian population movement was not a phenomena isolated to west-central Kentucky. In the Lower Ohio River Valley, the southern concentration (15BA14) at Twin Mounds (15BA2 and 15BA14) is an Emergent/Early Mississippian settlement (circa. 800-1000 AD), (Kreisa 1995:170). This occupation also ceased and the population dispersed elsewhere. Timing of this abandonment coincided with that observed at Jonathan Creek. The reasons why these two abandonment events transpired are unknown. Populations at both sites probably dispersed to other settlements, founded new communities, or left the area completely.

On the Mississippi River, Lewis (1990a:40) proposed a separate chronological sequence to define Late Prehistoric occupation phases. In Lewis' scheme, Early Mississippian is represented by the James Bayou Phase (circa 900-1100 AD). Cultural assemblages from this phase were distinct from earlier Woodland representations. They possessed more Mississippian style ceramics, house structures, and intensification of agricultural activities (Lewis 1996:66-67). Kreisa (1987:93) noted a florescence of activity at the Sassafras Ridge (15FU3) site during the James Bayou phase suggesting its transformation into a major regional center. Marshall (15CE27) also contained a significant James Bayou Phase component (Lewis 1991:281). These sites were probably occupied continuously throughout the tenth through thirteenth centuries.

While sampling biases cannot be dismissed, Kreisa (1991:111) observed a lack of temporal continuity among several small, reoccupied sites. At the Adams Site (15FU4), for example, changes in village foci between Late Woodland and Mississippian deposits lack spatial continuity demonstrating that the simple presence of both Late Woodland/Early Mississippian and later Mississippian settlements was not enough to imply continuous occupation (Lewis 1986:100). Population migration within the region was a strong possibility.

Middle Mississippian (1250-1600 AD)

There are a great number of Middle Mississippian sites, implying a regional increase in population. Excavations at Tinsley Hill (15LY18), a single mounded habitation site along the Cumberland River, revealed that site occupation was long enough for the community to be re-organized. A mound was constructed in the early phases of occupation (circa 1262 AD), but

temporal shifts in community arrangement indicated that it was not always the focus of site activity. Clay (1997:22) argues that the importance of this mound changed meaning during the site's history. If mounds helped to define power in the community, then this authority was either lost or expressed differently by the time the site was abandoned.

There are numerous smaller villages and farmsteads scattered throughout the Tennessee-Cumberland Rivers Drainage Basin, but most have not been extensively explored. Many of these settlements were probably inhabited at the same time. Some form of contact probably extended between coeval communities. Relations may not have always been friendly. Lane (1993:79) observed that at least one individual from Tinsley Hill received violent injuries at or near the time of death.

Disagreements among communities -- whether as a result of competition between socio-political polities, different kin groups, individuals or perceived threats -- affected the way these villages were constructed. Palisade lines surround many settlements, including sites at Annis (15BT2) and Morris (15HK49). In contrast, some of the smaller sites on the Kentucky side of the Ohio River, like Papineau (15CN1) and Roach (15TR10), never assumed a defensive posture (Butler et al. 1981; Kreisa 1991; Railey 1984:163; Rolingson and Schwartz 1966:33). These unprotected settlements may have been isolated from hostilities or protected by other unrealized defense systems.

Other occupation increases in the Middle Mississippian period were not isolated to Kentucky's interior. Along the Ohio River, deposits from northern aspects of the Twin Mounds (15BA2) site (dating after the mid-eleventh century) included an intensely utilized Middle Mississippian habitation area. The Twin Mound's inhabitants constructed no less than two platform mounds and a well-defined plaza (Kreisa 1995:170). These activities evidenced a brief burst of development and like that at Tinsley Hill; the power present at the commencement of occupation did not survive through to abandonment.

Along the Mississippi River the Middle Mississippi Period is divided into the Dorena, Medley, and Jackson Phases. Changes in ceramic style frequencies exemplify the Dorena Phase. This

phase continues the same cultural patterns observed in the Early Mississippian James Bayou Phase. Many sites displaying both James Bayou and Medley Phase components possess the intermediate Dorena Phase. These indicate a temporal continuity within these sites, but excavations have not confirmed this possibility. In southwestern Kentucky, the Sassafras Ridge (15FU3) site emerges as an important center of socio-political power (Mainfort 1996:93). While smaller communities are assumed to be present during the Dorena Phase, little is known about them. It is unclear how well the ceramic differences used to identify Dorena Phase can distinguish it in smaller, less complex sites.

During the subsequent Medley Phase Mississippian populations tended to concentrate at the larger sites. While smaller settlements still remained in the region, domestic areas at the Turk and Adams villages increased dramatically (Kreisa 1991:10). Settlements, such as Wickliffe, exhibited a distinct decline in activity. Mississippian populations were probably abandoning some villages and contributing to the prominence and growth of others (Lewis 1996b:142). This transition occurred not only along the Mississippi and Ohio Rivers, but involved such upland sites as Chambers (15ML109), (Pollack and Railey 1987:92-96).

Finally, a period of general depopulation and systematic reduction in size and number of sites along the Mississippi River, referred to as the Jackson Phase, occurred from about 1500 AD to 1700 AD. Williams's (1954,1990) analyses of the Confluence Region concluded that the Mississippian Culture gradually underwent some form of population decline. He implied that major changes in the socio-political structure were reflected in site abandonment, population reorganization, and loss of distinctive artifact styles.

Counter to Williams' ideas, Lewis (1988a) argues that a material cultural transition occurred, exemplified by a lack of stylistic changes in ceramics and the appearance of temporally diagnostic artifacts. Other researchers do not believe that the phase cannot be defined by a distinct material culture (Eisenberg 1989; Wesler 1991b). While Lewis (1990a:54) suggests that components of the Adams and Sassafras Ridge sites might extend into the Jackson Phase no definitive Jackson Phase

sites are found in western Kentucky. At best, evidence for this argument relies on radiocarbon date ranges that extend into the protohistoric period.

Southern Illinois

Terminal Late Woodland/Emergent Mississippian - Early Mississippian (700 - 1250 AD)

This period is marked by a sequence of cultural transformations within several Late Woodland/Emergent Mississippian populations and continues through several Mississippian representations (Table 6-2), (Butler 1991:266-267). There are no clean temporal or stratigraphic divisions within the region's cultural sequence. Most analysts tend to treat these phases as overlapping, rather than abutting temporal divisions.

Table 6-2. Notable Late Prehistoric Phases in Southern Illinois.

Phase	Cultural Affiliation	Temporal Affiliation
Douglas	Late Woodland	850-1000 AD
Dillinger	Late Woodland	800-1000 AD
Jonathan Creek	Early Mississippian	1000-1100 AD
Kincaid/Angelly	Middle Mississippian	1200-1300 AD
Tinsley Hill	Middle Mississippian	1350-1450 AD

There is ample, albeit widely dispersed, evidence of Late Woodland occupations in southern Illinois. Identification of southern Illinois' Late Woodland manifestations follows Maxwell (1951). There are more settlements over a wider range of environmental settings than seen in earlier woodland components. These shifts are probably associated with increases in population size (Hargrave et al. 1991:160). Sites with distinct Dillinger Phase assemblages are characterized as small village/hamlet-sized habitation areas with no earthworks. Some, such as the Ware and Linn sites, are overlain with Mississippian components, suggesting an acculturation of the Mississippian material culture (Hargrave et al. 1991:161). Douglas Phase people may have been responsible for the initial construction of at least one mound at Kincaid (Muller 1986:164).

Both Late Woodland and Early Mississippian representations in the Black Bottom emphasize the development of numerous dispersed hamlets and single mounded villages. Choice of site location is attributed to local soil conditions. In the Black Bottom, more than 90% of the Mississippian sites are located on soils rich in the nutrients needed to successfully grow maize-style plants (Muller 1986:189). The size of these settlements appears to be related to the amount of area immune to annual flooding. The overwhelming majority of these sites are small, either farmsteads or small village/hamlet sized settlements (Muller 1978:175). The low density of houses in this area would suggest a "dispersed" community pattern (Butler 1977:256). Rather than congregating the community's population at a few densely nucleated locales, the dispersed community employed a widely scattered population over the available countryside in an effort to maximize manpower efficiency and exploitation of fertile soils (Riordan 1975:172). It is likely that dispersed and nucleated communities possessed comparable population sizes.

Middle Mississippian (1250-1600 AD)

At some socio-economic level, most outlying sites in the Black Bottom were affiliated with Kincaid. Kincaid was the largest multi-mounded living and ceremonial center in the southern Illinois-western Kentucky region. Economically, Kincaid occupied a strategic position opposite the confluences of the Tennessee, Cumberland and Ohio Rivers (Cole et al. 1951). It had access to resources along all these drainages as well as the Black Bottom, the largest bottomland area on the Ohio River. Many of the sites along the Ohio River, east of the Ohio-Tennessee/Cumberland River confluences were probably part of the Kincaid Chiefdom (Railey 1984:162-163). While Woodland and Early Mississippian (Jonathan Creek Phase) assemblages were present, cultural fluorescence occurred after about 1100 AD. At Kincaid, the Kincaid/Angelly Phase were characterized by increases in mound and palisade construction. Secular power and regional socio-political integration peaked during the thirteenth century (Butler 1991:271). At least 19 mounds were built at Kincaid. Excavations indicated that the population was living in widely dispersed hamlets or discrete living areas within the Kincaid complex (Muller 1978:276). It does not appear that Kincaid was ever the home to a large, densely congregated population.

Kincaid's dispersed settlement system did not remain in place throughout the entire Mississippian occupation period. During the terminal occupation phase (Tinsley Hill Phase), ceramic data indicates a population congregation at Kincaid (Orr 1951:350-252). Prevailing social conditions may have prompted a contraction of communities from the outlying areas to Kincaid (Clay 1997:26). No evidence of hostilities were present at Kincaid. Based on analogies with European climatic changes, Muller (1993:137) suggested that climatic cooling after 1250 AD reduced the Lower Ohio Valley's agricultural potential. Gradual depopulation and eventual abandonment of the region occurred as a result of a reduced carrying capacity.

Southern Indiana

Terminal Late Woodland/Emergent Mississippian - Early Mississippian (700-1250 AD)

As seen in most of the Lower Ohio Valley, native Woodland communities in southern Indiana acculturated the Mississippian lifeway. Sites containing Late Woodland/Emergent Mississippian Yankeetown components were often intermixed with Woodland or Mississippian ceramics, indicating that the region was not completely abandoned prior to the Mississippian cultural appearance (Table 6-3), (Blasingham 1953:74-80; Redmond 1990:274, 280).

Table 6-3. Notable Late Prehistoric Phases in Southern Indiana:

Phase	Cultural Affiliation	Temporal Affiliation
Yankeetown	Late Woodland/Emergent Mississippian	850-1000 AD
Angel 1	Early Mississippian	1000-1200 AD
Angel 2	Middle Mississippian	1200-1325 AD
Angel 3	Middle Mississippian	1325-1450 AD
Caborn-Welborn	Middle Mississippian	1450-1700 AD

Yankeetown settlements were not permanent occupations rather they appear to have been only sporadically occupied. Redmond (1990:268) identified seasonality, particularly the availability of subsistence resources, as the major factor influencing when certain sites were occupied. With

increased Mississippian influence, Yankeetown communities gradually became more sedentary. These habitation areas were often situated on or close to floodplains (Hargrave et al. 1991:161). They were probably occupied in the warm seasons when aquatic and floodplain resources could be maximized. Yankeetown villages were devoid of mounds and most contained an overlying Mississippian component (Muller 1986:164-165).

Middle Mississippian (1250-1600 AD)

The most influential late prehistoric community of the southern Indiana Mississippian culture occupied the Angel Site. Angel consisted a large (~100 square acres) settlement surrounded by a stockade and no less than eight mounds (Hilgeman 1992:19-20). There are numerous smaller (<1 hectare) outlying communities that share material affinities with Angel, they probably formed allied satellite communities (Green and Munson 1978). The extent of Angel's grasp on the surrounding cultural landscape has yet to be determined.

While no definitive Early Mississippian occupation deposits were identified at Angel, Angel 1 Phase assemblages were found in area deposits, notably the Stephan-Steinkamp (12PO33) site (Hilgeman 1992:288). Ceramics from 12PO33 exhibited many features similar to those seen in the Jonathan Creek and Early Wickliffe assemblages. Angel 1 probably represented the earliest components of many later Mississippian period sites. Hilgeman (1992:289) felt that subsequent Mississippian land use eradicated traces of Angel 1 occupation, making this elusive component's presence difficult to identify.

Late Mississippian occupation at Angel was divided into two distinct periods, Angel 2 and Angel 3 (Hilgeman 1992:290-292). As Clay (1997:27) pointed out, Angel's monumental architectural development occurred at the same time as mound building at Twin Mounds and Kincaid, with Angel's active mound construction phase continuing into the latter aspects of its occupation. One important distinction between early and late period mounds at Angel were their size. Late period structures did not rival the magnitude of earlier forms. Hilgeman (1992:293) pointed out that the most intensive occupation of Angel probably occurred during Angel 3 or latter aspects of the site's occupation, after mound construction had subsided. The narrow construction period for these

structures was a potential "fashion trend" among elites. Use of the mound as a symbol of power subsided after this brief florescence.

Most analysts agree that Angel represents a chiefdom. However, which form of chiefdom remains controversial. Emphasis on commanding a labor force capable of building and maintaining Angel's mounds and stockade, as well as the impressive size of the regional center, lead some analysts to analogize Angel's community with complex chiefdoms (Schurr and Schoeinger 1995:321). Hilgeman (1992:303) notes that the Angel political hierarchy was not dependent on an extensive goods exchange network with surrounding chiefdoms. She does not feel that Angel ever evolved much farther than a simple Chiefdom. Outlying communities, therefore, represent autonomous settlements.

The Caborn-Welborn Phase represents a cultural manifestation between the end of the archaeologically identified Angel occupation sequence and commencement of the historic period. Caborn-Welborn sites appear to be highly dispersed villages and hamlets found in much of the southern Indiana and abutting north-central Kentucky area (Green and Munson 1978:294; Lewis 1990:409). At Slack Farm, several hundred individuals occupied a village divided into separate house clusters, each probably representing a different moiety (Pollack et al. 1996:9).

Southeast Missouri

Terminal Late Woodland/Emergent Mississippian - Early Mississippian (700-1250 AD)

Many Late Woodland[2] assemblages in southeast Missouri are only marginally represented in unmolested archaeological contexts. Alluvial action, subsequent site reoccupation, and agricultural activities have reduced most detected sites to secondary contexts. Many portions of

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[2] Use of the terms 'Baytown' and "Late Woodland' in Central Missouri have created some confusion in the literature. Baytown is defined as a distinct Late Woodland phase in the Southern Mississippi Valley, however the term also refers to a cultural period between Middle Woodland and Mississippian cultures (See Conner et al. 1995:12; Williams 1974:1-2). Baytown also refers to a period encompassing the entire Woodland sequence (Williams 1954:32). To avoid confusion 'Baytown' will be used as a specific phase that is not inclusive of all Late Woodland phases and 'Late Woodland' will refer to a broader suite of cultural activities that include 'Baytown'.

southeastern Missouri are not adequately surveyed. As a result, knowledge of the Late Woodland culture is restricted to specific regions.

Several Late Woodland occupations on the Malden Plain were recorded through the efforts of the University of Washington. Originally, Williams (1954:204) used sand tempering as an index feature to distinguish Late Woodland from later Mississippian cultural representations. Dunklin Phase deposits also share little in common with the surrounding regional assemblages. Dunnell and Feathers (1991:44) use these diverse artifact assemblages to suggest that Dunklin Phase societies were relatively isolated from other communities (Table 6-4).

Table 6-4. Notable Late Prehistoric Phases in Southeastern Missouri.

Phase	Cultural Affiliation	Temporal Affiliation
Baytown	Late Woodland	<600-1000 AD
Dunklin	Late Woodland	600-900 AD
Hoecake	Late Woodland	700-900 AD
James Bayou	Early Mississippian	800-1000 AD
Hayti	Early Mississippian	700-1000 AD
Cairo Lowlands	Middle Mississippian	1000-1200 AD
Dorena	Middle Mississippian	1100-1300 AD
Powers	Middle Mississippian	1100-1300 AD
Medley	Middle Mississippian	1300-1500 AD
Jackson	Middle Mississippian	1500-1700 AD

It does not appear that there were ever large populations of Late Woodland people on the Malden Plain. Early Dunklin Phase sites emerge as discrete farmsteads or hamlets that are widely dispersed across the landscape. Morse and Morse (1983:186) suggest that the Dunklin Phase people followed a semi-sedentary lifestyle, creating temporary habitation sites and utilizing them only on a seasonal basis. Dunnell and Feathers (1991:39) examination of the dense middens found in Dunklin Phase sites, however, propose that these communities represent more permanent residences. Over time, Dunklin Phase sites seem to consolidate into larger settlements (Dunnell and Feathers 1991:37). Lipinott et al. (1995:290) feel that the general absence of exotic materials and

relative homogeneity among Late Woodland assemblages reflect a lack of political centralization. Throughout most of the Late Woodland, permanent habitation areas are home to only a few extended families. By roughly 1000 AD, the appearance of permanent large planned settlements indicates that at least some Mississippian cultural features were diffusing into the region (Conner and Ray 1995:120-121; Teltser 1988:156).

In the Cairo Lowlands, there was a gradual increase in material culture complexity during the Late Woodland or Hoecake Phase (700-900 AD). Over time, small relatively isolated communities became larger, forming densely populated fortified villages. At Hoecake, a large (>80 hectare) village, with at least 31 mounds, was established (Williams 1974:55). This and other Late Woodland villages demonstrated a continuous sequence of occupation through the Mississippian phases. Most archaeologists accept these as evidence that a cultural transition, not a replacement, between Late Woodland and Mississippian occurred in this area (Morse and Morse 1983:214-216; O'Brien 1996:313). Although temporal, taphonomic and other site biases prevent direct comparison, similar transitions probably also occurred in the Pemiscot Bayou region (Lipinot et al. 1995:293-294; O'Brien 1994:54).

Middle Mississippian (1250-1600 AD)

Unlike the western Kentucky cultural sequence, Mississippian towns and villages in the Cairo Lowlands frequently demonstrate long continuous occupation sequences extending from the Late Woodland through the later Mississippian phases. This stability may be evidence that fundamental differences in community organization separated southeast Missouri and western Kentucky Mississippian societies[3].

Compared to most Mississippi Valley bottoms in Missouri, the Cairo Lowlands were extensively investigated (O'Brien 1996:310). At one time it was the most thoroughly documented district of the Lower Mississippi Valley (Phillips 1970:925). Despite all this attention, the region's

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[3] Note that this stability is in occupation, not in site use. There is ample evidence present to indicate that community innovations frequently changed the spatial layout of southeast Missouri sites while they were inhabited.

cultural chronology is poorly understood. In 1982, Lewis (p.83) identified that Stephen Williams's Mississippian cultural model for the Cairo Lowlands contained more variation than could be adequately explained by a single phase. To accommodate the growing wealth of ceramic variation data, Lewis developed a temporal scheme that was also applied, virtually unmodified to western Kentucky (Lewis 1991:275). While literally hundreds of Mississippian settlements were documented, very few were extensively examined and even fewer were adequately addressed in the literature.

As noted in the western Kentucky sequence, Dorena Phase sites show many of the same cultural features seen in earlier Hoecake and James Bayou phase sites. The only known exclusively Dorena Phase site is the Mort hamlet (23MI69), (Williams 1968, In Lewis 1990b: 381). Most Dorena Phase sites are continuations of occupations commencing in the James Bayou Phase and ending around 1300 AD. Populations in the Cairo Lowlands probably grew throughout the Mississippian cultural period, however there is little evidence to indicate that the region's carrying capacity was ever threatened (Lewis 1974:32).

Towards the end of the Dorena Phase, populations from the Malden Plain moved southward to occupy the Western Lowlands of the Missouri Bootheel and extreme northeast Arkansas. The resulting short-lived Powers Phase is characterized by a well-defined multi-community organization, apparently centered on the Power's Fort mound complex (J. Price 1978). Powers Phase Mississippians moved into the region as fully developed communities, erecting a fortified mound center and establishing satellite communities.

Lewis (1991:286) observed that Cairo Lowland sites in the general vicinity of the Mississippi-Ohio Rivers confluence were placed in defensive positions. They frequently contained numerous rebuilt stockades, moats or ditches and modified landscapes to emphasize their natural defensive features. At Towosahgy/Beckwith's Fort (23MI2), site placement adjacent to a bayou and construction of a perimeter ditch and embankment around the central village emphasized concerns for protection. Similar structural components were also present at Lilbourn (Chapman et al. 1974:4). These data infer that violence, or at least its threat, was a consideration in designing a village use area. In contrast to these observations, Healan (1972:37) observed distinct differences in ceramic

assemblages recovered outside and interior to the Towosahgy wall. These fortifications probably served a more ceremonial purpose -- that of differentiating exclusive elite use areas from space made available to non-elites[4].

During the Medley Phase, some aspects of the population were living in satellite communities, like the Cairo Lowland hamlets at Callahan-Thompson and Hess (Lewis 1974, 1982). They were not the norm. Most of the region's population concentrated around the big, fortified centers (O'Brien 1994:354). O'Brien suggested that this movement resulted in greater population densities. Perhaps in response to these pressures, regional centers in the Cairo Lowlands clearly underwent a population reduction. Some eventually were abandoned (See differing views from Arkansas). These populations may have moved southward into southern Pemiscot County, northeastern Arkansas or northwestern Tennessee (O'Brien 1994:17).

Williams (1980:109) noted that the distribution of post-sixteenth century artifact forms in the Central Mississippi Valley leaves an open space around the Cairo Lowlands area. Williams believes that a drastic depopulation of the region left, at best, only an ephemeral scatter of dispersed communities (Williams 1990:173).

Not everyone agrees. Lewis (1990) contends that the traditional stylistic differences observed among many artifact forms were simply not introduced to the region. The key to identifying late period sites in the central Mississippi Valley is determining which artifact forms are temporally unique. Lewis's Jackson Phase is definable by distinct sets of highly stylistic ceramics and a few radiometric dates. Radiocarbon age estimates for late components at the Callahan-Thompson and Hess sites suggest that occupation of long standing hamlets extended through to the Jackson Phase (Lewis 1990a:54). Other sites with potential Jackson Phase components are Wolf Island and Story Mounds (Lewis 1990a:54, 1996b:145). Morse and Morse (1983:299) suggest that the Hickman site may also have a protohistoric component present. Thermoluminescence dates from the County Line

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[4] Butler (1977:181) has also suggested that non-defensive social demarcation may have been a factor in the palisade built at Kincaid.

(23SO166) site indicating that protohistoric abandonment may not have extended to the Malden Plain (Lafferty and Price 1996:34).

Not all parts of southeast Missouri fall within the Williams' "Vacant Quarter". Many Mississippian sites in Pemiscot Bayou are recognized as Jackson Phase habitation areas. Regional centers, villages/hamlets and farmsteads are all probably present. Excavations at the McCoy (23PM21) site are evidence of a community arranged in an oval pattern (O'Brien and Williams 1994:299). While a mound can be identified at this locale, it is unclear whether palisades or other architectural features are also present. The organizational structure of these communities is not known.

Arkansas

Terminal Late Woodland/Emergent Mississippian - Early Mississippian (700-1250 AD)

Unlike other parts of the Middle Mississippi Valley, Arkansas tends to lack a gradual transition between Late Woodland and Mississippian material assemblages (Table 6-5). Mississippian cultural development appears to have involved both the migration of new inhabitants into the area and acculturation of Mississippian lifeways among the indigenous Late Woodland peoples of Arkansas. In east central Arkansas, excavations at the Toltec Mound Complex (3LN42) indicate that population aggregation, mound construction and hierarchical settlement patterns developed among the Plum Bayou people, prior to arrival of the Mississippian culture (House 1996:144).

At Zebree, artifact assemblages spanning Late Woodland through Mississippian occupations are encountered and represent acculturation rather than population replacement (P. Morse and D. Morse 1990:51). Houses are clustered together into discrete units separated by midden piles. These probably indicate internal community divisions. . While population estimates place occupation of the village at less than 200 people at any one time, it is likely that artifact scatters found in the outlying lowlands represent farmsteads associated with this village (P. Morse and D. Morse 1990:64).

Table 6-5. Notable Late Prehistoric Phases in Arkansas.

Phase	Cultural Affiliation	Temporal Affiliation
Baytown	Late Woodland	<600-900 AD
Big Lake	Emergent Mississippian	700-1000 AD
Cherry Valley	Mississippian	1000-1350 AD
Coles Creek	Middle Mississippian	1200-1400 AD
Matthews	Middle Mississippian	1200-1400 AD
Parkin	Middle Mississippian	1350-1650 AD
Kent	Middle Mississippian	1400-1600 AD
Nodena	Middle Mississippian	1450-1500 AD
Armorel	Middle Mississippian	1500-1700 AD

The first appearance of true Mississippian culture in eastern Arkansas occurs during the Big Lake Phase. Morse (1977:186) suggests that migrations of fully Mississippianized people from southeastern Missouri entered Arkansas and interacted with the widely scattered, indigenous population. On the outskirts of Parkin, contemporaneous Baytown (Late Woodland) and Middle Mississippian settlements are found in close association (<0.25 km), but they are clearly living independently of one another (Morse 1981:40-41). This indicates that there was ample opportunity for populations to come in contact with each other; some cultural contact and ensuing acculturation undoubtedly occurred.

Middle Mississippian (1250-1600 AD)

Many of the sites occupied during the Middle Mississippian period share the same environmental features; namely rises in the topography with easy access to such resources as fresh water and fertile cropland; as Late Woodland populations. As a result, early occupation portions of these habitation areas are intensively reoccupied by later peoples, who, like those in southern Indiana, severely impact the visibility of any pre-existing earlier settlements (Morse and Morse 1983:238). While clearly larger communities of Mississippian people were present, sites that provided cultural development information are the less disturbed and far more numerous hamlets and farmsteads. In the neighborhood of several thousand Middle Mississippian habitation sites

probably exist in eastern Arkansas. Most have not received adequate archaeological attention. There are a few important exceptions.

Two regional centers at Golightly and Hazel (3PO6) contain deposits, whose earlier forms can be discerned from later occupations. There are numerous smaller outlying settlements that suggest use of a dispersed community pattern (Morse and Morse 1983:241, 247). Coles Creek Phase habitation areas are intensively occupied sites in southeastern Arkansas's Lower St. Francis River Basin. No less than six ceremonial centers and 14 hamlets are assigned to this cultural assemblage (Jeter et al. 1979:4). House (1996:147) suggests that a highly dispersed community settlement pattern similar to that in southern Illinois, with a regional center at the Barrett Mound Complex was present . Continuous occupation of the Barrett Mounds site indicates that the later Kent Phase probably emerged as a result of cultural evolution, not population replacement (House 1987:48).

Sites with Matthews Phase materials are found throughout eastern Arkansas (D. Morse and P. Morse 1990:158). Structurally, they are organized very much like those from the Dorena and Medley Phases of southeast Missouri. During the latter parts of the Matthews phase's existence, outlying communities are abandoned and populations are believed to have nucleated around the larger, regional centers. It is unclear why these settlement systems chose to decrease access to their hinterland resources.

Perhaps the best evidence of very late prehistoric population movement in the Central Mississippi Valley has been documented in northeastern Arkansas. Movement of populations, principally from southeastern Missouri, during the mid-fourteenth century was suggested by Williams (1990:176) to be the result of political instability. Northeast Arkansas underwent a series of social reorganizations resulting in a variety of different cultural forms, including Armorel, Nodena, Parkin, Wells-Belle Meade and Kent Phase (Hoffman 1993:263). Many of the former inhabitants (or new migrants) pushed southward and impacted communities in the northern reaches of the Lower Mississippi Valley (Williams and Brain 1983:414).

Artifacts of these late Mississippian population shifts are communities in the Parkin Phase. Parkin Phase sites are compact, highly nucleated communities that occupy strategically defendable positions in the landscape. Currently, there are no less than 21 smaller sites documented as satellites around the larger Parkin site (P.Morse 1990:118). Parkin site (3CS29) is a medium sized (6.9-hectare) regional center with at least seven mounds. It has a large ditch and palisade that surrounded it on three sides (P.Morse 1981:19). While no skeletal data has been identified that supports this position, Parkin Phase settlements suggest a community threatened by violence. Phyllis Morse (1990:126) has suggested that the Parkin Phase may be synonymous with the province of Casqui, a locale visited by DeSoto in the sixteenth century. If true, the aggressors were other competing chiefdoms.

Another very late prehistoric cultural representation is the Nodena Phase. Settlement structure is very similar between Nodena and Parkin, although Nodena appears to be a little more dispersed. Rather than a single regional center, as many as three separate Nodena community clusters are present in northeastern Arkansas. Nodena villages tend to be large rectangular structures with defensive palisades and ditches surrounding them (Morse 1989:97-101). There are numerous mounds associated with the larger settlements. Use of European artifacts as grave goods have led Dan Morse (1990:69, 77) to speculate that the Nodena settlement system may represent the sixteenth century province of Pacaha. If this is correct, then the settlement structure may provide evidence that Nodena represents a single complex chiefdom.

Western Tennessee

Terminal Late Woodland/Emergent Mississippian - Early Mississippian (700-1250 AD)

Western Tennessee lacks a strong Late Woodland presence. Smith (1996:109) notes that a few widely dispersed, very small sites, representing farmsteads and hamlets, are scattered along the Mississippi Rivr and lower river drainage flood plains. The densest occupation of the area appears to be the Reelfoot Lake Drainage Basin. Very few large settlements are recorded suggesting that Late Woodland population sizes in this area were always very small. In general, northwestern

Tennessee displays a continuation of the same basic patterns of Late Woodland-Mississippian transition seen in western Kentucky. Large nucleated settlements at Hamilton (40OB98) and Murphy (40IB128) contain large, dense middens indicating that intensive (permanent?) occupation of these settlements occurred prior to the eleventh century (Mainfort 1996:83). During the eleventh century populations dispersed from these large villages and several multiple sized communities emerged. The Samburg site (40OB1) appears to have been a major political center for the region (Mainfort 1996:85). It is possible that all Late Woodland settlements in the area were part of the same community.

Middle Mississippian (1250-1600 AD)

Recent examinations of the Reelfoot Lake Drainage Basin (which includes parts of southwestern Kentucky) indicate that fourteenth through sixteenth century Mississippian sites are present. Radiocarbon dating and the presence of European trade goods at the Otto Sharp Site (40LK4) are evidence that the site's ceramic styles are contemporaneous with the late prehistoric Pemiscot County, Missouri forms (Lawrence and Mainfort 1995; Mainfort 1996:94). This evidence contradicts Lewis's assertion that Jackson Phase ceramics are indistinguishable from earlier late period ceramics in western Kentucky. Other artifacts, such as snub nose scrapers, are found in other Fulton County, Kentucky sites (including Sassafras Ridge), suggesting that early Jackson Phase components may be present. Post-1300 AD populations along the western Tennessee-Kentucky border appear to nucleate around central settlements (Mainfort 1996:95). This may be an indication of shifts in the region's political structure and a greater need for social cohesion than outlying resource extraction.

In much of the rest of western Tennessee, the very late prehistoric record is documented in sites located along the Mississippi River. While eleventh through thirteenth century occupational components are represented in deposits at Woodlyn (22DS517) and Chuckalissa (40SY1), the full extent of Middle Mississippian occupation is not known (Smith 1996:111). Minimally, secondary centers, such as Chuckalissa, were originally spaced every 2-3 miles along the Mississippi River floodplain and probably represent pieces of a larger social network (Smith 1990:143).

Chuckalissa, perhaps the best preserved and most intensively investigated regional center in west Tennessee, contains numerous platform or structure mounds around a large central village plaza, but lacks any defensive palisades (Nash 1972:5). A multi-mounded complex located in the Ft. Pickering/DeSoto Park area of downtown Memphis probably dominated Chuckalissa and its sister secondary centers. There may be numerous hamlets and other small community sites scattered throughout the floodplain and along streambeds, however current land use has hampered opportunities to verify their presence.

American Bottom

Terminal Late Woodland/Emergent Mississippian - Early Mississippian (700-1000 AD):

The large fertile flood plains along the Mississippi River near present day St. Louis were undoubtedly instrumental in attracting early agriculturalists to the region. Agriculture in the American Bottom probably emerged as a slash and burn technology (Kelly et al. 1984a:156). Small, kin based habitation sites, equating to little more than farmsteads or hamlets, were widely scattered across the flood plain. Extended family groups probably used these occupation areas.

The success of this new form of subsistence gradually increased population sizes throughout the Late Woodland Period. As population densities rose, there were fewer areas to agriculturally develop and as a result, the larger, more permanent settlements competed for shares of the local resources (Kelly et al. 1984a:157; Kelly et al. 1984b:126). In the eighth century, the Patrick and Sponeman cultural traditions divided the population into distinct social/ethnic groups (Table 6-6), (Kelly 1990a:117, 144). Interaction between and within each group provided a means for the development of internal social ranking, and may have underlain later emphasis in goods exchange.

During the Dohack Phase (AD 750-850) villages landscapes were dominated by distinct house clusters (Kelly 1990b:88). This may be evidence of social fusion among formerly independent moieties. Coinciding with these changes, Kelly (1990b:76) argues that agricultural intensification is evidenced by a decrease in the use of upland areas for hunting purposes. Transformation of

domestic space to increase storage capacities and a greater utilization of non-local lithic resources are indications that the production (or procurement) of agricultural surpluses for trade purposes emerged as important cultural factors during the latter parts of the Late Woodland and early aspects of the emergent Mississippian Period (Kelly 1990b:76-77).

Table 6-6. Notable Late Prehistoric Phases in the American Bottom.

Phase	Cultural Affiliation	Temporal Affiliation
Rosewood	Late Woodland	<600-900 AD
Patrick/Sponeman	Late Woodland	<600-750 AD
Dohack/Collinsville	Late Woodland	750-850 AD
Lohman	Early Mississippian	1000-1050 AD
Sterling	Early Mississippian	1050-1100 AD
Moorehead	Early Mississippian	1150-1250 AD
Sand Prairie	Middle Mississippian	1250-1400 AD

Mississippian (1000-1400 AD)

The Mississippian Culture of the American Bottom is divided into four chronological units, the Lohman Phase, the Sterling Phase, the Moorehead Phase, and the Sand Prairie Phase (Milner 1991:30). There are distinct socio-cultural developments associated with each phase.

A clear hierarchical community arrangement is visible in sites dating to the Lohman Phase. Several communities emerge as large, densely populated centers with numerous indications of status differentiation present between community members (Kelly 1990a:136). Distinct political organizations are believed to have gradually consolidated towards a single power structure during this phase.

At Cahokia the development of large, monumental architectural projects identify that at least one powerful centralized chiefdom emerged and was able to direct the planned construction of the largest prehistoric ceremonial center in the Eastern United States. Extensive land remodeling, initiated prior to AD 1000, indicates that the power base, presumably an elite assembly, mustered a labor pool large enough to complete these projects without jeopardizing the community's subsistence

base (Holley et al. 1993). This labor supply may have then been diverted towards crafts specialization during the Sterling Phase (Pauketat 1997:5).

During the Sterling Phase, Cahokia emerged as a paramount regional center with control over numerous highly populated secondary regional centers. Material redistribution was clearly an important aspect of Cahokia's power base. Raw materials arrived at Cahokia where they were processed; transformed into finished products – often with the meaningful symbols of Cahokia attached – and then made available for both internal and external exchange (Pauketat 1997:11).

Kelly (1990a:137) and Milner (1991:32) observe an increase in the number of outlying settlements. These outlying settlements, principally farmsteads, are situated in places where the inhabitants could maximize access to fertile land. Fowler (1969:372) notes that farmsteads were typically placed in the center of prehistoric agricultural fields. There is little to no evidence that defensive measures were part of this settlement pattern. These dispersed non-elites not only indicate that lifestyles (and labor) shifted towards maximizing agricultural production, but that competition between different political segments within and between chiefdoms was peaceful.

Deposits left by these dispersed populations show a greater diversity of faunal exploitation than seen in the central communities, indicating a greater self sufficiency than seen within the more urbanized portions of the chiefdom (Pauketat 1997:12). The low number of projectile points and high amount of meaty deer parts in Cahokian refuse piles suggest that more valuable foods were passed from the outlying areas to other groups within the central chiefdom (Pauketat 1994:61). An examination of stable carbon isotope ratios from populations in the American Bottom indicate that maize consumption is less than seen on other Mississippian societies, notably the Ohio Valley (Buikstra and Milner 1991:325; Schurr and Schoeninger 1995:334). While maize was a major dietary contributor, the distribution of non-maize agricultural and gathered/hunted foods in the American Bottom provided nutrition to the community more efficiently than seen in other Mississippian cultural regions.

While competition between various elite groups was almost certainly present, aggression was probably prevented by the degree of political and economic freedom present within the "lower"

elite echelons. Political linkages between power bases at secondary and tertiary centers enabled resources, such as raw materials and manpower, from other districts to be acquired through intermediation within the political chain of command (Milner 1991:31). Competition among elites, therefore, probably centered on the acquisition and maintenance of alliances; a system that meant that the political structure was constantly in a state of flux and providing numerous opportunities for the system to decompose.

The Moorehead Phase is characterized by indications of an organizational collapse within Cahokia's paramount chiefdom. At this time, population levels in the American Bottom decline to less than half what they were in the Sterling Phase (Milner 1986:232-233). There is little to no evidence that disease or violent conflict was involved in this depopulation. Milner (1991:36) argues that at least some of this loss can be attributed to migrations into the upland areas flanking the main Mississippi Valley. It is unclear why populations left, however resource depletion and environmental degradation have been suggested as contributing agents (Brown et al., in Milner 1991:36; Fowler 1975).

Finally, during the Sand Prairie Phase, population levels in the American Bottom drop to the lowest point of the Mississippian occupation (Milner 1986:232-233). Habitation sites are frequently only ephemerally identified. Centralized political authority appears to have been replaced by localized community autonomy. The lack of palisaded or defensively situated habitation sites is an indication that aggressive competition between communities was at a minimum. While evidence for social ties can be found in existing data, it is doubtful that community interactions extended much farther than minor trade and support networks.

Conclusions

Within the Central Mississippi River Drainage Basin, there arose a lifestyle that enabled population sizes to increase to a higher level than seen before. Based on a few general features, these societies can be classified as Mississippian. Much beyond this, however, the material record indicates that Late Prehistoric communities followed a wide array of behavioral patterns. It cannot be

assumed that a high degree of continuity extended from one region to another. To some degree it seems evident that material cultural differences were present between different communities with regions as well. Much of this variation seems to be related to differences in community organization. While settlements can be categorized into three general size gradients, the relationship between these habitation areas is far from uniform. Fowler's (1966) trimodal hierarchical arrangement between sites can be identified in many places, but evidence can be found that suggests that each size gradient could also be acting as an autonomous community. Not all gradients need to be present; some regional centers appear to be surrounded by farmsteads, while small self supporting villages may also possess their own satellites. The presence of dispersed settlement systems also is evidence that hierarchical models may not be universally valid.

Settlement size probably identifies some aspect of the society's structural arrangement in the landscape. But it seems doubtful that magnitude is purely a function of socio-political power. Regional community arrangement appears to also be influenced by resource extraction strategies, the distribution of extractable resources across the landscape, size of the colonizing population, and protection from natural and human hazards. Based solely on the size of a particular settlement it cannot be assumed that a community occupies a specific niche within a power matrix. Beyond the vague notion that Late Prehistoric societies formed chiefdoms, it seems unlikely that any general organizational principles can be applied to a particular site.

One feature clearly contributing to the high level of diversity seen is cultural evolution. It is probably safer to assume that Late Prehistoric communities are changing in a more independent and less unified manner to stresses in their social and natural environments. Community trajectories indicate that the timing of colonization, expansion, divergence, and decline are for the most part, unsynchronized events. This feature suggests that settlement systems express a greater level of political heteronomy than homogeny. The support network surrounding each community is limited – it probably did not extend to a pan-regional scale. Having said this, however when examined on a regional scale, sets of contemporary communities do display similar sets of features. These suggest that a common agent was causing some Mississippian societies to react in a particular manner. In

the 14th and 15th centuries many of the large settlements experience a nucleation of populations, sometimes accompanied by a decrease in regional population density. It can be demonstrated that this event was substantial enough to cause communities to react in similar manners. In southeastern Missouri, one common reaction was to migrate elsewhere within the region, while on the eastern side of the Mississippi River, population aggregation and eventual abandonment of the region were the general response. This was the social environment around the Wickliffe community.

Chapter 7. Late Prehistoric Mortuary Behavior

Very little is known about the Mississippian mortuary programs from the Central Mississippi River and Ohio River Valleys. Like other Mississippian cultural arrangements, death event symbolism does not follow a uniform pattern. Mississippian funerary rituals exhibit considerable variation. This chapter reviews how late prehistoric communities choose to care for their dead.

Western Kentucky

Only a few mortuary deposits have been recorded from western Kentucky. Most of these focussed largely on graves encountered at larger sites in the region. Funerary practices at the smaller locales are virtually unknown. Among the twelfth century village/hamlet-sized communities, excavations at the Kirtley site (15McL19) recovered several primary interments in association with the site's domestic areas (Lewis 1988b:35; Rolingson 1961:48). A total of 15 burials were encountered at the Jonathan Creek (15ML4) village (Webb 1952). These were also located within the habitation area and were probably related with specific households. The domestic areas were not the only location where graves were found at Jonathan Creek. Webb (1952:75) also noted that a low mound located outside the village's palisade line contained the probable remains of several stone box graves.

The presence of these dichotomous burial areas may be related to time. Clay (1997:24) suggests that the use of stone boxes may be related to the site's later occupation. If correct, then a considerable transformation in mortuary activity occurred during Jonathan Creek's occupation. First, use of domestic space as an acceptable burial place was no longer considered applicable. Segregation of the dead outside the village in a specially constructed facility may be evidence that space was ritually prepared and set aside for the sole purpose of conducting mortuary activities. Secondly, Jonathan Creek exhibited a change in grave preparation. Initially graves lacked durable liners. This behavior was replaced with the addition of a stone liner. This modification in grave furniture may imply that ideas expressed by these mortuary rituals also changed.

Use of mounds for mortuary purposes has been documented along the Green River at sites, such as Annis Mound (15BT2), and possibly at Martin Mound (15BT1). At the Martin Mound, Greenacre's field notes indicate that stone vaults were employed to enclose some of the interments placed in this structure (In Young 1962:8). Stone grave liners are commonly associated with Woodland and Mississippian period mortuary assemblages. They were generally used between the eleventh and seventeenth centuries (I. Brown 1981:18).

At Tinsley Hill (15LY18), mortuary deposits were identified in two different places. Several infants were buried in close association with residential house floors (Clay 1997: 19). No adult graves were encountered in the village, suggesting that burial in the site's domestic space was reserved for youthful interments. Adults and other non-infants were interred in a cemetery outside of the village's confines (Schwartz 1962). Both primary and secondary body treatments were encountered. Most skeletal deposits were found in stone boxes. Clay (1984:141) suggested that grave form and body treatment in the Tinsley Hill Cemetery were the result of intentional skeletonization, storage in a village facility, and subsequent reinterment of those remains in the original mortuary activity area[1].

Unfortunately, post-interment aboriginal activities obscured mortuary features among many of these burials. Graves were frequently reused. Numerous graves demonstrated that earlier contents were moved to one side and new interments added (Schwartz 1962:91-92). In several cases, stone liners were robbed from one grave and used to construct another. Construction with a common wall between graves was observed. These burial receptacles were not considered to be exclusive to a particular interment, rather the dead and their final resting place were subject to manipulation at a later date. Many of the graves are shallow deposits and vertical stones may have protruded through the ground's surface. It is possible that some form of surface designation marked where each grave was located.

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[1] Clay (1997:22) has since changed his mind and no longer feels that these features are evidence of status differences and chamelling activities.

It is extremely doubtful that the Tinsley Hill cemetery is representative of the whole village occupation sequence. Schwartz (1961:93) believed that historic artifacts found with some graves were indicators of Anglo-American contact. More recently, Lane (1993:24) suggested that these might also represent chance inclusions, not deliberate grave goods. Another possibility is that the cemetery and village have no association. No other temporally sensitive artifacts were recovered from the cemetery. A single charcoal radiocarbon date was obtained from the bottom of a burial sequence. This estimate places death of the plant between 1260 and 1475 AD (Butler 1991:272). Burials on top of this would have been deposited at some later time. If this is a reasonable approximation, Tinsley Hill's mortuary accumulation period coincided with latter aspects of the village's occupation period. Temporal overlap between the village and cemetery is still incomplete. There are no indications where or how the earlier village adult population was interred.

Tinsley Hill provides evidence of change in a Mississippian community's mortuary structure. The location used to bury the dead shifted between when the village's domestic occupation sequence commenced and when the stone box cemetery's accumulation period began. It is not known why this change took place.

Mortuary deposits have not been systematically explored on Kentucky's side the Ohio and Mississippi Rivers. C.B. Moore carried out some of the earliest reported mortuary excavations around the turn of the twentieth century. At Colvin Lake (15BA31), Moore's excavations (1916:488) encountered 36 interments on a low rise in association with the habitation area[2]. Most of the graves Moore encountered were primary adult interments, but several infants and secondary interments were also present. Moore's description does not indicate when these interments were placed in the burial area or their exact relationship with the Colvin Lake site. It is possible that infant and adult burial areas were not segregated or that one burial areas shifted and subsequently overlapped with the other. No professional excavations have been conducted at Colvin Lake. However, survey work

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[2] These descriptions do not indicate whether this rise was located in the habitation area or outside of it and if it is a natural or man-made feature.

by Kreisa (1991:126) suggests that Colvin Lake is a multi-component settlement. Whether several cultures used the same burial area cannot be distinguished from the available data, but the illegal recovery (and subsequent sale) of effigy figures from the cemetery strongly implicate a Mississippian presence.

As seen at Jonathan Creek, mortuary space was treated as a component of the domestic use area on several western Kentucky sites. At Massac Creek (15McN1), Moore (1916:490) recovered 20 skeletons from the village's habitation area[3]. Excavations in the Sassafras Ridge village (15FU3) also encountered adult human remains (Moore 1916:505).

More recent excavations identified that human remains within the village use area. These consisted of isolated adult bone fragments or were confined to the infant/subadult age group. McGill's (1985:52) examination of remains recovered from village midden excavations at Turk (15CE6) encountered no adult interments within the perimeters of the village. Allen's (1986) investigation of the human remains recovered at Adams (15FU4) identified infant primary inhumations in the habitation/midden areas, while adult remains consisted of a few scattered skeletal elements. Allen (1986:75) believed that rodent activities were responsible for transporting these remains, but this does not explain why only adult remains were being selectively transported. Matternes (1996a:314) has alternatively suggested that adult inhumation in living areas may have been followed by disinterment for secondary burial elsewhere. The small fragmented elements recovered could represent elements missed during the aboriginal recovery process.

For the most part, it appears that adult burials were concentrated to discrete areas on sites along the Mississippi River. Webb and Funkhouser (1933:14) indicate that the mortuary area at McLeod Bluff (15HI1) was located in a discrete portion of the village, not interspersed in the domestic area. Based on surface collected materials, Stout (1987:19) felt that the Adams Site (15FU4) adult

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[3] This assessment may not be well founded. Funkhouser and Webb (1932:252) note that the 20 skeletons at Massac Creek were actually recovered from a mound also located at this site. Moore's description is too vague to confirm or dispel this possibility. The same may also be true of the Sassafras Ridge recoveries. Strong evidence of adult burial in the domestic area is lacking for most sites along the Mississippi River.

burial areas were located outside the village's recognized confines. At the Duncan (15TR1) site, a small stone box cemetery was located a short distance from a Mississippian habitation area (Funkhouser and Webb 1931).

Many local collectors have attested that graves were present in the Twin Mounds earthworks (15BA2, 15BA14), but there have been no formal explorations of the mortuary deposits. At least one burial area was formed during each of the site's two occupation phases. Based on Twin Mound's large size the accompanying mortuary assemblage would have to be substantial.

More concrete evidence for the use of manmade mounds and natural earthworks as mortuary sites are recorded in the region. At Tolu (15CN1), Webb and Funkhouser (1931) encountered a large (~4 acre) mound containing a dense burial deposit. They recovered 23 skeletons. None of the observed bodies were in stone boxes. Most burials contained some form of grave good. Tolu probably was a regional center; it operated as an important satellite of the Angel Chiefdom (Kreisa 1991:98). The burial program represented there may have been reserved for the elite or more economically prosperous segments of the chiefdom's population. Funkhouser and Webb (1932:15) note that "clay" mounds along Mayfield Creek were used for mortuary purposes[4]. The Carrsville Mound (15LV30) may also represent a Mississippian burial area that was spatially separated from village and midden areas (Kreisa 1991:86).

Information on mortuary practices at the small outlying hamlets and farmsteads are extremely limited. Recovery of an infant burial in close association with a wall trench at 15McN24 indicates a continuation of the infant burial pattern observed on larger sites at these smaller locales. While unconfirmed, several local collectors note that adult burials are occasionally encountered at many small Mississippian habitation sites.

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[4] Examination of similar structures led Mattemes (1995a:107) to suspect that these mounds are actually natural geologic features and not the result of aboriginal earthmoving activities.

Southern Illinois

Unlike western Kentucky's non-existent Late Woodland mortuary record, some indications of Late Woodland mortuary practices were recorded in southern Illinois. Several Dillinger Phase stone box graves were reported, but this practice was not widespread or uniform among interments from a given mortuary site (Muller 1986:159). Some form of social meaning was probably communicated by this choice of grave form.

In the Black Bottom, only a few Mississippian mortuary sites were ever reported. Most cemeteries contain stone box graves and were found in association with hamlets (Butler 1977:196). There have been no formal investigations of these structures. These small cemeteries indicated that choice of burial location was a function of the local cultural regimen. Graves were placed at the local social center or where permanent access to the burial area (i.e., not on inundateable land) was possible. While the appearance of stone boxes was indicative of a later (Angelly or Tinsley Hill Phase) development elsewhere, no definitive temporal affiliations were assigned to any of these structures in the Black Bottom. In southern Illinois, stone lined graves could represent a surviving Woodland funerary behavior.

Mortuary activity at Kincaid, the area's regional center, is incompletely represented. As noted earlier, there appears to have been an influx of Mississippian people back to the Kincaid regional complex during its latter aspects, but this cultural resurgence is not associated with the construction of new monumental architecture. Instead, it appears that many of the existing structures were renovated and given new functions. At least one mound was reused was for mortuary purposes (Muller 1978:282). A single cemetery was present at Kincaid. However, its location was isolated from other excavations and little was learned about its construction and relationship with the rest of the site[5]. Butler (1991:269-270) attributed most interments in the

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[5] This cemetery is in the eastern portion of the Kincaid site and the main excavation focus was in the western part. Practically no excavation has occurred around the cemetery, so little is known about how this portion of the site was used. The relationship between the mound cemetery and complete pattern of use at Kincaid remains unresolved.

cemetery to a later period (>1300 AD) use of the site. The cemetery contained a variety of grave forms (wood lined, stone lined and unlined grave pits) and body manipulations (single, multiple, primary and secondary interments). Whether burial ever occurred at Kincaid prior to this cemetery's accumulation phase was not verified, nor was it clear if the diversity of mortuary forms seen were the result of change in mortuary custom during the reoccupation phase or a incomplete representation of the Kincaid mortuary program.

Southern Indiana

There are a number of similarities between southern Illinois and Indiana Late Woodland mortuary practices. Burials are sporadically found in association with habitation areas or in concentrations that might represent more formal spatial arrangements. Excavations reveal that, like interments from the Dillinger Phase, some graves are stone lined (Muller 1986:166). The Woodland use of stone slabs as a grave liner is not clearly linked to later Mississippian use.

Numerous outlying Woodland and/or Mississippian communities possess stone lined cysts containing dense concentrations of secondary interments. These graves suggest that human skeletal elements were allowed to accumulate in the community use areas and periodically subjected to some en masse burial. While it is tempting to see these as evidence of chamel or grave house activities, the data is far too tenuous to draw more definitive conclusions. Many of these secondary burials contain grave goods, but the enclosed materials are not temporally sensitive enough to separate Woodland from Mississippian cultural assemblages (Johnston and Black 1962). At best, they must be accepted as Late Prehistoric features.

Numerous Mississippian mortuary areas were detected in the Angel Mounds complex. Many of these were associated with "neighborhoods" or village foci within the compound (Black 1967). They probably shifted as changes in community orientation took place. As seen elsewhere, there were a variety of grave forms and body treatments, including primary, secondary bundled, and secondary cremated forms (Black 1967:532). Mortuary treatment was probably used as a form of social communication. Elite burials were frequently reduced to secondary assemblages and

probably stored in specially constructed chamel structures (Schurr and Schoeninger 1995:321). Final burial occurred in segregated mound top cemeteries, often without the accompaniment of elaborate grave goods (Black 1967:532). Differences in body position led Schurr and Schoeninger (1995:321) to suspect that familial relationships were being expressed.

The application of greater energy, manpower, and/or manipulation of the elite dead is consistent with Tainter's (1978) expectations in a ranked society. However, the argument is somewhat circular – these are largely the features used to associate these interments with the community"s elite. "Elite" mortuary deposits are located in Mound F, one of the last mounds to be formed; its temporal accumulations date to the Angel 3 period (Black 1967:273-282; Schurr 1992:306). Contemporaneity has not been absolutely established between elite and non-elite burial areas. As a result, the mortuary relationship between elite and non-elite is not definitively separated (Schurr 1992:306). Another likely possibility is that funerary practices changed through time. Clay (1997:30) suggests that mound-deposited secondary interments do not represent Angel's inhabitants at all; rather they are the product of other late period communities using abandoned habitation sites to bury their dead. At Slack Farm, Caborn-Welborn Phase Mississippians bury their dead in discrete mortuary areas associated with discrete house clusters (Pollack et al. 1996:10). More research is needed to clarify the relationships between cemeteries at and around the Angel Mound Complex.

Southeastern Missouri

Late Woodland mortuary deposits were not extensively explored in southeast Missouri. In the Dunklin Phase, funerary activity deposits were virtually unrecorded. While the evidence was extremely limited, the use of Woodland burial mounds (seen elsewhere in Missouri) may not have extended to the Malden Plain (Dunnell and Feathers 1991:23-24). At Hoecake (23MI8), primary interments were detected within village domestic areas (Williams 1974:74). Burial locations were not limited to living areas, the dead were also placed outside of excavated domestic use areas. At Story Mound I, three subsurface log lined facilities containing numerous individuals were recovered (Williams 1974:82-83). Other groups were placed within the mound's fill.

Mississippian mortuary data from southeastern Missouri was also rather sparse. The presence of fine crafted, exotic ceramic grave goods prompted the whole-scale excavation of many Mississippian cemeteries during the nineteenth century (and continuing to the modern day), (O'Brien 1994:4; Thomas 1985:183; Williams 1949). Unfortunately, few records were ever kept. In many cases the only surviving documentation consisted of inferential statements made by those few collectors who took the time to examine the graves.

Depositional environments in the Cairo Lowlands were notorious for their ability to destroy organic artifacts, including bone. As a result, skeletal preservation was often minimal. At Hearnes (23MI7), skeletal recovery in two salvaged mounds was so poor, that graves frequently were identified by the presence ceramic grave goods (Klippel 1969:65-76). Close examination of burial pit fills were able to identify that these burials were intrusive to the mound; although it was unclear whether the mortuary assemblage represented high status interments or reuse of the mound as a mortuary facility. Mound burial was available to more than just high-ranking individuals. Williams (1949:44-46) noted that over 500 burials were recovered from a low-lying mound at Sandy Woods. This was perhaps as many people who lived in the community. More than just elites were probably represented in this facility. Burials tended to cross depositional layers in the mound, suggesting re-use of a previously existing structure. This facility shifted emphasis away from former burial areas and focussed it on this new location.

As seen elsewhere, spatial segregation was used as a form of information transmission in southeastern Missouri cemeteries. At Lilbourn (23NM38), the practice of interring infants in habitation areas indicated that age was a factor selecting against burial in a formal cemetery area (Chapman and Cottier 1977). Most adults, representing burial practices from the James Bayou and Dorena Phases, were found in burial concentrations (Chapman and Evans 1977:95). They probably represented distinct kin or clan burial areas within the community. At Towosahgy (23MI2),

excavations never revealed the presence of a distinct cemetery[6], but several adult inhumations were recovered in the habitation area. Williams (1949:45) noted a similar pattern at Sandy Woods.

Some inferences about community organization were possible from the interments recovered at Lilbourn. Evans (1977:111) noted that adults were segregated into small groups or were positioned relative to a central structure, such as a charnel facility. Most burials were single primary interments with their heads oriented to the east (Gilbert and Wanner 1974:103).

Perhaps one of the more intriguing mortuary deposits in southeastern Missouri comes from excavations at the pre-thirteenth century Kersey Mound Group (23PM42). The site was located on the southern portion of the community's habitation area (O'Brien and Marshall 1994:185). In Mound 1, represented by little more than a low rise in the surface topography, an elliptical postmold pattern encompassed 38 interments. Almost 60% of these graves contained secondary interments and were arranged as rectangular bundles (Marshall 1965:44). Four distinct phases of mortuary activities could be discriminated at Kersey. Infants were initially deposited in a pre-mound habitation deposit. The area was then redefined and an oval charnel structure containing numerous bundled interments added and subsequently removed (Marshall 1965:51). Finally, primary and secondary interments were placed over the approximate area of the charnel structure. This activity indicated that the mound/charnel facility was identified as an appropriate burial place even after its principal mortuary function has subsided.

Among Powers Phase sites, mortuary deposits were situated in close proximity to habitation areas. At the Snodgrass (23BU21B) village, adult interments were found distributed within the domestic areas (J. Price 1978:215). There were no patterned arrangements noted. At the Turner (23BU21A) site, 54 interments containing no less than 118 individuals were positioned in the center of the village plaza (Black 1979:7). The cemetery reflected an orderly arrangement with five distinct rows of graves falling within the excavation boundaries. Single, multiple, primary and secondary

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[6] Cottier and Southard (1977:263) note that a formal burial area may be located north of the park boundaries. If correct, then adults were buried in at least two distinct areas.

interments were all represented. Very few differences in grave furniture and inclusions were found, leading Black (1979:117-118) to conclude that the assemblage represented non-elite members of the Power's Phase community. Elite members of the Power's Phase community were presumably buried at the larger regional centers.

The mortuary deposits recovered from the Campbell Village (23PM5) and sites along the Pemiscot Bayou exemplified late Mississippian mortuary practices. At the McCoy (23PM21) village, primary interments were identified as a component forming part of a domestic ring around the village's central plaza (O'Brien and Williams 1994:302). At the Denton Mounds (23PM549), both adult and subadult remains were recovered from domestic areas (O'Brien and Williams 1994:290). No formal burial was defined.

Ceramics recovered from the Campbell site indicate placement in the Nodena, Jackson, or Armorel Phases[7]. Mortuary deposits consisted almost exclusively of primary interments placed within the central portion (plaza?) of the site. A vessel accompanied many of the recovered interments. It is probable that the Campbell cemetery represented a single cemetery appearing as separate assemblages by modern land use (O'Brien and Holland 1994:201). Graves at Campbell lacked a consistent orientation. Discernable clusters or rows have not been identified from the grave distribution.

Holland (1991:95-96) observes that Campbell's mortuary deposits probably consist of adult non-elites. All graves contain individuals with relatively similar mortuary treatments, indicating that the community elites were buried in places other than the site's extensive mortuary fields. Subadults are likewise missing, suggesting that the pattern of domestic area interment was probably practiced well into the region's protohistoric period. The possibility that material differences in mortuary programs were a form of social communication is evidenced in several Pemiscot Bayou cemeteries. At the Murphy/Caruthersville Mound (23PM43) horizontal and vertically arranged bundled interments

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[7] Certain late period southeastern Missouri sites have been included in a number of different chronological sequences, because of their strategic location in time and space.

have variable grave good inclusions. O'Brien and Marshall (1994:173-175) suggest that this indicates social differences between interments. Variances in time may also be represented. The 23PM43 complex also contains cremations, secondary (bundled) and primary extended interments (O'Brien and Marshall 1994:168). Stratigraphic placement of these interments indicate that these burial treatments are not contemporaneous, rather that there was a distinct change in how the dead were manipulated through time.

Arkansas and West Tennessee

Arkansas' Late Woodland mortuary record is not well documented. Phillips, Ford and Griffin (1951:444) cited work by C.B. Moore at Chandler Landing as possibly representing of a Baytown burial mound. Graves were scattered throughout the mound and did not have many accompaniments. It was assumed that the mound was built as a mortuary facility. At Zebree (3MS20), primary interments were placed within the habitation area (Morse and Morse 1983:231). In addition, isolated human bones were recovered from several locations suggesting that some form of secondary body treatment was used.

Excavations at the Cherry Valley Mound Complex indicate that Late Woodland/Early Mississippian peoples built a centralized mortuary facility to serve several outlying villages and hamlets. The facility consists of a mounded multiple occupation chamel structure(s) in association with high concentrations of secondary and a few extended interments (Perino 1967:24). Many of these human remains exhibited cremated bones. P. Morse and D. Morse (1990:58) place use of the facility at around 1000-1200 AD

Coles Creek Phase sites display a pattern of burial within the confines of prepared mounds. At the Kelley-Grimes (3DE74) site primary and secondary interments intrude into a previously existing mound; it is unclear whether the mound was prepared as a burial facility or was transformed at a later date (Jeter et al. 1979).

Mississippian cemetery deposits in Arkansas have largely fallen victim to the same commercialization that plagued southeastern Missouri. Late period sites were especially hard hit.

Kent Phase sites contained formal cemetery arrangements that included both primary and secondary forms (House 1987:51). To date these have not been explored professionally. Bunn (1990, in Conner et al. 1995:25) noted that at less densely inhabited sites such as the Priestly (3PO490) hamlet, special mortuary facilities including charnel structures were part of the cultural landscape. Outlying Kent Phase hamlets and farmsteads were also reported to contain burials (House 1987:54). Mortuary deposits from the Parkin Phase were exemplified by interment in elevated locations, such as domiciliary mounds, natural levees or even in raised occupational midden deposits (Holland 1991:29; Morse 1981:21-23).

During the Nodena Phase, the dead were frequently interred in large cemeteries closely associated with habitation areas (D. Morse 1990:75; Morse and Morse 1983:287). Burials were also densely deposited in mound contexts (Hampson 1989:36). In this latter location, no evidence for subadult interments were found, implying that infant burial segregation was part of the mortuary pattern. Graves commonly contained water bottles or bowls placed by the individual's head (Finger 1989:31). At Pecan Point, Thomas (1985:220), noted the use of wood or bark to line extended interments. Graves at these sites formed concentrations, suggesting that family, lineage or similar intra-community groups were represented. Mound C from the Upper Nodena site contained more than 300 individuals, possibly representing a single event deposit (D.Morse 1990:76). Graves located underneath Mound B indicated that village space was reallocated to fit the changing needs of the community.

There have been almost no professional investigations of mortuary deposits in the Reelfoot Basin portions of western Tennessee. Schock's (1986) excavation of three mounds at the Rabbit Effigy (40OB6) site near Samborg, Tennessee was the only reported investigation. At least 60 accretionally buried primary interments were concentrated in low-lying mounds along a ridge outside the habitation area. Radiocarbon assays place these structures in the Late Woodland to James Bayou Phase time frame. Ceramics associated with these burials suggested that Mississippian mortuary activities were greater than Late Woodland (Schock 1986:14). A transition between Late Woodland and Early Mississippian mortuary practices, as evidenced at 40OB6, could have occurred

elsewhere in west Tennessee and Kentucky. Locally, this transformation was more pronounced. Middle Mississippian cemeteries focussed on small conical mounds associated with some of the larger habitation sites, but these may only represent the region's elite.

In western Tennessee, mortuary deposits from Chuckalissa are represented in domestic and circum-plaza locales. Circum-plaza burials appear as fully extended interments; they represent individuals from the community's elite status (Lahren and Berryman 1984:17). "Neighborhood" interments are clustered in association with house/living areas (Smith 1990:144). They probably represent non-elite kin groups within the community. Nearly every burial was placed in an extended position and about half the interments are accompanied by ceramic grave goods. Seriation of the vessel forms, particularly among stratified mortuary deposits, enabled Nash (1972:ii) to identify that use of mortuary areas changed during the site's occupation. The most likely explanation for this is that cemetery location and use changed as settlement foci within the community shifted.

Central Mississippi Drainage Basin

Like other places in the Central Mississippi Drainage Basin, evidence for mortuary behavior in the Late Woodland Period is extremely sparse. This is probably related to the ephemeral, dispersed nature of Late Woodland settlements in general. Droessler (1981:18) notes that Perino's excavations at Koster found evidence of a multistage mortuary program, involving burial in the habitation area and subsequent disinterrment for final dispensation at another locale. Kelly (1990a:122) feels that secluded habitation area burials and isolated skeletal elements in non-mortuary settings may be part of a similar pattern. Cutmarks on some Late Woodland skeletal elements indicate that body reduction was being practiced (Milner 1984a:233). Evidence of semi-permanent cultural fixtures in the American Bottom proper may be represented at the Leingang (11MO722) site. Kelley et al. (1984b:109) note the presence of a low earthen mound, possibly containing a mortuary structure, during the Rosewood or Initial Late Woodland Phase. This structure may correlate with Late Woodland mortuary facilities identified at Yokum (Perino 1971:163-169).

Mississippian period mortuary activities in the American Bottom are perhaps the best documented for the entire Eastern United States. During the Emergent Mississippian period, Milner (1984a:233) notes a continuation of the same mortuary pattern observed during the Late Woodland period. Further development in Mississippian social complexity, however, involves transitions in mortuary behavior. The appearance of space specially set aside for the purpose of mortuary activities emerges in many Mississippian communities.

Beginning in the Lohman Phase, elites were able to muster enough power to legitimate exclusive funerary rituals. Segregated burial in unique mortuary facilities and the inclusion of highly valued grave goods emerge as features that distinguish elites from non-elites (Milner 1991:32). Several spectacular examples of this were recovered from Mound 72 in Cahokia's Grand Plaza. The central burial from 72Sub1 consisted of an individual placed in a discrete mortuary facility and surrounded by a lavish accompaniment of finely made stone, copper and shell grave goods (Fowler 1991:10). Perhaps in further emphasis of the deceased position in Cahokian society were several mutilated male retainers. The funerary site also featured a separate pit containing the remains of at least 50 young females. In other portions of the mound, groups of mass partially decomposed burials were found, indicating that some deceased community members had been maintained in a charnel facility. Other mounds containing charnel structures and/or assemblages of elite secondary interments include Wilson Mound, Mitchell Mound, Powell Mound, and Rattlesnake Mound (Milner 1984b:480). None of these funerary behaviors were associated with mortuary programs that were made available to the non-elite.

Non-elite mortuary areas during most of the Mississippian occupation are present in cemeteries associated with outlying communities or in non-plaza areas of regional centers. In the outlying communities, burials tend to be positioned on prominent points in the landscape and contain a variety of body treatments (Milner 1984b:470). At the Kane Mounds cemetery, body orientation suggested some affiliation with local secondary centers (Melbye 1963:9). Non-elite burial in regional centers focused on small assemblages of individuals or on burial in large nonmounded cemeteries.

These were separated from the general residential areas (Milner 1984b:478). Graves contained both primary and secondary interments.

During the Sand Prairie Phase, political control at Cahokia diminished to a point where mounds lost their former elite functions and were transformed into mortuary sites for the non-elite (Milner 1991:36). In the outlying communities, mortuary activity focussed on the local residence; burials occurred singly or in small groups representing mortuary facilities for use by several widely dispersed residential communities. It is possible that community solidarity and/or kin affiliation were expressed through shared mortuary activity areas. At the Florence Street Site (11-S-458) graves were oriented to suggest the presence of a chamel house (Emerson et al. 1983:223). Evidence for non-elite use of a chamel house/mortuary processing facility is also present at the East St. Louis Stone Quarry Site (11-S-468). A limestone platform was recovered with a large assemblage of secondary interments resting on it and was encircled by at least 72 stone lined and unlined graves (Milner 1983: 11). Many graves show signs of re-use, leading to the belief that many subsurface facilities were never intended as permanent graves, rather they only served as a means of reducing the deceased to a skeletal state (Milner 1983:32).

Stone box mortuary facilities have been encountered in a number of east-central Missouri contexts. Relatively isolated facilities, such as those reported by Diesing (1955) and Ross (1966) imply that mortuary activities were not limited to communal areas. Rather, they may have been practiced at isolated and/or short occupation sites as well. Use of the stone box and analogous material variants as grave furniture extends from the Late Woodland through the Mississippian period. However, the greatest popularity in use among sites from the Central Mississippi Valley seems to have occurred during the late prehistoric period (Milner and Schroeder 1992:64).

Conclusions

Data from any particular mortuary assemblage in the Central Mississippi River Drainage Basin is limited in its scope and interpretability. But when seen in a larger more regional perspective, there are a great number of similarities and differences. In general, the choice of burial as a final

body dispensation practice appears to have been universal throughout the examined Mississippian cultural areas.

Individuals were subjected to a number of body treatments. Many of these carried a very distinct meaning to members of the culture. The most widespread form, primary body treatment, does not possess any regional, temporal, or social limitations. While the placement of a body in a primary interment facility may be seen to imply a degree of permanence, evidence indicates that the sanctity of the grave could be outweighed by needs to accomplish other mortuary related tasks. Cremation or more natural forms of decomposition reduced these bodies to a hard tissue state. Intentional cremation seems to have received a very limited use, most notably to the Early Mississippian cultures of eastern Arkansas.

Other secondary body treatments were accomplished by scaffolding, burial and subsequent disinterment, defleshing, or partial exposure in an enclosed subsurface structure. Secondary interments were scattered throughout the culture area. They may appear singly or in mass burials, indicating that deposition was either accretional or periodic, depending on the needs and uses of secondary interments in the community's culture.

To some degree, secondary bundled interments are associated with two mortuary phenomena -- stone lined graves and charnel structures. These associations are also subject to a considerable degree of variation. Stone lined graves may act to facilitate intentional and unintentional secondary burial formation. But they are not absolutely needed to insure secondary-bundled grave development. Likewise, evidence for maintenance of the dead within the community is best supported, but not absolutely dependent on the reduction of the deceased to a disarticulated skeletal state.

Mortuary sites within the examined areas indicate also that important social differences are present. These seem to be most directly tied with where components of the community were allowed burial. Age seems to be an important distinction. Regardless of the size of the site, adults and non-adults received different burial areas. Infants uniformly were interred within the domestic use area, while adults were afforded burial in another location. This pattern, however, is not absolute

as adults may be interred within the household work area. These burials may not represent permanent receptacles and could be related to the secondary interment transformation process.

Spatial segregation is also reflected within the adult ranks. While there is a general pattern of lacing adult mortuary sites on natural or man-made high ground, some adults received greater material attention as a part of the funeral ritual than others. Burial in active, centrally located mounds, or in prominent centralized locations was not made available to all members of a community. Rather, it seems to have been restricted to higher ranking segments of the society. Among some groups, body treatment may be associated with status. The amount of capital and energy expended to 'properly' bury an elite was considerably greater than what was afforded to a non-elite community member. With the exception of sacrificial retainers, no one feature seems to separate elite from non-elite burials. Lower echelons of society were generally buried in less centralized locations, often outside the confines of the domestic use areas. There are a great variety of grave forms, body treatments, and specific locations found within these groups. While elites in outlying satellites may be buried at the central elite burial ground, non-elites were interred in relatively close proximity to their domicile.

If all these variations were not enough, Late Prehistoric mortuary programs appear to have undergone a fair degree of change. Cemeteries exhibit shifts in location at most major sites and there is some evidence that change in material goods and grave form may have occurred. Coinciding with the approximate shift in community patterns in the 13th and 14th century, many Mississippian sites demonstrate a dramatic change in mortuary location, particularly among non-elite cemeteries. Unoccupied mounds and other former use areas within the central location of many sites are transformed into burial areas for non-elites. The presence of intrusive interments at sites where nucleation is believed to have occurred is strong evidence that some shift in regional community organization took place.

Chapter 8. Archaeological Investigations at the Wickliffe Mound Group

Excavation History

The Wickliffe Mound Group sits on approximately 26 acres of land atop bluffs about one kilometer northeast of the Ballard County Courthouse in Wickliffe, Kentucky (Figure 8-1). It is currently within properties maintained by the Wickliffe Mounds Research Cemetery (WMRC). Ownership of the property prior to the late nineteenth century is not well established. Portions of the current WMRC property were formerly owned by S.B. and B.J. Caldwell, G.W. Newton, Jerry Sullivan, and Martha Harton (Ballard County Courthouse 1895:302, 1897:177). The properties were consolidated into a single tract through purchases made by the Wisconsin Chair Company. The Wisconsin Chair Company erected a timber processing station somewhere on their landholding, that subsequently burned during the early twentieth century (Hunt 1942:25). The whereabouts of this historic structure has not been ascertained, but a 1933 *New York Times* article implied that its location was within the boundaries of the current WMRC landholdings (*New York Times* 1933:6).

Given that the chronology of Native American abandonment is not well established, other temporal inferences can be obtained for historic use of the site. The exact dates that Europeans settled the Ohio-Mississippi Rivers confluence are not known, however it is unlikely to have ocurred much before the Marquette and Jolliet expedition of 1673 (McBride and McBride 1990:583). Most, if not all historic activities at Wickliffe probably date much later than this time. Prior to intensive archaeological activity, the site was used as pastureland (Cairo Evening Citizen and Bulletin 1932:3). This was probably a secondary use of the land. A relatively thin plow zone was detected across the top of Mound C indicating that at some point, the mound was used for agricultural purposes. Other indicators of historic land use include three short concrete footers poured through the plow zone on the western portion of the mound's summit. Their parallel arrangement suggests use as equipment mounts rather than as architectural supports. These might be associated with the Wisconsin Chair

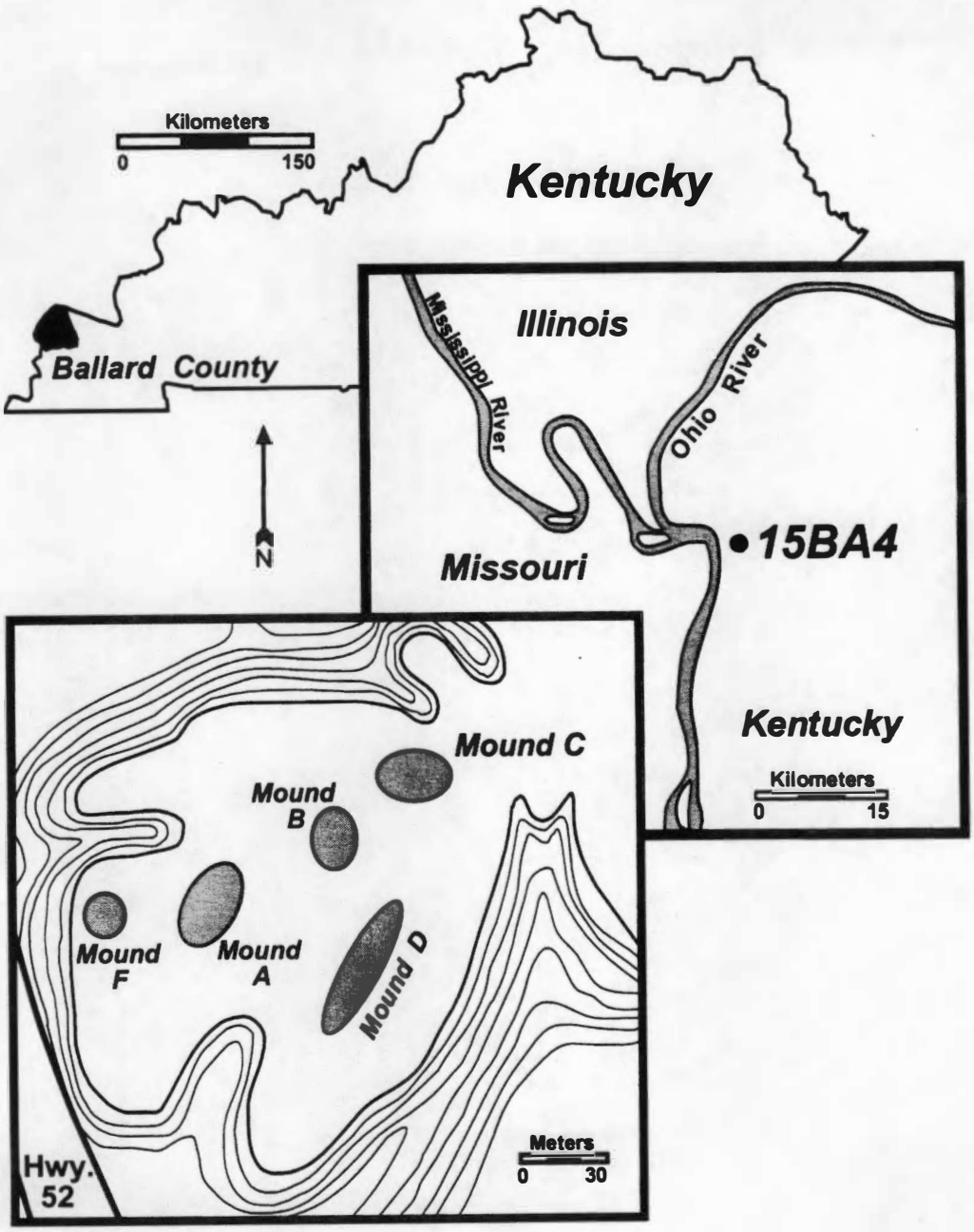


Figure 8-1. Location of the Wickliffe Mound Group (15BA4), Ballard County, Kentucky.

Company's use of the land. A concrete pad along the eastern rim of the original excavation area provides an absolute temporal marker of AD 1932 for these depsosits.

Although knowledge of the site's existence probably extends much earlier, the Wickliffe Mound Group was first officially recognized as a vestige of past human behavior in 1888 when Kentucky Geological Survey surveyor R.H. Loughridge published the first map of the mound group. While Mound C was clearly defined as a cultural feature at that time, there was no evidence acknowledging the mortuary facility's presence.

In 1930, the construction of U.S. Highway 51 removed a considerable portion of the bluff situated southwest of Mound A (Wesler 1988:83). Archaeological deposits, possibly even a burial field, were disturbed during these operations. News of these discoveries prompted Colonel Fain W. King, a businessman from Paducah, Kentucky to buy the site from the Wisconsin Chair Company (Ballard County Courthouse 1932:423).

King's interest in Native American antiquities can be traced to his teens. However, he lacked formal training as an archaeologist (Hunt 1942:25). Despite these shortcomings he and his wife, Blanche Busey King, opened excavations in several of the mounds between 1932 and 1939. The Kings were known for having a rather stormy relationship with many of the region's archaeologists, but they did manage to learn the basic techniques of systematic excavation (Wesler 1988:84-86). In some of the King excavations, information was recorded in five by five-foot units, leaving any visually spectacular artifacts or features in place (King 1939:33; King 1936:36). Large sherds and other artifacts were retained and at least some were segregated by unit and level provenience. While some attempts were made to systematically catalogue artifacts by provenience, there are few indications that King made any field maps or kept detailed field notes (Wesler 1988:84).

King probably was aware of Don Dickson and the commercial success of his Dickson Mounds enterprise. Highway 51's strategic location, formerly the main artery between Memphis and St. Louis, meant that many travelers would pass by the site. King built wooden halls over several of his excavations and opened them to the public as a tourist attraction. Three of these buildings are

still standing. The Kings operated the site until 1946, when they transferred ownership to the Western Baptist Hospital of Paducah. Between 1946 and 1983, the hospital operated the site as a commercial attraction. No substantive excavations occurred during this time. In the early 1980's the hospital reviewed its ownership of the property and, following the recommendations of the Louisville Archaeological Survey, donated the site and its artifact collections to Murray State University in 1983 (DeBlasi and Granger 1982).

Archaeological inquiries at the Wickliffe Mound Group resumed between 1984 and 1996. Largely under the auspices of the site's director, Dr Kit W. Wesler, detailed and controlled excavation at the site provided a wealth of new information about the depositional sequences present (Lewis 1986; Wesler 1985, 1989, 1991a, 1996; Wesler and Neusius 1987). Analysis of new and existing site collections have provided new information on a wide range of topics including lithic resources (Carr and Koldehoff 1994), textile manufacturing (Drooker 1992), sedimentology (Stein 1991), subsistence patterns (Kreisa and McDowell 1995); artifact chronology (Wesler 1991b), and archaeobotany (Edging 1991).

These data indicate that people following the Middle Mississippian cultural pattern formed the Wickliffe Mound Group. The site is most closely allied with sites forming the Cairo Lowland Phase (Phillips 1970:926). These artifact patterns are not well integrated with Mississippian assemblages from the Ohio and Tennessee-Cumberland River Valleys (c.f., Clay 1979). Only recently have tentative ceramic assemblage affiliations between these regions and the Central Mississippi Valley been established (Clay et al. 1991). Stratigraphic location, radiometric dates and ceramic variation frequencies are cross-referenced to position the site in a regional chronological framework (Wesler 1989:89-116). Wesler places the site's occupation between about 1000 AD and 1350 AD. While habitation appears to have been continuous during this period, differences in site use have prompted Wesler to divide the site into three distinct phases, Early, Middle, and Late (Table 8-1). A detailed discussion of these phases is provided in Chapter 9.

Table 8-1. Temporal Phases at the Wickliffe Mound Group.

Wickliffe Phase	Time Frame	West Kentucky Cultural Affiliate[1]	Tennessee Cumberland Cultural Affiliate[2]
Early Wickliffe	1000-1200 AD	Dorena (1100-1300 AD)	Jonathan Creek (1100-1200 AD)
Middle Wickliffe	1200-1250 AD	Dorena (1100-1300 AD)	Angelly (1200-1350 AD)
Late Wickliffe	1250-1350 AD	Medley (1300-1300 AD)	Angelly (1200-1350 AD)

Source:
[1] Lewis, R.B.
1990b Mississippi Period. In *The Archaeology of Kentucky: Past Accomplishments and Future Directions*, edited by D. Pollack, pp. 375-466. Kentucky Heritage Council, Frankfort.
[2] Clay, R.B., S. Hilgeman, and K.W. Wesler
1991 Lower Ohio Valley Mississippian Ceramic Sequence. Presentation at the Ceramic Workshop, Kentucky Heritage Council Archaeological Conference, Bowling Green, Kentucky.

Excavations in Mound C

Human skeletal materials were recovered in a variety of locations around the Wickliffe Mound Group. Mound D contained a substantial number of burials. The Kings reported that 52 infants and several adults were found, leading them to suspect that Mound D was an; "...infant mound...a miniature of the adult burial mound [Mound C] for the children to lie surrounded by their chosen possessions" (King 1937:89). Other examinations of Mound D confirmed the presence of infant interments (Wesler 1989:27; Robinson 1991). Mattemes (1994:7) reports that an adult male skull with a labeled provenience to Mound B was recovered from an assemblage of largely unprovenienced skeletal material found in the back of a former museum storeroom. Labels identifying adult remains from Mound D have been found in several out of context assemblages (Figure 8-2).

No other place in the Wickliffe Mound Group contains the number of human skeletal materials found in Mound C. It is unclear who first recognized that Mound C contained human skeletal remains. The presence of agriculturally disturbed human burials on the summit of Mound C implies that farming may have triggered the cemetery's discovery.

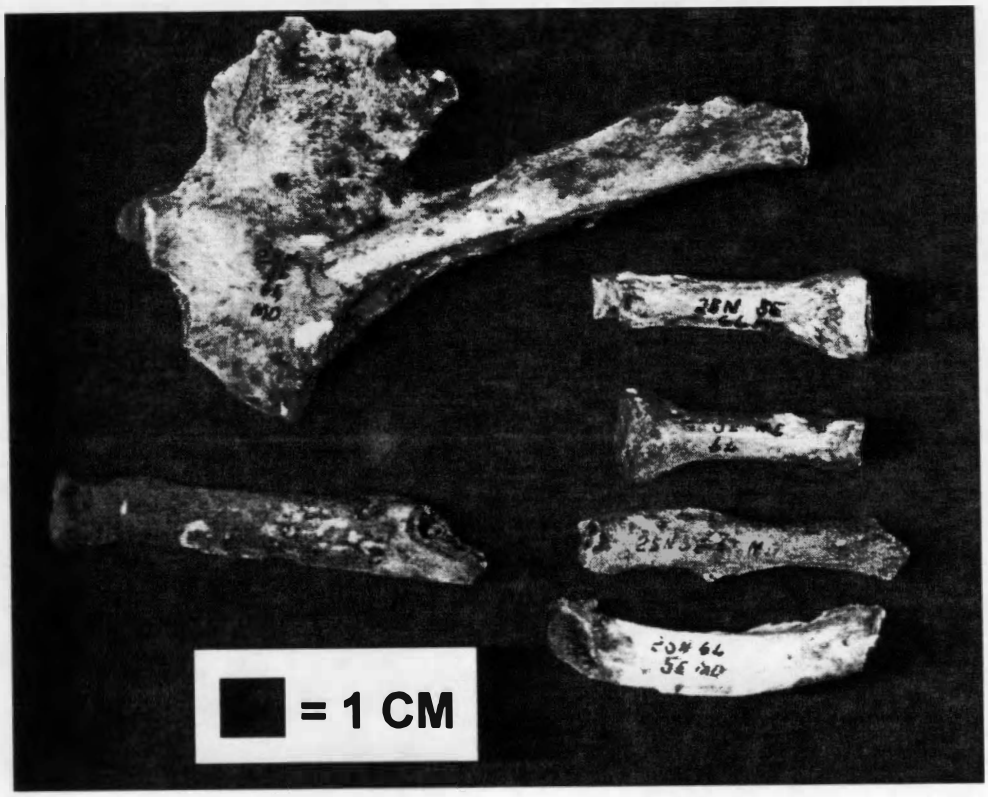


Figure 8-2. Adult Human Bones with Labels indicating a Mound D Provenience.

C.B. Moore conducted the earliest reported excavations in Mound C. Moore (1916:508) reported that; "Careful digging over this site failed to find artifact or burial, though there is a history of objects having been found there." It is evident from this statement that he was not the first person to test the site. In Mound C, shovel marks on the bones from Burial 333 indicated that the contents of this stone lined grave were disturbed at some point during the historic period. A ten by ten foot excavation pit was found on the north-central portion of the mound's summit, but it was abandoned after the top 50 centimeters of fill were removed. There are no indications that this unit encountered any interments. Another historic excavation was encountered several meters northeast of the mound. The exact dimensions of the original unit were not determinable, but it's excavators clearly pursued cultural deposits until sterile subsoil was reached. Several highly disturbed fragments of human bone were found at the unit's base. It is unclear who was responsible for these historic features, but they could represent test pits placed around Mound C by Fain King (1934:16). Other less than professional excavations probably occurred prior to King's arrival on the site and may have been responsible for these disturbances.

The Mound C Cemetery was clearly the showcase of King's "Ancient Buried City". King was probably aware of the cemetery's presence at the time of or soon after he purchased the site. Formal excavation of the mortuary complex did not commence until 1932, when Walter Jones and others from the Alabama Museum of Natural History (AMNH) placed several units in the southeastern side of Mound C. An examination of AMNH excavation notes and photographs indicate that about 10 individuals were encountered(Wesler 1988:86; WMRC). Excavation of the rest of the "King Block", a polygonal continuous excavation encompassing a little over 80 square meters, occurred during or very soon after the AMNH excavation terminated. Quotations of the number of bodies encountered indicate that the bulk of excavation was completed prior to the publication of Lewis's 1934 (p.26) article. Several photos were made during or shortly after excavation revealing some aspects of the excavation strategy. They indicate that the Kings probably were not excavating systematically, rather they uncovered graves within a large truncated rectangle as defined by the presence of a large canvas tent. A building was eventually erected around the

King Block. Wesler (1988:86) noted that King's excavations tended to be more systematic and better detailed after excavating Mound C, perhaps in response to contact with the AMNH crew. In Mound C, King's excavations became shallower as one moved northwesterly across the block. One archival photograph exhibits a ramp extending out from the northwest corner of the block. This may have served as the point of entry and exit. To date, the only records that the WMRC was able to uncover from King's excavations are those few photos and notes made prior to the mid-1940s.

Soon after its excavation, the Kings and others published a string of short overviews of the Ancient Buried City. While none of these addressed questions specifically about Mound C and its cemetery, they also never failed to capitalize on the cemetery's impressive skeletal assemblage. Fain King (1936:38) estimated that the King Block contained no less than 153 skeletons. While no inventory records have been found to confirm this, reexamination of the King Block encountered some bones with labeled proveniences and numerous hand carved wooden tags bearing inventory numbers. These suggest that some record was maintained of the assemblage. The skeletal assemblage was largely left as found for the better part of 60 years. A few additional interments were uncovered through the years, however records do not indicate when these recoveries took place.

Between 1932 and 1991, considerable modifications to the exhibited skeletal assemblage occurred. Most of those responsible for these changes were never identified. In 1934 Richard G. Morgan of the University of Chicago was enlisted to restore broken skulls in the cemetery exhibit (Cairo Evening Citizen and Bulletin 1934:3). Other incomplete bones were reconstructed using plaster or mud-clay, occasionally pooling several bones (not always necessarily the same individual or even same skeletal element) to appear as a single element. Human bones were cut to improve their visual appeal or to aid reconstruction (H. Matternes 1993:35). Modified and unmodified non-human elements were added to the exhibit in an effort to make incomplete remains appear more complete. Some of the photos in Blanche King's 1939 publication, *Under Your Feet,* portrayed post-cranial remains that were restored using plaster of paris.

In 1989, Wesler's investigations in the northern portions of the village encountered the western margin of the cemetery. The abrupt boundary encountered here (and subsequently

elsewhere around the cemetery's margin) indicated that a material or symbolic boundary probably separated the cemetery area from the surrounding landscape (Mattemes 1994:10, 1997a).

In 1991 and 1992, human skeletal materials in the King Block were systematically removed and a formal interpretation of the cemetery's stratigraphic sequence was initiated. While field and laboratory methods were developed to control for historic alterations of the cemetery, a preliminary assessment of the collections by Mattemes (1996b:39) concluded that the given mortuary proveniences could not be treated at face value – some aspects of the data had been clearly compromised. Reliable information from pristine excavations was needed to reconstruct data from the King Era investigations. On a more practical note, the true size and shape of the cemetery were not known, inhibiting what development could and could not be done in the northeastern quadrant of the site. In 1992 and 1993 excavations proceeded outside the confines of the formerly excavated areas to include other portions of the mound. There have been no excavations inside the cemetery's margin since 1993.

A plan view map of the cemetery reveals that it is about 22 meters long along the north-south axis and at least 25 meters in the east-west dimension (Figure 8-3). Its center coincides with the summit of Mound C. Burials tend to be densely congregated within this circumscribed space. While no physical evidence of an enclosure has been found, the space set aside for ritual activity appears to have been specifically defined by the burial community.

The exact size of the cemetery is not known, but can be conservatively estimated at about 350 square meters. A little over 42 percent of this area has been investigated by the Wickliffe Mounds Research Center.

Examinations of the Skeletal Collections

At best only a cursory examination of the site's burial data was ever made during the King era. For the most part, conclusions about the mortuary data tended to stray away from the scientific (even for the period) and more towards speculatory social classifications of each individual's place in the community. For example, Blanche King's synopsis of burials in Mound C concluded:

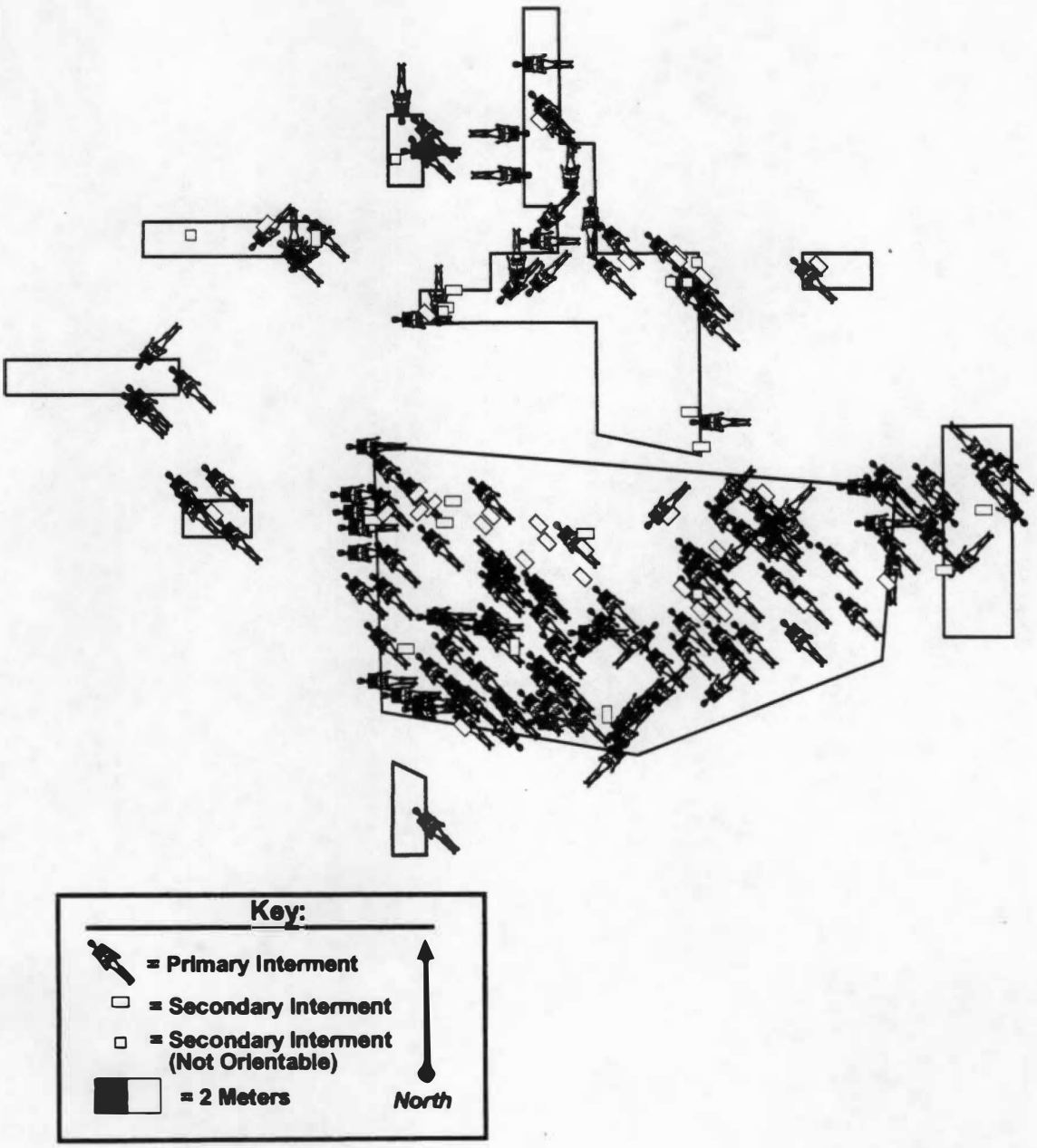


Figure 8-3. Plan View of the Mound C Cemetery.

> The pottery maker...lies buried with her six various sized, mushroom-shaped trowels, made of pottery clay, a piece of round-edged gravel for making incised lines and a piece of cannel coal at her head. As no other pottery trowels were found, it is evident that she was the pottery-maker for the community.
>
> In another section of the Burial Mound are the remains of a man who...was a leather worker, for close to his side are his tools – bone implements consisting of needles, skivers, awls, spatulas and scrapers, some made from fish spines, others from bone of deer and wild turkey. Near him is a family group, father, mother, and baby clasped closely in the mother's arm...
>
> One man was found buried face down with a rock on his head. He evidently was in some disgrace (1939:43-44)."

While substantive data to support his conclusions are lacking, Lewis (1934:26) offered a more comprehensive consideration of the Mound C skeletal population:

> ...on the average these people were rather short in stature as compared to our present racial standards. Furthermore, longevity seems to be the exception, there being but one individual present who might have exceeded the age of seventy.

In all instances, analysts made specific statements based on information recovered from the cemetery. However, in no case was any of the data presented. Particularly in the Kings' interpretation of the cemetery social aspects, the community is viewed as a single moment in time, not a progression of community members (and social positions) throughout time. Whether these conclusions were drawn from information actually collected by the authors, inferred from what others may have said, or were the result of pure, unsupported speculation was not documented.

In some cases the conclusions reached about the cemetery contradicted the evidence that was presented[1]. Perhaps the worst tragedy was that these poorly documented ideas were passed to the American public as immutable facts for most of the twentieth century. There were no records to indicate whether the cemetery was ever examined professionally while under the control of Western Baptist Hospital. In anthropological circles, it is commonly believed that all professional requests to examine the collection were summarily refused. None of the anthropological interests pursued by the Kings were ever followed while the mound group was under the hospital's directorship.

Donation of the site to Murray State University was a pivotal event in the cemetery's interpretation. Initially, examinations of selected skeletal remains from the cemetery were made by students enrolled in introductory physical anthropology classes at Murray State University (Haskins 1990:5). These examinations were extremely limited in scope, but they were evidence that human remains at Wickliffe were no longer viewed as morbid curiosities, rather as important anthropological resources. Robinson (1991) conducted what is believed to have been the first formal laboratory examination of human remains from the Wickliffe Mound Group, however her examination did not include any materials from the Mound C assemblage.

Haskins (1990) was the first qualified physical anthropologist to address the Mound C Cemetery. Tasked with the goal of attempting to determine the number of interments, the quality of the data represented and the possibility of future study, Haskins provided an important overview of the collection's standing after half a century of inadequate care[2]. Her findings were rather dismal:

> It is clear that the Wickliffe Mound C skeletal remains do not offer the maximum potential for further bioarchaeological research...There has been a great deal of disturbance to the burials, and the actual provenience and original burial association of many elements is questionable. As a consequence, the prospects for paleodemographic and paleopathological studies are limited (Haskins 1990:74).

Despite these conclusions, Haskins was able to verify that at least 128 skeletal assemblages were present and provided the first detailed inventory of materials present in the King Block.

As Mattemes (1994:14-36) has outlined, the Mound C cemetery possesses an exceedingly complicated taphonomic history. The effects of numerous destructive agents have limited the collection's ability to answer many research questions. Despite these shortcomings, several analysts have been able to use the skeletal collections to provide some insight into aspects of the mortuary data. In order to outline the general demographic structure of the sample population, Mattemes

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[1] As an example of this point, Blanche King states that adult burials do not vary in orientation (King 1939:44), but the presented burial photographs demonstrate that burial orientations were far from consistent.

[2] Haskins efforts were severely limited by an inability to examine materials that were still embedded in their original matrix. She was also hampered by temporal and manpower constraints, that disabled her ability to acquire little more than proveniences (both photographic and mapped) for each assemblage and conduct a cursory examination of the loose skeletal elements.

(1994:2) systematically examined the collection. A battery of standardized age and sex observations were obtained from the collection and then used to construct a life table following the generalized approaches outlined in Mattemes (1994:117-123, 132). This analysis indicated that the cemetery was composed mostly of older (over age 30) individuals. These data were supported by preliminary health assessments from a test sample of the Mound C skeletal population, concluding that there were very few indicators of skeletal stress represented (Mattemes 1992).

Morphological analysis of the population was limited to stature estimations based on a sample of 28 femoral and tibial lengths (Hosick 1992). Hosick determined that male height tended to fall between 164.75 and 171.9 cm while females were between 154.38 and 162.94 cm tall. These estimates were several inches shorter than stature estimates obtained from a sample of living Western Kentuckians.

Chapter 9. Social Organization

Cemeteries express important aspects of a community's ideology. In a sense they are a form of social dialogue, serving to inform an audience about ideas that are important to the burial community. One commonly represented idea in the mortuary setting is how the burial community is structured (e.g., Binford 1971; Braun 1981; J. Brown 1981; Saxe 1970). By examining the relationship and components of graves, one to another, the underlying organizational principles of a burial community can be discerned (Brown 1995:11).

Most social analyses of mortuary deposits occur in assemblages that can be related with other sets of cultural remains. As Bartel (1982:53) has noted, organizational components of the community represented in mortuary data are only a small portion of its total structure. These analyses are not blind, analysts possess some idea of what social groups may be represented from information inferred in other aspects of the archaeological record.

Analysts have been struggling with the issue of community structure in western Kentucky since at least the 1930s. Largely by default, sociopolitical organization of the region has traditionally been viewed as a chiefdom. Wesler (1991a:122) laments that; "we make this assumption partly because we equate Mississippian with chiefdoms. We also cannot imagine platform mound sites in the Mississippian heartland being anything but chiefdoms". The properties of a chiefdom are reviewed to see if this assumption is reasonable.

Features of Chiefdoms

A chiefdom can be thought of as an assemblage of communities that placed permanent social control under the jurisdiction of a single paramount leader (Carniero 1981:45). Chiefdoms imply that some ranked social differences beyond age and sex are recognized and that access to community resources (predominantly meaningful status symbols and excesses of goods or labor) are delegated according to these differences. In their simplest form, chiefdoms contain at least two levels of stratification. They are divided into non-elites, who play the smallest role in the community decision making processes, and elites, a more exclusive group who are more involved in the

community power structure (Earle 1987:288). Elites are usually linked and ranked by their genealogical relationship to a living, ancestral, or mythological figure (Steponaitis 1978:419).

By pooling excess resources, chiefdoms attempt to obtain materials that are not locally available. Economic contact and competition with other communities are important aspects of their structure. Chiefs or their counterparts do not have exclusive rights to community resources, they merely have the greatest access (Earle 1997:70). Most chiefdoms function through the use of redistributive economic strategies. In this system, non-elites place access to surplus resources (generally goods or labor) in the hands of the elite with the expectation that the elite will then provide a product that is beneficial to the non-elites (Service 1975:151; Steponaitis 1978:419). Leaders who are unable to gain or maintain access to the non-elite's resources run the risk of being ousted or abandoned in favor of a more accommodating candidate (Earle 1991:4). Likewise there is considerable competition within the ranks of a chiefdom, resulting in constant alliance and power shifts (Anderson 1994:4; Earle 1991:13). Chiefdoms must be viewed as temporary, unstable political structures that periodically dissolve and reform (Service 1971:143; Webb 1973:379).

Chiefdoms can be divided into two forms - simple and complex. Simple chiefdoms usually maintain control over a single community. Power is often ascribed to an individual who acts as a part-time administrator and whose duties focus on caring for the community's welfare. In simple chiefdoms, non-elites probably get the greatest return for their investment. Elites are not socially and economically powerful enough to subsist solely on the labors of the non-elites and as a result, much of the non-elite's investment (and return) is redistributed back to the populace (Steponaitis 1978:420). Feinman and Neitzel (1984:48) view many aspects of simple chiefdoms as analogous with big-man forms of social complexity.

Earle (1991:3) points out that chiefdoms use two political strategies to balance control over their communities and maintain their prestige among other communities or potential trade partners. In Group Oriented Chiefdoms, the role of the individual elite is down-played in favor of promoting the community as a whole. Solidarity among community members is promoted by frequent group or

communal activities as a means of maintaining political control (Camiero 1981:47). These elites are expected to maintain a minimal degree of visible social distinction between the elite and non-elites.

Among Individualized Chiefdoms, the elite emphasize their personal positions as being higher in the social ranks than their subordinates (Earle 1991:3). Visible displays of wealth and prestige, such as special attire, monumental housing and presentation of elaborate funerary rituals are features used to accentuate the elite's social position (Feinman and Neitzel 1984:57). In order to achieve success in the social environments surrounding chiefdoms, resource bound elites must apply both group solidarity and social superiority tactics. Most chiefdoms reflect some mixture of both strategies in their organization. Both Group Oriented and Individualized political strategies may be practiced in complex or simple chiefdoms.

Among Complex Chiefdoms, control over several communities is centralized to a single ruling elite. A hierarchical arrangement among the elites emerge with a paramount figure serving to direct access to the resources available among lower ranking elites, who in turn represent distinctly different communities (Steponaitis 1978:420). Complex chiefdoms contain at least two tiers of bureaucratic management. These are spatially arranged across the chiefdom's territory. Population size seems to be the single most important factor influencing the stage of bureaucratic control (Feinman and Neitzel 1984:67). Complex chiefdoms, therefore, reflect a distinct hierarchical settlement structure with a single, highly populated large center, at least one smaller, less populated secondary center and a host of smaller subordinate communities. Relative size generally reflects a community's status in the social order.

Elites in a complex chiefdom are often full-time administrators who live off of the surpluses provided to them by the non-elites. Elite positions are often inherited, but acceptance of the position is subject to whether the applicant's personal qualities meet the approval of the populace (Feinman and Neitzel 1984:61). In complex chiefdoms the non-elite's actual return for their resource investment is less than in a simple chiefdom.

Chiefdoms represent an evolutionary transition between local autonomous rule and statehood (Service 1971:134). The mechanics of how they actually operate are highly variable and

subject to a host of social and environmental factors. As a result, chiefdoms are rarely uniform in appearance or structure. Most social analysts recognize that there is a tremendous range of diversity represented within this descriptor (Earle 1991:2; Service 1971:133). As a result, describing a society as a chiefdom actually implies very little about its social arrangement. Muller (1984:489) points out that chiefdoms should not be viewed as a categorical classification of social complexity, rather this term should be used only as a general descriptor of the degree of social integration within a region. Earle (1987:281) notes that chiefdoms more realistically follow a range of continuous variation. Operationalization of these concepts, however, is lacking.

Despite this wide range of variability, chiefdoms do possess some common features. Peebles and Kus' (1977) examination of ethnographic accounts about chiefdoms uncovered five features that identify chiefdoms in any socio-environmental context (Table 9-1). The importance of this work stems not only from its general, near universal application, but from its ability to reexamine the archaeological record for signs of a ranked cooperative community structures. These features have become the mainstay of chiefdom delineation in American archaeology.

Table 9-1. Chiefdom Features Visible on a Regional Scale.

Feature No.	Feature
1	Ascribed Ranking among Individuals.
2	A Hierarchy of Settlement Types and Sizes.
3	Settlements located in Areas of High Subsistence Procurement.
4	Organized Production Activities that are Greater than a Single Household in Scale.
5	Evidence for Mixed Strategies to overcome Regional Environmental Fluctuations.

Source:
Peebles, C., and S.M. Kus
1977 Some Archaeological Correlates of Ranked Socieities. *American Antiquity* 42:421-448.

Chiefdoms in Western Kentucky

Many analysts believe that chiefdoms were present in western Kentucky. Butler (1977:262-268) proposed that Mississippian sites in the Lower Ohio River Valley were part of the Kincaid

chiefdom. Muller (1986:187) expanded the area of Kincaid's influence to include many of the west (including Wickliffe) and west-central Kentucky Mississippian communities. Muller emphasized that the strategic, fortified nature of these sites was indicative of communities on the periphery of Kincaid's control, while sites situated away from the borders would have little need for strong protective measures.

Kreisa's (1995:173) examination of sites on the Kentucky side of the lower Ohio River supported this idea. Kreisa recognized that Twin Mound's geographic location, enabled it to potentially exert economic control over agricultural and aquatic resources at the Ohio/Mississippi Rivers confluence. This may have been a critical factor prompting the site reoccupation. Mississippian components at the Kincaid and Twin Mound sites were undoubtedly contemporary. Organizational structures at Twin Mounds, namely its large size, impressive mounds and possible satellite communities, led Kreisa (1995:170-171) to believe that it served as a secondary center. The most likely candidate for socio-economic control over this community was Kincaid. The Twin Mounds community was over 60 kilometers from Kincaid. This distance appears substantial, but Hally (1993:164) concluded that the distribution of Twin Mounds and other Lower Ohio River Valley mound sites could easily represents administrative centers for a single unified chiefdom.

Kreisa (1995) believes that the western Kentucky regional centers of Twin Mounds, Tolu, and Rowlandtown were also secondary centers, a natural result of the Kincaid chiefdom's expansion. Secondary centers develop from power concentrations at isolated nodes outside of the paramount political center. They serve as administrative centers. Subordination to a more powerful community is advantageous for all participants. Linkages with more politically important chiefdoms enable leaders at the smaller community to gain access to social resources (such as internal power and political or military support), while members of the chiefdom's infrastructure acquire greater access to the region's resources, manpower and as well as increasing regional cooperation. Classification of a site as a secondary center implies that the community achieved a particular point in its political development. Price (1978:183) notes that secondary centers require the community to possess a

political infrastructure and enough resources to be able to support the number of non-producers (bureaucrats, administrators, and constabulary) needed to maintain the organization.

Some analysts do not accept defining complex chiefdoms as western Kentucky's dominant Mississippian social arrangement. One issue called into play is contemporaneity. Clay (1997:25-26) argues that before one can accept all of a site's structural features as part of the same assemblage, they must be considered relative to time. Are the organizational features of one point in time (like mound construction) valid throughout the site's occupation? Since Twin Mound's architectural construction period begins during the latter phases of mound building at other sites in western Kentucky, Clay questions whether any social inferences obtained from Twin Mounds' earthworks imply the presence of elite power beyond the construction period. Why couldn't Twin Mounds be an autonomous village and its mounds a function of Mississippian architectural fashion during a brief period in its habitation?

In keeping with Peebles and Kus (1977), Kreisa's community model is based on a view that chiefdoms follow a diagnostic organizational pattern - a view which has been critically challenged by Cobb and Garrow (1996). In essence, Cobb and Garrow (1996) recognize that chiefdoms do not universally possess the same social components and as a result should not be expected to follow a universal social model. Smith (1978:500) and Muller (1993:134) also doubt whether the traditional trimodal hamlet-village-town hierarchical model is the foundation of Mississippian social organization. This model tends to focus on the dependence of certain sized social assemblages to the overall structure and de-emphasize the semi-autonomous nature that exists in most separate communities. Competition is not simply between polities, but extends through the lower order communities from resources available within and between chiefdoms (Earle 1989:87). Muller (1986:134) notes that the fundamental social unit of Mississippian society was the household, and that the size and number of amalgamated households present at a locale is more a factor of environmental and agricultural concerns than an indicator of place in the region's hierarchy of political control. At best, size and structure should be considered after agricultural and environmental factors have been extensively addressed.

Some sites in western Kentucky follow a regional pattern that suggests that they represent interlinked communities. The pattern, however, seems to be confounded by the region's irregular topography. Many Mississippian sites; including those from the American Bottom, southeast Missouri, eastern Arkansas, the Black Bottom, and the Lower Ohio River Valley, are situated on broad flood plains. They contain vast areas of potential agricultural land. Settlement locations are limited only by the availability of spots that are not flooded on a regular basis. West Kentucky's Mississippi River floodplain, however, is vastly different. In many places, the river is bounded by steep bluffs, resulting in narrower annually flooded bottomlands that are frequently difficult to access.

Many bluff top communities (including Wickliffe) have a very limited amount of agriculturally developable flood plain available to them[1]. Put very simply, there is almost no place for satellite communities to develop and take advantage of renewable agricultural land. A scarcity of upland Mississippian agricultural settlements is indicative that limited successes in resource extraction may not have allowed a successful colonization away from the riverine environments.

While settlement sizes in these bluff top settlements suggest that they represent secondary communities or small regional centers, the lack of associated satellite communities brings into question whether other settlements are dependent on these socio-economic resources. In the absence of satellite communities, the bluff top settlement's social organization would technically be limited to that found in simple chiefdoms.

Part of the problem with classifying social structure arises from the form of chiefdoms explored in the archaeological record. In many cases, Mississippian chiefdoms have been defined by what are undoubtedly complex chiefdoms (c.f., Anderson 1994; Peebles and Kus 1977; Larson 1971; Morse 1981; Price 1978), but very little attention has focussed on distinguishing chiefdoms with a single autonomous settlement structure from those with larger, more integrated structures.

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[1] Kreisa and McDowell (1995:216-217) note that the situation may have been more severe than modeled. Changes in the Mississippi River's channel during the Middle Mississippian occupation decreased the amount of flood plain available, thus reducing the number of resources available to satellite communities.

Size of the integrated community seems to be the single feature most capable of defining a difference. Population sizes for these organizations would likewise be limited to only a few hundred individuals. This is consistent with estimates provided by Earle (1987:288) of autonomous simple chiefdoms.

Bluff top communities in western Kentucky are generally situated every eight to ten kilometers up and down the bluff line. Most communities are roughly the same size, suggesting that each settlement's capacity to extract resources from the local environment is equally matched. Where variations in settlement size exist, there are also variations in topography.

At some locales, there is a greater availability to fertile land. The resulting larger sites appear to have several satellites in close proximity. Many of these smaller sites contemporaneous with some aspect of the larger settlement suggesting that a hierarchical socio-political relationship between farmsteads, hamlets and villages, and regional centers was able to develop. Specifically, the communities at Sassafras Ridge, Adams, and McLeod Bluff are believed to have exerted socio-economic influence over the surrounding smaller settlements (Kreisa 1988b:151, 1989:30). Clearly these integrated communities have larger population sizes and their regional distribution imply a complex chiefdom. Unless definitive evidence can be found linking these bluff top communities into a single community structure, it is possible that both complex and simple chiefdoms contemporaneously occupied west Kentucky.

Ethnographic and archaeological examinations of late prehistoric and early historic southeastern chiefdoms lend credence to the idea that singular political structures within the region cannot be universally applied to the Mississippian Culture (Anderson 1994; DePratter 1991; Feinman and Neitzel 1984). Even in their simplest political forms, chiefdoms possess numerous important structural differences, including form of rule, importance of redistribution to the socio-economic framework, whether political authority was ascribed or inherited, whether neighboring communities were threats or allies, the role of elites in the community, number and form of competing groups within the community, and the resource base that wealth and power is based. While is seems likely that these were important components of the western Kentucky Mississippian communities, critical

aspects of these features have not been realized. The types of socio-political organizations found within the western Kentucky region were considerably more variable than can adequately be described in the standard definition applied to a chiefdom. The question of autonomy or subordination in western Kentucky Mississippian sites is still an open issue.

Another issue broadly hinted at by Clay (1997) is time. Since the Late Woodland period, villages and towns in western Kentucky show periodic florescence, declines, abandonments, and reoccupations. This highly unstable socio-political situation indicates that social relationships between different communities are not constant throughout time. When reconstructing the political structure of the region it becomes necessary to define specifically when and what communities were involved in a particular socio-political arrangement. This type of approach has not been applied. Given this, a single community can possess several different political arrangements (c.f., autonomous, simple chiefdom, first or second order community) during its occupation. Unless emphasis is placed on a single point in a site's occupational history, social reconstruction must trace the evolution of power arrangements across time. Structural analyses should note whether community structures became more complex, less complex, or both. This degree of specificity has not been applied to Mississippian communities in the western Kentucky region.

Chiefdoms cannot be discussed without considering time. Political instability is a hallmark of a chiefdom's presence. Their failure to evolve into more efficient forms of social control acts to perpetuate their existence. Anderson (1994:9) argues that "cycling", the "...recurrent process of emergence, expansion and fragmentation of complex chiefdoms amid a regional backdrop of simple chiefdoms", results in a periodic reorganization of the regional social order. Regional cycling results in patterns of community size and structure fluctuations that are very reminiscent of the socio-political evolution visible in western Kentucky communities. It cannot be assumed that the identification of one form at a site identifies the form present throughout its history. This must therefore hold true for the socio-political structure present at Wickliffe.

Social Structure at Wickliffe

An important basic component in determining the structural complexity of a community's organization is its capacity to interact with other social groups. It is therefore difficult to look at a single site and accurately identify aspects of its socio-political evolution without some consideration of its place in the regional cultural matrix. Classification of communities into tribes, chiefdoms, and states is largely the result of regional examinations (Earle 1987:288). However, since some socio-economic interactions occur at each node in a complex community structure, it is possible to approximate the degree of structure present at a single site, during a given period of time. Emphasis must be placed on the degree of integration present both within the community, as represented by evidence of coordinated community activities, and between communities, as evidenced by signs and degrees of contact with external communities. Joyce's (1994) examination of structural complexity in Oaxaca provided some important insights to features that present at a site within a chiefdom (Table 9-2).

Table 9-2. Chiefdom Features Visible at Single Sites.

Feature No.	Feature
1	Unequal Social Status corresponding to Ascribed Lineages.
2	Evidence for Organized Production above the Household Level.
3	Site Placement in an Area of High Subsistence Efficiency.
4	Evidence of High Status via Prestige Goods.
5	Evidence of High Ranking via Ritual Structures.
6	Storage Facilities to House Goods Distribution.
7	Evidence for a Settlement Hierarchy.

Source:
Joyce, A.A.
1994 Late Formative Community Organization and Social Complexity on the Oaxacan Coast. *Journal of Field Archaeology* 21:147-168.

There are a few correlates preserved in Wickliffe's archaeological record. These indicate a dynamic structural arrangement. The Wickliffe village was a habitation site that clearly was used for several hundred years. Despite archaeological division of the site into three occupation phases,

there is no evidence indicating that occupation was interrupted prior to domestic abandonment. Its social evolution is assumed to be continuous. There is ample evidence indicating the social structure did not remain constant throughout time.

During the Early Wickliffe Phase (1100-1200 AD), the site consisted of little more than a cluster of houses nestled tightly around a central plaza. This simple plan is commonplace among any number of small late prehistoric communities. Throughout much of the Early Wickliffe Phase, the Wickliffe settlement reflected the structure and complexity of a Mississippian hamlet. Socio-economic decision making was probably based on kinship. If more than a single kin group is represented, some form of corporate decision making body would have been the responsible power base. No clear evidence of status differentiation has been found in the remains examined by Wesler (1987, 1989, 1991a).

The village is strategically located in a place where it is able to take full advantage of several different environments. Its proximity to the Mississippi River enabled inhabitants at Wickliffe to have access to aquatic resources and renewable fertile land without the threat of annual flooding in the village. There is fresh water available on two sides of the bluff top, readily attainable clays suitable for pottery making along the site's bluff margins and lithic resources (mounds gravel deposits) less than 0.25 kilometers from the village. The site also has immediate access to the many forest and meadow environments of the Kentucky uplands. Wickliffe's location enabled its inhabitants to maximize their ability to procure subsistence needs with very little effort. While the social importance of site location may not have been strong during the Early Wickliffe Phase, its location was undoubtedly a factor enabling social interactions to increase during later periods.

Wickliffe's early period lasted for several generations. During this time, the community enlarged, probably as a result of both natural increases and in-migration from other locales. Ceramics from the Early Wickliffe Phase are identical to those from other twelfth century sites, providing evidence that Wickliffe's inhabitants probably arrived from regions manufacturing the same vessel styles. It is likely that Wickliffe's colonizing population splintered from one of the local communities. At the time of Wickliffe's initial occupation, there are a number of other settlements,

including Sassafras Ridge, Marshall, Hoecake, Towsahgy, and Kincaid in existence. It is not known whether the Early Wickliffe population maintained a state of community independence or was socio-economically allied with its parent community. Most artifacts from Early Wickliffe deposits appear to be locally made. There are no strong indications of substantial ties with non-regional communities. There is also insufficient evidence present to definitively classify the Early Wickliffe Phase hamlet as part of a chiefdom. It seems most likely that the village was either autonomous or represented a minor node in a larger ranked community.

Throughout the early and into the Middle Wickliffe Phase (1200-1250 AD), there is an increase in the settlement's size, suggesting that a substantial population increase occurred over time. The Middle Wickliffe Phase, currently seen as representing only a 50 year period, is characterized by an outward expansion of the site's boundaries, an increase in the number of structures and the construction of at least three of the site's mounds (Mounds A, B, and C), (Wesler 1996:281, 294). While structures were undoubtedly represented on top of these only one, Mound B, has provided evidence that it served a residential function. Data from Wickliffe's mounds provide considerable evidence for social change.

The Middle Phase's larger population indicated that local resource procurement was successful enough to support more people than lived at the site during the initial settlement phase. Population increase may have been due to natural, migratory or both types of expansion, one important end result was that subsistence efficiency and manpower were substantial enough to redirect some of the community labor resources towards non-subsistence purposes. Mound building best evidenced this.

Wickliffe's mounds are important indicators of internal social integration. Initially, construction involved some element of community planning. Mounds A and B both occupy prominent points in the village's plaza, they are the result of restricting where dwellings could be built or by renovating the size and scope of the existing plaza. Neither of these tasks could have been possible without coordinating each household's space needs towards a broader master plan.

Direction and implementation of this plan would have been delegated to a subgroup of the community's population.

Physical construction of these mounds is beyond the capacity of a single individual or household. They appear to represent group efforts. Command can realistically be viewed as access to a labor pool large enough to result in a monumental product. Barbara Price (1978:165) views this concept of mound building as a sensitive indicator of power integration. Labor could be pooled to complete a task needing more personpower than available in a single household. Members of the Wickliffe community were integrated to a point of engaging in work projects, some of which may not have benefited all participants.

During the Middle Wickliffe phase, most houses were built on the ground's surface. A few were constructed on top of mounds. A minority of living and work areas, therefore, was afforded more prepared surfaces. Since few structures were placed on the site's mounds, only a finite amount of personpower was invested in this activity[2]. The benefits from access to this labor pool were limited to only a few members of the community (Camiero 1981:53). Differences in social standing can be inferred as a reason behind the dichotomy in Wickliffe's living and work areas.

Of particular importance is the deposition of several distinct building episodes on Mound B, a locale almost certainly used as a residence. Recognizing that the Middle Wickliffe Period is fairly short, encompassing no more than perhaps three generations, the numerous renovation projects attest that access to the community labor pool was directed towards Mound B on several different occasions. Unless ownership of the mound was not inherited, access to this exclusive space probably passed between members of the same kinship group[3]. Individuals living on this mound possessed not only a status living position, but also their ceramics display a disproportionate number

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[2] Finite availability may be either physically limited by the number of person-hours available or socially limited by decisions to control the number of personhours available for mound building.

[3] A review of ethnographic literature from the Southeastern United States where possession of an exclusive living area was not normally passed to other members within the same kinship group.

of serving to utilitarian vessels (Wesler 1992). These imply that activities on Mound B did not include as much utilitarian or domestic elements as seen elsewhere in the village. Likewise, it appears that differences in food quality may have existed. Kreisa and McDowell (1995:217) note that a higher food utility, particularly among the cuts of meat consumed, is present in middens from Mound B than found elsewhere on the site. These data suggest that a different socio-economic relationship existed at this locale. The exclusiveness of location, access to the labor pool, material and consumable goods over a short, multigenerational period of time are evidence that different statuses were present within the Wickliffe community. These seem to be analogous to elite statuses observed among other, larger Mississippian chiefdoms. Wickliffe's internal structure during the Middle Wickliffe Period indicates a considerable degree of group integration and marked heterogeneous differences between certain subgroups of people. There is reason to believe that the community's structure increased in complexity during this short phase.

Wickliffe's Middle Phase probably represents the pinnacle of socio-economic activity at the settlement. During the final century (Late Wickliffe Phase; 1250-1350 AD) the village's boundaries extend out beyond the Middle Phase village. This probably indicates that more people were living at the site.

Access to the community work force continued into the Late Wickliffe Period. Mounds A and B were renovated and Mounds D and F were constructed. In contrast, other Middle Wickliffe construction projects do not see additional work. Mound C, for example, exhibited little of the attention given to other earthworks.

Mound D provides some evidence that aspects of the community plan were given new meaning. Mound D was originally described as a linear ridge mound (King 1937:83). However, closer examination by Wesler (1990) has concluded that it actually represents two structures. Excavations by the Kings in the 1930s encountered several adult graves in the upper levels of the mound(s) (King 1936:36). Details on these interments are extremely sketchy. Blanche King (1939:50) described these remains as; "...three feet from the base of the mound, two adult extended burials were found completely covered with cypress and other bark. We also found a burial pit, the

bottom covered by stones and six bundle burials." An examination of the surviving records and artifacts has enabled Wesler (1990) to suggest that several high status burials may have been important factors in developing the two aspects of Mound D.

Grave placement and material control are hallmarks of status differentiation (Brown 1987:298; Carniero 1981:54). It is likely that these individuals commanded sufficient power and status to receive treatment not documented elsewhere in the archaeological record. This may have included construction of a separate burial facility for their exclusive use. Interestingly enough, no occurrence of a similar burial pattern was documented in many other Middle Wickliffe mound structures. If Wesler is correct, then exclusive burial plots within the village confines are evidence of a substantial increase in the community's internal complexity.

Much of the social evidence found at Wickliffe implies that a relatively complex level of social interpretation evolved prior to its abandonment. The site's location enabled the community to maximize its resource interaction potential and provide a labor force capable of being deviated away from subsistence and put to use in other manners. The fruits of this labor demonstrate that the final products, namely mounds, required more effort than could be produced in a single household. Access to the construction of specialized facilities appears to have been limited to specific subgroups of community, who probably also restricted who could and could not utilize these. To some degree, control over these features appears to have been multi-generational.

Wickliffe's social evolution shows signs of two distinct social groups, those with and those without access to all of the community's socio-political resources. Knight (1990:18) observes that social ranking in most protohistoric Southeastern Native American societies is based on clan membership. Knight (1990:3) contends that the exogamous ranked clan was a principal factor defining a person's place in Mississippian society. The social order at Wickliffe probably did not differ strongly from this model. Power focussed in the clan with the greatest economic or political power in the community if not in the region.

The extent that power could be utilized or expressed by a particular clan appears to have been somewhat limited. While the presence of a few high status burials may be implied from the

King era excavations, no substantive assemblage, indicating a multi-generational high status burial area or burial pattern, such as those found at Moundville, Etowah, Cahokia or Dallas Culture, has been found (Fowler 1991, Hatch 1976, Larson 1971, Peebles 1971). Wickliffe's few "high status" interments indicate that at best, the community possessed several individuals whose personal accumulation of wealth, symbols, or power was substantial enough to warrant special burial privileges. These mortuary treatments were more than likely the exception, rather than the rule. In the absence of evidence for other segregated mortuary areas within the community's confines, burial among members of an empowered clan would be expected to occur at other ritual sites outside the village's perimeter. Since both primary and secondary burials were represented in Mound D's elite assemblage, differences in body treatment did not express social difference or more than one clan was afforded "elite" mortuary rites on the edge of the plaza.

Freid (1960:719) has noted that in many societies, those in power differ from their neighbors by simple possession of the appropriate status symbols. In Wickliffe's limited socio-environmental context, symbolism might be an expected form of social differentiation. Likely markers of power may include body modification or decoration, exclusive attire, and restrictive control over certain objects and symbols. Many of these features either did not survive into the archaeological record or were too valuable to be removed from circulation and placed in a mortuary deposit (O'Shea 1984:50). There were a few possible exceptions. Wesler (1990) has suggested that particular vessel forms, such as conch effigies, might be symbols of Wickliffe's power. The form and design represented in a few surviving fragments of charred fabrics have enabled Kuttruff (1990) to speculate that these might represent high status items. These objects indicate that expressions of social rank, particularly in a mortuary setting, may focus stronger on the non-durable or funerary aspect than on more durable artifacts.

Since there is a lack of satellite communities that can be associated with Wickliffe, the ability to extract resources must be conservatively limited to the village's population. Given that only several hundred people probably lived there at any one time, it is doubtful that the dominant clan could live solely off of the non-elite. Wickliffe's elite probably do not represent full time

administrators, although some may have enjoyed the perks of their more powerful position. Domestic debris associated with Mound B indicates that this mound's residents may have lived better than others. However, the differences do not appear to have been substantial. Following a modified version of Stanley South's assemblage patterning method, Wesler (1991a:123-133) was unable to identify major differences in artifact classes between suspected high and low status areas. Those possessing socio-economic power at Wickliffe would not be expected to express strong differences in biological stress from those who were not in charge.

Following the criteria provided by other social analysts, Wickliffe possesses many features found in chiefdom-like societies. Its social organization probably represents a power structure that is largely based on links to a particular clan and swayed by the amount of influence an individual clan member was able to acquire. In many respects, Wickliffe's socio-political structure probably shares many features with an ascribed bigman[4] or a simple chiefdom. Such organizations are inherently unstable, rarely maintaining the same structural integrity for more than several generations. Communities expressing these degrees of social integration are subject to fluctuation based on a host of social and environmental variables. Without evolving into a more complex form of social organization, they are doomed to collapse. The abandonment of Wickliffe can be seen as the simple result of social selection brought on by an unstable form of social integration.

Data from the village suggests that the social complexity seen in a chiefdom was probably responsible for the florescence and eventual decline of the Wickliffe community. Participation in this social strategy meant that organizational fluctuations were inevitable. It is unlikely that the village's chiefdom represented a stable social element. McGuire (1988:471) has noted that changes in a community's dominant ideology can have an affect on its death beliefs and these in turn can influence how a cemetery is used over time. During the site's occupation, expansion of power and wealth would have changed intra-community dynamics. New social roles and personalities were introduced and previously existing forms may have been redefined. As these data also demonstrate,

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[4] See comments by Sahlins (In Thomas 1989:36) and Service (1975: 73-74).

the type and rate of community change varied during the occupation period. In order to understand how community events might have affected the cemetery, it is necessary to identify when burials were allowed to accumulate in Mound C.

Chapter 10. Placing the Mound C Cemetery in Time

Archaeological settings frequently restrict the capacity to examine a cemetery as part of a community's cultural record. One of the most limiting features is an inability to accurately identify what other community events occurred during a cemetery's accumulation period. Analysts must either assume temporal associations between mortuary and other depositional events or approach them as independent material constructs. This has been the analytical environment confronting investigations of the Mound C cemetery. Archaeological research at the WMRC can identify that Mound C contained a Native American cemetery and that some of the artifacts correspond with Late Prehistoric-like materials, but cannot link these to the surrounding village.

A critical stumbling block to associating the Mound C cemetery with other archaeological events was adequate control over time. Evidence of the cemetery's temporal position has at best been tenuous. Recovered graves lacked artifacts with narrow time ranges and temporal estimates for the mound were based on a very small sample of ceramic forms. Grave pits rarely indicated their stratigraphic origin, limiting precise determination of when graves were placed in the facility. All that was known with certainty was that the cemetery could not pre-date the grave-containing substrates.

Precise temporal estimates for Mound C are capable of linking the cemetery to the community. Put simply, if the cemetery and village deposits are contemporary, then the Wickliffe village is the most likely community represented. If the cemetery dates to one period and the enclosing deposits to another, different communities may have formed them. Radiometric analysis represents one means of estimating time for both the cemetery and the village.

Stratigraphic Interpretations of the Mound and Cemetery

Traditionally, the Mound C Cemetery has been considered the village burial ground and its accompanying interments were believed to represent various personages in a static community structure (e.g., King 1937, 1939; King 1936). The Kings did not believe that Mound C was intentionally constructed as an earthwork, rather that its morphology was the result of use, not an end product designed for mortuary activities. Blanche King (1939:97) described Mound C as an

accretionally derived earthwork, with burials being added over time. Matternes (1996a:310) noted that this pattern would have resulted in a scatter of burials throughout the entire mound structure – a development strategy that is inconsistent with the true distribution of burials in Mound C. A closer examination of the mound's depositional sequence revealed that burials are located within one meter of the mound's present day surface, and some undisturbed sections of the mound contained no evidence for burial activities. The accretional development model did account for this type of internal structure.

Careful reconstruction of the depositional sequences enabled Wesler (1996) to ascertain how Mound C was built. Underneath the mound are several pits and at least one house floor. While an exact temporal estimate has not been solidly demonstrated, these features possess all the appearances of a Mississippian deposit. Mound C was not the result of a single building event; it was erected in several episodes (Figure 10-1). Sometime, presumably during the Middle Wickliffe Period, two small independent earth structures (Mounds C_1 and C_2) were erected and a basket-loaded mound consolidated the structure into a single earthwork (Wesler 1996:294). Ceramic attributes indicate that these substructures were combined prior to early phases of the Late Wickliffe Period. A domestic midden containing Late Wickliffe-like artifacts was then allowed to accumulate on Mound C. None of these features have been radiocarbon dated.

Burials placed within the midden possessed no discernable grave pit. It was not possible to determine whether midden/debris accumulation and funerary deposition were coincident uses of the same space. Debris accumulations were extensive. Undisturbed thicknesses of 50 centimeters or more were detected in several aspects of the mound. The absence of discernable grave pits disabled any stratigraphic arguments that the cemetery accumulation commenced after the midden deposition terminated. The surface of Mound C was plowed during the historic period and a concrete pavement poured around some of the exhibit margins.

Chronologically and stratigraphically, very little was actually known about Mound C. Excavations established minimal temporal event perimeters, but were not able to order these events.

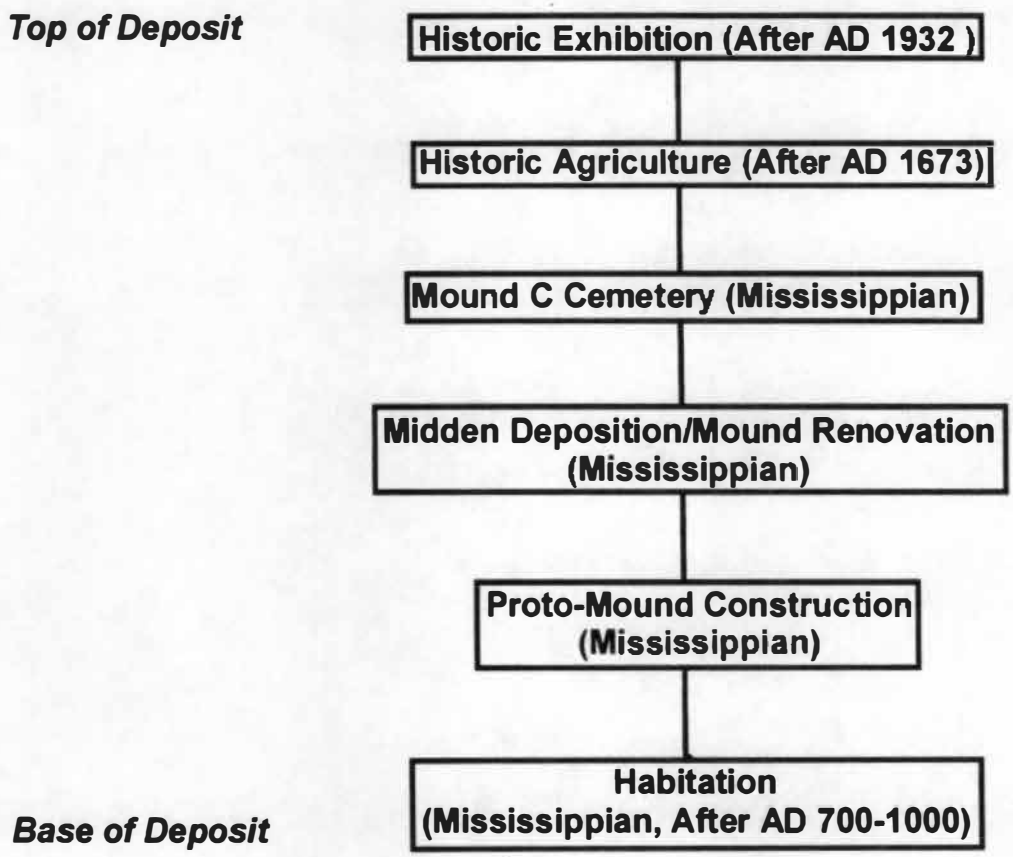


Figure 10-1. A General Model of Prehistoric Events Recorded in Mound C.

Ceramic attribute frequencies demonstrated that the final episode of Mound C's architectural renovation probably occurred during the Late Wickliffe period (Wesler 1996:294), but there were no data indicating when it was discontinued. Some graves were placed in the mound after deposition had commenced but the presence of graves in mound structures beneath the midden indicated that a possible pre-midden mortuary sequence might also be present.

This places commencement of the cemetery's accumulation period after the village's initial occupation phase. The mound's stratigraphic record is vague and can be interpreted in at least three different manners. First, the midden and cemetery could represent contemporary deposits, with both the cemetery and midden accumulation phases terminating with the abandonment of Mound C as an activity area. The accumulation periods for both midden and burials are viewed as accretional events developing over enough time to allow early interments to completely skeletonize prior to disturbance by continued construction of new graves and midden development occurring fast enough for graves to accumulate in it. This model conforms to the current view of archaeological events, where site abandonment is defined by the cessation of significant cultural activities at the village by the mid-fourteenth century.

Second, graves have been found both above and, to some extent, within Mound C's fill. It is possible that burial accumulation could have started before midden development. Support for this model infers that one of the original functions associated with the 'un-middened' Mound C was as a focus for funerary rituals. This model is supported by initial burial event dates that differ strongly from midden and terminal burial event dates.

A third possibility is that the cemetery post-dates midden accumulation. If Mound C were used as a trash pile and midden accumulation terminated at the same time as village abandonment, then intrusive mortuary deposits would be later than both of these events. Recognizing that, by some estimates, the Jackson Purchase was inhabited for a century and a half after Wickliffe was abandoned, there was ample opportunity for Mississippian-like people to re-utilize the mound as a mortuary facility. Placement of the cemetery on a high, conspicuous landmark away from the occupation area has been observed among other late prehistoric cemeteries (Milner and Schroder

1992:61). Data supportive of this model would place cemetery accumulation dates after those for the midden.

Sample Selection

Temporal data from the cemetery needed to be sensitive enough to determine whether one model was the more appropriate than others. As a general rule, the value of a temporal estimate was only as good as the association between the dated object and the event one hoped to date. The only useful medium common to both the cemetery and midden was bone. Technically, chronometric dating of skeletal material identifies the time when carbon ceased to be absorbed by the skeleton. This generally occurrs with the organism's death. To avoid known contamination from being on display since the 1930s, only bone samples obtained directly from an archaeological context were considered. Many of the sampled bones were primary interments. Their articular arrangement indicated a minimum degree of soft tissue decomposition prior to burial. This implied that burial occurred relatively soon after death. The disarticulated skeletal elements in secondary interments were evidence that the period between death and secondary interment may not always have been short. To reduce this exposure bias, candidate bones were screened and rejected if evidence of pre-depositional breakage, weathering and other signs of prolonged exposure in a non-burial environment were found. In using these bones to date depositional events, it was assumed that the date of death did not differ strongly from the date of deposition. Since this analysis pursued multiple dates for the same event from samples representing several organisms, it was also necessary to assume that the time between the event and metabolism of ^{14}C in each organism was the same (Buck, Litton and Scott 1994:254).

The three outlined stratigraphic models identified very different relationships between the burial population, the village community and sequence of events at the close of the village's occupation period. In order to sort out the stratigraphy, it was necessary to define three critical archaeological events – when midden was deposited, when burial accumulation was initiated and

when it terminated. Harris diagrams were constructed to aid precise stratigraphic circumscription of these features.

Harris (1975:113) recognized that archaeological stratigraphy is often complex and cannot be fully realized until properly ordered; in 1979 he proposed the use of a stratigraphic diagram (or matrix) to clarify depositional sequences. The Harris Matrix is largely grounded on the Law of Superposition, where the upper (or outermost) layers of an undisturbed stratified sequence indicate younger deposits and deeper layers imply older strata (Harris 1989:5). By graphically outlining the sequential relationships expressed by successive vertical and horizontal interfaces, the diagram also relates the relative chronological order in which events occurred. It is important to recognize that the Harris Matrix is not a means of analysis, only of clarifying the sequence of depositional events (Barker 83:202-203).

This seemingly simple process has not been without controversy. Harris's treatment of archaeological stratigraphy as phenomena independent of geology has not been accepted by all analysts and some felt that his 'laws' over-complicated interpretations (Farrand 1984:5; Roskams 1990). Another issue was that the Harris Matrix was unable to identify the exact chronological relationship between two or more equally positioned nonoverlapping deposits (Roskams 1990:972). Dalland (1984:117-118) recognized that the diagram cannot indicate how two non-interfacing independent deposits relate to one another and Haigh (1985:88-89) emphasized that poor control over these interfaces prevented precise definition of archaeological phases. Paice (1991) was able to partially overcome these weaknesses by adding additional notation and weighting the interval between interfaces to reflect real differences in time. In general, it seems that most critics have not objected with the matrix's basic approach, only that it provided little information beyond simple relative chronological ordering. When the basic approach was applied to the Mound C Cemetery, the

The midden accumulation on top of Mound C represented the last known habitation deposit in direct association with burials. This date was established by two samples (Field No. 95-7 and 97-11) obtained from upper aspects of the midden. They came from areas outside of potentially disturbed by aboriginal grave-digging activities (Figures 10-2 and 10-3). This provenience provided a

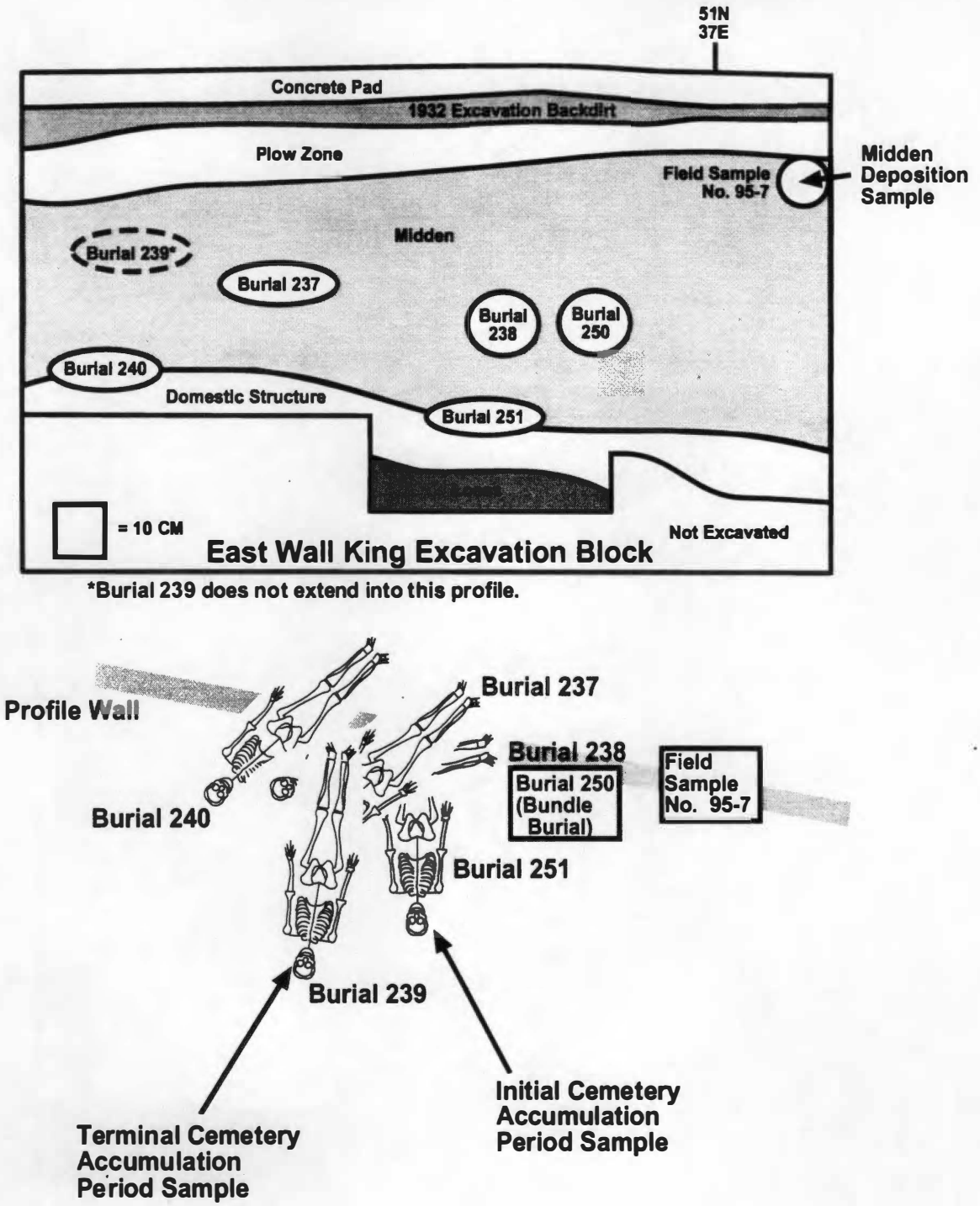


Figure 10-2. The Stratigraphic Relationship Between Midden Deposition, Initial Burial Accumulation and Terminal Burial Accumulation Period Samples.

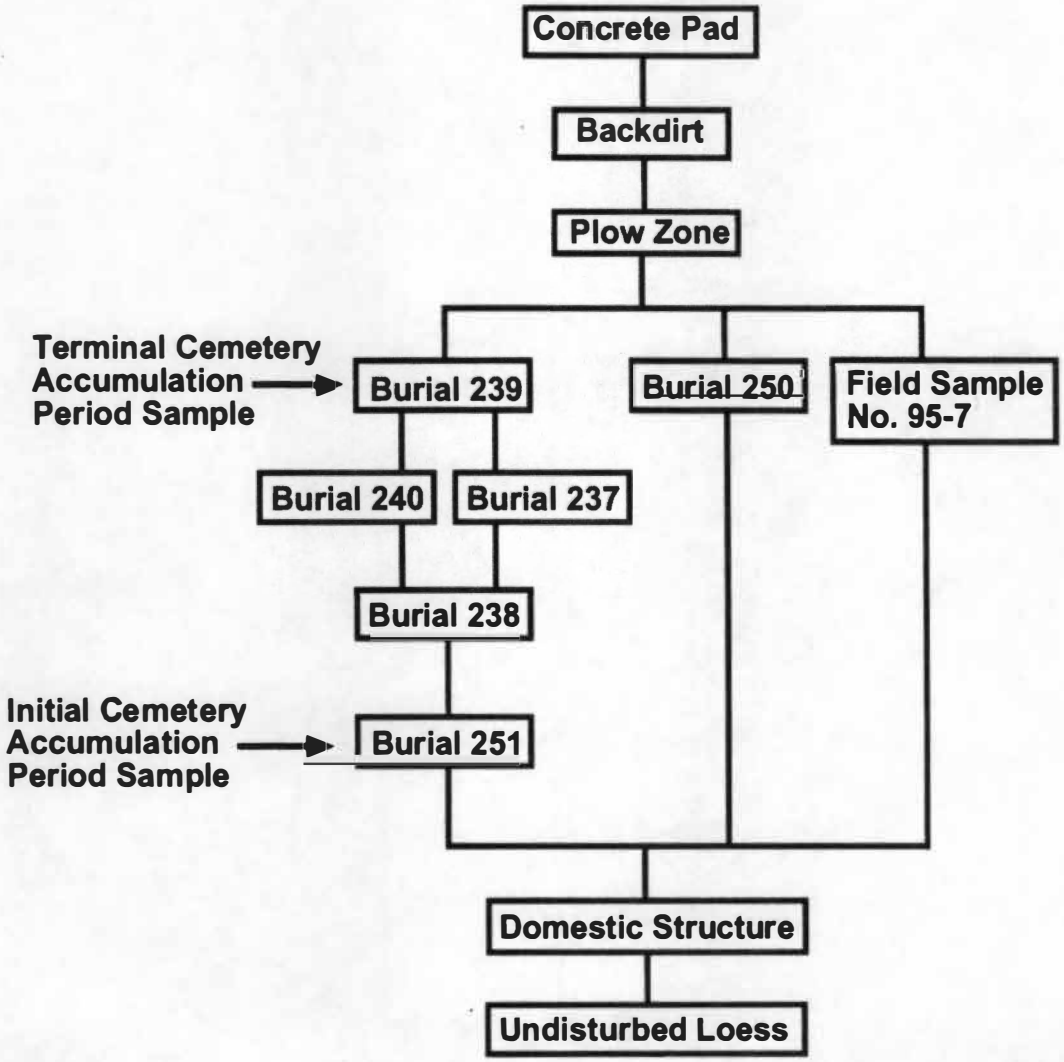


Figure 10-3. Harris Diagram of Skeletal Materials in the East Wall of the King Excavation Block.

maximum date for midden formation. These bones represented faunal remains discarded relatively soon after procurement. Neither of the sampled bones showed any signs of weathering.

Since cemeteries are rarely formed as single deposit events they represent accumulations over time. The relationship between village and cemetery, therefore, could not be based on a single point in time, but a sequence of points over time. This association commences with initial placement of graves in the mound. Fortunately, the Mound C Cemetery exhibits extensive use and there are numerous independent burials super-imposing one another. The Initial Burial Accumulation Phase is estimated by selecting bone samples from seven graves located at the base of these stratified assemblages (See Figures 10-2 and 10-3).

At a given point in time, the burial community stopped placing graves in Mound C. To estimate when the accumulation period ended (or Terminal Burial Accumulation Phase), seven bone samples from interments located on top of super-imposed grave assemblages were selected. In all cases, initial and terminal accumulation date samples were pair-matched from the same super-imposed grave assemblage.

There were 16 samples available for submission to the National Science Foundation Accelerator Facility at the University of Arizona-Tucson (NSFAF) for Accelerator Mass Spectrometry (AMS) to estimate the ^{14}C radioisotope content (Table 10-1). AMS dating directly tabulated the number of ^{14}C ions in a given sample's collagen, providing a more accurate temporal estimate for bone than the traditional Beta count method. This eliminated counting ions of similar mass and substantially reduced the amount of submitted bone (Browman 1981:281-282; Hedges and Van Klinken 1992:279). The procedures used to recover collagen from the skeletal matrix and to determine the concentration of radiocarbon present in the collagenous fraction followed Hedges and Van Klinken (1992), Long et al. (1989), and Linnick et al. (1986). Only 15 of the samples contained enough organic matter to obtain radiocarbon age estimates. Details of each sample submission were outlined in Matternes (1999:23-68).

Table 10-1. Summary Radiocarbon Age Data.

Burial No.	Pair Match	Archaeological Event	Uncalibrated Radiocarbon Age (1-Sigma)	2-Sigma Calibrated Age [a] AD	2-Sigma Calibrated Age [a] BP	^{13}C Value	^{13}C Corrected Age
44	218B	Initial Cemetery	965 +/- 45 BP	993 (1031) 1188	957 (919) 762	-9.5	940.88
49	246	Initial Cemetery	745 +/- 50 BP	1212 (1279) 1381	738 (671) 569	-11.1	728.76
95	102	Terminal Cemetery	825 +/- 50 BP	1044 (1220) 1284	906 (730) 666	-10.2	805.53
96	221	Initial Cemetery	1015 +/- 50 BP	900 (1019) 1158	1050 (931) 792	-11.3	993.28
102	95 & 221	Initial Cemetery	880 +/- 50 BP	1024 (1163, 1173, 1180) 1264	926 (787, 777, 770) 686	-12.0	862.40
147	150	Initial Cemetery	770 +/- 40 BP	1194 (1271) 1295	756 (679) 655	-9.9	750.90
150	147	Terminal Cemetery	810 +/- 45 BP	1159 (1224, 1321, 1239)1285	791 (726, 719, 711) 665	-9.6	790.40
218B	44	Terminal Cemetery	995 +/- 50 BP	993 (1036, 1144, 1146) 1212	957 (914, 806, 804) 738	-10.1	932.27
221	96 & 102	Terminal Cemetery	745 +/- 60 BP	1188 (1279) 1387	762 (671) 563	-10.7	728.16
239	251	Initial Cemetery	No Estimate	-	-	-	-
246	49	Terminal Cemetery	725 +/- 55 BP	1216 (1283) 1389	734 (667) 561	-13.1	712.1
251	239	Terminal Cemetery	815 +/- 55 BP	1044 (1222) 1290	906 (728) 660	-13.2	800.66
279	280	Terminal Cemetery	865 +/- 55 BP	1025 (1190, 1202, 1206) 1278	925 (760, 748, 744) 672	-15.0	852.89
280	279	Initial Cemetery	850 +/- 55 BP	1032 (1212) 1281	918 (738) 669	-12.5	833.85
Field No. 95-7	Faunal	Midden Accumulation	715 +/- 50 BP	1221 (1285) 1390	729 (665) 560	-22.7	716.00
Field No. 95-11	Faunal	Midden Accumulation	670 +/- 50 BP	1266 (1297) 1401	684 (653) 549	-21.3	669.06

[a] Calibration Curve Intercepts Presented in Parentheses (From Matternes 1999:60).

The Bayesian Approach

The Wickliffe Mound Group has seen considerable use of radiometric analyses as a means of estimating when in time certain events occurred (e.g. Mattemes 1999; Wesler 1987, 1991). However, these analyses have been unable to incorporate known temporal information, largely derived from archaeological sources, directly into the analysis. At best, these radiometric age estimates were interpreted independent of any known absolute and relative date information about the site's archaeological events. Buck, Litton and Scott (1994:253) have warned that isolating radiocarbon data from other chronological information can produce misleading results. Recent advances in archaeometry, however have enabled this chronological information to be directly integrated into the dating analysis through the use of Bayesian statistics.

Most archaeometric analytical procedures have operated within a framework assuming that radiometric age estimates are equally likely to occur at any time within a calibrated range (Buck et al. 1994:233). These universal constructs cannot recognize that each archaeological situation is unique and that most archaeological contexts provide information that can specify more likely calendric estimates within the time range. The Bayesian approach does not work from this type of universal model, rather it recognizes that there are numerous stratigraphic models capable of explaining important aspects of the data. Bayesian approaches directly incorporate previously known information about an event into to the analysis by using probabilities to express the strength that an event occurred at a given time, before and after examining the data at the point of date calibration (Buck and Christen 1998:304; Christen, Clymo and Litton 1995:432). Prior probabilities are assigned by the analyst and posterior probabilities are computed from the application of these and the data to distribution simulation techniques, principally Markov Chain Monte Carlo methods (Buck, Cavanagh and Litton 1996:188; Litton and Buck 1995:6). Each posterior probability in this study is based on the results of 1000 simulations. Radiocarbon calibration follows the standards outlined in Stuiver et al. (1998). One additional advantage of the Bayesian approach is that it enables the analyst to explicitly

ascertain how likely a given age estimate is representative (or unrepresentative) of its temporal context.

The basic model used in Bayesian radiocarbon analyses requires an estimate of the standard deviation for all radiocarbon determinations under investigation (Buck and Christen 1998:308). This model assumes that the analyst has no clear information about temporal relationships between sets of radiometric age estimates. This will be referred to as a 'No Relationship' model. By adding stratigraphic information to the basic model, it is possible to determine whether the improved model can explain an event's position in time and whether some stratigraphic models can interpret the data more precisely than others. In Mound C, relative stratigraphic information can be built into the basic model to ascertain the liklihood that a given archaeological event occurred earlier than, later than, or at the same time as other dated events. It is also possible to refine whether these events were sequential, overlapped or shared common boundaries.

Archaeological examinations of the Mound C stratigraphy established several important chronological limits for cemetery-related events. Lacking prior radiometric estimates, it was not possible to precisely date when activities commenced in Mound C. Many of the habitation features underneath Mound C were formed by the Mississippian culture, indicating that all overlying deposits had to be at least Mississippian Period cultural deposits (See Figures 10-1, 10-2 and 10-3). Since a basket-loaded mound separates the cemetery from most pre-mound deposits, there is a recognizable hiatus between mortuary and habitation events. Mississippian habitation underneath Mound C can be estimated to occur later than the introduction of Mississippian Culture to the region (AD 700-1000), with an equal liklihood that any date within this range is the true calendric date. Mortuary deposits are also bound by historic activities at the top of the mound. The historic plowzone disturbs (abutts) the underlying midden, sealing these deposits in a prehistoric context. While the origin of the plowzone is not clearly known, it clearly predates use of the site for lumbering, as a pasture and for museum/cxhibit purposes. It could not have formed prior to Anglo-European settlement of the region. The AD 1673 Marquette and Jolliet expedition represents as an absolute

chronological marker, indicating the earliest point when this plowzone could have formed[2]. The possibility of a hiatus between the end of the prehistoric and start of historic use of Mound C is emphasized in this interpretation. These chronological perimeters framed Mound C's mortuary activities between the start of Mississippian occupation of the region and Anglo-European contact.

Intra-Cemetery Temporal Relationships

During the initial transformation from atmospheric to organic contexts (i.e. from a component of the atmosphere to part of an organism), isotopic fractionation affects the ^{14}C's physical and chemical properties (Geyh and Schleicher 1990:165). Delta ^{13}C values provided by the NSFAF and a mean Delta ^{13}C value of 22.0, obtained from Geyh and Schleicher's (1990:166) Table 6.5, were used to correct uncalibrated estimates. These values were added to Geyh and Schleicher's (1990:165) Equation 6.60 to correct for metabolic transformations. The corrected unadjusted radiometric values were tabulated and presented in Table 10-1. When possible these corrected values were used to examine Mound C's radiometric dates.

The Delta ^{13}C corrected radiocarbon data were examined to learn how group estimates were structured. The first question pursued was the temporal relationship between initial and terminal burial accumulation periods. These phases were initially modeled with no temporal relationship established between them. Stratigraphically, initial burial accumulation period specimens underlay terminal burial accumulation period samples. Many of these pair-matched grave relationships contained interstitial burials, implying a passage of time between events. These phases could not be accurately viewed as abutting episodes. The terminal burial accumulation period was modeled as an earlier deposit than the initial burial accumulation period. This model assumes that spatially, all points within the area set aside for mortuary accumulation had an equal chance of use (relative to the social messages associated with cemetery space). Since each pair-matched stratigraphic column of interments was independent, there was no means of ordering them. It was possible that

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[2] Note that by this time Native American communities no longer permanently inhabited this portion of west Kentucky. This point estimate therefore marks the maximum date for prehistoric

some pair-matched stratigraphic columns could have termination samples that temporally overlapped with the initial phase samples from other columns. Two models, one emphasizing that the initial burial accumulation period was earlier than the terminal burial accumulation period (Model 2) and the other indicating that initial deposits were earlier and overlapped with the terminal burial accumulation period (Model 3), were considered.

All burial-based radiocarbon ages were included in this query. Following Buck et al. (1994:232), prior probabilities that each given date represented an outlier were estimated at 0.10. Posterior Probabilities were tabulated and presented in Table 10-2. Posterior probabilities from the No Relationship Model (Model 1) exhibited little indication that any of these dates were outliers. Similar results were obtained from Model 3. In Model 2, however Burials 96 (AA31221) and 44 (AA31218), both representing graves from the terminal accumulation period, exhibited high posterior probability values. A review of the data indicated that these two interments were about 150 years earlier than other top-of-the-strata burials. These age estimates were also much earlier than those obtained from their pair-matched underlying compliments. Mattemes (1999:70-71) suggested that prolonged burial retention might be an underlying factor. It was also possible that these date estimates may be laboratory artifacts, created by the actual radiocarbon counting process. In the case of these two radiocarbon age estimates, the assumed close temporal relationship between death and burial events was not valid, hence these samples provided no good estimate of when these graves were interred. Since no stratigraphic relationships between interment phases were recorded in Model 1, this age discrepancy could not be detected. Likewise in Model 3, a lack of control between pair-matched stratigraphic columns enabled these outliers to mimic reasonable estimates. Model 2's separation of initial from terminal burial accumulation periods was able to detect probable temporal discrepancies. Age estimates from Burials 96 and 44 were deemed unreliable and subsequently removed from the test assemblage. A retest of the data without these outliers revealed no substantive improvement in Model 1 and 3's ability to cope with these estimates.

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activity.

Table 10-2. Prior and Posterior Probabilities that Burial Radiocarbon Ages were Outliers, By Model.

Provenience (Burial)	Prior Probability	Posterior Probability		
		Model 1. No Relationship	Model 2. Initial Earlier than Terminal	Model 3. Initial is Earlier & Overlapping Terminal
44	0.10	0.01	0.25	0.05
49	0.10	0.04	0.06	0.05
95	0.10	0.03	0.03	0.04
96	0.10	0.06	0.55	0.09
102	0.10	0.03	0.04	0.04
147	0.10	0.03	0.05	0.04
150	0.10	0.03	0.06	0.04
218B	0.10	0.09	0.08	0.04
221	0.10	0.05	0.14	0.06
246	0.10	0.06	0.00	0.07
251	0.10	0.03	0.04	0.04
279	0.10	0.03	0.02	0.03
280	0.10	0.03	0.03	0.03
		Retest without Outliers		
49	0.10	0.04	0.03	0.04
95	0.10	0.03	0.03	0.03
102	0.10	0.03	0.08	0.04
147	0.10	0.00	0.03	0.04
150	0.10	0.03	0.03	0.03
218B	0.10	0.10	0.07	0.07
221	0.10	0.05	0.08	0.06
246	0.10	0.06	0.12	0.08
251	0.10	0.03	0.03	0.03
279	0.10	0.03	0.03	0.03
280	0.10	0.03	0.02	0.03

Most posterior probabilities remained the same for Model 1, while Model 3 achieved marginal decreases in posterior probability values. In Model 2, the removal of outliers resulted in a decrease in posterior probability for most dates. None of the models elevated radiocarbon age estimates to the outlier probabilities produced earlier. This implied that these adjusted models could be used to evaluate these data.

Another means of evaluating these models was to examine how start and end date probabilities are distributed across time. Models with relatively high probabilities scattered over relatively short time ranges were able to more adequately account for the information. Figures 10-4 and 10-5 illustrated temporal probability estimates for mortuary events as interpreted by each model. In Model 1, beginning and end date estimates for both initial and terminal burial accumulation periods resulted in relatively long tailed probability distributions. Probability estimates that a given date was the true archaeological event date were very low. As a result, high probability density areas tended to be very wide (Table 10-3). In Model 2, probability estimates were more temporally constrained, with many calendric date probabilities achieving higher values than observed in Model 1. High probability density areas were at least twice as narrow as those from Models 1 or 3. These differences imply a significant improvement in this model's explanatory power over a No Relationship (Model 1) construct. The distribution of probability estimates per calendric date for Model 3 was considerably broader than for Model 2. As a result, probability values were lower and high probability density area ranges were larger. This model demonstrated only a marginal improvement over Model 1.

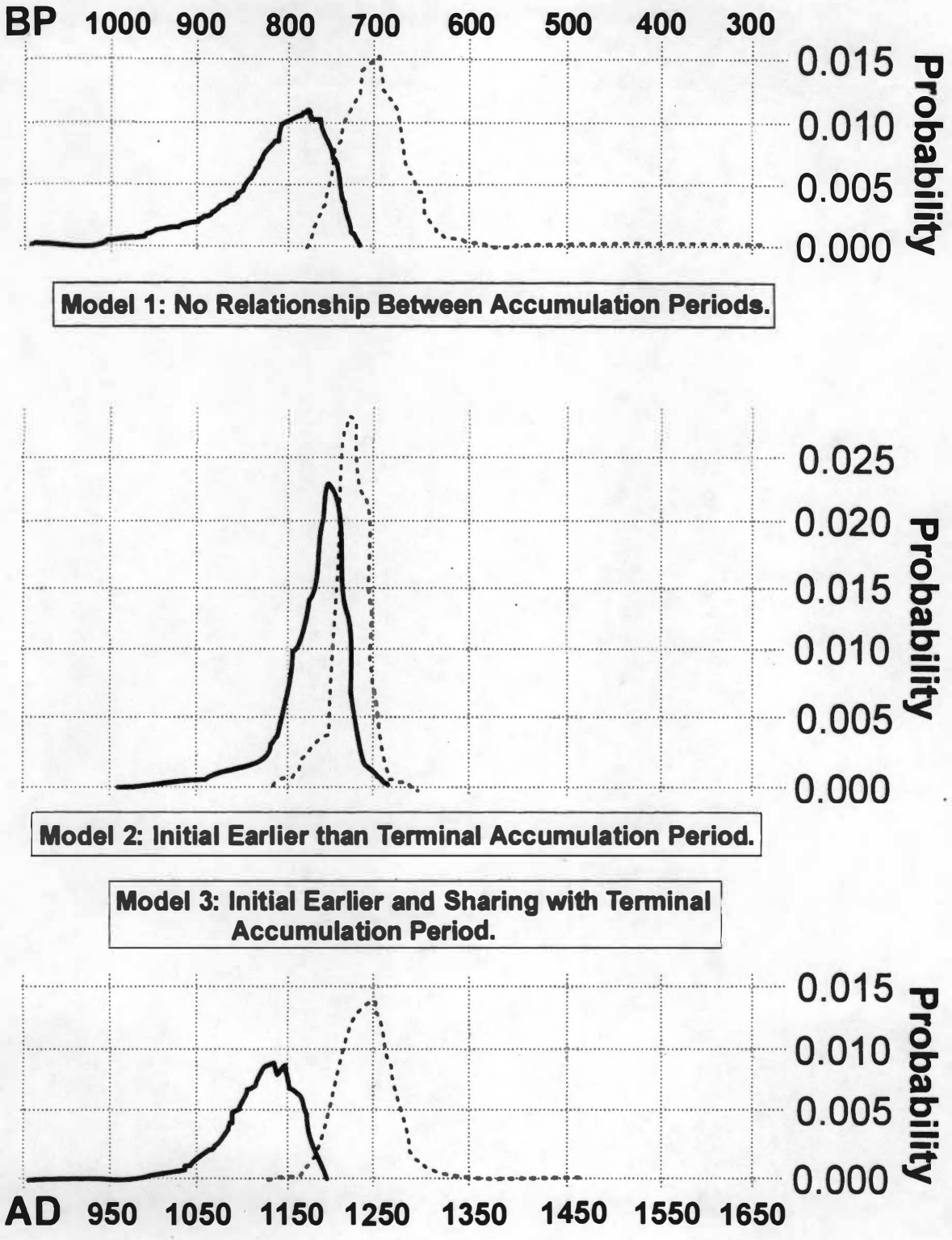


Figure 10-4. Probability Estimates for Beginning (Solid Line) and End (Dotted Line) of the Initial Accumulation Period, By Model.

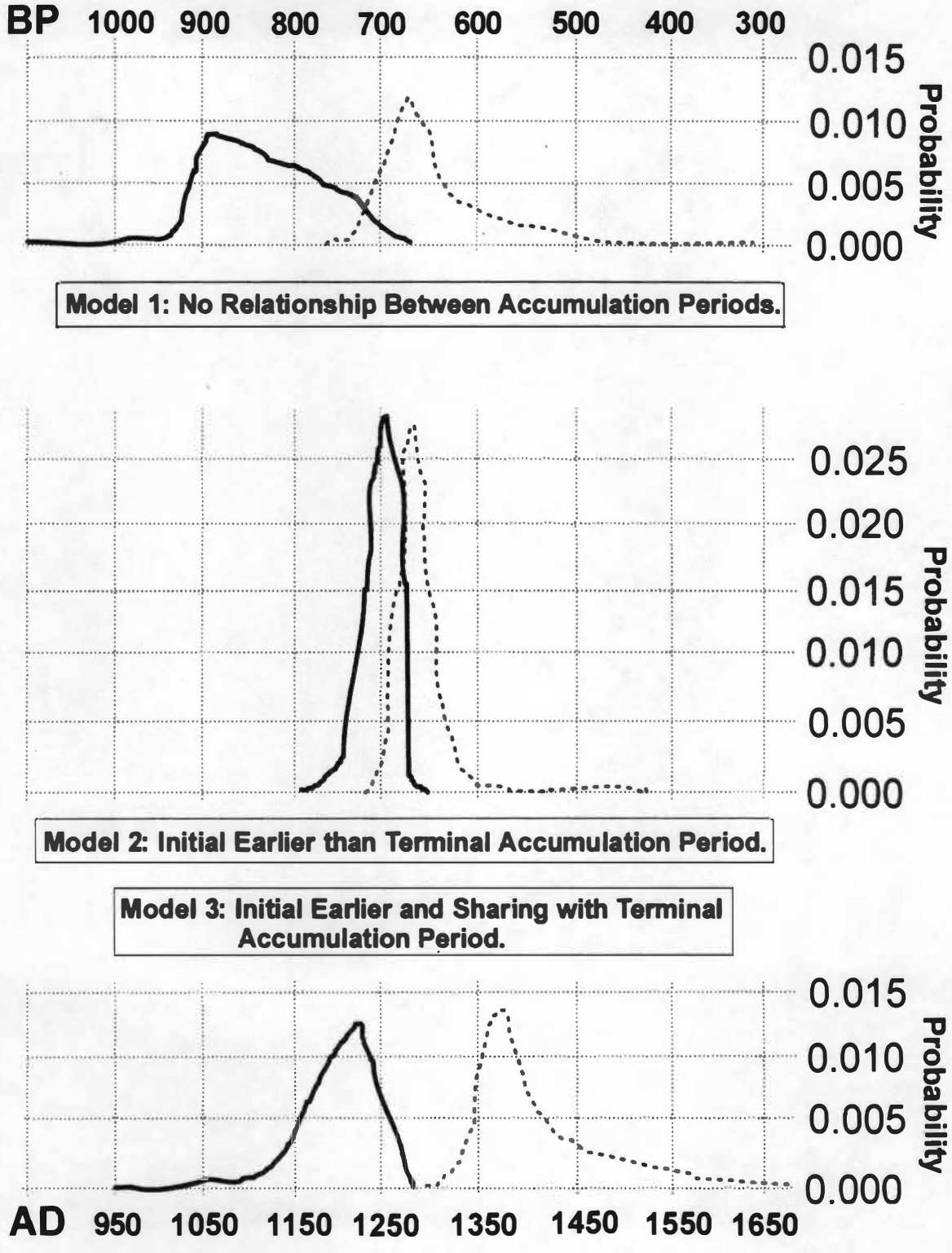


Figure 10-5. Probability Estimates for Beginning (Solid Line) and End (Dotted Line) of the Terminal Accumulation Period, By Model.

Table 10-3. 95 Percent High Probability Density Regions for Burial Accumulation Periods, By Model.

Model	Burial Accumulation Period	Event	Interval	
			Calibrated BP	Calibrated AD
1	Initial	Start	901-690	1049-1260
2	Initial	Start	731-573	1219-1377
3	Initial	Start	926-710	1024-1240
1	Initial	End	731-573	1219-1377
2	Initial	End	739-680	1211-1270
3	Initial	End	725-617	1225-1333
1	Terminal	Start	1021-673	929-1277
2	Terminal	Start	725-672	1225-1278
3	Terminal	Start	818-681	1132-1269
1	Terminal	End	731-489	1219-1461
2	Terminal	End	713-623	1237-1327
3	Terminal	End	706-485	1244-1465

In general, it appears that Model 2 produced the most succinct range of potential start and end dates for initial and terminal burial accumulation periods. There were noticeable improvements in this model's capacity to interpret burial age estimates over the No Relationship Model. Model 2 implied that burial accumulation in Mound C probably started around 740 BP (AD 1210) and ended about 675 BP (AD 1275). As shown in Figure 10-6, the accumulation period was most likely to be less than 100 years. However, because pair-matched stratigraphic columns of burials cannot be spatially controlled over time, Model 3 cannot be eliminated from possibility. When calibrated independently (See Mattemes 1999) pair-matched burial sites, such as Burials 49 and 246 and Burials 279 and 280, emphasized that end date estimates at or slightly after some start dates were possible. Model 3 still showed less improvement over the No Relationship construct and were deemed a less likely possibility.

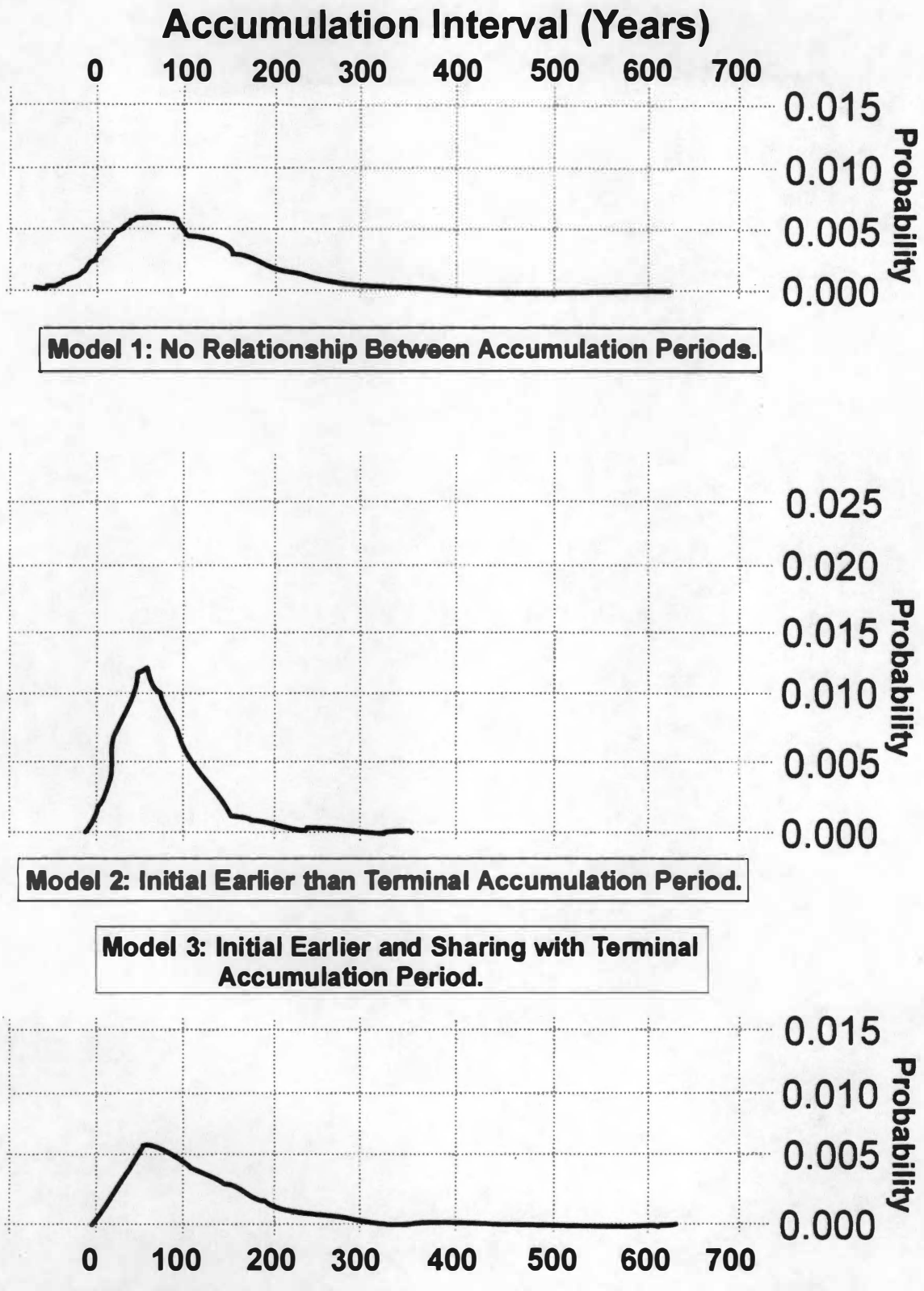


Figure 10-6. Probability Estimates for the Mortuary Accumulation Period, By Model.

Mound and Cemetery Temporal Relationships

Radiometric data from Mound C are not limited to burial age estimates, the midden is also represented by two radiometric age samples. Recall that midden samples came from bones positioned outside of potential grave shaft disturbances and in the overlying trash deposits. Their exact relationship with the cemetery is not known, but they provide an idea of when domestic village activities were drawing to a close. Given that Model 1 expresses no temporal relationship between events, the cemetery accumulation phase can be modeled as earlier than (Model 2), later than (Model 3), or contemporary to (Model 4) to the midden. These models evaluated the relationship between the mortuary accumulation period and the abandonment of Mound C. Because the underlying habitation and basket loaded deposits and overlying plowzone enclose both the cemetery and midden, the same prior temporal constraints were applied to both midden and cemetery as outlined in the previous analysis.

Radiocarbon ages were screened for potential outliers (Table 10-4). Models 1 and 2 exhibited comparable results, with low posterior probability values for all samples except Burial 218B. In both models this grave proved to be more problematic, but posterior probabilities were only slightly greater than the prior probability estimates. A review of this sample's provenience indicates that it tends towards the earlier end of the cemetery's accumulation period, but not out of the range of possibility. This evidence was not strong enough to consider removing it from the sample. In contrast, over 60% of the radiocarbon samples in Model 3 were conceivably outliers. This inability to explain the data within the applied temporal limitations implies a major incompatibility between the stratigraphic possibilities of Model 3 and the data's distribution. It is unlikely that these outliers reflect true aberrations in the data. Model 4's view of contemporary deposits produced no strong evidence that outliers were present. This model tended to produce the lowest posterior probability values achieved among the models and the only model whose performance was superior to the No Relationship (Model 1) construct. Given that temporal parameters were set as equivalent, data falling within the assemblage's minimum and maximum values would be expected to be consistent with contemporaneity. While no outliers were identified, Model 4's results may likely be an analytical

Table 10-4. Prior and Posterior Probabilities that Burial Radiocarbon Ages were Outliers, By Model.

Provenience (Burial)	Prior Probability	Posterior Probability			
		Model 1. No Relationship	Model 2. Cemetery Earlier than Midden	Model 3. Cemetery Later than Midden	Model 4. Cemetery Contemporary with Midden
49	0.10	0.03	0.05	0.16	0.00
95	0.10	0.03	0.03	0.05	0.03
102	0.10	0.04	0.04	0.82	0.02
147	0.10	0.04	0.05	0.06	0.01
150	0.10	0.03	0.03	0.04	0.01
218B	0.10	0.12	0.15	0.52	0.03
221	0.10	0.02	0.05	0.36	0.03
246	0.10	0.06	0.07	0.99	0.04
251	0.10	0.02	0.03	0.05	0.03
279	0.10	0.03	0.03	0.04	0.03
280	0.10	0.02	0.03	0.95	0.03
95-7	0.10	0.03	0.06	0.18	0.02
95-11	0.10	0.04	0.02	0.67	0.02

artifact. No samples were removed from this analysis and the examination proceeded to other aspects of the data.

Figures 10-7 and 10-8 clarified the temporal probability estimate relationships for midden and cemetery accumulation events. The No Relationship Model produced very long tailed probability distributions. Probability estimates that a given date was the true archaeological event date were low. Shorter tails corresponding with earlier estimates were obtained for the cemetery. Model 2 exhibited short tailed entry date probabilities for both the midden and cemetery accumulations and longer tailed terminal date probabilities. In contrast, Model 3's midden possessed the opposite pattern. In this model, the cemetery accumulation range was limited to point estimates between 565 and 575 BP (AD 1375 and 1385). Probability estimate were many times higher than for other models and events because so few calendric dates were involved. Note that this was possible only after treating most of the cemetery's data as outliers. Finally, modeling the cemetery and midden as contemporary events (Model 4) produced long tailed low probability curves with considerable time between start and end dates. Cemetery accumulation ranges for this model do not fit those obtained in the previous analysis, demonstrating a lack of consistency between Model 4 and other constructs. It is unlikely that this model is accurately portraying these data.

An examination of high probability density areas indicated that only Model 2 reflected a narrower range than the No Relationship Model (Table 10-5). Models 3 and 4 demonstrated improvements in individual parameter ranges, but these were accompanied by declines in the accuracy expressed by other dimensions. Only Model 2 reflected an overall narrowing of all probability ranges. Among the four models examined, Model 2 demonstrated a superior ability to explain the observed radiocarbon data within the ranges set by this and other examinations and without having to discard major portions of the data. The other stratigraphic interpretations cannot be eliminated from consideration, however adopting these as real engenders an acceptance of broader, and more problematic interpretations. Modeling the cemetery accumulation period as earlier than the dated midden samples more succinctly portrays the relationship between mound and cemetery

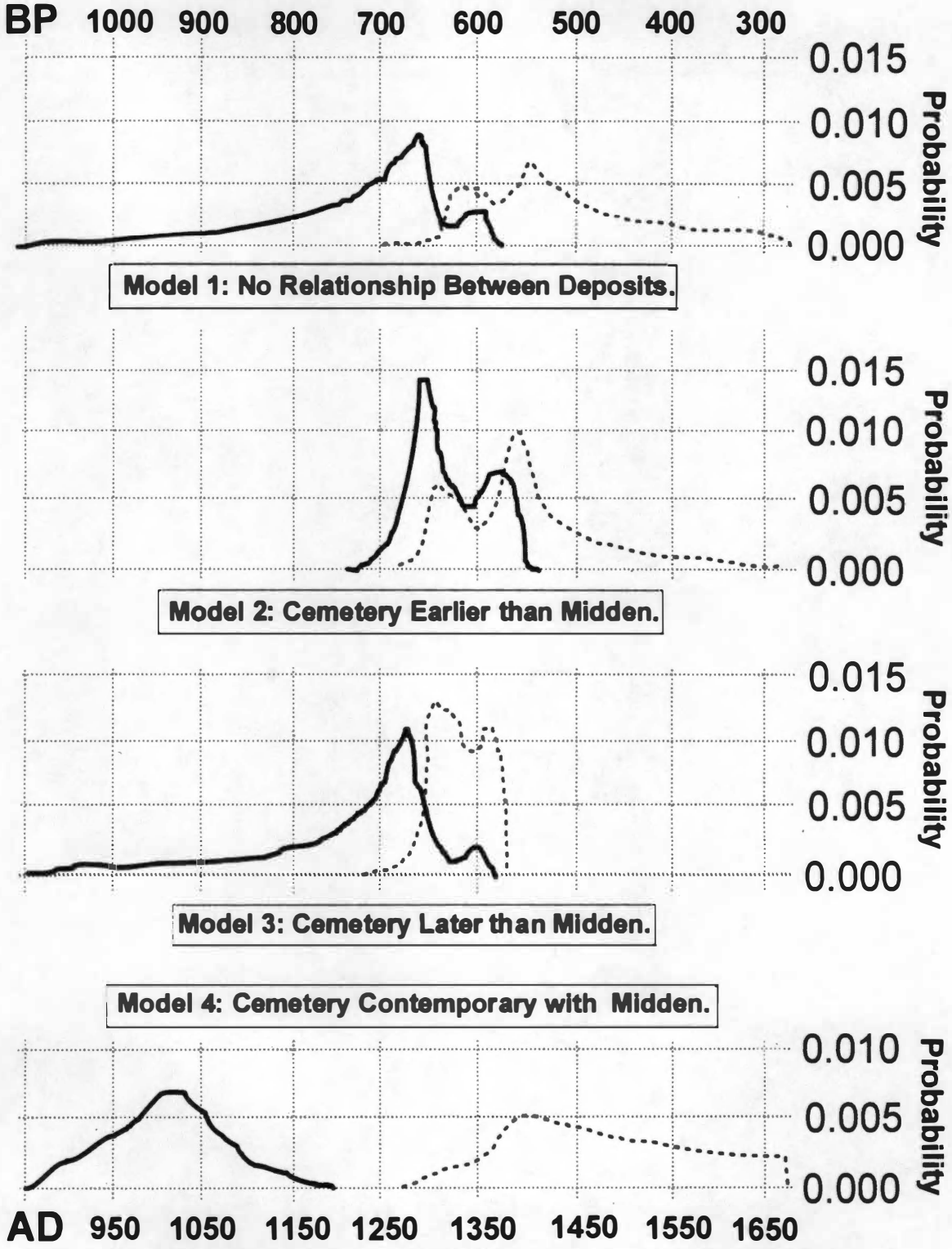


Figure 10-7. Probability Estimates for Beginning (Solid Line) and End (Dotted Line) of the Midden Sample Accumulation, By Model.

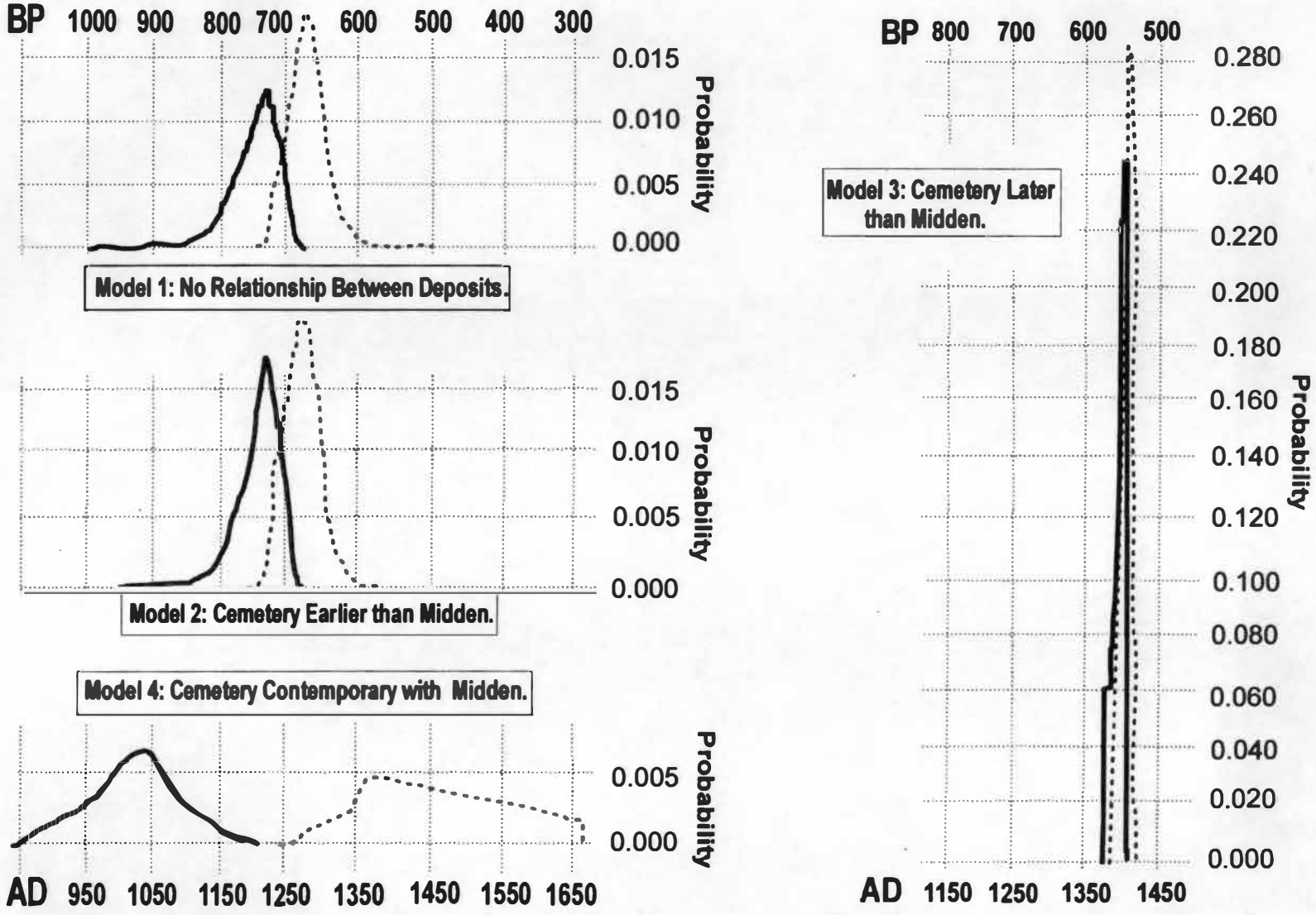


Figure 10-8. Probability Estimates for Beginning (Solid Line) and End (Dotted Line) Dates for the Cemetery, By Model.

Table 10-5. 95 Percent High Probability Density Regions for Cemetery and Midden Accumulation Periods, By Model.

Model	Burial Accumulation Period	Event	Interval	
			Calibrated BP	Calibrated AD
1	Cemetery	Start	825-689	1125-1261
2	Cemetery	Start	803-689	1147-1261
3	Cemetery	Start	570-586	1380-1364
4	Cemetery	Start	1106-814	844-1136
1	Cemetery	End	724-632	1226-1318
2	Cemetery	End	726-646	1224-1304
3	Cemetery	End	564-580	1386-1370
4	Cemetery	End	600-278	1350-1672
1	Midden	Start	999-569	951-1381
2	Midden	Start	698-572	1252-1378
3	Midden	Start	911-580	1039-1370
4	Midden	Start	1106-814	844-1136
1	Midden	End	671-343	1279-1607
2	Midden	End	671-391	1279-1559
3	Midden	End	666-572	1284-1378
4	Midden	End	600-278	1350-1672

events. This clearly places the cemetery within the time that domestic debris was allowed to accumulate on Mound C.

These dates seem to present a paradox. The Mound C Cemetery appeared to be earlier than its surrounding matrix. Recall, once again, that both of the midden dates were from bones situated above the mortuary deposits. These bones, providing maximum age estimates of midden deposition, could easily have been deposited after the graves were in place. Since no stratigraphic divisions were observed to separate human and animal bone sites in the midden, the most likely scenario was that midden and mortuary deposits occurred at the same time, with the midden accumulation continuing after mortuary use. Unless both midden and cemetery accumulations represent post-village abandonment events, it is unlikely that the cemetery was formed by a non-Wickliffe village cemetery.

Community and Regional Event Affiliations

Can results from this Bayesian approach help interpret the cemetery's relationship with Mound C and other community deposits at the Wickliffe Mound Group? The most likely synthesis of temporal and stratigraphic information places the community accumulation before the termination of midden deposition in Mound C. This implies that the burial and village communities are probably one and the same. Since initial and terminal burial accumulation periods overlap considerably, it is also unlikely that more than one mortuary use period is represented in the cemetery. Likewise overlap between midden and burial accumulation periods suggest that these were contemporary uses of the same part of the community landscape. Note that trash deposits extend above both grave and midden bone recovery sites, providing an opportunity for midden to have accumulated after the dated human and faunal deposition events.

These results imply that a single community probably formed the midden and cemetery, but they do not indicate whether the association between the cemetery/midden activities is consistent with other Wickliffe events. To date, 17 other radiometric estimates, representing beta counts of wood and other plant-based carbon, have been obtained from a number of contexts at the Wickliffe Mound Group (Table 10-6). They indicate a potential occupation range between AD 656 and 1486. These dates were compared to those from the cemetery to learn how village and mortuary events corresponded.

The Mound C and Wickliffe Mound Group radiocarbon dates were adjusted to produce comparable data sets. Unfortunately, most of the Wickliffe Mound Group dates were obtained without the luxury of Delta ^{13}C values and therefore cannot be corrected to correspond with those from Mound C. In order to keep the data comparable, unadjusted radiometric values from the cemetery were used in this examination. Wesler (1993, n.d [book]) has divided the Wickliffe Mound Group dates into arbitrary early, middle and late phases based on stratigraphic placement and artifact affiliations (See Table 8-1). These were ordered with the Early Wickliffe Phase representing the initial village occupation, the Middle Wickliffe Phase as an intermediate phase, and the Late Wickliffe Phase as occurring just prior to village abandonment. Since these dates were not recovered

Table 10-6. Wickliffe Mound Group Radiocarbon Ages and the Probability that They Represent Outliers.

Sample No. / Burial No.	Period Assignment	Uncalibrated Radiocarbon Age (1 Sigma)	2 Sigma Calibrated Age (AD) [a]	Prior Probability	Posterior Probability
B12529	Early	520 +/- 70	1299 (1416) 1483	0.10	0.98
B25218	Early	920 +/- 60	999 (1061, 1086, 1123, 1138, 1156) 1257	0.10	0.03
B39030	Early	1265 +/- 60	656 (721, 743, 770) 894	0.10	0.10
ISGS1143	Middle	830 +/- 77	1023 (1218) 1297	0.10	0.02
ISGS1156	Middle	765 +/- 76	1064 (1275) 1390	0.10	0.03
B25217	Middle	1030 +/- 90	781 (1004, 1008, 1017) 1213	0.10	0.21
B25216	Late	430 +/- 60	1405 (1445) 1635	0.10	0.21
B31520	Late	620 +/- 50	1283 (1315, 1354, 1384) 1418	0.10	0.03
B31833	Late	1060 +/- 70	782 (991) 1157	0.10	0.79
B33584	Late	760 +/- 80	1059 (1276) 1393	0.10	0.04
B33585	Late	760 +/- 90	1040 (1276) 1398	0.10	0.04
B25220	Late	730 +/- 50	1217 (1282) 1385	0.10	0.04
B25219	Late	740 +/- 70	1163 (1280) 1393	0.10	0.04
B25911	Late	770 +/- 60	1161 (1271) 1379	0.10	0.04
ISGS1171	Late	720 +/- 70	1191 (1284) 1399	0.10	0.04
B27506	Late	750 +/- 60	1164 (1278) 1385	0.10	0.01
B27507	Late	580 +/- 60	1289 (1332, 1340, 1398) 1439	0.10	0.04
49	Cemetery	745 +/- 50	1212 (1279) 1381	0.10	0.05
95	Cemetery	825 +/- 50	1044 (1220) 1284	0.10	0.03
102	Cemetery	880 +/- 50	1024 (1163, 1173, 1180) 1264	0.10	0.03
147	Cemetery	770 +/- 40	1194 (1271) 1295	0.10	0.04
150	Cemetery	810 +/- 45	1159 (1224, 1321, 1239) 1285	0.10	0.03
218B	Cemetery	995 +/- 50	993 (1036, 1144, 1146) 1212	0.10	0.18
221	Cemetery	745 +/- 60	1188 (1279) 1387	0.10	0.04
246	Cemetery	725 +/- 55	1216 (1283) 1389	0.10	0.06
251	Cemetery	815 +/- 55	1044 (1222) 1290	0.10	0.03
279	Cemetery	865 +/- 55	1025 (1190, 1202, 1206) 1278	0.10	0.03
280	Cemetery	850 +/- 55	1032 (1212) 1281	0.10	0.03

[a] Calibration Curve Intercepts Presented in Parentheses (From Matternes 1999:75).

from a single stratigraphic context, absolute relationships between dates are not well demonstrated. Hiatuses between dated deposits are assumed to have occurred. Most dates were obtained either below a historic plowzone or with demonstrateably Mississippian artifacts. The absolute date of 1673 for historic intervention and uniformly distributed range of AD 700-1000 for Mississippian development were again used as temporal perimeters. Because the question is one of relationship between the cemetery and village, no relationships were modeled between these data sets. The cemetery was treated as a single archeological phase.

Prior examinations by Mattemes (1999:74-76) noted inconsistencies with the Wickliffe Phase model suggesting that these dates do not form homogenous sets of radiometric information. A review of the posterior probabilities revealed that the current temporo-stratigraphic model was incapable of accommodating the information supplied by at least two Wickliffe Mound Group dates (B12529 and B31833), (Table 10-6). While beyond the scope of this investigation, Wickliffe's current tempo-stratigraphic model is in need of some detailed revision. This model, however, can provide some idea of how the village and cemetery relate in time.

Figure 10-9 illustrates the beginning and end date probability estimates for Wickliffe's archaeological events. The Mound C Cemetery's accumulation period corrsponds best with major components of the Middle Wickliffe period, with date possibilities extending into both the Early and Late Wickliffe periods. In contrast to earlier speculations (e.g., Clay 1997; Mattemes 1994, 1996a; Wesler and Matternes 1991) that the cemetery was formed outside or at the end of the village occupation period, the cemetery now appears to be most closely associated with the community actually living at the Wickliffe Mound Group.

To obtain a more regional perspective, Mound C dates were compared with the western Kentucky late prehistoric chronologies. Using the Tennessee-Cumberland chronologies, the Mound C Cemetery fell within the Jonathan Creek and Angelly Phases. Clay (1997:16) noted that this time frame marked changes in how Mississippian chiefdoms were organized. These changes may have influenced why the cemetery and village were eventually abandoned. While a variety of other temporo-cultural constructs have been suggested (c.f., Clay et al. 1991; Cole et al. 1951; Williams

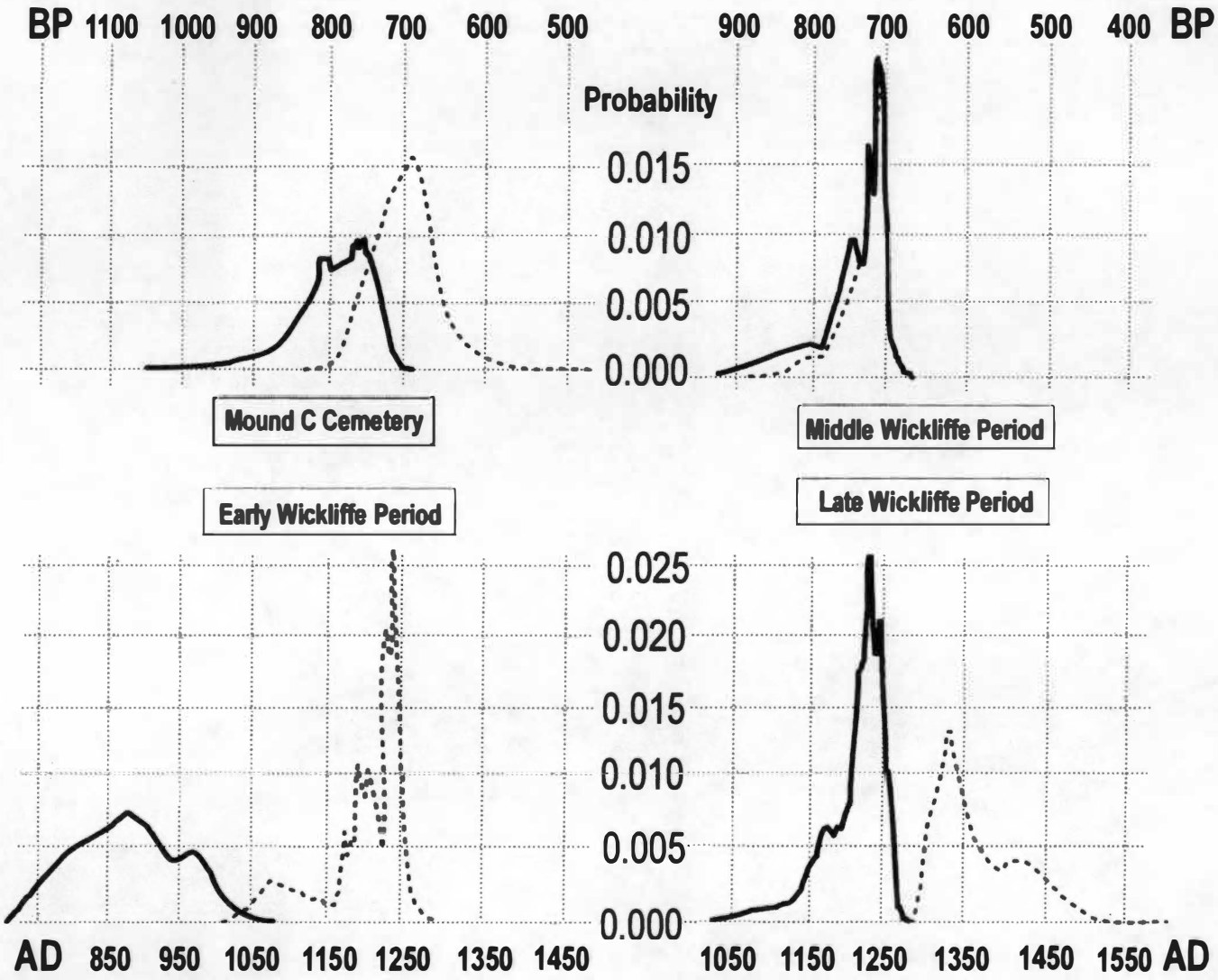


Figure 10-9. Probability Estimates for Beginning (Solid Line) and End (Dotted Line) Dates for Wickliffe's Cemetery and Temporo-Stratigraphic Phases.

1954, among others), the most widely accepted and developed chronological model applied to western Kentucky was the University of Illinois-Urbana's West Kentucky Project sequence. This model outlined important changes in settlement and artifact patterns as sequenced by well-documented radiometric data. Since the focus of these phases was not to define specific event periods but to record trends in cultural activity, mean event dates were arbitrarily divided into 200-year increments (Lewis 1990a). The cemetery was comfortably situated within the Dorena and Medley Phases (Figure 10-10). During the Dorena phase, the earlier trend of population nucleation continued to develop a more structured hierarchical settlement system, designed to maximize agricultural exploitation of the fertile river bottoms (Kriesa 1991:10). Matternes' (1999:78) survey of radiocarbon dates from other Mississippian sites in Western Kentucky revealed dates from Adams (15FU4), Chambers (15MI109), Marshall (15CE27), Turk (15CE6), and Twin Mounds (15BA2) that were contemporary with the Mound C Cemetery. If the Mound C community were not a satellite, socio-economic contacts probably extended to these or other more politically powerful towns. The Medley Phase stressed the decline of many smaller outlying sites and progressive population growth at the region's fortified towns (Kriesa 1991:11). Lack of substantive prehistoric activity in Mound C after the cemetery and midden were deposited is consistent with abandonment of the Wickliffe Mound Group during the fourteenth century.

These results indicated that the community living at the Wickliffe Mound Group probably formed the Mound C Cemetery. The burial accumulation period coincided with a period of socio-economic expansion. During this time, new wealth, power and possibly inhabitants would have tested the community's structure and required some shift in the way its inhabitants thought of themselves. The cultural fluorescence associated with the Middle Wickliffe period was a socially unstable time, change in community definitions would reflect itself in various outlets, including site size, architectural choice and arrangement source and form of material goods. Changes in mortuary representation would have coincided with these community events.

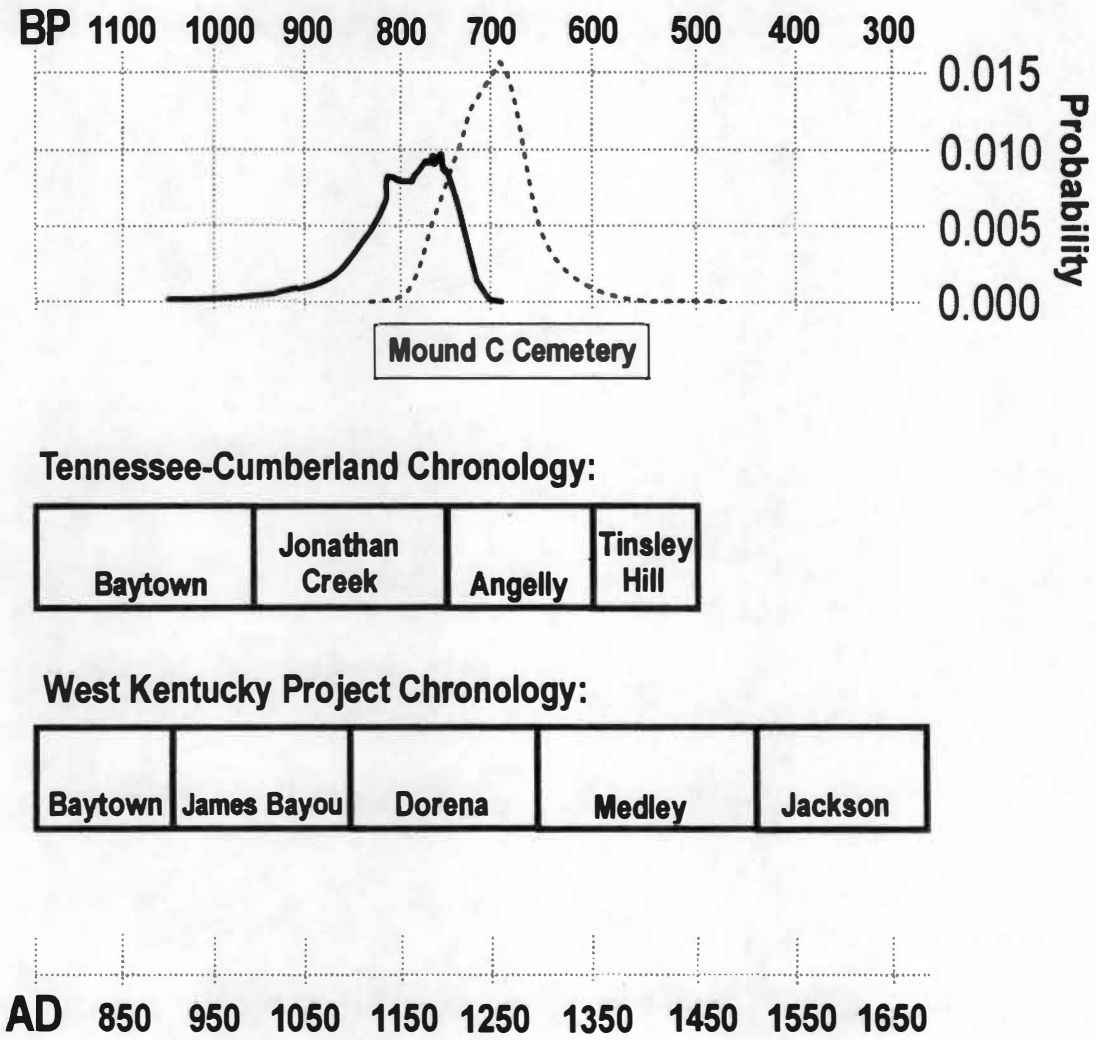


Figure 10-10. Probability Estimates for Beginning (Solid Line) and End (Dotted Line) Dates for Wickliffe's Cemetery and Regional Chronologies.

Chapter 11. Forms of Variability in the Mound C Cemetery

Burial is one means of removing the deceased from the living community's environment and placing them in a location set aside for the dead (O'Shea 1984:3; Brown 1971:4). Beyond this common disposal method, there are innumerable ways that interment can be accomplished. An examination of surviving material expressions can identify variations that result from social differences between community members. One must have some knowledge of how the mortuary ritual is practiced to know where to look. Unfortunately, mortuary rituals are rarely constrained to a single locale. Many aspects of the ritual are practiced in places that are outside the physical boundaries of the burial area.

Mattemes (1996a:314) has suggested that the presence of non-infant human remains in the domestic areas may represent remnants of a cyclic burial, recovery, and eventual reburial. Aspects of mortuary rituals may have been practiced independent of more permanent burial areas, such as Mound C. Often the material remains of these and other non-gravesite behaviors are too perishable to be recovered from an archaeological context. These provide no information about their meaning. Artifacts recovered outside of the Mound C area are not diagnostic enough to indicate a mortuary affiliation, preventing the use of non-Mound C archaeological data to infer Middle Wickliffe mortuary behavior. This represents an important limitation – most of what can be discerned about the mortuary rituals used at Wickliffe is exclusively represented in the mortuary deposits. The most reliable source for archaeologically acquired mortuary information is the burial locale. This chapter will describe evidence for variations in mortuary expression as recovered from Mound C.

Intentional and Unintentional Inclusions

Mortuary deposits contain only samples of each funerary ritual's original material expression. Some objects are not durable enough to survive in an archaeological environment, while the community selectively retains other materials. Only a few artifacts may actually enter and survive as part of the archaeological record. The amount of variation detected from durable mortuary remains represents, at best, a conservative estimate of the original ritual's total expression.

Materials recovered from a mortuary context can arrive there as a consequence of intentional and unintentional agent interactions with the mortuary environment. Intentionally included artifacts are the result of direct purposeful acts committed during the course of the mortuary ritual. They are forms of symbolic communication. The range of intentionally included artifacts incorporates such materials as grave goods, costume, and grave furniture, as well as the physical remains. Variations in intentional artifact form, defined as deviations away from a singular mortuary representation, reflect how differences between community members were taken into consideration during preparation and presentation of the mortuary ritual. Intentional artifact variations indicate that differences between interments carry meaning. These variations may include such features as status related disparities in grave goods, segregation of infants from the adult burial area, or distinctive clan/family group based artifact motifs.

Unfortunately, intentional human responses to the ritual event are not the only way that materials can arrive in a mortuary context. Objects also accumulate from circumstances having little to no bearing on symbolic communication. Unintentional artifact inclusion occurs as a byproduct of human and non-human activities in the depositional environment. Their association with a given interment is purely coincidental with the deceased's mortuary ritual. Unintentional artifact inclusions result from other non-ritual related factors interacting with the deposit; these inclusions do not communicate meaning as part of the mortuary ritual. Unintentional agent interactions with the mortuary record embrace such phenomena as artifact transport from physical forces (wind, water, chemical, etc.) and animal activities, the inclusion of previously deposited artifacts as a component of the grave fill, and material gains or losses from later human activities. While the initiation of unintentional agent interactions may be causally linked to the presence of mortuary deposits (disturbance by foraging animals, for example), the absence of meaning during any part of the mortuary ritual discriminates these factors as unintentional. Variations resulting from unintentional agents may provide a wealth of information about other aspects of the archaeological record, but they convey very little about the mortuary ritual's expression.

Intentional and unintentional forms of variation must be identified. Treating unintentional artifacts as intentional forms generates an artificial inflation of the number, form and complexity found in ritual expression. The resulting analysis will erroneously define meaning where none exists. Likewise, misidentification of intentional as unintentional agent byproducts underestimates the ritual's true expression. O'Shea (1984:23-31) has detailed the analytical dangers of confusing intentional and unintentional artifact inclusions.

Defining Intentional Inclusions

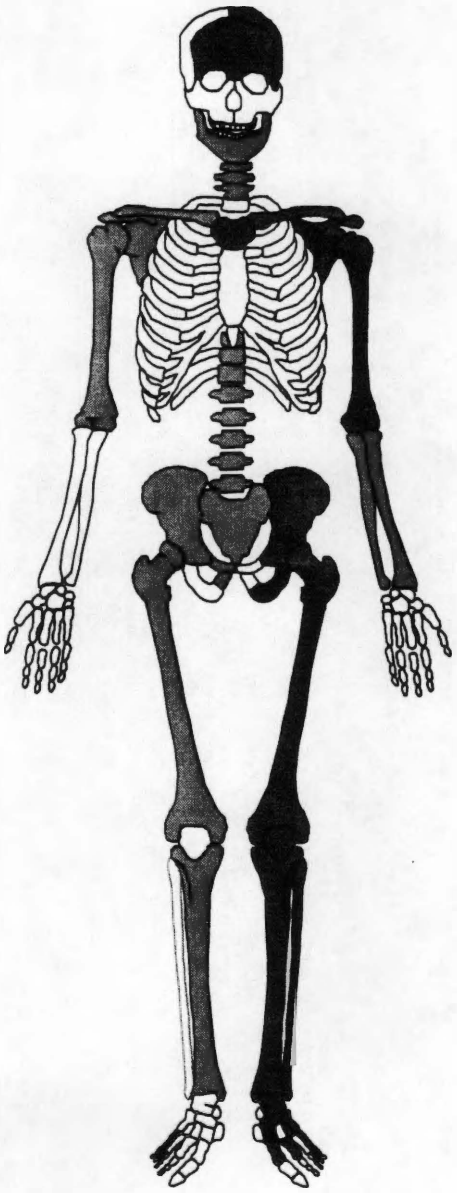
A systematic procedure was used to separate unintentional variability from intentional variability in the Mound C Cemetery. Many of Mound C's graves were situated in a midden deposit. This domestic accumulation contained numerous broken ceramics, animal bones, burned plant residue and lithic debris. Since there is an excellent chance that these materials came into association with human remains as grave-fill inclusions, there is little evidence that they can be discerned as intentional mortuary inclusions. Artifact forms that duplicate those found in non-mortuary Mound C midden contexts were removed from the list of mortuary variation candidates[1].

Mattemes (1993:35) recognized that burials exhibited during the King era were modified and enhanced in order to make them more interpretable to a modern audience. This meant that any original meaning was historically compromised by the addition of other meanings. Recognition, control and eventual elimination of these spurious meanings were accomplished following the methods outlined in Mattemes (1996b).

Mattemes (1996b:36) recognized that materials in the King era excavations were divided into sets of objects where the original context was completely unknown, those where the context was altered but recoverable, and materials still in their original context (Figure 11-1). Removal of all

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[1] While some of the midden artifacts could represent mortuary materials, these objects cannot be confidently associated with mortuary activities during the Mound C mortuary accumulation phase. Removal from analysis facilitated a more conservative estimation of the Mound C Cemetery's mortuary expression.



= Archaeological Sample:
Valid Archaeological Context.
Valid Biological Association.
Fully Analyzable.

= Exhibit Sample:
Partial Archaeological Context.
Reconstructable Biological Association.
Analyzable after Reconstruction.

= Exhibit Sample:
No Archaeological Context.
No Biological Association.
Not Analyzable.

Figure 11-1. Artifact Context in Mound C.

historically compromised materials, designated the "Exhibit Sample", left undisturbed mortuary components. These remains possessed a reliable set of mortuary features, capable of indicating aspects of the grave's original meaning. These were carefully recovered and used to help identify Exhibit Sample materials that were part of the original burial assemblage. Photographs made early in the King era helped define the exact configuration present. A test of the method by Matternes (1996b:37-40) reconstructed 71% of the test sample's form and cast considerable doubt that the remaining 29% ever existed as Native American mortuary deposits. Some historically manipulated interments were too badly compromised to reconstruct. The remaining reconstructed graves represented a conservative estimate of the original mortuary assemblage's variation. Unfortunately, this procedure could not reconstruct all aspects of the original interments. Severely compromised data, including exact limb position and grave good inclusion, could not be included in this project. While this context validation method reduced the pool of useable variables, it served to remove all unintentional variation introduced by historical modification.

Some intentionally included objects displayed differences in form due to sedimentation and other pedogenic processes, natural decay, animal activities or human modification. The presence of these objects was noted and they were eliminated as potential sources of meaningful information.

Some reconstruction was necessary to identify mortuary inclusions among most interments. This was particularly evident in data describing grave pit morphology. Characteristics of grave pits, such as their location, shape and dimensions, orientation, and position relative to other features, were formed as part of the mortuary ritual. These features represented potentially meaningful mortuary variables. Regretably, the depositional environment in Mound C prevented an accurate definition of most grave pit properties. Human disturbances, bioturbation, geochemical properties of the soils, and animal activities contributed to reduced pit visibility in Mound C. These data were not completely lost, however, because their contents, namely human skeletal remains, approximate many of the grave pit's original dimensions. Aspects of the archaeological provenience for human skeletal materials in Mound C were used to infer pit characteristics.

Mortuary Variables in Mound C

The choice of variables has a major impact on the cemetery's interpretation. While studies of mortuary variability tend to focus on grave good data, there is no strong scientific rationale for this limitation (Brown 1987:301). These self-restrictive analytical choices run the risk of limiting the information obtained to only a few social dimensions. Meaning can be conveyed in a variety of different material forms. Table 11-1 demonstrates some of the dimensions visible in mortuary contexts. Five general domains of variability are recorded in the Mound C Cemetery. Attributes in each potentially meaningful mortuary variable were carefully defined to ensure that these features were uniformly classified. The following descriptions defined the range of attributes associated with each variable.

Table 11-1. Archaeologically Visible Mortuary Variables.

Mortuary Variable	General Domain	Recovered from Mound C?
Disposal Type	Body Treatment	Yes
Limb Arrangement		No
Post-mortem Modifications		Yes
Number of Individuals	Grave Contents	Yes
Number of Grave Goods		No
Type of Grave Goods		No
Object Location		No
Type of Receptacle	Facility Preparation	Yes
Receptacle Dimensions		No
Receptacle Orientation		Yes
Receptacle Depth		No
Location in Cemetery	Provenience	Yes
Location in Community		Yes
Age	Biological Features	Yes
Sex		Yes
Health		Yes (Very Limited)

Body Treatment

Body treatments reflect how human remains are modified prior to deposition. One of the most fundamental decisions made in a death event is the length of time that the deceased's remains are available to the community. Shorter periods of manipulation entail less transformation of the corpse, while longer periods of availability require some form of tissue reduction. These decisions define how a body is represented in the archaeological record. Four forms of postmortem modification were defined within the Mound C cemetery.

Primary Body Treatment

Human remains, where the form reflects mortuary decisions to dispose of the body before it reached an advanced state of decomposition, are referred to as primary treatments. Primary body treatment entails only minor manipulation of the corpse's physical form as part of the funerary program.

Archaeologically, this behavior is manifested by the recovery of human skeletal remains in correct anatomical order. In Mound C, burials with primary body treatments are uniformly placed in an extended supine position with their hands to their side (Figure 11-2).

Secondary Body Treatment

Secondary body treatments result from decisions to maximize the postmortem to pre-interment period by reducing the body to a biologically inert state. This is accomplished through soft tissue elimination methods including defleshing, cremation, dehydration, and natural skeletonization. Subsequent permanent disposal of the body in a mortuary facility generally occurs after the dead are more or less reduced to a hard tissue state. Human remains that undergo this form of treatment generally appear in the archaeological record as disarticulated concentrations of bone. There are very few clues how secondary remains in Mound C were reduced to disarticulated bones. The methods or cultural criteria supporting retention of the dead are not well understood. Several forms of secondary body treatment were detected in the cemetery.

1. Bundled. Some cultural decisions favored retention of body parts for extended periods of time. Bodies were maintained long enough to lose most of the soft tissue. Bodies

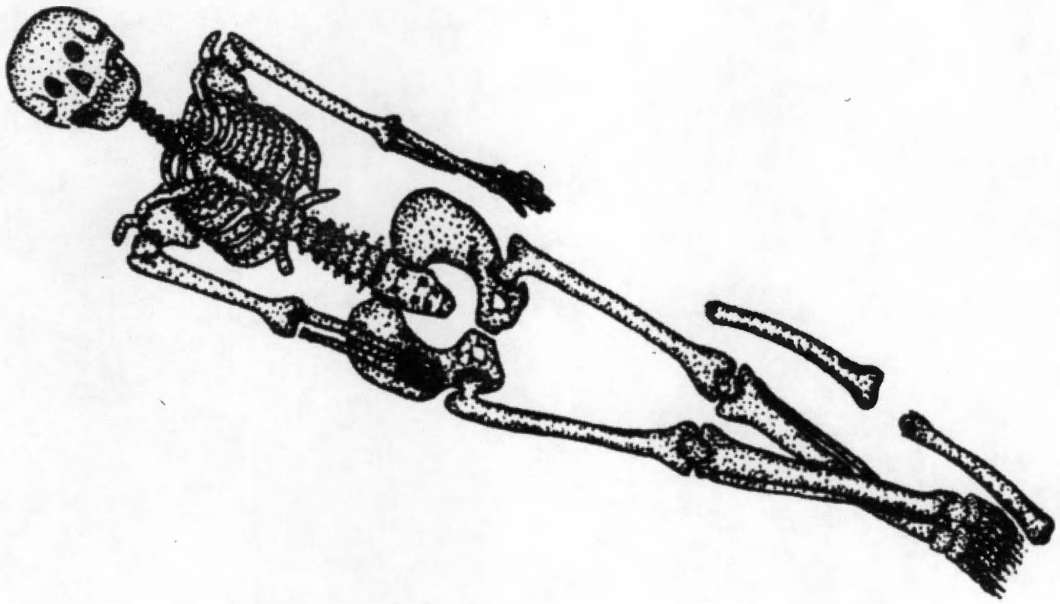


Figure 11-2. A Primary Body Treatment from Mound C.

subjected to this type of behavior appear as clusters of disarticulated human bones. These dense concentrations suggested that they were interred in a non-durable container. Bundled mortuary features appeared as neatly arranged rectangular or circular concentrations of bone (Figure 11-3). The long bones were usually stacked at the base of the feature with other elements scattered around the sides or on top. Crania tended to be placed at one end of the bundle. The shape of these interments implied arrangement inside a blanket, basket or box.

2. Cremated. A few fragments of highly oxidized human bone are present in the assemblage. Cremation is a labor-intensive form of body reduction. Adequate quantities of fuel must be gathered in order to thermally reduce the human form to a mineralized fragmentary state and sufficient time must be allotted to allow this transformation to take place. Miles (1965:161) suggests that the labor and capital demands make cremation dependent on the social and economic status of both the deceased and the presentation team. While acknowledged as present, cremated bone concentrations from Mound C are too poorly provenienced and represented to ascertain their social affiliation. They are intentionally omitted from this analysis.

3. Isolates and/or Disturbed Remains [2]. Not all skeletal elements are associated with a particular individual or set of remains. Many of these isolated human bones vary in condition from complete, well preserved elements to highly fragmentary, poorly preserved human remains. Most isolated bones originated in skulls, mandibles, and long bones. They represented elements disturbed from other mortuary activities, elements prehistorically exposed by animal intrusion or erosion, or individual bones brought to the site from other mortuary contexts. While deposition form and proof of intention were not clear in all cases, they were evidence that inclusion within a mortuary area was an important consideration.

Disturbed remains represent elements removed from their original context and replaced during the aboriginal occupation period (Figure 11-4). These assemblages contain bones

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[2] This category includes mortuary phenomena Matternes (1994:26-27) described as unconsolidated secondary interments.

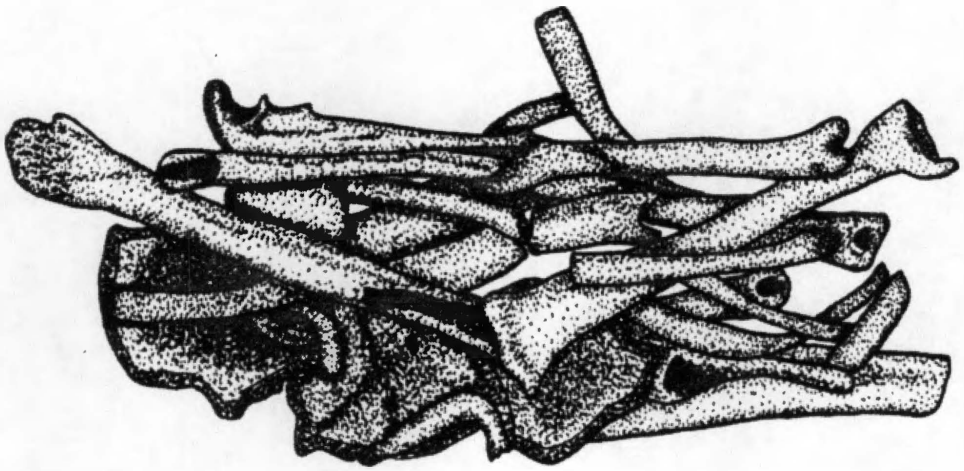


Figure 11-3. A Bundled Treatment from Mound C.

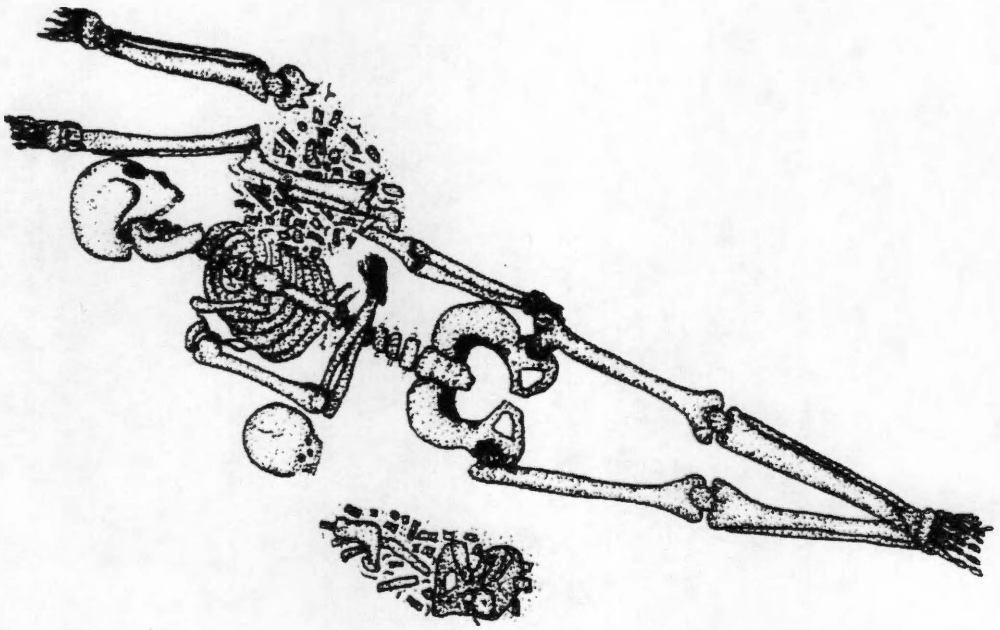


Figure 11-4. Two Disturbed Bone Scatters Resulting from Placement of an Extended Interment.

corresponding to missing elements from nearby graves. When possible, the data from these remains were pooled with the undisturbed skeletal aspects.

Disturbed remains were pooled with isolated remains because the gradient of variability makes separating these two forms impossible. This classification probably combined several distinct mortuary practices into a single taxon, but attempted to discriminate internal differences produced results that were little more than subjective conjecture. A review of these remains indicated that too few of their social variables could be ascertained to enable inclusion in this analysis. Their presence was recognized as an unclear component of the cemetery's total expression. They were not pursued in this analysis.

Multiple Body Treatments

Graves in Mound C did not uniformly contain single interments and single body treatments. In a few circumstances, individuals receiving both primary and secondary body treatments were included in the same deposit. These indicated that separate burial facilities were not constructed for each body treatment, rather that the same facility could house more than one form. The major distinguishing criterion for this designation was evidence for discrete, intentional element inclusion.

Graves with multiple treatments were distinguished from disturbed burials on a number of grounds. First, multiple treatments contained elements in the same receptacle. Graves exhibiting multiple body treatments possessed extremely close associations, preferably with both forms exhibiting the same orientation. Stratigraphic evidence for contemporaneity was also an important consideration. Graves deemed multiple interments lacked indications that the secondary interment came from disturbances during the grave's manufacture. The addition of two isolated tibiae with Burial 264 was interpreted as evidence of intentional inclusion (Mattemes 1996:302). Burial 264, and graves like it, have been designated as multiple treatment mortuary features.

Grave Contents

The term "burial" describes the sequence of cultural decisions resulting in the physical placement of human remains in a subsurface environment. This definition, however, provides no indication of the number of people represented. The terms "Single" and "Multiple" come from

Sprague's (1968:281, 284) burial classification scheme. They are used to indicate the number of individuals represented in a single grave.

In terms of representation in a mortuary setting, the difference between single and multiple interments is profound. Singular interments indicate that the individual's social characteristics are retained and presumably used between the death event and final phases of the burial ritual. These characteristics are available for manipulation by the presentation team and may serve to influence the form and location of final interment. In contrast, individuals combined to form multiple interments lose their identities prior to the final interment. When placed with another body, each individual's social characteristics are merged to form a corporate identity. This new construct is used by the presentation team to reaffirm social characteristics.

In a multiple interment, mortuary expression focussed on the group. At some level, individuals receiving a multiple burial had socially compatible personas. As a means of accurately scoring multiple interments, individual characteristics were given secondary consideration to group or unified features. Graves identified as multiple interments were not scored for individual characteristics. Scoring graves as singular or multiple expressions was based on whether one or more individuals could be identified as intentional components of a final mortuary event. The Minimum Number of Individuals (MNI) for each burial activity was determined by counting each duplicated element, and those of contrasting age and sex differences, as discrete individuals.

Single Burials

Graves containing single burials contain only one person. Individuals buried as single interments were afforded unique burial facilities and (presumably) graveside funerary rituals. They probably indicate a unique death experience in the community. Social characteristics associated with a single burial relate most closely to the interred individual.

Multiple Burials

Multiple burials contained more than one individual. Both primary and secondary interments in Mound C followed this pattern. Among multiple burials incorporating primary body treatments, individuals were placed in the same grave pit at the same orientation (Figure 11-5). A lack of

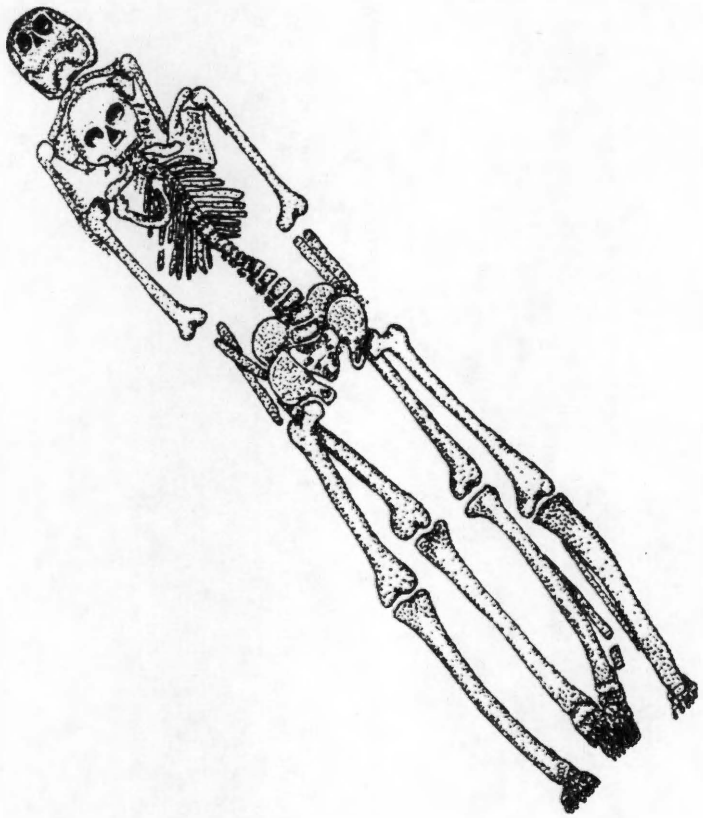


Figure 11-5. Grave Displaying Multiple Primary Inhumations.

differences in skeletal articulation and condition indicated that two death events occurred over a relatively short period of time. These individuals were not provided with discrete burial facilities. Graves containing multiple primary inhumations were distinguished from independent site uses by a lack of disturbance in the bottom-most interment, an intermingling of settled skeletal elements, and little to no soil accumulation between superpositioned interments. Most disarticulated human assemblages in Mound C contained bones that were mixed prior to deposition in the ground (Figure 11-6). In a few circumstances, separate individuals were represented by discretely oriented sets of bundled remains in the same mortuary feature.

Facility Preparation

Humans rarely bury their dead in simple, unsymbolized grave pits. Usually in conjunction with a graveside mortuary ritual, humans furnish a burial site with materials and symbols that reduce the harsh realities of a grave's true purpose and emphasize associations between the dead and selected cultural values. Placing the deceased in some form of container provides a means of separating the dead from the grave fill and frequently aids in body transport. Griffin and Neumann (1942:74) note that furniture used in the past to hold the dead includes urns, blankets, logs, hides, wood and stone enclosures, boxes, baskets, and bark or reed wrappings. Native Americans rarely buried the dead in unfurnished pits. Interments placed in Mound C were probably harbored in some form of enclosure. Grave receptacles are classified into three forms: Unlined (Non-durable Liners), Wooden Liners, and Stone Liners.

Unlined (Non-durable Liner)

Interments of this nature were classified as graves lacking a durable liner. Most mortuary deposits in Mound C consisted of little more than human bone and the occasional artifact. Kuttruff and Drooker (2000) indicate that the dead were attired in some form of clothing. They probably were laid in a prepared container made from materials like reeds, skins, or textiles (albeit strong evidence for these non-durable artifacts has not been recovered). Mound C's graves typically lacked any indications of the measures taken to prepare a facility for the dead.

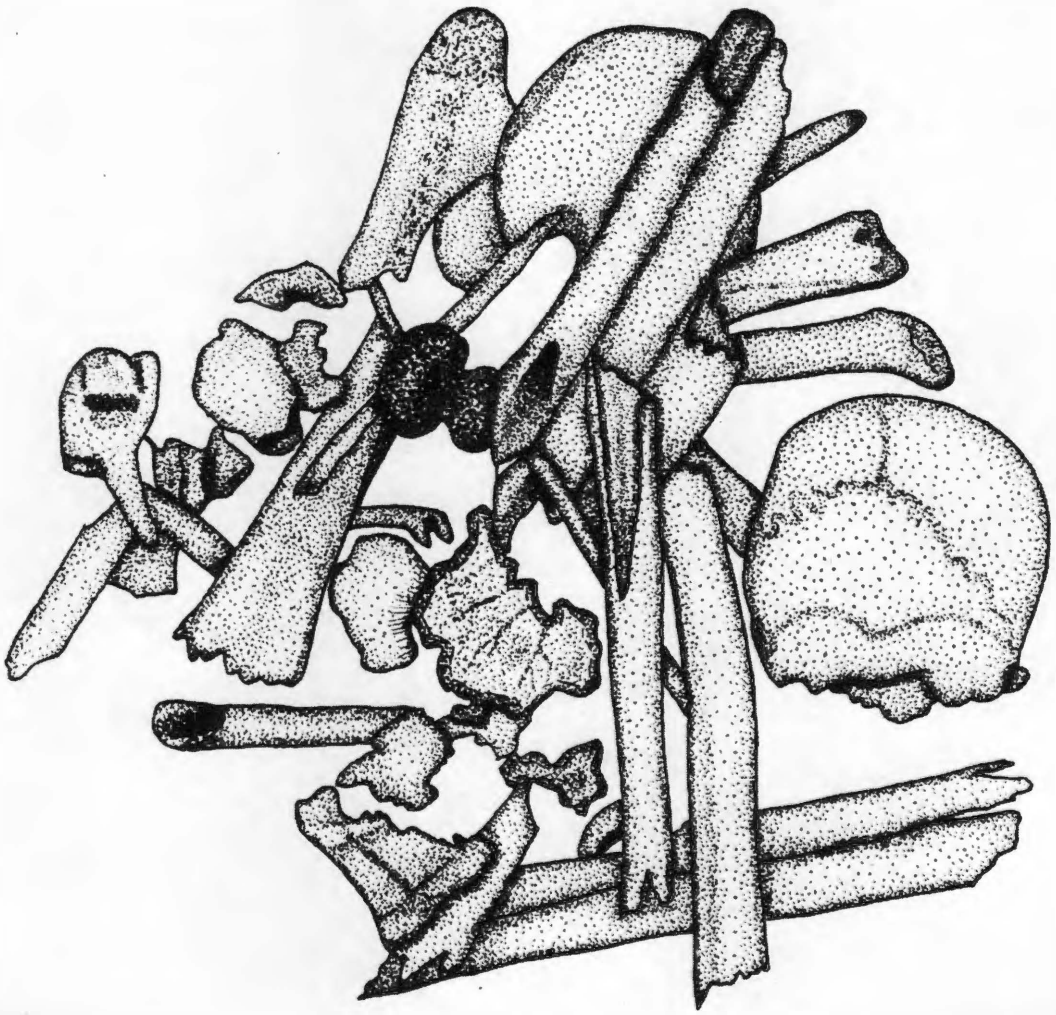


Figure 11-6. Grave Displaying Multiple Secondary Inhumations.

Wooden Liner

Mississippian graves provide ample evidence that various material resources were utilized to line the grave pit (I. Brown 1981). The most commonly encountered durable liner in Mound C was wood (Mattemes 1996:311). These liners were evidenced by the presence of unmodified and carbonized wood fragments.

Since wood carbon constitutes an element found in the mound's deposits, simple presence of these artifacts was not sufficient to classify a grave as wood lined. Three features were used to distinguish burial affiliated from non-burial affiliated carbon concentrations. First, concentrations of wood carbon needed a direct association with human remains to be considered a grave liner candidate. The wood carbon concentration needed to be dense, preferably representing continuous sheets of carbonized material. Finally, the carbon concentration needed to possess some definable shape. Specifically, individual fragments of carbonized wood liners exhibited parallel fibers rather than less structured fiber orientations.

In some instances, actual fragments of bark or wood were associated with skeletal material. Classification as a liner followed the same guidelines as above, however, most graves contained only fragmentary evidence. This required a more liberal interpretation of what constituted a concentration. Prehistoric wood was not encountered in any mound/midden deposit outside of a direct burial contact. This helped define wood or bark concentrations as unique mortuary artifacts.

Stone Liner

Some Mississippian peoples used limestone, sandstone and other mineralized substances as grave liners. Williams (1954:11) attributed the lack of stone lined graves in the Cairo Lowlands to an absence of naturally occurring deposits of useable stone. This same fate can be found on the eastern side of the Mississippi River (Gildersleeve and Roberts 1945:88). In Mound C, however, there was evidence that conglomerate slabs were part of the grave preparation process.

Pebbles and small (≤2 lb) conglomerates were occasionally encountered in the Mound C matrix. Simple presence of conglomerates was not sufficient to define these as unique mortuary

features. Stone liners were defined by the presence of a large (≥5 lb) linear conglomerate slab in contact or close association with a skeletal concentration. Slabs were placed horizontally above or below and/or vertically beside an interment. This classification did not require a grave be enclosed in stone. Accommodation for agricultural displacement and natural settling was also considered when determining whether a particular grave possessed a stone liner.

Orientation

Traditionally, orientation data was taken by drawing a centerline through a grave or skeleton and measuring the angle (Sprague 1968:482). Natural, aboriginal and historic disturbances, as well as excavation strategies, prevented scoring the Mound C Cemetery with precise orientation data.

Approximate orientations, however, were obtained. A compass was divided into eight units, consisting of 45-degree arcs (Essentially 22.5-degree arcs on either side of a cardinal or minor direction) and graves were assigned to the category most closely describing their orientation (Figure 11-7). A primary interment orientation was determined by approximating a line from the top of the head through the base of the sacrum. Orientation was scored according where the head was positioned (For example, the orientation of a primary interment with the head at about 250 degrees classified the burial in a west orientation). No principal directions were determined for secondary interments. These burials were scored by the plane paralleling the long surface of the assemblage. Secondary interments in circular, irregular and other non-linear arrangements were classified as non-oriented graves.

Provenience

Graves in the Wickliffe Mound Group are not equally distributed across the village, rather are largely segregated to Mound C. This implies that some spatial associations between the mound and mortuary activity are present. Spatial arrangements may have been communicated information about the deceased.

To test this, a cemetery center point was derived from the average midpoint of graves found around the central margin and distance measurements were then taken from this to every burial. Mid-point estimates were defined for each grave. The center of concentration in secondary

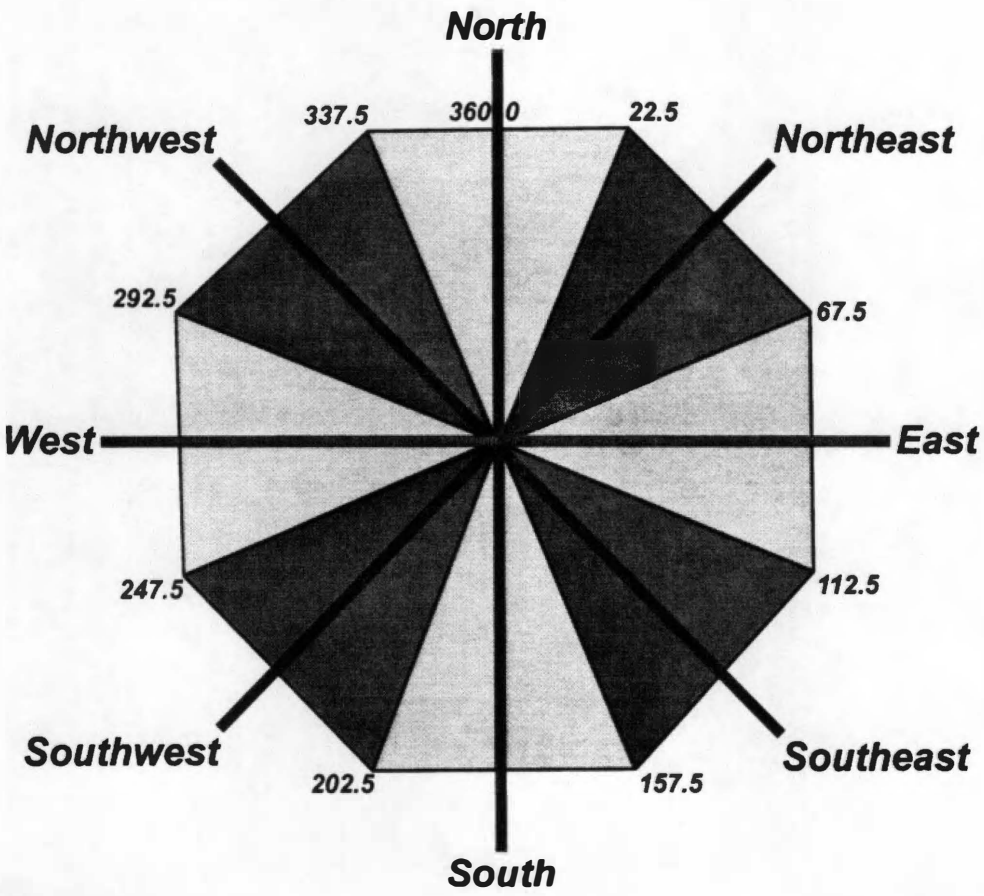


Figure 11-7. Grave Orientation Key.

interments and the middle of the sacrum among primary burials served as midpoints. These data were examined on two levels. First, univariate examinations were considered (See Chapter 12). Distance from the cemetery's center was again approached as an independent means of mortuary communication.

Biological Features

Humans tend to recognize age, sex and health as social and biological features. They are important foundations for many of the social roles made available to the individual. Unlike other forms of mortuary variation, the presentation team has no control over biological representations. They can, however, decide whether the attributes present are used to symbolize social ideas. The presentation team can choose to utilize morphology; such as allowing an old man's frail features indicate his age; or de-emphasize the biological state, as occurs when a disfiguring injury is hidden behind a closed coffin or shroud. This ability to manipulate whether morphology is an appropriate symbol is what enables biological features to be treated as mortuary variables.

Age and Sex

Age and sex estimations are largely dependent on the presence of osteological features in a given interment. In general, skeletal materials recovered from the 1932 and the more recent WMRC investigations display similar patterns of skeletal decomposition. Variations in preservation can be attributed to differences in subsurface conditions and human intervention (Mattemes 1994:14-36). Bones from the Mound C deposit exhibited a considerable amount of chemical weathering. Periosteal surfaces were often lost and many of the soft, trabecular aspects had deteriorated. Crania were rarely complete enough to obtain metric data. Additionally, materials from the former exhibit area showed considerable surface erosion, fragmentation, loss and displacement from improper curation. These conditions acted to compromise the materials available for examination. Another influencing agent was the research environment. Cultural and monetary constraints limited age and sex assessment procedures to field observations. These analytical restraints limited the range of useable age and sex estimation techniques to those applicable to incomplete fragmentary remains. No destructive age or sex estimation methods were applied to the collection.

Age and sex estimation data were broken into three sex and two age batteries. Sex was determined by the results of separate evaluations of pelvic, cranial and limb morphology. Age evaluation was based on eleven observation sites. The details and results of age and sex evaluations were outlined in Chapters 13 and 14.

Health

The Mound C Cemetery has never received an adequate examination of the burial community's state of health. Health determinations are largely dependent on the same skeletal preservation issues that confront age and sex analyses. Determining why individuals lack good health is primarily a function of the stress agents available, their behavior and ability to leave detectable responses in the skeletal tissues, and whether the individual was placed in a health risk situation. An epidemiological approach was taken to investigate health in the cemetery. A health screening of long bones detected the presence of several stress agents. Corrections for missing data biases were applied to ascertain whether these conditions varied from those observed elsewhere during the Mississippian period. Unfortunately, Mound C's preservation biases proved to be too great to accurately separate individuals with good health from those with poor health. The details and results of health evaluations were outlined in Chapter 15.

Agents of Variability in the Mound C Cemetery

In an optimal setting, both mortuary variables and the agents they symbolize would be known and available for examination. Unfortunately, most archaeological settings do not allow this line of research. In only a few rare circumstances, can an agent of variability can be recognized as independent of the mortuary variables.

Table 11-2 outlines how the agents responsible for mortuary variability might be recognized in a mortuary setting. The variants associated with most of these features are identified through some form of biological analysis. Note, however, that bio-osteological examinations are not capable of defining variation for every agent nor are they absolutely independent of biologically based mortuary variables. Classifications of non-biologically represented forms are made as independently

Table 11-2. Archaeologically Visible Agents of Mortuary Variability.

General Category	Major Domain	Recovered from Mound C?
Gender	Skeletal Dimorphism in the Skeleton	Yes
	Historical Documentation	No
Age	Skeletal Maturation	Yes
	Historical Documentation	No
Status	Agent Interaction	Yes
	Internal Inference	Yes
	Historical Documentation	No
Resource Fixity	Isotopic Dietary Indicators	Yes
	External Inference	Yes
Organizational Variability	External Inference	Yes
Idiosyncratic (Rare) Variations	Internal Inference	Yes
Circumstances of Death	Paleopathology	Yes (Limited)
	Presence of Medical Artifacts	No
	Historical Documentation	No
	Internal Inference	Yes

as possible from the material expression. In an historical setting, independent verification is achieved through written documentation. These resources, however, are not available from the Late Prehistoric Period. This limits precise agent identification. It is assumed that the agent forms identified approximate those present in the depositing community.

Gender

Gender does not represent the same social variable as sex. Sex emphasizes social features that exclusively separate humans according to their reproductive morphology. Gender recognizes that some of the rules assigned to those of a given sex are not rigid and only tend to be assigned to one sex (J. Matternes 1993:6-24). It is possible for roles to be fulfilled by individuals lacking a specific sex-based morphology.

Having said this, sex and gender display a considerable mount of social overlap. It is possible to use sex as a means of identifying some gender patterns. If sex is a component of a

gender role, the association between a mortuary variable and sex also identifies a relationship with gender. Sex, based on the morphological features outlined in Chapter 13, was used as a conservative estimator of gender in the Mound C assemblage.

Age

Humans also recognize age as a biological and social phenomenon, enabling skeletal (biological) age to be used as a conservative estimate of age's social dimensions. As outlined in Chapter 14, skeletal age was patterned into three divisions based on differences in risk of death.

Status

Humans universally recognize social differences between community members. Frequently individuals are categorized by these social qualities. Some status variations are important enough to be included in the mortuary presentation. Archaeological representation of status can rarely be inferred from data that are independent of symbolic communication. In the absence of strong independent evidence for social rank, analysts rely on their own interpretation of material expressions. Differences in Mississippian status have been suggested by variations in the number or quality of grave goods, form of interment, and/or location of the grave in the cultural landscape. If the major agent contributing to variation tends to crosscut age, sex and circumstances of death differences, then the information expressed separates social personalities along other lines of social differentiation. Status is assumed to heavily influence these agents.

Resource Fixity

The distribution of populations across a particular landscape is heavily influenced by resource availability. When resources are too scarce to enable permanent habitation (and burial is the chosen method of body disposal), an interment's form and locale are affected by the community's perception of an acceptable burial protocol and the given circumstances. Hofman (1986) emphasizes that resource fixity is a particularly important agent of variation among mobile populations. Interment can occur at more than one location simply as a result of community mobility between death events. In more sedentary communities, where resource predictably allows a more permanent occupation, the effects of resource fixity approach negligibility. Resource fixity is treated

as a constant if the depositing community was able to predictably extract resources from the local environment without displacement of the entire community.

Late Prehistoric Native American activity in Western Kentucky emphasized a sedentary agricultural lifestyle where materials that could not be obtained locally were procured through trade or by dispatching logistical task forces (Lewis 1996b:128-129). In Ballard County alone, there were renewable croplands, flora, fauna, and easily obtainable mineral resources. Artifacts from the village indicated that the community's socio-technological structure enabled its inhabitants to extract these resources without mobilization of the entire community (e.g., Carr and Koldehoff 1994; Drooker 1992; Edging 1991; Kreisa and McDowell 1995; Wesler 1985, 1989, 1991a). In light of this, resource fixity was treated as a constant for all interments.

Organizational Variability

As mobile communities move from predictable resource to predictable resource, the size and structure of group organization fluctuates. This influences the form and location provided to a particular interment. Among more sedentary populations (including the Wickliffe community) where size and structure do not undergo drastic seasonal (or predictably periodic) transitions, organizational variability is generally viewed as constant.

Idiosyncratic and Rare Variation

Idiosyncratic variability cannot be discerned independent of other mortuary expressions without a detailed knowledge of a community's structure and interactions between its inhabitants. As such, archaeological approaches to mortuary variation are rarely able to clearly discern personalized relationships between the dead and particular community members and variations that arise from relatively uncommon social personas. These indistinguishable agents were inferred by the presence of material forms that were infrequently encountered in the cemetery sample.

Circumstances of Death

Sometimes how people die influences how they are buried. By itself, the manner of death rarely serves as a means of communication (These are usually considered a health feature). Circumstances of Death can generally be thought of as a distinct feature influencing how other

materials are expressed. Evidence for circumstances of death are obtained from two sources – paleopathological and medical artifact data.

Medical artifact data results from the examination of objects designed to increase or decrease the victim's quality of life. These include such objects as medicinal applications, surgical implants or prostheses, as well as objects embedded in the body, including projectiles, weapons, or life threatening toxins. Objects of this nature suggest why a particular individual died. Burial features, including number of grave occupants, can sometimes infer aspects of the manner of death.

Circumstances of death are established by observing physiological responses to stress agents. While most evidence of disease and trauma cannot definitively identify what killed each individual in a population, health responses can sometimes infer what agents were major contributors to a victim's death. As noted earlier, stress response data from the cemetery could not accurately separate individuals with good from those with poor health.

Chapter 12. Spatial Associations in the Mound C Cemetery

Humans use materials to symbolize ideas. These ideas are expressed directly by the object and are enhanced by associating the object with other symbols. The spatial relationship between symbolized ideas act as one means bringing separate ideas together. Arrangement of the dead within the cultural landscape is a form of material communication. Placement of the dead provides two distinct forms of information. First, the dead's location within the community emphasizes the displayed social personality's relationship with other community functions. Among Mississippian communities, graves are found in socially reserved spaces, such as plazas or mounds, implying that the social personalities materialized by the dead, were also restrictive (Anderson 1994:313-314; Hatch 1976:137, 139). Many regional centers contain discrete assemblages of graves in close association with domestic areas (Holland 1991:194; Kreisa 1988:166; Larson 1971:66; Morse 1990:75; Nash 1972:13; Peebles 1971:83). These burial areas associate the assembled social personalities with the living area of a given clan or neighborhood. Among dispersed communities, concentrating graves to a central facility unites each group's social personalities as part of a common expression (Milner 1984:477-479). Communal cemeteries imply that shared social ideas were present and important enough to be part of each community's funerary program. Placement of the dead, as a material component of the social presentation, functioned as a means of transmitting information about the burial community's social composition.

Second, location within a mortuary facility is an important means of emphasizing aspects of the displayed personality. Graves may be positioned relative to other graves to convey some relationship between social personalities. Late Prehistoric period kin groups are most commonly organized to illustrate social bonds. (Black 1979:7; Fisher-Carroll 1997:102; Goldstein 1981:63). Space within the community may hold social meaning and a grave's location symbolizes the personality's relationship with that meaning. Age and possibly sex variations were noted in the Norris Farms No. 36 cemetery (Santure 1990:69) and Mainfort (1985:567-568) identified status and wealth influences on grave placement within rows.

Did the Wickliffe community use space as a mortuary communication medium? To explore this possibility, the cemetery's general structure and five dimensions of mortuary variability (body treatment, orientation, grave multiplicity, age and sex) were examined.

General Cemetery Structure

The Mound C cemetery was initially examined to learn how the facility was organized. Recall that the mound occupied a prominent point in the village's centeral area (Figure 8-1). Messages symbolized by the mound and its accompanying facilities were communicated as the community utilized the surrounding activity areas.

The cemetery was positioned around the summit of Mound C (Figure 8-6). Graves extended outward in all directions from this locale. While evidence of a formal boundary was not present, the concentration of graves to this confined space implied community recognition that cemetery and non-cemetery spaces were independent concepts.

Presence of Rows or Clusters

Graves within the excavated areas lacked a uniform distribution. Pearson (1999:13) suggested that the arrangement of graves in an unreconstructed cemetery map provided evidence for rows. This model divides space within the cemetery into formal grave linear arrangements, each carrying a separate meaning.

To find evidence for rows, the methodology proposed by Goldstein (1980) was considered. Initially she "examined maps and drew in patterns that seemed apparent" (Goldstein 1980:99). Then she asked her colleagues to repeat this exercise. Their assessments produced interpretations that were in close agreement. Copies of the cemetery plan view maps were provided to six colleagues at the University of Tennessee with instructions to identify where and how graves in Mound C might be patterned. Most analysts tended to emphasize some form of row structure in Mound C, but there was little agreement over how these were arranged (Figure 12-1).

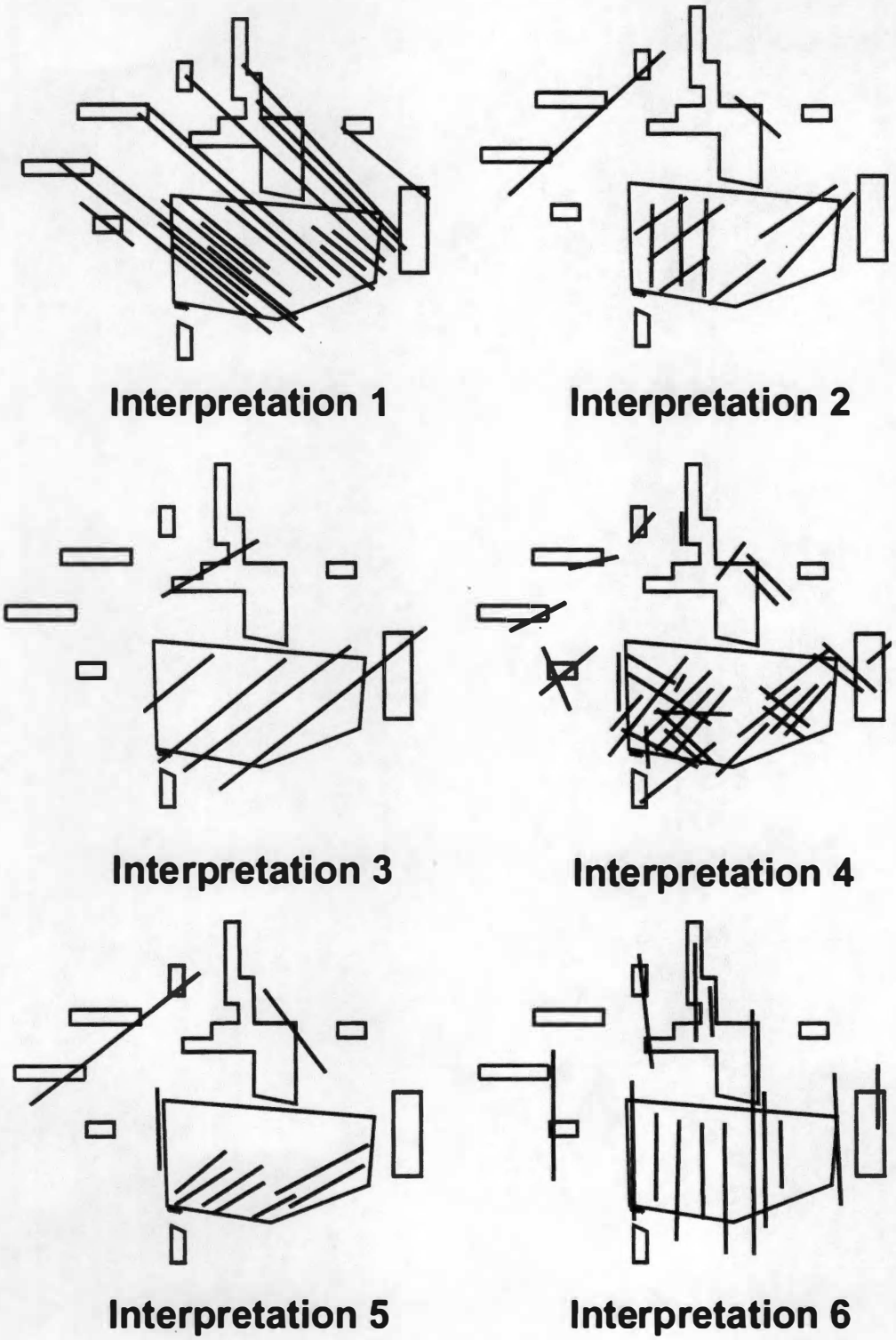


Figure 12-1. Interpretations of Grave Patterns within the Mound C Cemetery.

Goldstein (1980:103-104) defined rows as graves falling more or less side by side in linear arrangements along a 1.5 body length margin[1]. Rows could also be arranged head-to-foot to form patterns similar to the Norris Farms No. 36 cemetery arcs (Santure 1990:69-70). A plan view map was examined for spatial separations using a pre-measured template. Both of these spatial models failed to produce statistically testable results. The lowest number of possible outliers from any possible row arrangement was about 30% of the sample. This was deemed too variable to support evidence of rows or row-like constructs. A major problem with defining grave structure was density. There were numerous overlapping graves in Mound C - a feature that was not common in other better-defined cemeteries. While extensive re-use of the mortuary area may have blurred the original arrangement, there was no strong evidence for linear arrangements.

Graves could also represent clusters within the cemetery. Wesler (1997:268) suggested that the cemetery was divided into sub-areas for burial of clan or lineage members. In this model, discrete points in space were defined as socially meaningful, with grave arrangement forming less formal arrangements around it. In order to test this model, continuous blocks of space; where the number of graves, their position in space, and the position of graves between any given pair is known; were needed. This limited the sample to those graves with a centerpoint in the King Era excavation block.

To confirm the presence of intra-cemetery clustering, a K Means analysis, using the routines developed by Kintigh and Ammerman (1982) was applied to the cemetery. This non-hierarchical divisive clustering technique was designed to find clusters in the data by plotting cluster division against a function of the division's sum of squares error and examining this, relative to randomized combinations of the data. If no clusters were present, the actual data will follow the randomized pattern or consistently produce data points that extend above the random estimates across all iterations. Clustered data will diverge away from the random pattern when potentially meaningful

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[1] Body length margins were varied, but they achieved the same results.

differences are present. The appropriate number of clusters can be heuristically defined by distinct changes in the true data's line slope.

A sample of 110 graves was subjected to K-Means analysis. The analysis was modeled to find 12 clusters and run through three random iterations of the data. As demonstrated in Figure 12-2, the log of the sample's SSE was essentially reduced to zero after six divisions. All substantive variation was accounted for before completion of the modeled clusters. More important to the research question, the overlap between these Mound C and random data sets was almost perfect. This indicated that the distribution of Mound C interments within the King era block was not distinguished from random generation. There was no evidence that points within the burial field were influencing where graves were located. While these examinations did not preclude the possibility that internal structures were part of the cemetery arrangement, their form and exact location were not confirmed with the existing data. General grave distribution may be have been a function of other social issues.

The Mound's Summit

In the cemetery there is an area lacking interments that equates with the central portion of the mound's summit. The presence of burials on the summit (forming an interior margin) suggests that some space on the summit was reserved for special use or deemed unsuitable for burial. Centering this space on the mound's summit suggests that this earthwork was a focal point for mortuary activity. Mattemes (1998) concludes that the center of the Mound C Cemetery served as foci for non-graveside mortuary activities, including storage, processing, and possibly veneration of the dead.

Did this spatial arrangement influence where graves were located in the accompanying mortuary facility? If the Mound's summit emphasized the dead's social qualities, then interments would be concentrated near the center of the facility.

To test this, a cemetery center point was approximated from the average midpoint distance between burials forming the interior margin. Distance measurements were then taken from this point to a midpoint defined in each burial (See Chapter 11). Only graves with center points in excavated

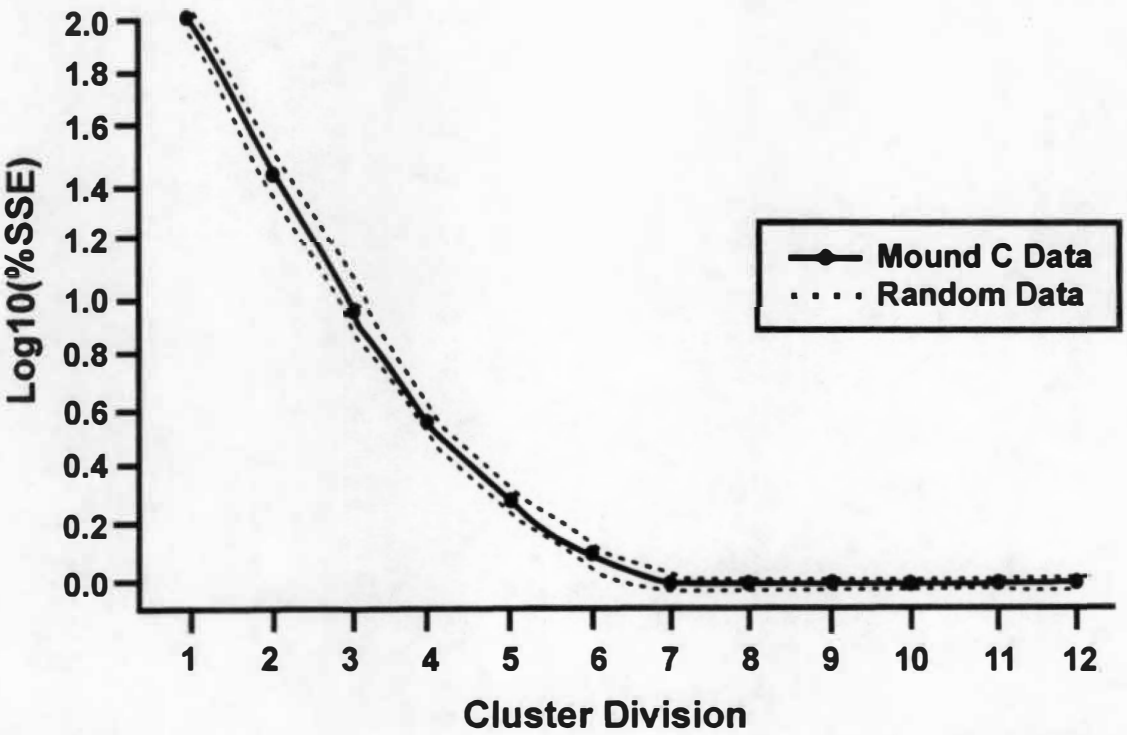


Figure 12-2. Mound C Cluster Divisions Revealed through K-Means Analysis.

areas were used. This created a maximum sample of 147 interments. Distances to the center point of each excavated and unexcavated one-meter unit were then obtained to control for differences in excavation area. Over 72% of these interments were located between three and nine meters from the cemetery's center (Table 12-1). This distance also accounted for about the same proportion of the total area excavated in the cemetery. To test whether excavation area and burial frequency followed the same pattern, a Kolmogorov-Smimov Two-Sample Test (KS) compared these two variables. The null hypothesis for this test stated that the distributions were indistinguishable. A low D value (D=0.112) indicated that these distributions were similar and the accompanying probability estimate (P) emphasized that random sampling from the same population could easily result in these two distributions. Failure to reject the null hypothesis implied that the magnitude of excavation had affected burial frequency. As a means of correcting for this bias, the excavated area was divided by the number of graves per distance interval. The resulting density estimate indicates only a very gradual trend towards burial close to the cemetery's center. The mound's summit exerts a slight influence on burial placement.

Space and Other Mortuary Variables

The Mound C Cemetery was not composed of uniform graves, rather there was considerable variation between interments. Recognizing that social qualities, not the whole personality may be emphasized by location, the cemetery was re-evaluated according to other material variables.

Body Treatment

The spatial sample was divided into groups expressing primary and secondary body treatments and the degree of homogeneity estimated between excavated area and grave form frequency, using a KS test. A very low D value for primary interments indicated a high degree of sample homogeneity. The data presented in Figure 12-3 emphasized the close relationship between these two variables. Excavated area sample size probably biased primary body treatment representation. In contrast, secondary interments produced a high D value, indicating that excavated

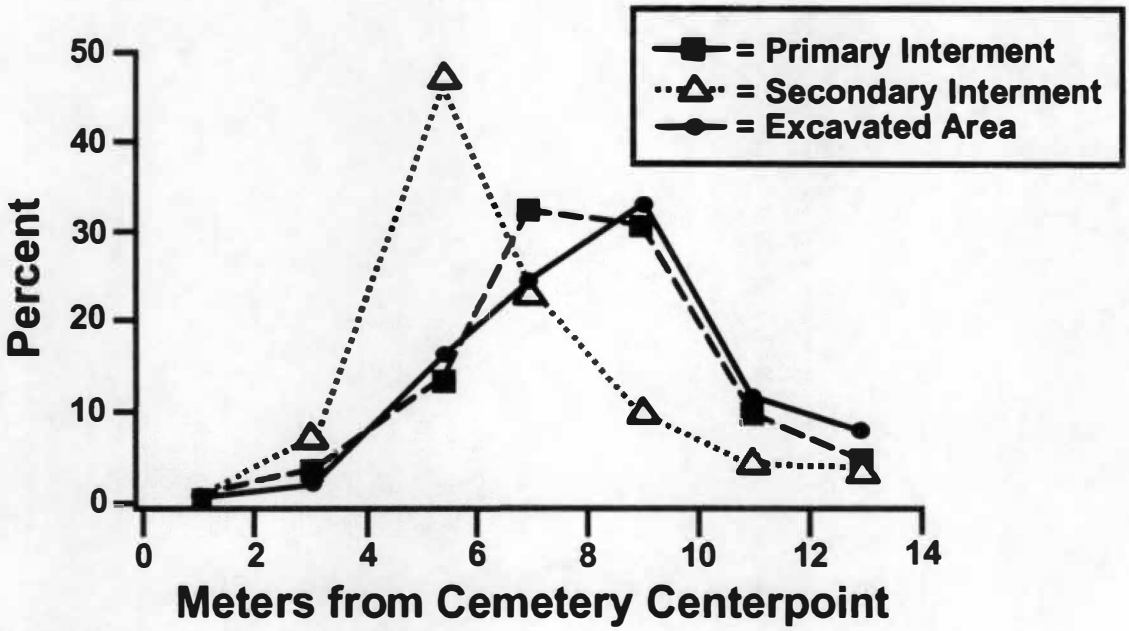
Table 12-1. General Dimensions of the Cemetery's Burial Field.

Interval Distance[a]	Total Area	Excavated Area in Burial Field[b]	Proportion of Total Area Excavated	Number of Burials	Burial Density
0-0.99	2.00	0.00	0.00	0	0.00
1-1.99	12.00	0.00	25.00	0	0.00
2-2.99	14.00	0.00	53.64	0	0.00
3-3.99	5.83	3.00	51.28	8	2.66
4-4.99	20.00	10.65	52.20	18	1.69
5-5.99	28.38	12.38	43.62	19	1.53
6-6.99	39.56	15.56	39.33	18	1.15
7-7.99	42.00	15.82	37.66	27	1.70
8-8.99	47.00	20.25	43.08	18	0.88
9-9.99	44.00	19.53	44.38	22	1.12
10-10.99	32.00	9.41	29.40	8	0.85
11-11.99	21.00	3.74	17.80	4	1.06
12-12.99	>8.00	>5.00	<100.00	4	0.80
13-13.99	>5.00	>5.00	<100.00	2	0.50

Note: *Kolmogorov-Smirnov Two Sample Test*
Excavated Area in Burial Field by Number of Burials: D=0.112; P=0.37.
[a] All measurements in meters/square meters.
[b] Does not include central empty space and historic disturbances.

area and secondary body treatment frequencies followed independent distributions. Multiple body treatment sample sizes prohibited a detailed analysis. They were found only in distance intervals with more extensive excavation areas, inferring that unit biases may be affecting their distribution.

Secondary interment frequency was considerably less biased by excavated area sample size, suggesting that there was a spatial difference between primary and secondary forms. A Chi-Square Test for Independence comparison of primary and secondary interments by metric interval from the center indicated that meaningful differences existed between body treatments. Secondary burials were more concentrated around the mound's summit, while primary interments were dispersed throughout the burial field. These data suggested that space within the cemetery emphasized social qualities linked with secondary body treatment.



Kolmogorov-Smirnov 2 Sample Test:

Excavated Sample Frequency By Primary:
D=0.05; P=0.999

Excavated Sample Frequency By Secondary:
D=0.38; P=<0.001

Chi Square Test for Independence:

Primary By Secondary:
X^2=31.39; DOF=10; P=<0.001

Figure 12-3. Relationship Between Body Treatment and Distance from the Summit.

Multiple Interments

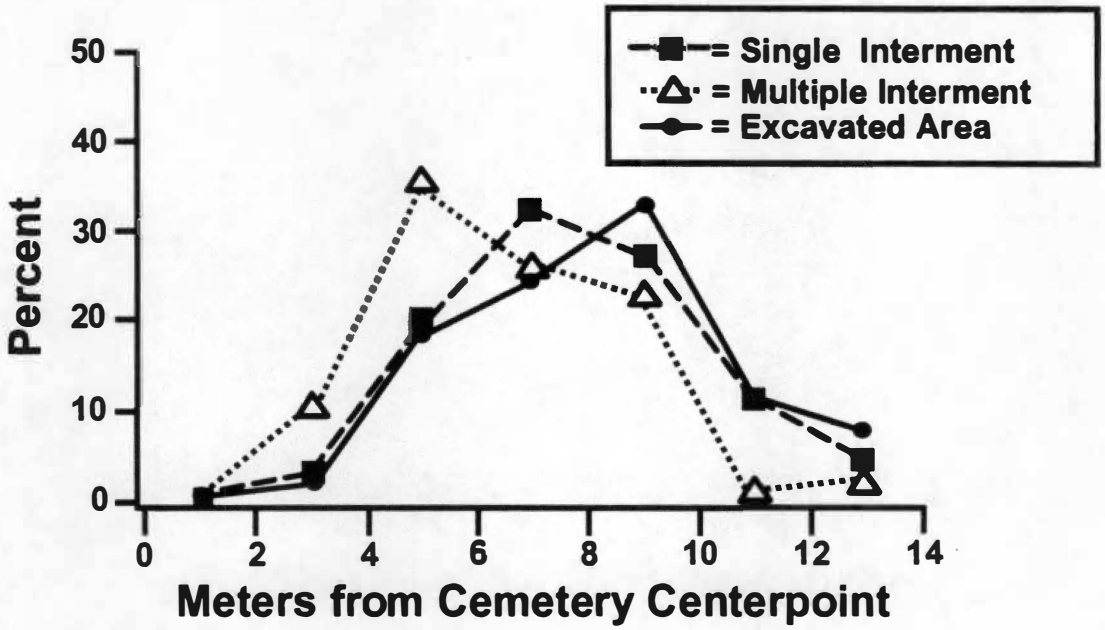
Graves were then divided into groups containing one individual and those bearing multiple representations. The distribution of single and multiple interments did not follow the same pattern (Figure 12-4). In general, multiple interments were more likely to be placed close to the cemetery's center, while single graves conformed more closely to the excavated area pattern. KS testing confirmed these observations. Both excavated area and single interment grave distributions reflected the same pattern, while multiple interments formed an independent relationship with distance from the cemetery's center.

A chi-square test comparison of single and multiple graves by metric interval from the center revealed significant differences. These grave forms probably were not samples of the same behavior. Corporate representation carried a slightly different meaning than single interments. Location within the cemetery may have emphasized this funerary representation's qualities.

Sex

One of the most visible role determinants among living community members was their sex. A sample of 44 single, non-corporate interments was complete enough for a biological assessment of sex, and spatially defined well enough to identify a centerpoint. A frequency plot by distance from the cemetery's center revealed a considerable degree of similarity between sex and excavation unit totals (Figure 12-5). Small sample sizes precluded valid observation within one-meter intervals. Pooling at two-meter intervals and subsequent testing indicated that at best there were minor differences between unit excavation frequency and each sex. The distribution of excavation units and small sample sizes probably biased the spatial pattern of these samples.

A Chi-Square Test for Independence comparison between sexes across metric interval from the cemetery's center provided a value of 4.65 (P=0.45). Failure to disprove this test's null hypothesis provided no evidence of sample independence. Sex probably was not an agent affecting placement in the cemetery.



Kolmogorov-Smirnov 2 Sample Test:

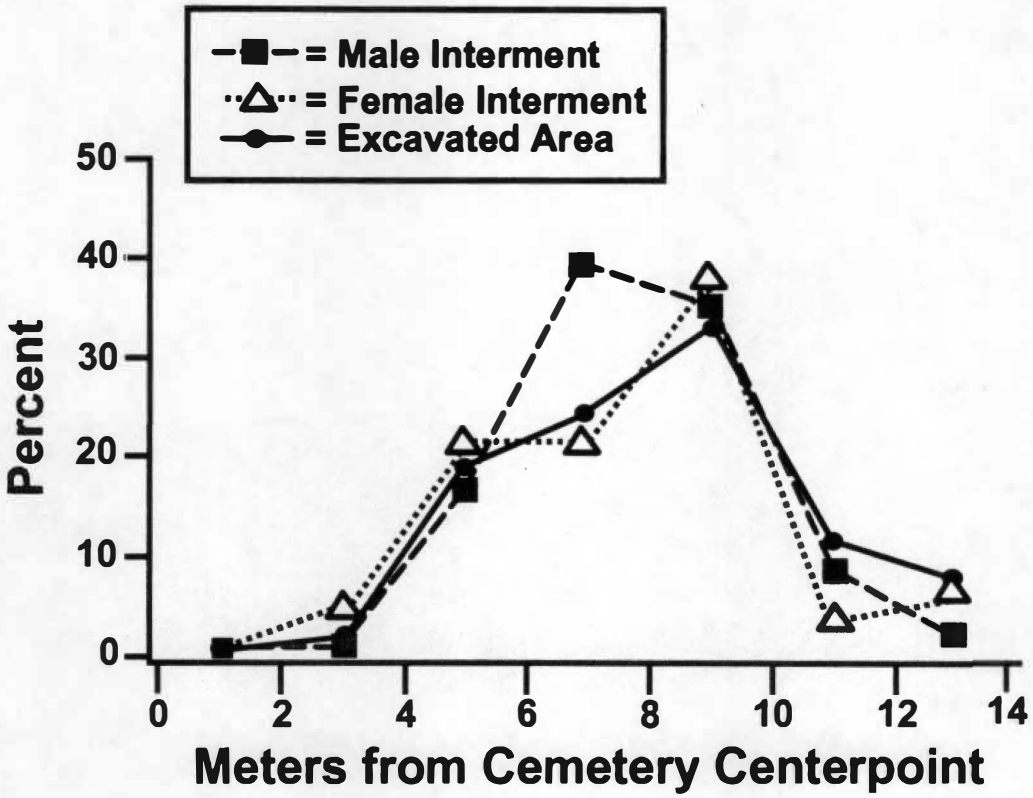
Excavated Sample Frequency By Single:
D=0.07; P=0.939

Excavated Sample Frequency By Multiple:
D=0.34; P=<0.001

Chi Square Test for Independence:

Single By Multiple:
X^2=20.7; DOF=10; P=0.02

Figure 12-4. Relationship Between Multiplicity from the Summit.



Kolmogorov-Smirnov 2 Sample Test:

Excavated Sample By Male:
D=0.36; P=0.013

Excavated Sample By Female:
D=0.31; P=0.051

Chi Square Test for Independence:

Male By Female:
X^2=4.65; DOF=5; P=0.45

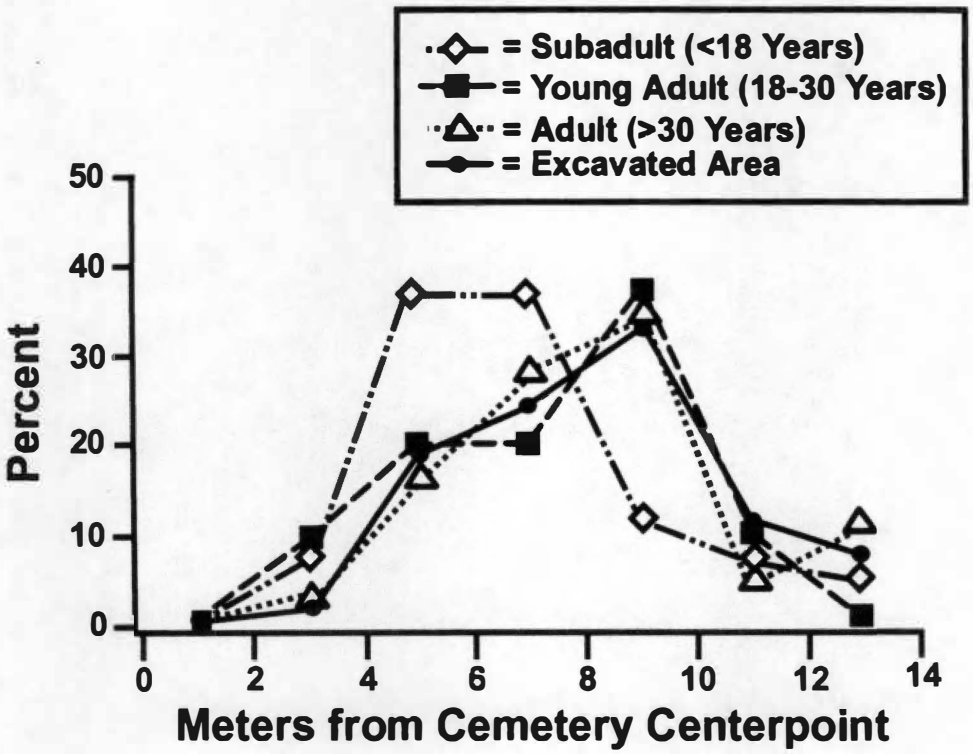
Figure 12-5. Relationship Between Sex and Distance from the Summit.

Age Representation

Age evaluation of 52 graves with definable center points divided the sample into three groups – Subadults (Individuals under 18 years), Young Adults (18 and 30 years) and Adults (Over 30 years). These divisions enabled subadult frequencies to be explored as robust samples. Despite this, small sample sizes again required examination in two-meter intervals. A plot of the frequencies indicated that while adult distributions compared favorably with the excavation unit pattern (Figure 12-6). Subadults were strongly concentrated in the 4-6 meter distance interval. High KS test results for subadults and distance indicated a deviation away from the excavation unit frequencies. Notable differences were observed between sample excavation frequency and young adults, suggesting that these individuals may also possess an independent distribution, but sample sizes were too small to place much confidence in this difference. Graves containing adults possessed less meaningful differences from distance, but clearly followed a pattern similar to the young adult form. It is possible that an age gradient-distance relationship was present. A Chi-Square Test for Independence comparison between subadults and a pooled Young Adult-Adult Sample indicated that these two assemblages could represent samples of the same age-distance relationship. Using a different sample, Matternes (1998) produced significant variations between adult and subadult samples. While not supported by all data in this sample, youth and proximity to the cemetery's center appeared to be features communicating social information.

Orientation

Ham (1980:66) argued that directionality communicated information about the individual and family or clan affiliations in Mississippian society. To assess this hypothesis, 144 orientable graves were examined by general plane of orientation. Small sample sizes once again reduced visibility to two-meter intervals. These data demonstrated that most orientation planes follow the excavated area frequency pattern (Figure 12-7). KS comparisons between orientation plane and excavated area frequency revealed several high D values. The small sample sizes associated with most orientations prohibited treating these as unbiased results. Only the NW/SE orientation plane has a



Kolmogorov-Smirnov 2 Sample Test:

Excavated Sample Frequency By Subadults:
D=0.53; P=<0.001

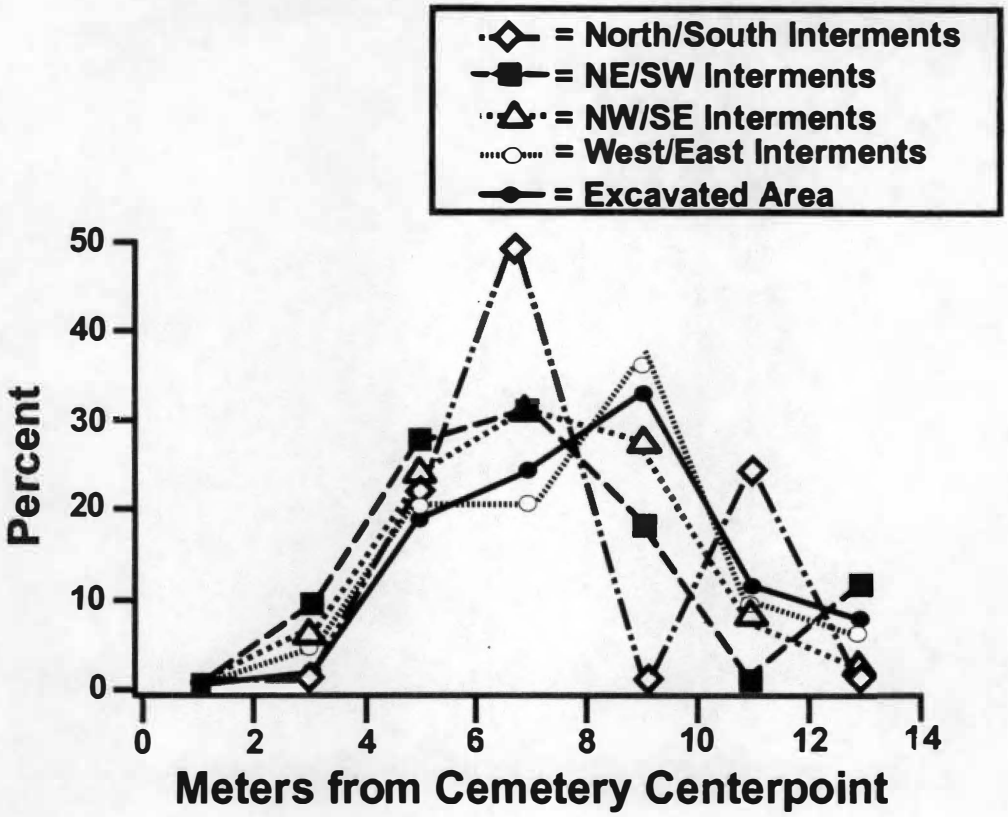
Excavated Sample Frequency By Young Adults:
D=0.39; P=0.08

Excavated Sample Frequency By Adults:
D=0.28; P=0.02

Chi Square Test for Independence:

Subadult By (Young Adult + Adult):
X^2 =5.04; DOF=5; P=0.41

Figure 12-6. Relationship Between Age and Distance from the Summit.



Kolmogorov-Smirnov 2 Sample Test:

Excavated Area Frequency By North/South:
D=0.50; P=0.26

Excavated Area Frequency By Northeast/Southwest (NE/SW):
D=0.36; P=0.01

Excavated Area Frequency By Northwest/Southeast (NW/SE):
D=0.17; P=0.08

Excavated Area Frequency By West/East:
D=0.30; P=0.10

Chi Square Test for Independence:

Northwest/Southeast By Pooled Orientations:
X^2=3.83; DOF=5; P=0.57

Figure 12-7. Relationship Between Orientation and Distance from the Summit.

statistically valid sample size. It demonstrated a marginal heterogeneity from excavation area frequency. Graves oriented NW/SE and a pooled sample of other orientations were compared to learn if differences between these sub-samples were tangible. The resulting chi-square and P values indicated no difference between samples. General plane of orientation was not related to distance from the cemetery's center.

Conclusions

Space was a highly meaningful form of social communication during the Late Prehistoric period. Houses, plazas, temples, mounds and the like were commonly arranged to convey information about the community. This concept was not exclusive to the world of the living; it was actively used as a form of mortuary representation.

One aspect of spatial manipulation was to communicate divisions in the social structure. The Mound C cemetery formed a dense accumulation of graves within a restricted area. At the very least, this communicated that the burial community thought of themselves as a unified entity. The cemetery's placement suggested that this cohesion among lineages or clans was an important social message. As noted in Chapter 14, the lack of infants indicated that not all village members were community members. Other individuals not deemed part of the cemetery community received burial outside the formal area.

The cemetery lacks evidence of the spatial segregation commonly associated with families or socio-political divisions. This structure re-emphasizes that solidarity was perhaps more important than discriminating factions within the community. Expressions of within-cemetery social differences were conveyed by other material expressions.

Graves in Mound C are not uniformly distributed across the cemetery area. At least two distinct activity areas are present within the facility. The lack of interments on Mound C's summit is evidence that this prominent point in the cultural landscape was reserved for other functions. Surrounding this is an area reserved for mortuary deposits. As an embodiment of social personalities, graves express an unconvincing association with the summit. Ideas associated with

the mound's summit and cemetery's center were not socially applicable to all community members. Graves with mortuary attributes that emphasize specific social personality components, however, do show strong spatial relationships with the summit and center. Interments containing subadults, multiple individuals and those with secondary body treatments are buried closer to the cemetery's center than their counterparts. As a group, these interments exhibit a high community investment. Placement in a burial facility accompanies a loss of potentially valuable community members, a loss of more than one community member and loss of culturally important and labor-intensive social representations. Matternes (1998) suggested that placing these burials near the center activity area helped stress this heightened social investment to audiences. Spatial association in and around the cemetery was an important vehicle of social communication at the Wickliffe Mound Group.

Chapter 13. Sex Identification

Sex assignments for the Mound C skeletal assemblage were based on data originally collected during the 1992-1994 field seasons and subsequent re-examination during the summer of 1996. Previously, sex had been assigned to specific individuals or skeletal elements by several analysts (See Haskins 1990:5, 10; Mattemes 1996b). A comprehensive examination was not accomplished until completion of the assemblage's demographic survey by Mattemes (1994, 1995b). Individual sex estimations were evaluated relative to the subject's age and general health; sex was then assigned according to the greatest agreement among morphological data. Individuals were initially scored into indeterminate, probable (Male?, Female?) and more confident (Male, Female) categories. As a means of verifying the results obtained in the original analyses, a probabilistic approach to sex determination was applied. Selected measurements and observations from the post-cranial remains, cranial morphology and pelvic form were re-evaluated in terms of their sex information value.

Sex data were collected following the guidelines developed in the University of Tennessee contract osteology laboratories. In general, this procedure collected as much osteological data as possible is collected in an effort to maximize the information obtained from highly incomplete human skeletal assemblages. The details of these procedures were outlined in Matternes and Jantz (1997), Mattemes et al. (1992), Langdon et al. (1989), and Willey et al. (1987). Sex data collected from the Mound C skeletal assemblage focussed on documented reliable sexual dimorphism represented in a number of studies from a suite of skeletal points.

Sex was determined for adults and older adolescents using a composite estimate, based on pelvic, cranial, and limb morphology (Table 13-1). Pelvic morphology was assessed and sexual dimorphism described following the standards outlined by Anderson (1962), Bass (1987), Iscan and Derrick (1984) and Phenice (1969). In the cranial vault, particular attention was paid to the temporal, frontal, maxillary, and nuchal aspects as sources of reliable sexually dimorphic features. Evaluations followed the patterns noted in Bass (1987) and Krogman and Iscan (1986). While measurements

Table 13-1. Sex Estimation Data Base Available for the Mound C Skeletal Collection.

Observation	Landmark Code	Reference
Cranial Morphology		
Orbital Morphology		
Supraorbital Torus		
Nasal Indentation		
Mastoid Process		
Nuchal Area		
Cranial Contour		
Chin Shape		
Gonial Angle		
Cranial Measurement		
Maximum Length	(g-op)	Martin (1928:625 #1)
Maximum Breadth	(eu-eu)	Martin (1928:628 #8)
Bizygomatic Breadth	(zy-zy)	Martin (1928:657 #45)
Basion-Bregma Length	(ba-b)	Martin (1928:631#17)
Cranial Base Length	(ba-n)	Martin (1928:627 #5)
Basion-Prosthion Length	(ba-pr)	Martin (1928:655 #40)
Maximum Alveolar Breadth	(ecm-ecm)	Martin (1928:661 #61)
Maximum Alveolar Length	(pr-alv)	Martin (1928:661 #60)
Biauricular Breadth	(au-au)	Martin (1928:630 #11)
Upper Facial Height	(n-pr)	Martin (1928:657 #48)
Minimum Frontal Breadth	(ft-ft)	Martin (1928:629 #9)
Upper Facial Breadth	(fmt-fmt)	Martin (1928:656 #43)
Nasal Height	(n-ns)	Martin (1928:660 #55)
Nasal Breadth	(al-al)	Martin (1928:660 #54)
Orbital Breadth	(d-ec)	Martin (1928:659 #51)
Biorbital Breadth	(ec-ec)	Howells (1973:178)
Interorbital Breadth	(d-d)	Martin (1928:658 #49)
Frontal Chord	(n-b)	Martin (1928:638 #29)
Parietal Chord	(b-l)	Martin (1928:638-639 #29)
Occipital Chord	(l-o)	Martin (1928:639 #31)
Foramen Magnum Length	(ba-o)	Martin (1928:627 #7)
Foramen Magnum Breadth	(FOB)	Martin (1928:630 #16)
Mastoid Length	(MDH)	Moore-Jansen et al. (1994:57 #24)

Sources:

Howells, W.W.
1973 *Cranial Variation in Man: A Study of Multi-Variate Analysis.* Peabody Museum Papers Vol 67. Havard University, Cambridge.

Martin, R.
1928 *Lehrbuch der Anthropologie.* Gustav-Fisher Verlag, Stuttgart.

Moore-Jansen, P.H., S.D. Ousley, and R.L. Jantz
1994 *Data Collection Procedures for Forensic Skeletal Material.* 3rd ed. Report of Investigations No. 48. Department of Anthropology, University of Tennessee, Knoxville.

were made, metric evaluation of crania was not possible in most specimens because of their fragmentary state or presence of cranial deformation.

Post-cranial metric data was also obtained as a means of evaluating sex. The poorly preserved trabecular aspects tended to remove many critical regions, limiting metric consideration to large areas of cortical bone. When possible, measurements were made following the landmarks and guidelines presented in Moore-Jansen et al. (1994) to standardize data collection. Measurements obtained from the original data collection are presented in Table 13-2.

Final sex evaluation in the Mound C assemblage placed each grave into a four-group classification. All single interment graves containing adults were classified as Male, Female or Indeterminate. Infants and most subadults were categorized as Sex-Subadult. Individuals from graves with an MNI>1 were subjected to sex evaluation. For further applications, however, these individuals were classified as a multiple interment and sex was not used as a sorting variable.

Post-Cranial Metric Sex Determination

Most of the methods available for sex determination were developed on populations that are far removed from the Late Prehistoric populations of western Kentucky. While there was a tendency in the Mound C skeletal assemblage to follow the same general patterns of sexual dimorphism observed in human populations, comparisons of post-cranial measurements with other standard reference assemblages (namely the Terry-Todd and Arikara skeletal collections) revealed that substantial morphological differences existed between these groups and the Mound C assemblage. In order to utilize the post-cranial measurements as a means of sex classification, more closely linked temporal, geographic and cultural references were needed. Lack of available samples and poor preservation among the remaining candidates reduced the selection to data collected from the Campbell Village (23PM5) population. This assemblage was recovered about 120 kilometers southwest of Wickliffe; it represents a Late Mississippian (Nodena/Armorel Phase) cultural representation (Williams 1980:105). While distinct temporal differences exist between Campbell and Wickliffe, they occupied similar environmental settings and were practicing similar lifeways.

Table 13-2. Post-Cranial Measurements Collected for Sex Estimation.

Observation	Measurement Reference
Pelvic Morpology	
Sciatic Notch	
Subpubic Angle	
Ventral Arc	
Ishio-Pubic Ramus	
Parturition Scars	
Preauricular Sulcus	
Auricular Size and Shape	
Sacrum Size and Shape	
Post-Cranial Measurement	
Clavicle:	
Maximum Length	Martin (1928:1005 #1)
Sagittal Diameter at Midshaft	Martin (1928:1006 #5)
Vertical Diameter at Midshaft	Martin (1928:1006 #4)
Scapula:	
Scapular Breadth	Martin (1928:1006 #1)
Scapular Height	Martin (1928:1002 #2)
Humerus:	
Maximum Length	Martin (1928:1010 #1)
Epicondylar Breadth	Martin (1928:1010 #4)
Maximum Vertical Head Diameter	Martin (1928:1011 #10)
Maximum Midshaft Diameter	Martin (1928:1011 #5)
Minimum Midshaft Diameter	Martin (1928:1011 #6)
Radius:	
Maximum Length	Martin (1928:1014 #1)
Sagittal Diameter at Midshaft	Martin (1928:1015 #5)
Transverse Diameter at Midshaft	Martin (1928:1015 #4a)
Ulna:	
Maximum Length	Martin (1928:1017 #1)
Dorso-Volar Diameter	Martin (1928:1020 #11)
Transverse Diameter	Martin (1928:1020 #12)
Physiological Length	Martin (1928:1018 #2)
Minimum Circumference	Martin (1928:1018 #3)

Sources:

Martin, R.
1928 *Lehrbuch der Anthropologie*. Gustav-Fisher Verlag, Stuttgart.

Table 13-2 (continued). Post-Cranial Measurements Collected for Sex Estimation.

Observation	Measurement Reference
Sacrum:	
Anterior Height	Martin (1928:1031 #2)
Anterior Surface Breadth	Martin (1928:1032 #5)
Innominate:	
Height	Martin (1928:1031 #1)
Iliac Breadth	Martin (1928:1033 #12)
Pubis Length	Moore-Jansen et al. (1994:67 #58)
Ischium Length	Moore-Jansen et al. (1994:68 #59)
Femur:	
Maximum Length	Martin (1928:1034 #1)
Bicondular Length	Martin (1928:1038 #2)
Epicondylar Breadth	Martin (1928:1041-42 #21)
Maximum Head Diameter	Martin (1928:1041 #18)
A-P Subtrochanteric Diameter	Martin (1928:1040 #10)
Transverse Subtrochanteric Diameter	Martin (1928:1040 #9)
A-P Transverse Midshaft Diameter	Martin (1928:1039 #6)
Transverse Midshaft Diameter	Martin (1928:1039 #7)
Midshaft Circumference	Martin (1928:1040 #8)
Tibia:	
Condylo-Malleolar Length	Martin (1928:1048 #1)
Maximum Proximal Epiphysis Breadth	Martin (1928:1049 #3)
Maximum Distal Epiphysis Breadth	Martin (1928:1049 #6)
Maximum Diameter at Nutrient Foramen	Martin (1928:1050 #8)
Transverse Diameter at Nutrient Foramen	Martin (1928:1050 #9)
Circumference at Nutrient Foramen	Martin (1928:1050 #10)
Fibula:	
Maximum Length	Martin (1928:1052 #1)
Maximum Diameter at Midshaft	Martin (1928:1052 #2)
Calcaneus:	
Maximum Length	Martin (1928:1058 #1)
Middle Breadth	Martin (1928:1058 #2)
Maximum Breadth (S-1)	Martin (1928:1033 #19)

Sources:

Martin, R.
1928 *Lehrbuch der Anthropologie.* Gustav-Fisher Verlag, Stuttgart.

Moore-Jansen, P.H., S.D. Ousley, and R.L. Jantz
1994 *Data Collection Procedures for Forensic Skeletal Material.* 3rd ed. Report of Investigations No. 48. Department of Anthropology, University of Tennessee, Knoxville.

Post-cranial measurements from the Campbell site's skeletal population were extracted from Holland (1991:Appendix V) and treated as a sex classification reference sample for the Mound C assemblage. Sex designation among most of the Campbell skeletal assemblage was based on pelvic and cranial morphology (Holland 1991:245-246). In a few cases, cranial metrics and robusticity evaluations were also considered. Since none of the measurements used in Holland's analysis are included in this metric sex evaluation battery, the post-cranial measurements from Campbell were independent of his original sex determination method.

There were 15 post-cranial measurements were common to the Campbell and Wickliffe data sets and sufficiently represented in the Wickliffe skeletal assemblage to be analytically useful (Table 13-3). These measurements were broken into five sets, each set representing measurements obtained from a separate skeletal element[1]. Separate discriminant functions were calculated for each bone and treated as independent evaluations of each individual.

In order to assign sex to skeletal elements from Wickliffe, the Campbell skeletal materials were subjected to a discriminant function analysis using PC SAS (Version 6.12). To increase the reliability of reference sample classification a cross-validation procedure was applied. The routine then compared post-cranial measurements from each Wickliffe interment to those of the reference sample in order to assign a probability of inclusion value (posterior probability) to each specimen.

The ability of each set of measurements to accurately differentiate sex within the reference sample was explored. Holland (1991:96) noted that about a third more females than males were represented in the Campbell Village assemblage. Differences of this nature can result from unbalanced living population sex ratios or from field sampling biases, particularly if the cemetery is not comprehensively excavated[2]. Disproportionate sex representation can effect the metric evaluations. The greater number of females in the reference sample equated to a greater number of

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[1] Left elements were preferentially used in this analysis. If the left was missing, the right measurement was substituted.

[2] Campbell was not systematically excavated, rather skeletons were detected relative to artifact inclusion. Of those exposed, only a portion were saved and curated at the University of Missouri-Columbia (See Holland 1991:1, 81-82, 85). It is suspected that excavation and curation biases were heavy contributors to gender differences.

Table 13-3. Sex Classification within the Campbell Village (23PM5).

Skeletal Element Examined [a]	Number of Individuals in Reference Sample		Correctly Classified		Generalized Distances (D^2) Between Sexes
	Females	Males	Females	Males	
Humerus (Midshaft, Maximum Diameter) (Midshaft, Minimum Diameter) (Shaft, Least Circumference)	37	23	91.8	73.9	3.11
Radius (Maximum Length)	37	18	81.0	77.7	3.81
Ulna (Maximum Length) (Physiological Length) (Shaft, Least Circumference)	26	12	80.7	83.3	4.11
Femur (Subtrochanter, A-P Diameter) (Stochanter, M-L Diameter) (Midshaft, A-P Diameter) (Midshaft, M-L Diameter) (Midshaft, Circumference)	41	21	85.3	95.2	5.02
Tibia (Nutrient Foramen, A-P Diameter) (Nutrient Foramen, M-L Diameter) (Nutrient Foramen, Circumference)	38	23	84.2	78.2	3.63

Note: [a] Measurements used in each function are presented in parentheses after the element.

female measurements in the sex estimation sample. This was reflected in Table 13-3. To determine if frequencies differed strongly between the number of male and female representations in the reference sample, a chi-square test was applied to sex frequencies in each skeletal element measurement set. The resulting Chi Value of 0.840 (Degrees of Freedom=4) and P Value of 0.932 indicated that no element was significantly over- or under-represented in these samples, relative to sex.

Comparisons between the reference sample and the Mound C skeletal assemblage resulted in 93 independent sex classifications. Assignments were based on the highest value obtained in the individual's posterior probability. Discriminant function programs were developed to classify an unknown sample to a group based on the similarity between group characteristics, however, computer generated classifications were often forced beyond the statistic's true ability to distinguish reliable from unreliable group associations. Rather than depend on an absolute interpretation of the posterior probability's numerical values to identify sex, sex was assigned in terms of reliability.

Posterior probability values for each sex range from 0.00 to 1.00. Classification is based on achieving a score of greater than 0.500 (Figure 13-1). Recognizing that a score of 0.5 indicates a 50% chance of belonging to a particular group and a value of 1.00 reflects certain sex identification, posterior probabilities that are closer to 0.5 can be considered less reliable than those close to 1.00. Seen from another perspective, misclassification is a more likely possibility as a posterior probability approaches 0.5. Given that group classification is assigned to values between 0.5 and 1.0, a division of reliability – where a sex classification can be seen as equally reliable and unreliable – can be estimated at roughly the midpoint of this range (0.75). Using this model, posterior probability values greater than 0.78 (When all values were pooled, a naturally occurring break in probabilities was observed between 0.76 and 0.79) were considered reliable, while those less than this value were not deemed reliable[3].

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[3] In Table 13-3, with the exception of male humeral measurements, all the initial percentages of correct classifications in the reference sample were above the modeled reliability estimate of 0.75. While male humeral classification values were very close, they are slightly less reliable than would be

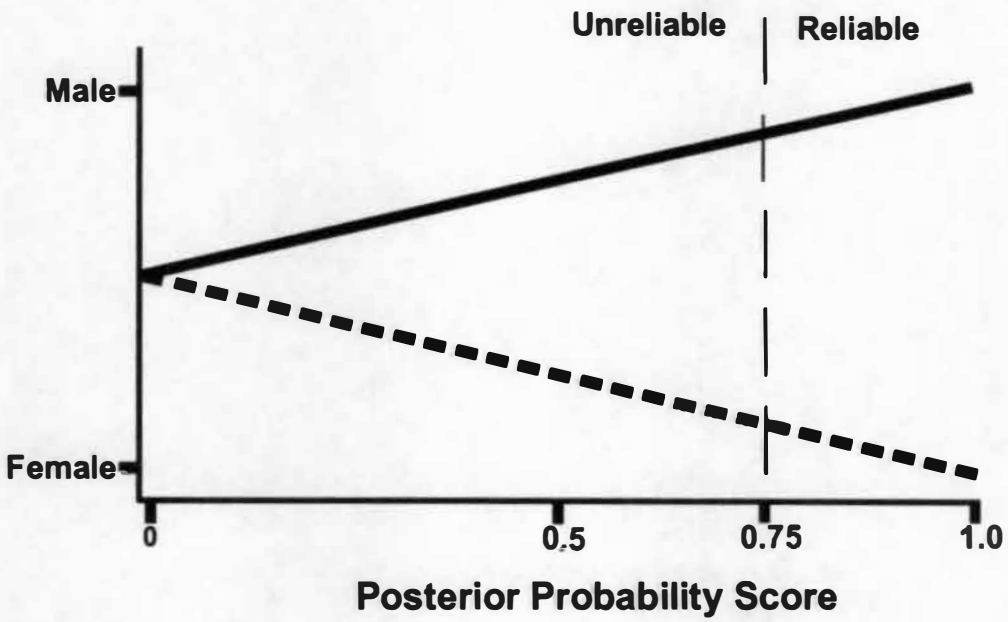


Figure 13-1. Reliability Model for Sex Classification.

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desired. These male sex classifications have been accepted as useful, but their acceptance as real sex reflections has been considered with more conservatism than the other post-cranial estimates.

In the reference sample, specimens of "known" sex that were misclassified represent unreliable classifications (i.e., Posterior Probability values lower than 0.5) and as such, the frequency of misclassified individuals indicated the number of unreliable classifications. A check of how well the reliability model fit the reference data reliability was obtained by comparing Campbell's classification and misclassification rates to those modeled from Mound C. A chi-square test was used to assess the hypothesis that classification rates between the two samples were independent. As shown in Table 13-4, nonsignificant differences were observed among all groups. These results suggested that similar rates of misclassification were present in the Mound C data. While it could not be established that sex evaluations for a given individual from either the reference or Mound C sample had correctly identified sex, there was a greater chance that elements with a posterior probability over 0.78 were correctly classified. The final sex classification of Mound C's post-cranial measurements were assigned in Tables 13-5 and 13-6.

Sex Estimation in the Skull

Sex differences in the morphology of the skull have been recognized for well over a century (Parsons and Keene 1920:58-59). In general, the male tendency towards larger, less neotonous cranial features and the female emphasis on more gracile structures can reliably determine the sex of an individual within a given population (Krogman and Iscan 1986:191-194). Sexual dimorphism in the skull can be examined from two perspectives – morphometric and non-metric observations. Unfortunately some cultural behaviors, including the Mississippian practice of cranial deformation, modify the skull's shape and location of anatomical landmarks. This reduces the reliability of morphometric assessments. Morphometric evaluations also tend to require a uniform set of obtainable measurements – a requirement not easily obtained from less than ideally preserved skeletal assemblages like the Mound C Cemetery.

A less problematic approach is the use of non-metric observations. The shape and form of numerous cranial features have been demonstrated to be very reliable sex indicators. These

Table 13-4. Misclassification Rates between Campbell and Wickliffe Post-Cranial Measurement Sets.

Measurement Set	Sample	Reliable Males? Yes	No	Reliable Females? Yes	No	Chi Value	Degrees of Freedom	P Value
Humerus	Mound C	8	3	5	1	4.03	3	0.25
	Campbell	17	6	34	3			
Radius	Mound C	7	1	3	0	7.00	3	0.07
	Campbell	14	4	30	7			
Ulna	Mound C	1	0	1	0	0.76	3	0.85 [a]
	Campbell	10	2	21	5			
Femur	Mound C	19	2	13	3	5.23	3	0.15
	Campbell	18	3	34	7			
Tibia	Mound C	9	5	9	1	4.99	3	0.17
	Campbell	19	4	32	6			

Note: [a] Fisher's Exact P Values for Males = 0.999, Females = 0.814.

Table 13-5. Discriminant Function Results – Pectoral Limbs

Individual Number	Humerus		Radius		Ulna	
	Largest Posterior Probability	Assigned As	Largest Posterior Probability	Assigned As	Largest Posterior Probability	Assigned As
6EL1	0.758	Male?				
22	0.837	Female				
30	0.965	Male			0.807	Male
38	0.920	Male				
53A	0.994	Female			0.994	Female
53B	0.599	Male?	0.979	Female		
55	0.800	Male	0.973	Male		
62	0.518	Male				
63A	0.744	Male				
64B	0.965	Female				
66	0.939	Male				
74C	0.611	Female				
76	0.990	Male				
83	0.970	Male				
88A	0.706	Female?	0.985	Female		
89	0.500	Female				
90			0.998	Male		
92			0.989	Male		
95	0.899	Male				
103			0.878	Female		
104	0.708	Male?	0.936	Male		
133			0.653	Male?		
148			0.799	Male		
171A	0.843	Male				
221			0.852	Male		
226			0.991	Male		

Table 13-6. Discriminant Function Results – Pelvic Limbs.

Individual Number	Femur		Tibia	
	Largest Posterior Probability	Assigned As	Largest Posterior Probability	Assigned As
6	0.526	Male	0.525	Male?
18	0.859	Female	0.873	Female
20A	1.000	Male	0.985	Male
35F	0.995	Male	0.989	Male
44A	0.975	Male		
45	0.999	Male		
47A	0.976	Male	0.799	Male
49A			0.999	Male
50			0.622	Male?
53A	0.993	Male	0.656	Female?
53B	0.873	Female	0.994	Male
62	0.928	Male	0.745	Male?
64B	0.994	Female		
66	0.936	Female		
68	0.922	Female	0.961	Female
74C	0.764	Male?		
76	0.998	Female	0.993	Female
77	0.678	Male?		
79A	0.993	Male		
79C	0.991	Male		
79D			0.932	Male
80A	0.992	Female	0.976	Female
80B	0.997	Male		
82	0.986	Male	0.654	Male?
83	0.523	Female?		
88A	0.662	Female?		
88B	0.995	Female		
89	0.975	Female	0.981	Female
90	0.972	Male	1.000	Male
92	0.814	Male	0.805	Male
95	0.913	Male		
100	0.998	Male		
103	0.989	Female	0.950	Female
104	0.975	Male	0.560	Male?
149	0.935	Female		
170	0.929	Female	0.988	Female
171A	0.595	Female?	0.981	Female
219	0.840	Male	0.833	Male
226	0.924	Male		
246			0.616	Female

observations do not require complete skulls and cultural modification (including cranial modification) does not appear to have impacted the target feature morphology. The discrete, categorical nature of these observations has traditionally made sex identification difficult, particularly if several conflicting indicators are present. Recent advances in quantitative approaches, however, demonstrate that reliable probabilistic results can be obtained. A newly developed method by Konigsberg and Hens (1998) can be used to aid sex determination in the Mound C assemblage.

While most human populations share similar suites of sexually dimorphic features, the range of expression is not uniform throughout the human genome. As a result, the choice of an appropriate reference sample is as important for non-metric observations as it is for metric features. Populations following the Mississippian cultural pattern, located within the Mississippi River drainage basin and from approximately the same time period are the most suitable references.

Recent reassessments of the Averbuch (40DV60) skeletal assemblage, a fourteenth century composite cemetery near Nashville, Tennessee, provided data complementing that gathered from the Mound C cemetery (Eisenberg 1986:31; Konigsberg and Frankenberg 1995). Five cranial features; Orbital Rim Sharpness (Orbital Margin), Projection of the Browridges (Supraorbital Torus), Size and Projection of the Mastoid Process (Mastoid Process), Muscle Attachment Topography in the Nuchal Region (Nuchal Form), and Shape of the Chin (Chin Form); were independently scored by a five point classification system (i.e., Male, Male?, Indeterminate, Female?, Female) in a manner comparable to that used at Wickliffe (Konigsberg and Hens 1988:103). In both cases, guidelines common to Acsadi and Nemeskeri (1970:75-79), Bass (1987:81-82), El Najjar and McWilliams (1978:84-85) were used to detail masculine and feminine morphologies[4]. To apply the Mound C data to the Konigsberg-Hens system sex estimators were collapsed into a three-point system. These consisted of Male, Female, and indeterminate categories. These categories were then

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[4] Subsequent to the collection of this data from Mound C, Buikstra and Ubelaker (1994:19-21) released a data collection standard that objectively complemented these forms. The original scoring of the Mound C data closely parallels the variants expressed in this publication.

rescored to fit on an ordinal scale, where male morphology equaled '3', indeterminate forms as '2' and female features as '1'.

Use of the Averbuch assemblage as a reference sample and the Konigsberg-Hens system required several assumptions. First, the degree and form of sexual dimorphism present in the reference and Mound C samples were assumed to be the same. From my own examinations of the Averbuch collection, I have noted that many of these cranial features show similar ranges of expression. While some differences undoubtedly exist, there was no reason to believe that they spuriously defined sex between Mound C and Averbuch assemblages. A more problematic assumption involved inter-observer scoring. Since the observations made of these features were subjectively categorized, the ranges of morphology were assumed to be scored in similar manners. Nuances in scoring between Wickliffe and the Averbuch collections were reduced by applying a simplified complementary scoring system to the generalized three-point classification scheme.

In addition to Averbuch's comparable temporal and cultural proximity to the Mound C assemblage, there were two methodological advantages to using the Averbuch site as a reference sample. First, Konigsberg and Hens (1998) established a procedure that provided test subjects with a posterior probability of membership to a given sex. Given that sex for the Mound C individual was not a known feature, sex assessment could be expressed as a probabilistic statement. This enabled sex to be assigned according to whatever scale the researcher felt was appropriate to the assemblage. Since sex in the Averbuch assemblage was based on pelvic morphology, these assessments were also independent of how sex was established in the reference population (Konigsberg and Hens 1988:103). Second, the Konigsberg and Hens method was designed to maximize incomplete data sets. Following the adjusted logistic regression formulae provided for each combination of observations (See Konigsberg and Hens 1998:101, 105), it was possible to

provide a probabilistic evaluation of sex for many incomplete skulls[5]. This substantially increased the number of crania (and subsequently the number of individuals) available for sex estimation.

Several structural aspects of the reference sample may have influenced the Mound C results. Eisenberg (1986:47) noted that at least 860 individuals are represented in the Averbuch collection, but only portions of these were used to verify sex. The Averbuch reference sample used to construct sex evaluation formulae consisted of 138 individuals (Konigsberg and Hens 1998:105). About half of these lack complete observation suites. For a given observation, no more than 95% of the sample could be used to establish sex parameters. The reference sample, therefore, reflects a preservation bias. Sample sizes and subsequent statistical robusticity between different observation formulae could not be considered equal – different sample sizes meant that different amounts of information were used to determine formulae components. Each variable's contribution to these formulae was not equal. This limited any examination of result reliability to classification rates within a formula or gross observation sites.

The Averbuch sample's sex distribution is much more balanced than seen at Campbell, however there are consistently 15-20% more males than females for each observation. A chi-square test was applied to learn whether sex frequencies varied in each observation set in the Averbuch sample. The null hypothesis stated that there were no substantial differences. The resulting Chi value of 0.278 (Degrees of Freedom=4) and P Value of 0.991 provided ample evidence that sex and observation were not biasing agents in these data. The larger number of males in this sample did mean, however, that male morphology is slightly better understood than the female form. It is still possible that the smaller female sample size influenced the formulae's ability to classify sex accurately. Konigsberg and Hens (1998:110) noted that females had a slightly greater misclassification rate than males.

Use of the Konigsberg and Hens formulae resulted in a total of 39 independent sex estimations. As with the post-cranial discriminant function analyses, sex was assigned to the form

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[5] Posterior probabilities are calculated for males only. Since only two classifications are possible (i.e., male or female), female posterior probabilities were obtained by subtracting the male

rendering a probability greater than 0.500 and sex classifications were considered reliable only among those estimates that were greater than 0.750. The posterior probabilities and sex assigned to each tested cranium are presented in Table 13-7.

Was the modeling point of 0.75 accurately estimating this method's ability to classify sex? To check how well the modeled classification point fit the reference data's reliability, a comparison was made between Averbuch and Mound C classified and misclassified individuals. Unlike the post-cranial comparison, where all bones were evaluated according to the same function, variable combinations of cranial features were used to assess sex in the skull. These formulae did not weigh all observations the same. Weights varied according to the total number of elements present[6]. Unfortunately sample sizes in the Mound C (and to some degree the Averbuch) sample were too small to test for individual formulae accuracy. A more generalized comparison could be obtained by pooling the sexes and comparing the classification to misclassification rates between Mound C and Averbuch[7]. A Chi Square test was used to assess whether classification rates between the two samples for a given observation set were congruent. Nonsignificant differences were noted in each comparison (Table 13-8). These data lack evidence for independent assemblages among the Wickliffe and Averbuch cranial sex classification, implying that similar rates of misclassification are probably present in the Mound C data. While there is a greater opportunity for female misclassification to occur, it seems most likely that individuals with posterior probabilities greater than 0.75 have an increasingly greater chance of being properly classified. The Konigsberg-Hens cranial sex assessment method resulted in a sample of 9 reliable male, 22 reliable female, and 8 unreliable (indeterminate) classifications.

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probability from 1.00.

[6] In contrast, recall that in the post-cranial sex evaluation, elements lacking the complement of skeletal measurements were simply not used.

[7] Since the score of '2' or 'Indeterminate' for a given sex estimator could not be independently verified in the Mound C assemblage, these scores could not be assessed in terms of reliability. They were not subjected to reliability testing.

Table 13-7. Categorical Gender Assessment of the Skull.

Individual Number	Largest Posterior Probability	Assigned As
17	0.735	Female?
20A	0.732	Male?
30	0.935	Male?
41	0.910	Male
44B	0.963	Female
47B	0.972	Female
53A	0.877	Male
53B	0.954	Female
62	0.672	Female?
63A	0.946	Female
64A	0.824	Male
74A	0.756	Male
74C	0.972	Male
76	0.965	Female
79D	0.966	Female
83	0.673	Male?
85	0.970	Female
88B	0.955	Female
89	0.765	Female
95	0.719	Male?
96	0.987	Female
102	0.977	Female
103	0.790	Female
104	0.515	Male?
105	0.790	Female
108	0.977	Female
112	0.910	Male
114A	0.833	Male
122A	0.972	Female
129	0.946	Female
133	0.617	Female?
134	0.877	Male
138	0.977	Female
147A	0.987	Female
218A	0.819	Male
230C	0.966	Female
272	0.977	Female
312C	0.935	Female
325	0.948	Female

Table 13-8. Misclassification Rates between Averbuch and Wickliffe Cranial Observations.

Observation	Sample	Correctly Classified	Misclassified	Chi Value	Degrees of Freedom	P Value
Orbial Margin	Mound C	21	5	0.169	1	0.680
	Averbuch	82	28			
Supraorbital Torus	Mound C	21	5	0.065	1	0.797
	Averbuch	83	20			
Mastoid Process	Mound C	26	7	0.072	1	0.788
	Averbuch	88	30			
Nuchal Form	Mound C	20	7	0.022	1	0.881
	Averbuch	81	27			
Chin Form	Mound C	22	5	0.055	1	0.813
	Averbuch	84	25			

Pelvic Morphology and Sex Determination

The most sex sensitive aspect of the human skeleton is the pelvic girdle. With the onset of puberty, maturation of the innominates modifies the androgenous subadult morphology to meet the reproductive demands of adulthood (Phenice 1969:298; Grant 1962:192-193, 228-230; Weinker 1986:232). As a result, highly reliable sex specific morphological features are recorded in adult human pelvic bones. Many of these features can be observed across human populations, suggesting that the basic anatomical differences in pelvic morphology are universal. While minor variations are expressed between both populations and individuals, the general pattern remains the same.

Sexual dimorphism in the pelvis was used to aid sex identification in the Mound C assemblage. The choice of an appropriate reference population for comparison was guided largely by the availability of reliable sex classifications and ability to model classification statistics. Since positive sex identification was not possible among archaeologically derived Mississippian populations, other skeletal assemblages were considered. The reference sample used for

evaluating Mound C pelvic morphology was drawn from a nineteenth century cemetery located at the St Thomas Anglican Church in Belleville, Alberta, Canada (Rogers and Saunders 1994:1048). Inscriptions left on 49 coffin plates positively identified the individual's sex. The innominates and sacra were preserved well enough in these individuals to provide meaningful quantitative estimates of sex-based variation. Equally as important to this investigation, the authors provided critical information necessary to construct probabilistic sex estimates. The expression of sex in pelvic morphology was assumed not to differ substantially between St. Thomas and Mound C assemblages, despite considerable temporal and genetic differences in these populations.

Seven sexually dimorphic pelvic features were examined in the Mound C skeletal assemblage and scored based on definitions outlined in Krogman and Iscan (1986:208-213), Bass (1987:108,200-206), and Phenice (1969), (Table 13-9). These definitions emphasized the same morphological characteristics as those guiding sex differentiation in the St. Thomas Anglican Church Cemetery assemblage (See Rogers and Saunders 1994:1049, Table 1). As with other sex estimation features, pelvic morphology in Mound C was originally scored on a five point scale (i.e., Male, Male?, Indeterminate, Female?, Female). Questionable forms were collapsed to single sex groups (i.e., Male, Indeterminate, Female) to ensure comparability with the reference sample and other aspects of the Mound C sex classification battery.

Table 13-9. Pelvic Observation Battery Applied to the Mound C Skeletal Assemblage.

Number	Observation Site
1	Subpubic Concavity
2	Ventral Arc
3	Auricular Surface Height
4	Sciatic Notch
5	Pre-Auricular Sulcus
6	Ishio-Pubic Ramus
7	Sacrum Shape

Note: These represent sexually dimorphic observation sites common to the Mound C and St Thomas Anglican Church Pelvic Assemblages.

To date, probabilistic classification of observable pelvic morphology has seen very little development. Most researchers prefer to explore metric approaches or treat non-metric observations as absolute sex indicators. In the absence of a reference sample database capable of providing posterior probabilities, posterior probabilities for Mound C were modeled from the St. Thomas Anglican Church cemetery summary data. Posterior probabilities function to determine whether the information obtained from an unknown population parameter fall within an estimated range, based on information modeled from a reference population (Rindskopf 1997:322). The value obtained expresses the chance that the test estimate falls within modeled estimates.

In keeping with Krzanowski's (1988:336) recommendations, parameter estimations are outlined according to known features in the reference population. In the St. Thomas Anglican Church assemblage, the possession of certain pelvic morphologies demonstrates a positive association with a known sex. Through the use of multiple trials, Rogers and Saunders (1994:1050-1051) demonstrated that, even with some minor variation, they achieved accurate sex estimation with the same observations collected in the Mound C pelvic observation battery. Since these observations appear to be reliable, it can be assumed that the true reliability value is greater than the modeled reliability value. Possession of a given morphology can be modeled as indicative of a certain sex.

Recognizing that these pelvic features are not truly ordinal expressions, rather that they are continuous variables, some individuals will possess morphological expressions that do not follow a normative pattern. Misclassification rates from the St. Thomas data demonstrate this phenomenon. Pelvic morphology cannot be treated as an absolute -- there is a probability that any individual can be mis-sexed according to how his or her morphology fits the sex norms. This phenomenon is approximated by including the misclassification rate with the posterior probability estimate. Group norms for each observation are not uniformly known. Most observation sites do not contain the entire St. Thomas Anglican Church sample. This means that knowledge of the observation sample's distribution is subject to error. The effects of this variability are modeled by including the observed sample size as an indicator of knowledge about the reference population's form.

Through an examination of the pelvic morphological features present in a given case from Mound C, sexually dimorphic morphology are evaluated according to how well the case fits the reference sample's modeled posterior probabilities. Modeled posterior probabilities are composed of three essential components - a density function that determines where group norms are located, given the information available on the reference group; a classification or performance evaluation of the test observation within the reference population; and prior probabilities that model how the test result should follow the reference population's norms (Johnson and Wichern 1982:495). Through various iterations, different aspects of these components are combined to determine how likely test group results can fit into reference group results. While the information needed to calculate true posterior probabilities was not available for the St. Thomas sample, an estimate of the minimum value was obtained.

Values reflecting the amount of knowledge available about the expression of a given form were estimated for each observation site. As a means of evaluating the effects of incomplete knowledge about the reference sample's morphology, observed and unobserved observation site sample sizes were converted to a function of the total sample size (Figure 13-2). Performance evaluation was estimated by dividing the number of correctly classified individuals by the observation site sample size. Likewise, misallocation rates were obtained by summing all incorrectly grouped and indeterminate forms and dividing this by the observed sample size. For all univariate approaches, sex-biasing parameters independent of the morphology were assumed to be the same. Sex determination from pelvic morphology has been considered a very reliable means of determining sex; modeled probabilities were conservatively estimated at 0.75. The true value was expected to be considerably greater than this. When applicable, the two-trait observation probability was substituted for this value in each observation site's equation. Inverse or unreliability rates of 0.25 or 1.00 minus the two-trait observation probability were also computed.

To conservatively estimate how well a particular morphology reflects sex, values supportive of the sex were summed and placed in a column reflecting the sex assigned to that feature, for a given individual. Contrasting values that did not support the estimate were added together and

Factors Supportive of Sex Classification	Factors Not Supportive of Sex Classification
a. Observed Sample (%)	a. Unobserved Sample (%)
b. Prior Probability	b. Inverse Prior Probability
c. Classifcation Rate (%)	c. Misallocation Rate (%)

Example:

Sciatic Notch:

Individual 104 - Sciatic Notch Classified as Male.

Male	Female
a. 1.000	a. 0.000
b. 0.750	b. 0.250
c. 0.857	c. 0.143
2.607	+ 0.393
$\frac{2.607}{3.000} = 0.869$	$\frac{0.393}{3.000} = 0.131$

Figure 13-2. Factors Used to Estimate Knowledge in a Single Pelvic Observation.

placed in the non-assigned sex for each individual. Since indeterminate observations do not identify sex, they were not pursued. The effects of indeterminate observations in the reference sample, however, were considered as negative support for a sex classification and included in the misallocation rate. The effects of reference group sample size, classification/misallocation and modeled prior probabilities were assumed to be equally important to the final estimate. Each equation's factors were weighted equally by summing and dividing by three. The resulting value was treated as an estimate of the knowledge judging if sex has been correctly/incorrectly identified. Among individuals possessing a single observation site, this value also served as the estimated posterior probability. As a means of evaluating pelvic morphology in individuals possessing more than one observation site, the knowledge estimates for each observation site were summed by sex, divided by the number of observation sites included and sex of the pelvis was evaluated according to the reliability model estimate outlined earlier.

The results provided 45 sex evaluations. Classification as male or female was attributed to the sex providing the greatest value, with reliable estimates classes as scores greater than 0.750. The estimated posterior probabilities and sex assignments for each tested pelvic girdle are presented in Table 13-10.

Among the classified sample 71% were reliably sexed. This value compared favorably with the lowest accuracy level of observation sites common to both Mound C and the St. Thomas pelvic samples. As a means of evaluating how well the Mound C pelvic sex estimates fit the data obtained from the original reference sample, reliably classified and less reliably assigned groups were compared. The Mound C sex sample sizes were too small to evaluate each combination of pelvic features independently. A more generalized evaluation was obtained by pooling and comparing classification rates to the St. Thomas data. Chi Square and Fisher's Exact tests were used to assess whether classification rates between the two samples for each observation were independent (Table 13-11). Six of the seven samples lacked significant differences. These results implied that similar rates of misclassification were probably present in both samples. Among the pre-auricular sulcus observations, the higher Chi value indicated that the null hypothesis should be rejected. Mound C

Table 13-10. Categorical Sex Assessment of the Pelvis.

Individual Number	Largest Posterior Probability	Assigned As	Individual Number	Largest Posterior Probability	Assigned As
4	0.859	Female	108	0.565	Female?
17	0.881	Male	112	0.875	Male
18	0.843	Female	114A	0.875	Male
30	0.652	Male?	118A	0.869	Male
38	0.841	Male	122A	0.859	Female
45	0.605	Male?	123	0.869	Male
53A	0.859	Male	129	0.869	Female
53B	0.843	Female	131	0.859	Male
55	0.843	Female	133	0.875	Female
62	0.526	Female?	134	0.652	Male?
68	0.859	Female	137B	0.859	Male
76	0.869	Female	141	0.543	Female?
83	0.869	Male	147A	0.788	Female
85	0.828	Female	148	0.863	Male
88B	0.841	Female	221	0.605	Male?
89	0.843	Female	222	0.506	Female?
90	0.526	Female?	227	0.855	Male
95	0.725	Female?	242	0.826	Male
102	0.875	Female	243	0.875	Male
103	0.859	Female	244	0.506	Female?
104	0.824	Male	322	0.506	Female?
105	0.843	Female	324	0.858	Female
107	0.652	Male?			

Table 13-11. Misclassification Rates Between St. Thomas Church and Wickliffe Pelvic Observations.

Observation	Sample	Number Correctly Classified	Number Misallocated	Chi Value	Degrees of Freedom	P Value
Sacrum	Mound C	9	6	0.771	1	0.379
	St. Thomas	82	28			
Pre-Auricular Sulcus	Mound C	22	13	8.187	1	0.004
	St. Thomas	44	4			
Ventral Arc	Mound C	3	0	0.060	1	0.805 [a]
	St. Thomas	33	5			
Sciatic Notch	Mound C	30	11	1.481	1	0.223
	St. Thomas	42	7			
Sub-Pubic Concavity	Mound C	2	1	0.0001	1	0.968 [b]
	St. Thomas	31	6			
Ishio-Pubic Ramus	Mound C	6	0	0.394	1	0.530 [c]
	St. Thomas	32	8			
Auricular Surface	Mound C	21	9	0.005	1	0.939
	St. Thomas	36	13			

Note: [a] Fisher's Exact (1 Tailed) Test = 0.66.
[b] Fisher's Exact (1 Tailed) Test = 0.44.
[c] Fisher's Exact (1 Tailed) Test = 0.29.

and St. Thomas appeared to represent independent populations. Probable differences in population expression of sexual dimorphism were major contributing factors to misclassification of the Pre-Auricular Sulcus height. However since these values indicated a bias towards under-classifying sex, they were accepted as a conservative error. Most of the Mound C misallocation values (which do not include those individuals expressing only indeterminate morphological forms) tended to be higher than the St. Thomas rates. The true number of correctly identified sexes was undoubtedly higher than this minimum estimate.

Final Sex Determination

Observations of the pelvis, cranium, and post-cranial skeletal elements from individuals in Mound C yielded an array of calculated and estimated probabilistic sex estimates. As a means of determining sex from all morphological data available on each individual, the posterior probabilities were combined into a single probability estimate. Each observation battery yielding a posterior probability was treated as an independent estimate. All male estimates for a given case were multiplied together. The same was accomplished for all female estimates. These totals were then summed and divided by the male (or female) product. The resulting posterior probability was carefully considered relative to the modeled reliability estimate and sex reliably assigned accordingly. In several cases, multiple observations yielded sex estimates that were lower than the reliability estimates, yet consistently identified the same sex. Individuals possessing two or more morphological estimations that were consistent and with average ratings below the reliability estimate were classified as possible representations of that sex. More problematically, individuals with high marks in both sex categories and among multiple observation sites, were judged indeterminate. Finally, individuals with low, single observation based estimates or multiple conflicting estimates were assigned to an indeterminate category.

In Table 13-12 the results of sex determination in 86 individual skeletal assemblages revealed 34 males, 37 females 1 unreliably sexed and 14 individuals of indeterminate sex. A ratio of 0.92 males to every female was calculated, indicating that within the reliably sexed sample, there

Table 13-12. Categorical Sex Assessment of the Mound C Assemblage.

Individual Number	Largest Posterior Probability	Assigned As	Individual Number	Largest Posterior Probability	Assigned As
4	0.859	Female	80B	0.997	Male [a]
6	0.603	Male?	82	0.820	Male
17	0.572	Indeterminate	83	0.837	Male
18	0.858	Female	85	0.899	Female
20	0.896	Male	88A	0.895	Female [a]
20C	0.837	Female [a]	88B	0.898	Female [a]
30	0.839	Male	89	0.812	Female
35	0.992	Male	90	0.860	Male
38	0.826	Male	92	0.869	Male [a]
41	0.910	Male	95	0.591	Indeterminate
44A	0.975	Male [a]	96	0.987	Female
44B	0.963	Female [a]	100	0.998	Male
45A	0.802	Male	102	0.926	Female
47A	0.887	Male [a]	103	0.893	Female
47B	0.972	Female [a]	104	0.753	Male
49B	0.999	Male [a]	105	0.816	Female
50	0.622	Indeterminate	107	0.652	Indeterminate
53A	0.513	Indeterminate	108	0.771	Female
53B	0.840	Female [a]	112	0.892	Male
55	0.843	Female	114	0.854	Male
62	0.609	Indeterminate	118A	0.869	Male [a]
63A	0.600	Indeterminate [a]	122A	0.915	Female [a]
64A	0.824	Male [a]	123	0.869	Male
64B	0.979	Female [a]	129	0.907	Female
66	0.936	Female	131	0.859	Male
68	0.914	Female	133	0.612	Indeterminate
71B	0.936	Female [a]	134	0.764	Male
74A	0.760	Male [a]	137B	0.859	Male [a]
74C	0.941	Female [a]	138	0.977	Female
76	0.766	Female	141	0.543	Indeterminate
77A	0.678	Indeterminate [a]	147A	0.887	Female [a]
79A	0.993	Male [a]	148	0.815	Male
79C	0.991	Male [a]	149	0.935	Female
79D	0.516	Indeterminate [a]	170	0.963	Female
80A	0.987	Female [a]	171A	0.577	Female [a]

Note: [a] Individual located in (and designated as) a multiple individual grave.

Table 13-12 (continued). Categorical Sex Assessment of the Mound C Assemblage.

Individual Number	Largest Posterior Probability	Assigned As	Individual Number	Largest Posterior Probability	Assigned As
218A	0.819	Male [a]	243	0.875	Male
219	0.837	Male	244	0.506	Indeterminate
221	0.728	Male?	246	0.616	Indeterminate
222	0.506	Female	272	0.977	Female [a]
226	0.957	Male	312C	0.935	Female [a]
227	0.855	Male	322	0.506	Indeterminate
230C	0.966	Female [a]	324	0.858	Female
242	0.826	Male	325	0.948	Female

was a slight bias towards female representation. Similar results have been obtained from other Late Prehistoric Assemblages. A comparison with other Mississippian populations in the Mississippi Drainage basin indicated that greater female representation is the norm (Table 13-13). Mound C tended to display a more balanced sex distribution than found in other assemblages. Contrasting male and female representations at Mound C and other sites found little evidence to suspect that these represented independent samples. While systematic methodological biases cannot be eliminated, greater female birth rates and survivorship to adulthood in these populations were possible contributors to ratio imbalances. Cultural practices such as sex biased infanticide and male biased burial segregation could also have been important behavioral agents contributing to unbalanced sex representations.

Table 13-13. A Comparison of Male-Female Compositions at Mound C and Selected sites from the Central Mississippi Drainage Region.

Site	Sex Ratio [a]	Males	Females	Chi Value	Degrees of Freedom	P Value
Mound C	94.44	34	36			
Nodena	71.42	80	112	0.733	1	0.391
Turner	47.82	22	46	3.120	1	0.077
Campbell	69.84	44	63	0.674	1	0.411
Tinsley Hill	72.00	18	25	0.250	1	0.616

Note: [a] Male/Female X 100

Chapter 14. Age Structure

If the age attained at death is a significant element in the deceased's social representation then the depositing community must have possessed some understanding of its own life history. Most cultures are aware that death is likely at certain ages. Survival beyond these ages (and death before them) elicits change in the survivor's social personality. Recognition of patterns among age related events; including the transitions from infancy through adulthood, the periods of male and female fertility, and passage into senescence; can influence how social features are distributed across a community. When death occurs outside of these expectations, the community response can be more pronounced than if it had occured during a more likely age. As a means of understanding what might represent important periods in a community's life history, the approximate ages of death are estimated for the Mound C assemblage and an abridged life table helped place these individuals in age groups.

Methods and Biases in Skeletal Age Determination

Choice of Age Battery

The human skeletal frame is a dynamic structure capable of changing to meet needs in the surrounding tissue. During periods of development, bone increases in size and composition in order to maximize growth in other tissue systems (McLean and Urist 1968:26). Likewise, mature bone modifications occur as a result of routine skeletal tissue maintenance or when chronic stress is greater than the unmodified bone can accommodate. The universal representations of some age responses in human bone enable age at death to be determined from the skeleton.

As a system, the human skeleton reflects morphological transformations capable of recording the age of death during any point in the life cycle. Unfortunately, there are severe interpretive limitations. First, there are no single observation sites with definable morphological changes across the entire age spectrum. When examining a skeletal assemblage, reliance on a single age estimator results in an incomplete report of the assemblage's age structure. In contrast, the use of more than one age estimator provides a more comprehensive view of the population

structure, but the methods available are more difficult to quantify and frequently require the analyst to make additional assumptions about the data.

Age changes in the skeleton are not uniformly informative. They rarely can pinpoint the exact age of death, but they can provide ranges between when death occurred. When using a skeletal age estimator, the observed morphology can be viewed as representing one of two general states at the time of death -- it is either active or inactive. During an inactive period, the tissue's morphology is not undergoing a change that is useful for age estimation. At best, age can only be approximated (i.e., before or after), relative to the active phases. Age estimates in this phase cannot lead to precise age estimates. During an active phase, or utility range, predictable changes in skeletal morphology are formed. These can provide specific estimates of the individual's age of death. Among age estimators emphasizing developmental features, the range of utility is frequently very accurate and very short. Age estimates that focus on post-maturation features are capable of recording tissue changes over long periods of time, but they are frequently overshadowed by individual variations. As a result, the range of utility may be very long, but it will lack age accuracy. As individuals approach senescence, age estimation precision decreases and most estimators are reduced to relative age indicators. Buikstra and Konigsberg (1985:319) recognize that individuals over the age of 50 cannot be reliably aged[1]. Knowledge of the population structure is therefore biased against these advanced age groups.

Given that more than one age estimator is needed and that the results obtained will vary in precision, the skeletal assemblage should be evaluated from a common battery of estimators. Unfortunately, archaeological representation from the Mound C skeletal assemblage is not complete. The size, structure and chemical composition of bone frequently lead to a poor skeletal representation. Many of the most accurate skeletal age estimators, namely the pubic symphysis, epiphyseal centers and immature dental tissue, are located on difficult-to-recover osseous tissue. Walker et al. (1988:185) note that preservation biases tend to select against the less calcified bones

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[1] For the purposes of this study, individuals over age 60 were placed in the same upper age estimation group.

of subadult and elderly skeletons. In Mound C, human activities have additionally removed even the more durable age estimation aspects, like the auricular surface and cranial vault sutures. These missing data compromise age determination and may ultimately skew the mortality representation away from its true form (Boldsen 1988:340). To overcome this bias, the age structure must either be based on a very small sample of individuals aged by a common method or grounded on a large skeletal sample that have been aged by a non-uniform assemblage of age estimators.

In response to these limitations, age at death and the cumulative age structure for the Mound C assemblage can only be approximated. The incomplete nature of the collection and desire to maximize the number of aged individuals require that ages be based on a number of age estimators. The choice of these age estimators emphasized a pool of utility ranges spanning an age structure from 0 to 65 years (Figure 14-1). A battery of 11 observation sites was selected from the original age estimation data (Table 14-1). Ages were recorded as probable ranges. This battery was used to provide age estimates for 139 individuals.

The Age Estimation Battery

Ages for infants, children, and adolescents were determined from an examination of dental and skeletal development. When preservation permitted, individual teeth were examined to learn the amount of enamel and root development among both deciduous and permanent dentition. These observations were compared to results reported by Moorees et al. (1963a, 1963b), Thoma and Goldman (1960), and Smith (1991). Radiographic images were obtained for many cases to aid in this assessment. When observations of individual tooth development were incomplete or could not be ascertained, the pattern of eruption outlined in Ubelaker (1978:46-47, 112-113) was used to assess dental age.

Subadult human skeletons do not grow isometrically, rather they form from several growth centers (Mays 1998:47-49). The appearance and eventual fusion of epiphyseal and diaphyseal elements are used to estimate the degree of maturation. These observations are compared to the ranges reported in Bass (1987), Flecker (1932), Krogman and Iscan (1986), and McKay (nd). Because of their sensitivity to young adult ages, particular attention is paid to anterior iliac crest and

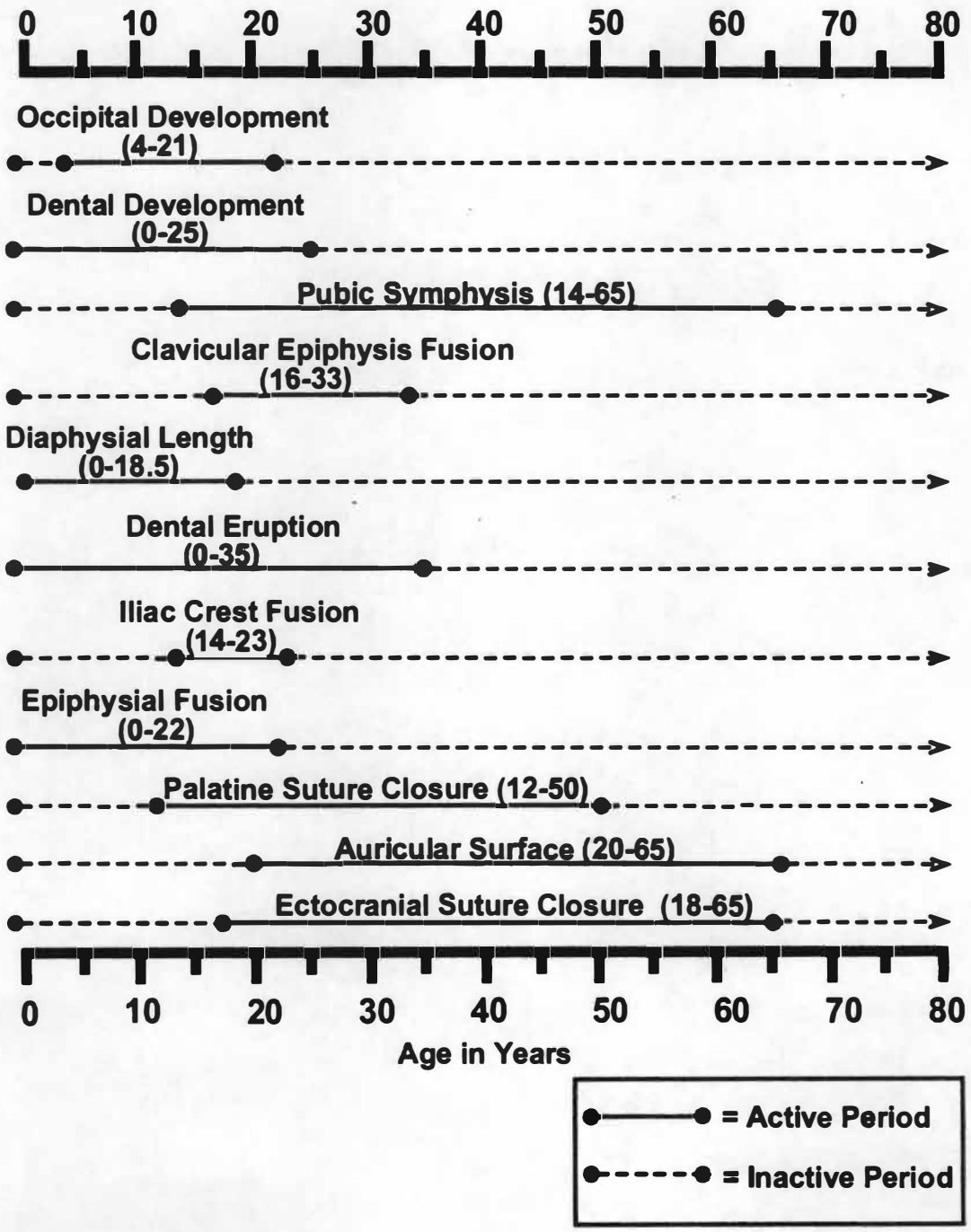


Figure 14-1. Utility Ranges for Skeletal Age Estimators in the Mound C Assemblage.

Table 14-1. Age Estimators Applied to the Mound C Cemetery.

Estimator	Reference
Dental Development	Moorees et al. (1963a, 1963b) Thoma and Goldman (1960) Smith (1991)
Dental Eruption	Ubelaker (1978)
Epiphyseal Fusion	Bass (1987) Krogman and Iscan (1986) McKay (nd)
Anterior Iliac Crest and Medial Clavicle Epiphysis	Webb and Suchey (1985)
Occipital Development	Suchey (nd)
Diaphysis Length	Fazekas and Kosa (1978) Johnson (1962) Merchant and Ubelaker (1977)
Pubic Symphysis	Todd (1920, 1921) Katz and Suchey (1986)
Auricular Surface	Lovejoy et al. (1985)
Ectocranial Suture Closure	Meindl and Lovejoy (1985)
Palatine Suture Closure	Mann et al. (1991)

medial clavicular epiphysis (See Webb and Suchey 1985). Development of the occipital bone is used to assess cranial vault maturity (Suchey nd). Metric evaluations are used to supplement visual estimations of the developmental state. Measurements of limb and pelvic bones are compared to results obtained by Fazekas and Kosa (1978), Johnson (1962), and Merchant and Ubelaker (1977) to determine age based on skeletal size.

Age estimation among adults tended to evaluate chronic skeletal responses to everyday stress. The pubic symphysis was evaluated following the observations noted by Todd (1920, 1921) and Katz and Suchey (1986). Since the auricular surface was one of the more commonly preserved skeletal regions, the age related changes in morphology outlined by Lovejoy et al. (1985) were extensively used. Rates of suture ossification were also considered. Approximate ages for various aspects of suture closure were obtained from Meindl and Lovejoy's (1985) ectocranial ossification data as a means of identifying age ranges from the cranial vault. Closure of the maxillary palatine sutures were recorded and evaluated following Mann et al. (1991). Long bone deterioration was sometimes used to infer young from old adults (Acsadi and Nemeskeri 1970).

Age Estimation and Its Associated Biases

In recent years, the use of skeletal age evaluation methods for community/population analysis has come under severe scrutiny. Some paleodemographers recognize that age, based on skeletal morphology, cannot provide the precision seen in other forms of demographic analysis (Bocquet-Appel 1986; Jackes 1992; Konigsberg and Frankenberg 1992). In essence, these analysts acknowledge that by basing age on the morphology expressed in a reference population, the poor correlation between age and age sensitive morphology is embedding aspects of the reference population's age structure into the case population's age structure (Konigsberg and Frankenberg 1992:237). In particular, if the age range for a given morphology is relaxed (i.e., it contains a large number of potential ages), there is a greater chance of the reference sample's age structure entering the case sample's structure (Bocquet-Appel and Masset 1982:323-324). The resulting age structure is not an independent sample of the case assemblage's age pattern, rather it is a reflection of the reference and case population's age structure.

To overcome this bias, paleodemographic analysts have sought statistical methods capable of splitting skeletal age morphology from the reference sample. While it would seem that the use of multiple age estimators would eliminate the bias introduced by single age estimation techniques, most methods employing multiple age estimation ground these observations on a single reference sample to avoid other methodological issues. The subsequent use of principal components analysis to estimate age reduces the bias introduced by a single age estimator's effect on the case sample, but it does not eliminate the cumulative effect of the single reference population on the case sample's age distribution (e.g., Meindl et al. 1988; Mensforth 1990). A more abstract approach, Maximum Likelihood Estimation, has met with a certain degree of success in paleodemographic circles (Boldsen 1988; Konigsberg and Frankenberg 1995; Konigsberg et al. 1997; Paine 1989). This approach uses the morphology of a given age estimator to predict when a given form is most likely to appear. While this method can successfully unchain the age estimator from the reference population, it requires an assumption of universal response among skeletal age estimation sites and its use is currently limited to single age estimators – it therefore cannot be used to illuminate a population's entire age structure. Too few individuals in the Mound C assemblage are represented by a single age estimator to expect a reasonable approximation of the age structure to be obtained. Perhaps more damaging to use on the Mound C age data, Boldsen (1988:341) points out that the degree of preservation needs to be identical, otherwise the approach will reflect the preservation distribution, not the age structure.

It is currently impossible to obtain unbiased age estimates directly from skeletal age indicators and equally not possible to apply methods capable of extracting these biases. Recognizing that age estimation was going to be flawed, a method was chosen that illuminated where biases were most represented and emphasized the age estimates common to several reference samples.

The age estimation data collected for each individual were evaluated and reduced to a single age range in a manner similar to that used in forensic analyses. Each observation's age estimate was assumed to have an equal chance of occurring during the period stipulated by the

morphology. Given that multiple observations were employed, the period of overlap between age estimates was viewed as the most likely interval when death occurred (Siven 1991:101). Maximum age range, representing the greatest age estimate overlap agreement, was assigned to each individual. Use of the maximum age range assumed that the age-morphology correlation would be greater in multiple than single age estimators. Quantitative applications of the maximum age range approach can provide highly accurate age estimates if morphologies can be matched and seriated into a single order (See Mensforth 1990:84-85). Mattemes (1994:32-36), however, identified that age dependent skeletal features were not continuously represented for all age groups, precluding the use of statistical evaluation techniques like those outlined in Meindl et al. (1985) and Lovejoy et al. (1985).

Evaluation of maximum age ranges in Mound C, however, could be established intuitively. To do this, it was additionally assumed that the physiological response to age observed at one observation site was independent of others and that each age estimator correlated with age equally among all human populations. In this sense, Mound C's reference sample was the sum of all reference populations used to provide age-related morphology. The negative aspect of this procedure was that no probability of a correct categorization could be obtained, so there was no means of determining whether the age estimate was biased by the reference sample (Konigsberg and Frankenberg 1995:97).

The location and distribution of reference sample biases in the Mound C age data could be determined. In Table 14-2, note that the battery of eleven observation sites are based on the morphology observed in no less than 14 distinct reference assemblages. From the case assemblage of 139 skeletons the proportion employing each age estimation technique varies. This indicates that the contribution each age estimator provided to Mound C's age structure is not equal. Since age estimators are not based on the same reference population, the influence of each reference population on Mound C's age structure is not equal either – some reference populations had a greater impact on the age structure simply because the reference sites observed are not

Table 14-2. Distribution of Age Estimators in the Mound C Age Structure.

Estimator	Used	Percent	Reference Collection
Dental Development	6	4.3	Modern American
Dental Eruption	18	13.2	Mostly Modern American and European
Epiphyseal Fusion	23	16.6	Modern European (Mixed)
Anterior Iliac Crest Epiphyses	20	14.4	Los Angeles Medical Examiner
Medial Clavicle	9	6.5	Los Angeles Medical Examiner
Occipital Development	7	5.0	Modern American (Pooled UniversityCollections)
Diaphysis Length	10	7.2	Indian Knoll; Arikara; European Fetal
Pubic Symphysis	10	7.2	Todd Anatomical Collection; Los Angeles Medical Examiner
Auricular Surface	39	28.2	Todd Anatomical Collection; Libben; Ohio Medical Examiner
Ectocranial Suture Closure	47	34.0	Hamann-Todd Anatomical Collection
Palatine Suture	35	25.3	Terry Anatomical Collection, Closure Louisiana State University and University of Tennessee Anatomical Collections

equal. In particular, the Hamman-Todd, Terry, and Modern/Forensic Collections are major influences on Mound C's age structure.

The weight of these collections was not uniform across age. Since the age estimators used in this analysis discriminated age on the basis of changes in skeletal morphology, reference sample age biases were especially sensitive to each observation's utility range. In Figure 14-1, the cumulative utility range for each age estimator employed was distributed across the age spectrum. If these utility ranges overlapped for a given age, then the reference samples used as morphological guides are potentially biasing that estimate[2]. Likewise, observations and reference populations not addressing a given age were not influential in this sample's bias. In short, a reference population's contribution to the bias in each age estimate was not the same, rather age specific reference sample biases were a composite of biases varying according to utility ranges that included (or should include) the given age.

[2] A reference sample's contribution to bias is subject to the feature's presence in a skeleton.

Determining Age Structure

The principal goal of any demographic examination is to ascertain the organization of a group of organisms (Namboordiri 1991:1). While paleodemographers have primarily focussed on the biological structure of demographic data, Pointek and Weber (1990:72) emphasize that demographic theory is based on social development, not biology. What is most commonly ascertained from human demographic studies are social not biological structures. The biological analyst's goal must be to reconstruct and then assess the biological reality of each assemblage from its social context. Recalling that the goal of this analysis is to determine what ages may engender change in the dead's social personality, an examination of the assemblage's life history is capable of emphasizing when major life changes were likely to occur. The most applicable method for data constrained by Mound C's incomplete representation and non-comparable age estimation techniques is the construction of an abridged life table.

Most demographers would agree that any age sensitive structure must be based on the community's underlying biological organization. While the basic question does not address the community's biological structure, this aspect must be estimated to determine the community's social characteristics. Jackes (1992:189) recognizes that the reconstruction of biological organization must originate in evidence obtained from the archaeological record. Life tables represent only one component of the paleodemographer's research tool kit. Bogue (1969:551) emphasizes that life tables are mathematical constructs that describe the mortality structure of a population within a given circumstance. Among cemetery assemblages, life tables portray the structure of death events among the dead placed in the facility during accumulation periods. They infer the age structure of a community only as far as their underlying data can be demonstrated to represent valid samples of a community's structure. In an archaeological setting, this presents some important limitations.

Very few paleodemographic variables are absolute. The overwhelming majority of past population features are, at best, estimated features. These are grounded on other information about the population and what can be extrapolated from similar populations (Nam and Gustavus 1976:22). As a result, the exact state of a population at a given point in time is unattainable. Archaeologically

grounded demographic data cannot, for instance, provide the burial sequence or precise age-at-death among cemetery members. The resulting age data are therefore limited to general classification. An abridged life table is a construct able to provide information within this limitation.

In Mound C, where the structure of birth cohorts is unknowable, the most applicable data structures are synthetic or mortality-age cohorts. These classes assume that each generation undergoes the same life experience and thus can be pooled to represent the population's life experiences (Weiss 1973:9). Variable rates of mortality, inward and outward migration and fertility for each generational cohort can be factored into a living or historically documented population's structure. Among archaeological samples, any a priori estimation of these features must be based on independent evidence. Rarely does the archaeological record provide specific information on these variables, making control over them virtually impossible. One means of reducing the bias introduced by these variables is to ground them to a common norm. Lotka's Stable Population Theory is commonly used to achieve this goal (In: Weiss 1973:6). The Stable Population Theory assumes that all vital population growth rates are fixed. The population is considered to have equal birth and death rates; a lack of in/out migration; and no size limitations (Weiss 1973:6; Acsadi and Nemeskeri 1970:45; Bogue 1969:558). For the purposes of social analysis, it also is assumed that a population's conception of important differences in age groups is stable. These assumptions are fallacies -- populations never achieve states of ubiquitous balance. However, universal acceptance of the Stable Population Theory for life table construction and analysis enables the results from different cemetery assemblages to be compared from a common reference point. Recognizing that human populations are dynamic, it is possible that the errors introduced by the Stable Population Theory may not have differed strongly from conditions present in the Late Prehistoric Central Mississippi River Drainage Basin. Holland (1991:96) noted that in many cases, Late Prehistoric Native American growth rates within the Central Mississippi Valley would have approximated zero.

Previous age analyses of the Mound C assemblage have considered the data obtained from all individuals (Matternes 1994, 1995a). In this examination, a different sample of age estimations was used, resulting in a different sample and ultimately, a different structure. As a means of

pinpointing critical periods in the community's life history, the age-able sample was further refined to reduce noise introduced by generalized age estimates. Age ranges of less than 25 years for adults and 8 years for children were considered sensitive enough to provide meaningful data. This reduced the aged sample size from 138 to 126 individuals. With the exception of children, where infancy was separated from childhood at age four[3], ages were broken into ten year increments. Individuals with age estimates spanning more than one category were apportioned by the number of years represented. Following Asch (1976:27), these ages were broken into proportions and distributed across age categories by the appropriate person-year representation. Variables were recorded to the third decimal place. Unlike most analyses, cohort frequencies were not rounded to the nearest individual. Each age category or cohort was totaled and this value recorded as D_x. For each age cohort, the percentage of deaths occurring (d_x), survivorship to the next cohort (l_x), probability of death within the cohort (q_x) was determined following the calculations provided in Ascadi and Nemeskeri (1970:33-35) and Weiss (1973:36-37). The resulting abridged life table is presented in Table 14-3.

A graphic representation of each cohort's proportion of the sample (d_x) emphasizes a gradual increase in age representation, peaking at the 30-39 year age cohort and then declining (Figure 14-2). Over half the age-able assemblage consists of 30-50 year old adults. These results are comparable to those originally reported by Mattemes (1994). Note that this assemblage contains an astonishingly low number of infants. The probability of death (q_x) among subadults under the age of four was very close to zero (Figure 14-3). A review of mortality results obtained from the analysis of both industrial and pre-industrial societies by Coale and Demeny (1966) determined that similar

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[3] Armelagos (1990:137) noted that weaning stress at Dickson Mounds peaked in the 1-4 year old range. Age four was used as a means of approximating the age of weaning in the Mound C community.

Table 14-3. Mound C Life Table (Unadjusted).

Cohort	D_x	d_x	l_x	q_x
0.0-3.9	7.76	0.062	1.000	0.062
4.0-9.9	11.16	0.089	0.938	0.094
10.0-19.9	15.05	0.120	0.849	0.141
20.0-29.9	18.26	0.145	0.729	0.198
30.0-39.9	35.35	0.281	0.584	0.481
40.0-49.9	27.08	0.215	0.303	0.709
50.0-59.9	10.39	0.083	0.088	0.943
60.0^+	0.55	0.005	0.005	1.000

Notes: D_x = Count of Individual Deaths Per Cohort.
d_x = Proportion of Individual Deaths Per Cohort.
l_x = Proportion of Individuals Surviving to Next Age Cohort.
q_x = Probability of Death within an Age Cohort.

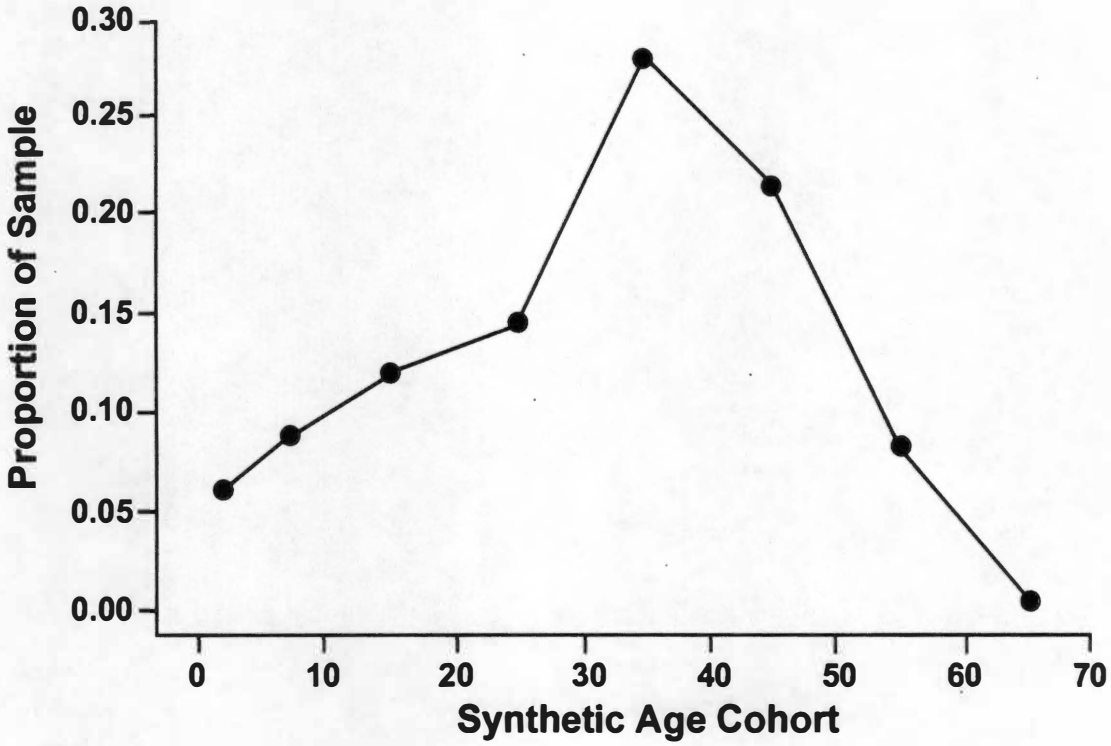


Figure 14-2. Proportionate Distribution of Mound C Sample (d_x) Across Age Cohorts.

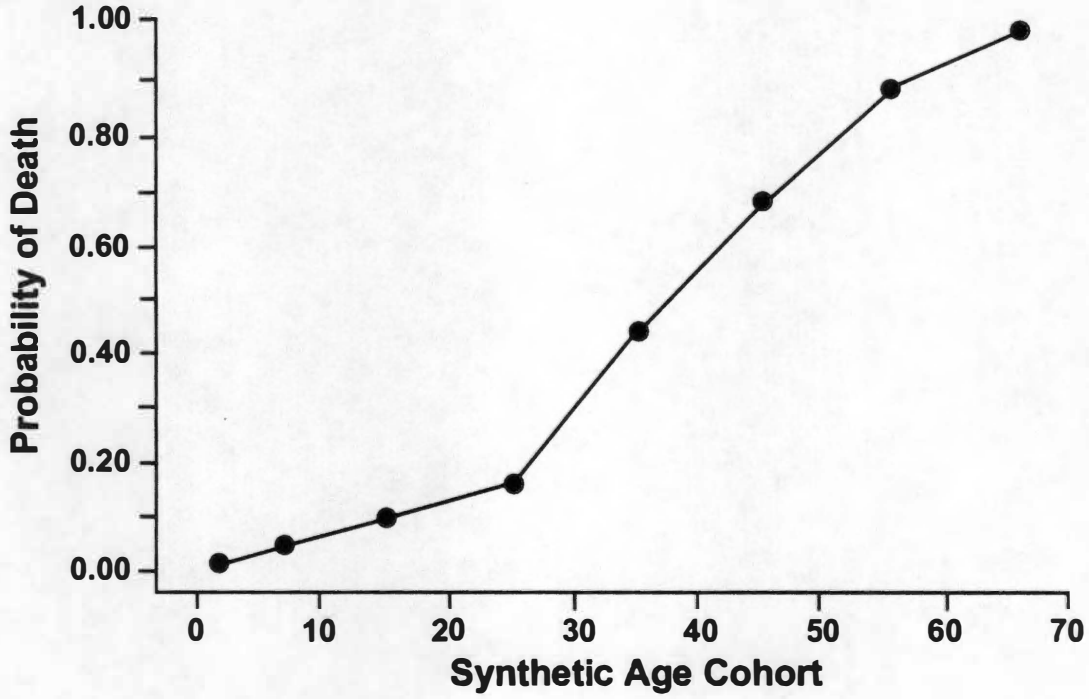


Figure 14-3. Survivorship Curve (qx) for the Mound C Sample.

mortality patterns do not occur naturally in populations prior to the implementation of industrialized cultural strategies. Quine (1990:1283) has observed that a child's ability of survive the first few years of life is extremely dependent on the quality of health care available and generally reflects the overall quality of health in the community. While Matternes (1995b:197) has argued that the Mound C assemblage reflects a less stressed population, it is hard to accept that so few selective pressures were present as to lower infant mortality to these levels. Mattemes (1994:66) has suggested that these levels of infant mortality would have resulted in a marked population growth. Independent evidence supportive of this phenomenon has not been detected in contemporaneous Mississippian or Protohistoric assemblages in the Central Mississippi Valley.

A more likely explanation for these unrealistically low infant representations is cultural segregation. Buikstra et al. (1986:528) observe that this pattern is prevalent throughout a number of Late Prehistoric mortuary assemblages in the Central United States. Locally, infant under-numeration has been detected at Campbell (Holland 1991:95-96) and Turner (Black 1979:86). This phenomenon may reflect a difference in social identity, where survival past the age of weaning, reflecting one of the most dangerous periods in an individual's life, is marked by inclusion in the community cemetery.

Model life tables for pre-industrial social groups were compared to the Mound C sample as a means of understanding what biological patterns should be present. Well grounded, age data for undeveloped cultures were not extensively gathered or explored prior to the 1960s and 1970s. While still highly contested in some circles (See Bocquet-Appel and Masset 1982; Peterson 1976), integration of these data with archaeologically based information is considered a valuable component of mortuary analysis by many analysts (Roth 1992). Non-subadult age data from Mound C was compared to model life table distributions presented in Weiss (1973). Weiss' model tables are composite estimates. They are not based on single population statistics and are structured to address slightly different questions than those posed here. As a means of estimating the infant/subadult biological structure originally present in Mound C, the l_x and q_x values presented in Weiss (1973:Appendix C) were multiplied to obtain d_x values for each model life table. Since Weiss's

values were not perfectly aligned to fit Mound C's age data, cohorts under the age of ten were combined and removed from each life table. The d_x values for each table were then re-apportioned to fit the ten-year cohort classification applied to Mound C. All individuals over the age of 60 were combined into a composite cohort. q_x and l_x values were then recalculated for each life table. In Mound C, apportioned data set frequencies for individuals over the age of 9.9 were tabulated and used to reconstruct the life table.

Recognizing that the q_x value is a very sensitive indicator of the cumulative life events within a given life table (See Buikstra and Konigsberg 1985:325), q_x values from the restructured model life tables and those from Mound C were used to discriminate the best fit. q_x values were substituted for C_x values and Weiss' (1973:65) Index of Dissimilarity was calculated for each model. The best absolute fit (|0.861|) was with the Model 15-70 table, however a graphic comparison of this survivorship curve with the Mound C data lacked a good fit (Figure 14-4). This was largely due to intersection values close to the middle-adult age groups counteracting the substantial difference in contributions provided by younger and older age groups. The absolute difference did not account for these differences in magnitude. Mound C's older adult groups were more likely to be influenced by reference sample biases and wide age estimation ranges. To overcome these potential problems, greater emphasis was placed on fitting Model q_x values from the more tightly aged younger aspects of the mortality distribution. Model fitting focussed on the most reliable section of the life table sample, namely the 10-19, 20-29, and 30-39 year old cohorts. This assemblage consisted of over half of the total age sample. From this subsection of the life table alone, the Model 15-70 life table provided a very poor fit with the Mound C data.

Some of the issues with life table fitting can be overcome by evaluating the similarity of each age group's contribution to the overall difference between model and Mound C survivorship curves. If the contribution of each cohort to the overall difference is the same, then the survivorship curves would parallel each other and the model with the smallest difference would be the best fit. This type of evaluation does not need to account for differences in shape. If the survivorship curves are

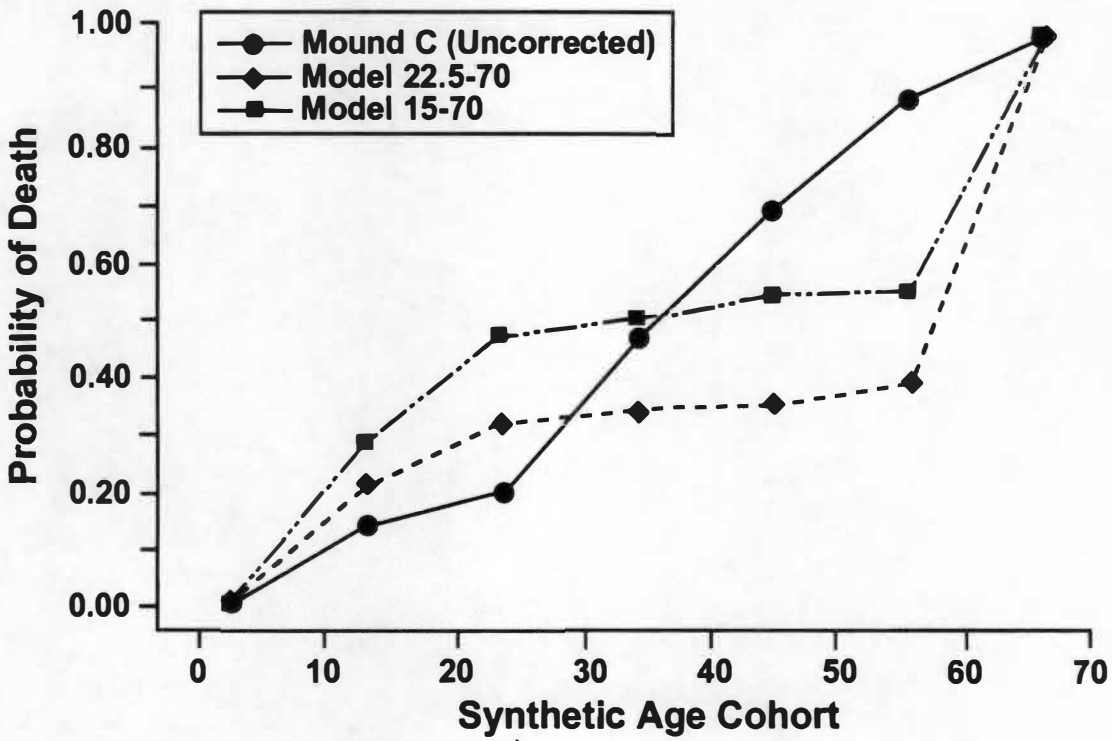


Figure 14-4. Q_x Comparison of Mound C and Regional Life Tables.

different and each age contribution varies, then subtracting the average difference from each cohort's difference would result in a value weighted to control and emphasize magnitude variations.

The absolute difference between Mound C and Model survivorship curves was divided by the number of cohorts contributing to the summed difference. A statistical horizontal line (Slope=0) was created by subtracting each cohort's difference from the average distance. These weighted values were summed. The total resulting in the smallest value indicated the closest model approximation to the Mound C structure. A comparison of the outlined more reliably aged sample from each model survivorship table resulted in a sample difference of |0.0724|, suggesting that of the available model distributions, the MT 22.5-70 table was perhaps the most appropriate model. Visually, it can be ascertained that the model's form approximated the Mound C 10-39 year old sample, which accounted for about 55% of the entire ages assemblage, more closely than the 15-70 model. There still, however were substantial differences between these survivorship curves. Following Lovejoy (1971:105), a Kolmogorov-Smirnov Two-Sample comparison was used to evaluate whether the total error in this estimate negated its association with Mound C. The resulting D value of 0.26 and a P value of <0.001 indicated that these samples could have come from the same population.

The 22.5-70 model life table reflects a population with an average adult life expectancy of 33 years. This estimate compares favorably with Matternes' (1994:63) estimate of 31 years for the entire assemblage. C_x values for the original model life table emphasize an assemblage dominated by youths, young adults and only a small percentage of more mature adults.

This pattern is consistent with undeveloped populations (Swedlund and Armelagos 1976:11-12). Similar living population forms are noted to possess relatively high fertility, counterbalanced with elevated rates of mortality. These populations tend to have an equal or greater proportion of the community who are dependent on the rest of the community for survival. To ensure survival individuals between the approximate ages of 14 and 65 must be able to produce enough resources to support themselves and the dependent portion of the population. Populations of this nature can be characterized by both high mortality and fertility rates. Following Buikstra et al. (1986), Matternes

(1994:71) determined that the fertility rate for the Mound C assemblage (0.45) approximated those found in other regional Mississippian communities. Mattemes (1994:89) has also demonstrated that at least 30% of the population was under the age of 21. These data suggest that this was probably a low estimate. Weiss's (1973:118) C_x values indicated a value closer to 50% as more realistic. The Mound C assemblage probably possessed a similar structure to other Mississippian populations and to the 22.5-70 model life table.

Given these data, the Model 22.5-70 life table was used to reconstruct Mound C's original biological structure. Approximately 27% of the population modeled in the 22.5-70 life table were under the age of ten. This population was added to the Mound C life table and the restructured life table presented in Table 14-4. An examination of the adjusted Probability of Survival (q_x) data indicated that the chance for death to occur never dropped below ten percent for a given cohort. In general, a pattern of high infant mortality, followed by low subadult mortality and gradual increasing chances of death were present. Members of a prehistoric community could have easily detected this general pattern.

Table 14-4. Adjusted Mound C Life Table.

Cohort	D_x	d_x	l_x	q_x
0.0-9.9	39.58	0.269	1.000	0.269
10.0-19.9	15.17	0.104	0.731	0.142
20.0-29.9	18.38	0.125	0.627	0.199
30.0-39.9	35.48	0.241	0.502	0.480
40.0-49.9	27.20	0.185	0.261	0.708
50.0-59.9	10.51	0.071	0.076	0.934
60.0^+	0.68	0.005	0.005	1.000

Notes: D_x = Count of Individual Deaths Per Cohort.
d_x = Proportion of Individual Deaths Per Cohort.
l_x = Proportion of Individuals Surviving to Next Age Cohort.
q_x = Probability of Death within an Age Cohort.

Within the restructured life table, there are notable changes in survival, indicating that important differences between cohorts were present. Recognizing that the transition from infant to subadult was detected by the community as an important change in age, more dramatic changes in the q_x value might be observable in the social data as well. One particularly important transition was noted between the 20-29 and 30-39 year old cohorts, where the probability for death more than doubles. The proportionate change in these values was probably higher than those prompting subadult segregation (See Weiss 1973:123). This transition was hypothesized to indicate an important life history transition, where survival (or failure to survive) served as an important social discriminant. This pattern was robust enough to be present in the original life table q_x values. There is little reason to believe that this phenomenon was introduced by using the model life table as a reference sample.

Mortality curves for the adult Mound C sample were compared to results from other regional Mississippian Cemetery populations from Campbell (Holland 1991), Turner (Black 1979), and Tinsley Hill (Lane 1993), (Figure 14-5). While differences in acquiring age estimates vary between studies, and thus preclude any exact comparison between groups (See Ubelaker 1974:64), their general distributions indicate that Wickliffe followed the mortality pattern found in other Mississippian populations. Note that major transitions in survival occur between most population's 20-29 and 30-39 year old cohorts. This period of transition is consistent throughout the Central Mississippi Valley, suggesting that Mound C is not unique in this phenomenon.

The transition outlined between 20-29 and 30-39 years was treated as a possible discriminant in the Mound C social structures. As stated earlier, the change in survivorship is more pronounced than in other socially discriminant age groups, inferring that if survival was a socially recognized factor, change from young to mature adulthood would be a detectable discriminant. The point separating 20-29 and 30-39 categories is represented by over half of the age estimation utility ranges in this age battery. It is one of the best documented age areas in the assemblage. Many of the morphological changes observed in the 29-30 year old transition tend to be abridged within

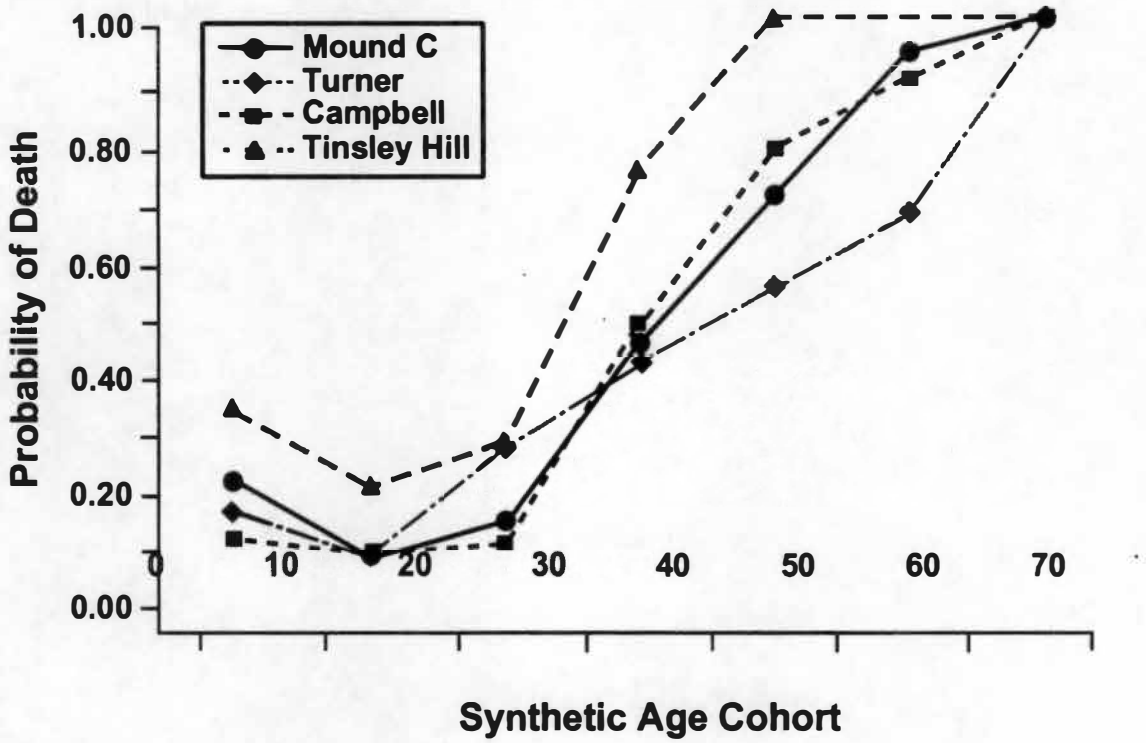


Figure 14-5. Comparison of Survivorship Curves from Mound C and Regional Samples.

relatively tight age ranges. Among adults, this is one of the most reference sample bias-free age groups available.

While other major changes in the q_x value were noted in older aspects of the Mound C assemblage, fewer and less precise age estimators represented these age estimates. The possibility of reference sample biases would be greater on these aspects of the assemblage. To reduce the amount of reference sample bias entering into the Mound C social classification, ages were conservatively categorized as outlined in Table 14-5. All ageable individuals were placed within this classification. If age estimates crossed age classes, categorization was established by placing the individual in the group with the greatest person-year representation. A list of the final age classifications was provided in Table 14-6.

Table 14-5. Age Categories Applied to the Mound C Cemetery.

Grave Glass	Age Range	Definition
I	0.0-3.9	Infant
Y	4.0-29.9	Subadult/Young Adult
A	30^+	Mature Adult
M	0.0^+	Multiple Individual Grave

Table 14-6. Final Age Classifications for the Mound C Skeletal Assemblage.

Individual Number	Age Range	Grave Class	Life Table Sample	Individual Number	Age Range	Grave Class	Life Table Sample
6	45-60	M	Y	79A	20-29	M	
17	25-45	A	Y	79B	10-11	M	Y
18	50-60	A	Y	79E	6-7	M	Y
20	32-42	M	Y	79G	0-3	M	Y
21	1-2.5	M	Y	80A	20-40	M	
30	35-45	A	Y	80B	20-40	M	
38	30-49	A	Y	83	35-50	A	Y
41	30-40	A	Y	85	30-45	A	Y
42	6-7	Y	Y	88B	30-40	A	Y
44B	32-46	M	Y	89	20-24	Y	Y
44C	17-21	M	Y	91	14-17	Y	Y
45	35-45	A	Y	92	30-40	M	Y
45EL1	0-2	A	Y	95	30-49	A	Y
46	13-17	Y	Y	99	30-45	M	Y
47C	3-10	Y	Y	102	30-40	A	Y
47E	<10	Y		103	45-55	A	Y
49A	9.5-11.5	Y	Y	104	30-40	A	Y
52	1.5-2.5	I	Y	105	45-60	A	Y
53A	50-60	M	Y	107	25-35	Y	Y
53B	50-60	M	Y	108	20-25	Y	Y
55	25-40	A	Y	112	35-45	A	Y
57EL1	3.5-7	Y	Y	114	30-40	A	Y
58EL1	40-50	A	Y	115	30-50	A	Y
59A	7-12	M	Y	118A	30-60	M	
62	40-50	A	Y	122A	35-45	M	Y
64A	30-39	M	Y	123	50-60	A	Y
64B	20-29	M	Y	124A	17-21	M	Y
65	13-15	Y	Y	125	1.5-3	I	Y
66	25-34	Y	Y	129	30-50	A	Y
68	45-55	Y	Y	131	40-50	A	Y
74A	35-50	M	Y	133	20-30	Y	Y
74C	17-25	M	Y	134	25-35	Y	Y
75	35-58	A	Y	137A	17-30	M	Y
76	18-25	Y	Y	137B	50-60	M	Y

Table 14-6 (continued). Final Age Classifications for the Mound C Skeletal Assemblage.

Individual Number	Age Range	Grave Class	Life Table Sample	Individual Number	Age Range	Grave Class	Life Table Sample
141	35-45	A	Y	267A	0-17	M	
146	15-25	Y	Y	269	25-35	M	
147A	35-50	M	Y	270	0-2	I	Y
148	45-60	A	Y	272	40-50	A	Y
150	3-7	M	Y	276B	0-7	M	Y
151A	6-9	M	Y	276C	35-45	M	Y
151B	40-50	M	Y	277	35-50	A	Y
152	4-7	Y	Y	278	21-36	Y	Y
155	16-17	Y	Y	280	10-12	Y	Y
170	30-60	A		281A	4-7	M	Y
171A	11-18.5	M		281B	20-30	M	Y
207	20-35	Y	Y	281C	0-7	M	Y
208	14-18	Y	Y	282	10-12	Y	Y
209	>45	A		283	20-30	Y	Y
211A	34-52	M	Y	284	35-45	A	Y
211B	30-39	M	Y	294	35-45	A	Y
212	29-48	A	Y	297	23-44	A	Y
218A	40-50	M	Y	298	25-40	A	Y
218B	20-40	M		300	0-0.5	I	Y
219	30-50	A	Y	301	35-45	A	Y
221	30-40	A	Y	302	20-30	A	Y
222	40-50	A	Y	303	7.5-8.5	Y	Y
227	35-45	A	Y	304	10-13	Y	Y
230A	31-42	M	Y	309A	30-52	M	Y
230B	41-52	M	Y	311A	30-39	M	Y
230C	20-40	M	Y	312A	17-25	M	Y
234	40-50	A	Y	312C	30-45	M	Y
240	30-40	A	Y	317	34-43	Y	Y
242	50-60	A	Y	318	>40	A	
243	17-30	Y	Y	320	14-16	Y	Y
244	30-39	A	Y	322	17-23	Y	Y
258	30-40	A	Y	324	40-50	A	Y
261	30-40	A	Y	325	31-41	A	Y
264A	20-30	M	Y	333	2-10	Y	Y
265	5-10	Y	Y				
266A	30-40	M	Y				
266B	8-13	M	Y				

Chapter 15. Health Diagnosis

"The process of classifying disease in paleopathology
is like trying to navigate through a minefield with
aid of the sun and a Mickey Mouse watch."
- Tony Waldron (1994)

As stated earlier, health and the circumstances of death may act as vehicles for social communication. In order to be considered in this analysis, however, evidence for good and bad health needed to be quantifiably visible enough to allow statistical manipulation. While statements of community health have been made (e.g. Wesler 1997:269), these have been based on little to no data. State of health in the community is virtually unknown. An examination, engendering the identification of health interactions, their distribution across the sample, and frequency relative to other Mississippian communities evaluated health's potential for social analysis.

Approaches to Health Studies

Humans are constantly exposed to tangible and intangible forces that inhibit normal cellular function. These forces can collectively be referred to as health risks. Human genotypes produce the basic physiologies needed to overcome many environmentally selective forces. Unfortunately, they are not capable of meeting every challenge. People still manage to live far short of their potential limits. Understanding why human physiologies are incapable of attaining maximum life span defines the limits of phenotypic expression. It also identifies what aspects of the socio-biological environment tax the human phenotype.

Differences in health can be attributed to variations in phenotype and contact with environmental risk agents (Wood et al. 1992). These agents interact to interfere with the body's ability to maintain homeostasis. Forces that divert the body's energy away from normal physiological functioning are referred to as stress agents[1]. Gilbert (1985:340) notes that stress agents can be

[1] It is important to recognize that the features attributed to stress are identical to those that some scholars associate with disease (c.f., Boyd and Sheldon 1980:55). This seems to be a matter of

divided into three general types – Direct Environmental Factors; brought about when the body comes in direct, injurious contact with the stress agent; Indirect Environmental Factors; which are physiological consequences brought about by a stress agent's presence in the environment; and Psychosocial Factors. These include stresses generated from real or perceived inabilities to communicate with the social environment in a manner that allows the victim/host to obtain what they need or desire. Within each of these broad groups are a variety of different forms of stress (Table 15-1). It is important to recognize that any stimuli producing a non-homeostatic response can at some level be thought of as a potential stress agent.

Table 15-1. Stress Agents Requiring A Biological Response.

Stress Agents	Stress Agents
Hereditary	Chemical
Traumatic	Metabolic
Physical	Nutritional
Infectious	Psychological
Inflammatory	Iatrogenic
Congenital	Idopathic
Vascular	Tumerous

Source:
Sheldon H.
1988 *Boyd's Introduction to the Study of Disease*. 10th ed. Lea and Febinger, Philidelphia.

Human bodies initially respond to stress by the release of epinephrine or norepinephrine (Tortora and Angagnastakos 1978:413-414). These compounds act on various organ systems to increase energy by altering the amount of oxygen and glucose available. This initial response is followed by physiological resistance to the stress agent and concludes with the body either successfully removing the stress agent as an energy draining force, adapting body functions to the stressor's presence, or exhausting the body's capacity to withstand the stress agent (Selye 1978:37-

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perspective. Stressors are viewed as agents that cause physiological responses (or diseases) while diseases are the physiological responses brought on by stress.

38). Failure to overcome a stress agent allows the malady to continue drawing energy away from the host's other functions and introduces the opportunity for new stress agents to affect the body. Disruption of growth, loss of physiological function, decreased work capacity, lowered fertility, disruption of the socio-economic structure and death are often the ultimate result of unbridled stress responses (Goodman 1991:32).

Good health can be defined as the physiological state where the effects of stress agents have been minimized by genetic, physiological and cultural resistances within a given socio-environmental context. An adaptivist model recognizes that an individual's capacity to achieve good health is therefore constrained by the environment (Goodman 1991:31). Environmental factors that are most important to causing disease in human populations are those that either produce stress or limit the availability of resources. Responses to a stressor encompass four interactive forms: a). Cultural responses can act to remove or buffer the host's physiology from the effect of the stress agent, b). The host's body can rely on genetic adaptations to circumvent the effects of stress, c). Phenotypic plasticity enables the host's morphology to acclimate, thereby reducing a stress agent's destructive power and d). The host's body can divert energy reserves to provide immediate relief from a stress agent. The effectiveness of these responses determines how effective an individual will be at achieving or maintaining good health. The application of these concepts to skeletal populations is presented in Figure 15-1.

Health Epistemology

Identification and control over health risks have largely been the domain of epidemiological research (Robertson 1992:3). This approach focuses on testing the association between an environmental variable and the stress agent response. It has commonly been employed to learn whether these phenomena are linked in modern populations (Rockett 1999). In anthropology, epidemiology gauges the efficiency of biological and cultural adaptations in countering environmental demands (Kelley and Eisenberg 1987:89).

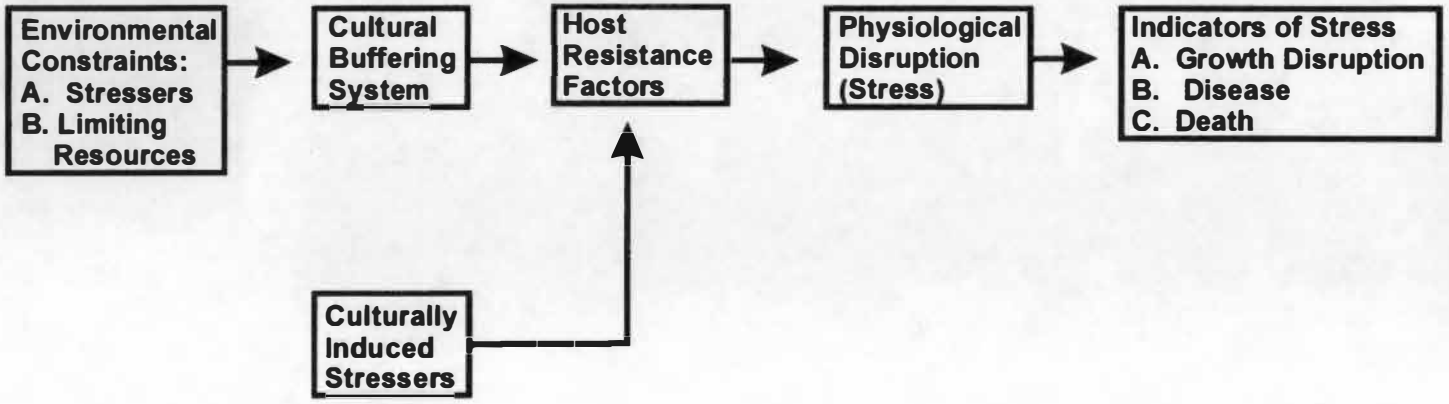


Figure 15-1. A General Model of the Relationship Between Stress, Adaptation and Health in Human Populations

Source: Goodman, A.
1991 Health, Adaptation and Maladaptation in Past Societies. In *Health in Past Societies: Biocultural Interpretations of Human Skeletal Remains in Archaeological Contexts*,edited by H. Bush and M. Zvelebil, pp.38. BAR Series No. 567. British Archaeological Reports, Oxford.

Relationships between good health and stress agents are not simply features observable in living populations, they can also be established for non-living populations. Some health risks leave a detectable impact on the human skeleton. Archaeologically recovered human remains, therefore, can be used to infer past human activity. By combining archaeological data with osteological observations, inferences can be made about the impact these behaviors had on the individual's ability to maintain homeostasis. The study of stress in skeletal populations has undergone a dramatic shift in epistemology over the last several decades. Traditional examinations have applied a clinical approach to health and disease features in bone (Buikstra and Cook 1980:439). These studies sought to specifically diagnose risk agents. Unfortunately, analysts rarely provided detailed descriptions of the observed phenomena or clearly identified the criteria used to reach a given diagnosis. As a result, the comparative capacities of these studies were extremely limited. In the 1970s and early 1980s, the issue of poorly defined diagnosis criteria was addressed by a number of analysts and pathological skeletal morphology was explicitly outlined (c.f., Hackett 1976; Ortner and Putschar 1981; Pindborg 1970; Steinbock 1976; Zimmerman and Kelley 1982). These texts emphasized the commonality and variability in skeletal responses to specific pathological agents, as well as the limitations of dry bone diagnosis and need for clear descriptions of specific skeletal stress responses.

With several notable exceptions (c.f., Hooten 1930), there was little consideration of ancient skeletal pathology as little more than a medical curiosity prior to the 1960s. Pathologies were noted and exceptional specimens occasionally subjected to intensive case study examination. Development of a grounded diagnosis criterion provided the means necessary to explore bioanthropological applications of the association between human cultural patterns and disease/stress indicators (Goodman et al. 1988:176). The study of synergistic, evolutionary relationships between disease and human cultural complexity emerged as one of the dominant perspectives in the study of human skeletal assemblages (c.f., Cohen and Armelagos 1982). These models of singular pathogen-host-environment response relationships were somewhat simplistic and unable to address human health questions from a more systematic perspective (Armelagos

1990:133). More recently, paleopathologists have realized that the multiple interactive relationships between host, pathogen and human cultural environments needed to be addressed from social, economic or even political perspectives (Goodman 1991:32).

Disease:

Health data often provide an indication of the type (and effectiveness) of health hazards located within an environmental setting as well as implicating important social and organizational variables (c.f., Goodman et al. 1982; Larson 1982; Magennis et al. 1985; Wells 1964). By identifying and comparing health hazards, the analyst strives to determine how each health risk influenced survival in an environment relative to other health hazards and other populations.

Prior to the use of antibiotics, acute respiratory infections were responsible for a significant proportion of human deaths (Boyd and Sheldon 1980:52). Very few of these agents became chronic enough to invade other organ systems and those that do not leave a mark on the skeleton (Ubelaker 1978:77). As a result, identification of the specific cause of death from most non-traumatic agents cannot be reliably accomplished. But, chronic conditions that are visible on the skeleton allow some insight into the stress factors acting to retard human health.

For unrecorded human groups, the only available indices of health are skeletal remains (Goldstein 1957:299). The methodology needed to interpret the health of a population from the skeletal record was not standardized among paleoepidemiologists. Recent work by Wood et al. (1992) noted several important discrepancies in anthropological applications of disease theory. In particular, they stated that anthropologists assumed that static, stable population structure are present; that differences in individual phenotype imparted differences in risk; and that the population for study represented only those who died and not the entire population at risk.

Some aspects of these issues are unique to anthropological populations, however, a majority of the points Wood et al. (1992) address actually apply to epidemiological data in general. By steering away from arguments relating specific disease forms to their distribution in living and in skeletal population samples, questions of good health – as represented in the skeletal assemblage – can be addressed. The health data available have many flaws and at best are only a conservative

estimate of the health status can be estimated. Rather than limiting data to the precise diagnosis of maladies and concentrating on nonlethal nonspecific skeletal responses, heterogeneity in individual resistance to specific stress agents and risk differences due to selective mortality become less important issues. In the absence of strong independent evidence of population expansion or decline, it must be assumed that the population is stable.

Trauma:

Trauma is clearly a major factor influencing population mortality and the quality of life. Violence and unintentional injury account for a considerable number of deaths in modern American populations (Centers for Disease Control 1994). As much as 30 percent of all lost person-years in modern populations under the age of 65 can be attributed to trauma (Centers for Disease Control 1993:252). This impact far outweighs the losses attributable to nontraumatic major health maladies. Traditionally, analytical approaches have emphasized the victim's inability to respond to the environment in an appropriate manner as a major source of injury (Waller 1994:664). These examinations applied the traditional epidemiological triad to the study of injury and merely substituted the role of biological agent with that of injury vehicle (See Gordon 1949:513). While this model was able to identify the agent of injury to each specific risk situation, these models were not able to define common causes among traumatic events. From a more biological perspective, this focus emphasized an individual's morphological inability to overcome natural selection events without necessarily defining these agents or vehicles. Trauma analysis imparted little more than a biological description of how morphology failed and an identification of the biological response (Lovejoy and Heiple 1981:529).

More recent applications of injury analysis focus on defining aspects of the environment, not the individual, that are responsible for causing injury (Waller 1994:665). In a modern research setting, where memory and non-durable artifacts are available, the relationships between human, environmental, and vehicle influences on energy release before, during and after the traumatic event can be outlined and analyzed as a risk reduction measure (Haddon 1972). Archaeological data rarely provides an opportunity to precisely define a traumatic event, but does allow some aspects of

injury to be discerned. These factors include the host, elements present in the physical and socio-cultural environment, the form of energy released, and sometimes, the vehicle of energy loss (Figure 15-2), (Haddon 1972; Kraus and Robertson 1992:1022). These can provide an assessment of how trauma has affected a population's ability to survive in a particular socio-biological environment.

Health in the Late Prehistoric Period

The Mississippian reliance on agriculture as a major form of subsistence and accompanying increases in sedentism served to intensify human activity within limited geographic areas. This, in turn, increased human exposure to potential health hazards that were components of the local ecology. Agricultural use of the Ohio and Mississippi River flood plains by Late Prehistoric communities increased interaction with potentially hazardous agents, such as poisonous or injurious riverine animals, disease laden insects, periodic flooding and the rough, irregular terrain. Physical contact with the soil brought the host into greater contact with hazardous organisms living in the soil, including stinging or biting insects, bacteria (staphylococococcus) and fungi (blastomyces). Greater utilization of the bottomland engendered a greater contact with the region's health risks.

Agriculture involved intensive repetitive motions that invariably impacted the human frame. Throughout the world the transition to agriculture decreased the prevalence of arthritis. In contrast, the form of crop production used by Native Americans in the Southeast actually increased joint stress (Bridges 1992:78). In particular, Goodman et al. (1982:294-295) noted increased levels of arthritis in Dickson's Mississippian populations. Males were slightly more prone to it than females. Dobbs (1988:204) found that osteophytosis severity in the vertebrae also was less among male Mississippians from the Tennessee River Valley than among Archaic males. These observations probably reflect a sexual division of labor.

Another result of agriculture was injury. Changes in the form of trauma present were noted in several populations (Donisi 1982; Lallo 1973). In general there was a decrease in the number of 'unintentional' long bone fractures as one moves from mobile to sedentary lifestyles.

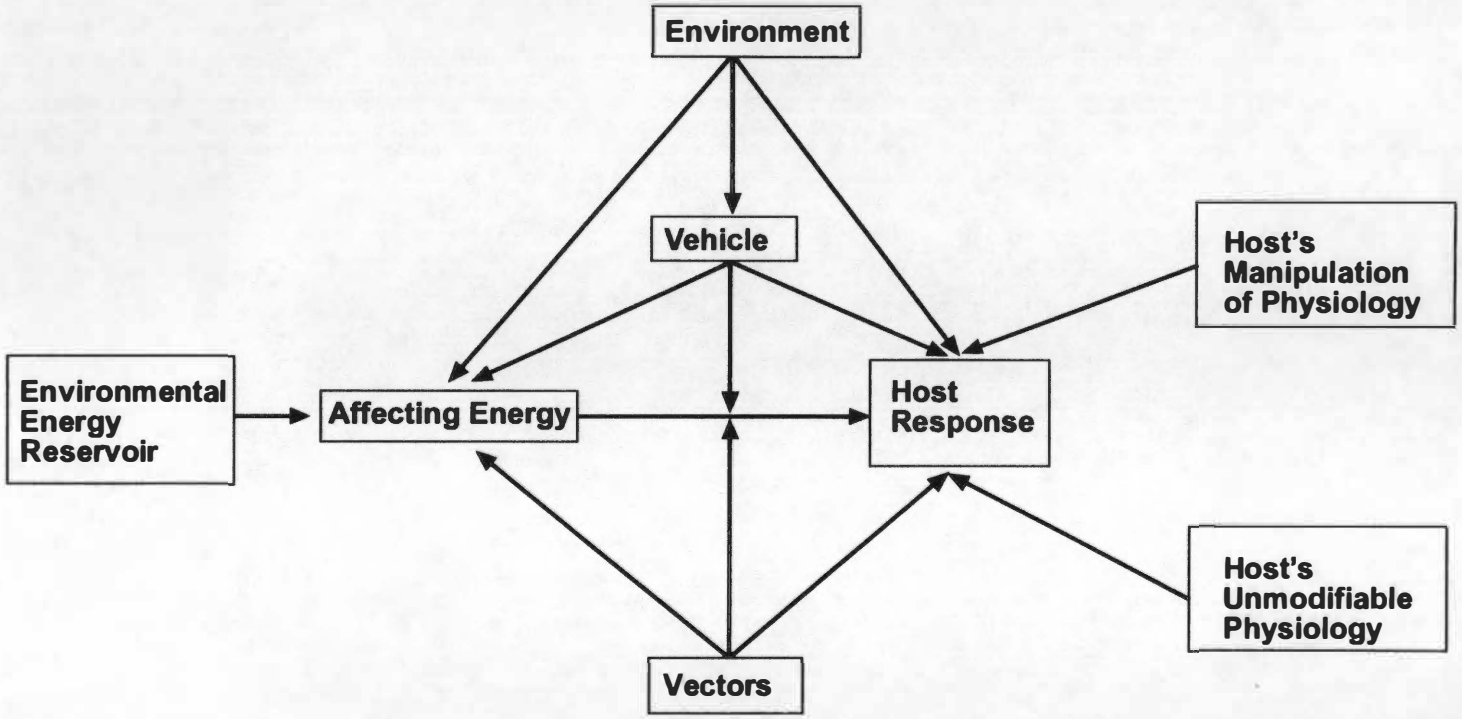


Figure 15-2. Trauma Agents and Response Model.

Source: Kraus, J.F., and L.S. Robertson
1992 Injuries and the Public Health. In Maxcy-Rosenau-Last Public Health and Preventative Medicine. 13th ed, pp.1022. Appleton and Lange, Norwalk.

Sedentism, usually accompanies intensive agriculture, it also acts to increase problems associated with refuse. The transition from a hunter-gatherer short-term use of domestic space to long-term or a permanent establishment of domestic areas entails a greater accumulation of biological and cultural waste. Trash accumulations concentrate their associated hazards and increase the opportunity for contact between host and agent. Along with injury from contact with these materials, concentrations of human waste provide an environment for propagating and spreading parasites or disease agents through the population (Armelagos 1990:129).

One of the end products of intensive agriculture is an increase in food availability. Mississippian diets were grounded on the production of maize, beans, chenopods, and the selective gathering of wild plants and animals (Edging 1991; Powell 1988:48, 55). This provided a dependable abundant food source that was obtainable at a relatively low level of energy expenditure. Crops such as maize, sunflower, and squash, all of which have been recorded at the Wickliffe Mound Group (Edging 1991; Wesler, Unpublished Data), can be stored in semi-nonperishable forms. These provide the community with a reliable source of nutrition during the winter and other periods of hardship. While this production strategy successfully reduces the hazards associated with starvation, it introduces a whole new range of risk variables. Intensive reliance on only a few food types reduces the full range of proteins and micro-nutrients. This nutritional stress lowers the energy available to overcome this and other stresses. A cycle of nutritional and disease stress interactions often results in permanent (and consequently mortal) damage to the individual's homeostatic state (Scrimshaw 1975). Vestiges of the relationship between high maize consumption and reduced good health are visible in several skeletal assemblages (El Najjar 1977; Lallo 1973). Intensive maize agriculture can be attributed to developmental deficiencies resulting in anemias and has been linked to increased frequencies of infectious lesions (El Najjar et al. 1976; Lallo 1977).

Nutrition also has the ability to affect health by more direct introduction of pathogenic hazards. Maize contains high concentrations of fructose and sucrose that promote the growth of lactobacillus and streptococcus bacteria in the oral cavity (Hillson 1996:269-279). Combined with a pattern of naive dental hygiene, caries rates are considerably higher among agriculturalists than non-

agriculturalists; even in the same environments (Cook 1979; Larson 1983). Increases in caries enable secondary infection to develop, thereby reducing the effectiveness of mastication and introducing a new suite of health hazards to the individual.

Psychosocial stress can be implicated in the human remains from several skeletal assemblages. Differences in status appear to have affected exposure to stress agents. Higher status individuals appear to have been better nourished, spatially displaced from major accumulations of debris, and some were less exposed to the rigors of intensive agriculture. At Moundville, Powell (1988:193-198) was able to demonstrate that status affected the frequency of periostitic and tubercular lesions. Similar variations in social status correlate with differences in infectious and non-infectious conditions recorded in cemeteries at Etowah (Blakeley 1980). Increases in Mississippian status did not necessarily mean that one was exposed to fewer maladies, only that the risks were considerably different.

Status appears to have been a factor affecting exposure to violent injury. Lahren and Berryman's (1984) examination of fracture patterns at Chuckalissa noted more fractures among high status males than found in females or low status individuals. Even the simple presence of a high status individual in one's environment may also have served as a health risk. Examinations of Mound 72 at Cahokia documented the presence of over 50 individuals who were dispatched and interred with a single high status individual (Fowler 1991). Safety could not be expected within the shadows of high ranking Mississippians.

Despite the romantic image of peaceful agriculturalists, evidence suggests that social relations were not always friendly. There are numerous accounts of violent injury among interments recovered from the Central Mississippi River Valley (c.f., Lane 1993; Powell 1988; Milner and Smith 1990). Obvious evidence of violent injury, such as projectile point intrusion, indicates that humans were clearly the vehicles of health risk (Black 1979:64; Morse 1969:117). In other situations, distinguishing whether injuries, such as scalping and mutilation, occurred prior to or after death is not known, but these injuries are clear indications that social relations had degenerated to a less than civil form (Lane 1993; Milner and Smith 1990; Snow 1941).

Approaches to Health Screening

Valid Health Data

Determination of health in a population is inherently linked with the ability to detect a health hazard's effect on the host. In this respect diagnosing health from a skeletal assemblage is no different than among living populations. In both, population health is based on the application of a screening procedure. The presence and frequency of diagnostic signs that indicate ill health are recorded within the test group and health is judged relative to these findings. The goal or 'gold standard' for health screening is to divide the test population into discrete groups representing truly healthy and unhealthy people (Fletcher and Wagner 1996:45). This standard, however, is not always attainable. Limitations in a diagnosing criterion's ability to differentiate healthy from unhealthy individuals frequently lead to errors in health classification. The validity of health assessments, therefore, is grounded on the amount of error in the screening procedure. This error can be reduced by ensuring that the procedures used to define health conditions reliably discriminate healthy and unhealthy people and that the same criteria are used to judge each subject's state of health.

Error can also be introduced by misunderstanding what the collected information is capable of inferring. Recognizing inherent weaknesses in epidemiological data can lessen potential sources of interpretive error, particularly when applied to skeletal assemblages. There are three weaknesses in health data.

1). Lack of information about the unafflicted population. Good health cannot be demonstrated. Currently, there are no objective methods that determine whether a living individual is in good health – there are only tests that identify stress responses. Good health, therefore is defined by a lack of evidence for disease[2]. This definition is valid only in terms of the

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[2] Good health is not the same thing as disease-free. Disease free defines a condition where there are no risk agents affecting the victim. This environmental state does not exist outside of a few laboratory settings. Good health recognizes that within a given environment, where health risks are constantly impacting the victim, homeostasis is maintained and tissue loss is minimized. It is possible for individuals to be impacted by stress agents (such as parasites or skin irritations) and still be in good health for a given environment.

screening method applied to a population. The state of a subject being universally 'unafflicted' by health risks is assumed. This is a particularly disturbing problem for paleoepidemiology. Wood et al. (1992:344) note that mortuary assemblages are a biased sample of the original living population. These assemblages contain individuals whose health was compromised by some risk agent. Even if a 'good health test' could be devised that was applicable to skeletal materials, the samples available could not be validly tested with it.

The epidemiological emphasis on determining biological responses to disease has resulted in a poor understanding of those features associated with individuals who lack a particular malady (Fletcher and Wagner 1996:46). The situation is no better in paleoepidemiology. While correlations are commonly made between a particular health hazard and a socio-environmental feature, there have been no examinations of the association between these features and populations without the targeted health hazard. As a result, nothing is actually known about what constitutes a healthy skeletal population and even less about Mississippians with good health. 'Good health' can only be assumed.

2). Lack of information about who is represented in the 'negative test' sample.

Very few hazard agents actually target the human skeleton. Bone represents one of several tissues designed to respond as a unit to defend, nutrify and mechanically support the body (Junqueira et al. 1989:91). Since bone serves as a storage and structural mainstay, defense against biological and mechanical hazards initially falls on the structure surrounding it. Osseous tissue is not normally exposed to external environmental stimuli. Hazard agents must reach bone by passage through these other tissues (Aergerter and Kirkpatrick 1975:251). Representations of health conditions in bone are usually the result of inabilities in the surrounding tissues to withstand or control the invading hazard. When a hazard precipitates an osteological response, there can be little doubt that a stress agent has affected the host's homeostatic balance. It, therefore, must be recognized that skeletal lesions are relatively sensitive responses to physiologically demanding stress agents. These manifestations can be found in subjects who are represented in the sample and can be used as a positive indication of a stress agent's presence.

But, this does not represent all the disease that is present in the original community. The sample of information available concerning physiological stress is limited only to those agents that leave some indication of their presence in bone. In short, a stressor must act on the body long enough for it to effectively alter some aspect of skeletal tissue -- most virulent stressors do not follow this pattern (Zinvanovic 1982:221). Skeletal data, therefore, lacks specificity. Most health risks do not entail a skeletal response. As Cadien et al. (1974) have pointed out, skeletal populations do not equate to living biological populations. The availability of information is limited to that preserved in the skeletal record. This is an error that cannot be corrected. At best it must be recognized that the skeletal data in Mound C can provide only a conservative approximation for the living population's true health status.

3). Lack of objective standards for disease diagnosis. Histologically, stress triggers skeletal tissues to respond by the deposition of matrix by osteoblastic cells and osteoclastic resorption of damaged or stressed tissues (Ortner and Putschar 1981:38-39). While knowledge of past human physiology is limited, Wood (1979:39) has argued that human responses to stress have not changed drastically for several thousand years. Lacking the ability to verify this, analysts studying health in skeletal populations rely on observational analogy as a source of health diagnosis (Putschar 1966:57). Bone does not differentiate between hazards. Rather, it provides a generalized response to many stimuli, including both disease and trauma (Frost 1963:42). Discrete skeletal responses to risk agents cannot always be differentiated from one another. Infections, trauma and normal biological variation can possess similar morphologies. This means that variations in biological response to a risk agent can result in misclassification. The possibility of falsely associating a given lesion with a specific hazard agent can be rather high. The impact these problems have on the validity of health assessments can be reduced substantially by grounding the health screening methodology on well-documented observation features.

4). Lack of Control Over Observation Sites. Observation sites are defined as the anatomical place or physiological system where health features are located. Technically, these sites should be pinpointed to a three dimensional location on a subject. In an empirical sense, only the

presence of a health feature at each coordinate (or aspects of a system) could then be validly compared. The problem with this approach is that for any single individual, the number of potential observation sites is limited only by the analyst's ability to accurately measure a particular location. For practical purposes, observation sites are collapsed into larger units that are common to all subjects in the sample population. Observation sites are usually tabulated and quantified in terms of the number of subjects exhibiting or not exhibiting a given health response.

In living population studies, health analyses typically use the individual as both the unit of observation and unit of measure. While specific aspects of an individual's anatomy may be examined, subjects are more or less whole individuals and missing observation sites are rare occurrences. Unlike living individuals, skeletons are composed of independent elements and there is no guarantee that all observation sites are present. In many mortuary assemblages, skeletons are often incomplete, so the number of individuals rarely equals the number of observations. To further complicate the issue, it should be recognized that skeletal elements themselves are often incomplete representations. If more than one observation site is scored for each individual in a skeletal assemblage, the number of individuals represented is generally greater than the number of observation sites scored. This incongruity means that diagnoses cannot be based on the same set of features if all subjects of a study are to be included. This is a particularly profound problem when the data is subjected to statistical manipulation. One answer is to limit the analysis to only those subjects with a full complement of observations. This solution drastically reduces sample sizes and ignores considerable amounts of potentially meaningful health information.

To overcome aspects of this problem, some analysts have opted to score only complete skeletal elements (c.f. Jurmain 1991; Lovejoy and Heiple 1981; Milner and Smith 1990:133-134). This method, however, does not take full advantage of the data available. In skeletal assemblages such as that from Mound C, where as much as 80% of a given skeletal element sample is incompletely represented. It cannot be realistically expected that this method would provide meaningful information. Zimmerman and Kelley (1982:204) have recommended scoring and tabulation by the number of sites observed. Among assemblages containing large quantities of

fragmented bone, observation sites can be defined as portions of skeletal elements. This method has seen little use because it tends to constrain health data interpretations to small portions of bone.

The method is able to take advantage of all the data available in a population regardless of where its original provenience may have been and not eliminate observation sites on the basis of preservation in other aspects of the bone. When quantitatively approached, controlling for portions of a skeletal element observed ensures that missing data do not confound 'healthy' and 'unhealthy' observation frequencies. Since bone portion observation sites are components of individuals, it is possible to validly use individuals or observation sites as the unit of measure.

A Health Registry

As represented in a skeletal assemblage, the true state of a living population's health represented in a skeletal assemblage is usually unknown, largely because the true range of potential health risks cannot be determined from skeletal tissue alone. Features recorded in the osseous tissues during life, however, can be used to identify some of the risk agents responsible for ill health. Without making a priori assumptions about exposures to past hazards, it is first necessary to identify what hazards impacted on the living population.

Screening skeletal materials can identify cases where skeletal tissue morphology has deviated away from a homeostatic balance, but cannot by itself identify the risk agent. Defining the potential causes for an ailment are determined through diagnosing the morphology (Waldron 1994:29).

Achieving accurate classification requires a detailed screening of complete or near-complete skeletons. In less than perfect specimens or where only certain elements are screened, the ability to accurately identify risk agents is heavily dependent on the materials observed. Health responses frequently follow distinctive patterns of involvement across the skeletal system and these patterns can be used to infer the presence of specific risk agents in the environment. In many cases, diagnosis is largely dependent on correlating health responses with skeletal localities that risk agents are likely to target (Bergener and Kormano 1987:35; Zimmerman and Kelley 1982:107). Many diseases possess more than one form of transmission and, as a result, there are often multiple

interactions with the host (Deitz 1995:6-7). Other complicating factors include changes in targeted tissue systems and introduction of tertiary agents to an infected tissue site. Once diagnoses are completed, stress data are frequently organized into a health registry. These registries are not designed to identify all agents acting on the living population, only those leaving a trace on the observed tissues.

Health Data Collection

One of the most limiting factors in skeletal analysis has been a lack of standardized methodologies, particularly in terms of how data are collected (Buikstra and Ubelaker 1994:2-3). Unlike the data produced by modern population epidemiologists there are no reporting agencies to ensure that data collection is uniform among all reporters. Comparable data can sometimes be gained from secondary sources. Use of these materials means accepting that the skeletal morphology was not necessarily judged by the same criteria by each analyst. The levels of detail provided frequently limit these data. Often clearly fragmentary remains have been detailed pathologically without reference to total proportions of material present or exactly what portion of the sample was statistically manipulated (c.f., Black 1979; Eisenberg 1986:76, 231; Lane 1993:44). A more desirable means of obtaining health data is to draw it directly from skeletal assemblages. The resulting data will be analytically consistent with the analyst's perception and thus comparable between populations.

The choice of skeletal materials to screen for health response was largely based on preservation issues in the Mound C assemblage. Skeletal elements that were the most complete, best provenienced, least affected by taphonomic agents, most numerous and sensitive to a variety of health risks were the long bones. Health conditions on left and right aspects of the humeri, radii, ulnae, femora, tibiae, and fibulae served to define good from ill health.

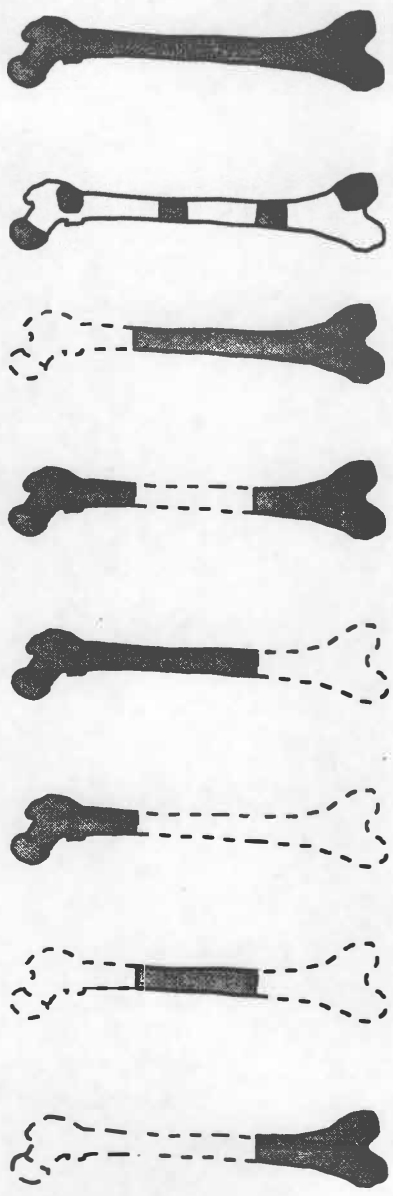
Observation sites were defined in terms of bone thirds. All elements containing a complete third (proximal, central or distal) were included in this sample. A nine-stage classification of each skeletal element was used to score all observation sites and then for those containing a health response (Figure 15-3).

Following Jurmain (1991:241), classification of health conditions was based on macroscopic and radiographic observations (when possible). Potential indicators of skeletal tissue stress were defined as morphological variations that fell outside the range of normal human variation and could not be accounted for by mortuary behavior or taphonomic processes. A battery of macroscopic observations, as outlined in Table 15-2, recorded the presence of osteological responses to stress by the specific location on afflicted skeletal elements. Data on whether the response was active or in remission at the time of death, severity, degree of localization and a brief description of each observed feature were also included. When possible, this information was modified to fit the standards outlined in Buikstra and Ubelaker (1994)[3].

Putschar (1966:56) and Roberts (1991:235) have argued that identification of trauma and other pathological conditions in skeletal materials must include radiographic data of the skeletal architecture. All skeletal elements from Mound C suspected of possessing pathological features were radiographed at the University of Tennessee's Student Health Clinic. A Litton J-300 'Jupiter 300' X-ray machine was employed to expose Kodak radiographic film. All skeletal images were examined for signs of internal reorganization.

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[3] Much of the Mound C data used was collected prior to circulation of this publication and these skeletal materials are no longer available for re-examination.



Score	Range of Completion
1	Complete
2	Fragmentary
3	Distal 2/3 Present
4	Proximal and Distal 1/3 Present
5	Proximal 2/3 Present
6	Proximal 1/3 Present
7	Shaft Present
8	Distal 1/3 Present

Figure 15-3. Skeletal Element Scoring Procedure.

Table 15-2. Health Observation Battery Used to Evaluate the Mound C Skeletal Collection.

Observation	Definition
Osteolysis	See General Bone Responses (This Chapter).
Density Loss	See General Bone Responses (This Chapter).
Bowing	See General Bone Responses (This Chapter).
Cortical Thinning	See General Bone Responses (This Chapter).
Injury	See General Bone Responses (This Chapter).
Degeneration	See General Bone Responses (This Chapter).
Density Increase	See General Bone Responses (This Chapter).
Cortical Volume Increase	See General Bone Responses (This Chapter).
Medullay Volume Increase	See General Bone Responses (This Chapter).
Ossification of Connective Tissue	See General Bone Responses (This Chapter).
Cartilage Ossification	See General Bone Responses (This Chapter).
Severity:	
Slight (SL)	Health response affects less than 10% of the observation site. Condition is detectable only on close observation. Each response is judged to have engendered only minor biological impairment.
Moderate (M)	Health response affects 10-50% of the observation site. Condition is immediately detectable by the presence of large readily identifiable features. Mechanical and/or metabolic activities in the bone would have been impaired.
Severe (SEV)	Health response affects more than 50% of the observation site. Health responses have deformed the bone and there are indications of major systemic compromise. Stress agents have reduced the bone to a dysfunctional state.
Distribution:	
Localized (L)	Health responses are limited to singular or isolated occurrences.
Widespread	Reactions to stress form a network of responses across the observation site.

Health Registry Results:

Skeletal preservation, historic and prehistoric disturbances have left the Mound C's skeletal assemblage ill-suited to address many quality of health questions. However, by abandoning the more conventional 'whole skeleton' approaches to paleopathology and applying a more epidemiological screening method, some approximation of the community's state of health can be gained.

It is important to recognize that the data obtained by screening and whole skeleton examinations are not easily comparable. Data derived from examining the whole skeleton encompasses all potential skeletal responses to health. This approach treats the individual as the unit of study. Screened data is limited to health responses found only in the targeted observation sites. Risk agents that do not target these observation sites cannot be detected. Comparison between approaches can only be accomplished when risk agents affect complementary remains in both examinations. In the screened approach, the observation site and the individual can both be manipulated as study units. When individuals are used, the same structural features found in the whole-skeleton approach influence health distribution. Additionally, the taphonomic structure of skeletal assemblages can influence how the sample's health responses are distributed. When working with screened data, it is imperative to have some basic understanding of the distribution of skeletal observation sites.

Sample Structure

The Mound C screened data were drawn from a sample of 894 long bones, representing no less than 252 individuals (Table 15-3). The 1577 observational sites were proportionately represented for most elements and bilateral representations were subsequently pooled for further exploration. A Chi-Square Test for Homogeneity was employed to determine if these elements were distributed equally. The mean number of limbs (149) was compared to each limb frequency total. The resulting Chi Value of 43.570 ($P=<0.001$) indicated a substantial divergence from parity. Large skeletal elements, principally the femora and tibiae, were observed to be more numerous in the

Table 15-3: Screened Long Bone Summary Statistics and Test Results.

	Limb			Observation Site					Degrees of	
	Left	Right	Total	Proximal Third	Central Third	Distal Third	Mean	Chi Value	Freedom	P Value
Humerus	78	76	154	55	131	76	87	22.487	2	<0.001
Radius	43	51	94	36	82	47	55	9.915	2	0.007
Ulna	54	53	107	54	88	26	56	18.123	2	<0.001
Femur	115	107	222	104	201	101	135	21.882	2	<0.001
Fibula	57	63	120	37	114	52	68	22.909	2	0.001
Tibia	99	98	197	87	179	107	124	17.721	2	<0.001
Total	446	448	894	373	795	409	19 [a]	43.570 [a]	5 [a]	<0.001 [a]

Note: [a] Test with Limb Totals.

sample than smaller long bones. Among observation sites within each bone, the central shaft thirds were considerably more frequent than those from either end. A Chi-Square Test for Homogeneity was used to ascertain whether observation sites on each limb were distributed equally. Mean observation site frequencies were calculated and independent tests conducted for each limb element. Chi values for each test indicated substantial variation from equal representation. If modelled correctly, removal of the central shaft third from the sample would have produced comparable proximal and distal distributions. Proximal and distal thirds were then compared separately to learn whether they were drawn from the same distribution. Separate tests for homogeneity were conducted for each limb bone (Table 15-4). For all elements but the ulnae, chi values indicated that these samples could easily have been drawn from the same distribution. Distal ulnae were considerably under-represented. The distribution of ulnar observation sites does not appear to follow the same pattern seen in other limbs. These comparisons emphasize that observation sites from the center of all limbs were better represented than from those at either end.

The distribution and morphological features of elements in the long bone sample influence what stress agents were most likely to be detected. Structurally, the screened sample reflects thick cortical bone deposits, large medullary regions, major muscle attachment sites and large joint surfaces. These aspects of the skeleton are important for structural support, movement of the body,

Table 15-4: Test Results for Proximal and Distal Observation Sites Only.

	Observation Site					
	Proximal Third	Distal Third	Mean	Chi Value	Degrees of Freedom	P Value
Humerus	55	76	65	1.380	1	0.724
Radius	36	47	41	0.485	1	0.485
Ulna	54	26	40	4.358	1	0.036
Femur	104	101	102	0.002	1	0.960
Fibula	37	52	44	0.949	1	0.329
Tibia	87	107	97	0.837	1	0.360
Total	373	409	391	0.739	1	0.389

hematopoiesis and material storage. Stress agents affecting bones in the screened sample would be expected to target one or more of these features.

Does the sample provide evidence of stress responses? 101 distinct pathological observations were recorded on 77 individual bones; these represent no less than 44 individuals (Table 15-5). Once again bilateral element observations were very proportional. A mean limb frequency of 17 was calculated and compared with limb distributions, again using the Chi-Square Test for Homogeneity. The resulting Chi value of 37.851 (P=0.001) supported rejection of the null hypothesis that pathological observations were equally distributed across the sample. Proportionately, the pathological sample was dominated by bones from the pelvic girdle, with tibiae alone representing 43% of the entire assemblage. Bones of the lower limb, therefore were more informative about environmental stress than those of the arms. Pathological observation sites within each limb bone sample were examined to learn if they were equally distributed. Mean observation sites were calculated and compared separately for each limb. Chi values from the legs indicated that observation sites for most bones were not equally represented. Tibial and fibular midshafts, distal femora and possibly distal humeri tended to be over-represented. These sites contain large areas of cortical bone, considerable endosteal soft tissue space and large synovial joint capsules. Stress agents may have specifically targeted these morphological characteristics.

Table 15-5: Pathological Subsample Summary Statistics and Homogeneity Test Results.

	Limb			Observation Site						
	Left	Right	Total	Proximal Third	Central Third	Distal Third	Mean	Chi Value	Degrees of Freedom	P Value
Humerus	7	1	8	0	0	8	3	[a]	[a]	[a]
Radius	0	1	1	0	0	1	1	[a]	[a]	[a]
Ulna	4	4	8	6	1	1	3	2.950[a]	2 [a]	0.228 [a]
Femur	9	9	18	0	6	12	6	8.000	2	0.018
Fibula	5	10	15	0	15	0	5	15.000	2	<0.001
Tibia	23	28	51	15	35	6	19	11.963	2	0.001
Total	48	53	101	21	57	28	17 [b]	37.851	5 [b]	<0.001 [b]

Note: [a] Sample size too small to test or accept as valid.
[b] Test with Limb Totals.

General Bone Responses

Health responses were initially classified as bone loss or increase relative to the dominating form at periosteal, cortical or endosteal stress sites. Health responses were frequently specific to a tissue or bone layer. Adequate documentation of a complex response often required multiple classifications. These were scored as separate line entries. A registry of health responses was constructed (Table 15-6). Long bones were initially screened for evidence of 11 distinct health responses. However, since density loss and increase responses were not observable, quantifiable information was available for only nine responses. The histological activity and distribution of these responses in the Mound C health sample were explored as an aid towards understanding their presence in this community.

Osteolysis

Osteolytic responses were localized excavations that resulted in the loss of hard matrix. Osteolytic lesion morphology varied by the speed of excavation. Rough, poorly remodeled bone margins inferred that lesion formation was faster than osteoblastic responses (Ortner and Putschar 1981:38). Likewise well remodeled lesion edges indicated a slowed excavation. Osteoclastic and/or stress agent induced excavation areas possessed remodeled bone surfaces and thus could be differentiated from peri/post-mortem trauma that lack these features.

Table 15-6: Health Registry for Mound C Limbs.

Burial No.	Age	Sex	Element	Path Site	Response	Active	Severity	Spread	Diagnosis
100	>18	Male	Rt.Fibula	Central 1/3	Bowing	Remission	M	W	Indeterminate (Developmental?)
114	30-40	Male	Lt.Tibia	Central 1/3	Bowing	Remission	M	W	Treponematosis
51	>18	Indeterminate	Rt.Tibia	Central 1/3	Bowing	Remission	M	W	Treponematosis
100	>18	Male	Lt.Tibia	Proximal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
100	>18	Male	Rt.Tibia	Proximal & Distal 2/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
100	>18	Male	Rt.Ulna	Proximal 1/3	Cartilage Ossification	Active	M	L	Osteoarthritis
104	30-40	Male	Lt.Ulna	Distal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
123	50-60	Male	Rt.Femur	Distal 1/3	Cartilage Ossification	Active	SL	L	Osteoarthritis
123	50-60	Male	Rt.Tibia	Proximal 1/3	Cartilage Ossification	Active	SL	L	Osteoarthritis
18	50-60	Female	Lt.Femur	Distal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
18	50-60	Female	Lt.Tibia	Proximal & Distal 2/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
18	50-60	Female	Rt.Tibia	Distal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
234	40-50	Indeterminate	Rt.Femur	Distal 1/3	Cartilage Ossification	Active	M	L	Osteoarthritis
234	40-50	Indeterminate	Rt.Tibia	Proximal 1/3	Cartilage Ossification	Active	M	L	Osteoarthritis

Table 15-6 (continued): Health Registry for Mound C Limbs.

Burial No.	Age	Sex	Element	Path Site	Response	Active	Severity	Spread	Diagnosis
30	35-45	Male	Lt.Femur	Distal 1/3	Cartilage Ossification	Active	SL	L	Osteoarthritis
44A	>18	Male	Lt.Tibia	Proximal 1/3	Cartilage Ossification	Active	M	W	Osteoarthritis
44A	>18	Male	Rt.Ulna	Proximal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
53A	50-60	Indeterminate	Rt.Femur	Distal 1/3	Cartilage Ossification	Active	SL	L	Osteoarthritis
53A	50-60	Indeterminate	Rt.Tibia	Proximal 1/3	Cartilage Ossification	Active	SL	L	Osteoarthritis
59EL3	>18	Indeterminate	Lt.Ulna	Proximal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
62	40-50	Indeterminate	Lt.Tibia	Proximal 1/3	Cartilage Ossification	Active	M	W	Osteoarthritis
62	40-50	Indeterminate	Rt.Femur	Distal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
62	40-50	Indeterminate	Rt.Humerus	Distal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
62	40-50	Indeterminate	Rt.Ulna	Proximal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
79EL1	>18	Indeterminate	Lt.Tibia	Proximal 1/3	Cartilage Ossification	Active	M	L	Osteoarthritis
90	>18	Male	Lt.Femur	Distal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
90	>18	Male	Rt.Femur	Distal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
90	>18	Male	Rt.Radius	Distal 1/3	Cartilage Ossification	Active	SEV	L	Osteoarthritis

Table 15-6 (continued). Health Registry for Mound C Limbs.

Burial No.	Age	Sex	Element	Path Site	Response	Active	Severity	Spread	Diagnosis
95	30-49	Indeterminate	Lt.Ulna	Proximal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
95	30-49	Indeterminate	Rt.Ulna	Proximal 1/3	Cartilage Ossification	Active	SL	W	Osteoarthritis
96	>18	Female	Lt.Humerus	Distal 1/3	Cartilage Ossification	Active	M	W	Osteoarthritis
120A	>18	Indeterminate	Rt.Tibia	Central 1/3	Cortical Thinning	Indeterminate	SEV	W	Indeterminate (Medullary Infect?)
137A	17-30	Indeterminate	Rt.Tibia	Central 1/3	Cortical Thinning	Indeterminate	SEV	W	Indeterminate (Medullary Infect?)
71A	>18	Indeterminate	Rt.Tibia	Central 1/3	Cortical Thinning	Indeterminate	M	W	Indeterminate (Medullary Infect?)
100	>18	Male	Rt.Tibia	Central 1/3	Cortical Volume Increase	Remission	SL	W	Periostitis
170	>30	Female	Lt.Tibia	Central 1/3	Cortical Volume Increase	Active	SL	L	Periostitis
114	30-40	Male	Lt.Tibia	Central 1/3	Cortical Volume Increase	Active	M	W	Treponematosis
122A	35-45	Female	Rt.Tibia	Central 1/3	Cortical Volume Increase	Remission	SL	L	Periostitis
137A	17-30	Indeterminate	Lt.Tibia	Central 1/3	Cortical Volume Increase	Active	SEV	W	Indeterminate (Medullary Infect?)
137A	17-30	Indeterminate	Rt.Tibia	Central 1/3	Cortical Volume Increase	Remission	SEV	W	Indeterminate (Medullary Infect?)
148EL3	>18	Indeterminate	Rt.Fibula	Central 1/3	Cortical Volume Increase	Remission	M	W	Periostitis
153A	>18	Indeterminate	Rt.Tibia	Central 1/3	Cortical Volume Increase	Remission	M	W	Periostitis

Table 15-6 (continued). Health Registry for Mound C Limbs.

Burial No.	Age	Sex	Element	Path Site	Response	Active	Severity	Spread	Diagnosis
171A	11-18.5	Female	Lt.Tibia	Central 1/3	Cortical Volume Increase	Remission	SL	L	Periostitis
224A	>18	Indeterminate	Rt.Tibia	Central 1/3	Cortical Volume Increase	Active	M	L	Periostitis
225	<18	Indeterminate	Rt.Fibula	Central 1/3	Cortical Volume Increase	Active	M	W	Periostitis (Treponematosis?)
227	35-45	Male	Rt.Femur	Central 1/3	Cortical Volume Increase	Remission	M	W	Treponematosis
227	35-45	Male	Rt.Fibula	Central 1/3	Cortical Volume Increase	Active	M	W	Treponematosis
227	35-45	Male	Rt.Tibia	Central 1/3	Cortical Volume Increase	Remission	M	W	Treponematosis
30	35-45	Male	Lt.Fibula	Central 1/3	Cortical Volume Increase	Remission	M	W	Treponematosis
30	35-45	Male	Lt.Tibia	Central 1/3	Cortical Volume Increase	Remission	M	W	Treponematosis
30	35-45	Male	Rt.Fibula	Central 1/3	Cortical Volume Increase	Active	SEV	W	Treponematosis
30	35-45	Male	Rt.Tibia	Distal 1/3	Cortical Volume Increase	Remission	SL	W	Treponematosis
38	30-49	Male	Lt.Fibula	Central 1/3	Cortical Volume Increase	Remission	M	L	Periostitis
38	30-49	Male	Lt.Tibia	Central 1/3	Cortical Volume Increase	Remission	SL	L	Periostitis
47A	>18	Male	Lt.Tibia	Central 1/3	Cortical Volume Increase	Active	M	L	Periostitis
47A	>18	Male	Rt.Fibula	Central 1/3	Cortical Volume Increase	Remission	SL	L	Periostitis

Table 15-6 (continued). Health Registry for Mound C Limbs.

Burial No.	Age	Sex	Element	Path Site	Response	Active	Severity	Spread	Diagnosis
49A	9.5-11.5	Indeterminate	Lt.Fibula	Central 1/3	Cortical Volume Increase	Active	M	L	Periostitis
4A	>18	Female	Lt.Tibia	Central 1/3	Cortical Volume Increase	Remission	SL	L	Periostitis
50	>18	Indeterminate	Rt.Fibula	Central 1/3	Cortical Volume Increase	Active	M	W	Periostitis (Treponematosis?)
51	>18	Indeterminate	Lt.Tibia	Central 1/3	Cortical Volume Increase	Active	SEV	W	Osteomyeletis
51EL2	>18	Indeterminate	Rt.Fibula	Central 1/3	Cortical Volume Increase	Remission	SEV	W	Treponematosis
51EL2	>18	Indeterminate	Rt.Tibia	Central & Distal 2/3	Cortical Volume Increase	Active	SEV	W	Treponematosis
55	25-40	Female	Rt.Tibia	Central 1/3	Cortical Volume Increase	Remission	SL	L	Periostitis
71A	>18	Indeterminate	Lt.Tibia	Central 1/3	Cortical Volume Increase	Remission	M	W	Indeterminate (Medullary Infect?)
72A	>18	Indeterminate	Lt.Humerus	Distal 1/3	Cortical Volume Increase	Remission	M	W	Periostitis
90	>18	Male	Lt.Tibia	Central 1/3	Cortical Volume Increase	Active	SL	W	Periostitis
92	30-40	Male	Lt.Fibula	Central 1/3	Cortical Volume Increase	Remission	SL	W	Periostitis
123	50-60	Male	Rt.Tibia	Proximal 1/3	Degeneration	Active	SL	L	Osteoarthritis
96	>18	Female	Lt.Humerus	Distal 1/3	Degeneration	Active	M	L	Osteoarthritis

Table 15-6 (continued). Health Registry for Mound C Limbs.

Burial No.	Age	Sex	Element	Path Site	Response	Active	Severity	Spread	Diagnosis
114	30-40	Male	Lt.Tibia	Central 1/3	Enthesophyte	Remission	M	W	Activity Stress
123	50-60	Male	Rt.Tibia	Proximal 1/3	Enthesophyte	Remission	SL	L	Activity Stress
141	35-45	Indeterminate	Lt.Femur	Distal 1/3	Enthesophyte	Remission	SL	L	Activity Stress
141	35-45	Indeterminate	Lt.Humerus	Distal 1/3	Enthesophyte	Remission	M	W	Activity Stress
148	45-60	Male	Lt.Femur	Central 1/3	Enthesophyte	Remission	M	L	Activity Stress
149	>18	Female	Lt.Femur	Central 1/3	Enthesophyte	Remission	M	W	Activity Stress
224A	>18	Indeterminate	Rt.Tibia	Proximal & Central 2/3	Enthesophyte	Remission	M	W	Activity Stress
226EL2	>18	Indeterminate	Lt.Ulna	Central 1/3	Enthesophyte	Remission	M	L	Activity Stress
234	40-50	Indeterminate	Rt.Tibia	Proximal 1/3	Enthesophyte	Remission	M	L	Activity Stress
45A	35-45	Male	Rt.Femur	Central 1/3	Enthesophyte	Remission	M	L	Activity Stress
71A	>18	Indeterminate	Rt.Femur	Central 1/3	Enthesophyte	Remission	M	W	Activity Stress
72A	>18	Indeterminate	Lt.Humerus	Distal 1/3	Enthesophyte	Remission	M	W	Activity Stress
234	40-50	Indeterminate	Rt.Femur	Distal 1/3	Medullary Increase	Indetermin-ate	M	L	Indeterminate (Medullary Infect?)
30	35-45	Male	Lt.Tibia	Central 1/3	Medullary Increase	Indetermin-ate	M	W	Treponematosis

Table 15-6 (continued). Health Registry for Mound C Limbs.

Burial No.	Age	Sex	Element	Path Site	Response	Active	Severity	Spread	Diagnosis
50	>18	Indeterminate	Rt.Fibula	Central 1/3	Medullary Increase	Indeterminate	M	W	Periostitis (Treponematosis?)
51	>18	Indeterminate	Lt.Tibia	Central 1/3	Medullary Increase	Active	SEV	W	Osteomyeletis
51EL2	>18	Indeterminate	Rt.Fibula	Central 1/3	Medullary Increase	Indeterminate	SEV	W	Treponematosis
51EL2	>18	Indeterminate	Rt.Tibia	Central & Distal 2/3	Medullary Increase	Indeterminate	SEV	W	Treponematosis
71A	>18	Indeterminate	Lt.Femur	Central 1/3	Medullary Increase	Indeterminate	M	L	Indeterminate (Medullary Infect?)
71A	>18	Indeterminate	Lt.Tibia	Central 1/3	Medullary Increase	Indeterminate	M	W	Indeterminate (Medullary Infect?)
224A	>18	Indeterminate	Rt.Tibia	Proximal 1/3	Osteolysis	Remission	M	L	Tumor
227EL1	>18	Indeterminate	Lt.Humerus	Distal 1/3	Osteolysis	Remission	M	L	Indeterminate (Lytic Lesion?)
234	40-50	Indeterminate	Lt.Femur	Distal 1/3	Osteolysis	Remission	M	L	Osteoarthritis
234	40-50	Indeterminate	Rt.Tibia	Proximal 1/3	Osteolysis	Remission	M	L	Osteoarthritis
89	20-24	Female	Lt.Femur	Distal 1/3	Osteolysis	Active	M	L	Mechanical Failure

Table 15-6 (continued). Health Registry for Mound C Limbs.

Burial No.	Age	Sex	Element	Path Site	Response	Active	Severity	Spread	Diagnosis
141	35-45	Indeterminate	Lt.Fibula	Central 1/3	Injury	Remission	M	L	Mechanical Failure
120A	>18	Indeterminate	Rt.Tibia	Central 1/3	Medullary Increase	Indeterminate	SEV	W	Indeterminate (Medullary Infect?)
137A	17-30	Indeterminate	Lt.Tibia	Central 1/3	Medullary Increase	Indeterminate	SEV	W	Indeterminate (Medullary Infect?)
137A	17-30	Indeterminate	Rt.Tibia	Central 1/3	Medullary Increase	Indeterminate	SEV	W	Indeterminate (Medullary Infect?)
137B	50-60	Male	Lt.Tibia	Central 1/3	Medullary Increase	Indeterminate	M	L	Indeterminate (Medullary Infect?)
96	>18	Female	Lt.Humerus	Distal 1/3	Osteolysis	Remission	M	W	Osteoarthritis

Osteolytic activity was observed in six adult bones. With the exception of Burial 89's left femur, all lesions were heavily remodeled, indicating a very slow, if not inactive health response.

Density Loss

Density loss is identified as the removal of extra-cellular matrix within the cortical or trabecular structure. This phenomenon is a normal homeostatic function. Usually this osteoblastic activity is balanced by osteoblastic deposition. Left unchecked, however, osteoblastic removal can lead to osteoporosis. Radiographically, density loss is best identified by a distinct decrease in cortical radio-opaqueness and trabecular rarification. In extreme cases, density loss can be detected by unusually light weight among affected bones. Taphonomic conditions, including earth pressure and leeching, tended to shatter thinned bone, precluding accurate scoring of density loss responses in the Mound C assemblage.

Bowing

Bowing is defined as abnormal bone curvature. It can emerge from three distinct phenomena. True bowing occurs when mechanical forces are greater than the bone's structural integrity and the bone bends from constant pressure. Bowing of this nature tends towards the weakest structural plane (Jaffe 1972:393). Among the legs, medio-lateral deformation is the most common (Mann and Murphy 1990:122-123). This condition is usually associated with nutritional or metabolic disorders (Jaffe 1972; Ortner and Putschar 1981; Rathbun 1948). Developmental bowing occurs when the growth of one bone is hindered by its attachment to others (Jaffe 1972:921). Differences in growth speeds are accommodated by allowing growth (hence bowing) to occur in the plane experiencing the greatest amount of cell activity. Pseudobowing is a condition where accelerated bone deposition on one surface (usually the anterior) accentuates the bone's curvature (Jaffe 1972:937; Webb 1994:157). Bones with this condition frequently appear to be bowed anteriorly and flattened medio-laterally (Mann and Murphy 1990:116). In actuality, posterior and medio-lateral dimensions are often unaffected. Developmental bowing and pseudobowing occur together to form sabered tibiae (Hackett 1976:420; Rogers and Waldron 1989:619). While probably

representing two distinct responses, sabering is generally considered to be a single syndrome. Only three cases of bowing were observed in elements from the lower legs. None of these responses appeared active at the time of death.

Cortical Thinning

Identified either along broken margins or in radiographs, the osteoclastic removal of cortical tissue resulted in a thinned cortical surface. Cases did not display a change in radio-opacity. Cortical thinning was observed in three right adult tibiae. All conditions were noted in the midshaft. Surface remodeling and increased cancellous bone formation on the endosteal surfaces suggested that these responses might be affiliated with other health responses. It was unclear whether these conditions were active at the time of death.

Degeneration

Degeneration is principally a feature of teeth and articular surfaces. This loss is primarily associated with contact surfaces between hard tissue and other mediums. Bone and enamel are gradually removed leaving a rubbed or polished surface. If loss is greater than replacement, joints frequently develop ebumated surfaces. These features are indicative that cartilage and other joint capsule components have deteriorated (Bullough 1998:8.8.3-8.8.4). Erosion on many joint surfaces precluded accurately identifying articular joint porosity, another result of gradual breakdown in the joint capsule. A moderate degree of ebumation is present in one adult distal humerus and a right proximal tibia. Both conditions were active at the host's death.

Injury

Merbs (1989:160) identifies injuries as the result of any traumatic encounter with an environmental hazard. Injuries are characterized as health response to an agent whose impact on the skeleton is acute, if not instantaneous, and whose objective is not to secure energy or nutrition from bone and soft tissues. Skeletal responses often entail losses and increases of connective tissue. Injuries are frequently grouped by the type of damage they leave on the skeleton.

Bones shatter when strained beyond their tensile strength. They may be broken before or after archaeological deposition. Conical or spiraling fractures are diagnostic indications of peri-

mortem injury (Villa and Mahieu 1991). These differ significantly from the flat, linear fractures common in archaeologically broken bone (Villa and Mahieu 1991). These latter forms are not scored as an injury.

Perimortem fractures imply that injury was a factor contributing the host's death. Broken bones frequently exhibit biological responses, including woven, lamellar, and compensatory remodeled cortical deposits. Well-healed fractures are identifiable by abrupt changes in bone angle and resorption of the fractured margins. Pseudo-arthroses are also indications of past skeletal trauma. A single well-healed fracture was observed in the midshaft of an adult left fibula.

Injury to the skeleton was not limited to fractures. Skeletal tissue may also be damaged by laceration, punctures, chemical and thermal damage. These may be evidenced by cut or chop marks, embedded objects, projectile pathways, and burned or dissolved bone. Health responses to each of these damages are similar to those for fractures. The passage of uncontrolled energy through a joint can result in dislocation of the bones. Joint injuries were detected by atrophy of existing joint structures and the formation of new articular surfaces and changes in articular surface orientation. There were no observations of these injuries noted in the health sample.

Large irregular nodules of connective tissue ossification (Myositis Ossificans traumatica) at muscle attachment sites are indicative that the connective tissue tore away from the point of insertion (Zimmerman and Kelley 1982:49). These exostoses were also not observed in the Mound C health sample.

Density Increase

Augmentation of bone density within the existing tissue matrix is usually the result of abnormal osteoblastic mineralization processes. Sometimes weight and radio-opacity differences can identify this condition, but these responses are more precisely detected through chemistry and ionizing techniques (See Willey et al. 1997). Mound C's soil and taphonomic condition preclude detailing density increases without using destructive methods. Density was not scored for the Mound C health assemblage.

Cortical Volume Increase

Any expansion of surface volume from the deposition of additional bone on the exterior surface was scored as a cortical bone volume increase. Much of this activity can be attributed to osteoblasts located in the periosteum's cambial layer (McLean and Urist 1968:12). Health responses were differentiated from normal cellular activity by the distinct patchy development of woven or lamellar bone on the original bone's surface. Woven bone and porous lamellar surfaces are indicative that the condition was active at the time of death, while uninterrupted sheets of sclerotic or lamellar bone infer an inactive or chronic skeletal response (Janssens 1970:72; Steinbock 1976:115).

There are 33 cases of cortical volume increase in the sample. With the exception of a single distal humerus, these responses are confined to the leg bones. Most cortical responses (61%) were among the tibiae. Active skeletal responses were noted in 13 cases, with the remaining 20 exhibiting lamellar deposits, possibly indicating recovery from the malady. Moderate to slight activity was noted in all but six bones.

Medullary Volume Increase

In contrast, volume increases as a result of swelling within the bone were identified as medullary cavity volume responses. If medullary volume increases are gradual, cortical bone remodeling enables expansion without irritation of the periosteal membrane. This can result in a swollen bone with an otherwise unremarkable cortical surface. Medullary cysts are defined radiographically by pockets surrounded by sclerotic bone. Rapid increases in medullary volume can result in cortical necrosis and ultimately the development of sequestra. Pressure release can also be accomplished by cloaca or drainage channels from the medullary cavity to the bone's surface. These responses are diagnostic of inflammation by an organic stress agent.

A total of 13 cases representing nine individuals were observed. All cases were from adult leg bones. Swelling of the tibiae dominated the assemblage (70%) with the remaining 30% equally distributed between femora and fibulae. Only one active case could be positively identified. No evidence for medullary cysts could be verified.

Ossification of Connective Tissue (Enthesophytes or Enthesopathies)

Ossification of tendons or ligaments at sites of attachment is included in this category. These are skeletal responses to chronic tension at connective tissue attachment sites (Rehoy et al. 1998:6.13.2). The morphology of enthesophyte growth reflects the recency of the demand. Jagged, irregular projections indicate accelerated growth triggered to alleviate an immediate environmental pressure, while smooth edged 'pillowy' projections infer a more fulfilled environmental demand and opportunity for remodeled growth. Enthesophytes tend to be thinner, more irregular and project away from the bone than normal tubercles.

Enthesophyte development was identified in 12 skeletal elements, with most (75%) being from the lower legs. All observations exhibited remodeled lamellar bone, suggesting that the response was inactive by the time death occurred.

Cartilage Ossification

Cartilage ossification refers to irregular osseous growths or lips in or around articular surfaces. These are ultimately the result of minor irritation in cartilaginous portions of the joint capsule (Ubelaker 1978:78-79). Cartilage ossification is categorized by lipping along articular margins and osteophytosis of the joint surface. Lipping is an osseous replacement of cartilage extensions out from the sides of a joint. Both cartilaginous and osseous lips are physiological efforts to relieve joint pressure (Bourke 1967:354; Johnson 1959:229-230; Sokoloff and Hough 1985:383). These conditions frequently reduce joint movement. Osteophytes are recognized as raised protrusions or 'bumps' in the articular surface. They represent a localized replacement of avascular cartilage for vascularized bone (Johnson 1959:1227). This condition occurs when cartilage can no longer nutrify itself through diffusion. The size, shape, and position of a given articular surface osteophyte depend on the degree of instability in the joint capsule (Bullough 1998:8.8.6). No occurrences of osteophytes were noted in the Mound C health sample.

Osseous deposition along the margins of articular surfaces was noted in 28 cases. Nearly all remains exhibited slight to moderate lipping. They were all considered active at the time of death.

Health Risk Diagnosis

The simplistic responses of bone to a particular agent limit the number of morphological variations possible. One unfortunate result of this phenomenon is that very few responses can be attributed to a specific health risk. To further complicate issues, a given agent may not affect all target sites in the same manner. Diagnosis of specific medical conditions, as a means of identifying health agents in the Mound C assemblage, was accomplished by reviewing all health responses listed in a health registry for each individual and correlating these with known health response distributions. When possible, responses were pooled into sets and assigned to potential risk agents that could have been responsible for all responses. Only 84% of the 101 responses could be assigned to probable agents. These conditions were explored to illustrate how these agents affected the host and the Mound C community.

Periostitis

Technically, periostitis is a descriptive term that refers to any nonspecific inflammation of the bone (Ortner and Putschar 1981:137). Following Mann and Murphy (1990:109), its use here has been limited to inflammation of the exterior surfaces only. Periostitis results from irritation of the bone's periosteal membrane. This tissue primarily acts as a barrier, helping to protect the bone's material stores from biological agents (Peacock and Van Winkle 1976:578; Sigerist 1962:49). It also helps insulate the hard structure from mechanical stress. Irritation of the periosteum triggers migration of osteogenic cells to the stress site where they proliferate, transform into osteoblastic cells, and secrete collagen, all in an attempt to isolate the irritating agent within bone matrix. The results are sheet-like deposits of fibrous or lamellar bone on the affected bone's surface.

Periostitic responses result from two distinct sorts of stress - infectious and mechanical agents. Since bone is not normally exposed to the external environment, pyrogenic bacteria generally reach the periosteum by either the vascular or lymphatic systems (Aergerter and Kirkpatrick 1975:251). The transition from soft to hard tissue on the bone's surface inhibits circulation, providing excellent places for biological agents to accumulate and grow (Eisenberg 1986:91). Since tissue irritation is a function of where an agent is carried by the vascular system,

these types of periosteal infection can occur anywhere on a bone's surface (Gehweiler et al. 1970:500-501). Steinbock (1976:115) notes that periosteum covering the tibiae, fibulae, clavicles, radii and ulnae are extremely vulnerable to these types of infection.

Infection can also set in from the surface. Skin ulcerations can allow infectious agents to 'seep' through the tissue and come in contact with the periosteum (Aergerter and Kirkpatrick 1975:251). Skin ulcers and psoriasis represent two agents associated with surface originating periosteal infections (Brown and Middlemiss 1956:213; Goupille et al. 1996:1553).

Periostitis can also be caused by injury. This results when physical stress, such as blunt force or mechanical strain, is passed through the overlaying tissues to the periosteum. Frequently the periosteum may become dislodged from the bone. Bones lacking thick layers of insulating muscle tissue are particularly vulnerable to this type of stress (Wells 1964:76). Modern clinical studies also associate traumatic periostitis with shin splints (Onieal 1994:214-228).

Periosteal infections are generally associated with low levels of chronic stress or disease conditions (Ortner and Putschar 1981:40). Clinically, the condition must be present for at least three weeks before it can be radiographically detected (Bergener and Kormano 1997:35). Minor cases are usually remodeled without leaving a skeletal signature. The forms present in dry bones represent recently acquired or more serious cases. Periosteal inflammation may serve as a vehicle for tertiary infections or by themselves represent a secondary infection. It is a common component of many skeletal health responses. Radiographic examinations of modern cases by Bergener and Kormano (1997:37-44) affiliate it with no less than 100 individual maladies. Activating a periostitic response forces the body to expend energy and resources. This weakening of the body improves the opportunity for other agents to impact health. Low levels of periostitis in skeletal materials may reflect a high mortality rate from acute disorders or from acute phases of chronic disorders (Ortner 1979 In: Blakeley and Detweiler-Blakeley 1989:89).

The 20 observations from 17 individuals demonstrated periostitis that could not be attributed to other syndromes. Most cases appeared as smooth, linear or oval surface deposits of lamellar bone, implying that the infection was inactive and the surface remodeled (Figure 15-4). Nearly all

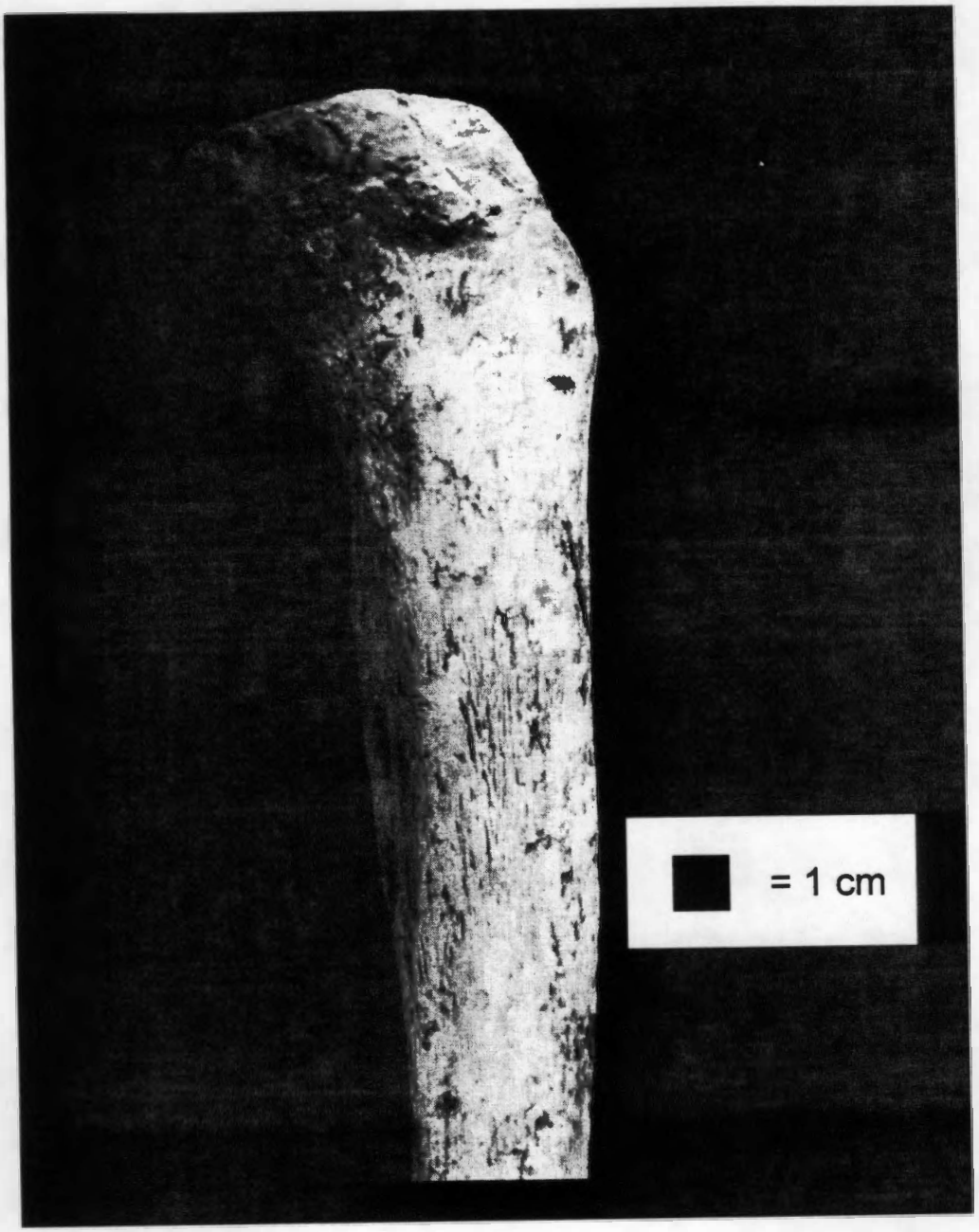


Figure 15-4. Periostitis on Burial 4A's Left Tibia.

periosteal lesions were identified in the legs. Tibiae (55%) and fibulae (43%) dominated the assemblage. A single left distal humerus was also observed with periostitis. Severity was equally distributed between slight and moderate representations. Most of these were inactive. Given the location and inactive state of these responses they probably represent non-fatal localized sites of injury or infection. Right fibulae from Burials 225 and 50 exhibit extensive episodes of inflammation and remodeling. It is possible that these conditions may represent nondiagnostic treponemal infections.

Osteomyeletis

Like periostitis, there is considerable variation in what analysts perceive as osteomyeletis. For the purposes of this discussion, osteomyeletis is strictly defined as an inflammation of the medullary cavity (Steinbock 1976:60). Medullary cavities serve as blood cell production sites and are used to store undifferentiated hematopoietic tissue and adipose fat deposits (Junqueira, Carneiro and Kelly 1989:246-247). These reserves and the limited circulation brought about by the bone's hard matrix provide an ideal environment for pathogenic activity.

Osteomyeletis is nearly always the result of organismal invasion. Almost 90% of these cases are caused by Staphylococcus aureus with the vast majority of the remaining cases brought on by streptococci, haemophilus influenzae, pseudomonas aeurginosa, and salmonella (Rogers and Waldron 1989:611-612; Webb 1994:126). These organisms usually gain access through vascular channels (Aergerter and Kirkpatrick 1975:251). Vascular based infections are most frequently acquired in youth with males being considerably more susceptible than females (Ortner and Putschar 1981:110). Trueta (1959:674) notes that slow blood flow through maturing metaphyses creates ideal environments for bacterial proliferation. As the pathogen spreads, blockage of the bone's vascular system induces tissue necrosis and osteoclastic activities result in an empty space or sequestrum around the dead bone (Steinbock 1976:66). Invasion of the marrow cavity may also create pressure in the confined space, resulting in widespread necrosis of the overlying cortex (Ortner and Putschar 1981:112). When possible, new bone is deposited to help maintain structural integrity. On the surface, infection of subperiosteal space triggers formation of an involucrum or

subperiosteal bone mass. These deposits are designed to isolate the pathogen from its necessary blood supply. Since the malady's distribution is dependent on circulatory physiology, osteomyeletis in one skeletal element can easily spread to others. Direct exposure of the marrow cavity from severe trauma is also a common pathway for osteomyelitic pathogens.

Once contracted, osteomyeletis is extremely difficult to eradicate. Organisms responsible for the condition remain with the host as a low-grade infection, constantly requiring energy expenditures to fight the infection and repair tissue damage. Its presence in active forms can be perceived as an agent contributing to a host's death.

Osteomyeletis rarely is limited to infection of the marrow cavity. It will generally include some involvement of other tissue systems as well. Most osteomyelitic pathogens excrete a variety of volatile substances, collectively called pus. Drainage passages (Cloaca) develop in order to drain pus into the surrounding soft tissues. This phenomena not only compromises the bone's structural integrity, it also acts to spread the infection to surrounding tissues. Both cortical thinning and periosteal responses are very commonly associated with these infections. Prior to modern medical intervention, mortality from osteomyeletic infections was no less than 20 percent (Ortner and Putschar 1981:115).

Diagnostic cases of Hematogenous (Pyogenic) Osteomyeletis can be defined by the presence of sequestra, cloaca, and involucrum (Ortner and Putschar 1981:121, 123; Rogers and Waldron 1989:612). These, expressions, however are based on observations of the surface and do not include the primary target of infection - the medullary cavity. Bones demonstrating advanced destruction of the medullary cavity were examined radiographically and along broken margins. One likely case of osteomyeletis was identified. It was represented on the shaft of the adult left tibia recovered from Burial 51 (Figure 15-5). This tibia exhibited a large smooth sided cloaca on the distal aspect of the anterior shaft. Radiographs confirmed that the aperture communicated with the medullary cavity (Figure 15-6). A second cavity, possibly representing another cloaca or sequestrum was identified on a post-mortem break. No definitive signs of surface involvement were observed. There were several large active periosteal deposits on the shaft suggesting that treponemal

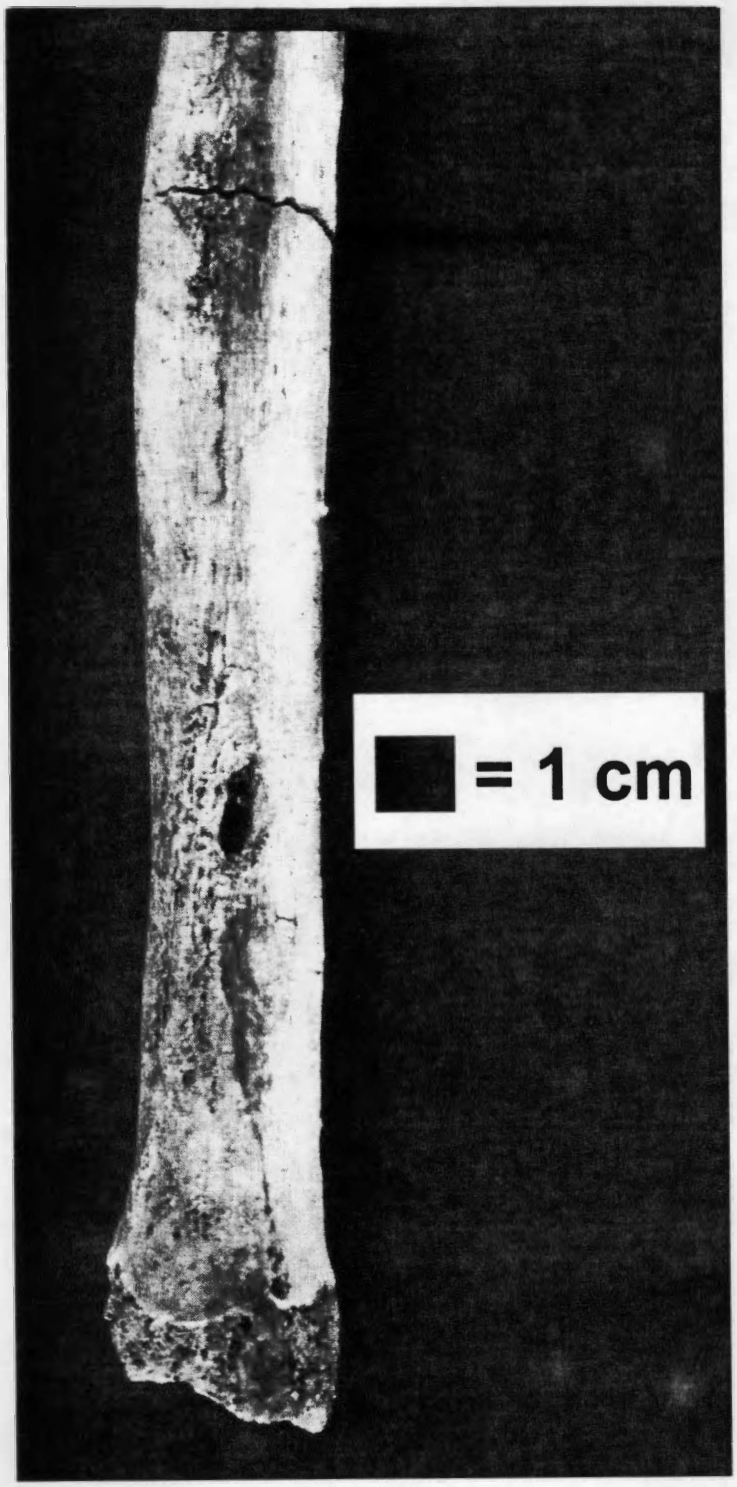


Figure 15-5. Cloaca on Distal Left Tibia from Burial 51.

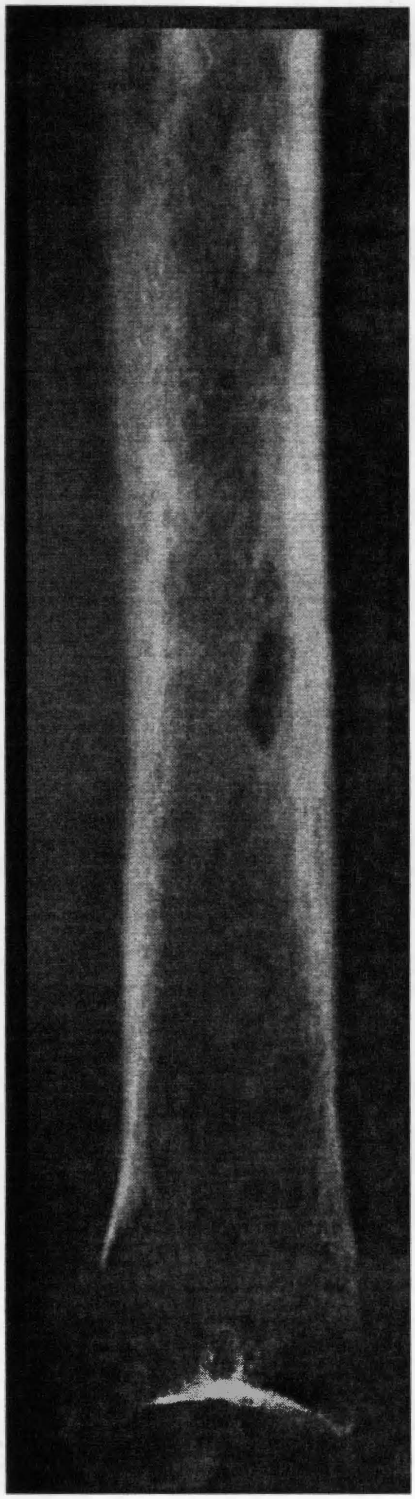


Figure 15-6. Radiograph of Burial 51's Left Tibia.

organisms may have been involved. The corresponding fibula also possessed extensive lamellar surface deposits and a trabecularized medullary cavity. This individual may have been host to more than one biological agent.

Treponematosis

Pathologists currently recognize pinta, yaws, endemic (Nonvenereal) and venereal syphilis as manifestations of a single organism, Treponema pallidum. These bacteria produce a variety of syndromes ranging from the skin irritations of pinta through the skeletal ulcerations of yaws and nonvenereal syphilis and the systemic infections of venereal syphilis. Treponemas are primarily agents impacting the soft tissues. Among living populations without the aid of modern medical intervention individuals exhibiting skeletal responses to treponemas represent a small component (usually less than 20%) of an infected population (c.f., Gamer et al. 1972; Rosahn 1946; Sowder 1940). The presence of treponematosis in a skeletal population must be viewed as a minimum representation of the true prevalence. With the exception of severe cases, skeletal responses to yaws, endemic and venereal syphilis are very difficult to separate in complete skeletal representations (Hackett 1976:113). Diagnosis is limited to confirming the presence of treponemal bacteria as a health risk to the Wickliffe community.

Treponemes are highly adaptable spirochetes. The specific syndrome manifested in a host is a function of the environment. These hydrophilic organisms remain close to the skin's surface in very hot, moist climates (as seen in pinta), but will retreat to the mouth, nose, crotch, armpits and subcutaneous membranes in dryer, more temperate conditions (as in yaws and endemic syphilis). As a host passes through different environments (and social conditions) the clinical symptoms exhibited by one syndrome will frequently transform to those of another (Hudson 1965:888-890). This plasticity enabled the treponemes to achieve a worldwide distribution prior to modern medical intervention.

Treponemes require specific social conditions to proliferate. Therefore, they provide an excellent window to village living conditions. Treponemes are communicable organisms, they spread through physical contact. Villagers living in communal living quarters, where intentional and

unintentional contact is high and sharing common eating and drinking utensils, are at great risk for spreading the disease (Grin 1952:11-14; Hudson 1958:81; Steinbock 1976:93). Minimizing the amount of clothing worn also increases body contact between potential hosts. Children are especially susceptible to infection under these conditions. In communities where clothing and improved living conditions reduce physical contact, sexual intercourse becomes the major means of transmission (Venereal syphilis). Population size (and possibly density) also has some influence on treponemal infection. Studies by Grin (1952:13) and Hudson (1958:48-50) indicate that among less developed modern societies smaller populations living in communal facilities tend towards a higher prevalence of non-venereal syphilis. This may be related to the degree of sharing needed to survive in these smaller community structures.

Treponematoses typically enter the body through the skin or mucous membranes. They target the circulatory system, primarily attacking arteriole walls. Periosteal inflammation of these tissues, usually in response to the slowed circulatory conditions found in the long bones, results in widespread deposition of woven bone. As infection continues, lamellar bone deposits may replace these. The same circulatory conditions that promote osteomyeletis are probably responsible for the tibia, clavicle, radius and ulna being the most common target elements (Steinbock 1976:102; Zimmerman and Kelley 1982:99). Typically, periosteal infections are characterized by numerous active and inactive hypervascular deposits initially laid down in striae and gradually expanding into patchy plaques of sclerotic bone (Rogers and Waldron 1989:620). In a more diagnostic lesion, collagenized connective tissues will envelop treponemal organisms, killing them and creating a soft buildup of toxic materials called gumma. In dry bone, these deposits appear as depressions in the center of periosteal infections, sometimes reaching deep into the bone's cortex.

Cortical and medullary involvements are common indications of chronic infections. Inflammation of the periosteum continues into the cortex where the underlying bone is compromised by the destruction of capillaries in the haversian canals (Steinbock 1976:123). Swelling of the cortex and/or the medullary cavity may be exhibited. As the cortex becomes inflamed, trabeculae are erratically placed in the medullary cavity to help support the weakened bone, only to be replaced with

sclerotic bone. This transformation permanently reduces the medullary volume. In severe cases, the cavity can become completely filled.

Treponematoses acquired in childhood may affect skeletal maturation. In many cases, periosteal apposition on the tibia will occur prior to completion of growth remodelling, enabling sabered and pseudobowed tibial surfaces to appear unremarkable (Webb 1994:158). The fibulae are rarely affected in these cases (Rogers and Waldron 1989:619). Developmental bowing of the tibia is also viewed as an indication of subadult treponemal infection (Jaffe 1972:921; Steinbock 1976:104).

The diagnosis of treponemal infections in dry bone has received considerable criticism over the years and most pathologists are uncomfortable classifying the condition based on isolated bones or health responses. Cortical volume increases, demonstrating chronic periosteal infections, gumma-like deposits and tibiae exhibiting sabering, pseudobowing or developmental bowing were treated as evidence of treponematosis. A sample of 17 observations, representing only five individuals, exhibited skeletal lesions that could be attributed to treponemal bacteria. Probably the most definitive case of treponematosis was revealed in Burial 114's pseudobowed left tibia, this bone also exhibited several active deposits on the shaft (Figure 15-7). A second pseudobowed tibia from Burial 51 inferred that this individual had acquired the disease as a youth. Both tibiae and fibulae from Burial 30 demonstrate widespread patches of active and sclerotic bone responses. The right tibia also possessed a probable gumma depression near the distal fibular attachment. In Burial 51EL2, numerous active and inactive periosteal deposits on the right tibia and fibula were accompanied with a swollen, trabecularized fibular medullary cavity. The most diagnostic case, Burial 227, was represented by large woven and sclerotic bone deposits over much of the right femur and tibia (Figure 15-8). Radiographs revealed that the tibia's cortex was diffused and the medullary cavity was considerably narrowed at the lesion site (Figure 15-9). This infers that the agent had spread into the bone prior to death. It is likely that in each case, treponemal organisms were active risk agents.

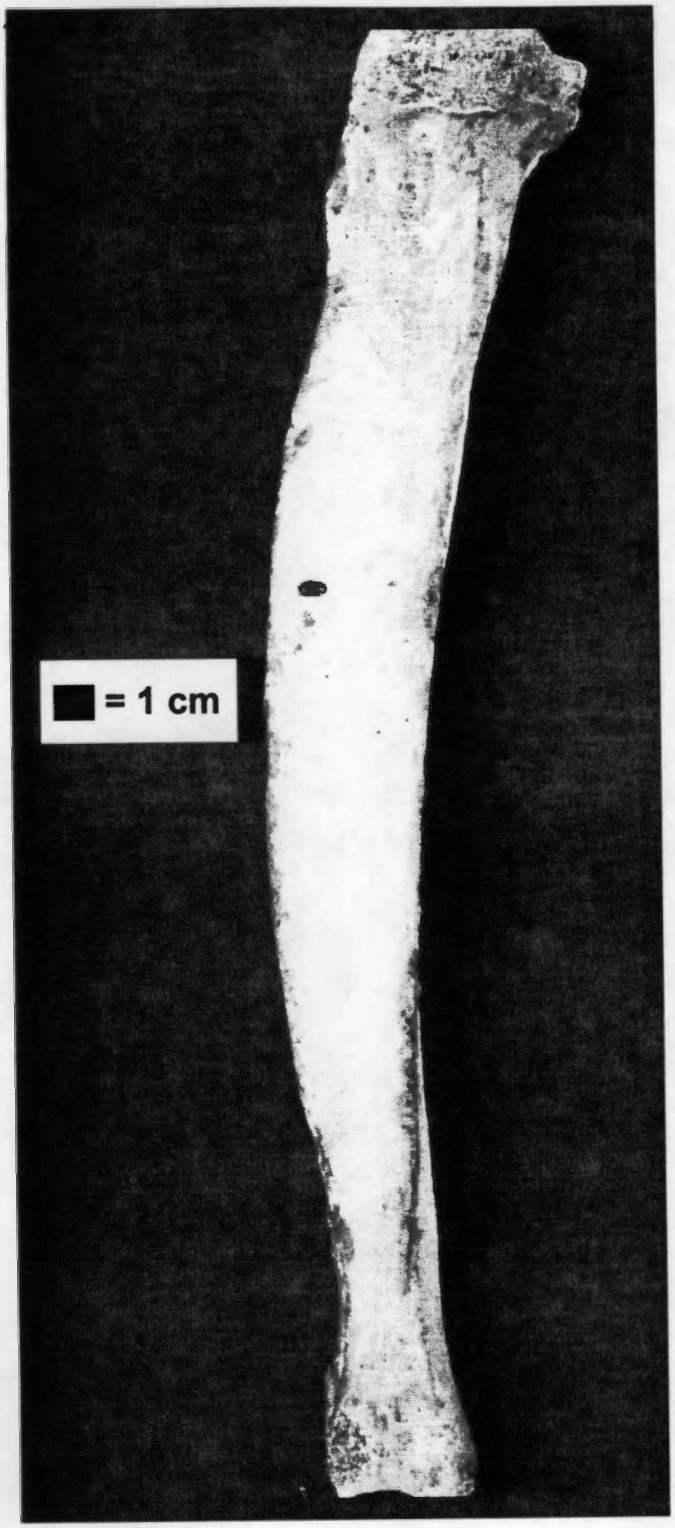


Figure 15-7. Pseudobowing in Burial 114's Left Tibia.

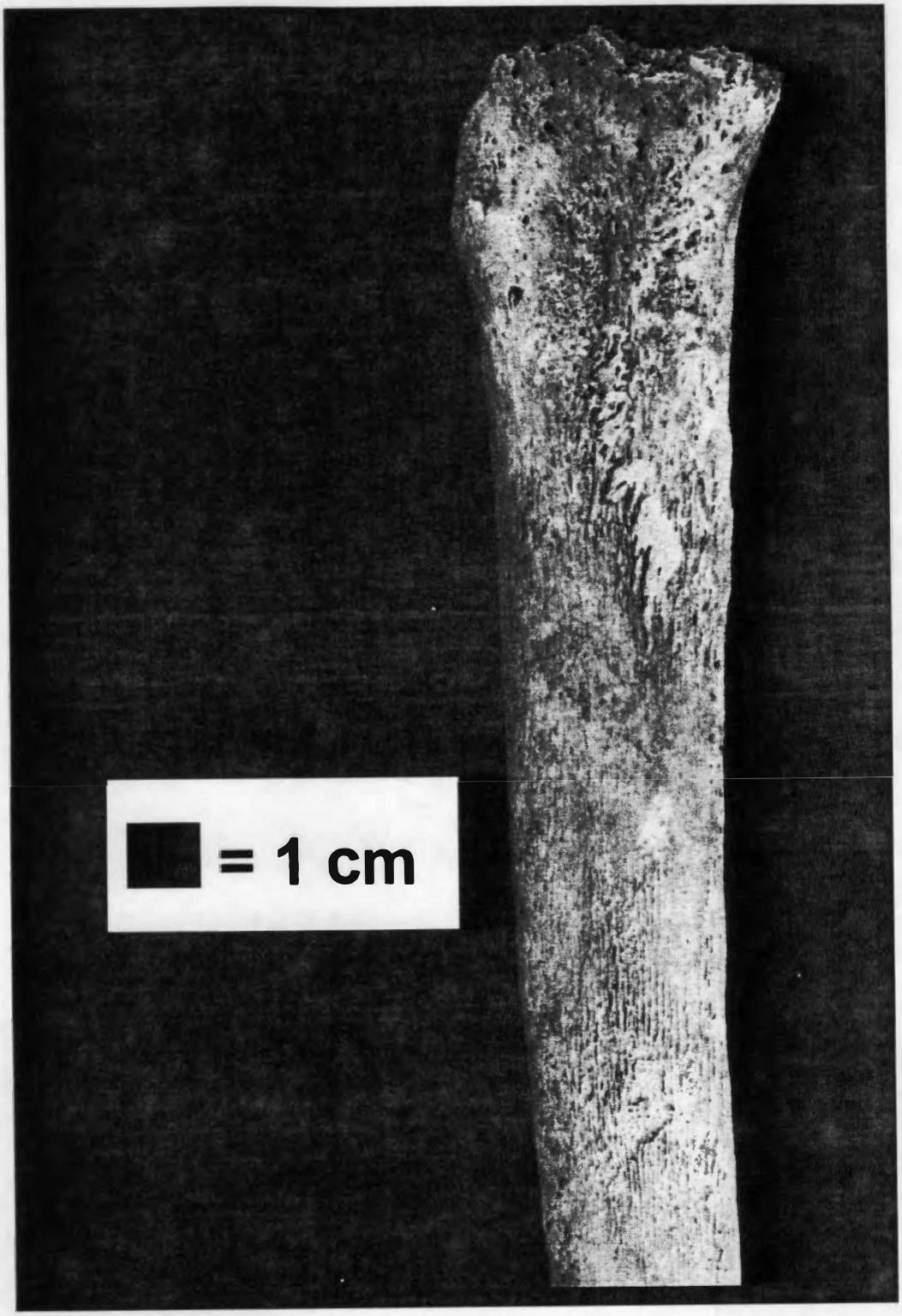


Figure 15-8. Surface Deposits on Right Tibia from Burial 227.

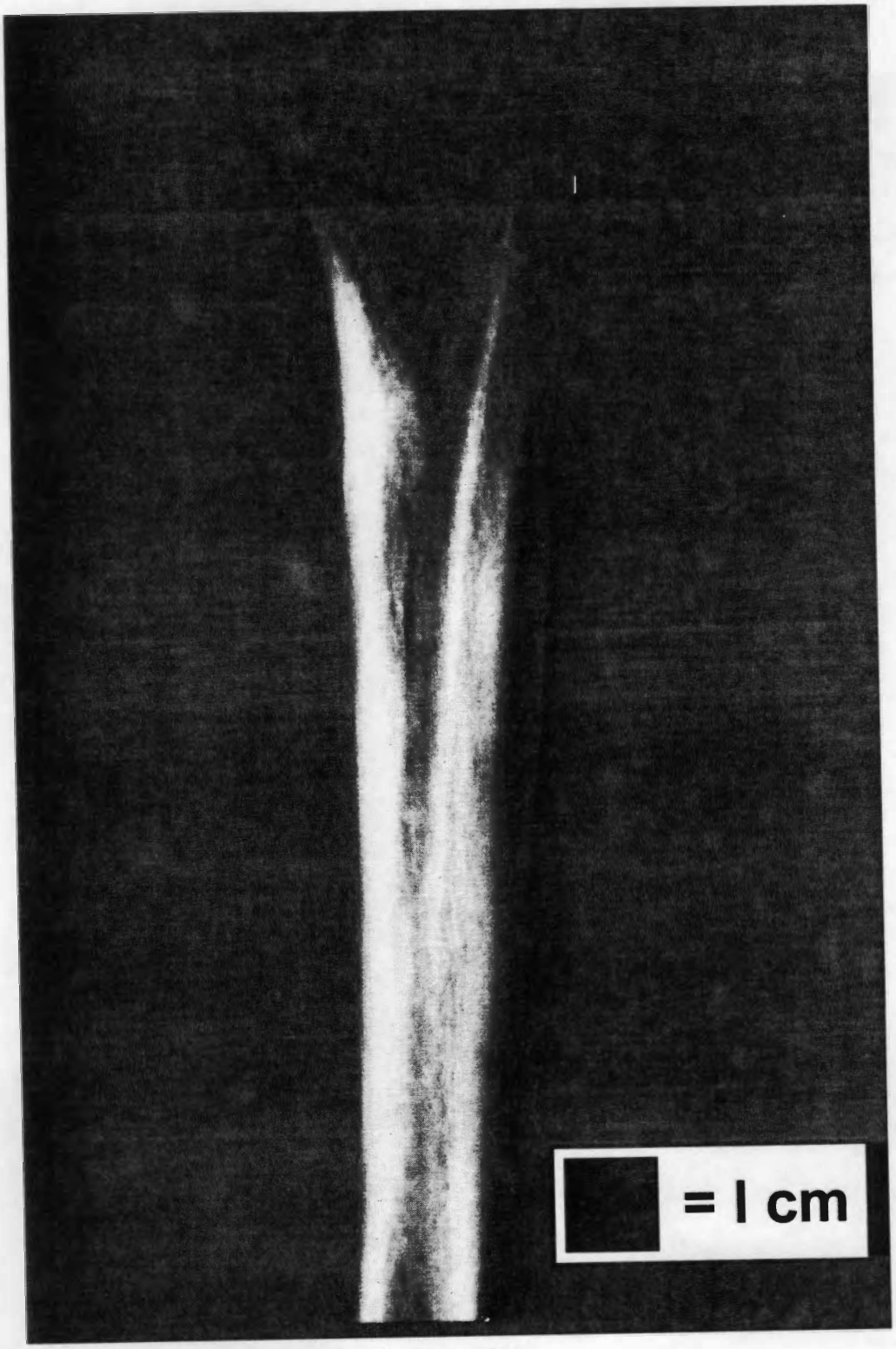


Figure 15-9. Radiograph of Burial 227's Right Tibia.

Degenerative Joint Disease (Osteoarthritis)

Degenerative Joint Disease (DJD) is characterized by the gradual deterioration of synovial joints, frequently in association with advancing age. However, since this syndrome is also a function of physiological wear, phenotype, and use it is usually diagnosed as a separate health risk (Jurmain 1977:354). DJD is largely a soft tissue malady. As a synovial joint is exposed to wear and tear, cartilage and associated membranes lose their ability to produce new cells and chemically balanced synovial fluid. These limitations place greater demands on the remaining tissue, stressing their ability to support and maintain the joint. The stimulation of osseous activity is an indication of advanced cartilage deterioration. Skeletal responses include replacement of overstressed cartilaginous articular surfaces with bone (surface osteophytes), development of synovial fluid filled cysts in and below the joint surface, sclerotic thickening of the underlying trabecular structure (pitting), and endochondral replacement cartilage along the margin with osteophytes (lipping). In addition to these responses, if cartilage loss exceeds replacement, contrasting bone surfaces may become ebumished, triggering intensive sclerotic bone formation within the articular surface. Among weight bearing joints, progressive remodeling of the articular surfaces tend to decrease the available joint surface area as a means of further accommodating for these changes (Johnson 1959:1225-1229). DJD commonly results in joint swelling, pain and reduced joint movement (Dieppe and Buckwalter 1998:8.9.1).

DJD is most commonly associated with weight bearing joints and those receiving a considerable amount of use. These include the knees, hips, temporomandibular joints, shoulders, fingers and toes (Ortner and Putschar 1981:419; Steinbock 1976:279). Joint capsules rarely respond to DJD with a unified tissue response. Instead joint tissues attempt to isolate and adapt local tissues to fulfill mechanical demands at points of compromise. Multiple independent skeletal responses often occur within a single joint (Some of the syndromes classified as Activity Stress may also be components of Degenerative Joint Disease Syndrome).

While all human populations are susceptible to DJD, the distribution of the condition across the skeleton varies by social context. Jurmain (1977:363) has attributed varying activity levels to differences in osteoarthritis between prehistoric and modern American cultures. Differing social roles within a culture may also be responsible for varying degrees of DJD (Ortner 1968:139). For example, activities entailing extensive flexion of the arm joints, such as cotton picking, coal mining, foundry work or bus driving are capable of producing extensive osteoarthritis (Kellgren and Lawrence 1958:395; Lawrence 1961:270, 1969:388; Lockshin et al. 1969:25; Mintz and Fraga 1973:78; Naira 1932:214-215). Among modern populations, the knee represents the most commonly afflicted joint. Whites are also very susceptible to DJD in the hip, whereas blacks are more prone to shoulder degeneration (Bridges 1992:71). While genetics cannot be overlooked, social differences these two groups would have been important contributing factors. Jurmain (1980:149) has suggested that within individuals, differences in osteoarthritis of the elbow may be due to handedness.

There are a number of health responses that indicate DJD as a risk agent. Ebumation, lipping, joint surface pitting are considered reliable indicators of DJD in the limbs, particularly if the case involves an older individual and there are no associated signs of trauma or other joint maladies (Ortner and Putschar 1981:420).

A total of 35 joint surfaces from 14 individuals exhibited health responses to DJD. Most (56%) focused on changes in the knees. Left and right observations were balanced and when available, changes in the distal femur were frequently accompanied by deterioration of the proximal tibia. Slight to moderate arthritic lipping was a component of each malady (Figure 15-10). Minor pitting of the articular surfaces was identified in tibiae from Burials 123, 224a and 234. A more pronounced excavation was noted in the lateral condyle of Burial 234's left femur (Figure 15-11). These health responses indicate that the knees received extensive use. Minor lipping was also noted in four distal tibiae emphasizing that the impact of these activities was not limited to the knees. The rugged terrain surrounding the mound group cannot be overlooked as a factor contributing to tissue deterioration in the legs.

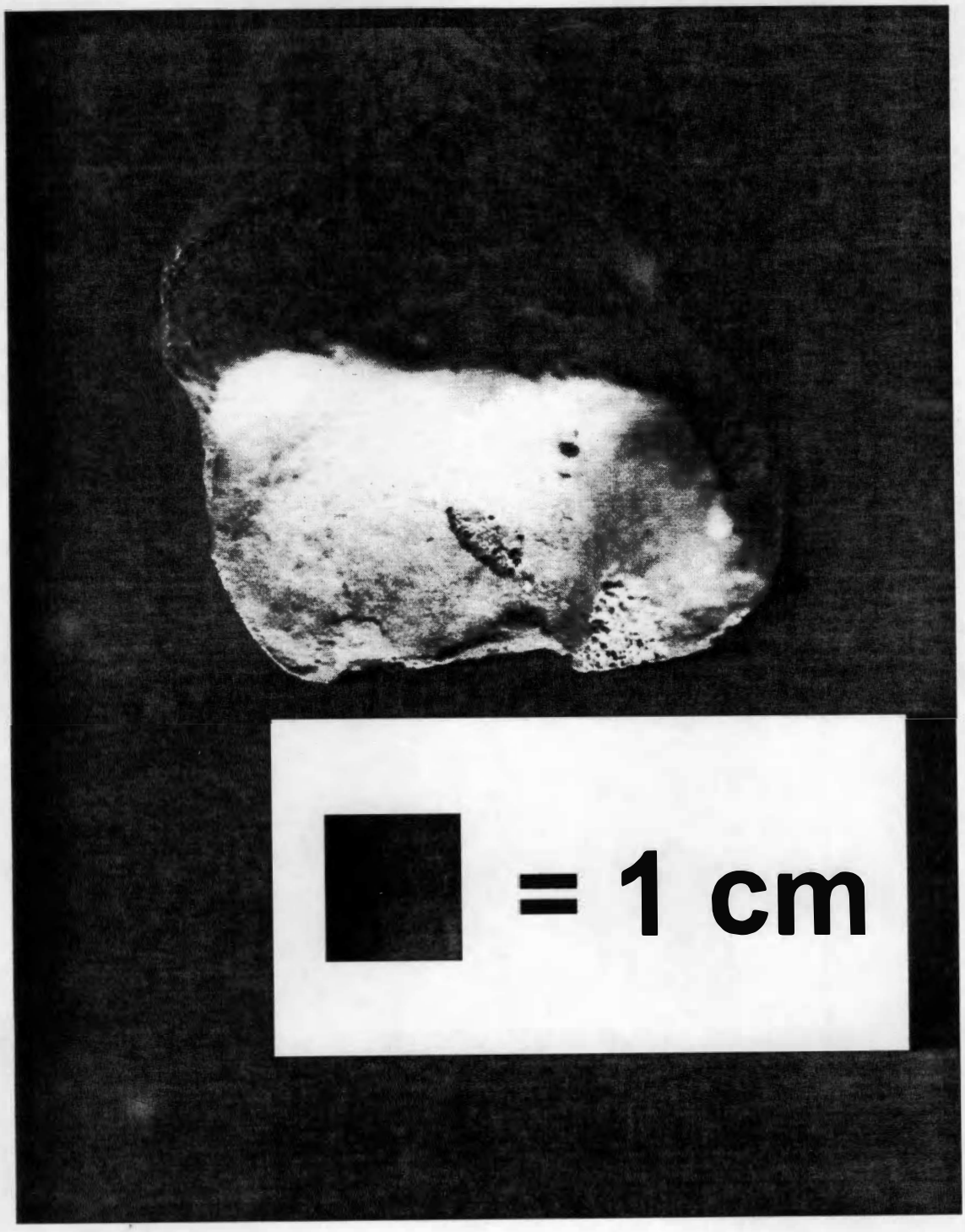


Figure 15-10. Arthritic Lipping in the Distal Right Tibia of Burial 100.

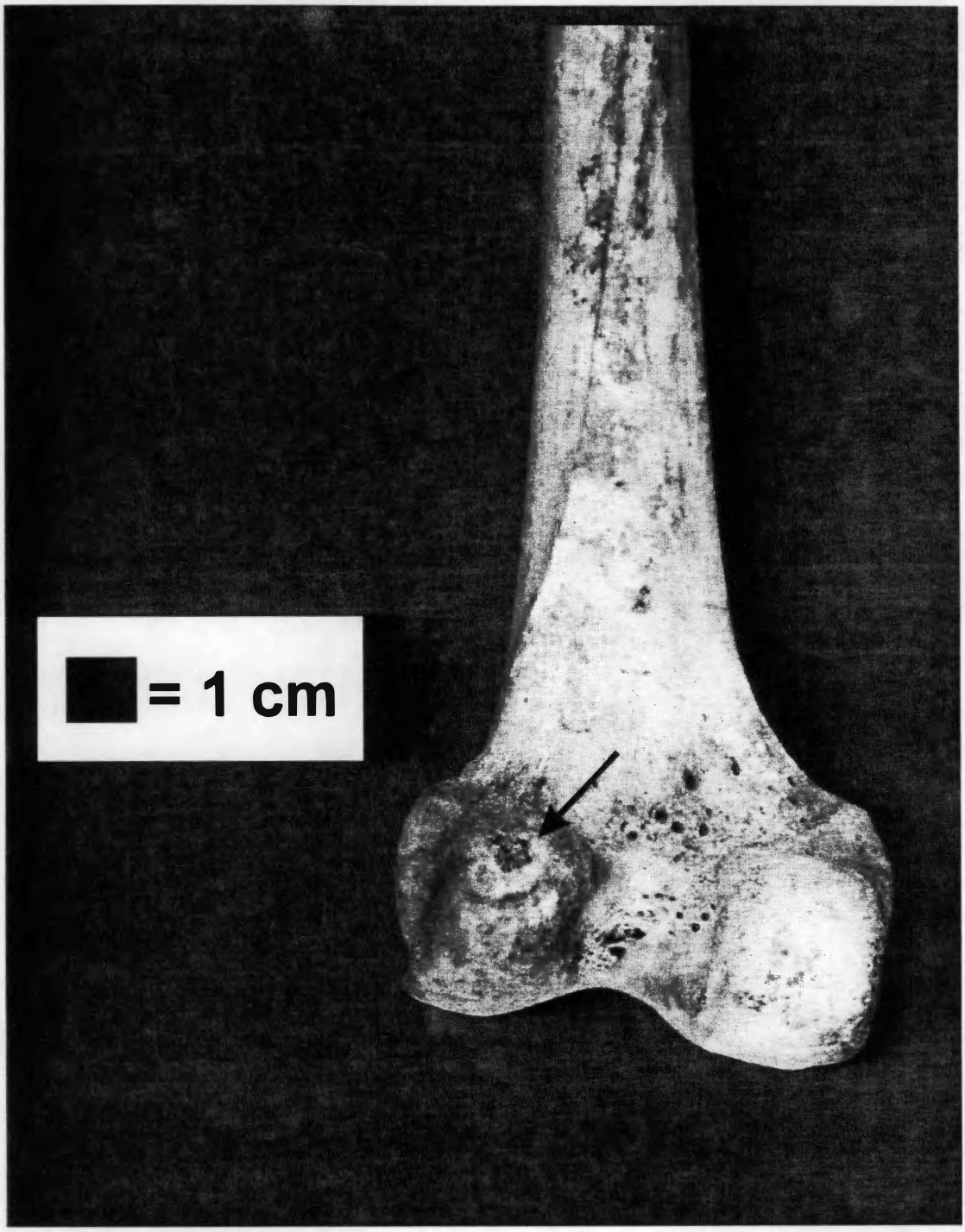


Figure 15-11. Left Femur of Burial 234 Exhibiting Condylar Deterioration.

Slight, distinct rims around the ulnar olecranon and coronoid processes indicate that considerable flexion was required. Corresponding lipping on the distal humeral trochlea was also present. While surface erosion compromised accurate identification of many possible humeral articular surface features, articular pitting and ebumation in Burial 96's left humerus indicated that flexion and rotation motions were extensive enough to limit much of the joint's effectiveness. Notable lipping in the wrist of Burials 90 and 104 emphasize these areas as other joints receiving extensive use. While it is unlikely that DJD was a primary cause of death in these individuals, there is ample evidence to indicate that the malady restricted the body's ability to operate efficiently.

Activity Stress

Workloads that tax tissue structure are common stress agents. Hyperextension of the tissues from over-use frequently results in discomfort and temporary reductions in the muscle's effectiveness. Tissue damage can occur from continued over-use. When the host demands a greater physical activity than the body is capable of producing, mechanical failure can be prevented by changing tissue structure. Plastic responses to work include the addition of more cells, changes in metabolic output and efficiency, transformation in cell size, and consumption of previously stored materials. By themselves, these conditions are not directly attributable to degenerative processes, diseases or biochemical imbalances (Kennedy 1989:156). Stress responses to work are more closely allied with physiological acclimitizations. The presence of these responses indicates that the host was able to overcome any immediate danger imposed by increased work demands. They also indicate that work was a chronic stressor.

The skeletal system is not immune to activity-based stress, it too can be modified in order to satisfy environmental demands (Merbs 1983:147-157). Most skeleto-muscular stress responses fulfill mechanical demands. Extended use of a muscle will result in muscle dysfunction, inflammation of the muscles and tendons and expansion of muscle and attachment fiber diameters to accommodate mechanical demands (Cailliet 1996:6-8; Kaplan and Tanner 1989:4; Slager et al. 1985). If the activity is prolonged, tension at tendon and ligament attachment sites stimulate ossification as a means of more firmly anchoring tissues to bone. These enthesophytes are the end

product of very prolonged exposure to mechanical stress. Development of enthesophytes on the achilles tendon's insertion, for example is a skeletal adaptation to muscular stress among modern long distance runners (Clement et al. 1984:181; Lehman 1984:160). Intense occupational exertion has been suggested as the probable agent responsible for tendon ossification in the arms and shoulders of slave populations (Kelley and Angel 1987:207-208; Owsley et al. 1987:191).

An important contributing factor to enthesopathic development is age. Hayflick (1978:32) notes that with increasing age, tissues generally operate at a reduced capacity and gradually lose their ability to replicate effectively. As a means of compensating for these losses, ossification of connective tissue reduces age-based soft tissue impairment. Enthesophytes rarely occur in infant and subadult skeletal materials, where changes in tissue structure can be accomplished as part of developmental maturation (Galera and Garralda 1993:250). They are a common observation among adult and geriatric skeletal remains, where activity demands are greater than the developed skeleton has been designed to handle (Mann and Murphy 1990:72).

There are 13 observation sites from 11 individuals exhibiting enthesophyte growth in the Mound C assemblage. The legs contain most (64%) of these exostoses. Enthesophytes were most common on muscle attachment sites along the central shaft of all limbs. Age-able burials with these responses represented middle to older aged individuals. All specimens exhibited a rounded, remodeled shape, indicating that the response was not active at the time of death.

Dutour (1986) has demonstrated that the distribution of enthesopathic lesions can indicate what soft tissues were involved and provide an idea of the motions precipitating the response. Enthesopathic lesions were traced to connective tissue attachment sites to ascertain what motions were tied to lesion presence. Burials 45A, 71A, 141 and 148 exhibited growth along aspects of the linea aspira. The vastus and adductor muscle groups were attached along this feature. The origin for Burial 149's gastrocnemius was also accentuated. These muscles were all-important components of leg movement. They indicated that walking and running placed greater than normal strain on the skeleto-muscular system. All four enthesopathic tibiae showed ossification of the knee's capsular ligament. Burials 234 and 274A were noted earlier with DJD, emphasizing that

deterioration of the joint capsule required skeletal responses for a number of different joint tissues. Recognizing that the Wickliffe Village is situated amidst very irregular terrain between upland and lowland environments, movement to and from these places may also have been an agent aggravating age-related syndromes in these individuals.

Distal humeri from Burials 72A and 141 possessed enthesophytes at flexor and extensor muscle attachments. These indicate that the wrist was subjected to unusual stress and strain. Bony buildups along the brachioradialis attachment site showed that flexure of the elbow was also greater than the host's structural capacity. Finally, the interosseous membrane securing 226EL2's left ulna and radius was exaggerated. Pronation of the wrist would place strain on this ulnar attachment, once again indicating that the wrist was subjected to prolonged strenuous activity.

Mechanical Failure

Mechanical failures represent one of the most straightforward diagnoses possible in skeletal material - they all cause injuries. Mechanical failures are all caused by a single agent - physical energy. Mechanical failure occurs when uncontrolled energy is directed at the body (Haddon 1972; Waller 1994:665). These epidemiologists currently recognize that radiation, mechanical, thermal, chemical, and electrical energy, as well as asphyxiation (lack of energy), are capable of damaging the human body. These energy forms and the vehicles transmitting or inhibiting their transfer are important factors in determining how the skeleton is affected.

When analysts have addressed mechanical failure in the skeleton, their interest has concentrated less on identifying the agent and more on the vehicles of transmission. Direct or indirect collisions with an energy force that was greater than a diaphysis's mechanical strength results in a fracture. A single case of this type of energy collision is present in Burial 141's left fibula (Figure 15-12). Uncontrolled energy transmission resulted in an oblique fracture across the proximal shaft. Despite its well-healed appearance, the fracture line is partially visible macroscopically and in radiograph (Figure 15-13). The shattered epiphyseal end has bent slightly out of proper alignment. Mechanical energy directed through the bone was not adequately transmitted, causing the bone to fail in a spiral fracture. An injury of this nature could easily have been accomplished through jumping

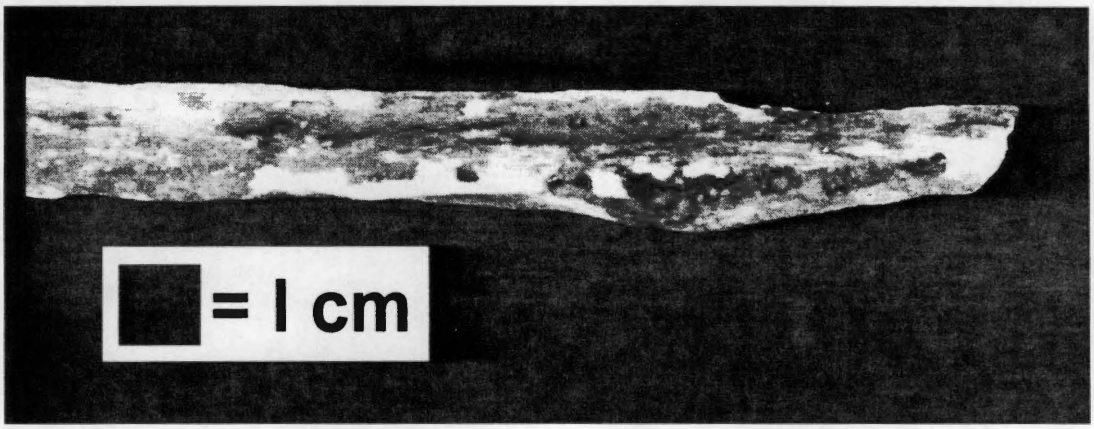


Figure 15-12. Healed Fracture in Left Fibula of Burial 141.

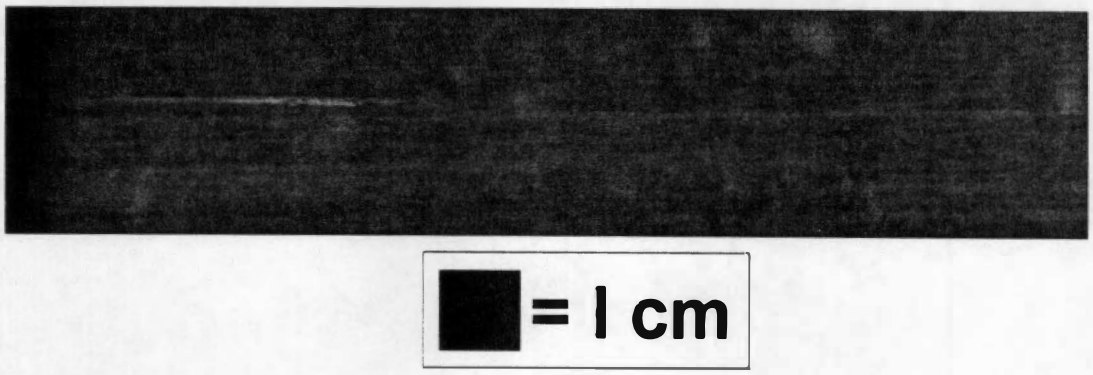


Figure 15-13. Radiograph of Burial 141's Left Fibula. Note Fractured Cortical Surfaces.

or hyper-constriction of the soleus muscle (King et al. 1990:210). Merbs (1983:176) suggests that falls and severe ankle twists while trying to cross uneven terrain may cause these fractures. These types of injuries are frequently accompanied with ankle trauma (Adams and Hamblen 1999:261). Isolated fibular fractures are also indications of a direct blow to the bone (Dias 1991:1273).

Muscle attachments for the gastrocnemius, on the dorso-posterior side of Burial 89's left femur exhibit an irregular osteolytic excavation into the bone (Figure 15-14). The excavation surface is very rough with numerous small spicules of bone protruding from the surface. The condition has received very little attention and the agents responsible for its formation are poorly understood. Analysts suggest that this sub-periosteal cortical defect is formed by a tumor, developmental variation, or localized bone resorption (c.f., Kimmelsteil and Rapp 1951; Mann and Murphy 1990:103; Resnick and Greenway 1982; Simon 1968). Based on a more comprehensive examination of dry and wet bone specimens, Resnick and Greenway (1982:252) suggest that the lesion was caused by overextension or trauma to the gastrocnemius muscle. Acute hyperextension of the muscle tendon can result in tears at its weakest point - along the site of insertion into the bone (Cailliet 1996:343). The excavation represents either an osteoclastic resorption of damaged bone or a means of increasing attachment surface area and the spicules are an artifact of muscle tension based ossification of tendons. The gastrocnemius is an important component of walking, running and jumping. Aggravation of this attachment site suggests that movement in and across the local terrain required considerable effort.

Tumors

Tissue formation as a result of abnormal increases in osteoblastic and other mesenchymal cell activity result in tumors. Despite origination in the host's tissue, tumors compete for space and resources at the expense of other tissue systems. There are a number of tumors that impact the skeleton (Jaffe 1958). The exact neoplasm present in a given response is attributable to the type of originating cell, the specific location within the osseous environment and the metabolic state of the host (including their age, sex and general state of health). Tumors often possess unique growth signatures that differentiate them from other health responses. These include hyper-sclerotic surface

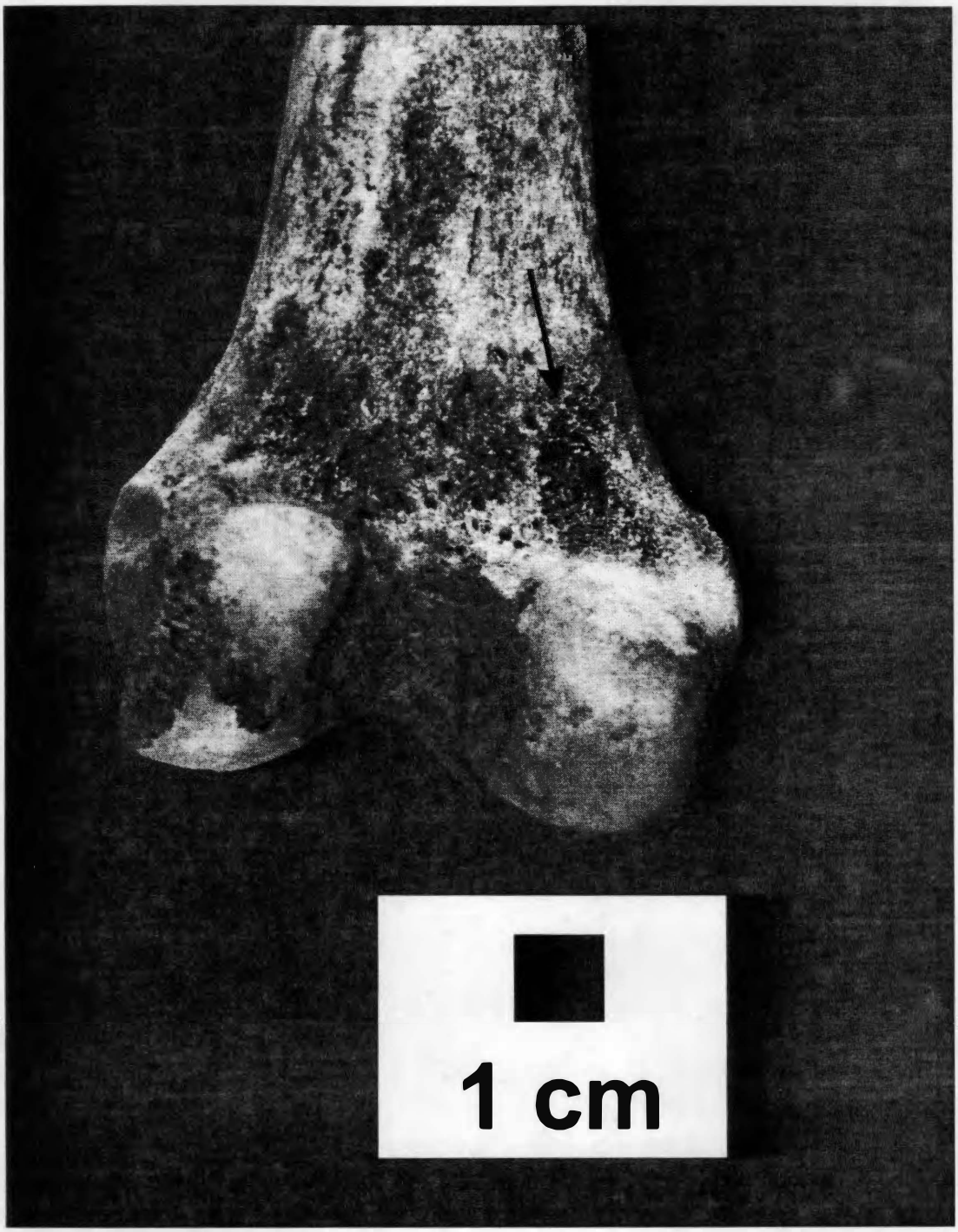


Figure 15-14. Muscle Tear in Burial 89's Left Femur.

deposits (osteomas or ivory buttons), irregular growth trajectories, and endosteal cysts lined with sclerotic bone. Tumors tend to grow in predictable locations. Despite this, dry bone tumorous growths are exceedingly difficult to differentiate without clinical backgrounds or destructive analyses.

The superior dorsal surface of Burial 224A's right tibia exhibits a large (>1cm wide) osteolytic-like excavation into the trabecular bone (Figure 15-15). Sides of the lesion have been extensively remodelled with thin sclerotic-like deposits resembling cortical bone. All surrounding bone appears to be unaffected. Radiographs detected no communication between the pit and the medullary cavity. This unremarkable morphology suggests a lack of skeletal involvement. It is located on the epiphyseal fusion boundary. This environment is conducive to the development of several different types of tumors or tumor-like cysts, particularly during maturation (Ortner and Putschar 1981:366-376). The presence of a pre-existing soft tissue condition at the metaphysis would have forced developing bone to grow around it. While the possibility of a giant cell tumor, chondroblastoma, periosteal chondroma, or juxtacortical fibrous cortical defect or a unicameral bone cyst cannot be dismissed, the lack of any enveloping osseous surface over the pit and/or surface response are evidence that the excavation may have housed a non-osteogenic neoplasm. Hudson (1987:147) notes that some benign cartilage tumors, including chrondromyxoid fibromas, lack osseous sheaths and are bound into the bone by periosteum. Periosteum may be present to line the internal margins of the excavation (Jaffe 1958:206). These types of fibromas are most commonly observed in the proximal tibial metaphysis (Huvos 1979:192).

While the exact agent responsible for this feature may not be definable, the condition is a precursor to other potential health risks. The excavation into the bone represents a discontinuity in the cortex and loss of trabecular bone. This weak spot increases the potential for mechanical failure. Penetration into the bone also provides a greater potential for infectious agents to access medullary tissues. Finally, if correctly identified as a neoplastic defect, these tissues pose a risk of producing malignant cells (Huvos 1979:192). No evidence of malignant cell activity was observed in the limbs from Burial 234, but the possibility that carcinomas in other tissues were present cannot be dismissed.

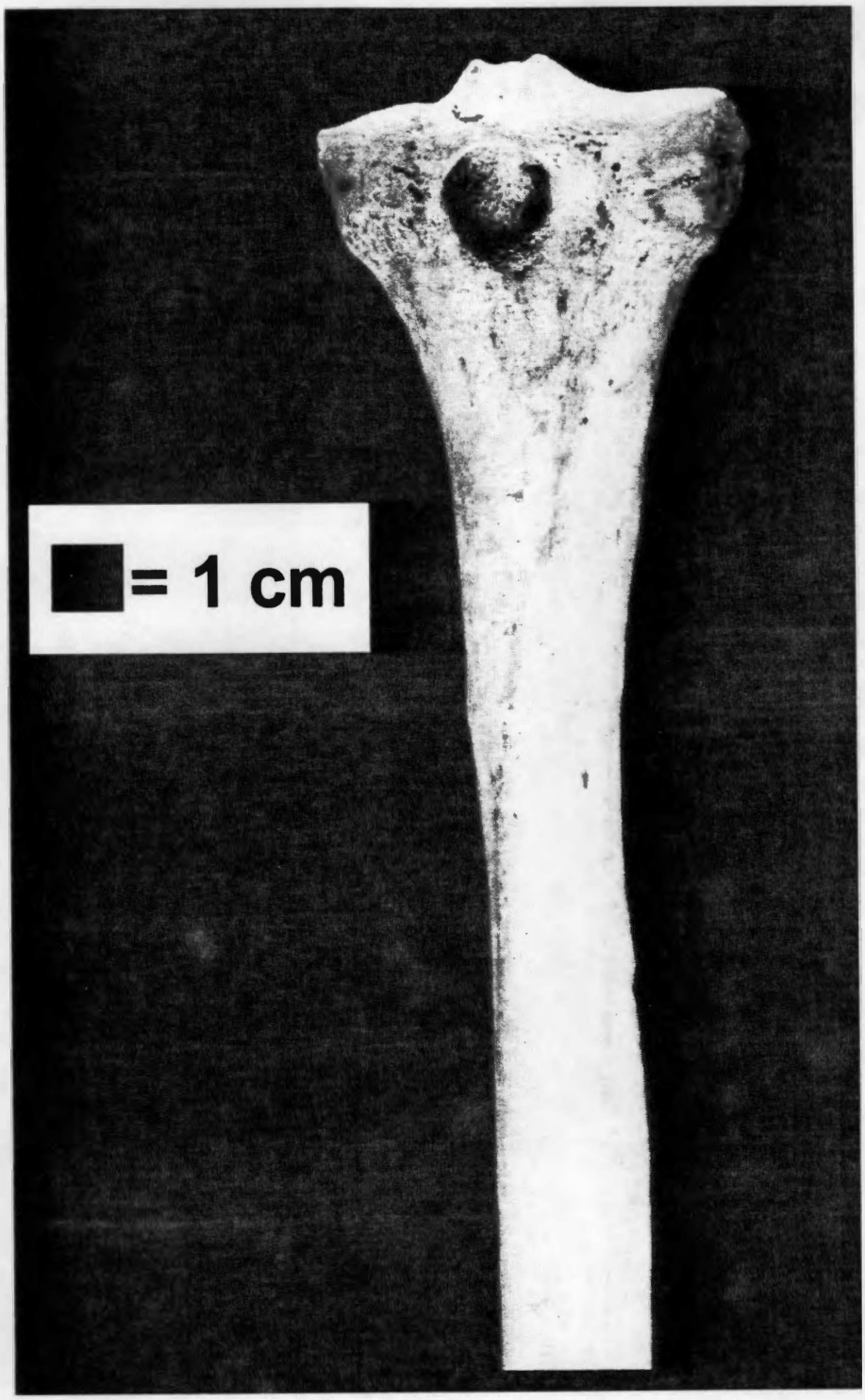


Figure 15-15. Tumorous Lesion in Burial 224A's Right Tibia.

Non-diagnostic Responses

Several skeletal responses exhibited distinctive patterns of tissue involvement, but were not diagnostic to a particular syndrome. Confirmation of the suggested diagnosis frequently required some examination of the entire skeleton, which was in many cases unavailable. A causal agent(s) is suggested for each potential form.

1). Possible Lytic Excavation. On the inferior posterior aspect of the left humerus from Burial 227EL1, there is a small irregularly shaped aperture (<25mm), (Figure 15-16). This excavation is smooth sided and there is no evidence of periosteal response or sclerotic remodelling. The aperture lies below attachment for the triceps and probably is not associated with any muscular response. The humerus possesses a well-developed septal aperture immediately below it. Radiographs reveal that the pit does not continue more than a few millimeters below the surface. It is unlikely that circulatory and neural variations are responsible for its presence. This location is also well outside of the epiphyseal fusion area. Hudson (1987:542) reports that small (10-50mm) benign soft tissue tumors comprise 90% of all forms. They are common in this area. Given these environmental conditions, the range of possibilities are limited to a congenital variation, a small neoplasm or a degenerative response.

2). Possible Developmental Bowing. The right fibular from Burial 100EL1 exhibits a very pronounced anterior bowing (Figure 15-17). With the exception of minor degrees of periostitis and DJD, the accompanying tibia and other long bones are unremarkable. The condition suggests a developmental constraint was placed on the fibula's growth. They forced the diaphysis to bow in order to meet growth demands within the element. No analogous condition could be found in the literature. The response is similar to tibial developmental bowing. It is possible that this bowing is an artifact of an early treponemal infection or a metabolic disorder, but the skeleton lacks diagnostic evidence for either condition. The possibility that this represents a congenital defect cannot be ruled out. Abnormal bowing weakens the bone's ability to displace weight and force properly, providing a precursor for mechanical failure.

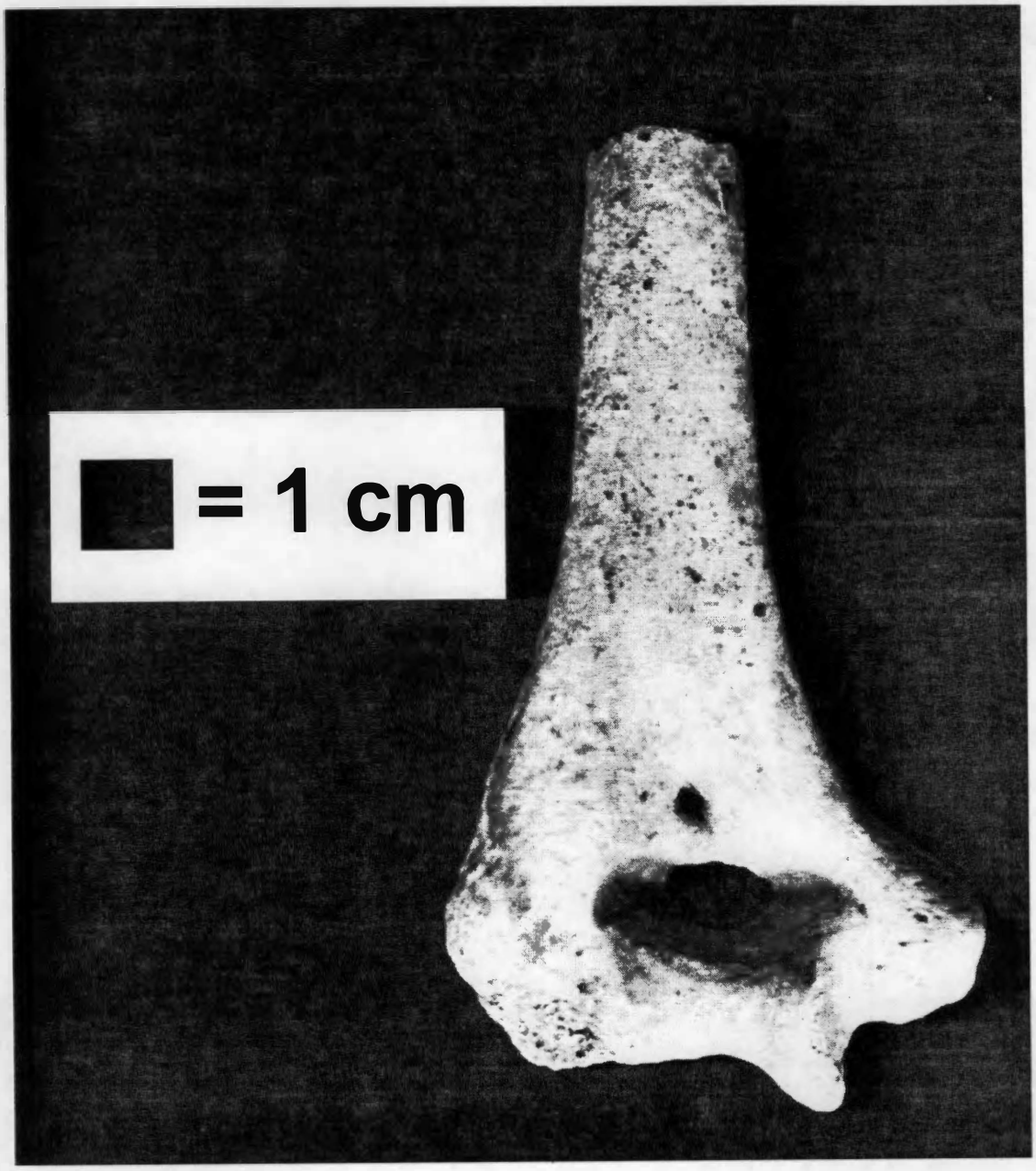


Figure 15-16. Possible Lytic Lesion in Burial 227EL1's Left Humerus.

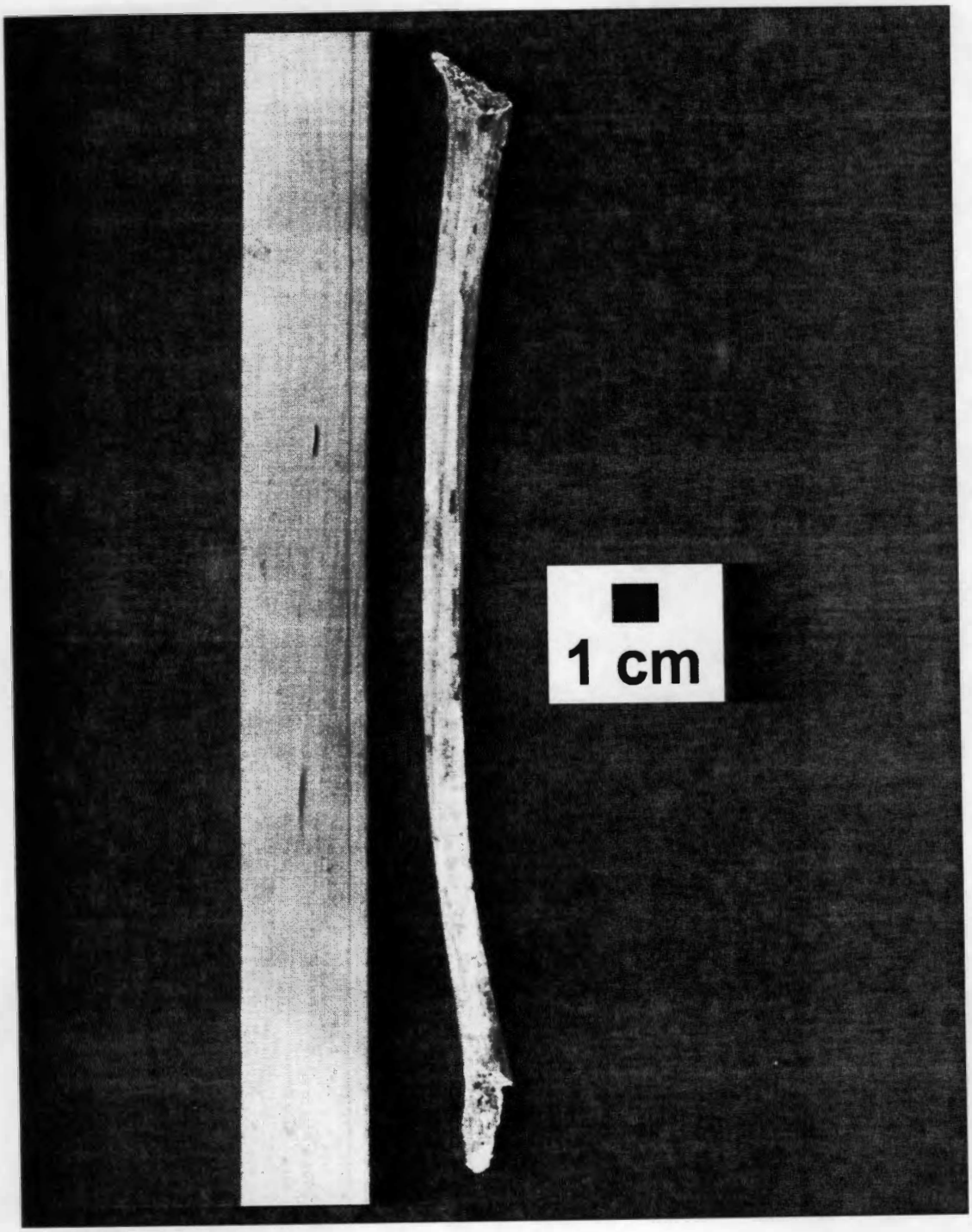


Figure 15-17. Burial 100EL1's Right Fibula (Anterior-Posterior View) with Straight Edge.

3). Possible Medullary Infections. Several examples of medullary cavity expansion were observed, suggesting the presence of osteomyelitis-like infections. They lacked the necessary diagnostic surface features. These responses appeared to have been relatively contained within the medullary cavity. In each case, the medullary cavity had expanded, causing the bone to appear swollen from the exterior and the interior space filled with a network of trabecular bone. There were no indications of cyst-like cavities. The overlying cortical bone was frequently thinner than that observed in healthier specimens. Most shafts exhibited a highly remodeled lamellar bone surface. A few isolated active periosteal deposits were identified on some specimens. Many of these features were similar to responses caused by treponemal agents, however, they were not diagnostic to a known stress agent (Ortner and Putschar 1981:197). Treuta (1959:678) has suggested that many adult onset of hematogenous osteomyelitis are limited to infections isolated within the medullary cavity. These forms may represent early active skeletal responses, remissive phases, or recovery stages.

An assemblage of 14 cases, representing six mature individuals, of medullary cavity expansion was identified in the Mound C health sample. Two cases were observed in femora and the rest represented inflammation of the tibia. Bilateral representations were about equally distributed. With the exception of one response, identified on the dorso-ventral aspect of Burial 234's distal right femur, all cases were mid-shaft observations. Figure 15-18 of Burial 120A's right tibia demonstrates an extreme example. The distribution of these features overlaps with skeletal elements most commonly targeted by both osteomyeletis and treponemal agents (Jaffe 1972; Ortner and Putschar 1981; Steinbock 1976). It is possible that these health responses represent early manifestations of these or other similar infectious agents.

The critical feature used to group these cases was an increase of the medullary cavity volume. This was accompanied by cortical thinning (33%) and some evidence of periosteal remodelling (44%). Remodeled lamellar bone surfaces were clearly present in four cases; this indicated that minimally, the malady was in remission. Two individuals exhibited more than one bone

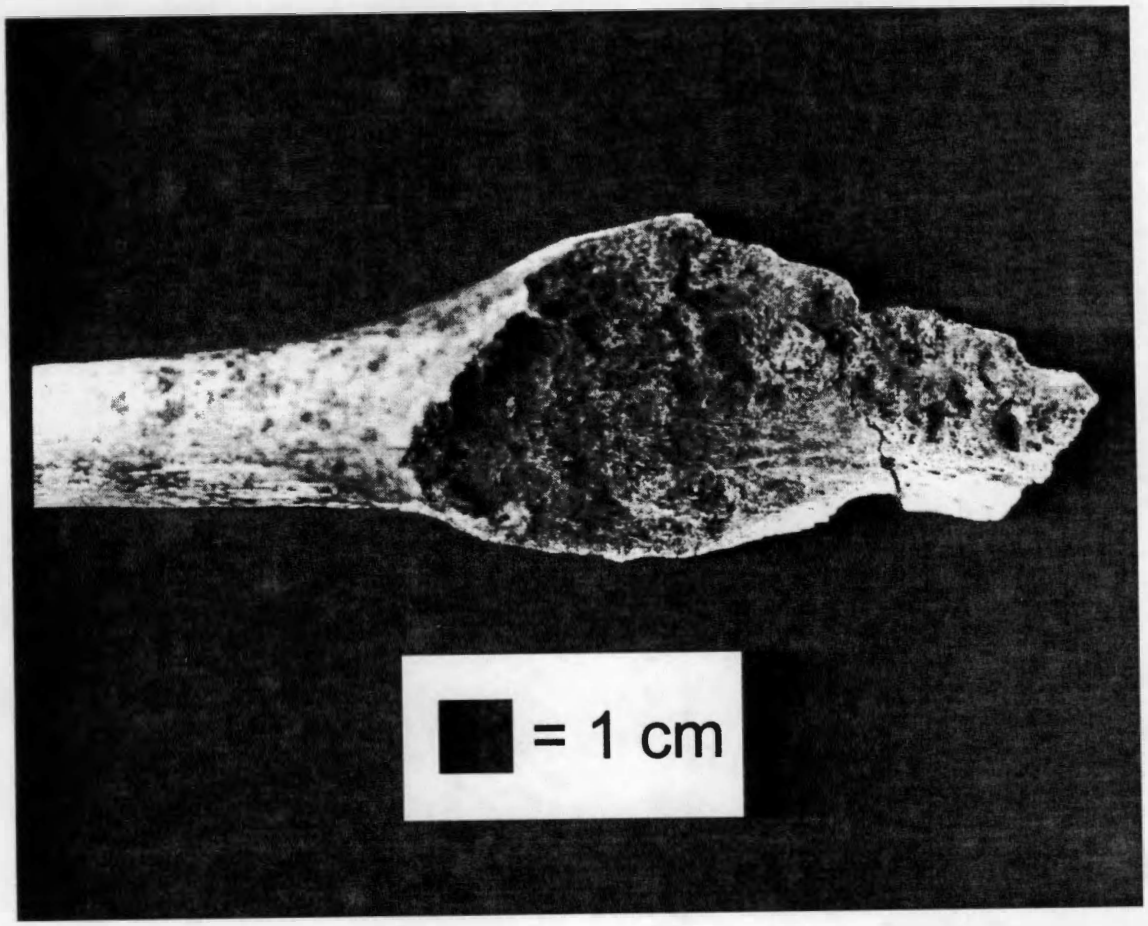


Figure 15-18. Medullary Infection in Burial 120A's Right Tibia.

with this health response, suggestive of a systemic condition. One of these, Burial 137A, possessed inactive and several very small active lesions on the left tibia. This indicated that the condition might have been taxing the body's immunological defense systems at time of death.

Comparative Analysis

While confirmation of the presence of a risk agent in the Wickliffe community implies that the environmental state allowed the agent to exist, it does not indicate how much community health was impacted. A shared risk exposure is indicated if responses to a risk agent are detected in several individuals. In modern communities, shared health risks are frequently patterned. They indicate that particular segments of a population are more susceptible to certain health risks than other groups (Lillienfield and Stolley 1994:103). This differential risk profoundly impacts the capacity of a population to survive in a given environmental situation. Differential risk is most visible when contrasted against other populations.

Among non-living populations, valid comparisons are more difficult to make than among living populations. If good health can only be defined as an abstract concept in a single skeletal population, how can be it be compared between two reconstructed assemblages? In and by itself there are many unknown variables that prohibit treating health in most skeletal assemblages with the same degree of accuracy found in living population analyses. But, comparisons of the frequency that maladies appear allow some perspective to be gained about interactions with the local ecology.

It is important to recognize that skeletal data is much more limited than living population data. Many modern population health research methods are grounded on knowing the incidence. Incidence describes the frequency of new cases occurring over a specific period of time (Rockett 1999:18). At best, archaeological time is approximated and the accumulation period for Mound C is not precisely dated. There is no way to establish a time rate for health hazard incidence. This reduces the quantitative methods largely to those based on prevalence.

Prevalence in a population is determined by a much less stringent control over time. Rather than calculating the appearance of health maladies over a given period of time, prevalence is simply

a measurement of the proportion (%) of cases present within a population at any given time (Rockett 1999:18). Cemetery data is often examined by use of the long duration periods allowable by prevalence (Waldron 1994:45). In the Mound C assemblage, time is defined as the period between birth of the oldest earliest interment and death of the most recent interment in the examination sample.

While prevalence data can be used in skeletal health analysis, it lacks much of the statistical power and accuracy found in incidence data. Prevalence data can rarely, if ever, be treated as anything but categorical information, limiting analysis to strictly non-ordinal statistics. Calculation of a condition's prevalence and odds ratio provides the basic statistics needed to assess whether the risk agent was more or less of a threat to community health than in other communities.

Compared Assemblages

In order to understand how quality of life at Wickliffe compared with other Mississippian communities, health response data was collected from the Averbuch (40DV60) and Tinsley Hill (15LY18a/b) skeletal assemblages. Both collections were examined and scored following the same procedures outlined for Mound C.

The Averbuch assemblage was represented by three mortuary concentrations associated with a large palisaded habitation area in Davidson County, Tennessee (Reed 1978:1-3). Super-positioning of graves, structures, and palisade lines indicate several temporal shifts in village organization, but evidence implicating the presence of more than one community is lacking (Eisenberg 1986:37). Application of a 2-Sigma error range to the site's Late Thirteenth-Early Fourteenth radiocarbon dates, as reported by Reed (1984:2-4), place site occupation well within the Wickliffe cemetery accumulation period (See Mattemes 1999:71-74). Demographic and health aspects of the community have been documented by Berryman (1981) and Eisenberg (1986). Eisenberg (1986:174) characterizes the assemblage as that of a 'marginal' population with a broad-based maize dependent nutritionally stressed subsistence pattern and a relatively high disease load. $_{13}C$ values, reported by Buikstra et al. (1988:247) indicate a diet containing high concentration of maize, implying less reliance or availability of other nutritional resources. The Tinsley Hill

assemblage was represented by a mortuary sample from the Mississippian period cemetery associated with a small mound and village complex on the banks of the Cumberland River in Lyon County, Kentucky (Schwartz 1961:2). The exact size and distribution of the cemetery remains unclear. There are numerous super-positioned graves and prehistoric disturbances of fully skeletonized human remains inferring that the area designated for mortuary behavior was used for a considerable period of time. Clay (1997:22) suggested that the village was occupied in the late thirteenth century; however a single questionable date from the cemetery implied cultural activity into the late fourteenth century (Clay 1997:23). These dates are slightly later than those generally obtained from Wickliffe contexts, but they not out of the range of contemporaneity. Demographic and health profiles for the Tinsley Hill assemblage have been considered by Schwartz (1961), Lewellyn (1964) and most comprehensively by Lane (1993). Lane (1993:103-105) felt that Tinsley Hill's quality of life was less severe than that noted at Averbuch, probably in relation to the region's lower population density and greater range of subsistence alternatives.

Calculating Prevalence

Any direct comparison of diagnosed conditions is problematic. Comparing prevalences for diagnosed health problems between Mound C and other Mississippian assemblages requires these diagnoses to be based on the same battery of observations, each given the same interpretive weight and scored on the same set of observation sites. Previous health examinations have been made of Mississippian skeletal assemblages following different approaches and most diagnoses have been based on a more comprehensive screening of skeletal elements. Rather than re-diagnose comparative collections from the perspective of limbs alone, and thus wrestle with inter-observer variations and false negatives (where original diagnoses were grounded on materials outside the screened observation sites), a less problematic comparison was made by simply comparing health skeletal responses.

As stated earlier, unmodified (Crude or Period) prevalence is the simple proportion of individuals with a response relative to the population size. It is defined as the following relationship:

$$\frac{\textit{Number of Cases with a Risk Agent (Health Response)}}{\textit{Total Population of Subjects (Observation Sites)}} \qquad ((1))$$

Basing comparisons on skeletal health responses, rather than specific diagnosed risk agents, modifies how prevalence was measured. Skeletal health responses are rarely diagnostic of a specific risk agent. Instead, they identify that environmental conditions existed that were capable of supporting health response inducing agents. Prevalence of health responses relate the degree that these environmental circumstances impacted the study assemblage. It is possible to compare health responses between assemblages if it can be assumed that the agents capable of producing a given skeletal lesion are the same for each assemblage.

It is important to recognize that risk agent and health response prevalences are not mutually exclusive. Health responses generally do not convey much meaningful information about specific risk agents. If a diagnosed risk agent impacts limb bone health, its presence will be reflected as a contribution to a given health response. Health response prevalences may lack risk agent specificity, but they have the advantage of accurately comparing health conditions within less than ideal analytical environments. Prevalence can be an extremely unforgiving statistic. It has the power to misrepresent health data if care is not taken to precisely define what features were represented in a specifically defined population sample. In this study, prevalences were calculated for each health response relative to each observation site. Since the period in question reflects the life history of those represented during burial accumulation, active lesions and those in remission were pooled into the same assemblage.

Epidemiologists generally calculate prevalences according to the proportion of subjects examined with the condition of interest. When applied to less than completely represented skeletal populations, however, definition of a 'subject' greatly affects the resulting statistic. Among living populations, subjects generally refer to 'whole' individuals. Unlike limb observation sites on most living individuals, skeletal limb observation sites are located on two distinct objects, both of which were present during the individual's lifetime, but frequently may not be part of an archaeological assemblage. By treating the individual as a unit of study, presence of a health response on one or both limbs identifies the individual as a 'case'. The absence of a response on both limbs, however, is needed to define the subject as 'unaffected'. When only a single 'unaffected' observation site is

present, the analyst must either reject including the subject in the study and reduce the study's sample size or make allowances for the missing observation site's health.

There are a number of correction methods available to account for relatively small proportions of missing data. When applied to highly incomplete skeletal assemblages, where any given pair of observation sites may be missing 50% or more of the data, it is unclear whether these methods have any bearing on reality. The alternative is to work within the bounds of the data. As stated earlier, in order to meet epidemiological standards from skeletal materials, pairs of bilateral observation sites must be examined to classify subjects as healthy, but only one affected bone is needed to deem an individual as a case. This requirement makes it hard to assign individuals an unaffected status. Given that no physiological condition has influenced the preservation of unaffected limbs, simple quantification of the known values (shown in Equation 2) will overestimate prevalence by removing unaffected single-limb individuals from the comparative population. True prevalence can be expected to be less than this value[4].

$$\frac{(\textit{Cases Based on 2 Observation Sites}) + (\textit{Cases Based on 1 Observation Site})}{\textit{Total Population of Individuals with 2 Observation Sites}} \qquad ((2))$$

Another approach is to treat each observation site as the unit of study and calculate prevalence from a population of observation sites (See Equation 3). This technique determines prevalence from the actual sample of materials present and includes all materials in the total sample size. In order to use this approach, however, the analyst must assume that bilateral observation sites in the same individual are physiologically independent. This assumption may not be valid for every health response or underlying risk agent. More disturbingly, in any population where the agent does not bilaterally affect observation sites, this approach will add false negatives to the denominator. The resulting prevalence value will underestimate the assemblage's true prevalence.

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[4] Since the entire sample is not considered, it is possible for the numerator to be greater than the denominator. The resulting prevalence will be larger than the study scaled population size. In these cases, the overestimated prevalence has the effect of assuming that all individuals were affected.

$$\frac{\textit{Observation Site with a Condition}}{\textit{Total Number of Observation Sites}} \qquad ((3))$$

If the outlined 'individual' approach overestimates true prevalence and the 'limb' method underestimates it, then the true prevalence must be represented between them. Quantitative differences expressed by both approaches would also imply real differences in true prevalence rates. Prevalences were calculated using both the individual and limb approaches to provide a range encompassing true prevalences.

Prevalences assume that all individuals described within a given proportion have an equal chance of contracting the studied response. Studies by Gage (1991) and Wood et al. (1992) (among others) have demonstrated that many agents target specific age groups more than others. Several of the health conditions diagnosed from Mound C clearly manifest at different points in the host's life cycle, and thus demonstrate differential risk by age. This problem is compounded by differences in age structure, where prevalences from more than one assemblage are contrasted. Prevalences were standardized to correct for these biases. Waldron (1994:64-66) suggests the use of an artificial standard as a means of clarifying prevalence, where separate age groups are defined and summed across each compared assemblage. Rather than scaling the unmodified prevalences by 1000, prevalence rates for each age group were computed and then multiplied by the summed age count (See Equation 4).

$$\frac{\textit{Observed Cases (Within an Age Class)}}{\textit{Observed Subject (Within an Age Class)}} \times \textit{Age Specific Count} = \textit{Age Standardized Prevalence} \qquad ((4))$$

The resulting standardized prevalences ground the compared populations to a common age structure. These results imply nothing about health relationships with other non-standardized assemblages (Waldron 1994:65).

Vagaries in age determination from preservation biases severely compromised the ability to accurately age limbs from Mound C. Most limbs, however, could be identified as reflecting a mature or immature degree of size, shape and skeletal development, particularly when compared with other, more reliably aged specimens. Mound C limbs could be reliably divided into adult and subadult

groups. Frequencies by age groups were calculated and limbs from Averbuch and Tinsley Hill were likewise divided. Age estimates crossing the age 18 sectioning point were apportioned by person-years to each category. In Table 15-7, unmodified d_x values within each assemblage's age group were summed to create an artificial age standard[5]. The observed samples were placed in age classes and multiplied by the appropriate age standard. The age-adjusted prevalences were computed for both the individual and limb approaches (Tables 15-8, 15-9 and 15-10).

Table 15-7. Artificial Age Standard.

Age Group (Years)	Apportioned Age Frequency			Ave Standard (Sum)
	Mound C	Averbuch	Tinsley Hill	
0-17.99	31.35	265.00	28.00	324.35
18-~60	96.62	451.00	57.00	604.62
Total	128.00	716.00	113.00	928.97

Calculating Prevalence Odds Ratios

Where observation sites are common between assemblages, the prevalence ranges provided by individual and limb approaches, tend to be concordant. These data may indicate that health conditions did not differ dramatically between communities. In some cases, ranges vary considerably. The magnitude of variation between prevalences infers that sample size disparities may be biasing these statistics. It is unlikely that these data can be accurately interpreted at face

[5] Note that differences in available samples from Averbuch and Tinsley Hill required re-evaluation of d_x. These values therefore differ from those reported by other analysts.

Table 15-8. Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Humerus	Cartilage Ossification	>18			4.41	11.933		
Humerus Prevalence	Cartilage Ossification				4.66	12.902		
Ulna	Cartilage Ossification	>18	74.15	151.762	100.27	192.281	18.89	75.54
Ulna Prevalence	Cartilage Ossification		103.21	232.242	106.21	203.920	20.64	232.067
Radius	Cartilage Ossification	>18			23.71	57.779		
Radius Prevalence	Cartilage Ossification				26.73	68.092		
Femur	Cartilage Ossification	<18						
Femur	Cartilage Ossification	>18						
Femur Prevalence	Cartilage Ossification							
Tibia	Cartilage Ossification	>18	69.17	202.977	20.74	44.375	100.76	151.08
Tibia Prevalence	Cartilage Ossification		96.10	265.420	22.97	50.441	98.82	218.416

Table 15-8 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Fibula Prevalence	Cartilage Ossification						46.44	326.1
Ulna	Bowing	>18						
Ulna Prevalence	Bowing							
Tibia	Bowing	<18						
Tibia	Bowing	>18						
Tibia Prevalence	Bowing							
Fibula	Bowing	>18						
Fibula Prevalence	Bowing							
Humerus	Cortical Volume Increase	<18						
Humerus	Cortical Volume Increase	>18						
Humerus Prevalence	Cortical Volume Increase							
Ulna	Cortical Volume Increase	<18			8.91	25.539	24.94	81.087

Table 15-8 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Ulna	Cortical Volume Increase	>18			5.98	12.818	56.68	151.08
Ulna Prevalence	Cortical Volume Increase				14.26	36.252	82.57	232.067
Radius	Cortical Volume Increase	<18						
Radius	Cortical Volume Increase	>18			4.44	12.381	25.45	100.72
Radius Prevalence	Cortical Volume Increase				5.01	14.591	25.10	92.827
Femur	Cortical Volume Increase	<18			1.22	3.133	17.07	46.335
Femur	Cortical Volume Increase	>18			1.03	2.472	40.3	71.096
Femur Prevalence	Cortical Volume Increase				2.19	5.338	58.06	116.033
Tibia	Cortical Volume Increase	<18			3.86	14.102	19.07	64.87
Tibia	Cortical Volume Increase	>18			16.3	38.828	100.76	251.8

Table 15-8 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Tibia Prevalence	Cortical Volume Increase				21.33	54.645	118.58	327.624
Fibula	Cortical Volume Increase	<18			8.26	10.462		
Fibula	Cortical Volume Increase	>18			8.74	17.274	151.15	403.07
Fibula Prevalence	Cortical Volume Increase				16.24	27.593	232.24	530.440
Humerus	Degeneration	>18						
Humerus Prevalence	Degeneration							
Ulna	Degeneration	>18			1.49	4.272		
Ulna Prevalence	Degeneration				1.58	4.531		
Femur	Degeneration	>18						
Femur Prevalence	Degeneration							
Tibia	Degeneration	>18	7.68	25.414	4.44	11.093	20.15	50.36
Tibia Prevalence	Degeneration		10.67	33.197	4.92	12.610	19.76	554.604

Table 15-8 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Humerus	Injury	>18						
Humerus Prevalence	Injury							
Ulna	Injury	>18						
Ulna Prevalence	Injury							
Radius	Injury	>18						
Radius Prevalence	Injury							
Femur	Injury	>18			2.07	4.945		
Femur Prevalence	Injury				2.19	5.338		
Tibia	Injury	>18						
Tibia Prevalence	Injury							
Fibula	Injury	>18			2.91	8.637		
Fibula Prevalence	Injury				3.24	9.197		

Table 15-8 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Humerus	Enthesophyte	>18						
Humerus Prevalence	Enthesophyte							
Ulna	Enthesophyte	>18						
Ulna Prevalence	Enthesophyte							
Radius	Enthesophyte	>18						
Radius Prevalence	Enthesophyte							
Femur	Enthesophyte	<18						
Femur	Enthesophyte	>18						
Femur Prevalence	Enthesophyte							
Tibia	Enthesophyte	>18	23.05	76.116	1.48	3.697		
Tibia Prevalence	Enthesophyte		32.03	99.532	1.64	4.203		
Fibula	Enthesophyte	>18					71.13	204.44

Table 15-8 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Fibula Prevalence	Enthesophyte						92.89	265.22
Humerus	Medullary Volume Increase	<18						
Humerus	Medullary Volume Increase	>18						
Humerus Prevalence	Medullary Volume Increase							
Ulna	Medullary Volume Increase	<18			1.78	5.107		
Ulna	Medullary Volume Increase	>18			2.99	8.545		
Ulna Prevalence	Medullary Volume Increase				4.75	13.594		
Radius	Medullary Volume Increase	<18						
Radius	Medullary Volume Increase	>18			1.48	4.127		
Radius Prevalence	Medullary Volume Increase				1.67	4.863		

Table 15-8 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Femur	Medullary Volume Increase	>18						
Femur Prevalence	Medullary Volume Increase							
Tibia	Medullary Volume Increase	<18						
Tibia	Medullary Volume Increase	>18			1.48	7.395		
Tibia Prevalence	Medullary Volume Increase				3.28	8.406		
Fibula	Medullary Volume Increase	<18						
Fibula	Medullary Volume Increase	>18			5.82	8.637		
Fibula Prevalence	Medullary Volume Increase				6.49	9.197		
Humerus	Osteolysis	<18			1.47	5.067		
Humerus	Osteolysis	>18						
Humerus Prevalence	Osteolysis				1.55	4.300		

Table 15-8 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Proximal Observation Sites.

Element	Health Response	Age	Bone Mound C Proximal	Individual Mound C Proximal	Bone Averbuch Proximal	Individual Averbuch Proximal	Bone Tinsley Hill Proximal	Individual Tinsley Hill Proximal
Radius	Osteolysis	>18			1.48	4.127		
Radius Prevalence	Osteolysis				1.67	4.863		
Femur	Osteolysis	>18						
Femur Prevalence	Osteolysis							
Tibia	Osteolysis	<18			1.92	5.64		
Tibia	Osteolysis	>18	15.37	50.744				
Tibia Prevalence	Osteolysis		20.87	66.355	3.28	4.203		
Fibula	Osteolysis	>18						
Fibula Prevalence	Osteolysis							
Tibia	Cortical Thinning	<18						
Tibia	Cortical Thinning	>18						
Tibia Prevalence	Cortical Thinning							

Table 15-9: Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Humerus	Cartilage Ossification	>18					98.31	
Humerus Prevalence	Cartilage Ossification							
Ulna	Cartilage Ossification	>18						
Ulna Prevalence	Cartilage Ossification							
Radius	Cartilage Ossification	>18						
Radius Prevalence	Cartilage Ossification							
Femur	Cartilage Ossification	<18						
Femur	Cartilage Ossification	>18						
Femur Prevalence	Cartilage Ossification							
Tibia	Cartilage Ossification	>18						
Tibia Prevalence	Cartilage Ossification							

Table 15-9 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Fibula	Cartilage Ossification	>18						
Fibula Prevalence	Cartilage Ossification							
Ulna	Bowing	>18						
Ulna Prevalence	Bowing							
Tibia	Bowing	<18			15.35	5.73	11.08	32.435
Tibia	Bowing	>18	7.78	22.971	8.1	8.964	11.24	30.216
Tibia Prevalence	Bowing		10.37	29.966	9.26	14.613	22.38	61.884
Fibula	Bowing	>18	5.77	16.874				
Fibula Prevalence	Bowing		8.14	24.446				
Humerus	Cortical Volume Increase	<18			9.56	10.135		
Humerus	Cortical Volume Increase	>18			5.15	7.125		
Humerus Prevalence	Cortical Volume Increase				8.61	15.899		

Table 15-9 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Ulna	Cortical Volume Increase	<18			5.28	13.656	14.74	54.058
Ulna	Cortical Volume Increase	>18			5.87	11.538		
Ulna Prevalence	Cortical Volume Increase				10.76	23.419	16.29	48.856
Radius	Cortical Volume Increase	<18			11.68	22.841	39.91	162.175
Radius	Cortical Volume Increase	>18			2.01	4.742		
Radius Prevalence	Cortical Volume Increase				11.31	19.947	33.17	123.769
Femur	Cortical Volume Increase	<18			8.45	12.216	8.94	21.623
Femur	Cortical Volume Increase	>18	3.34	10.201	15.49	25.213	67.41	104.193
Femur Prevalence	Cortical Volume Increase		4.62	13.865	23.94	37.588	77.41	126.582
Tibia	Cortical Volume Increase	<18	2.88	4.504	22.23	43.55	24.94	75.573

Table 15-9 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Tibia	Cortical Volume Increase	>18	73.04	205.138	100.54	155.388	188.41	352.318
Tibia Prevalence	Cortical Volume Increase		98.60	269.700	105.56	202.494	212.65	433.132
Fibula	Cortical Volume Increase	<18	69.52	300.324	31.35	48.652	12.71	28.602
Fibula	Cortical Volume Increase	>18	51.99	134.997	5.93	99.417	149.45	376.416
Fibula Prevalence	Cortical Volume Increase		89.63	244.465	91.85	148.901	159.25	384.111
Humerus	Degeneration	>18						
Humerus Prevalence	Degeneration							
Ulna	Degeneration	>18						
Ulna Prevalence	Degeneration							
Femur	Degeneration	>18						
Femur Prevalence	Degeneration							
Tibia	Degeneration	>18						
Tibia Prevalence	Degeneration							

Table 15-9 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Humerus	Injury	>18			1.79	4.071		
Humerus Prevalence	Injury				1.91	4.542		
Ulna	Injury	>18			1.95	4.615		
Ulna Prevalence	Injury				2.15	5.204		
Radius	Injury	>18						
Radius Prevalence	Injury							
Femur	Injury	>18						
Femur Prevalence	Injury							
Tibia	Injury	>18			0.9	1.992		
Tibia Prevalence	Injury				0.92	2.087		
Fibula	Injury	>18	5.77	16.874	0.94	8.115		
Fibula Prevalence	Injury		8.14	24.446	4.08	8.889		
Humerus	Enthesophyte	>18					13.81	40.288
Humerus Prevalence	Enthesophyte						14.29	40.359

Table 15-9 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Ulna	Enthesophyte	>18	7.29	31.956				
Ulna Prevalence	Enthesophyte		10.55	48.893				
Radius	Enthesophyte	>18					15.21	54.938
Radius Prevalence	Enthesophyte						16.58	61.884
Femur	Enthesophyte	<18			0.84	2.036		
Femur	Enthesophyte	>18	13.43	40.804			8.22	20.838
Femur Prevalence	Enthesophyte		18.48	55.460	0.79	1.789	8.60	21.097
Tibia	Enthesophyte	>18	7.78	22.971	0.90	1.992	11.24	30.216
Tibia Prevalence	Enthesophyte		10.37	29.966		2.087	11.19	30.942
Fibula	Enthesophyte	>18			2.82	4.057		
Fibula Prevalence	Enthesophyte				3.06	4.444		
Humerus	Medullary Volume Increase	<18			1.47	2.895		
Humerus	Medullary Volume Increase	>18			0.62	2.035		

Table 15-9 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Humerus Prevalence	Medullary Volume Increase				1.91	4.542		
Ulna	Medullary Volume Increase	<18			1.32	6.828		
Ulna	Medullary Volume Increase	>18						
Ulna Prevalence	Medullary Volume Increase				1.07	5.204		
Radius	Medullary Volume Increase	<18			2.19	4.568		
Radius	Medullary Volume Increase	>18			1.00	2.371		
Radius Prevalence	Medullary Volume Increase				2.26	5.699		
Femur	Medullary Volume Increase	>18	3.34	10.201	1.54	3.361		
Femur Prevalence	Medullary Volume Increase		4.62	13.865	1.59	3.593		
Tibia	Medullary Volume Increase	<18	2.1	2.425	3.86	6.876		
Tibia	Medullary Volume Increase	>18	34.42	79.482	6.33	15.937		

Table 15-9 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Tibia Prevalence	Medullary Volume Increase		46.70	104.883	10.18	22.963		
Fibula	Medullary Volume Increase	<18			3.61	10.811		
Fibula	Medullary Volume Increase	>18	11.55	33.749	4.71	2.028		
Fibula Prevalence	Medullary Volume Increase		16.29	48.893	5.10	11.112		
Humerus	Osteolysis	<18						
Humerus	Osteolysis	>18						
Humerus Prevalence	Osteolysis							
Radius	Osteolysis	>18						
Radius Prevalence	Osteolysis							
Femur	Osteolysis	>18						
Femur Prevalence	Osteolysis							
Tibia	Osteolysis	<18						
Tibia	Osteolysis	>18						
Tibia Prevalence	Osteolysis		5.18		0.92			

Table 15-9 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Central Observation Sites.

Element	Health Response	Age	Bone Mound C Central	Individual Mound C Central	Bone Averbuch Central	Individual Averbuch Central	Bone Tinsley Hill Central	Individual Tinsley Hill Central
Fibula	Osteolysis	>18						
Fibula Prevalence	Osteolysis							
Tibia	Cortical Thinning	<18	1.05	2.425				
Tibia	Cortical Thinning	>18	11.37	33.538				
Tibia Prevalence	Cortical Thinning		15.55	44.950				

Table 15-10. Age Adjusted Prevalences (per 1000 Individuals) for Distal Observation Sites.

Element	Health Response	Age	Bone Mound C Distal	Individual Mound C Distal	Bone Averbuch Distal	Individual Averbuch Distal	Bone Tinsley Hill Distal	Individual Tinsley Hill Distal
Humerus	Cartilage Ossification	>18	8.68	93.018	58.23	115.165	98.31	431.657
Humerus Prevalence	Cartilage Ossification		12.22	132.710	64.30	135.772	100.97	386.779
Ulna	Cartilage Ossification	>18	28.79	120.924	30.13	62.981	82.44	302.16
Ulna Prevalence	Cartilage Ossification		35.72	154.838	32.71	71.459	107.18	371.308
Radius	Cartilage Ossification	>18	14.39	75.577	38.79	83.716	131.43	362.592
Radius Prevalence	Cartilage Ossification		19.76	116.121	43.80	97.786	149.83	348.101
Femur	Cartilage Ossification	<18			1.58	213.500		
Femur	Cartilage Ossification	>18	55.9	163.85	132.38	215.294	79.55	185.944
Femur Prevalence	Cartilage Ossification		73.58	209.767	141.29	230.323	84.45	195.425
Tibia	Cartilage Ossification	>18	18.38	31.965	13.51	11.377	89.57	120.864
Tibia Prevalence	Cartilage Ossification		26.04	44.236	15.35	13.380	106.16	154.711
Fibula	Cartilage Ossification	>18						
Fibula Prevalence	Cartilage Ossification							

Table 15-10 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Distal Observation Sites.

Element	Health Response	Age	Bone Mound C Distal	Individual Mound C Distal	Bone Averbuch Distal	Individual Averbuch Distal	Bone Tinsley Hill Distal	Individual Tinsley Hill Distal
Ulna	Bowing	>18			2.00	6.298		
Ulna Prevalence	Bowing					7.145		
Tibia	Bowing	<18						
Tibia	Bowing	>18						
Tibia Prevalence	Bowing							
Fibula	Bowing	>18						
Fibula Prevalence	Bowing							
Humerus	Cortical Volume Increase	<18			9.33	24.125		
Humerus	Cortical Volume Increase	>18	8.68	46.509	6.81	13.368		
Humerus Prevalence	Cortical Volume Increase		12.22	66.355	15.04	32.156		
Ulna	Cortical Volume Increase	<18			7.78	19.079		
Ulna	Cortical Volume Increase	>18			2.00	6.298		
Ulna Prevalence	Cortical Volume Increase				8.72	21.437		
Radius	Cortical Volume Increase	<18			2.4	7.91		
Radius	Cortical Volume Increase	>18			1.61	4.65	26.28	120.864

Table 15-10 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Distal Observation Sites.

Element	Health Response	Age	Bone Mound C Distal	Individual Mound C Distal	Bone Averbuch Distal	Individual Averbuch Distal	Bone Tinsley Hill Distal	Individual Tinsley Hill Distal
Radius Prevalence	Cortical Volume Increase				3.65	10.865	29.96	116.033
Femur	Cortical Volume Increase	<18			5.09	4.412		
Femur	Cortical Volume Increase	>18			11.32	25.117		
Femur Prevalence	Cortical Volume Increase				16.53	30.709		
Tibia	Cortical Volume Increase	<18			4.11			
Tibia	Cortical Volume Increase	>18	12.25	31.965	36.47	35.757	117.56	302.16
Tibia Prevalence	Cortical Volume Increase		17.36	44.236	44.52	42.052	185.79	386.77
Fibula	Cortical Volume Increase	<18			17.07	11.38		
Fibula	Cortical Volume Increase	>18			16.69	43.773	111.96	241.728
Fibula Prevalence	Cortical Volume Increase				30.03	60.149	149.83	371.308
Humerus	Degeneration	>18	8.68	46.509				
Humerus Prevalence	Degeneration		12.22	66.355				
Ulna	Degeneration	>18						
Ulna Prevalence	Degeneration							

Table 15-10 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Distal Observation Sites.

Element	Health Response	Age	Bone Mound C Distal	Individual Mound C Distal	Bone Averbuch Distal	Individual Averbuch Distal	Bone Tinsley Hill Distal	Individual Tinsley Hill Distal
Femur	Degeneration	>18			4.24	10.764	15.91	46.486
Femur Prevalence	Degeneration				4.50	11.516	16.88	48.856
Tibia	Degeneration	>18						
Tibia Prevalence	Degeneration							
Humerus	Injury	>18						
Humerus Prevalence	Injury							
Ulna	Injury	>18			6.02	18.894		
Ulna Prevalence	Injury				6.54	221.437		
Radius	Injury	>18			11.31	32.556		
Radius Prevalence	Injury				12.77	32.028		
Femur	Injury	>18						
Femur Prevalence	Injury							
Tibia	Injury	>18						
Tibia Prevalence	Injury							
Fibula	Injury	>18						
Fibula Prevalence	Injury							
Humerus	Enthesophyte	>18	17.36	93.018			19.66	86.331

Table 15-10 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Distal Observation Sites.

Element	Health Response	Age	Bone Mound C Distal	Individual Mound C Distal	Bone Averbuch Distal	Individual Averbuch Distal	Bone Tinsley Hill Distal	Individual Tinsley Hill Distal
Humerus Prevalence	Enthesophyte		24.44	132.71			20.19	77.355
Ulna	Enthesophyte	>18						
Ulna Prevalence	Enthesophyte							
Radius	Enthesophyte	>18					26.28	120.864
Radius Prevalence	Enthesophyte						29.96	116.033
Femur	Enthesophyte	<18						
Femur	Enthesophyte	>18	6.98	23.407				
Femur Prevalence	Enthesophyte		9.19	29.966				
Tibia	Enthesophyte	>18					22.39	32.236
Tibia Prevalence	Enthesophyte						26.54	52.503
Fibula	Enthesophyte	>18			1.85	5.471		
Fibula Prevalence	Enthesophyte				2.31	6.683		
Humerus	Medullary Volume Increase	<18			1.69	5.361		
Humerus	Medullary Volume Increase	>18						
Humerus Prevalence	Medullary Volume Increase				1.36	3.572		
Ulna	Medullary Volume Increase	<18			5.18	9.539		

Table 15-10 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Distal Observation Sites.

Element	Health Response	Age	Bone Mound C Distal	Individual Mound C Distal	Bone Averbuch Distal	Individual Averbuch Distal	Bone Tinsley Hill Distal	Individual Tinsley Hill Distal
Ulna	Medullary Volume Increase	>18						
Ulna Prevalence	Medullary Volume Increase				4.36	7.145		
Radius	Medullary Volume Increase	<18						
Radius	Medullary Volume Increase	>18						
Radius Prevalence	Medullary Volume Increase							
Femur	Medullary Volume Increase	>18	6.98	23.407	2.83	3.588		
Femur Prevalence	Medullary Volume Increase		9.19	29.966	3.00	3.838		
Tibia	Medullary Volume Increase	<18						
Tibia	Medullary Volume Increase	>18	6.12		1.351	1.625		
Tibia Prevalence	Medullary Volume Increase		8.68	22.118	1.53	1.911		
Fibula	Medullary Volume Increase	<18						
Fibula	Medullary Volume Increase	>18			1.85	5.471		
Fibula Prevalence	Medullary Volume Increase				2.31	6.683		

Table 15-10 (continued). Age Adjusted Prevalences (per 1000 Individuals) for Distal Observation Sites.

Element	Health Response	Age	Bone Mound C Distal	Individual Mound C Distal	Bone Averbuch Distal	Individual Averbuch Distal	Bone Tinsley Hill Distal	Individual Tinsley Hill Distal
Humerus	Osteolysis	<18						
Humerus	Osteolysis	>18	17.36	93.018	1.23	3.03		
Humerus Prevalence	Osteolysis		24.44	132.710	1.36	3.572		
Radius	Osteolysis	>18						
Radius Prevalence	Osteolysis							
Femur	Osteolysis	>18	13.97	46.815	7.07	17.941	15.91	46.486
Femur Prevalence	Osteolysis		18.39	59.933	7.51	19.193	16.88	48.856
Tibia	Osteolysis	<18						
Tibia	Osteolysis	>18						
Tibia Prevalence	Osteolysis							
Fibula	Osteolysis	>18					22.39	60.432
Fibula Prevalence	Osteolysis						29.96	92.827
Tibia	Cortical Thinning	<18						
Tibia	Cortical Thinning	>18						
Tibia Prevalence	Cortical Thinning							

value. Affected and unaffected elements of each assemblage, however, can be evaluated to determine if the assemblages are proportionately similar.

True differences between populations can be realized by calculating a Prevalence Odds Ratio. The Prevalence Odds Ratio (or Relative Risk) estimates the risk of developing a health response from exposure to a particular environment. Given that the Wickliffe, Averbuch and Tinsley Hill skeletal assemblages were formed by different communities, each with unique socio-biological settings, similarities in risk may imply analogous environmental situations. Likewise, differences are evidence that some community environments varied. This indirectly indicates whether risk agents are more or less successful at reducing the quality of life in a particular community.

Prevalence Odds Ratios were calculated following the methods outlined by Clayton and Hills (1993:166-173) and Mantel and Haenszel (1959). To determine if the range of variation significantly differed between Mound C and the comparative populations, a 95% confidence interval was constructed for each comparison, following Gardner and Altman (1989:59-61). Ranges where the odds ratio did not include 1.00 (a value indicating the possibility of equal proportionate representation) as a possible value were considered significantly variable enough from one another to infer an environmental difference. As a means of estimating whether these proportionate representations could have been produced by random fluctuations, P values were obtained by submitting each comparison to a Chi-Square Test for Independence. Comparisons detecting significant variations between assemblages for both limb and individual approaches would suggest that the true prevalences are also different. If only one of the approaches reveals statistically meaningful variation, then the possibility of true differences represent only one of the alternatives present within the prevalence ranges.

For these tests, fractional values were recorded to the nearest whole number. A total of 92 comparisons (46 Individual Approach; 46 Limb Approach) were possible between Mound C and the Averbuch or Tinsley Hill assemblages (Tables 15-11 and 15-12). Table 15-13 summarized the statistically significant variations observed in this comparison. In general 22 comparisons encompassed 14 observation sites. About 24% of these comparisons exhibited significantly variable

Table 15-11. Prevalence Odds Ratios for Individual Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval		Chi Value	Degree Of Free-dom	P Value
									Mini-mum	Maxi-mum			
Cartilage Ossification	Humerus - Distal	>18	2	11	Tinsley Hill	5	2	0.072	0.007	0.66	4.059	1	0.043
Cartilage Ossification	Humerus - Distal	>18	2	11	Averbuch	38	161.5	0.772	0.164	3.62	0.001	1	0.972
Cartilage Ossification	Ulna - Proximal	>18	5	14.92	Tinsley Hill	1	7	2.345	0.228	23.99	0.047	1	0.827
Cartilage Ossification	Ulna - Proximal	>18	5	14.92	Averbuch	45	96.5	0.718	0.245	2.09	0.134	1	0.713
Cartilage Ossification	Ulna - Distal	>18	1	4	Tinsley Hill	2	2	0.25	0.013	4.73	0.056	1	0.812
Cartilage Ossification	Ulna - Distal	>18	1	4	Averbuch	10	86	2.15	0.218	21.11	0.004	1	0.947
Cartilage Ossification	Radius - Distal	>18	1	7	Tinsley Hill	3	2	0.095	0.006	1.493	1.141	1	0.234
Cartilage Ossification	Radius - Distal	>18	1	7	Averbuch	18	112	0.888	0.103	7.64	0.177	1	0.673
Cartilage Ossification	Femur - Distal	>18	7	18.83	Tinsley Hill	4	9	0.836	0.103	3.60	0.015	1	0.899
Cartilage Ossification	Femur - Distal	>18	7	18.83	Averbuch	59	109	0.686	0.193	1.72	0.358	1	0.549
Cartilage Ossification	Tibia - Proximal	>18	8	15.83	Tinsley Hill	3	9	1.516	0.273	7.18	0.016	1	0.898

Table 15-11 (continued). Prevalence Odds Ratios for Individual Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval Mini-mum	Odds Ratio 95% Confidence Interval Maxi-mum	Chi Value	Degree Of Free-dom	P Value
Cartilage Ossification	Tibia - Proximal	>18	8.00	15.83	Averbuch	12	151.5	6.380	2.27	17.90	12.17	1	<0.01
Cartilage Ossification	Tibia - Distal	>18	2.00	35.83	Tinsley Hill	2	8	0.223	1.827	0.02	0.59	1	0.438
Cartilage Ossification	Tibia - Distal	>18	2.00	35.83	Averbuch	7	177	1.411	7.056	0.28	0.001	1	0.97
Bowing	Tibia - Central	>18	2.00	50.64	Tinsley Hill	1	19	0.750	0.064	8.74	0.181	1	0.67
Bowing	Tibia - Central	>18	2.00	50.64	Averbuch	4.5	299	2.624	0.483	14.23	0.492	1	0.482
Cortical Volume Increase	Humerus - Distal	>18	1.00	12.00	Averbuch	4.5	195	3.611	0.366	32.49	0.133	1	0.715
Cortical Volume Increase	Femur - Central	>18	1.00	58.27	Tinsley Hill	5	24	0.082	0.003	0.73	5.151	1	0.023
Cortical Volume Increase	Femur - Central	>18	1.00	58.27	Averbuch	15	344.7	0.394	0.051	70.3	0.304	1	0.581
Cortical Volume Increase	Tibia - Central	<18	0.13	9.23	Tinsley Hill	2.33	7.67	0.046	0.001	13.29	0.001	1	0.999

Table 15-11 (continued). Prevalence Odds Ratios for Individual Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval		Chi Value	Degree Of Freedom	P Value
									Minimum	Maximum			
Cortical Volume Increase	Tibia - Central	<18	0.13	9.23	Averbuch	19	122.5	0.090	0.003	21.88	0.028	1	0.865
Cortical Volume Increase	Tibia - Central	>18	17.86	34.78	Tinsley Hill	11.66	8.34	0.367	0.127	1.053	3.062	1	0.08
Cortical Volume Increase	Tibia - Central	>18	17.86	34.78	Averbuch	78	225.5	1.484	0.793	2.77	1.158	1	0.281
Cortical Volume Increase	Tibia - Distal	>18	2	35.83	Tinsley Hill	5	5	0.055	0.008	0.362	9.381	1	0.002
Cortical Volume Increase	Tibia - Distal	>18	2	35.83	Averbuch	22	162	0.411	1.827	0.092	0.851	1	0.356
Cortical Volume Increase	Fibula - Central	<18	2	0.16	Averbuch	18	102	70.83	0.425	11, 796.9	2.57	1	0.108
Cortical Volume Increase	Fibula - Central	<18	2	0.16	Tinsley Hill	1	10.34	129.2	0.533	311, 288.3	1.85	1	0.173

Table 15-11 (continued). Prevalence Odds Ratios for Individual Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval Mini-mum	Odds Ratio 95% Confidence Interval Maxi-mum	Chi Value	Degree Of Free-dom	P Value
Cortical Volume Increase	Fibula - Central	>18	8	27.83	Tinsley Hill	11	6.66	0.17	0.050	0.60	6.343	1	0.011
Cortical Volume Increase	Fibula - Central	>18	8	27.83	Averbuch	49	249	1.45	0.624	3.37	0.404	1	0.524
Degener-ation	Tibia - Proximal	>18	1	22.83	Tinsley Hill	1	11	0.48	0.027	8.42	0.066	1	0.796
Degener-ation	Tibia - Proximal	>18	1	22.83	Averbuch	3	160.5	2.34	0.236	23.71	0.001	1	0.983
Injury	Fibula - Central	>18	1	34.83	Averbuch	4	294	2.11	0.229	19.38	0.003	1	0.954
Entheso-phytes	Humerus - Distal	>18	2	11	Tinsley Hill	1	6	1.09	0.268	48.42	0.349	1	0.554
Entheso-phytes	Tibia - Proximal	>18	3	20.83	Averbuch	1	162.5	23.40	2.328	234.6	9.012	1	0.002
Entheso-phytes	Tibia - Central	>18	2	50.64	Averbuch	1	302.5	11.94	1.063	134.1	2.943	1	0.086
Entheso-phytes	Tibia - Central	>18	2	50.64	Tinsley Hill	1	19	0.75	0.064	8.74	0.181	1	0.67
Medullary Volume Increase	Femur - Central	>18	1	58.27	Averbuch	2	357.7	3.06	0.274	34.31	0.166	1	0.897

Table 15-11 (continued). Prevalence Odds Ratios for Individual Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval Mini-mum	Odds Ratio 95% Confidence Interval Maxi-mum	Chi Value	Degree Of Free-dom	P Value
Medullary Volume Increase	Femur - Distal	>18	1	24.83	Averbuch	1	167.5	6.74	0.408	111.1	0.23	1	0.628
Medullary Volume Increase	Tibia - Central	<18	0.07	9.29	Averbuch	3	138.5	0.34	0.000 1	641.6	0.22	1	0.631
Medullary Volume Increase	Tibia - Central	>18	6.92	45.72	Averbuch	8	295.5	5.59	1.93	16.15	10	1	0.001
Medullary Volume Increase	Fibula - Central	>18	2	33.83	Averbuch	1	297	7.55	1.552	198.1	4.84	1	0.027
Osteolysis	Humerus - Distal	>18	2	11	Averbuch	1	198.5	36.09	3.04	428.1	10.17	1	0.001
Osteolysis	Femur - Distal	>18	2	23.83	Tinsley Hill	1	12	1.00	0.082	12.21	0.40	1	0.523
Osteolysis	Femur - Distal	>18	2	23.83	Averbuch	5	163.5	2.74	0.504	14.91	0.40	1	0.525
Entheso-phytes	Femur - Central	>18	4	55.27	Tinsley Hill	1	28	2.02	0.216	18.95	0.02	1	0.88
Medullary Volume Increase	Tibia - Distal	>18	1	36.83	Averbuch	1	183	4.96	0.304	81.12	0.883	1	0.766

Table 15-12. Prevalence Odds Ratios for Limb Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval Mini-mum	Odds Ratio 95% Confidence Interval Maxi-Mum	Chi Value	Degree Of Free-dom	P Value
Cartilage Ossification	Humerus - Distal	>18	1	68.62	Tinsley Hill	5	25.75	0.075	0.008	0.719	5.88	1	0.01
Cartilage Ossification	Humerus - Distal	>18	1	68.62	Averbuch	47	441	0.136	0.019	1.035	4.24	1	0.03
Cartilage Ossification	Ulna - Proximal	>18	6	42.92	Tinsley Hill	1	31	4.326	0.493	37.55	1.04	1	0.3
Cartilage Ossification	Ulna - Proximal	>18	6	42.92	Averbuch	67	337	0.702	0.289	1.715	0.33	1	0.56
Cartilage Ossification	Ulna - Distal	>18	1	20	Tinsley Hill	3	18	0.300	0.028	3.15	0.27	1	0.59
Cartilage Ossification	Ulna - Distal	>18	1	20	Averbuch	15	286	0.953	0.119	7.566	0.22	1	0.63
Cartilage Ossification	Radius - Distal	>18	1	41	Tinsley Hill	5	18	0.088	0.009	0.830	4.53	1	0.03
Cartilage Ossification	Radius - Distal	>18	1	41	Averbuch	24	350	0.356	0.047	2.731	0.49	1	0.48
Cartilage Ossification	Femur - Distal	>18	8	79.51	Tinsley Hill	2	36	0.668	0.136	3.292	0.12	1	0.72
Cartilage Ossification	Femur - Distal	>18	8	79.51	Averbuch	93	334	0.364	0.168	0.771	6.47	1	0.01
Cartilage Ossification	Tibia - Proximal	>18	9	69.66	Tinsley Hill	5	25	0.643	0.197	2.103	0.17	1	0.67

Table 15-12 (continued). Prevalence Odds Ratios for Limb Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval Mini-mum	Odds Ratio 95% Confidence Interval Maxi-mum	Chi Value	Degree Of Free-dom	P Value
Cartilage Ossification	Tibia - Proximal	>18	9	69.66	Averbuch	14	394	3.618	1.500	8.61	7.63	1	<0.01
Cartilage Ossification	Tibia - Distal	>18	3	95.68	Tinsley Hill	4	23	0.180	0.037	0.86	3.59	1	0.05
Cartilage Ossification	Tibia - Distal	>18	3	95.68	Averbuch	10	437.5	1.384	0.372	5.09	<0.01	1	0.09
Bowing	Tibia - Central	>18	2	153.37	Tinsley Hill	1	52.75	0.693	0.061	7.75	0.13	1	0.71
Bowing	Tibia - Central	>18	2	153.37	Averbuch	6	661.5	1.440	0.287	7.15	<0.01	1	0.99
Cortical Volume Increase	Humerus - Distal	>18	1	68.72	Averbuch	5	483	1.400	0.160	12.06	<0.01	1	0.75
Cortical Volume Increase	Femur - Central	>18	1	179.5	Tinsley Hill	8	63.75	0.040	0.004	0.32	13.94	1	<0.01
Cortical Volume Increase	Femur - Central	>18	1	179.5	Averbuch	20	760.5	0.212	0.282	1.52	1.89	1	0.16
Cortical Volume Increase	Tibia - Central	<18	1	22.61	Tinsley Hill	2	27.25	0.587	0.050	6.97	0.02	1	0.86

Table 15-12 (continued). Prevalence Odds Ratios for Limb Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval Mini-mum	Odds Ratio 95% Confidence Interval Maxi-mum	Chi Value	Degree Of Free-dom	P Value
Cortical Volume Increase	Tibia - Central	<18	1	22.61	Averbuch	23	312.5	0.590	0.076	4.56	<0.01	1	0.93
Cortical Volume Increase	Tibia - Central	>18	19	136.37	Tinsley Hill	17	36.75	0.304	0.143	0.63	9.07	1	<0.01
Cortical Volume Increase	Tibia - Central	>18	19	136.37	Averbuch	111	556.5	0.700	0.420	1.18	1.50	1	0.22
Cortical Volume Increase	Tibia - Distal	>18	2	96.68	Tinsley Hill	7	20	0.059	0.011	0.31	14.85	1	<0.01
Cortical Volume Increase	Tibia - Distal	>18	2	96.68	Averbuch	27	420.5	0.321	0.075	1.37	1.86	1	0.17
Cortical Volume Increase	Fibula - Central	<18	2	7.32	Tinsley Hill	1	24.5	6.857	0.536	86.67	0.93	1	0.33
Cortical Volume Increase	Fibula - Central	<18	2	7.32	Averbuch	26	243	2.670	0.526	13.47	0.44	1	0.50

Table 15-12 (continued). Prevalence Odds Ratios for Limb Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval Mini-mum	Odds Ratio 95% Confidence Interval Maxi-mum	Chi Value	Degree Of Free-dom	P Value
Cortical Volume Increase	Fibula - Central	>18	9	95.68	Tinsley Hill	11	33.5	0.28	0.126	0.62	5.85	1	0.01
Cortical Volume Increase	Fibula - Central	>18	9	95.68	Averbuch	63.5	577.5	0.86	0.348	2.12	0.05	1	0.82
Degener-ation	Tibia - Proximal	>18	1	77.66	Tinsley Hill	1	29	0.37	0.022	6.12	<0.01	1	0.93
Degener-ation	Tibia - Proximal	>18	1	77.66	Averbuch	3	405	1.73	0.176	16.70	0.04	1	0.83
Injury	Fibula - Central	>18	1	103.68	Averbuch	4	637	1.53	0.173	14.14	0.06	1	0.79
Entheso-phytes	Humerus - Distal	>18	2	67.62	Tinsley Hill	1	29.75	0.88	0.077	10.15	0.28	1	0.59
Entheso-phytes	Tibia - Proximal	>18	3	75.66	Averbuch	1	407	16.07	1.639	155.3	6.35	1	0.01
Entheso-phytes	Tibia - Central	>18	2	153.37	Tinsley Hill	1	52.75	0.69	0.061	7.75	0.13	1	0.71
Medullary Volume Increase	Femur - Central	>18	1	179.5	Averbuch	2	778.5	2.17	0.041	5.12	<0.01	1	0.92
Medullary Volume Increase	Femur - Distal	>18	1	85.51	Averbuch	2	425	2.47	0.220	27.40	<0.01	1	0.99

Table 15-12 (continued). Prevalence Odds Ratios for Limb Approach.

Health Response	Element	Age	Individuals With Response	Individuals Without Response	Sample	Individuals With Response	Individuals Without Response	Odds Ratio	Odds Ratio 95% Confidence Interval		Chi Value	Degree Of Freedom	P Value
									Minimum	Maximum			
Medullary Volume Increase	Tibia - Central	<18	1	22.61	Averbuch	4	331.5	3.59	0.382	33.13	0.08	1	0.76
Medullary Volume Increase	Tibia - Central	>18	9	146.37	Averbuch	7	659.5	5.81	2.113	15.66	12.52	1	<0.01
Medullary Volume Increase	Fibula - Central	>18	2	102.68	Averbuch	5	636	2.47	0.471	12.83	0.31	1	0.57
Osteolysis	Humerus - Distal	>18	2	67.62	Averbuch	1	487	14.32	1.280	159.6	3.85	1	0.04
Osteolysis	Femur - Distal	>18	2	84.51	Tinsley Hill	1	37	0.87	0.077	9.97	0.27	1	0.60
Osteolysis	Femur - Distal	>18	2	84.51	Averbuch	5	422	1.98	0.089	2.86	0.10	1	0.74
Entheso-phytes	Femur - Central	>18	4	176.5	Tinsley Hill	1	70.75	1.60	0.176	14.59	<0.01	1	0.94
Medullary Volume Increase	Tibia - Distal	>18	1	97.68	Averbuch	1	446.5	1.51	0.283	73.55	0.06	1	0.80
Entheso-phytes	Tibia - Distal	>18	2	153.37	Averbuch	1	666.5	8.691	0.783	96.35	1.908	1	0.167

Table 15-13. Summary of Health Comparison Differences.

Health Response	Element	Age	Comparative Sample	Individual Approach	Odds Ratio Favors	Element Approach	Odds Radio Favors
Cartilage Ossification	Humerus - Distal	>18	Tinsley Hill	X	Tinsley Hill	X	Tinsley Hill
Cartilage Ossification	Humerus - Distal	>18	Averbuch			X	Averbuch
Cartilage Ossification	Radius - Distal	>18	Tinsley Hill			X	Tinsley Hill
Cartilage Ossification	Femur - Distal	>18	Averbuch			X	Averbuch
Cartilage Ossification	Tibia - Proximal	>18	Averbuch	X	Mound C	X	Mound C
Cartilage Ossification	Tibia - Distal	>18	Tinsley Hill			X	Tinsley Hill
Cortical Volume Increase	Femur - Central	>18	Tinsley Hill	X	Tinsley Hill	X	Tinsley Hill
Cortical Volume Increase	Tibia - Central	>18	Tinsley Hill			X	Mound C
Cortical Volume Increase	Tibia - Distal	>18	Tinsley Hill	X	Tinsley Hill	X	Tinsley Hill
Cortical Volume Increase	Fibula - Central	>18	Tinsley Hill	X	Tinsley Hill	X	Tinsley Hill
Connective Tissue Ossification	Tibia - Central	>18	Averbuch	X	Mound C		
Connective Tissue Ossification	Tibia - Proximal	>18	Averbuch	X	Mound C	X	Mound C
Medullary Volume Increase	Tibia - Central	>18	Averbuch	X	Mound C	X	Mound C
Osteolysis	Humerus - Distal	>18	Averbuch	X	Mound C	X	Mound C

odds ratios. The individual approach accounted for nine of these and the limb approach contributed an additional 14. A total of eight (57%) of the compared observation sites scored important differences for both individual and limb approaches. These observations are believed to represent true differences in response prevalences between Wickliffe and the comparative assemblages.

Conclusions

State of Health in the Mound C Community

This examination was able to confirm the presence of a few of the health risks impacting in the Wickliffe community's quality of life. These risks include invasion by several infectious microorganisms, over-exertion and deterioration of connective tissues, mechanical failure and physiological disorders. These conditions represent chronic maladies. Most were the result of indirect environmental factors. A few, including mechanical failure, indicate a more direct environmental influence. Acute disorders and those brought on by psychosocial factors were notably absent from the assemblage. Waldron (1994:43-44) has suggested that data capable of more stringent time control than possible at Wickliffe are needed to detect more acute health responses.

Most health responses record the presence of non-specific infections. These are recognized as important indicators of general health in a community (Webb 1994:126). Since they record chronic levels of infection, they provide a crude estimate of long term disease effects in the population (Mensforth et al. 1978). Low levels of skeletal response to stress agents are believed to reflect a high mortality rate from acute disorders or from acute phases of chronic disorders (Ortner 1979:596). While this study is not based on an examination of all aspects of the skeleton, and hence has not recorded all detectable maladies, the results do not contradict this model.

Injuries are not common in the Mound C Cemetery. Both forms represented are caused by mechanical energy being improperly controlled when passed through the legs. It is possible that the legs were at greater risk for trauma than the arms. In the modern environment, the rough irregular terrace, upland and floodplain terrain can be treacherous to negotiate. It is unlikely that conditions

were more favorable in the past. Movement through these environments is suspected to have played a major role in injury occurrence in the Mound C community.

While several of these responses were active at the time of death, and may have contributed to the host's weakened physiological state, cause of death could not be attributed to any specific risk agent. These conditions are consistent with risk agent responses reported in other Mississippian communities in the Southeast, including Averbuch, Campbell, Moundville and Tinsley Hill (c.f. Eisenberg 1986; Holland 1991; Lane 1993; Powell 1988). Several important health differences were noted between Wickliffe and Tinsley Hill assemblages. Most of these differences were noted in the Cortical Volume Increase, where the risk of developing a response was significantly lower in adult leg bones at Wickliffe. Cartilage Ossification was also notably lower in the adult distal humeri than seen at Wickliffe. As a population of long bones, adult distal radii and tibiae were also less at risk for Cartilage Ossification at Wickliffe than at Tinsley Hill. In general, agents irritating periosteal layers and joint capsules appear to be less or as prevalent at Wickliffe than at Tinsley Hill.

Rather surprisingly, Wickliffe's health profile was much closer to that found at Averbuch. Most health response risks were indistinguishable. It was noted however that maladies of the proximal and central tibia, notably Medullary Volume Increase, Cartilage and Connective Tissue Ossification were more common at Wickliffe. Osteolytic lesions were also more prevalent at Wickliffe. In the element approach, Cartilage Ossification from the distal humeri and femora was greater than noted at Wickliffe. Since these latter differences were noted only in this one method (and not by both approaches), it is possible that no true disparity is present.

The similarity between Mound C and Averbuch health responses raises several issues. As noted earlier, Averbuch has been viewed as a community with a marginal quality of life, where population density was higher and adequate subsistence was less than that found at Wickliffe. Despite occupation of a smaller village in a less densely inhabited region of the Mississippian Culture area, the comparable odds ratios with Wickliffe imply many environmental similarities. It is suggested that the immediate environment, formed from relationships between living, work and

disposal areas may not have differed strongly between Wickliffe and Averbuch. While outside the bounds of this present study, Matternes and Jantz (1999:35) have indicated the presence of malnutrition indicators in other aspects of the Wickliffe skeletal assemblage. Biochemical and faunal data from Wickliffe suggest a more enriched diet than associated with many marginal Late Prehistoric communities. However, it is unclear whether these differences were significant enough to counteract the effect of health agents (Schurr and Schoeninger 2000; Kriesa and McDowell 1995).

Tinsley Hill, on the other hand, has been generally viewed as a less distressed community than Averbuch, yet many of its health responses are greater than or equal to those seen at Wickliffe. These comparisons did not involve the same observation sites, but this pattern seems to indicate that Averbuch and Tinsley Hill may share similar health response rates. Significantly lower rates of Cartilage Ossification in the elbow may indicate less strenuous exertion of this joint among the Wickliffe Community. This may reflect a real difference in how the lower arm was used. The unexpected findings of these health comparisons call for a more thorough examination of Mississippian health in Western Kentucky.

Assessment of the data for use as a Mortuary Indicator

The results of this analysis indicate that there is evidence of health problems in the Mound C skeletal assemblage. In no case could the exact cause of death be attributed to a given individual and in most cases skeletal responses were only assigned to probable risk agents. The general uncertainty associated with many diagnoses cannot be adequately expressed as a single bivariate (present vs absent) response.

It is possible that health responses from other communities could be manipulated in a manner similar to that used in this health study to help model mortuary variability. The same issues of accurate accountability across observation sites will need to be addressed. To appropriately use health responses in Mound C and other highly incomplete skeletal assemblages, it must be assumed that health as reflected by a single health response and at a given observation site is a socially meaningful variable. A study assemblage based on the presence of a given observation site could be constructed, but the use of more than one observation site would constrain the study assemblage

to only those individuals with all observation sites. In Mound C, samples accounting for even half of the limb observation sites reduced the available assemblage to negligible sizes. Circumstances of death and health status have therefore been precluded from continued analysis of the study topic.

Chapter 16. Data Analysis and Interpretation

Mortuary theory identifies that the material structure of a cemetery is based largely on the social personality attributed to the dead by the depositing community. There are at least seven general agents responsible for material representation. For a given community, the funerary expressions vary because of differences in the dead's social qualities and time. In the Late Prehistoric Mississippian society of western Kentucky, there are ample indications that a variety of mortuary expressions were available. Organizational properties of the community exhibit cyclic fluctuations. At the Wickliffe Mound Group, the Mound C Cemetery can be correlated with a period of socio-political expansion. Does the variation in Mound C Cemetery's material symbolism remain the same throughout the accumulation period?

The answer to this question required a number of steps. First, the material variations were combined into independent units of expression. Next, the organizational structure was ascertained and socially significant divisions determined. This structure was examined to learn what organizational pattern it followed and whether agents of variability could be assigned to material expressions. Finally, stratigraphic data was combined with organizational structure to assess change over time. The results from each step were used to develop an answer to the research question.

Recall that valid data from the cemetery encompassed five domains with seven mortuary variables. A total of 34 distinct attributes were recorded. These data were collected on a sample of 104 individual interments. Each grave was scored in terms of the presence (1) or absence (0) for each attribute (Table 16-1).

R Mode Analysis

This technique examined each independent combination of features to determine if unique social identities were represented. Unfortunately, it also produced logically redundant variables (i.e., alternative states of the same variable were scored). The resulting data set lacked independent cells of information. Some of these redundancies were eliminated through screening. To detect more

Table 16-1. Mortuary Attribute Frequencies from Mound C.

Variable	Attribute	Present	Population
Treatment	Primary Treatment	66	63.4
	Secondary Treatment	35	33.7
	Multiple Treatment	3	2.8
Multiplicity	Single Interment	59	56.7
	Multiple Interment	45	43.0
Furniture	Unlined Grave	98	94.2
	Wood Lined Grave	2	1.9
	Stone Lined Grave	4	3.8
Orientation	Northeast Orientation	1	1.0
	Southeast Orientation	3	2.9
	Southwest Orientation	11	10.6
	Northwest Orientation	49	47.1
	West Oriented	6	5.8
	North/South Plane	2	1.9
	East/West Plane	5	4.8
	Northeast/Southwest Plane	5	4.8
	Northwest/Southeast Plane	19	18.3
	Unoriented	4	3.8
Provenience	3-3.99 Meters	6	5.8
	4-4.99 Meters	16	15.4
	5-5.99 Meters	15	14.4
	6-6.99 Meters	18	17.3
	7-7.99 Meters	14	13.5
	8-8.99 Meters	12	11.5
	9-9.99 Meters	13	12.5
	10-10.99 Meters	3	2.9
	11-11.9 Meters	5	4.8
	12-12.99 Meters	2	1.9
Sex	Male	18	17.3
	Female	15	14.4
	Sex-Subadult	26	25.0
Age	Infant (<4 Years)	3	2.9
	Subadult (4-29 Years)	29	27.9
	Adult (>30 Years)	27	26.0

imbedded scoring weaknesses in the data's structure, an R Mode examination of the degree of covariation was utilized.

R Mode and Principal Components Techniques

Prior to this investigation very little was actually known about the relationship between most mortuary attributes. Mattemes (2000:In Press) demonstrated that the meaning attached to specific attributes probably varied between Mississippian mortuary sites. Mortuary meanings cannot be assumed between cemeteries.

Attributes used to symbolize meaning can communicate in one of two ways – attributes can express meaning independently of other forms or several attributes can be combined to convey information. The first step towards answering the research question was to determine whether meaning was expressed by association between specific attributes or if attributes conveyed information discretely. These types of relationships were identified by the application of R Mode statistical comparisons.

One issue with methods designed to find generalities in attribute patterning is that without knowing whether meaning is discretely or interactively conveyed, some meanings are over-emphasized (i.e., weighted) at the expense of others. By treating all attributes as independently equal, these bits of information can distort and inhibit an accurate mortuary interpretation (Ciolek-Torrello 1984:134). The R Mode approach allows researchers to overcome potential biases in the data by identifying covarying attributes. R Mode methods accomplish this by reducing the number of variables (or variable space) and treating covarying objects, those that are distributed the same, as a single variable (Voorips 1982:118). Isolation of covarying attributes enables data to be described as sets of independent vectors. Vectors can be thought of as independent of each other.

There are a number of R Mode analytical techniques available, however, Principal Components analysis has received the greatest amount of success when applied in mortuary information studies (Braun 1979; O'Shea 1984; Ravesloot 1988). The goal of principal components analysis is to identify the degree of correlation between object attributes and use these to transform the original variables into a reduced set of composite variables (or principal components). Principal

components analysis is relatively model free, that is, it combines variables without consideration of any factor other than degree of correlation (Christenson and Read 1977:167).

Principal components analysis measures variability within a given structure. In a given set of attributes, the amount of variability present can be seen as occupying statistical 'space' (Anderberg 1973:107). In order to describe this space, an analyst must account for the differences in form and the distances (degree of similarity in how variables behave) between variables. Description is reduced if the analyst finds a common plane or component (such as a common behavior pattern) among variables. In other words, if objects covary, they do not need to be redundantly described. Principal components analysis defines commonalities between variables and the way they interact as a means of simplifying the data's structure.

Principal components analysis takes a matrix of subject and attribute scores and examines the relationship between each attribute relative to other attributes. The amount of covariation found within the data is expressed by a series of components that outline the relationship between an attribute and the 'plane' of covariation. The amount of covariation encapsulated is summarized in an eigenvalue. This value is used to ordinally arrange components from most to least amount of covariabilty expressed. Within each component, attribute similarity coefficients (or eigenvectors) are displayed. These describe how each attribute contributes to a particular component (Sneath and Sokal 1973:245).

Principal components analysis is a fairly simple form of factor analysis. Components are orthogonal; that is, they are not rotated to examine statistical 'space', and the eigenvectors are scaled, enabling covariation to be expressed equally (Anderberg 1973:109; Sneath and Sokal 1973:246). An examination of covarying attributes in a particular component can frequently identify common agents of variation. For the purposes of this analysis, covariance is treated as evidence that multiple attributes were used to express a particular social meaning.

Application to the Mound C Cemetery

To determine the degree that attributes covaried in the Mound C cemetery, observation scores were subjected to principal components analysis. The research hypothesis stated that if

more than one variable was used to communicate a social meaning, then covarying material expressions were present. The null hypothesis stated that each variable represented a unique mortuary expression.

Most principal component routines utilize a Pearson's 'R' to calculate the relationship between attributes. Since the data are scored as dichotomous expressions (present versus absent), these diverse attribute frequency forms skew 'R'. Phi, a re-expression of the Pearson's 'R' to account for this type of data, was substituted as a means of overcoming this bias (Doran and Hodson 1975:147; Hatch 1976:145-149).

The Correlation and Distances routines in SPSS (8.0) produced a Phi Correlation Matrix. Measures of association were expressed as a range, where +1.0 represented a perfect positive association and -1.0 indicated a perfect negative association. Notable correlations were observed between primary treatment and single interments with northwest orientations (Table 16-2). Secondary interments tended to possess multiple interments, with a bias towards the Northwest-Southeast Plane. Subadults had a tendency towards northeast primary orientation. These associations were never greater than 0.66. While several strong negative associations were observed, most of these tended to reflect contrasting mortuary attributes. These data provided little indication that strong patterns of covariation were present in the Mound C sample.

The Data Reduction routine in SPSS (8.0) transformed the Phi Correlation Matrix into a principal components matrix. The resulting data consisted of eigenvectors organized by component and attribute (Table 16-3). From the 34 components extracted, the first 14 accounted for 78% of the total variance (Table 16-4). Components 2 through 34 formed a continuously decreasing cluster of eigenvalues. None of these accounted for more than 8.2% of the assemblage's variance. A plot of the eigenvalues illustrated the relative variance expressed (Figure 16-1). Since components were arranged by the amount of variance expressed, substantial drops in eigenvalues were interpreted as important decreases in covariation. Component 1 possessed a much higher eigenvalue than the other components. It accounted for almost 17% of the assemblage's variance and represented a

Table 16-2. Phi Correlation Matrix.

Attribute	Primary Treatment	Secondary Treatment	Multiple Treatment	Single Interment	Multiple Interment
Primary Treatment		-0.958	-0.188	0.608	-0.608
Secondary Treatment	-0.958		-0.100	-0.569	0.569
Multiple Treatment	-0.188	-0.100		-0.160	0.160
Single Interment	0.608	-0.569	-0.160		-1.000
Multiple Interment	-0.608	0.569	0.160	-1.000	
Unlined Grave	0.333	-0.260	-0.266	0.283	-0.283
Wood Lined Grave	-0.188	0.048	0.490	-0.160	0.160
Stone Lined Grave	-0.269	0.281	-0.028	-0.229	0.229
Northeast Orientation	0.073	-0.070	-0.014	0.086	-0.086
Southeast Orientation	0.128	-0.123	-0.024	0.151	-0.151
Southwest Orientation	0.256	-0.245	-0.048	0.111	-0.111
Northwest Orientation	0.581	-0.631	0.148	0.280	-0.280
West Oriented	0.184	-0.176	-0.035	0.216	-0.216
North/South Plane	-0.188	0.197	-0.020	-0.160	0.160
East/West Plane	-0.302	0.316	-0.031	-0.167	0.167
NE/SW Plane	-0.302	0.316	-0.031	-0.076	0.076
NW/SE Plane	-0.636	0.664	-0.066	-0.391	0.391
Unoriented	-0.269	0.281	-0.028	-0.229	0.229
3-3.99 Meters	-0.750	0.086	-0.035	-0.117	0.117
4-4.99 Meters	-0.407	0.430	-0.060	-0.273	0.273
5-5.99 Meters	0.019	-0.061	0.142	0.082	-0.082
6-6.99 Meters	-0.032	0.051	-0.064	-0.110	0.110
7-7.99 Meters	0.058	-0.042	-0.055	0.060	-0.060
8-8.99 Meters	0.143	-0.130	-0.051	0.072	-0.072
9-9.99 Meters	0.159	-0.208	0.159	-0.022	0.022
10-10.99 Meters	0.128	-0.123	-0.024	0.151	-0.151
11-11.9 Meters	0.073	-0.065	-0.031	0.106	-0.106
12-12.99 Meters	0.104	-0.100	-0.020	0.122	-0.122
Male	0.234	-0.218	-0.064	0.400	-0.400
Female	0.305	-0.292	-0.057	0.359	-0.359
Sex-Subadult	0.244	-0.223	-0.081	0.504	-0.504
Infant (<4 Years)	0.128	-0.123	-0.024	0.151	-0.151
Subadult (4-29 Years)	0.283	-0.261	-0.087	0.543	-0.543
Adult (>30 Years)	0.348	-0.329	-0.083	0.517	-0.517

Table 16-2 (continued). Phi Correlation Matrix.

Attribute	Unlined Graves	Wood Lined Graves	Stone Lined Graves	Northeast Orientation	Southeast Orientation
Primary Treatment	0.333	-0.188	-0.269	0.073	0.128
Secondary Treatment	-0.260	0.048	0.281	-0.070	-0.123
Multiple Treatment	-0.266	0.490	-0.028	-0.014	-0.024
Single Interment	0.283	-0.160	-0.229	0.086	0.151
Multiple Interment	-0.283	0.160	0.229	0.086	-0.151
Unlined Grave		-0.566	-0.808	0.024	0.043
Wood Lined Grave	-0.566		-0.028	-0.014	-0.024
Stone Lined Grave	-0.808	-0.028		-0.020	-0.034
Northeast Orientation	0.024	-0.014	-0.020		-0.017
Southeast Orientation	0.043	-0.024	-0.034	-0.017	
Southwest Orientation	0.085	-0.048	-0.069	-0.034	-0.059
Northwest Orientation	0.151	0.008	-0.189	-0.093	-0.163
West Oriented	0.061	-0.035	-0.049	-0.024	-0.043
North/South Plane	0.035	-0.020	-0.028	-0.014	-0.024
East/West Plane	-0.330	-0.031	0.422	-0.022	-0.039
NE/SW Plane	0.056	-0.031	-0.045	-0.022	-0.039
NW/SE Plane	-0.096	0.115	0.035	-0.047	-0.081
Unoriented	-0.165	-0.028	0.220	-0.020	-0.034
3-3.99 Meters	-0.116	-0.035	0.165	-0.024	0.204
4-4.99 Meters	-0.237	-0.060	0.330	-0.042	-0.073
5-5.99 Meters	-0.133	0.341	-0.082	-0.040	0.093
6-6.99 Meters	0.113	-0.064	-0.091	-0.045	-0.079
7-7.99 Meters	0.098	-0.055	-0.079	0.250	0.100
8-8.99 Meters	0.089	-0.051	-0.072	-0.036	-0.062
9-9.99 Meters	0.094	-0.053	-0.076	-0.037	-0.065
10-10.99 Meters	0.043	-0.024	-0.034	-0.017	-0.030
11-11.9 Meters	0.056	-0.031	-0.045	-0.022	-0.039
12-12.99 Meters	0.035	-0.020	-0.028	-0.014	-0.024
Male	0.113	-0.064	-0.091	-0.045	-0.079
Female	0.102	-0.057	-0.082	-0.040	0.256
Sex-Subadult	0.143	-0.082	-0.115	0.171	0.033
Infant (<4 Years)	0.043	-0.024	-0.034	0.572	-0.030
Subadult (4-29 Years)	0.154	-0.087	-0.124	-0.061	0.021
Adult (>30 Years)	0.147	-0.083	-0.118	-0.058	0.160

Table 16-2 (continued). Phi Correlation Matrix.

Attribute	Southwest Orientation	Northwest Orientation	West Orientation	North/ South Plane	East/ West Plane
Primary Treatment	0.256	0.581	0.184	-0.188	-0.302
Secondary Treatment	-0.245	-0.631	-0.176	0.197	0.316
Multiple Treatment	-0.048	0.148	-0.035	-0.020	-0.031
Single Interment	0.111	0.280	0.216	-0.160	-0.167
Multiple Interment	-0.111	-0.280	-0.216	0.160	0.167
Unlined Grave	0.085	0.151	0.061	0.035	-0.330
Wood Lined Grave	-0.048	0.008	-0.035	-0.020	-0.031
Stone Lined Grave	-0.069	-0.189	-0.049	-0.028	0.422
Northeast Orientation	-0.034	-0.093	-0.024	-0.014	-0.022
Southeast Orientation	-0.059	-0.163	-0.043	-0.024	-0.039
Southwest Orientation		-0.325	-0.085	-0.048	-0.077
Northwest Orientation	-0.325		-0.234	-0.132	-0.212
West Oriented	-0.085	-0.234		-0.035	-0.056
North/South Plane	-0.048	-0.132	-0.035		-0.031
East/West Plane	-0.077	-0.212	-0.056	-0.031	
NE/SW Plane	-0.077	-0.212	-0.056	-0.031	-0.051
NW/SE Plane	-0.163	-0.396	-0.117	-0.066	-0.106
Unoriented	-0.069	-0.189	-0.049	-0.028	-0.045
3-3.99 Meters	-0.085	-0.068	-0.061	-0.035	0.137
4-4.99 Meters	-0.147	-0.242	-0.106	-0.060	-0.402
5-5.99 Meters	-0.052	0.051	0.016	-0.057	-0.092
6-6.99 Meters	0.008	-0.024	0.105	-0.064	-0.103
7-7.99 Meters	-0.044	0.023	-0.098	0.355	-0.089
8-8.99 Meters	-0.026	0.202	-0.089	-0.051	-0.081
9-9.99 Meters	0.154	0.051	0.156	-0.053	-0.085
10-10.99 Meters	-0.059	0.183	-0.043	-0.024	-0.039
11-11.9 Meters	0.069	-0.032	0.137	-0.031	-0.051
12-12.99 Meters	0.407	-0.132	-0.035	-0.020	-0.031
Male	0.091	0.179	-0.004	-0.064	-0.103
Female	0.126	0.106	0.016	-0.057	-0.092
Sex-Subadult	-0.054	0.078	0.238	-0.081	-0.026
Infant (<4 Years)	-0.059	-0.048	-0.204	-0.024	-0.039
Subadult (4-29 Years)	-0.005	0.143	0.214	-0.087	-0.040
Adult (>30 Years)	0.153	0.188	-0.052	-0.083	-0.133

Table 16-2 (continued). Phi Correlation Matrix.

Attribute	Northeast/ Southwest Plane	Northwest/ Southeast Plane	Unoriented	3-3.99 Meters	4-4.99 Meters
Primary Treatment	-0.302	-0.636	-0.269	-0.075	-0.407
Secondary Treatment	0.316	0.664	0.281	0.086	0.430
Multiple Treatment	-0.031	-0.066	-0.028	-0.035	-0.060
Single Interment	-0.076	-0.391	-0.229	-0.117	-0.273
Multiple Interment	0.076	0.391	0.229	0.117	0.273
Unlined Grave	0.056	-0.096	-0.165	-0.116	-0.237
Wood Lined Grave	-0.031	0.115	-0.028	-0.035	-0.060
Stone Lined Grave	-0.045	-0.035	0.220	0.165	0.330
Northeast Orientation	-0.022	-0.047	-0.020	-0.024	-0.042
Southeast Orientation	-0.039	-0.081	-0.034	0.204	-0.073
Southwest Orientation	-0.077	-0.163	-0.069	-0.085	-0.147
Northwest Orientation	-0.212	-0.396	-0.189	-0.068	-0.242
West Oriented	-0.056	-0.117	-0.049	-0.061	-0.106
North/South Plane	-0.031	-0.066	-0.028	-0.035	-0.060
East/West Plane	-0.051	-0.106	-0.045	0.137	0.402
NE/SW Plane		-0.106	-0.045	-0.056	0.153
NW/SE Plane	-0.106		-0.095	0.096	0.212
Unoriented	-0.045	-0.095		-0.049	0.053
3-3.99 Meters	-0.056	0.096	-0.049		-0.106
4-4.99 Meters	0.153	0.212	0.053	-0.106	
5-5.99 Meters	-0.036	0.018	-0.082	-0.102	-0.175
6-6.99 Meters	0.135	-0.019	0.173	-0.113	-0.195
7-7.99 Meters	-0.089	-0.041	-0.079	-0.098	-0.168
8-8.99 Meters	-0.081	-0.015	-0.072	-0.089	-0.154
9-9.99 Meters	-0.085	-0.103	-0.076	-0.094	-0.161
10-10.99 Meters	-0.039	-0.081	-0.034	-0.043	-0.073
11-11.9 Meters	-0.051	-0.106	0.189	-0.056	-0.096
12-12.99 Meters	-0.031	-0.066	-0.028	-0.035	-0.060
Male	0.135	-0.216	-0.091	-0.113	-0.125
Female	-0.092	-0.194	-0.082	0.016	-0.175
Sex-Subadult	-0.130	-0.101	-0.115	-0.048	-0.062
Infant (<4 Years)	-0.039	-0.081	-0.034	-0.043	-0.073
Subadult (4-29 Years)	-0.140	-0.128	-0.124	0.030	-0.087
Adult (>30 Years)	0.072	-0.280	-0.118	-0.147	-0.192

Table 16-2 (continued). Phi Correlation Matrix.

Attribute	5-5.99 Meters	6-6.99 Meters	7-7.99 Meters	8-8.99 Meters	9-9.99 Meters
Primary Treatment	0.019	-0.032	0.058	0.143	0.159
Secondary Treatment	-0.061	0.051	-0.042	-0.130	-0.208
Multiple Treatment	0.142	-0.064	-0.055	-0.051	0.159
Single Interment	0.082	-0.011	0.060	0.072	-0.022
Multiple Interment	-0.082	0.011	-0.060	-0.072	0.022
Unlined Grave	-0.133	0.113	0.098	0.089	0.094
Wood Lined Grave	0.341	-0.064	-0.055	-0.051	-0.053
Stone Lined Grave	-0.082	-0.091	-0.079	-0.072	-0.076
Northeast Orientation	0.040	-0.045	0.250	-0.036	-0.037
Southeast Orientation	0.093	-0.079	0.100	-0.062	-0.065
Southwest Orientation	-0.052	0.008	-0.044	-0.026	-0.154
Northwest Orientation	0.051	-0.024	0.023	0.202	0.051
West Oriented	0.016	0.105	-0.098	-0.089	0.156
North/South Plane	-0.057	-0.064	0.355	-0.051	-0.053
East/West Plane	-0.092	-0.103	-0.089	-0.081	-0.085
NE/SW Plane	0.036	0.135	-0.089	-0.081	-0.085
NW/SE Plane	0.018	-0.019	-0.041	-0.015	-0.103
Unoriented	-0.082	0.173	-0.079	-0.072	-0.076
3-3.99 Meters	-0.102	-0.113	-0.098	-0.089	-0.094
4-4.99 Meters	-0.175	-0.195	-0.168	-0.154	-0.161
5-5.99 Meters		-0.188	-0.162	-0.148	-0.155
6-6.99 Meters	-0.188		-0.180	-0.165	-0.173
7-7.99 Meters	-0.162	-0.180		-0.142	-0.149
8-8.99 Meters	-0.148	-0.165	-0.142		-0.137
9-9.99 Meters	-0.155	-0.173	-0.149	-0.137	
10-10.99 Meters	-0.071	-0.079	-0.068	-0.062	-0.065
11-11.9 Meters	-0.092	-0.103	-0.089	-0.081	-0.085
12-12.99 Meters	-0.057	-0.064	-0.055	-0.051	-0.053
Male	0.029	-0.059	-0.043	0.073	-0.019
Female	-0.013	-0.115	-0.002	0.194	0.093
Sex-Subadult	0.079	-0.029	0.033	-0.139	-0.084
Infant (<4 Years)	-0.071	0.073	0.100	-0.062	0.109
Subadult (4-29 Years)	0.111	-0.001	-0.057	-0.157	-0.041
Adult (>30 Years)	0.007	-0.039	0.088	0.267	-0.25

Table 16-2 (continued). Phi Correlation Matrix.

Attribute	10-10.99 Meters	11-11.99 Meters	12-12.99 Meters	Male	Female
Primary Treatment	0.128	0.073	0.104	0.234	0.305
Secondary Treatment	-0.123	-0.065	-0.100	-0.218	-0.292
Multiple Treatment	-0.024	-0.031	-0.020	-0.064	-0.057
Single Interment	0.151	0.106	0.122	0.400	0.359
Multiple Interment	-0.151	0.106	-0.122	-0.400	-0.359
Unlined Grave	0.043	0.056	0.035	0.113	0.102
Wood Lined Grave	-0.024	-0.031	-0.020	-0.064	-0.057
Stone Lined Grave	-0.034	-0.045	-0.028	-0.091	-0.082
Northeast Orientation	-0.017	-0.022	-0.014	-0.045	-0.040
Southeast Orientation	-0.030	-0.039	-0.024	-0.079	0.256
Southwest Orientation	-0.059	0.069	0.407	0.091	0.126
Northwest Orientation	0.183	-0.032	-0.132	0.179	0.106
West Oriented	-0.043	0.137	-0.035	-0.004	0.016
North/South Plane	-0.024	-0.031	-0.020	-0.064	-0.057
East/West Plane	-0.039	-0.051	-0.031	-0.103	-0.092
NE/SW Plane	-0.039	-0.051	-0.031	0.135	0.092
NW/SE Plane	-0.081	-0.106	-0.066	-0.216	-0.194
Unoriented	-0.034	0.189	-2.028	-0.091	-0.082
3-3.99 Meters	-0.043	-0.056	-0.035	-0.113	0.016
4-4.99 Meters	-0.073	-0.096	-0.060	-0.125	-0.175
5-5.99 Meters	-0.071	-0.092	-0.057	0.029	-0.013
6-6.99 Meters	-0.079	-0.103	-0.064	0.059	-0.115
7-7.99 Meters	-0.068	-0.089	-0.055	0.043	-0.002
8-8.99 Meters	-0.062	-0.081	-0.051	0.073	0.194
9-9.99 Meters	-0.065	-0.085	-0.053	-0.019	0.093
10-10.99 Meters		-0.039	-0.024	0.073	-0.071
11-11.9 Meters	-0.039		-0.031	0.016	-0.092
12-12.99 Meters	-0.024	-0.031		-0.064	0.341
Male	0.073	0.016	-0.064		-0.188
Female	-0.071	-0.092	0.341	-0.188	
Sex-Subadult	0.166	0.182	-0.081	-0.264	-0.237
Infant (<4 Years)	-0.030	-0.039	-0.024	-0.079	-0.071
Subadult (4-29 Years)	0.277	0.161	-0.087	-0.171	-0.011
Adult (>30 Years)	-0.102	-0.031	0.236	0.657	0.444

Table 16-2 (continued). Phi Correlation Matrix.

Attribute	Sex-Subadult	Infant	Subadult	Adult
Primary Treatment	0.244	0.128	0.283	0.348
Secondary Treatment	-0.223	-0.123	-0.261	-0.329
Multiple Treatment	-0.081	-0.024	-0.087	-0.083
Single Interment	0.504	0.151	0.543	0.517
Multiple Interment	-0.504	-0.151	-0.543	-0.517
Unlined Grave	0.143	0.043	0.154	0.147
Wood Lined Grave	-0.081	-0.024	-0.087	-0.083
Stone Lined Grave	-0.115	-0.034	-0.124	-0.118
Northeast Orientation	0.171	0.572	-0.161	-0.058
Southeast Orientation	0.033	-0.030	0.021	0.160
Southwest Orientation	-0.054	-0.059	-0.005	0.153
Northwest Orientation	0.078	-0.048	0.143	0.188
West Oriented	0.238	0.204	0.214	-0.052
North/South Plane	-0.081	-0.024	-0.087	-0.083
East/West Plane	-0.026	-0.039	-0.040	-0.133
NE/SW Plane	-0.130	-0.039	-0.140	0.072
NW/SE Plane	-0.101	-0.081	-0.128	-0.280
Unoriented	-0.115	-0.034	-0.124	-0.118
3-3.99 Meters	-0.048	-0.043	0.030	-0.147
4-4.99 Meters	-0.062	-0.073	-0.087	-0.192
5-5.99 Meters	0.079	-0.071	0.111	0.007
6-6.99 Meters	0.029	0.073	-0.001	-0.039
7-7.99 Meters	0.033	0.100	-0.057	0.088
8-8.99 Meters	-0.139	-0.062	-0.157	0.267
9-9.99 Meters	-0.084	0.109	-0.041	-0.025
10-10.99 Meters	0.166	-0.030	0.277	-0.102
11-11.9 Meters	0.182	-0.039	0.161	-0.031
12-12.99 Meters	-0.081	-0.024	-0.087	0.236
Male	-0.264	-0.079	-0.171	0.657
Female	-0.237	-0.071	-0.011	0.444
Sex-Subadult		0.299	0.780	-0.342
Infant (<4 Years)	0.299		-0.107	-0.102
Subadult (4-29 Years)	0.780	-0.107		-0.368
Adult (>30 Years)	-0.342	-0.102	-0.368	

Table 16-3. Component Matrix.

Attribute	Component 1	Component 2	Component 3	Component 4	Component 5
Primary Treatment	**0.890**	-0.035	0.123	-0.004	0.111
Secondary Treatment	-0.866	0.054	-0.296	0.108	-0.142
Multiple Treatment	-0.123	-0.062	0.587	-0.357	0.104
Single Interment	**0.855**	0.137	-0.011	0.311	-0.088
Multiple Interment	-0.855	-0.137	0.011	-0.311	0.088
Unlined Grave	0.490	-0.001	-0.657	-0.336	-0.138
Wood Lined Grave	-0.213	-0.034	0.668	-0.255	0.072
Stone Lined Grave	-0.442	0.025	0.319	0.590	0.115
Northeast Orientation	0.078	0.200	-0.152	-0.098	0.564
Southeast Orientation	0.139	-0.046	0.028	0.198	0.187
Southwest Orientation	0.204	-0.223	-0.113	0.195	0.273
Northwest Orientation	0.516	-0.086	0.386	-0.324	-0.265
West Oriented	0.206	0.318	-0.063	0.068	0.097
North/South Plane	-0.154	-0.034	-0.209	-0.208	0.203
East/West Plane	-0.356	-0.102	0.138	0.540	0.038
NE/SW Plane	-0.180	-0.135	-0.266	0.023	-0.298
NW/SE Plane	-0.563	0.093	-0.178	-0.149	-0.081
Unoriented	-0.289	0.006	-0.077	0.086	-0.042
3-3.99 Meters	-0.149	0.070	0.093	0.181	0.105
4-4.99 Meters	-0.490	0.096	-0.052	0.394	-0.139
5-5.99 Meters	0.055	0.061	0.430	-0.135	-0.135
6-6.99 Meters	-0.002	0.061	-0.287	-0.138	-0.225
7-7.99 Meters	0.091	-0.025	-0.224	-0.185	0.378
8-8.99 Meters	0.157	-0.349	0.019	-0.042	-0.119
9-9.99 Meters	0.123	-0.067	0.084	-0.203	0.270
10-10.99 Meters	0.171	-0.234	0.098	-0.004	-0.251
11-11.9 Meters	0.109	0.206	-0.051	0.088	-0.102
12-12.99 Meters	0.139	-0.272	-0.064	0.296	0.303
Male	0.350	-0.429	-0.071	0.068	-0.371
Female	0.375	-0.381	0.069	0.272	0.279
Sex-Subadult	0.368	**0.841**	-0.006	0.075	-0.004
Infant (<4 Years)	0.139	0.292	-0.150	-0.151	0.555
Subadult (4-29 Years)	0.414	**0.741**	0.094	0.152	-0.232
Adult (>30 Years)	0.490	**-0.714**	-0.052	0.241	-0.007

Note: Bold = Components >0.700 and <-0.700.

Table 16-3 (continued). Component Matrix.

Attribute	Component 6	Component 7	Component 8	Component 9	Component 10
Primary Treatment	-0.022	-0.106	-0.238	0.014	0.036
Secondary Treatment	0.033	0.046	0.234	-0.025	-0.014
Multiple Treatment	-0.039	0.210	0.024	0.036	-0.076
Single Interment	0.129	0.116	0.221	-0.033	-0.023
Multiple Interment	-0.129	-0.116	-0.221	0.033	0.023
Unlined Grave	-0.200	-0.162	0.020	-0.107	-0.068
Wood Lined Grave	-0.001	0.306	0.310	0.050	-0.009
Stone Lined Grave	0.242	-0.021	-0.246	0.094	0.089
Northeast Orientation	0.465	0.138	0.038	-0.180	0.001
Southeast Orientation	-0.083	-0.217	0.419	0.014	0.445
Southwest Orientation	-0.460	0.283	-0.080	0.222	-0.330
Northwest Orientation	0.242	-0.348	-0.281	-0.025	0.015
West Oriented	-0.128	0.372	-0.088	-0.127	0.139
North/South Plane	0.126	-0.200	0.173	0.544	-0.128
East/West Plane	0.194	-0.122	-0.159	-0.048	-0.189
NE/SW Plane	0.142	0.345	0.191	-0.131	-0.058
NW/SE Plane	-0.176	-0.101	0.350	-0.304	-0.076
Unoriented	-0.027	0.211	-0.288	0.360	0.486
3-3.99 Meters	-0.108	-0.361	0.065	-0.117	0.370
4-4.99 Meters	0.160	-0.062	-0.071	-0.178	-0.340
5-5.99 Meters	-0.053	0.227	0.518	-0.037	0.013
6-6.99 Meters	-0.029	0.385	-0.183	-0.023	0.407
7-7.99 Meters	0.403	-0.255	0.273	0.445	-0.092
8-8.99 Meters	0.069	-0.288	-0.096	-0.286	0.066
9-9.99 Meters	-0.277	0.093	-0.406	-0.200	-0.234
10-10.99 Meters	0.069	-0.179	-0.077	0.124	-0.216
11-11.9 Meters	-0.131	0.186	-0.150	0.401	0.153
12-12.99 Meters	-0.397	0.143	0.108	0.094	-0.226
Male	0.427	0.308	0.005	0.097	-0.120
Female	-0.302	-0.201	0.174	-0.151	0.174
Sex-Subadult	0.019	0.026	0.107	-0.001	-0.063
Infant (<4 Years)	0.385	0.271	-0.110	-0.322	0.068
Subadult (4-29 Years)	-0.210	-0.114	0.121	0.102	-0.088
Adult (>30 Years)	0.214	0.144	0.168	-0.018	0.038

Table 16-3 (continued). Component Matrix.

Attribute	Component 11	Component 12	Component 13	Component 14
Primary Treatment	-0.020	0.052	-0.070	0.014
Secondary Treatment	0.046	-0.065	0.030	-0.042
Multiple Treatment	-0.088	0.042	0.140	0.094
Single Interment	0.026	-0.056	0.022	-0.075
Multiple Interment	-0.026	0.056	-0.022	0.075
Unlined Grave	-0.074	-0.002	0.054	0.187
Wood Lined Grave	0.126	-0.007	-0.008	-0.074
Stone Lined Grave	0.001	0.008	-0.059	-0.173
Northeast Orientation	0.243	0.092	-0.082	0.232
Southeast Orientation	-0.313	0.079	0.014	0.250
Southwest Orientation	0.127	0.168	-0.296	0.034
Northwest Orientation	0.095	0.113	0.119	0.038
West Oriented	-0.313	-0.394	0.087	-0.366
North/South Plane	-0.192	0.094	0.202	-0.297
East/West Plane	-0.171	0.034	0.080	-0.016
NE/SW Plane	-0.250	0.245	0.270	0.302
NW/SE Plane	0.238	-0.183	-0.312	-0.192
Unoriented	0.242	-0.036	0.166	0.176
3-3.99 Meters	-0.245	0.206	-0.496	0.041
4-4.99 Meters	-0.019	-0.059	0.252	0.200
5-5.99 Meters	-0.027	-0.035	0.002	0.115
6-6.99 Meters	0.061	0.440	0.092	-0.393
7-7.99 Meters	-0.066	-0.023	0.011	-0.099
8-8.99 Meters	0.437	-0.355	0.067	-0.119
9-9.99 Meters	-0.475	-0.154	-0.011	0.032
10-10.99 Meters	0.107	0.350	-0.081	0.007
11-11.9 Meters	0.139	-0.475	-0.146	0.423
12-12.99 Meters	0.313	0.254	0.083	-0.030
Male	-0.161	-0.050	-0.384	-0.051
Female	0.067	-0.176	0.399	-0.051
Sex-Subadult	0.117	-0.005	0.037	0.001
Infant (<4 Years)	0.096	0.036	-0.012	0.034
Subadult (4-29 Years)	0.004	0.034	0.052	-0.064
Adult (>30 Years)	-0.011	-0.113	-0.024	-0.032

Table 16-4. Total Variance Explained.

Component	Initial Eigenvalue Total	Proportion of Variance	Cumulative Frequency
1	5.665	16.660	16.660
2	2.789	8.203	24.864
3	2.186	6.428	31.292
4	1.998	5.875	31.167
5	1.821	5.355	42.523
6	1.728	5.082	47.605
7	1.662	4.889	52.494
8	1.632	4.799	57.293
9	1.363	4.008	61.301
10	1.315	3.869	65.170
11	1.225	3.604	68.774
12	1.154	3.393	72.167
13	1.064	3.129	75.296
14	1.020	2.999	78.295
15	0.933	2.745	81.040
16	0.891	2.622	93.662
17	0.841	2.472	86.135
18	0.756	2.223	88.357
19	0.730	2.148	90.505
20	0.667	0.961	92.466
21	0.568	1.670	94.136
22	0.549	1.616	95.752
23	0.473	1.391	97.143
24	0.439	1.292	98.435
25	0.351	1.032	99.467
26	0.165	0.486	99.953
27	0.016	0.047	99.998
28	0.001	0.001	99.998
29	0.001	0.001	99.998
30	0.001	0.001	99.998
31	0.001	0.001	99.998
32	0.001	0.001	99.998
33	0.001	0.001	99.998
34	0.001	0.001	99.998

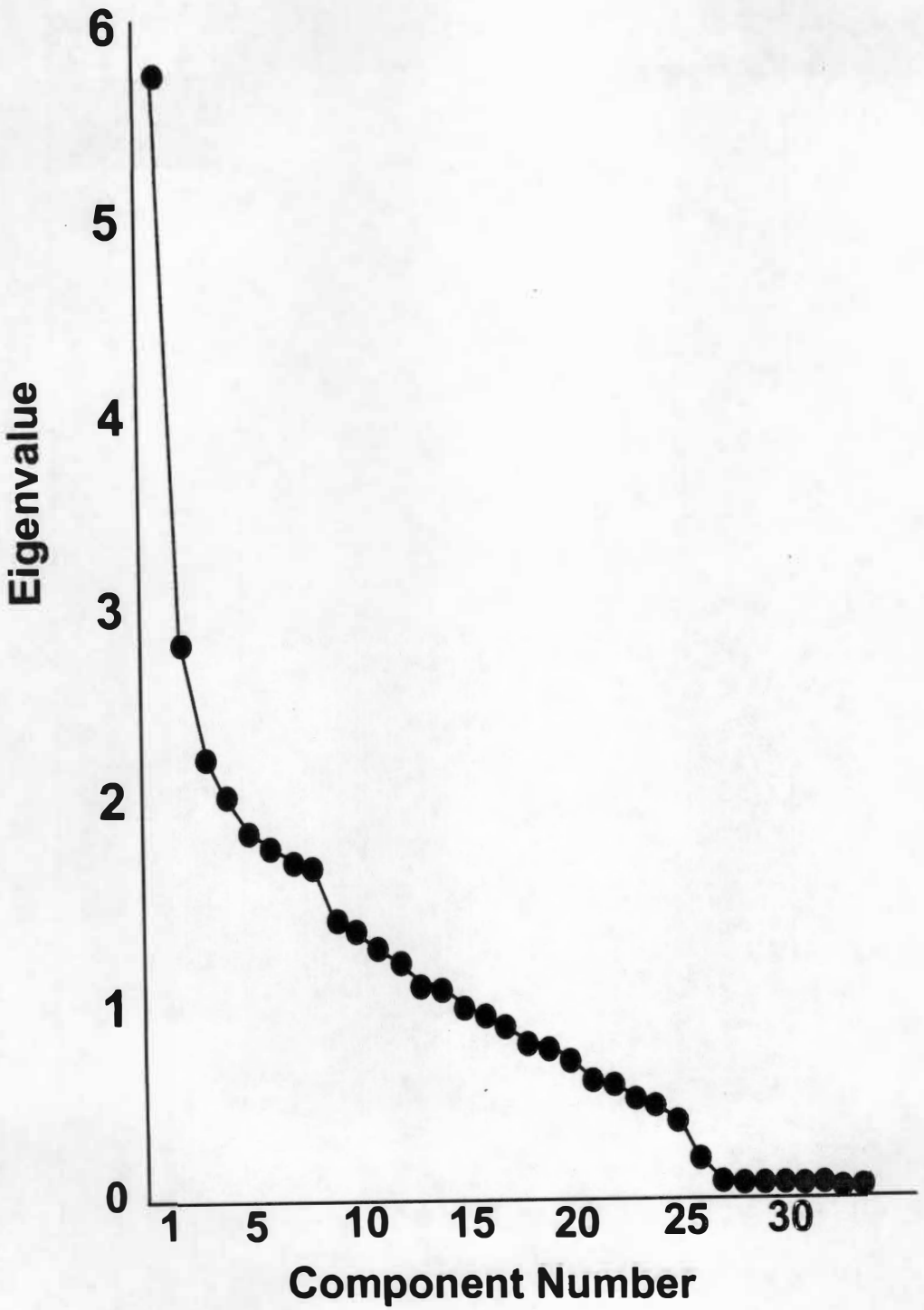


Figure 16-1. Distribution of Principal Component Eigenvalues by Component.

significant outlier to the pattern formed by other components. Component 1 provided the only evidence for strong covariation within the data.

As a means of determining what attributes were covarying in Component 1, eigenvectors for each attribute were plotted (Figure 16-2). Values expressing a positive loading represented positive associations with the component and negative loadings emphasized the reverse. Twenty-one attributes expressed a positive loading, however, single interment and primary burial treatment had considerably higher loadings than the other attributes. Covariation between single interment and primary treatment was treated as a unit of meaning and rescored within the attribute matrix by scoring multiplicity within the Primary Treatment grouping. This adjustment reduced the amount of variability present between other expressions. As a result, single-secondary and primary-multiple forms were defined as discrete units.

In Component Two, very high loadings were observed between sex-subadult and (age) subadult attributes. While not perfectly redundant categories, a review of the distribution indicated a considerable overlap in expression. Component 2 accounted for over 8% of the total variance, indicating that the covariation expressed by these two attributes is substantive. This was reduced by eliminating the sex-subadult attribute and allowing the non-adult categories to express subadult information. A summary of the resulting data (Table 16-5) revealed mortuary attributes that were transformed from simple attribute expressions to units of meaning. Since each attribute or attribute group represented a single meaning, individual meanings were weighted equally.

Q Mode Analysis

Many analysts believe that the organizational properties of mortuary data cannot be comprehensively understood without the application of both R and Q Mode analytical methods (e.g. Brown 1987:304; Mainfort 1985:560; O'Shea 1984:43; Rothschild 1979:662). While R Mode methods tend to divide samples according to how attributes occur together, Q Mode groups attributes in terms of their overall similarity (Sneath and Sokal 1973:256). Optimally, the results of R and Q mode analysis would be identical, however, analysts note a lack of equivalency between Q

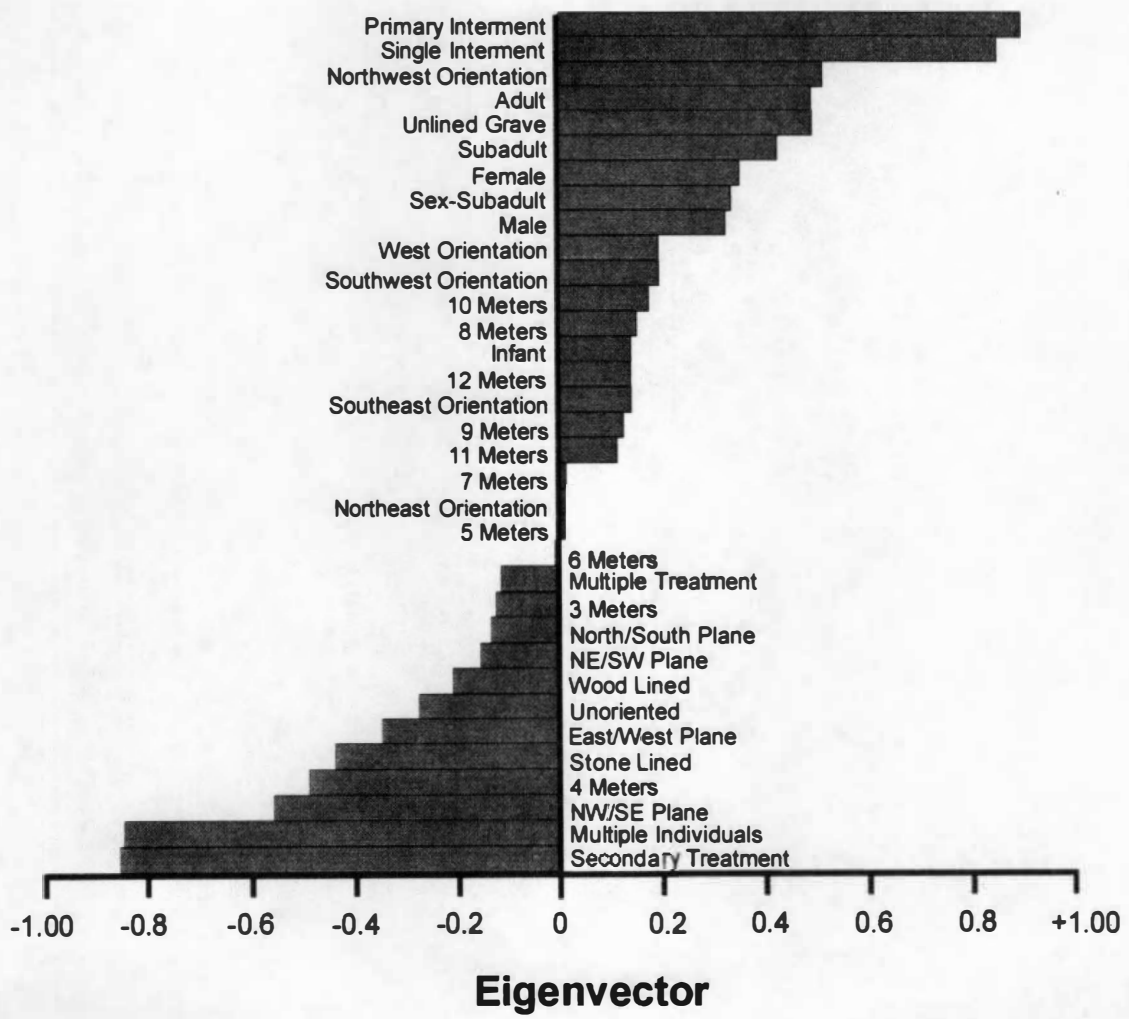


Figure 16-2. Distribution of Eigenvectors from Component 1.

Table 16-5. Frequencies of Restructured Mortuary Attributes from Mound C.

Variable	Attribute	Present	Population
Treatment	**Primary Treatment-Single**	**66**	**63.4**
	Primary Treatment - Multiple	**14**	**13.5**
	Secondary Treatment	35	33.7
	Multiple Treatment	3	2.8
Multiplicity	**Single (Secondary Treatment) Interment**	**6**	**5.8**
	Multiple Interment	**31**	**29.8**
Furniture	Unlined Grave	98	94.2
	Wood Lined Grave	2	1.9
	Stone Lined Grave	4	3.8
Orientation	Northeast Orientation	1	1.0
	Southeast Orientation	3	2.9
	Southwest Orientation	11	10.6
	Northwest Orientation	49	47.1
	West Oriented	6	5.8
	North/South Plane	2	1.9
	East/West Plane	5	4.8
	Northeast/Southwest Plane	5	4.8
	Northwest/Southeast Plane	19	18.3
	Unoriented	4	3.8
Provenience	3-3.99 Meters	6	5.8
	4-4.99 Meters	16	15.4
	5-5.99 Meters	15	14.4
	6-6.99 Meters	18	17.3
	7-7.99 Meters	14	13.5
	8-8.99 Meters	12	11.5
	9-9.99 Meters	13	12.5
	10-10.99 Meters	3	2.9
	11-11.9 Meters	5	4.8
	12-12.99 Meters	2	1.9
Sex	Male	18	17.3
	Female	15	14.4
	Sex-Subadult	26	25.0
Age	Infant (<4 Years)	3	2.9
	Subadult (4-29 Years)	29	27.9
	Adult (>30 Years)	27	26.0

Note: Bold = Rescored Variables

and R end results (See Hodson 1982:28). The question then becomes how important these differences are to the study's end results. Placement of mortuary features in the proper symbolic context sometimes requires a delicate determination of attribute affinities. Some researchers recognize that Q methods are slightly more sensitive to fine distinctions between attribute groups (Sneath and Sokal 1973:258). Since structural differences may imply different meanings, Q Mode analyses were applied to the Mound C cemetery.

Clustering as an Analytical Technique

Investigations of mortuary communication do not differ from many other forms of archaeological inquiry. They attempt to discover and describe cultural activities from traces of past human behavior (Spaulding 1982:2). In many respects this is an exercise in taxonomic classification. The end goal is to establish degrees of similarity (or dissimilarity) between groups of mortuary meanings as found within a particular assemblage. Since anthropology lacks a theory of classification specifically designed for its data, theoretical models must be borrowed from other disciplines (Read and Christianson 1978:506). Analysts interested in determining mortuary structure have largely focussed on Q Mode clustering techniques as a means of grouping multivariate expressions.

Q Mode Analyses typically form clusters from distance or similarity relationships. A similarity/dissimilarity coefficient matrix most efficiently describes the expression of differences between categorical phenomena (Seber 1984:366). This table expresses the degree of agreement between any two interments based on their binary structure (i.e., presence or absence). Graves sharing lots of the same features are more likely to express similar messages than graves sharing few features. The choice of similarity coefficient is grounded on whether binary values carry equal or unequal weight. In symmetric data sets, where both values are equally meaningful (an excellent example of this is classification as either male or female), the information portrayed by either classification are considered as an expression of similarity/dissimilarity (Kaufman and Rousseeuw 1990:23). The Simple Matching Coefficient is perhaps the most reasonable means of expressing this similarity. However, in a structure where any number of outcomes are substituted (some of

which must be recognized as unknown or not present in the sample) or the relationship between potential substitutes is not known, the only identical features can be validly associated is among identical features. This asymmetric data does not weigh binary expressions equally. Instead, it places more information value on the positive (or present) expression and no value on the negative (or absent) expression (Kaufman and Rousseeuw 1990:25)[1].

The Jaccard Coefficient is one of the most efficient means of expressing similarity/dissimilarity in this analytical environment. The Jaccard Coefficient (S_J) provides a numeric measure of similarity, where '0' represents completely incongruent sets of characteristics and '1' indicates identical structures (Sneath and Sokal 1973:131). Its simplicity has probably contributed to its widespread use in anthropology (Baxter 1994:150). In mortuary research, use by Rothschild (1979) and Pearson et al. (1989) have enabled large, varied sets of mortuary information to be summarized efficiently. The Jaccard Coefficient is best applied to relatively large assemblages of information (Baxter 1994:157).

Technically, the Jaccard Coefficient is not a clustering algorithm – it merely translates data into a more useable form. Since mortuary attributes represent components of a system of communication, they are not interpreted independently during the mortuary event. These attributes convey information of varying importance. The most realistic approach to ordering these types of systems is to view them as integrated, hierarchically arranged structures with discrete bits of information integrated into broadly communicated ideas (Seber 1984:372). Q Mode clustering methods are used to acquire these types of hierarchical structures. Q Mode clustering methods attempt to organize a system by defining homogenous clusters of identical components. Discrete components are systematically assembled on the basis of their similarity to one another (Seber 1984:360). The results are hierarchically arranged clusters containing internally similar elements that

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[1] A method accounting for information in negative matches was introduced by Gower (1971) and applied to a mortuary setting by Palumbo (1987). This method tends to produce clusters that are not cleanly separated, particularly among auto-associated variables. The effects of the Gower Coefficient on statistical space have not been deeply explored. Its use in analytic science is still considered developmental.

can then be described as discrete units within the system. As groups are combined, elements in each cluster become less alike, requiring a more generalized description of the data and emphasizing the overall complexity of the structure. The agglomerative process stops at the point where all clusters are contained within a single structure (i.e., they represent a system). When a system is completely described, its elements are hierarchically arranged in order of similarity (Figure 16-3).

There are a multitude of clustering methods available (Manly 1994; SAS Institute, Inc. 1989; Sneath and Sokal 1973). Each method is designed to approach specific forms of data and provide a distinct type of arrangement. All, however, begin with the assumption that there are natural divisions within the data (Lock 1991:84). Given the manner that symbolic expressions are used to express social qualities as a unit, determining the arrangement of these discrete units is analogous with finding natural divisions.

Statisticians and archaeologists do not agree which clustering methods are the most appropriate for anthropological data (c.f., Aldenderfer and Blashfield 1978; Cowgill 1982; Christianson and Read 1977; Hodson 1982; Kintigh and Ammerman 1982; Matson 1980). To date, no single method of clustering is recognized as superior to other forms (Manly 1994:128). The choice of analytical method employed is generally based on the best fit between mathematical assumptions within each method and definable data structures.

Most clustering methods tend to emphasize numeric data. The mortuary information available from Mound C, however, is describable only in categorical terms. Metric and ordinal procedures cannot be applied[2]. This severely constrains the choice of available methods.

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[2] Mixed data clustering algorithms are available, but their application in archaeology is still in the exploratory stages (Philip and Ottoway 1983:131).

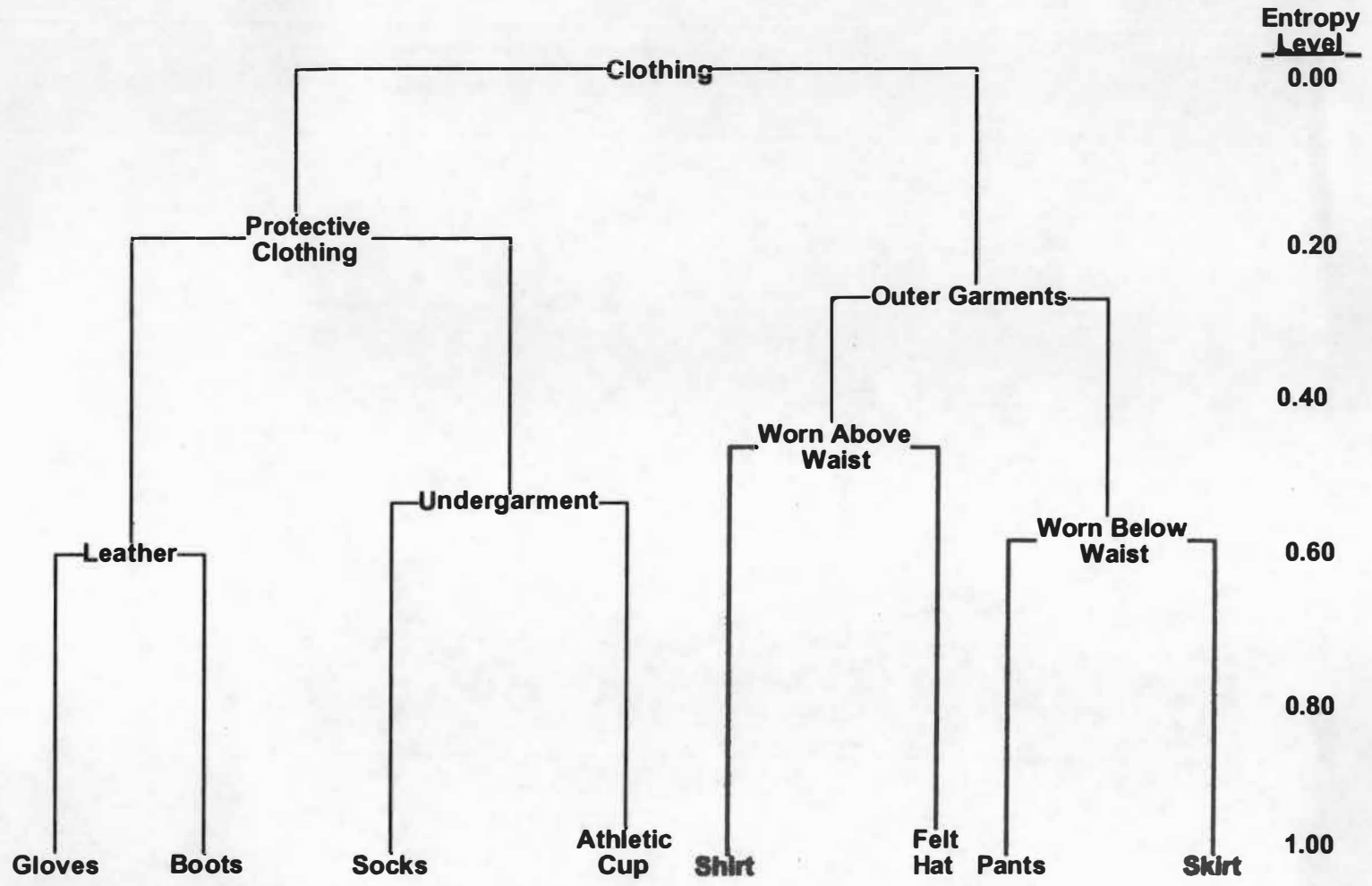


Figure 16-3. An Agglomerative High Entropy Dendrogram of Clothes.

Figure 16-3. An Agglomerative High Entropy Dendrogram of Clothes.

The applicable agglomerative hierarchical clustering methods require some assumptions about the data's structure (Gordon 1981:122; Baxter 1994:154). Among data where simple, well-defined structural differences are anticipated, single linkage methods (nearest neighbor analysis) are employed. The single linkage method measures similarity based on closest members to a given cluster. This algorithm inherently assumes a linear structure to the resulting output. As a result, points that are spatially distant may be incorporated (chained) into the same cluster (Kaufman and Rousseeuw 1990:48; Sneath and Sokal 1973:222). As a means of overcoming this problem the complete linkage algorithm (furthest neighbor analysis) is available. Complete linkage measures the relationship between the most distant points between groups and combines those that are closest. The results are tightly constrained within statistical space. Hence, the method may not identify elements forming a widely dispersed cluster (Kaufman and Rousseeuw 1990:48; Sneath and Sokal 1973:223-228). Complete linkage is very sensitive to slight changes in rank order (Baxter 1994:158).

A more realistic algorithm for data lacking rigidly linear structure is Average Linkage (Unweighted Pair Grouping). Rather than focus on the provenience of particular individuals within a cluster, average linkage defines similarity between groups by the average similarity expressed between distinct pairs of individuals (Baxter 1994:141-142). Similarities are based on measures of Euclidean space and this algorithm is very sensitive to clusters approximating a sphere in statistical space (Sneath and Sokal 1973:228). Unfortunately, this feature can produce dendrograms that are difficult to interpret (Kaufman and Rousseeuw 1990:230).

More intelligible dendrograms are produced by the Ward's Method (Error Sum of Squares) algorithm. This method measures the amount of variability present within each cluster and then merges those groups producing the smallest increase in overall variability (Sneath and Sokal 1973:241). Distances between clusters are approximated using the euclidean distance. While this method is an excellent means of identifying outliers, it also has a tendency to dismiss more linear relationships (Wright 1989, In Baxter 1994:157). It is more suited for analyzing uniform spherical clusters (Baxter 1994:158).

Most analysts tend to favor the Average Linkage and Ward's Method over Single and Complete Linkage methods. Average Linkage and Ward's Method dendrograms generate clusters that are difficult to tell apart, particularly among the macro-cluster (few cluster) solutions. Since Ward's Method strives to produce clusters with a minimum amount of internal variance there is a tendency towards greater within-cluster homogeneity than may be produced by other clustering algorithms.

Which clustering algorithm is the most appropriate? The simplest answer is to apply the one that best describes the data's structure. All clustering algorithms suffer a common drawback -- in order to define structure they distort distances between the original variables (c.f., Magne and Klassan 1991:396). As a result, the distance matrix derived after clustering is a departure from the original data's form. Without prior knowledge of structure in an unmodified distance matrix, external structures can be forced into the data by simply applying an inappropriate clustering algorithm.

One method of defining which algorithm best approximates the original data's structure is cophenetic correlation. Cophenetic analysis is designed to compare two distance matrices and provide an estimate of congruence (Rohlf and Sokal 1981:471-473). It is commonly employed to assess the strength of hierarchical arrangements in taxonomic studies. Cophenetic analysis calculates the correlation coefficient 'r_{COPH}' from a matrix expressing the differences between the original 'unmodified' distance matrix and a subsequent 'manipulated' cluster matrix (Sneath and Sokal 1973:278). This statistic, which is roughly comparable to the normalized Mantel 'Z' statistic, produces reliable results without the biases introduced by other matrix correlation procedures (Rohlf and Fisher 1968:408-409). In anthropology, cophenetic analysis is used to evaluate clustering algorithm performance on a given data set (Baxter 1994:166). 'r_{COPH}' values with the strongest correlation (obtained from comparison of original and each clustered distance matrices) provide evidence of the algorithm that best fits the data's structure.

Application to the Mound C Cemetery

The next step in answering the research question was to convert burial attributes into a similarity matrix. Scores from the revised burial attribute battery were transformed using the Classify,

Hierarchial Cluster and Jaccard routines in SPSS (8.0). The resulting coefficients reduced similarity between attributes from any two burials to a single numeric expression. While each Jaccard coefficient derives this similarity from the attribute battery, individual burial attribute scores are no longer a direct component of the resulting matrix.

The Jaccard Similarity Matrix cannot indicate what attributes are similar or divergent. The matrix and all subsequent derivations from it are blind to the original scores. This feature reduces researcher biases from entering the agglomeration process, but requires an evaluation of the completed procedure with the original attributes prior to drawing any substantive conclusions about the cemetery's mortuary structure.

The Jaccard coefficient is not a distance coefficient as generally required from most clustering procedures. Following Pearson et al. (1989:22), a pseudo-distance measure was produced by subtracting each coefficient from 1.00. The Jaccard pseudo-distance matrix was then submitted to clustering using Single Linkage, Complete Linkage, Average Linkage and the Ward's Error Sum of Squares algorithm procedures (via Proc Cluster) in SAS (6.0). Since the Jaccard procedure entails squaring the matrix, the No-Squared option was employed for the Ward's Method analysis. The resulting data sets consisted of fusion nodes and distance values (Single Linkage=Minimum Distance, Complete Linkage=Maximum Distance, Average Linkage=Root Mean Square Distance, Ward's Method=Semi-Partial R Squared Distance).

The Single, Complete and Average Linkage procedures were computed again in NTSYS using the SAHN clustering procedure. Use of the No-Norm option insured that comparable clustering results were obtained from both SAS and NTSYS. Cophenetic values were calculated using the COPH function outlined in the NTSYS software package. This constructed a cophenetic matrix from the distance values assigned at each fusion iteration. A cophenetic matrix of the Ward's Method Semi-Partial R Squared Distance value was constructed by hand[3] and submitted to NTSYS

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[3] The Cophenetic Ward's Method Distance Matrix was constructed by determining the X-Y intersection for each burial-to-burial comparison and inserting the iteration's fusion (distance) value in the corresponding cell. Portions of the Cophenetic Average Link Distance Matrix were constructed

for analysis. Comparison of these cluster-derived matrices to the original Jaccard pseudo-distance matrix used the MXCOMP routine.

Cophenetic correlation values (r_{COPH}) for each cluster algorithm were obtained from NTSYS and compared to determine which clustering method best fit the original pseudo-distance matrix. Relatively strong correlations were obtained from each clustering algorithm, with the Average Linkage method providing the most superior fit (Table 16-6). Average Linkage Clustering provided least distortion of the Mound C Cemetery's data structure. The Average Linkage Method was pursued as the most appropriate clustering algorithm[4].

Table 16-6. Cophenetic Correlations of Four Clustering Algorithms Applied to the Mound C Cemetery.

Cluster Algorithm	R_{COPH} Correlation Value
Average Linkage	0.88420
Complete Linkage	0.88280
Single Linkage	0.84853
Ward's Error Sum or Squares	0.74480

As stated earlier, clusters formed by the Average Linkage clustering algorithm were based on Root Mean Square Distance (Table 16-7). This value indicated the proportionate similarity between fused cases in the entire structure. The data's structure was arranged into a dendrogram (Figures 16-4 through 16-9). Fusion node numbers reflected where a given merger

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and compared with the corresponding NTSYS-produced cophenetic matrix to insure that congruent results were obtained.

[4] Recognizing that cluster algorithm performance is affected by structure within the original distance matrix, these correlation values provide some ideas of the original data's shape in statistical space. As noted earlier, Average Linkage is best suited for data possessing a spherical structure. In contrast, the poorest performing algorithm (Ward's Method) is also sensitive to spherical data clusters. Ward's Method, however, is not adept at detecting linear relationships. Judging from the performance of the linear sensitive Single and Complete Linkage methods, the Mound C mortuary data probably possesses a spherico-linear (oval?) structure.

Table 16-7. Clusters Developed by Average Link Clustering Algorithm.

Number	Joined	Joined	Distance	Common Structure
103	112	123	0.000	Adult Male NW Primary Unlined (7m) [Identical Form]
102	150	151	0.000	Multiple Unoriented Secondary Unlined (6m) [Identical Form]
101	152	155	0.000	Subadult W Primary Unlined (6m) [Identical Form]
100	105	18	0.000	Adult Female NW Primary Unlined (8m) [Identical Form]
99	171	218	0.000	Multiple NW/SE Secondary Unlined (4m) [Identical Form]
98	116	230	0.000	Multiple NW/SE Secondary Unlined (6m) [Identical Form]
97	**99**	263	0.000	Multiple NW/SE Secondary Unlined (4m) [Identical Form]
96	122	272	0.000	Multiple NW Primary Unlined (7m) [Identical Form]
95	278	283	0.000	Subadult NW Primary Unlined (5m) [Identical Form]
94	20	291	0.000	Multiple NW/SE Secondary Unlined (8m)[Identical Form]
93	137	295	0.000	Multiple NW Primary Unlined (9m) [Identical Form]
92	**93**	302	0.000	Multiple NW Primary Unlined (9m) [Identical Form]
91	303	304	0.000	Subadult NW Primary Unlined (10m) [Identical Form]
90	280	320	0.000	Subadult NW Primary Unlined (4m) [Identical Form]
89	324	325	0.000	Adult Female SW Primary Unlined (12m) [Identical Form]
88	146	333	0.000	Subadult NW Primary Unlined (6m) [Identical Form]
87	114	38	0.000	Adult Male NW Primary Unlined (6m) [Identical Form]
86	148	41	0.000	Adult Male NW Primary (5m) [Identical Form]
85	**92**	49	0.000	Multiple NW Primary Unlined (9m) [Identical Form]
84	**100**	55	0.000	Adult Female NW Primary Unlined (8m) [Identical Form]
83	107	57	0.000	Subadult NW Primary Unlined (7m) [Identical Form]

Notes: 1. Cluster Numbers Identified in Bold.
2. Common Structure Order: Multiplicity or Age, Sex, Orientation (Abbrev.), Treatment, Liner, Distance [(5m)=5=5.99 Meters], [] = Additional Notes.

Table 16-7 (continued). Clusters Developed by Average Link Clustering Algorithm.

Number	Joined	Joined	Distance	Common Structure
82	307	59	0.000	Multiple N/S Secondary Unlined (7m) [Identical Form]
81	30	6	0.000	Adult Male NW Primary Unlined (8m) [Identical Form]
80	**95**	65	0.000	Subadult NW Primary Unlined (5m) [Identical Form]
79	**97**	71	0.000	Multiple NW/SE Secondary Unlined (4m) [Identical Form]
78	74	77	0.000	Multiple NW/SE Secondary Unlined (3m) [Identical Form]
77	**79**	79	0.000	Multiple NW/SE Secondary Unlined (4m) [Identical Form]
76	47	80	0.000	Multiple E/W Secondary Unlined (4m) [Identical Form]
75	81	83	0.000	Adult Male NW Primary Unlined (8m) [Identical Form]
74	84	85	0.000	Adult Female NW Primary Unlined (8m) [Identical Form]
73	98	118	0.170	Multiple NW/SE Secondary Unlined (6m) [Identical Form]
72	134	**91**	0.170	Subadult NW Primary Unlined (10m)
71	**80**	66	0.170	Subadult NW Primary Unlined (5m)
70	242	45	0.250	Adult Male NE\SW Secondary Unlined
69	103	104	0.290	Adult SW Primary Unlined (9m)
68	102	**74**	0.290	Adult Female NW Primary Unlined
67	**103**	**87**	0.290	Adult Male NW Primary Unlined
66	**67**	131	0.290	Adult Male NW Primary Unlined
65	**66**	**86**	0.290	Adult Male NW Primary Unlined
64	**65**	219	0.290	Adult Male NW Primary Unlined
63	**68**	222	0.290	Adult Female NW Primary Unlined
62	124	282	0.290	Subadult NW/SE Secondary Unlined
61	**64**	**75**	0.290	Adult Male NW Primary Unlined
60	129	68	0.290	Adult Female SE Primary Unlined
59	108	76	0.290	Subadult Female NW Primary Unlined
58	**62**	91	0.290	Subadult NW/SE Secondary Unlined
57	**83**	133	0.330	Subadult NW Primary Unlined
56	**96**	**85**	0.330	Multiple NW Primary Unlined
55	**57**	**88**	0.330	Subadult NW Primary Unlined
54	147	**102**	0.330	Multiple Secondary Unlined (6m)
53	**77**	**94**	0.330	Multiple NW/SE Secondary Unlined
52	**55**	207	0.330	Subadult NW Primary Unlined
51	**101**	208	0.330	Subadult W Primary Unlined
50	**56**	262	0.330	Multiple NW Primary Unlined
49	**50**	262	0.330	Multiple NW Primary Unlined
48	**53**	276	0.330	Multiple NW/SE Secondary Unlined
47	**52**	**90**	0.330	Subadult NW Primary Unlined
46	245	301	0.330	Multiple SW Primary Unlined
45	267	309	0.330	Multiple Secondary Stone Lined

Table 16-7 (continued). Clusters Developed by Average Link Clustering Algorithm.

Number	Joined	Joined	Distance	Common Structure
44	**45**	312	0.330	Multiple Secondary Stone Lined
43	322	42	0.330	Subadult SW Primary Unlined
42	236	44	0.330	Multiple NE/SW Secondary Unlined
41	**49**	53	0.330	Multiple NW Primary Unlined
40	**41**	63	0.330	Multiple NW Primary Unlined
39	**40**	64	0.330	Multiple NW Primary Unlined
38	**48**	72	0.330	Multiple NW/SE Secondary Unlined
37	**38**	**78**	0.330	Multiple NW/SE Secondary Unlined
36	**46**	92	0.330	Multiple SW Primary Unlined]
35	**47**	**71**	0.357	Subadult NW Primary Unlined
34	**73**	**54**	0.366	Multiple Secondary Unlined (6m)
33	**35**	**72**	0.374	Subadult NW Primary Unlined
32	**69**	221	0.408	Adult SW Primary Unlined
31	**59**	89	0.408	Subadult Female Primary Unlined
30	243	**43**	0.430	Subadult SW Primary Unlined
29	46	**76**	0.430	E/W Secondary Unlined
28	**32**	**89**	0.441	Adult SW Primary Unlined
27	**63**	**61**	0458	Adult NW Primary Unlined
26	**34**	**37**	0.479	Multiple Secondary Unlined
25	**39**	88	0.496	Multiple NW Unlined
24	**33**	**31**	0.501	Subadult Primary Unlined
23	**44**	311	0.502	Multiple Secondary Stone Lined
22	**51**	**30**	0.527	Subadult Primary Unlined
21	**26**	**42**	0.527	Multiple Secondary Unlined
20	**27**	227	0.548	Adult Primary Unlined
19	**25**	**36**	0.549	Multiple Non-Secondary Unlined
18	**21**	211	0.553	Multiple Secondary Unlined
17	**28**	**60**	0.556	Adult Primary Unlined
16	**18**	**82**	0.563	Multiple Secondary Unlined
15	**24**	**22**	0.569	Subadult Primary Unlined
14	279	281	0.570	Multiple Multiple/Secondary Wood Lined
13	125	300	0.570	Infant Primary Unlined
12	13	52	0.570	Infant Primary Unlined
11	15	265	0.578	Subadult Primary Unlined
10	20	17	0.589	Adult Primary Unlined
9	16	29	0.603	Mostly Multiple Secondary Unlined
8	9	23	0.673	Multiple Secondary
7	10	11	0.686	Non-Infant Primary Unlined
6	58	70	0.700	Non-Multiple Secondary Unlined
5	7	12	0.710	Primary Unlined
4	8	6	0.732	Secondary Unlined
3	4	19	0.779	Non-Primary
2	3	14	0.805	Non-Primary
1	5	2	0.867	All Graves [Socially Stable, Constant Resources]

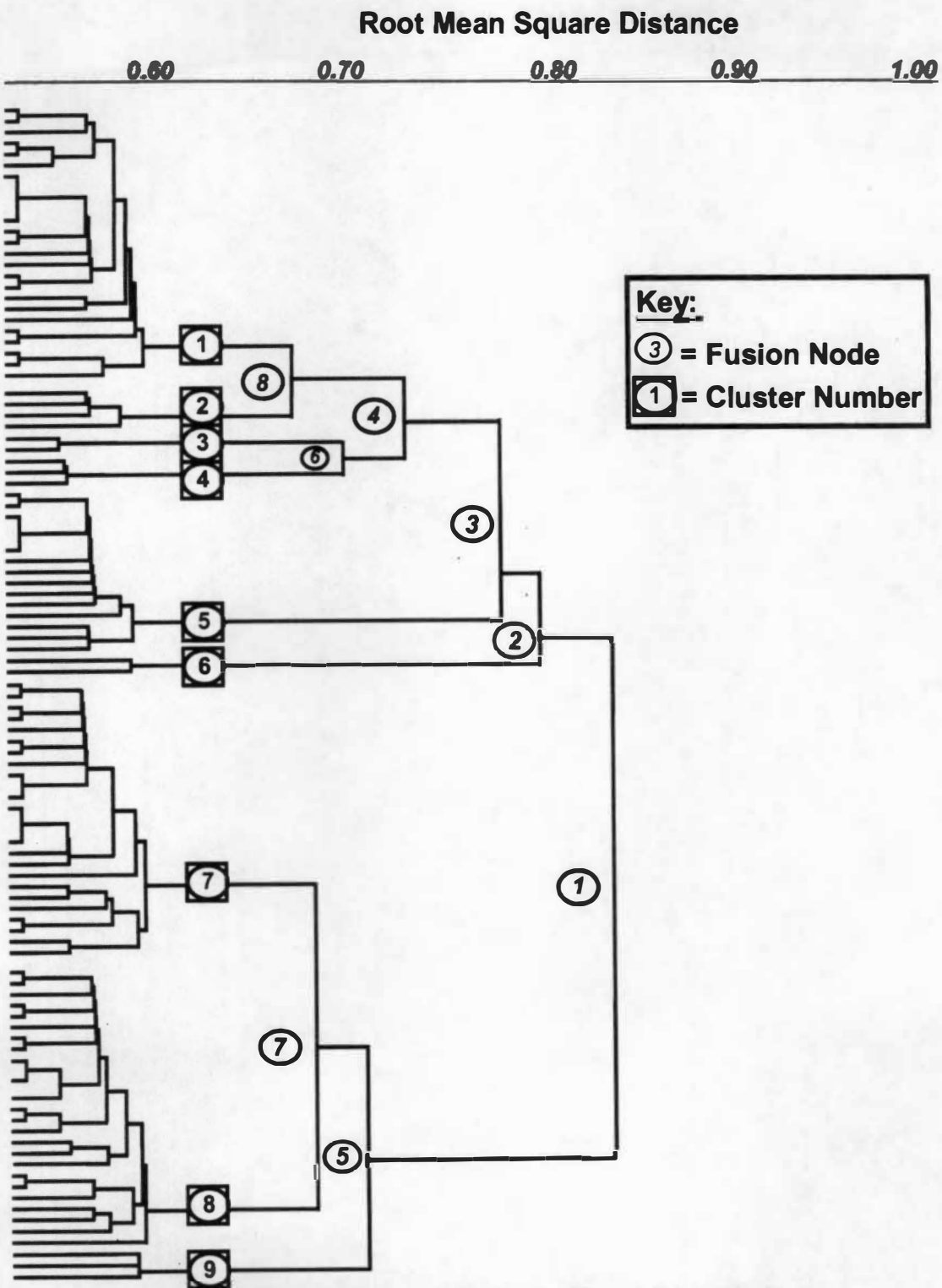


Figure 16-4. Mortuary Structure Dendrogram for the Mound C Cemetery (Average Linkage Method).

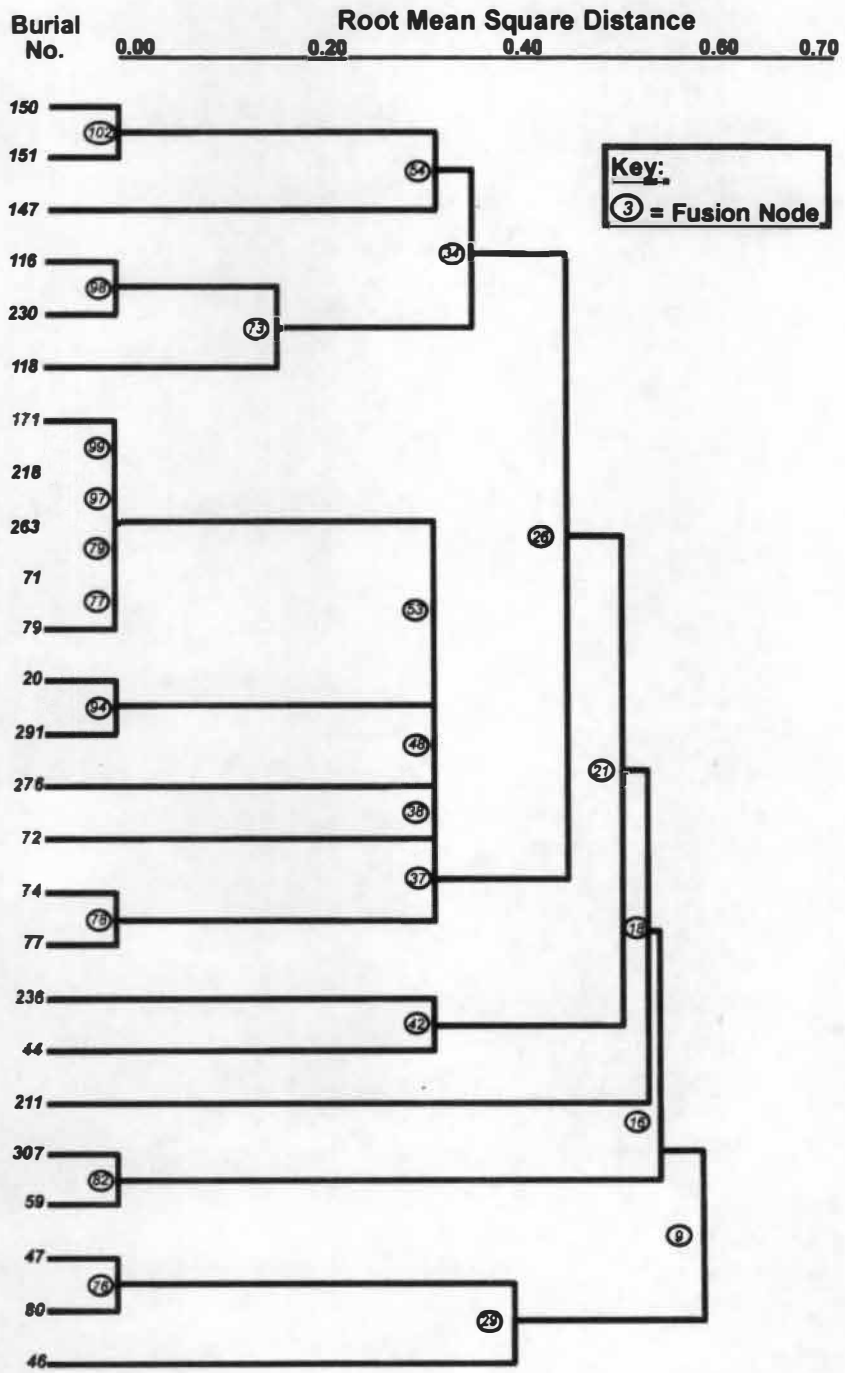


Figure 16-5. Dendrogram of Fusion Node 9: Multiple Secondary Unlined Graves.

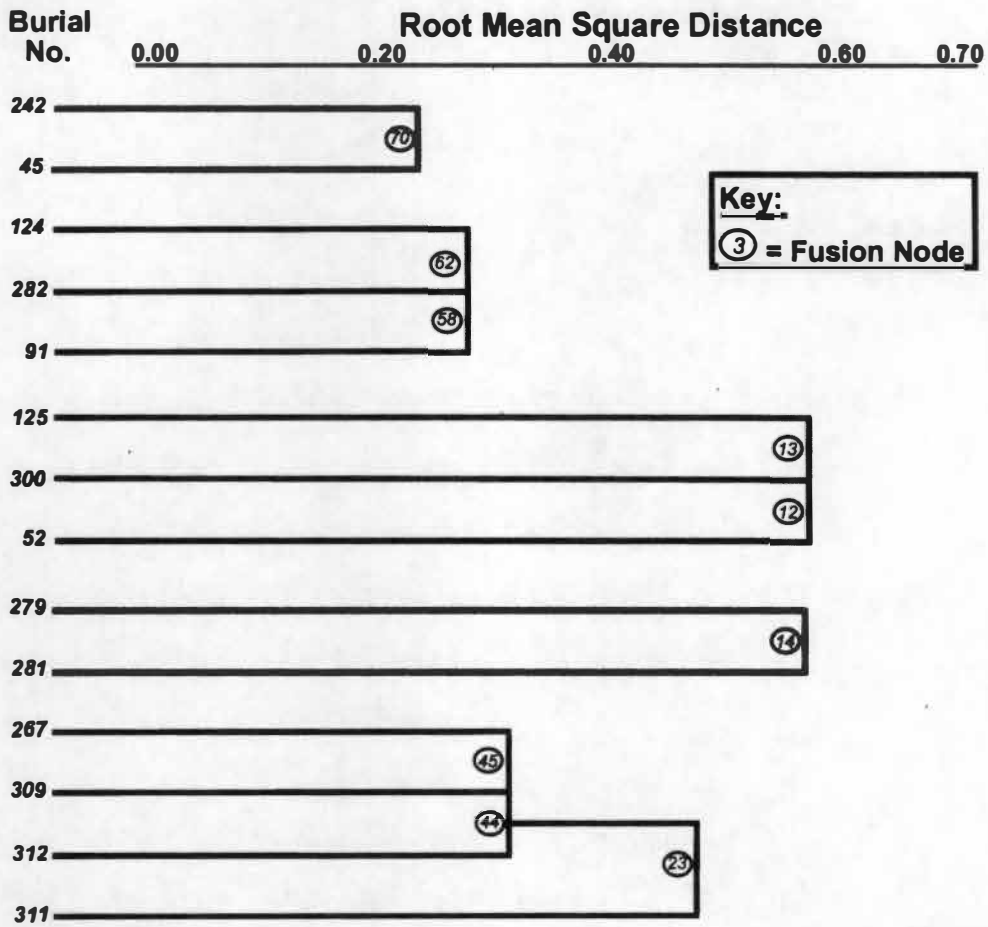


Figure 16-6. Dendrograms of Low Frequency Grave Clusters (Fusion Nodes 12, 14, 23, 58, 70).

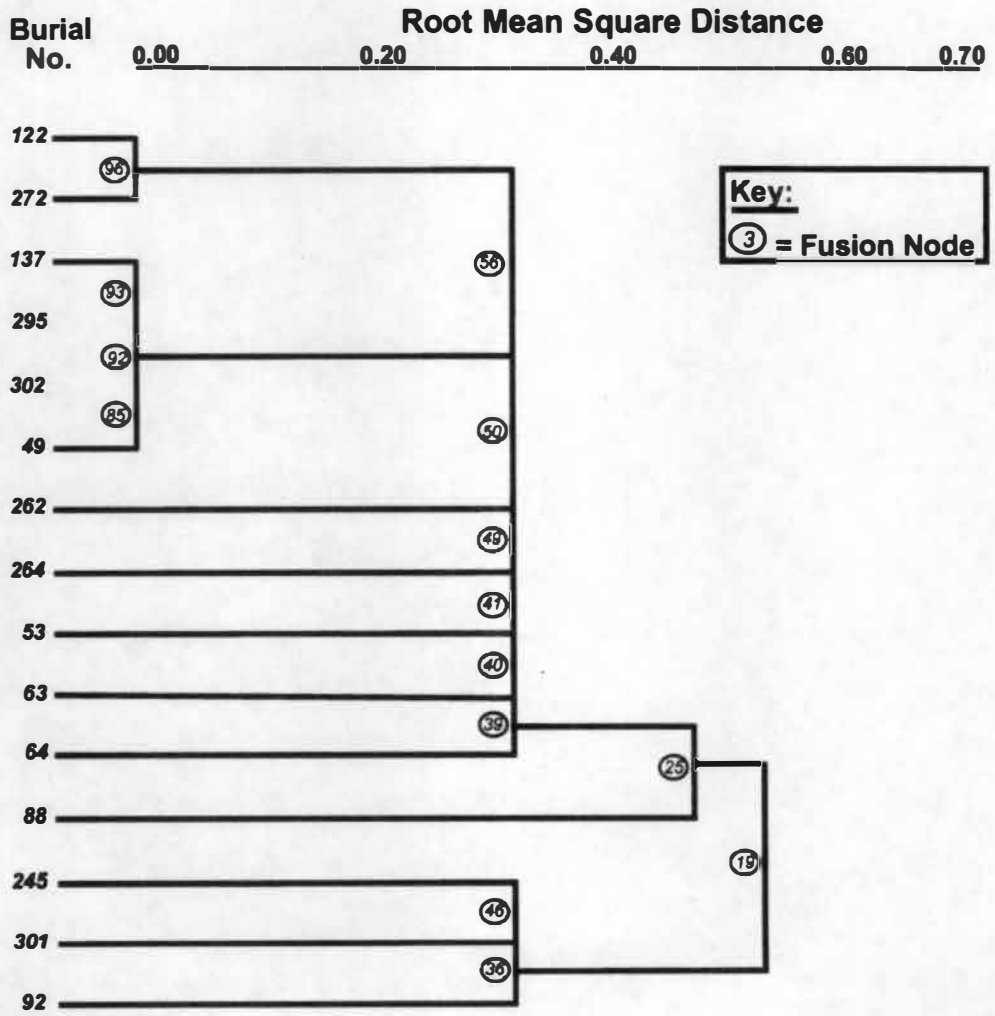


Figure 16-7. Dendrogram of Fusion Node 19: Multiple Non-Secondary Unlined Graves.

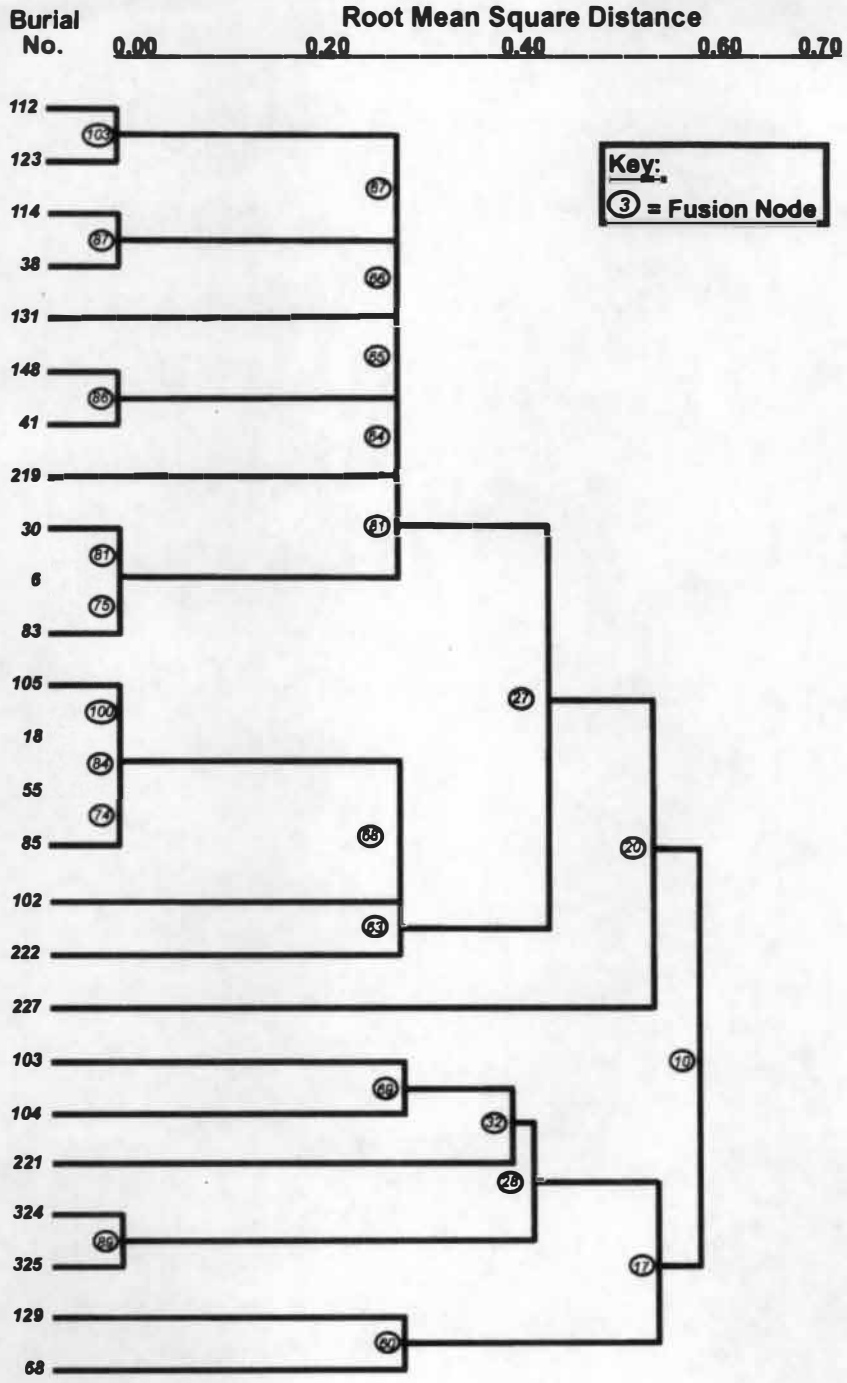


Figure 16-8. Dendrogram of Fusion Node 10: Adult Primary Single Unlined Graves.

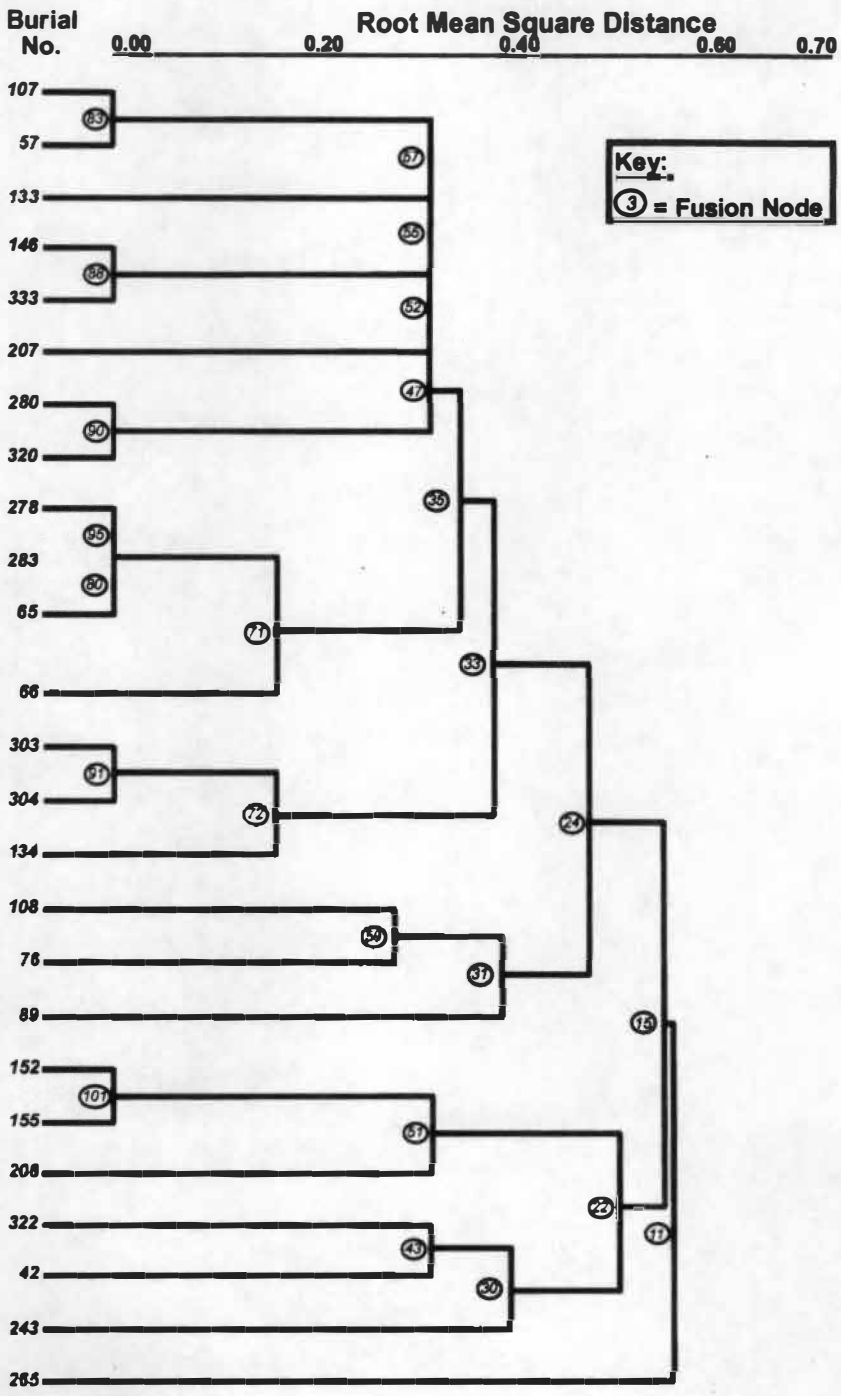


Figure 16-9. Dendrogram of Fusion Node 11: Subadult Primary Single Unlined Graves.

occurred during agglomeration. On the dendrogram, they also indicated the number and location of potential clusters present at a given point during agglomeration.

Structural Complexity

Attributes for a given system tend to follow one of two distributions – non-intersecting sets of features may form segregated groups or attributes may be shared between groups, forcing clusters to be based on a few unique characteristics. Social correlates are recognized by how mortuary attributes follow these trajectories. These aspects of structural complexity are estimated by measuring the amount of disorganization present in a system (Klir and Valach 1967:58). This is expressed by the magnitude of dissimilarity created with the merger of two cases. In many respects dissimilarity values are analogous to entropy, as originally measured in the information statistic. Systems that contain high amounts of entropy (or as expressed by the Average Linkage algorithm – numerous high Root Mean Square Distances) combine dissimilar objects in order to place all elements in the system (Hodder 1977:225). High entropy grave clusters possess few common suites of attributes. Symbols communicating social information about different personalities are segregated from one another. In a high entropy mortuary display, a person with one set of mortuary attributes could not possess the same social qualities associated with attributes found in other sets.

Knowledge of the characteristics of one element in a high entropy system may not be helpful when trying to predict the characteristics of other elements (Hodder and Orton 1976:10). For example in Figure 16-3, knowing that boots are made of leather tells you nothing about felt hats or socks. High entropy is generally associated with less complex structural arrangements; systems whose structures approximate perfect paradigms are expected to display sizeable entropy values (Saxe 1970:76). This is also true for uniformly high Root Mean Square Distances. Rothschild (1979:671) has noted that high system entropy is a feature of hunter-gatherer funerary behavior at Indian Knoll.

Lower entropy values are found in organizations composed of inherently similar objects. The features of one object can be used to predict some of the features found in others. In a system

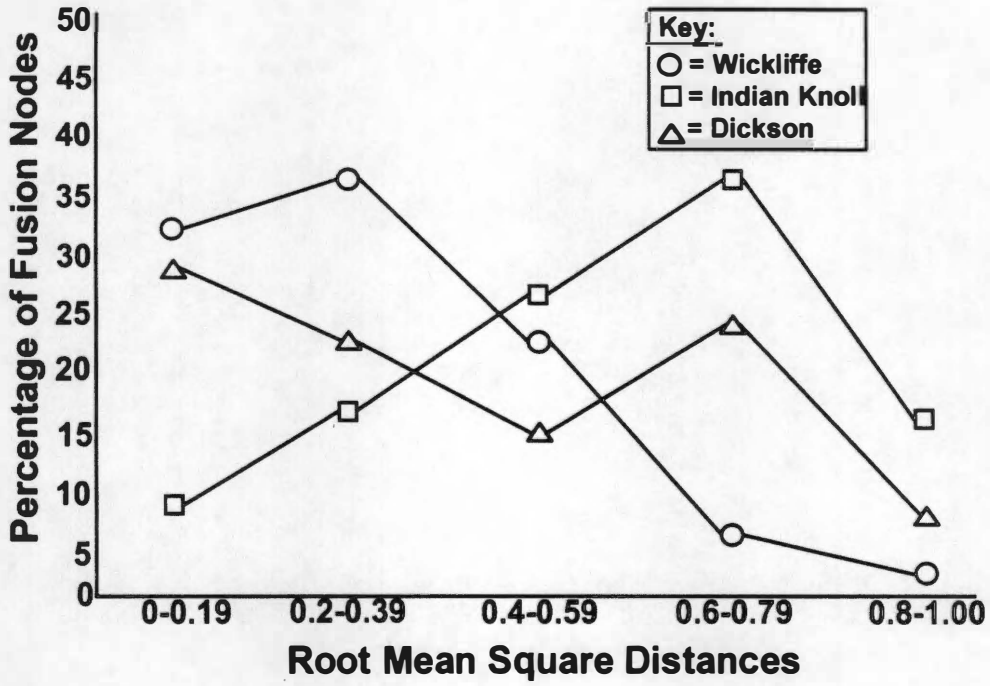
of interlocking gears, for instance, knowing that one is round can be used to infer the shape of other gears (i.e., they are also probably round). While differences in size and number of cogs may be used to distinguish discrete sets of gears, their overall similarity would produce lower overall entropy values than expressed in Figure 16-3. Systems with numerous low Root Mean Square Distances would reflect the same pattern.

Differences in a low entropy system are less profound than those in a higher entropy system. They are by no means less important. Among mortuary structures, shared attributes between clusters focus the display's social interpretations on a few divergent or key features, rather than restating the same social differences throughout the entire attribute suite. Shared attributes indicate that social features can be components of more than one expression. Low entropy systems are generally affiliated with complex structures and tend towards a perfect tree structural arrangement.

The Average Linkage algorithm uses Root Mean Square Distances to indicate the degree of similarity between fused cases. Root Mean Square Distances are scaled between 0.00, indicating identical attribute forms, and 1.00, reflecting no degree of similarity between attributes. In Mound C over 75% of all fusions possess R-Squared values between 0.00 and 0.50 (inclusive). This high concentration is at the low entropy aspect of the organizational scale implying that a considerable degree of similarity and attribute sharing is present. Grave clusters within Mound C possess many similar attributes and are separated from one another by only a few key features. This pattern is consistent with the expectations of complex organizational structures. Rothschild (1979:671) observed this general pattern in Mississippian mortuary attributes from in the Dickson Mounds complex. In a comparison between Mound C, Indian Knoll and Dickson both Mound C and Dickson mortuary expressions share high frequencies of low Root Mean Square Distance fusions (Figure 16-10). In many respects, Mound C's funerary attributes exaggerate the degree of similarity. This is attributable to the different sets of mortuary attributes used in this and Rothschild's study. A Kolomogorov-Smirnov two-sample comparison between Mound C and these mortuary distributions

reveal a greater degree of homogeneity with the Dickson series. This general pattern indicates that social expression in Mound C is most closely allied to the Mississippian pattern.

Following a complex structural arrangement implies that within the battery of characteristics used to describe funerary displays, some attributes are more universally expressed than others. Mortuary features that are distributed between low entropy clusters would express more generic social meanings while those forming the low entropy social groups communicate more exclusive social messages. Determining where attributes fall within the agglomeration sequence helps identify whether social messages are universal or segregated.



Kolomogorov-Smirov Two-Sample Test:
Mound C and Indian Knoll: D=0.441; P=<0.001
Mound C and Dickson: D=0.282; P=<0.001

Figure 16-10. Proportionate Distribution of Cluster Fusion Nodes – Mound C and Other Sites.

Mortuary attributes were sorted into the original seven major attribute groups and frequencies by Root Mean Square Distance value ranges were tabulated (Table 16-8). Groups expressing a high representation in the >0.59 range identify symbols and ultimately messages that divide the cemetery into social segments. Relative to frequency within each attribute group, burial treatment, grave furniture, age, and to a lesser degree multiplicity were identified as highly divergent attribute forms. The presence of stone or wood liners was an important discriminating feature, representing some of the last features agglomerated. These divisions were further refined by examining what specific attributes were defined by these clusters. Within age, divisions between adult and non-adult were contrasted and treatment separated primary and non-primary forms. These basic structural components imply that exclusive social meanings were attached to these groups. They probably represent fundamental divisions of the community's social structure. Among lower order clusters, distance, orientation, and gender were the most commonly fused elements, once again relative to the frequencies within each attribute group. At the 0.59 Root Mean Square Distance level, they comprise 87% of the non-identical fusion nodes. Greater similarity among these attributes did not indicate that the information expressed was less meaningful to the community, rather these symbols were less segregated to specific social divisions. Earlier, distance from the mound summit was demonstrated to be related to social investment. This example demonstrated that the social information conveyed may not divide community elements, rather it may communicate more universally shared messages.

Table 16-8. Distribution of Attribute Groups by Root Mean Square Distance.

Root Mean Square Value	Age	Dist-ance	Orient-ation	Sex	Multi-plicity	Treat-ment	Furni-ture	Identical Form	Total
0-0.19	0	0	0	0	0	0	0	33	33
0.2-0.29	0	12	0	1	0	0	0	0	13
0.3-0.39	0	21	4	0	0	0	0	0	25
0.4-0.49	0	4	1	1	1	1	0	0	8
0.5-0.59	0	2	11.5	1	0	0.5	0	0	15
0.6-0.69	1	0	1	0	0	0	1	0	3
0.7-0.79	1.5	0	0.5	0	1	1	0	0	4
0.8-0.89	1	0	0	0	0	1	1	0	2
0.9-0.99	1	0	0	0	0	0	0	0	0
Total	2.5	39	18	3	2	3.5	2	33	103

Note: Fractional Values Represent Apportioned Fusion of Two Features by a Single Iteration.

Cluster Determination

The Average Linkage clustering algorithm was capable of producing 103 potential clusters, but this did not mean that 103 unique social representations are present. Many of these represented the fusion of identical grave forms. During the cemetery's accumulation period, no less than 71 unique combinations of mortuary attributes were deposited. Each of these sets expressed a slightly different social meaning.

In a complex structural arrangement, many attributes are identical between higher order clusters. This means that the meanings affiliated shared mortuary attributes are also redundant. In other words, within sets of graves containing few key differences, many of the symbolized personality traits are likely to be identical. Since Root Mean Square Distances stress low entropy, most attributes are grouped into a few meaningful aggregates. It is unclear, however, where the division between exclusive social representation and common mortuary expression lies.

Many mortuary analysts observe that fundamental social differences between members of a cemetery community are identified by major changes in burial configuration (Goldstein 1980:46-49; Hatch 1976:157-161; Ravesloot 1988:17-18). This is operationalised as the entropy level (Entropy Threshold) where groups of dissimilar objects begin merging. Peebles (1972:5), suggests that an

examination of fusion values graphed against agglomeration sequences can provide an estimate of this point. The resulting curve reveals points of deceleration or flattening – indicators that the amount of information communicated has dropped substantially. The structural contents of these potential clusters are then examined to ascertain whether intelligible groups of attributes are present.

In Figure 16-11, a substantial increase in Root Mean Square Distances between fusion nodes 9 and 8 indicated that structurally dissimilar elements were combined. The clusters formed at this threshold emphasized divisions between treatment, multiplicity, furniture and age. These characteristics probably communicated major social differences within the depositing community.

Attribute-Agent Relationships

The Mound C Cemetery is an ordered structure where attributes are intermingled to convey information about the dead. Following the mortuary variability model, these material symbols relate social concepts from at least seven general agents to the individual. These agents may form simple relationships with attributes; they may combine with other agents to convey meaning; or they may not express a detectable relationship with a given attribute. While each material symbol's full meaning is beyond the reach of archaeological data, it is possible to identify components of the original message.

Some attributes possess simple relationships with an agent, where a single agent's ideas are symbolized by an attribute or suite of attributes. These attributes would express a very high correlation with a given agent. Examples of this would include presentation of the dead in a costume to illustrate group membership or allowing physical morphology to symbolize the dead's gender. If simple relationships were important components of the funerary presentation, high levels of entropy would result when attributes were fused with other attributes. Critical attributes express discrete clusters. In the Mound C Cemetery, attributes potentially expressing this relationship include body treatment, age, furniture and multiplicity. Low Root Mean Square Distance (low entropy) fusions infer that these attributes and associated meanings were not important components (if used at all) of the funerary presentation.

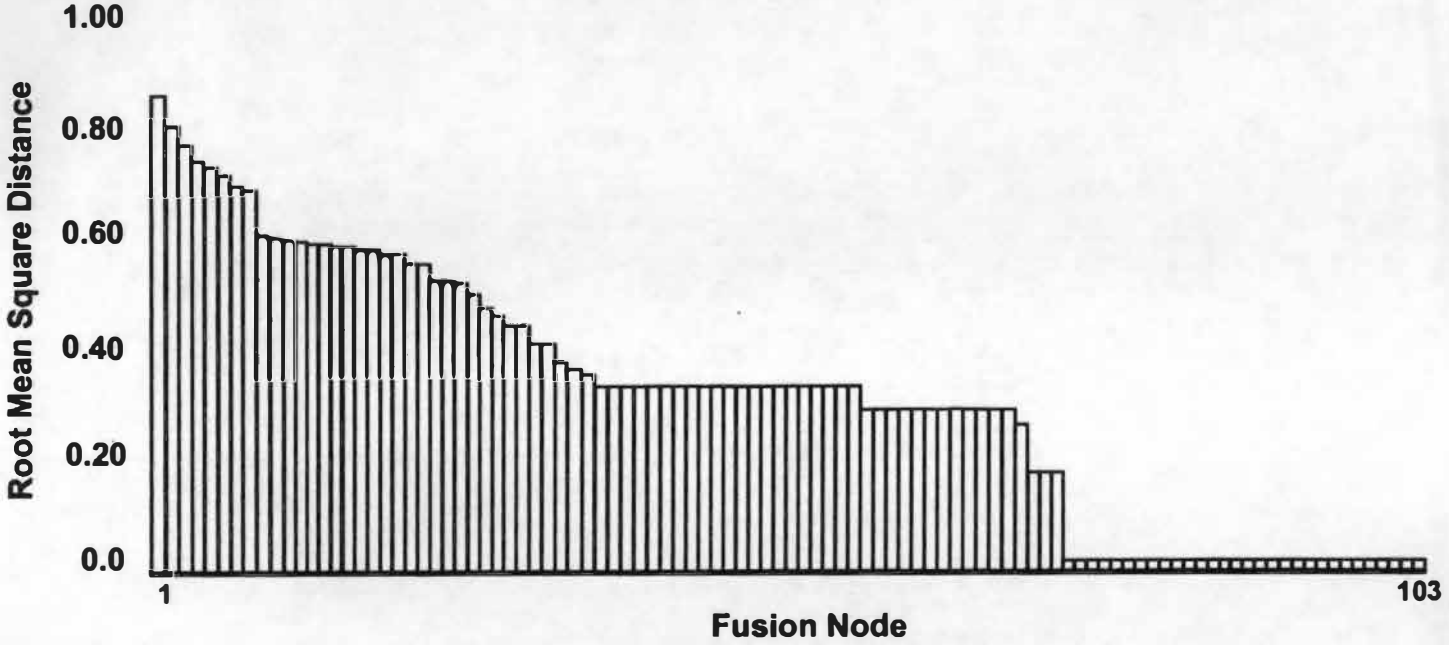


Figure 16-11. Cluster Similarity Curve from Mound C.

Agents and attributes may possess more complex relationships. Attribute messages may not address one agent, rather, they convey ideas by combining the properties of several agents. Single material symbols for such social constructs as a bigman's daughter crosscut concepts within age, sex and social status agents. These material representations would co-vary with several agents. Strong co-variations among attributes and again with multiple agents are potential indicators of complex relationships. Likewise, several agents are tied to attribute combinations assembled in a single cluster. The presence of these agents indicates their importance as a component of funerary presentation message.

Direct relationships between mortuary attributes and a governing agent were present with two variables – age and sex. Simple relationships were explored first. Given that an absolute relationship is assumed with these factors, any strong co-variation between gender and another attribute would infer a strong relation with sex. Returning to the data presented in the Phi Correlation Matrix (Table 16-2), neither sex expressed a strong correlation with any variable. This lack of relationship was emphasized in the low loadings obtained from the principal components analysis (Table 16-3).

Concepts associated with the dead's sex were not paramount factors in the symbolized social personas. Gender was not one of the variables distinguished in the final nine clusters, rather it probably provided less important details about the dead. While gender was undoubtedly an important aspect of the living persona, there was no evidence indicting that sex and gender representation, beyond biological morphology, was re-emphasized. In these regards, men and women were treated the same.

Direct relationships were explored with age. A review of the Phi Correlation Matrix and Principal Components results failed to produce evidence of a strong relationship with other attributes. Within the organizational structure, however, subadults and adults were contrasted in primary (Clusters 7 and 8) and to a lesser degree secondary (Clusters 3 and 4) body treatments. The shared attributes in these clusters implied that the underlying messages were applicable to both age groups.

Infants also formed their own primary treatment assemblage (Cluster 9). Maturity was probably an important component of some mortuary presentations.

Another possibility is that no detectable relationships are expressed. At some level, all agents of variability exert an influence on material expressions, but in many cases the contribution may be too small to detect. An example of this is status's influence on an expression defining the deceased as a grandfather. Poor agent association with an attribute (or set of attributes) is evidence of this relationship. Also, an agent's properties may be so ubiquitous among community members as to provide no additional information about the individual. In Mound C, inclusion in the cemetery recognizes that the dead are recognized members of the community, but does not discriminate personae within this assemblage. Resource Fixity and Organizational Variability probably also represent ubiquitously expressed agents. Lacking evidence of a non-sedentary lifeway, these agents are reduced to constants in Mississippian society.

Uncommon social messages and personalized material expressions were both aspects of idiosyncratic variation. These variants were detected by infrequent use of an attribute. The proportionate representations of attributes within each mortuary variable were plotted (Figure 16-12). All variables demonstrated a gap between the 0-6% representation and those used among at least 10% of the assemblage. This disparity suggested an appreciable difference in popularity among 15 elements (Table 16-9). These expressions were examined to learn how they were distributed between mortuary clusters. Most of these attributes agglomerated into several larger more expansive clusters. They probably represented acceptable variations or minor details within larger messages. Graves oriented to the NE/SW plane (Cluster 4) and those with stone and wood liners (Clusters 2 and 6) formed unique clusters emphasizing rarely used attributes. Contributions by idiosyncratic and age factors were suspected in Cluster 9. Single occupant infant graves were normally placed within the community's living areas. These exceptions imply that some circumstances enabled young children to be included in the community burial area. In general, the social messages conveyed by idiosyncratic agents were either so different from other presentations or so personalized as to render these graves as unique expressions. At the very least, these graves

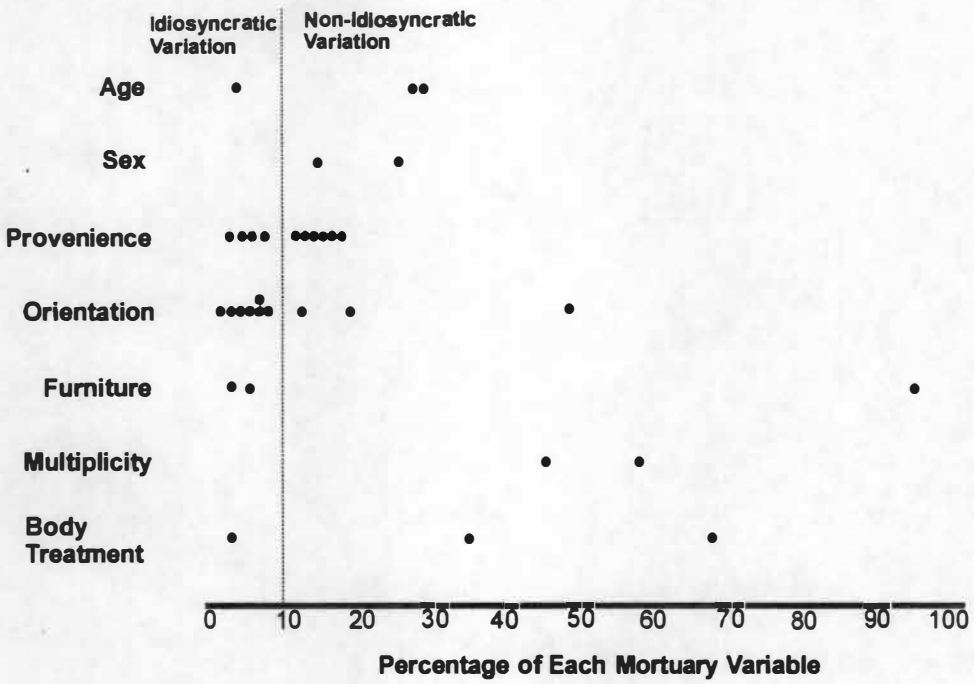


Figure 16-12. Distribution of Mortuary Attributes by Variable.

Table 16-9. Mortuary Attributes Expressing Idiosyncratic Influences.

Variable	Attribute	Frequency	Proportion of Variable
Body Preparation	Multiple Treatment	2	1.9
Facility Preparation	Wood Lined Grave	2	1.9
Facility Preparation	Stone Lined Grave	4	3.8
Orientation	Northeast Orientation	1	1.0
Orientation	Southeast Orientation	3	2.9
Orientation	West Orientation	6	5.8
Orientation	North/South Plane	2	1.9
Orientation	East/West Plane	5	4.8
Orientation	Northeast/Southwest Plane	5	4.8
Orientation	Unoriented	4	3.8
Provenience	3-3.9m from Center	6	5.8
Provenience	10-10.9m from Center	3	2.9
Provenience	11-11.9m from Center	5	4.8
Provenience	12-12.9m from Center	2	1.9
Age	Infant (0-3.99 Years)	3	2.9

demonstrate minimal boundaries between what the community accepted and rejected as legitimate material symbolism.

The most poorly represented attribute-agent relationships involved Circumstances of Death factors. Skeletal evidence indicated the presence of chronic health problems in the community. These may have influenced how the dead were presented, but the data needed to distinguish good from bad health was unattainable. Circumstances of Death may be linked to some multiple individual graves. Since primary interments indicated a short death-to-burial interval, the presence of two primary interments in a single grave (Cluster 5) denoted two closely occurring death events. Some aspects of the represented social presentation combined aspects of their social qualities into a shared representation. Part of the shared message may have been a short period between death events. Circumstances of death could represent a major contributor to this type of variation.

Status represents one of the most difficult agents to classify in mortuary data. O'Shea (1984) demonstrates that status encompasses a wide range of culturally specific, highly complex social relationships that tend to dominate mortuary representation. Since there is only a rudimentary

understanding of Wickliffe's community structure, it is highly unlikely that precise social distinctions between community members is determinable. Accepting health as an unseen contributor, the absence of strong relationships between agents and most attributes suggests that status differences are at least partially responsible for the clustered material variations. Features, including individual social rank, kinship and family ties, clan affiliation and occupational specialization, were probably important components of the living's social personage. These may be included among the symbolized messages.

Table 16-10 outlines what agents are probably contributing to the Mound C attributes. A lack of ethnographic data capable of detailing the type of social arrangements present in the Wickliffe community prevents a more substantive assignment of agents to attributes. Specific identification of attribute meaning and comparisons between attribute and agents are likewise severely limited. Some of these agents are associated with higher order or key attributes. An examination of the agents connected with key features illustrates important features of each cluster.

The highest entropy in this assemblage was between single individual interments with primary body treatments and everyone else. Individuals in Clusters 7, 8, and 9 were provided with a limited mortuary presentation period. These displays focussed on single deceased persons with burial occurring shortly after death. This unity suggested that a common social classification extended beyond age and sex boundaries. While age and to a lesser extent sex differences were visible within the cluster, a major component of the personae assigned to these individuals was the same.

Grave attribute combinations not receiving this classification inferred the presence of different social circumstances. A sizeable portion of the assemblage represented individuals with secondary body treatments. These individuals were provided a longer presentation period. This enabled greater community contact with the dead and their associated material symbols. This difference in presentation period, along with the great number of graves with secondary interments, indicated that the burial community commonly employed at least two distinct funerary practices.

Table 16-10. Agents of Variability Contributing to Attribute Expression.

Mortuary Attribute	Contributing Agents
Primary-Single	(Status?)
Primary-Multiple	(Circumstances of Death/Health?),(Status?)
Secondary Treatment	(Status?)
Multiple Treatments	Idiosyncratic Variation, (Status?)
Single (Secondary)	(Status?)
Multiple Interment	(Status?)
Unlined Grave	(Status?)
Wood Lined Grave	Idiosyncratic Variation, (Status?)
Stone Lined Grave	Idiosyncratic Variation, (Status?)
NE Orientation	Idiosyncratic Variation, (Status?)
SE Orientation	Idiosyncratic Variation, (Status?)
SW Orientation	(Status?)
Northwest Orientation	(Status?)
West Orientation	Idiosyncratic Variation, (Status?)
North/South Orientation	Idiosyncratic Variation, (Status?)
East/West Orientation	Idiosyncratic Variation, (Status?)
NE/SW Orientation	Idiosyncratic Variation, (Status?)
NW/SE Orientation	(Status?)
Unoriented	Idiosyncratic Variation, (Status?)
3-3.99 Meters	Age, Idiosyncratic Variation, (Status?)
4-4.99 Meters	Age, (Status?)
5-5.99 Meters	Age, (Status?)
6-6.99 Meters	Age, (Status?)
7-7.99 Meters	(Status?)
8-8.99 Meters	(Status?)
9-9.99 Meters	(Status?)
10-10.99 Meters	Idiosyncratic Variation, (Status?)
11-11.99 Meters	Idiosyncratic Variation, (Status?)
12-12.99 Meters	Idiosyncratic Variation, (Status?)
Male	Sex
Female	Sex
Infant	Age, Idiosyncratic Variation, (Status?)
Subadult	Age, Idiosyncratic Variation, (Status?)
Adult	Age, Idiosyncratic Variation, (Status?)

Most secondary interments contained multiple individuals. This signified that the social qualities of each person were at least partially fused into a single representation. This type of interment pattern may be evidence that group membership was carried on beyond death. Individual characteristics were less important than expressions of unity. Individuals saved for presentation in a chamel structure could have received these types of care.

A few of these corporate interments were afforded the luxury of a stone liner. Single occupant secondary interments were evidence that some retained individuals were still afforded their own private receptacle. Age may have also influenced these grave forms. In a few circumstances, primary and secondary forms were placed together, illustrating that body treatment variations were probably not caused by absolute social barriers. Likewise, the people given these differing rites were not socially identical.

Differences in status within the community probably account for a lot of the cemetery's variation. A summary of agents representing major influences to Mound C's clusters is presented in Table 16-11.

Comparing Mortuary Events

Mortuary expressions possess orderly arrangements of ideas. The importance of these ideas to the presentation is reflected in the cemetery's structure. When comparing the structure of any two graves, the fusion node linking them can determine the amount of entropy between structures. This similarity can be quantified by the node's Root Mean Square Distance value. For example, in Figure 16-3, the similarity between gloves and socks is based on a common fusion at 'Protective Clothing' and that between gloves and felt hats is at the 'Clothing'. Entropy values of 0.20 and 0.00 are respectively assigned to each comparison. Potential meaning similarities and differences can be ascertained by examining the structural arrangement of mortuary ideas.

Chapter 4 established that four basic comparative associations between mortuary expressions were possible. The attribute-agent relationships expressed in the Mound C data were not extensive enough to fully comprehend mortuary structure. It was therefore necessary to assume

Table 16-11. Agents of Variability Contributing to Cluster Expression.

Cluster	Major Contributing Agents
1	(Status?)
2	Idiosyncratic (Status?)
3	Age (Status?)
4	Age and Idiosyncratic (Status?)
5	(Circumstances of Health and Death?), (Status?)
6	Idiosyncratic (Status?)
7	Age (Status?)
8	Age (Status?)
9	Age and Idiosyncratic (Status?)
Messages Applied to all Cemetery Members:	
Community Membership	Age and Status
Stable Resource Base	Resource Fixity
Sedentary Organizational Structure	Organizational Variability

that meanings were not randomly assigned to attributes – that a common theme linked them within a given variable and that these meanings remained stable throughout the accumulation period. Each grave was compared to others in the sample to learn how and where they differed.

Case graves were traced from their inclusion as part of the organization to their common fusion node. The similarity between organizational structures was scored according to the associations outlined in Figure 16-13. Graves possessing identical structures were classified as Association 1 comparisons. These included interments with common Root Mean Square Distance values of 0.00 (0.00-0.17)[5]. These graves were placed in the same cluster and largely differed only at the point of individuation. These interments probably possessed identical social personalities, relative to the features examined.

Graves can express differences in the importance of ideas supported by the same personality. These were recognized as same-cluster graves where attributes of the same variable

[5] Fusion nodes 71-73 fused identical forms at a Root Mean Square Distance value of 0.17. These aberrant values probably represent methodological artifacts.

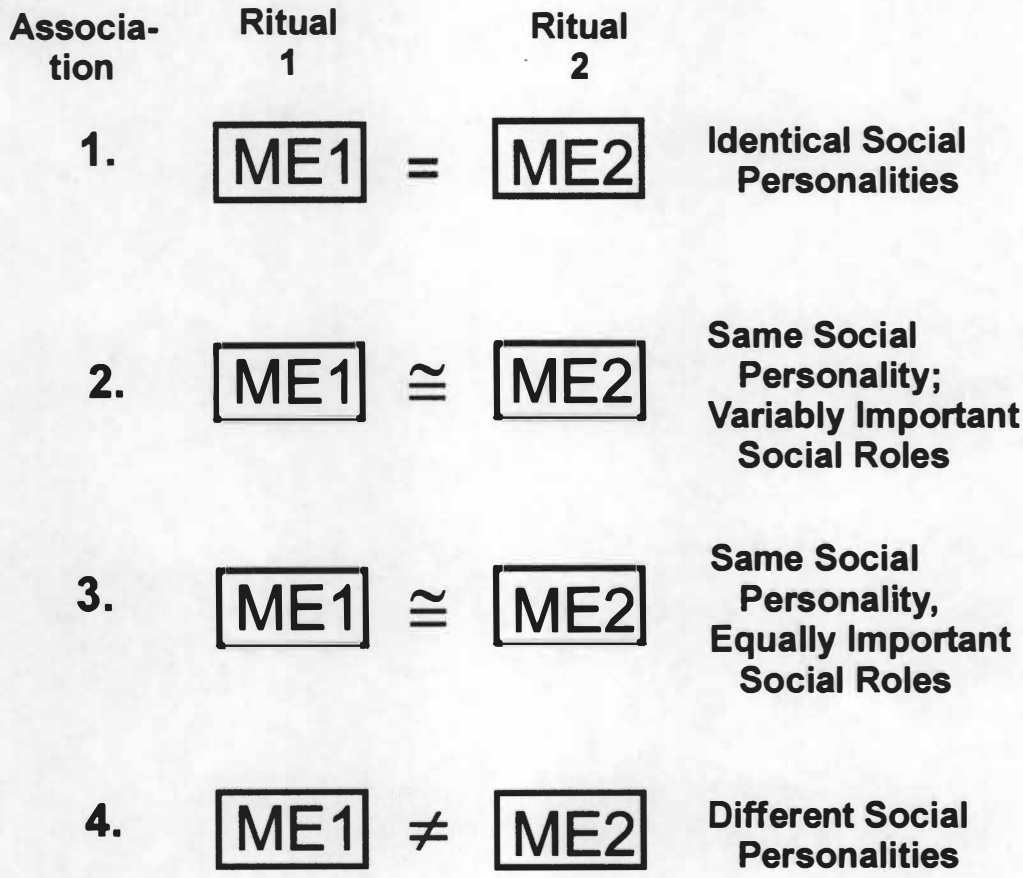


Figure 16-13. Basic Relationships Between Mortuary Expressions.

were ordered differently. The range of Root Mean Square Distance values for a given variable were examined to see if these ranges overlapped (allowing for variation by attribute). Graves expressing differences in importance between variables (and hence the ideas they represented) were scored as Association 2.

Two mortuary expressions could also differ in minor concepts. The structural arrangements of graves below a common fusion node were examined to ascertain if the only substantive differences were in the choice of attribute. Varying same-variable attributes with similar entropy levels indicated that comparable degrees of importance were expressed by the idea common to both attributes. Varying same-variable attributes with similar Root Mean Square Distance values were scored as Association 3.

Shifts in the degree of entropy in the cemetery's structure indicated that nine paramount social representations were present. When the only common fusion node between two graves occurred above the entropy threshold (i.e., a Root Mean Square Distance value greater than 0.603) dissimilar structural arrangements were defined. Graves representing two different social personalities were scored as Association 4.

The results of these comparisons are presented in Table 16-12. An important byproduct of grave-to-grave comparisons is an understanding of how ideas are organized within each cluster. If similar structural patterns are present within major clusters, then the importance tied to social roles and qualities would be similar. The presence of varying structural arrangements between clusters are evidence that they presented social personalities composed of different ideas or different arrangements of common ideas.

Of the 104 interments examined, 54 possessed structural arrangements shared with at least one other interment. These 21 assemblages of mortuary attributes were combined with the 50 interments that exhibited a unique attribute arrangement to create 71 possible social messages. These were further defined into nine sets of important social messages, probably equating to distinct social personalities.

Table 16-12. Association Matrix for Clustered Interments.

Interment	6	18	20	30	38	41	42	44
6	0							
18	3	0						
20	4	4	0					
30	1	3	4	0				
38	3	3	4	3	0			
41	3	3	4	3	3	0		
42	4	4	4	4	4	4	0	
44	4	4	3	4	4	4	4	0
45	4	4	4	4	4	4	4	4
46	4	4	2	4	4	4	4	2
47	4	4	2	4	4	4	4	2
49	4	4	4	4	4	4	4	4
52	4	4	4	4	4	4	4	4
53	4	4	4	4	4	4	4	4
55	3	1	4	3	3	3	4	4
57	4	4	4	4	4	4	3	4
59	4	4	3	4	4	4	4	3
63	2	4	4	4	4	4	4	4
64	4	4	4	4	4	4	4	4
65	4	4	4	4	4	4	3	4
66	4	4	4	4	4	4	3	4
68	4	2	4	2	2	2	4	4
71	4	4	3	4	4	4	4	3
72	4	4	3	4	4	4	4	3
74	4	4	3	4	4	4	4	3
76	4	4	4	4	4	4	3	4
77	4	4	3	4	4	4	4	3
79	4	4	3	4	4	4	4	3
80	4	4	2	4	4	4	4	2
83	1	3	4	1	3	3	4	4
85	3	1	4	3	3	3	4	4
88	4	4	4	4	4	4	4	4
89	4	4	4	4	4	4	3	4
91	4	4	4	4	4	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	6	18	20	30	38	41	42	44
92	4	4	4	4	4	4	4	4
102	3	3	4	3	3	3	4	4
103	6	2	4	2	2	2	4	4
104	6	2	4	2	2	2	4	4
105	3	1	4	3	3	3	4	4
107	4	4	4	4	4	4	3	4
108	4	4	4	4	4	4	3	4
112	3	3	4	3	3	3	4	4
114	3	3	4	3	1	3	4	4
116	4	4	3	4	4	4	4	3
118	4	4	3	4	4	4	4	3
122	4	4	4	4	4	4	4	4
123	3	3	4	3	4	3	4	4
124	4	4	4	4	4	4	4	4
125	4	4	4	4	4	4	4	4
129	2	2	4	2	2	2	4	4
131	3	3	4	3	3	3	4	4
133	4	4	4	4	4	4	3	4
134	4	4	4	4	4	4	3	4
137	4	4	4	4	4	4	4	4
146	4	4	4	4	4	4	3	4
147	4	4	3	4	4	4	4	3
148	3	3	4	3	3	1	4	4
150	4	4	3	4	4	4	4	3
151	4	4	3	4	4	4	4	3
152	4	4	4	4	4	4	3	4
155	4	4	4	4	4	4	3	4
171	4	4	3	4	4	4	4	3
207	4	4	4	4	4	4	3	4
208	4	4	4	4	4	4	3	4
211	4	4	3	4	4	4	4	3
218	4	4	3	4	4	4	4	3
219	3	3	4	3	3	3	4	4
221	6	2	4	2	2	2	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	6	18	20	30	38	41	42	44
222	3	3	4	3	3	3	4	4
227	3	3	4	3	3	3	4	4
230	4	4	3	4	4	4	4	3
236	4	4	3	4	4	4	4	3
242	4	4	4	4	4	4	4	4
243	4	4	4	4	4	4	3	4
245	4	4	4	4	4	4	4	4
262	4	4	4	4	4	4	4	4
263	4	4	3	4	4	4	4	3
264	4	4	4	4	4	4	4	4
265	4	4	4	4	4	4	3	4
267	4	4	4	4	4	4	4	4
272	4	4	4	4	4	4	4	4
276	4	4	3	4	4	4	4	3
278	4	4	4	4	4	4	3	4
279	4	4	4	4	4	4	4	4
280	4	4	4	4	4	4	3	4
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	4
283	4	4	4	4	4	4	3	4
291	4	4	1	4	4	4	4	3
295	4	4	4	4	4	4	4	4
300	4	4	4	4	4	4	4	4
301	4	4	4	4	4	4	4	4
302	4	4	4	4	4	4	4	4
303	4	4	4	4	4	4	3	4
304	4	4	4	4	4	4	3	4
307	4	4	3	4	4	4	4	3
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	4	4	4	4	4	3	4
322	4	4	4	4	4	4	3	4
324	6	2	4	2	2	2	4	4
325	6	2	4	2	2	2	4	4
333	4	4	4	4	4	4	3	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	45	46	47	49	52	53	55	57
45	0							
46	4	0						
47	4	3	0					
49	4	4	4	0				
52	4	4	4	4	0			
53	4	4	4	3	4	0		
55	4	4	4	4	4	4	0	
57	4	4	4	4	4	4	4	0
59	4	2	2	3	4	4	4	4
63	4	4	4	4	4	3	4	4
64	4	4	4	3	4	3	4	4
65	4	4	4	4	4	4	4	3
66	4	4	4	4	4	4	4	3
68	4	4	4	4	4	4	2	4
71	4	2	2	4	4	4	4	4
72	4	2	2	4	4	4	4	4
74	4	2	2	4	4	4	4	4
76	4	4	4	4	4	4	4	3
77	4	2	2	4	4	4	4	4
79	4	2	2	4	4	4	4	4
80	4	3	1	4	4	4	4	4
83	4	4	4	4	4	4	3	4
85	4	4	4	4	4	4	4	4
88	4	4	4	3	4	3	4	4
89	4	4	4	4	4	4	4	3
91	4	4	4	4	4	4	4	4
92	4	4	4	3	3	3	4	4
102	4	4	4	4	4	4	3	4
103	4	4	4	4	4	4	2	4
104	4	4	4	4	4	4	2	4
105	4	4	4	4	4	4	1	4
107	4	4	4	4	4	4	4	1
108	4	4	4	4	4	4	4	3
112	4	4	4	4	4	4	3	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	45	46	47	49	52	53	55	57
114	4	4	4	4	4	4	3	4
116	4	2	2	4	4	4	4	4
118	4	2	2	4	4	4	4	4
122	4	4	4	3	4	3	4	4
123	4	4	4	4	4	4	3	4
124	4	4	4	4	4	4	4	4
125	4	4	4	4	3	4	4	4
129	4	4	4	4	4	4	2	4
131	4	4	4	4	4	4	3	4
133	4	4	4	4	4	4	4	3
134	4	4	4	4	4	4	4	3
137	4	4	4	1	4	3	4	4
146	4	4	4	4	4	4	4	4
147	4	2	2	4	4	4	4	4
148	4	4	4	4	4	4	3	4
150	4	2	2	4	4	4	4	4
151	4	2	2	4	4	4	4	4
152	4	4	4	4	4	4	4	3
155	4	4	4	4	4	4	4	3
171	4	2	2	4	4	4	4	4
207	4	4	4	4	4	4	4	3
208	4	4	4	4	4	4	4	3
211	4	2	2	4	4	4	4	4
218	4	2	2	4	4	4	4	4
219	4	4	4	4	4	4	3	4
221	4	4	4	4	4	4	2	4
222	4	4	4	4	4	4	3	4
227	4	4	4	4	4	4	3	4
230	4	2	2	4	4	4	4	4
236	4	2	2	4	4	4	4	4
242	4	4	4	4	4	4	4	4
243	4	4	4	4	4	4	4	3
245	4	4	4	3	4	3	4	4
262	4	4	4	3	4	3	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	45	46	47	49	52	53	55	57
263	4	2	2	4	4	4	4	4
264	4	4	4	3	4	3	4	4
265	4	4	4	4	4	4	4	3
267	4	4	4	4	4	4	4	4
272	4	4	4	3	4	3	4	4
276	4	2	2	4	4	4	4	4
278	4	4	4	4	4	4	4	3
279	4	4	4	4	4	4	4	4
280	4	4	4	4	4	4	4	3
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	4
283	4	4	4	4	4	4	4	3
291	4	2	2	4	4	4	4	4
295	4	4	4	1	4	3	4	4
300	4	4	4	4	3	4	4	4
301	4	4	4	3	4	3	4	4
302	4	4	4	1	4	3	4	4
303	4	4	4	4	4	4	4	3
304	4	4	4	4	4	4	4	3
307	4	2	4	4	4	4	4	4
309	4	4	2	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	4	4	4	4	4	4	3
322	4	4	4	4	4	4	4	3
324	4	4	4	4	4	4	2	4
325	4	4	4	4	4	4	2	4
333	4	4	4	4	4	4	4	3

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	59	63	64	65	66	68	71	72
59	0							
63	4	0						
64	4	3	0					
65	4	4	4	0				
66	4	4	4	1	0			
68	3	4	4	4	4	0		
71	4	4	4	4	4	4	0	
72	3	4	4	4	4	4	3	0
74	3	4	4	4	4	4	3	3
76	4	4	4	3	3	4	4	4
77	3	4	4	4	4	4	3	3
79	4	4	4	4	4	4	1	3
80	2	4	4	4	4	4	2	2
83	4	4	4	4	4	2	4	4
85	4	4	4	4	4	2	4	4
88	4	3	3	4	4	4	4	4
89	4	4	4	3	3	4	4	4
91	4	4	4	4	4	4	4	4
92	4	3	3	4	4	4	4	4
102	4	4	4	4	4	2	4	4
103	4	4	4	4	4	2	4	4
104	4	4	4	4	4	2	4	4
105	4	4	4	4	4	2	4	4
107	4	4	4	3	3	4	4	4
108	4	4	4	3	3	4	4	4
112	4	4	4	4	4	2	4	4
114	4	4	4	4	4	2	4	4
116	3	4	4	4	4	4	3	3
118	3	4	4	4	4	4	3	3
122	4	3	3	4	4	4	4	4
123	4	4	4	4	4	2	4	4
124	4	4	4	4	4	4	4	4
125	4	4	4	4	4	4	4	4
129	4	4	4	4	4	3	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	59	63	64	65	66	68	71	72
131	4	4	4	3	4	2	4	4
133	4	4	4	4	3	4	4	4
134	4	4	4	3	3	4	4	4
137	4	3	3	4	4	4	4	4
146	4	4	4	3	3	4	4	4
147	3	4	4	4	4	4	3	3
148	4	4	4	4	4	2	4	4
150	3	4	4	4	4	4	3	3
151	3	4	4	4	4	4	3	3
152	4	4	4	3	3	4	4	4
155	4	4	4	3	3	4	4	4
171	3	4	4	4	4	4	1	3
207	4	4	4	3	3	4	4	4
208	4	4	4	3	3	4	4	4
211	3	4	4	4	4	4	3	3
218	3	4	4	4	4	4	1	3
219	4	4	4	4	4	2	4	4
221	4	4	4	4	4	2	4	4
222	4	4	4	4	4	4	4	4
227	4	4	4	4	4	2	4	4
230	3	4	4	4	4	4	3	3
236	3	4	4	4	4	4	3	3
242	4	4	4	4	4	4	4	4
243	4	4	4	3	3	4	4	4
245	4	3	3	4	4	4	4	4
262	4	3	3	4	4	4	4	4
263	3	4	4	4	4	4	1	3
264	4	3	3	4	4	4	4	4
265	4	4	4	3	3	4	4	4
267	4	4	4	4	4	4	4	4
272	4	3	3	4	4	4	4	4
276	3	4	4	4	4	4	3	3
278	4	4	4	4	1	4	4	4
279	4	4	4	4	4	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	59	63	64	65	66	68	71	72
280	4	4	4	3	3	4	4	4
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	4
283	4	4	4	1	1	4	4	4
291	3	4	4	4	4	4	3	3
295	4	3	3	4	4	4	4	4
300	4	4	4	4	4	4	4	4
301	4	3	3	4	4	4	4	4
302	4	3	3	4	4	4	4	4
303	4	4	4	3	3	4	4	4
304	4	4	4	3	3	4	4	4
307	1	4	4	4	4	4	3	3
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	4	4	3	3	4	4	4
322	4	4	4	3	3	4	4	4
324	4	4	4	4	4	2	4	4
325	4	4	4	4	4	2	4	4
333	4	4	4	3	3	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	74	76	77	79	80	83	85	88
74	0							
76	4	0						
77	1	4	0					
79	3	4	3	0				
80	2	4	2	2	0			
83	4	4	4	4	4	0		
85	4	4	4	4	4	3	0	
88	4	4	4	4	4	4	4	0
89	4	3	4	4	4	4	4	4
91	4	4	4	4	4	4	4	4
92	4	4	4	4	4	4	4	3
102	4	4	4	4	4	3	3	4
103	4	4	4	4	4	2	2	4
104	4	4	4	4	4	2	2	4
105	4	4	4	4	4	3	1	4
107	4	3	4	4	4	4	4	4
108	4	1	4	4	4	4	3	4
112	4	4	4	4	4	3	3	4
114	4	4	4	4	4	3	4	4
116	3	4	3	3	2	4	4	4
118	3	4	3	3	2	4	4	4
122	4	4	4	4	4	4	3	3
123	4	4	4	4	4	3	4	4
124	4	4	4	4	4	4	4	4
125	4	4	4	4	4	4	4	4
129	4	4	4	4	4	2	2	4
131	4	4	4	4	4	3	4	4
133	4	3	4	4	4	4	4	4
134	4	4	4	4	4	4	4	4
137	4	4	4	4	4	4	4	3
146	4	3	4	4	4	4	4	4
147	3	4	3	3	2	4	4	4
148	4	4	4	4	4	3	3	4
150	3	4	3	3	2	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	74	76	77	79	80	83	85	88
151	3	4	3	3	2	4	4	4
152	4	3	4	4	4	4	4	4
155	4	3	4	4	4	4	4	4
171	3	4	3	1	2	4	4	4
207	4	3	4	4	4	4	4	4
208	4	3	4	4	4	4	4	4
211	3	4	3	3	2	4	4	4
218	3	4	3	1	2	4	4	4
219	4	4	4	4	4	3	3	4
221	4	4	4	4	4	2	2	4
222	4	4	4	4	4	3	3	4
227	4	4	4	4	4	3	3	4
230	3	4	3	3	2	4	4	4
236	3	4	3	3	2	4	4	4
242	4	4	4	4	4	4	4	4
243	4	3	4	4	4	4	4	4
245	4	4	4	4	4	4	4	3
262	4	4	4	4	4	4	4	3
263	3	4	3	1	2	4	4	4
264	4	4	4	4	4	4	4	3
265	4	3	4	4	4	4	4	4
267	4	4	4	4	4	4	4	4
272	4	4	4	4	4	4	4	3
276	3	4	3	3	2	4	4	4
278	4	3	4	4	4	4	4	4
279	4	4	4	4	4	4	4	4
280	4	3	4	4	4	4	4	4
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	4
283	4	3	4	4	4	4	4	4
291	3	4	3	3	2	4	4	4
295	4	4	4	4	4	4	4	3
300	4	4	4	4	4	4	4	4
301	4	4	4	4	4	4	4	3

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	74	76	77	79	80	83	85	88
302	4	4	4	4	4	4	4	3
303	4	3	4	4	4	4	4	4
304	4	3	4	4	4	4	4	4
307	3	4	3	3	2	4	4	4
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	3	4	4	4	4	4	4
322	4	3	4	4	4	4	4	4
324	4	4	4	4	4	2	2	4
325	4	4	4	4	4	2	2	4
333	4	3	4	4	4	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	89	91	92	102	103	104	105	107
89	0							
91	4	0						
92	4	4	0					
102	4	4	4	0				
103	4	4	4	2	0			
104	4	4	4	2	3	0		
105	3	4	4	4	2	2	0	
107	3	4	4	4	4	4	4	0
108	4	4	4	3	4	4	3	3
112	4	4	4	3	2	2	3	4
114	4	4	4	4	2	2	4	4
116	4	4	4	4	4	4	4	4
118	4	4	4	4	4	4	4	4
122	4	4	3	3	4	4	3	4
123	4	4	4	4	2	2	4	4
124	4	3	4	4	4	4	4	4
125	4	4	4	4	4	4	4	4
129	4	4	4	2	2	2	2	4
131	4	4	4	3	2	2	5	4
133	3	4	4	4	4	4	4	3
134	3	4	4	4	4	4	4	3
137	4	4	3	4	4	4	4	4
146	3	4	4	4	4	4	4	4
147	4	4	4	4	4	4	4	4
148	4	4	4	3	2	2	3	4
150	4	4	4	4	4	4	4	4
151	4	4	4	4	4	4	4	4
152	3	4	4	4	4	4	4	3
155	3	4	4	4	4	4	4	3
171	4	4	4	4	4	4	4	4
207	3	4	4	4	4	4	4	4
208	3	4	4	4	4	4	4	3
211	4	4	4	4	4	4	4	4
218	4	4	4	4	4	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	89	91	92	102	103	104	105	107
219	4	4	4	3	2	2	3	4
221	4	4	4	2	3	3	2	4
222	4	4	4	3	2	2	3	4
227	4	4	4	3	2	2	3	4
230	4	4	4	4	4	4	4	4
236	4	4	4	4	4	4	4	4
242	4	4	4	4	4	4	4	4
243	3	4	4	4	4	4	4	3
245	4	4	3	4	4	4	4	4
262	4	4	3	4	4	4	4	4
263	4	4	4	4	4	4	4	4
264	4	4	3	4	4	4	4	4
265	3	4	4	4	4	4	4	3
267	4	4	4	4	4	4	4	4
272	4	4	3	4	4	4	4	4
276	4	4	4	4	4	4	4	4
278	3	4	4	4	4	4	4	3
279	4	4	4	4	4	4	4	4
280	3	4	4	4	4	4	4	3
281	4	4	4	4	4	4	4	4
282	4	3	4	4	4	4	4	4
283	3	4	4	4	4	4	4	3
291	4	4	4	4	4	4	4	4
295	4	4	3	4	4	4	4	4
300	4	4	4	4	4	4	4	4
301	4	4	3	4	4	4	4	4
302	4	4	3	4	4	4	4	4
303	3	4	4	4	4	4	4	3
304	3	4	4	4	4	4	4	3
307	4	4	4	4	4	4	4	4
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	3	4	4	4	4	4	4	3
322	3	4	4	4	4	4	4	3
324	4	4	4	2	3	3	2	4
325	4	4	4	2	3	3	2	4
333	3	4	4	4	4	4	4	3

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	108	112	114	116	118	122	123	124
108	0							
112	4	0						
114	4	3	0					
116	4	4	4	0				
118	4	4	4	1	0			
122	4	4	4	4	4	0		
123	4	1	4	4	4	4	0	
124	4	4	4	4	4	4	4	0
125	4	4	4	4	4	4	4	4
129	4	2	2	4	4	4	2	4
131	4	3	3	4	4	4	3	4
133	3	4	4	4	4	4	4	4
134	3	4	4	4	4	4	4	4
137	4	4	4	4	4	3	4	4
146	3	4	4	4	4	4	4	4
147	4	4	4	3	3	4	4	4
148	4	3	3	4	4	4	3	4
150	4	4	4	3	3	4	4	4
151	4	4	4	3	3	4	4	4
152	3	4	4	4	4	4	4	4
155	3	4	4	4	4	4	4	4
171	4	4	4	3	3	4	4	4
207	3	4	4	4	4	4	4	4
208	3	4	4	4	4	4	4	4
211	4	4	4	3	3	4	4	4
218	4	4	4	3	3	4	4	4
219	4	3	3	4	4	4	3	4
221	4	2	2	4	4	4	2	4
222	4	3	3	4	4	4	3	4
227	4	3	3	4	4	4	3	4
230	4	4	4	4	4	4	4	4
236	4	4	4	3	3	4	4	4
242	4	4	4	4	4	4	4	4
243	3	4	4	4	4	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	108	112	114	116	118	122	123	124
245	4	4	4	4	4	3	4	4
262	4	4	4	4	4	3	4	4
263	4	4	4	3	3	4	4	4
264	4	4	4	4	4	3	4	4
265	3	4	4	4	4	4	4	4
267	4	4	4	4	4	4	4	4
272	4	4	4	4	4	1	4	4
276	4	4	4	3	3	4	4	4
278	3	4	4	4	4	4	4	4
279	4	4	4	4	4	4	4	4
280	3	4	4	4	4	4	4	4
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	3
283	3	4	4	4	4	4	4	4
291	4	4	4	3	3	4	4	4
295	4	4	4	4	4	3	4	4
300	4	4	4	4	4	4	4	4
301	4	4	4	4	4	3	4	4
302	4	4	4	4	4	3	4	4
303	3	4	4	4	4	4	4	4
304	3	4	4	1	1	4	4	4
307	4	4	4	3	3	4	4	4
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	3	4	4	4	4	4	4	4
322	3	4	4	4	4	4	4	4
324	4	2	2	4	4	4	2	4
325	4	2	2	4	4	4	2	4
333	3	4	4	4	4	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	125	129	131	133	134	137	146	147
125	0							
129	4	0						
131	4	2	0					
133	4	4	4	0				
134	4	4	4	3	0			
137	4	4	4	4	4	0		
146	4	4	4	4	3	4	0	
147	4	4	4	4	4	4	4	0
148	4	2	3	4	4	4	4	4
150	4	4	4	4	4	4	4	1
151	4	4	4	4	4	4	4	1
152	4	4	4	3	3	4	3	4
155	4	4	4	3	3	4	3	4
171	4	4	4	4	4	4	4	3
207	4	4	4	3	3	4	3	4
208	4	4	4	3	3	4	3	4
211	4	4	4	4	4	4	4	3
218	4	3	4	4	4	4	4	3
219	4	4	3	4	4	4	4	4
221	4	2	2	4	4	4	4	4
222	4	2	3	4	4	4	4	4
227	4	2	3	4	4	4	4	4
230	4	4	4	4	4	4	4	4
236	4	4	4	4	4	4	4	3
242	4	4	4	4	4	4	4	4
243	4	4	4	3	3	4	3	4
245	4	4	4	4	4	3	4	4
262	4	4	4	4	4	3	4	4
263	4	4	4	4	4	4	4	3
264	4	4	4	4	4	3	4	4
265	4	4	4	3	3	4	3	4
267	4	4	4	4	4	4	4	4
272	4	4	4	4	4	3	4	4
276	4	4	4	4	4	4	4	3

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	125	129	131	133	134	137	146	147
278	4	4	4	3	3	4	3	4
279	4	4	4	4	4	4	4	4
280	4	4	4	3	3	4	3	4
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	4
283	4	4	4	3	3	4	3	4
291	4	4	4	4	4	4	4	3
295	4	4	4	4	4	1	4	4
300	3	4	4	4	4	4	4	4
301	4	4	4	4	4	4	4	4
302	4	4	4	4	4	1	4	4
303	4	4	4	3	1	4	3	4
304	4	4	4	3	1	4	3	3
307	4	4	4	4	4	4	4	3
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	4	4	3	3	4	3	4
322	4	4	4	3	3	4	3	4
324	4	2	2	4	4	4	4	4
325	4	2	2	4	4	4	4	4
333	4	4	4	3	3	4	1	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	148	150	151	152	155	171	207	208
300	4	4	4	4	4	4	4	4
301	4	4	4	4	4	4	4	4
302	4	4	4	4	4	4	4	4
303	4	4	4	3	3	4	3	3
304	4	3	3	3	3	4	3	3
307	4	3	3	4	4	3	4	4
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	4	4	3	3	4	3	3
322	4	4	4	3	3	4	3	3
324	2	4	4	4	4	4	4	4
325	2	4	4	4	4	4	4	4
333	4	4	4	3	3	4	3	3

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	148	150	151	152	155	171	207	208
148	0							
150	4	0						
151	4	1	0					
152	4	4	4	0				
155	4	4	4	1	0			
171	4	3	3	4	4	0		
207	4	4	4	3	3	4	0	
208	4	4	4	3	3	4	3	0
211	4	3	3	4	4	3	4	4
218	4	3	3	4	4	1	4	4
219	3	4	4	4	4	4	4	4
221	2	4	4	4	4	4	4	4
222	3	4	4	4	4	4	4	4
227	3	4	4	4	4	2	4	4
230	4	4	4	4	4	4	4	4
236	4	3	3	4	4	3	4	4
242	4	4	4	4	4	4	4	4
243	4	4	4	3	3	4	3	3
245	4	4	4	4	4	4	4	4
262	4	4	4	4	4	4	4	4
263	4	3	3	4	4	1	4	4
264	4	4	4	4	4	4	4	4
265	4	4	4	3	3	4	4	3
267	4	4	4	4	4	4	4	4
272	4	4	4	4	4	4	4	4
276	4	4	3	4	4	3	4	4
278	4	4	4	3	3	4	3	3
279	4	4	4	4	4	4	4	4
280	4	4	4	3	3	4	3	3
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	4
283	4	4	4	4	3	4	3	3
291	4	3	3	4	4	3	4	4
295	4	4	4	4	4	4	4	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	211	218	219	221	222	227	230	236
211	0							
218	3	0						
219	4	4	0					
221	4	4	2	0				
222	4	4	3	2	0			
227	2	2	3	2	3	0		
230	3	4	4	4	4	4	0	
236	4	3	4	4	4	4	3	0
242	4	4	4	4	4	4	4	4
243	4	4	4	4	4	4	4	4
245	4	4	4	4	4	4	4	4
262	4	4	4	4	4	4	4	4
263	3	1	4	4	4	4	3	3
264	4	4	4	4	4	4	4	4
265	4	4	4	4	4	4	4	4
267	4	4	4	4	4	4	4	4
272	4	4	4	4	4	4	4	4
276	3	3	4	4	4	4	3	3
278	4	4	4	4	4	4	4	4
279	4	4	4	4	4	4	4	4
280	4	4	4	4	4	4	4	4
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	4
283	4	4	4	4	4	4	4	4
291	3	3	4	4	4	4	3	3
295	4	4	4	4	4	4	4	4
300	4	4	4	4	4	4	4	4
301	4	4	4	4	4	4	4	4
302	4	4	4	4	4	4	4	4
303	4	4	4	4	4	4	4	4
304	4	4	4	4	4	4	4	4
307	3	3	4	4	4	4	3	3
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	4	4	4	4	4	4	4
322	4	4	4	4	4	4	4	4
324	4	4	2	3	2	2	4	4
325	4	4	2	3	2	2	4	4
333	4	4	4	4	4	4	4	4

Table 16-12 (continued). **Association Matrix for Clustered Interments.**

Interment	242	243	245	262	263	264	265	267
242	0							
243	4	0						
245	4	4	0					
262	4	4	3	0				
263	4	4	4	4	0			
264	4	4	3	3	4	0		
265	4	3	4	4	4	4	0	
267	4	4	3	4	4	3	3	0
272	4	4	4	3	4	4	4	4
276	4	4	4	4	3	4	4	4
278	4	3	4	4	4	4	3	4
279	4	4	4	4	4	4	3	4
280	4	3	4	4	4	4	4	4
281	4	4	4	4	4	4	4	4
282	4	4	4	4	4	4	4	4
283	4	3	4	4	4	4	3	4
291	4	4	4	4	3	4	4	4
295	4	4	3	3	4	3	4	4
300	4	4	4	4	4	4	4	4
301	4	4	3	3	4	3	4	4
302	4	4	3	3	4	3	4	4
303	4	3	4	4	4	4	3	4
304	4	3	4	4	4	4	3	4
307	4	4	4	4	3	4	4	4
309	4	4	4	4	4	4	4	3
311	4	4	4	4	4	4	4	3
312	4	4	4	4	4	4	4	3
320	4	3	4	4	4	4	3	4
322	4	3	4	4	4	4	3	4
324	4	4	4	4	4	4	4	4
325	4	4	4	4	4	4	4	4
333	4	3	4	4	4	4	3	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	272	276	278	279	280	281	282	283
272	0							
276	4	0						
278	4	4	0					
279	4	4	4	0				
280	4	4	4	4	0			
281	4	4	4	3	4	0		
282	4	4	4	4	4	4	0	
283	4	4	1	4	3	4	4	0
291	4	3	4	4	4	4	4	4
295	3	4	4	4	4	4	4	4
300	4	4	4	4	4	4	4	4
301	3	4	4	4	4	4	4	4
302	3	4	4	4	4	4	4	4
303	4	4	3	4	3	4	4	3
304	4	4	3	4	3	4	4	3
307	4	3	4	4	4	4	4	4
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	4	1	4	1	4	4	3
322	4	4	3	4	3	4	4	3
324	4	4	4	4	4	4	4	4
325	4	4	3	4	4	4	4	4
333	4	4	4	4	3	4	4	3

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	291	295	300	301	302	303	304	307
291	0							
295	4	0						
300	4	4	0					
301	4	3	4	0				
302	4	3	4	3	0			
303	4	4	4	4	4	0		
304	4	4	4	4	4	1	0	
307	3	4	4	4	4	4	4	0
309	4	4	4	4	4	4	4	4
311	4	4	4	4	4	4	4	4
312	4	4	4	4	4	4	4	4
320	4	4	4	4	4	3	3	4
322	4	4	4	4	4	3	3	4
324	4	4	4	4	4	4	4	4
325	4	4	4	4	4	4	4	4
333	4	4	4	4	4	3	3	4

Table 16-12 (continued). Association Matrix for Clustered Interments.

Interment	309	311	312	320	322	324	325	333
309	0							
311	3	0						
312	3	3	0					
320	4	4	4	0				
322	4	4	4	3	0			
324	4	4	4	4	4	0		
325	4	4	4	4	4	1	0	
333	4	4	4	3	3	4	4	0

Table 16-13 outlines the general structural arrangement for each cluster. There are several important differences between groups. In particular, orientation and distance values in Cluster 1 alternate, overlapping the Root Mean Square Distance value ranges. These variables probably share equal importance to the expression of ideas in this cluster. Cluster 7 contains two distinct fusion orders, emphasizing internal dissimilarities in the treatment of sex. Fusion Nodes 17 and 20 probably represent important distinctions within the cluster, with sex being less important in Fusion Node 17's expression. Most remaining clusters do not share common internal structures with other groups. This is evidence that the social meanings attached to these clusters entailed a different mixture of social roles and ideas. While key features separate the symbolized social personalities, the ideas used to detail these constructs emphasize different social features. They may not all represent variations on a common theme.

The Application of Time

Mortuary expressions are subject to temporal change much like other cultural features. These are modeled by two distinct relationships with time. Mortuary expressions may follow a synchronic pattern, where the idea remains stable over time, or symbolic representations may follow a diachronic pattern and change meaning. This latter relationship indicates that more than one set of rules governed how the dead were presented during the cemetery accumulation period. Evidence suggestive of temporal variability emphasizes that the population of social personae and material symbols available to a presentation team were not the same for each burial event. Diachronic mortuary data can include social qualities not recognized during the entire accumulation period. Temporal variation, therefore, must be addressed as a potential source of variation. Is there evidence present indicating whether the ideas used during one phase of the Mound C Cemetery's accumulation period varied from those at a different point? An examination controlling for time was pursued to answer this question.

The most obvious temporal controls were chronometric dates. Radiocarbon data from the cemetery indicate that the mortuary accumulation period probably did not exceed 75 years.

Table 16-13. Fusion Order of Variables By Cluster.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7		Cluster 8	Cluster 9
	Fusion Node 9	Fusion Node 23	Fusion Node 58	Fusion Node 70	Fusion Node 19	Fusion Node 14	Fusion Node 17	Fusion Node 20	Fusion Node 11	Fusion Node 12
Most Important	Treat-ment/ Orienta-tion (0.603)	Orienta-tion/ Distance (0.502)	Distance (0.290)	Distance (0.250)	Orienta-tion (0.549)	Treatment /Orienta-tion (0.570)	Distanc e (0.290-0.441)	Sex (0.458)	Orienta-tion/ Sex (0.408-0.578)	Distance/ Orienta-tion (0.570)
					Treat-ment (0.496)					
Least Important	Orienta -tion (0.330-0.549)/ Distance (0.330-0.563)	Orienta-tion (0.330)			Distance (0.330)	Distance/ Orienta-tion (0.570)	Sex (0.290)	Distance (0.290)	Distance (0.330-0.370)	Distance/ Orienta-tion (0.570)

Individual dates were obtained for only 13 interments. Internally, the radiometric sample is highly controlled for time, but they provide few direct references to time for other aspects of the clustered sample. There are no temporal estimates for the remaining 91 structurally organized graves.

Time can also be controlled by stratigraphy. Since objects deposited before others will appear as underlying stratigraphic features, arranging graves by the order in which they were deposited establishes a relative temporal sequence. Many of the graves in the clustered sample exhibit stratigraphic positions above or below other graves. This feature provides a means of partially ordering when they were added to the mound. There are important limitations to this approach. Relative dating cannot accurately identify when in time depositional events occurred, only the sequence. The treatment of time is limited to manipulation as an ordinal or categorical variable. Graves are temporally defined relative to other stratigraphic events. Burials lacking stratigraphic information cannot be temporally ordered. Stratigraphic data from WMRC excavations are able to relate the cemetery to the mound, but this information is not available for all interments. One consequence of the King Era investigations is a loss of the stratigraphic data tying many graves to the mound's stratigraphy.

Fortunately, provenience was not completely lost. It was only limited to the scope of this inquiry, namely, to the mortuary accumulation period. Graves were ordered by stratigraphic provenience following the methods outlined by Harris (1977; 1989). As outlined earlier, the resulting diagrams provided a temporo-stratigraphic foundation of the cemetery's accumulation structure.

In Figure 16-14 note that super-positioned graves reflect vertical information with few horizontal links between sequences. This means that independent grave sequences lack a strong horizontal datum. This limits cross-reference temporal ordering between graves. By themselves, it is unclear how each burial sequence relates to the others.

Uncertain stratigraphic sequence placement can be estimated by defining key sequences. Dalland (1984:120) emphasizes that these are nodes in the Harris diagram where the stratigraphic relationships are known and absolute. In Mound C, there were only two common temporal features known about each independent sequence – there are graves on the bottom of the sequence

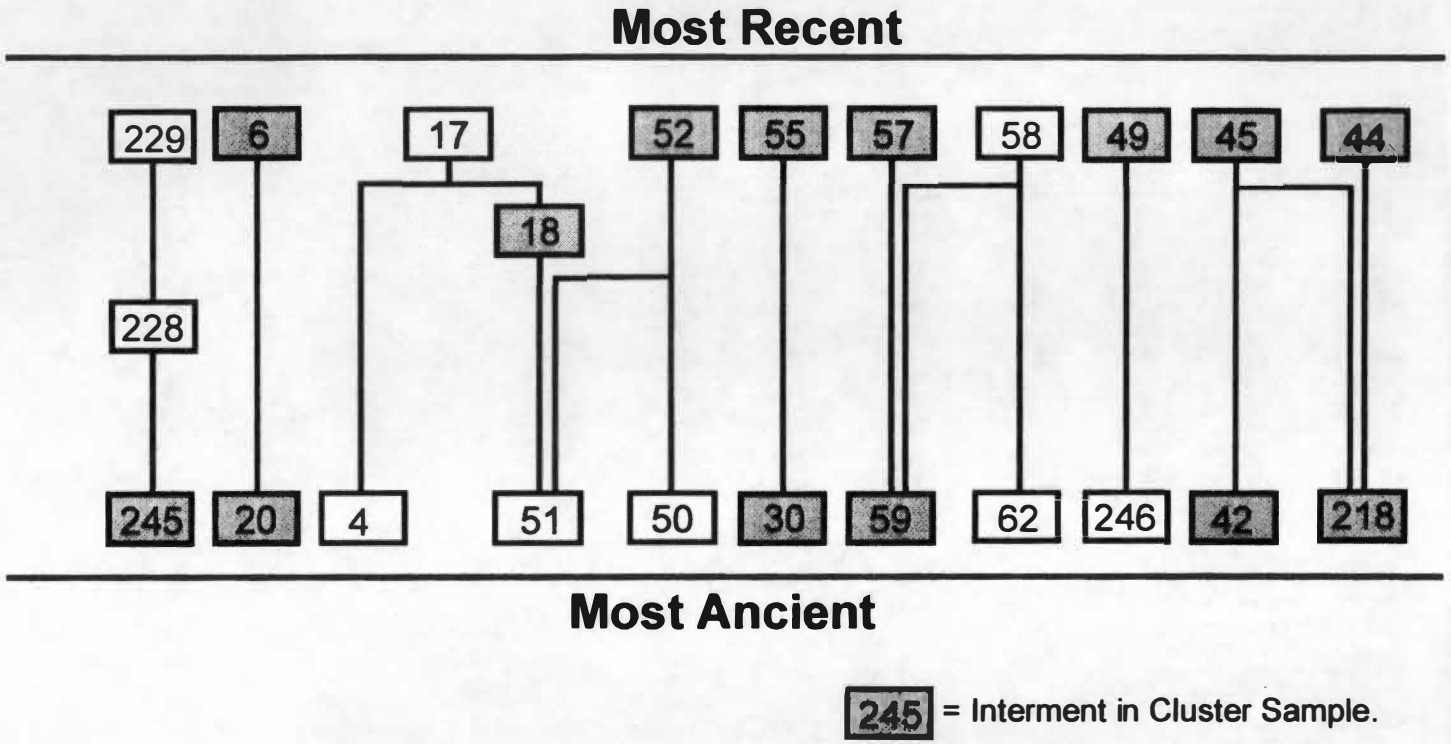


Figure 16-14[A]. A Modified Harris Diagram of the Mound C Mortuary Accumulation Period

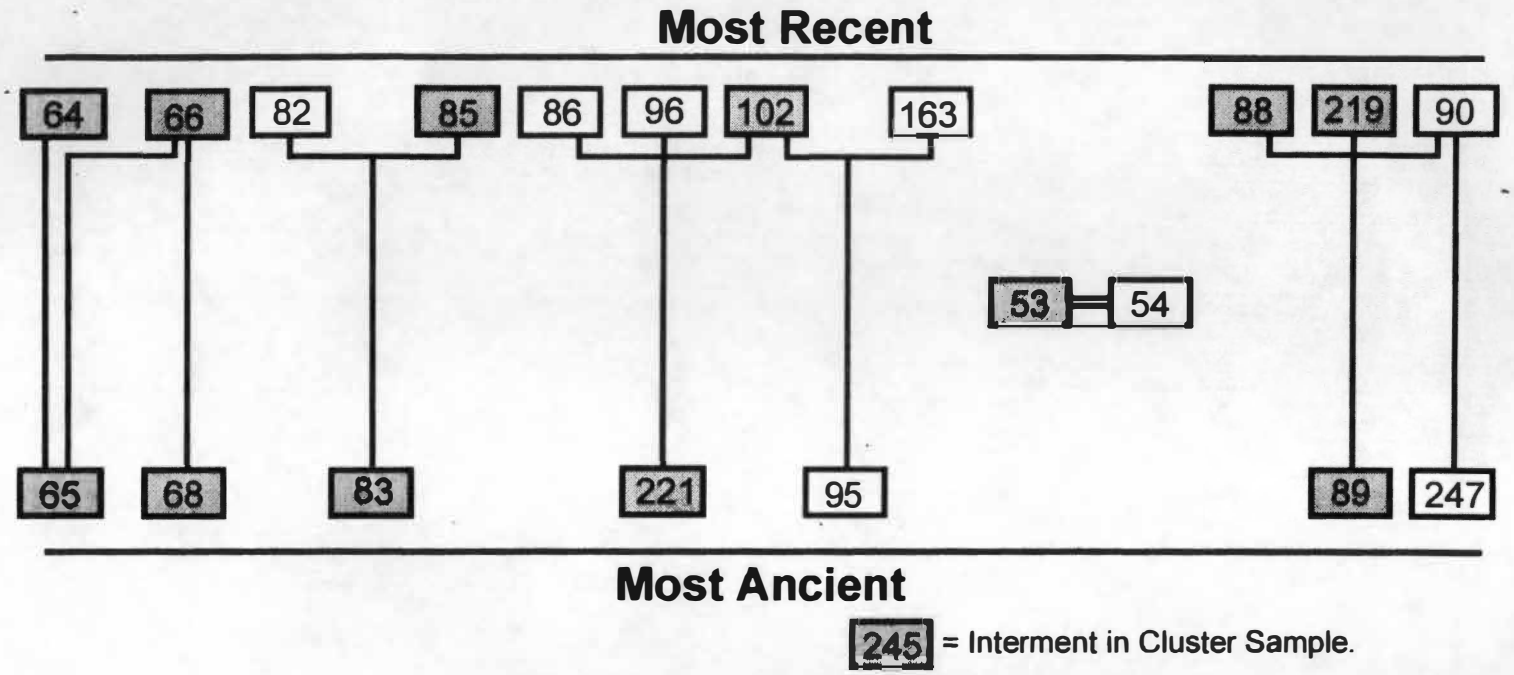


Figure 16-14[B] (continued). A Modified Harris Diagram of the Mound C Mortuary Accumulation Period.

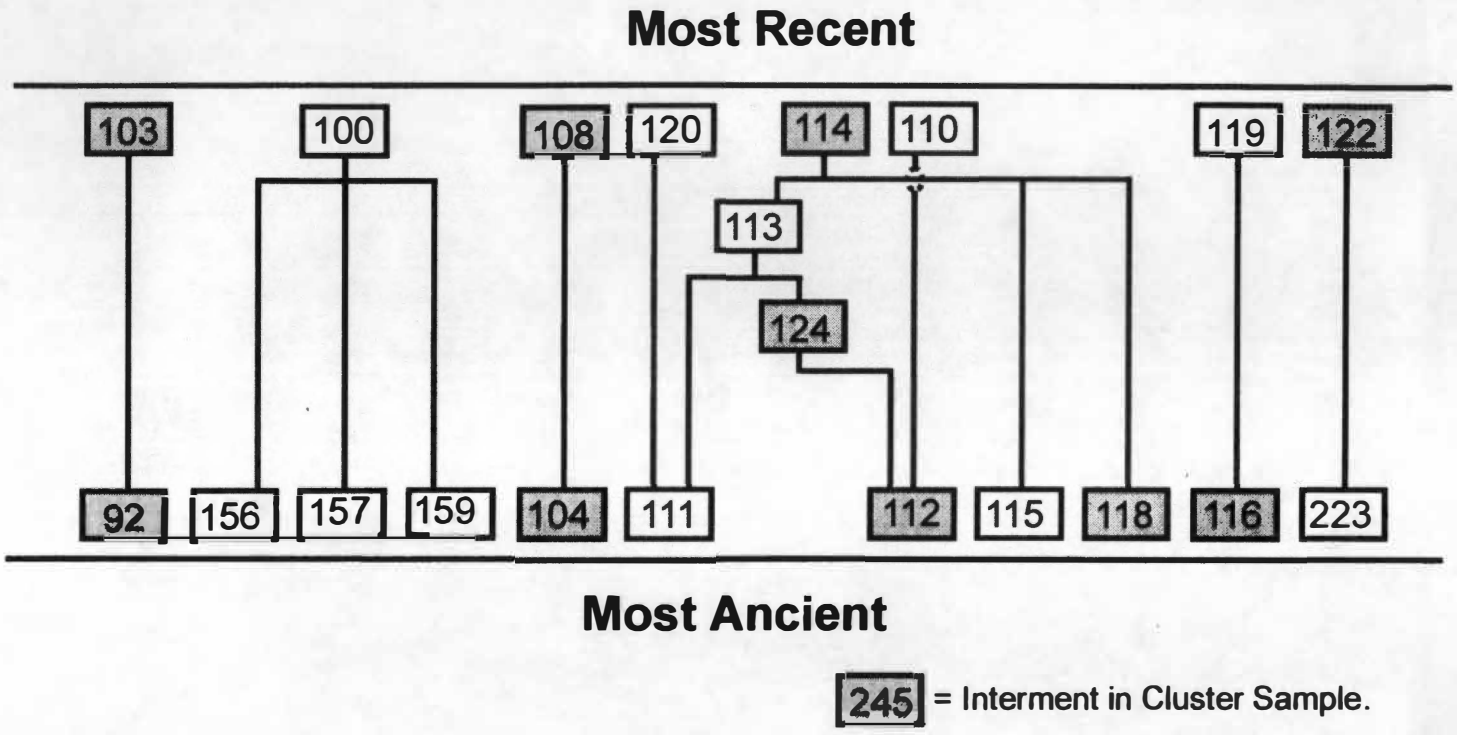


Figure 16-14[C] (continued). A Modified Harris Diagram of the Mound C Mortuary Accumulation Period.

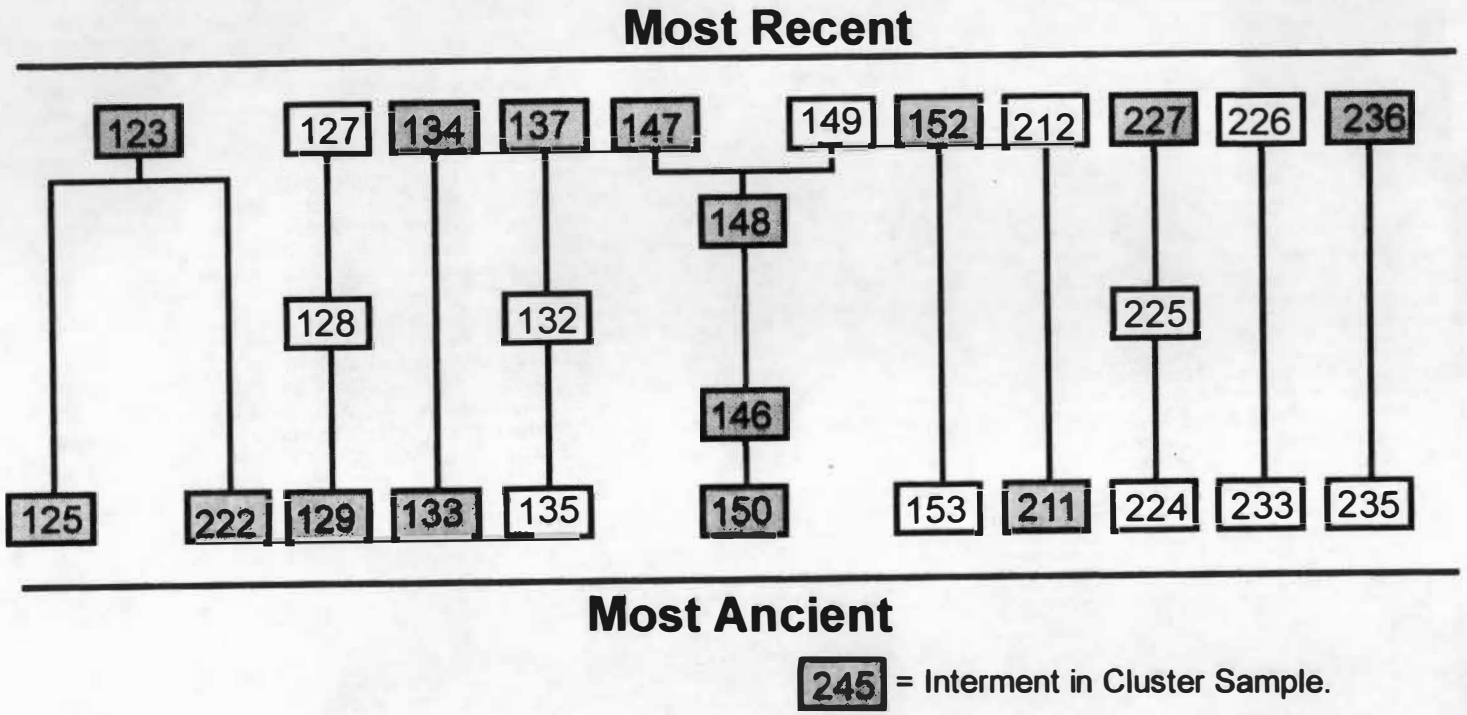


Figure 16-14[D] (continued). A Modified Harris Diagram of the Mound C Mortuary Accumulation Period.

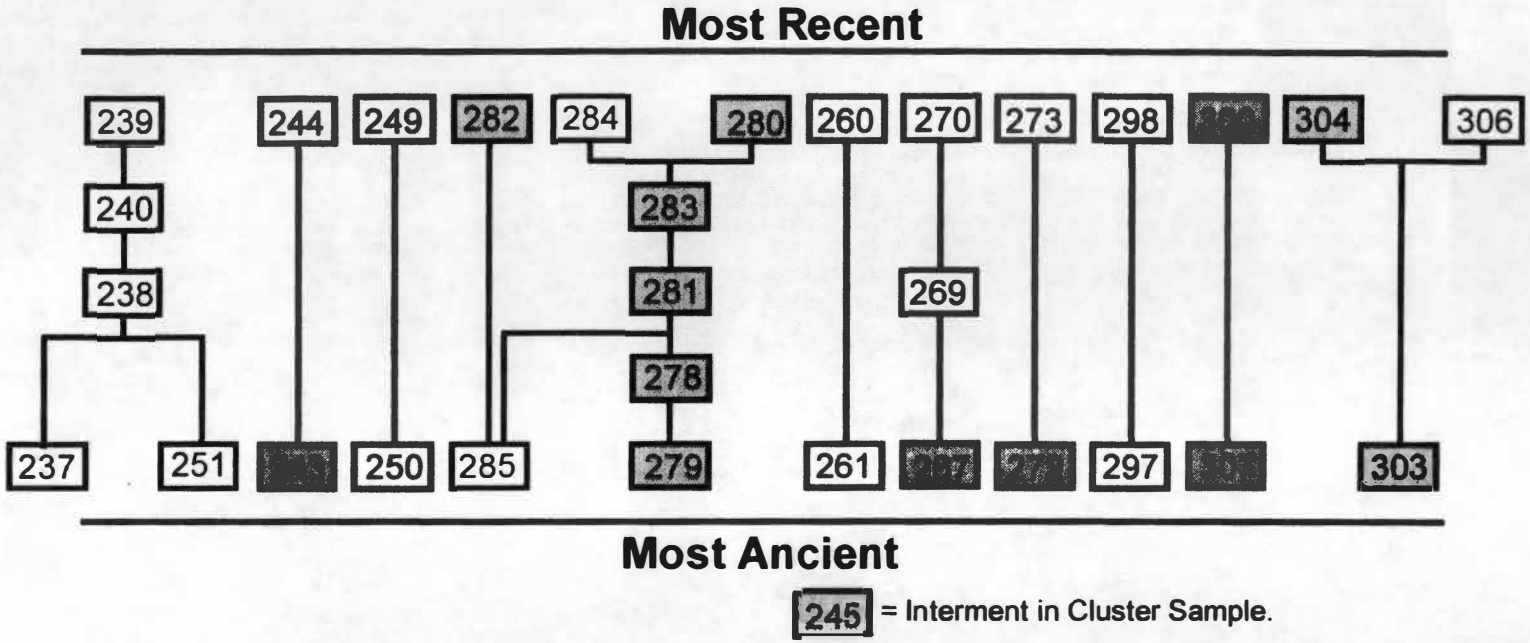


Figure 16-14[E] (continued). A Modified Harris Diagram of the Mound C Mortuary Accumulation Period.

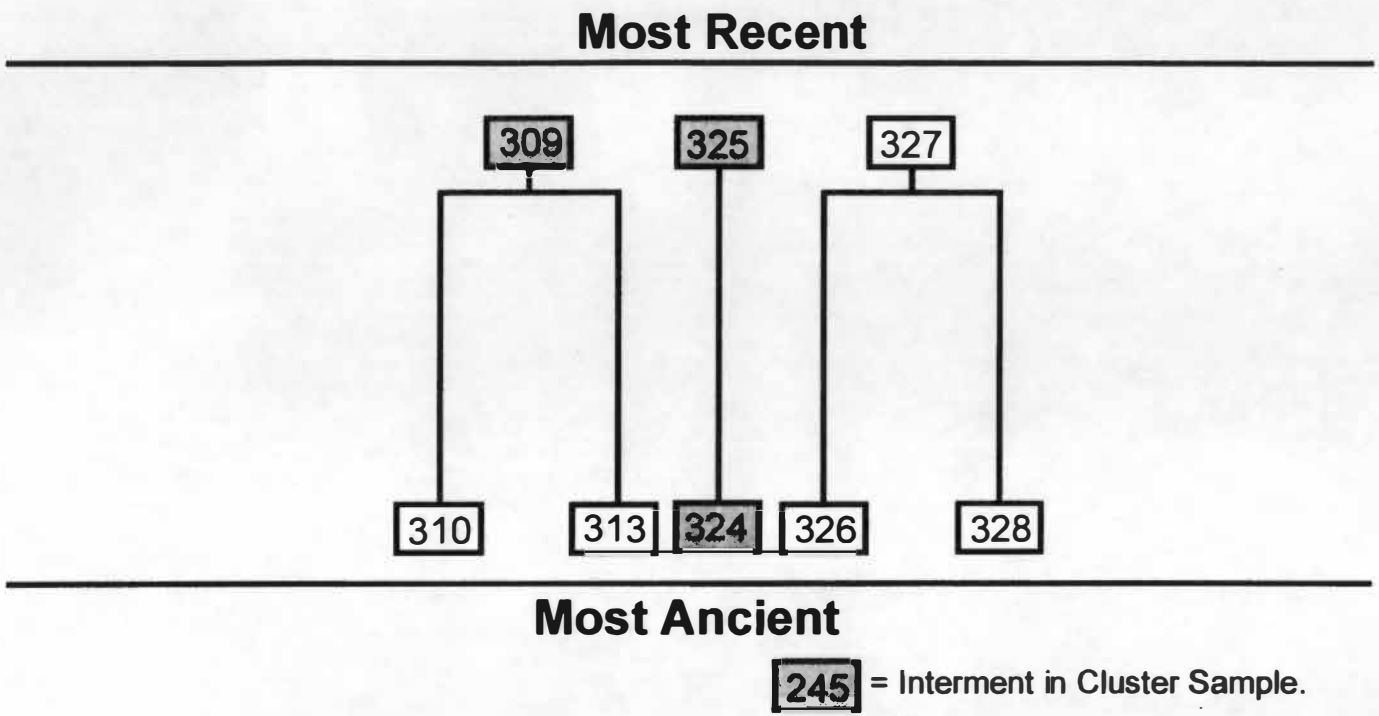
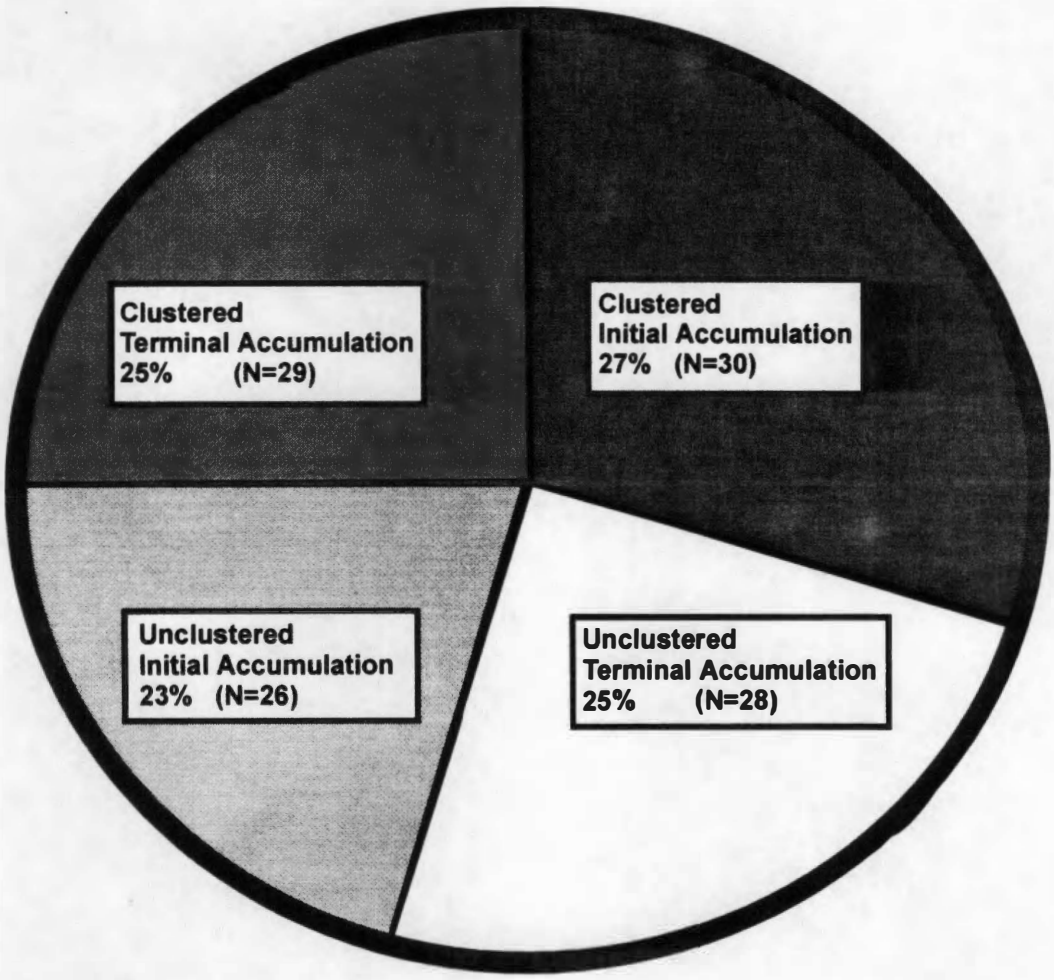


Figure 16-14[F] (continued). A Modified Harris Diagram of the Mound C Mortuary Accumulation Period.

indicating the start of accumulation and there were graves on top signifying that accumulation had stopped. These clearly represented independent temporal events. Given that super-imposed graves are scattered throughout the cemetery; that no evidence for change in cemetery boundaries were found; and that chronometric evidence indicates a relatively short accumulation period, space is assumed to be equally available for use throughout the mortuary accumulation period. In some cases, there are intermediate burials placed between start and stop depositional episodes. These record as many as five separate burial events and adds to between-sequence complexity. These interstitial deposits do not impact on the sequence's basic structural components. Initial and terminal stratigraphic positions qualify as key sequences.

Following Dalland (1984), graves were arranged in terms of their absolute relationship with time. Each vertical sequence was ordered by the relationship 'Most Recent' and then by 'Most Ancient'. These equated to initial and terminal mortuary accumulation events, respectively. 'Most Recent' and 'Most Ancient' served as common temporal denominators enabling the cemetery to be horizontally linked by relative placement during the accumulation phase. These modifications to the Harris diagram provided temporal subsets of graves clearly delimiting interments placed at the beginning and end of activity in each accumulation area. Graves lacking stratigraphic relationships with other graves or exhibiting an intermediate stratigraphic position were not assigned a temporal affiliation. These were subsequently removed from this analysis.

A total of 113 graves were represented in the initial and terminal interment assemblages; 59 of these also represented members of the clustered sample. Since temporal ordering included stratigraphic information from interments not included in the clustered sample, the distribution of initial and terminal graves was extremely vulnerable to sampling biases, particularly taphonomic differences between vertical locations. To determine if the frequency of clustered and non-clustered graves in the stratified sample were proportionately similar, a Chi-Square Test for Independence was employed. Clustered graves represented slightly over half of the temporally ordered sample and were evenly distributed between initial and terminal deposits (Figure 16-15). The resulting Chi value



X^2 Value= 0.009
Degrees of Freedom = 1
P Value = 0.921

Figure 16-15. Distribution of Initial and Terminal Stratified Graves.

indicated no substantial differences between frequency representations. Without evidence of sample biases, the clustered assemblage was accepted as a valid sample of temporally ordered graves.

Attribute data used to define clusters was examined for evidence of diachronic temporal relationships. If a given attribute followed a purely synchronic model, it would express no frequency variation throughout the mortuary accumulation period. Following this concept, a model frequency was produced by dividing the total count for each attribute by the number of time periods examined (i.e., 2 periods). The disparities greater than that produced by random sampling would have suggested a change through time, illustrating that the data followed a diachronic model.

Model values were compared to the original attribute frequencies using a Chi-Square Test for Normality (Blalock 1972:312). Most attribute frequencies were relatively balanced between temporal deposits (Table 16-14). Among the 18 possible tests, proportionate representation between initial and terminal accumulation event deposits produced no strong differences. Without evidence for diachronic change, attributes minimally did not change dramatically during the accumulation period. All mortuary attributes independently appeared to possess a more synchronic temporal relationship.

A second battery of tests were employed to ascertain whether clusters of attributes followed a diachronic or synchronic model. Graves within each cluster were sorted by stratigraphic relationship and the frequencies of those representing initial or terminal accumulations event deposits were tallied. Synchronic model frequencies were calculated as before. Again using the Chi-Square Test for Normality, model values were compared to temporal frequencies. No evidence for substantive variation was observed. These data support the model that the use of material representations did not change dramatically during the accumulation period.

One major fault with this method was an inability to detect subtle shifts over time. What can best be documented is that radical change in mortuary representation did not occur. Did change occur while the cemetery was in use? While these results imply that the ideas expressed at the beginning of the burial accumulation period were similar to those used at the end, this does not mean that the attribute-agent relationship remained stable. Using a larger sample of graves and assuming

Table 16-14. Comparisons Between Synchronically Modeled and Stratigraphically Defined Mortuary Attribute Frequencies.

Attribute	Most Recent	Most Ancient	Model	Chi Value	Degree of Freedom	P Value
Primary Single Interment	19	16	17	0.013	1	0.902
Primary Multiple Interment	4	3	3	0.090	1	0.763
Secondary Body Treatment	7	10	8	0.025	1	0.873
Multiple Body Treatments	1	0	1	-	-	-
Single (Secondary) Interments	2	0	2	-	-	-
Multiple Interments	10	13	11	0.194	1	0.889
Unlined Grave	30	27	28	0.008	1	0.927
Wood Lined Grave	0	1	1	-	-	-
Stone Lined Grave	1	1	1	-	-	-
North-South Orientation	0	2	1	-	-	-
East-West Orientation	0	1	1	-	-	-
Northeast/Southwest Orientation	4	0	2	-	-	-
Northwest/Southeast Orientation	3	5	4	<0.001	1	0.999
Northeast Orientation	1	0	1	-	-	-
Southeast Orientation	0	2	1	-	-	-
Southwest Orientation	2	7	4	0.473	1	0.491
Northwest Orientation	18	10	14	0.656	1	0.417
West Orientation	3	1	2	-	-	-
Unoriented	0	2	1	-	-	-
3-3.9m from Center	0	0	0	-	-	-
4-4.9m from Center	5	2	3	0.048	1	0.825
5-5.9m from Center	5	4	4	0.064	1	0.796
6-6.9m from Center	4	6	5	<0.001	1	0.999
7-7.9m from Center	4	7	5	0.035	1	0.849
8-8.9m from Center	3	4	3	0.090	1	0.763
9-9.9m from Center	7	3	5	0.208	1	0.648
10-10.9m from Center	2	1	1	-	-	-
11-11.9m from Center	0	1	1	-	-	-
12-12.9m from Center	1	1	1	-	-	-
Male	7	6	6	0.434	1	0.834
Female	7	5	6	<0.001	1	0.999
Infant (0-1.99 years)	2	1	1	-	-	-
Subadult (2-29 years)	8	6	7	<0.001	1	0.999
Adult (>30 Years)	11	4	10	<0.001	1	0.999
Cluster						
Cluster 1	5	3	4	<0.001	1	0.999
Cluster 2	1	1	1	-	-	-
Cluster 3	1	0	1	-	-	-
Cluster 4	1	0	0	-	-	-
Cluster 5	5	3	4	<0.001	1	0.999
Cluster 6	0	1	0	-	-	-
Cluster 7	10	9	9	0.02	1	0.865
Cluster 8	7	6	6	0.043	1	0.831
Cluster 9	1	0	1	-	-	-

contemporaneity between attribute types, Mattemes (2000:In Press) has documented a transition in orientation from multiple to only a few forms. It is possible that orientation did not originally possess a meaning, but gradually acquired one with time. Another likelihood is that the meanings expressed by several orientations were abandoned or consolidated in favor of fewer forms. These types of changes could not be defined by stratigraphy alone and require assumptions that were not supportable by this study's analytical approach. It is likely that as the cemetery grew during the accumulation period, mortuary ideas may have been subtly altered to reflect these new social conditions. As a dynamic aspect of a community's culture, changes in the material representation were undoubtedly present, but do not constitute a major shift in the attribute expression.

Chapter 17. Summary and Conclusions

Cemeteries are among the places that humans set aside for mortuary rituals. These cultural expressions are components of the human response to death that help fulfill a number of important social functions. When the physical remains of mortuary rituals are encountered, especially with evidence that these rituals were practiced numerous times at the same location, they can be examined to learn how a community adapted to its social and physical environments. This dissertation considers whether Mississippian mortuary deposits are sensitive to changes occurring in the depositing community's social environment.

The Mound C Cemetery accumulation dates to a period of politico-economic expansion. There is evidence that the population increased, that alternative means of acquiring resources were explored and that some community members commanded great influence. More people, shifts in resource extraction, changes in inter-community and intra-community relationships are all potential reasons for change in the village's established social roles and personalities. Shifts in the established individual, clan or kin-based statuses, reorganization of resource distribution patterns, development of full-time/part-time ritual or administrative specialists, and in-migration of new clan or kin groups are likely outcomes in this social environment. Among those aspects symbolized by seven mortuary variables, there is only minor evidence for change in the Mound C Cemetery.

There are several potential explanations for this perceived stability. First, it is possible that changes in cemetery symbology are not reflected in these attributes. Most of the attributes utilized in this study represented fundamental structural features of a grave. This varies from the more traditional structural approach where artifact inclusions comprise major components of the observation battery. Most of the changes anticipated to have occurred during the Middle Wickliffe Period involve relationship dynamics between kin or clan groups. Among other Native American groups, these distinctions are marked by durable and durable, symbolically distinctive artifacts (including both grave goods and clothing), (Mainfort 1985, O'Shea 1984:50-51). The Mound C

observational battery may include mortuary variables that symbolize more basic social qualities than those changing during the accumulation period.

Another possibility is that the Wickliffe social structure may have been flexible enough to absorb these social variations without a shift in mortuary communication. Presentation teams may not have recognized new roles as social qualities worthy of inclusion in the ritual. The community's social structure may have already included these social variables -- only the frequency of use changed.

Clearly any change that occurred in the Middle Wickliffe society was insufficient to alter Mound C's symbolic organization. This may reflect a third possibility – the Mound C Cemetery was a very short-term accumulation facility. The cemetery contains no less than 622 graves (See Mattemes 1994:87) and the accumulation period can be estimated at about 75 years. This equates to no less than eight funerary rituals a year or roughly one every 45 days. Even within the less used social divisions, this apportions into a very short span between rituals. Following the temporal variability model, short intervals between any two funerary events provides less opportunity for change to occur. Mound C may simply not reflect enough time depth between social personalities to elicit much change in variability. The most appropriate models for each of Mound C's social divisions are:

$$SP_{T1} \cong SP_{T2} \text{ and } V_{(GASROCI)T1} \cong V_{(GASROCI)T2}$$

A Bio-Social Reconstruction of the Mound C Cemetery

In life, members of human communities possess physical and social qualities that act to define their place in a cultural environment. These are manifested by different biological features; such as age, sex, health, physiognomy or genetic relatedness; and by social features including social rank, belief system, marital structure or status, clan affiliation or occupation. These features restrict an actor's behavior to a range deemed appropriate for a given social context. In death, these same rules apply. The dead are provided with a funerary ritual applicable to their former social and biological qualities. Kuper (1965:177) recognizes that socially derived variations in mortuary

expression are probably a universal human phenomenon. By examining mortuary variability, it is possible to understand how a depositing community is structured, both organizationally and biologically.

The Mound C Cemetery is a product of the Middle Mississippian community living at the Wickliffe Mound Group. The cemetery occupies a low broad mound on the northeastern edge of the village's central area. Space within the facility is divided into a non-burial area corresponding to the mound's summit and a burial field along the sides of this earthwork. Both areas were probably foci for funerary activities. Radiometric evaluations indicate that burials accumulated during the first half of the thirteenth century. This corresponds with the Middle Wickliffe Period, a time of increasing community growth and prosperity.

Assigning the Mound Group's place in the regional society is problematic. The cemetery corresponds to a period of population consolidation. Transformation from the Early Wickliffe hamlet to a socio-political node follows the general regional pattern outlined for the mound and village complexes lining the Mississippi River bluffs in western Kentucky. At least some of these are large settlements and it is possible that the Middle Wickliffe occupation represents a secondary node in a complex chiefdom. Poor archaeological visibility; including an absence of satellite communities allied to Wickliffe, a lack of evidence for organized production above the household level (and facilities to store these goods), and unclear relationships with other contemporary communities; severely hamper placing the Middle Wickliffe village into a regional settlement system. Village size, artifact and architectural patterns within the mound group also suggest a semi-autonomous community. The Middle Wickliffe community could represent a bigman or simple chiefdom society. Each of these social arrangements emphasize the presence of upper or lower order social ranks with full access to power and village resources administered by ascribed lineages. There is ample evidence that social rank differences were present during the Middle Wickliffe period. Some of these ranks and lineages are probably portrayed in the cemetery's symbolism.

The Mound C biological population exhibit features that are noted in other Central Mississippi Valley Mississippian skeletal populations. Many of the skulls are cranially deformed.

This probably acted as some form of social marker. Sexual dimorphism follows a similar pattern seen among other Mississippians although the sex ratios are more balanced than many regional samples. This latter observation may be an artifact of sampling biases. Unmodified age distributions reflect an unnatural absence of children in the cemetery. This reflects cultural decisions to segregate the unweaned from the community burial area. These children probably were not considered members of the community. When age distributions were corrected, they emphasize a high risk of death among subadults.

Most villagers did not live past their 35th year. Matternes (1994:87) estimates 843 individuals are buried in the cemetery. Using Konigsberg's (1985:130-131) equation, the living population size is estimated at 370.92 individuals. Among villagers qualifying for burial in the cemetery, this averages to about one death every month during a 75-year accumulation period.

Most skeletons do not indicate why mortality was so high, although acute infectious (respiratory) conditions are generally considered major killers among cultures lacking western medicine (Boyd and Sheldon 1980:52). There are several diagnosed cases of osteomyelitis and treponema, indicating chronic infections frequently contributed to poor health. Trauma is relatively low and consistent with accidental injuries. Prevalence estimates indicate that most health responses fell within the ranges observed in other Mississippian communities. Despite its less-than-marginal environmental context and presumably better diet, stress agents impacted the Middle Wickliffe community about the same. These results imply that a common vehicle, perhaps within the village environment, is more responsible for stress response patterning than socio-environmental setting.

The Mound C cemetery is the product of a complex mortuary program. Its graves display a wide variety of shapes, forms and contents. These material variations are artifacts of repeated social displays intended to attribute social qualities to both the deceased and the community. Socially important ideas are symbolized by this and other materials as a means of communication. The materials present in the cemetery provide an incomplete view of the original presentation. Only those durable elements deposited with the dead are available for examination.

Wickliffe's mortuary presentations were acted out by three sets of participants. The dead form the presentation's principal actors. During life, these actors occupied social niches in the community where they acquired social roles and other qualities. When death occurred, these features provided social concepts that were transformed into material symbols. At Wickliffe, most if not all of the dead resided in the village or its surrounding hinterlands. Those receiving interment in Mound C were attributed with social qualities emphasizing membership in the local community. Non-community members were permanently buried elsewhere. The role of 'the dead' was not limited to individuals, but could also be assigned to groups. These corporate representations combined the social qualities of each member to convey a unified social message. Separate representations may have been included as part of the funerary ritual for each individual, however, presentations associated with the burial event integrated the dead into a single social entity and into a common symbol.

The Presentation Team made the dead's social qualities tangible. Typically, the team probably consisted of clan or kin members who were recruited to prepare the mortuary ritual and participate in its presentation. Community members with social obligations to the dead and/or community were members of the presentation team. Most, if not all of the material variations seen in Mound C were the result of the presentation team's interpretation of the dead's social qualities. Considering how frequent death occurred, Presentation Teams were probably aware what the community expected for an appropriate funeral. The high death rate reflects a considerable drain on the community's resources. The absence of durable grave goods is probably a social adaptation designed by the Presentation Teams to minimize each death's impact on the community's assets.

Audience members included all non-participants witnessing the mortuary presentations. These individuals judged whether the mortuary display was acceptable, relative to the dead's social qualities. Audiences were composed of community members as well as representatives from other communities.

The form of rituals used by the Middle Wickliffe community were poorly detailed by the archaeological record. Only a few aspects were clearly identified. Most village members probably

died with little warning, leaving the community with little opportunity to prepare for the ensuing death event. Construction of a formal community enabled the community to be ready when these events arose. Some community members may have stockpiled less-than-immediately-obtainable resources (such as stone or wood liners) in anticipation of a death. Most graves lack evidence of elaborate preparation, suggesting that mortuary presentations were probably fairly simple.

Post-mortem funerary events could have occurred anywhere in the cultural landscape. The family/kin group's domestic area, the mound's summit and at the actual burial area were likely ritual sites. These areas were prepared, the appropriate materials acquired, necessary members of the presentation team assembled, and the sequence of presentations needed to provide a culturally acceptable funerary ritual were completed.

Wickliffe's dead were afforded two distinct post-mortem funerary event periods. Some individuals were buried before advanced decomposition. This required the presentation team to complete all functions needing the dead's remains within a relatively short period of time. It is unlikely that these dead were transported for great distances prior to interment.

In contrast, reduction of the body to a secondary form probably took longer than the primary interment's post-mortem funerary event period. Secondary body treatment remains were available for community manipulation for as long as the bones were meaningful. Facilities to process and eventually store secondary remains were necessary logistical consequences for lengthening the post-mortem funerary event period. Mississippian chamel houses were frequently constructed to accommodate these functions. Temporary facilities within the village area were probably also erected. Secondary body reduction, as a means of clan or lineage veneration, was associated with some Mississippian communities, but expressions of non-kin related ties and long distance transport (or both) were also possible explanations.

The manner inwhich graves were maintained shed some light on activities during the post-mortem funerary period. Mound C contained numerous cases where old graves were disturbed when new ones were added. The cemetery probably lacked any cultural indications where

interments were placed. This may imply that the location of individual social personalities in the landscape was less important than their inclusion on the cemetery's collective social representation.

Midden deposits cover much of the burial area. This implies that debris and burial deposits occurred simultaneously. While not a common observation, burial in midden areas is appropriate for some Mississippian mortuary programs. The association may be functional more than symbolic. The northwest side of the mound exhibits numerous thin interbedded fill and midden deposits. These are suggestive of repeated erosion events. Cultural debris may have been added to the mound as a means of retarding additional erosion. The most likely scenario is that the burial area was formally recognized by the community and maintained as a culturally important space until the village was abandoned.

Summary of the Mortuary Program

Mortuary behaviors are complex cultural adaptations. They take the totality of a living human's social being and reduce it to a statement that is as much a reflection of the culture as it is of the dead. While the cultural interplays from a single mortuary ritual can never be fully realized from archaeological data, some common patterns are recognizable.

There are no less than 71 unique combinations of mortuary attributes recorded in Mound C. These represent stable structures throughout the burial accumulation period. Most of the attributes examined in this study represented independent units of information. This enabled the presentation team greater freedom to manipulate their presence and emphasis. Fine social distinctions were possible with a minimum of symbolism. Structural ordering of 34 mortuary attributes defined nine dissimilar sets of information. These probably represent important social dimensions. The cemetery's symbolic structure most closely follows a perfect paradigm, where social features are shared by different social personae and differentiated by the use of a few key ideas. These are differentiated by unique attributes or attribute combinations (Table 17-1).

The meanings behind mortuary variations were poorly understood. Age and community membership were expressed by inclusion within the cemetery. Some graves communicated

Table 17-1. Attributes Visible in Mound C Clusters.

Attribute	Cluster								
	1	2	3	4	5	6	7	8	9
Treatment:									
Primary Single							X	X	X
Primary Multiple						X			
Multiple Treatment					X	X			
Secondary	X	X	X	X		X			
Multiplicity:									
Single	X		X	X			X		
Multiple	X	X			X	X			
Furniture:									
Unlined	X		X	X	X		X	X	X
Wood Lined						X			
Stone Lined		X							
Orientation:									
Northwest/Southeast	X	X	X			X			
Northwest					X	X	X	X	X
Southeast							X	X	
North/South	X								
Northeast/Southwest	X			X					
Northeast									X
Southwest					X		X	X	
East/West	X	X							
West							X	X	X
Unoriented	X	X							
Distance:									
3-3.99	X	X			X			X	
4-4.99	X	X		X	X			X	
5-5.99	X		X		X	X	X	X	
6-6.99	X			X	X		X	X	X
7-7.99	X		X		X		X	X	X
8-8.99	X				X		X	X	
9-9.99			X		X		X	X	X
10-10.99								X	
11-11.99	X						X	X	X
12-12.99							X		
Sex:									
Male				X			X		
Female							X	X	
Age:									
Infant (0-3.9)									X
Subadult (4-29)	X		X					X	
Adult (>30)				X			X		

elevated social investment by placement close to the mound's summit. Social differences may also have been expressed by burial outside the facility. Within the cemetery, social variables (principally status) accounted for much of the variation between graves. A comparison of the organizational properties associated with each grave revealed differing structures within and between some clusters. While many of these clusters possessed near identical structures, they did not convey the same information. The general contents of each cluster were outlined to summarize what was learned about each structure.

Cluster 1: Multiple Interment Secondary Unlined Graves (Fusion Node 9)

There are 25 graves in this cluster. Bundle burials, emphasizing the presence of at least two individuals, distinguish this assemblage from all others. The interment of multiple individuals at a single event emphasizes that each individual was treated as part of a corporate identity. The social messages communicated refer to a group, not individual personae.

All human remains were reduced to a hard tissue state prior to interment, providing an opportunity for the dead to remain safely available to the community. Since these remains are highly incomplete, the symbolic representation of an individual in the burial was more important than the absolute accountability of skeletal elements. These graves occupy unlined or non-durably lined burial pits and graves that tend to be oriented along the Northwest/Southeast plane. There is a slight tendency towards burial close to the mound's summit. Burial 46, a single subadult secondary interment represents an exception to this cluster's general arrangement. This idiosyncratic representation appears to have been added to this cluster because of its common distance from the centerpoint and rare East/West alignment. Cluster 1 probably represents a unique social segment in the Middle Wickliffe community.

Cluster 2: Multiple Individual Secondary Stone Lined Graves (Fusion Node 23)

This cluster contains four secondary interments with multiple individuals in stone lined chambers. In many respects, these graves are very similar to those in Cluster 1. Use of stone to line these graves is a key feature, helping to convey different social messages. Stone lined graves utilize a variety of orientations and are exclusively located close to the mound's summit. They may be high social

investment representations. Construction of a stone liner, with or without additional non-durable liners, may have helped differentiate these assemblages from other corporate representations.

Cluster 3: Single Non-Adult Secondary Unlined Graves (Fusion Node 58)

These three secondary interments emphasize the social qualities of single individuals. This cluster is distinguished from others by the application of secondary body treatment to subadults. All graves are unlined and possess a common Northwest/Southeast orientation. They probably share a common meaning with multiple forms placed in a similar plane. Cluster 3 interments are located 5-9 meters from the cemetery's center. They probably convey idiosyncratic messages about these youths.

Cluster 4: Single Individual Adult Secondary Unlined Graves (Fusion Node 70)

In contrast to Cluster 3, the two single individual secondary interments of Cluster 4 contain adults in the opposite (Northeast/Southwest) orientation plane. This orientation may emphasize adult age qualities among otherwise identical burial forms. Like Cluster 3, graves in Cluster 4 do not follow the more normative multiple individual-secondary or single adult-primary treatment patterns. The combination of single occupants and secondary treatment representations probably indicate a unique adult social division.

Cluster 5: Multiple Primary/Multiple Unlined Graves (Fusion Node 19)

There are five unlined graves containing at least one primary interment in this cluster. Most of these entail the burial of two primary interments, indicating that only a short interval passed between death events. Most of these graves are oriented with their head towards the northwest or southwest. They are generally found on the cemetery's periphery.

Burials 88 and 264 represent outliers to this pattern. For both cases, skeletal elements from a second individual accompany a primary interment. Inclusion of these graves with Cluster 5 negates the possibility that this cluster simply reflect short intervals between death-burial events. The meaning conveyed by this assemblage is not adequately understood.

Cluster 6: Multiple Individuals in Wood Lined Graves (Fusion Node 14)

Cluster 6 encompasses the rarest of Mound C's grave forms. This assemblage contains only two graves, both bearing wood grave liners. They are not very similar to each other. These interments are positioned in a Northwest/Southeast plane and both graves contain multiple individuals with at least one person reduced to a secondary form. The presence of a durable liner (with or without an accessory non-durable liner) may emphasize a common social feature assigned to these corporate representations.

Cluster 7: Single Adult Primary Unlined Graves (Fusion Node 10)

The 25 graves in this cluster emphasize the social qualities of one person in a funerary event. These social displays occurred relatively soon after death. Both males and females are present within this cluster indicating that sex based differences are not communicated by this feature. Major groups (Nodes 17 and 20) indicate that sexual dimorphic features were not manipulated the same for subgroups within this cluster. Two distinctly different social messages are probably grouped under a common social theme. All individuals possessed non-durable grave linings and are buried across the whole burial field. Northwest orientations are the most common. They probably represent members of a common social group.

Cluster 8: Single Subadult Primary Unlined Grave (Fusion Node 11)

Grave variations were identical between the described primary unlined adults and these 25 subadults. Age was the key attribute distinguishing this cluster. There was a tendency towards burial close to the mound's summit and most graves were oriented towards the northwest. Use of primary burial treatment was an important component of these burial events – this form of body manipulation enabled the dead's physical qualities to communicate youth.

Cluster 9: Single Infant Primary Unlined Graves (Fusion Node 12)

Most infants were probably viewed as non-community members and buried elsewhere. For these three infants, however, the community allowed burial in Mound C. They possessed no unique mortuary attributes and were linked solely by their age. These uncommon burial forms were located in the 7-9 meter range from the cemetery's center and do not reflect a high social investment. The

individual's biological development was sufficient to communicate ideas about with the individual's age. The social reasoning behind these idiosyncratic inclusions was not recovered.

Mortuary Change and Community Dynamics

Unlike many prehistoric mortuary assemblages, the Mound C cemetery is a component of a well-documented habitation site. These two aspects of the village landscape are integrated to reveal the presence of other community events. Radiometric data reveal that the Mound C Cemetery is a short-term single-use mortuary accumulation area from the middle of the village occupation period. Minimally, the village must have used two other burial locations.

Mortuary structures from the Early Wickliffe period are poorly defined. These encompass infants and subadults from the hamlet's habitation area. A few disarticulated adult bones suggest that burial within the village and subsequent transfer to another permanent facility was part of the regional Mississippian mortuary pattern (Mattemes 1996a). The lack of adult interments in or around the Early Wickliffe hamlet implies that a permanent adult facility was not located at Wickliffe. If the Early Wickliffe hamlet represents a colonizing community, then the most likely off-site burial area is the parent village.

These events have important implications for the Middle Wickliffe Period community. The burial of infants in the domestic occupation area and reduction of the dead to secondary forms are material concepts that were introduced to the landscape well before other Middle Wickliffe mortuary forms. It is unlikely that the rise in Wickliffe's socio-political importance and the appearance of the Mound C Cemetery represent independent social phenomena. Some change in the community's power structure is almost undoubtedly involved. Placement of the cemetery within the village's central core could not have been accomplished without support from the village's inhabitants. As a statement of community solidarity, the cemetery implicates independence from or development of more socially advantageous relationships with the parent community.

Mound C's accumulation period terminates prior to the village's abandonment. This disparity indicates that grave placement has again shifted. There are no indications that Mound C's position in

the village landscape was altered. While use of the burial area discontinued, activities on the mound's summit may have continued through abandonment.

Evidence for Late Wickliffe period mortuary activities is almost as poorly documented as from the early period. There are numerous unverified reports of grave concentrations within the Late Wickliffe village area, but none of these can be verified. Perhaps the closest to validation are the adult interments from Mound D. These primary and secondary interments are associated with several caches of materials that Wesler (1990) interprets as mortuary inclusions. Wesler (1990) identifies these graves as high status or elite mortuary interments. While accurate dates for these remains are lacking, Wesler (1997:275) believes that Mound D is a Late Wickliffe product. Interment of the adult Mound D burials would, therefore, also represent Late Wickliffe developments.

Mortuary data imply that a major social division occurred between the Middle and Late Wickliffe periods. The only evidence of high status interment at the Wickliffe Mound Group took place after the Mound C Cemetery was replaced as a burial area. Prior to this time, there are no indications that the community's socio-political authority manipulated mortuary representation to express their status as separate from all others.

While there is no question that high status personages were part of the Middle Wickliffe period, there are also no indications where they were interred. One possibility is that they lacked sufficient power to differentiate themselves from other community members. Service (1975:74) notes that power and wealth within bigmen and simple chiefdom societies are usually passed along kinship lines. Given that more than one kin group is undoubtedly present in Mound C, several generations could easily have accumulated during the Middle Wickliffe accumulation period. High status personages may be present in Mound C and are not recognizable. Separation of the high status group from others in the community would have compromised the burial area's basic premise (community solidarity) and required a redefinition of the cemetery's message. This may explain cemetery relocation.

Another possibility is that mortuary segregation may have always been part of the burial program. High status community members could have received exclusive burial at the parent

community during the Middle Wickliffe period. Transfer of this privilege to the Wickliffe village may be additional evidence of shifts in the local power structure. Placement of these visible mortuary symbols in the center of the village and shifting the community burial area to an outlying location may not represent independent transformation of the cultural landscapes.

Changes in mortuary location during the occupation period are not unique to Wickliffe. A review of Mississippian mortuary accounts indicates that this was a fairly common, frequently overlooked phenomenon. Given the Mound C Cemetery's temporal position and implications for change around it, shifts in socio-political dynamics may play an important role in Mississippian cemetery relocation. Mississippian cemeteries define groups of people and when these groups are redefined, their self-expressions are also changed. This pattern may have been applied well beyond the confines of a small mound and village complex in western Kentucky.

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APPENDICES

Appendix A. Mound C Cemetery Spatial Analysis Data.

Grave ID.No.	Grave Center-North	Grave Center-East	Distance (cm)	Treatment	Multiplicity	Sex	Age Group	Orientation
100	49.8	28.4	644	Primary	Single	Male	Indet.	NW/SE Plane
102	49.2	28.2	696	Primary	Single	Female	Adult	NW/SE Plane
103	47.4	29.8	912	Primary	Single	Female	Adult	NE/SW Plane
104	47.6	31.5	968	Primary	Single	Male	Adult	NE/SW Plane
105	48.4	30.6	854	Primary	Single	Female	Adult	NW/SE Plane
107	49.2	30.6	786	Primary	Single	Indet.	Yng A/Adlt	NW/SE Plane
108	48.4	31.8	916	Primary	Single	Female	Adult	NW/SE Plane
110	49.6	31.6	806	Secondary	Single	Indet.	Indet.	NW/SE Plane
112	50.2	30.8	712	Primary	Single	Male	Adult	NW/SE Plane
114	50.6	31.6	732	Primary	Single	Male	Adult	NW/SE Plane
115	50.1	32.01	794	Secondary	Single	Indet.	Adult	NW/SE Plane
116	51.4	31.5	670	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
118	50.4	30.6	684	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
119	51.2	30.8	634	Primary	Single	Indet.	Indet.	NW/SE Plane
120	49.8	30.9	750	Secondary	Single	Indet.	Indet.	NW/SE Plane
122	51.3	31.9	708	Primary	Multiple	Multiple	Multiple	NW/SE Plane
123	51.8	32.3	704	Primary	Single	Male	Adult	NW/SE Plane
124	49.9	31.2	760	Secondary	Single	Indet.	Yng Adult	NW/SE Plane
125	50.9	31.2	684	Primary	Single	Indet.	Subadult	NW/SE Plane
127	51.8	33.1	772	Primary	Single	Indet.	Indet.	NW/SE Plane
128	51.5	33.2	794	Primary	Single	Indet.	Indet.	NW/SE Plane
129	52.1	33.6	798	Primary	Single	Female	Adult	NW/SE Plane
131	48.8	32.4	1120	Primary	Single	Male	Adult	NW/SE Plane
133	48.8	31.6	870	Primary	Single	Indet.	Yng Adult	NW/SE Plane
134	48.9	33.8	1004	Primary	Single	Male	Yng A/Adlt	NW/SE Plane
135	50.4	33.2	862	Primary	Single	Indet.	Indet.	NW/SE Plane
137	50.1	33.9	924	Primary	Multiple	Multiple	Multiple	NW/SE Plane
138	49.6	35.4	1084	Primary	Single	Female	Indet.	NW/SE Plane

Grave ID.No.	Grave Center-North	Grave Center-East	Distance (cm)	Treatment	Multiplicity	Sex	Age Group	Orientation
141	51.1	34.8	948	Primary	Single	Indet.	Adult	NW/SE Plane
146	52.6	31.2	640	Primary	Single	Indet.	Subadult	NW/SE Plane
147	52.4	21.1	658	Secondary	Multiple	Multiple	Multiple	NE/SW Plane
148	52.8	21.9	570	Primary	Single	Male	Adult	NW/SE Plane
151	52.2	21.1	670	Secondary	Multiple	Multiple	Multiple	Not Oriented
154	51.2	22.1	658	Primary	Single	Indet.	Indet.	NW/SE Plane
155	51.5	21.3	694	Primary	Single	Indet.	Subadult	E/W Plane
159	47.2	22.5	968	Primary	Single	Indet.	Indet.	E/W Plane
160	47.2	23.1	944	Primary	Single	Indet.	Indet.	E/W Plane
161	49.2	23.8	734	Primary	Single	Indet.	Indet.	NW/SE Plane
162	50.2	25.2	596	Primary	Single	Indet.	Indet.	NW/SE Plane
163	48.2	29.8	840	Primary	Single	Indet.	Indet.	NW/SE Plane
166	46.25	28.7	992	Primary	Single	Indet.	Indet.	NE/SW Plane
17	47.1	23.1	954	Primary	Single	Indet.	Adult	E/W Plane
170	51.7	27.3	422	Primary	Single	Female	Adult	NW/SE Plane
171	51.52	27.52	458	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
18	47.9	23.4	868	Primary	Single	Female	Adult	NW/SE Plane
20	48.7	22.4	832	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
218	52.8	22.9	498	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
219	47.9	26.2	908	Primary	Single	Male	Adult	NW/SE Plane
221	48.8	27.6	722	Primary	Single	Male	Adult	NE/SW Plane
222	51.8	33	762	Primary	Single	Female	Adult	NW/SE Plane
226	53.6	22.1	510	Primary	Single	Male	Indet.	NW/SE Plane
234	52.2	31.6	594	Primary	Single	Indet.	Adult	NE/SW Plane
236	52.6	30.9	506	Second	Multiple	Multiple	Multiple	NE/SW Plane
237	53.8	36.8	1064	Primary	Single	Indet.	Indet.	NW/SE Plane
238	51.2	36.6	1108	Primary	Single	Indet.	Indet.	NW/SE Plane
239	52.2	36.2	1028	Primary	Single	Indet.	Indet.	E/W Plane

Grave ID.No.	Grave Center-North	Grave Center-East	Distance (cm)	Treatment	Multiplicity	Sex	Age Group	Orientation
240	52.4	36.5	1050	Primary	Single	Indet.	Adult	NW/SE Plane
241	52.6	33.6	770	Primary	Single	Indet.	Indet.	NE/SW Plane
243	52.9	32.4	646	Primary	Single	Male	Yng Adult	NE/SW Plane
245	53.1	31.8	604	Primary	Multiple	Multiple	Multiple	NE/SW Plane
246	46.4	25.1	968	Primary	Single	Indet.	Indet.	NW/SE Plane
248	50.5	36.2	1102	Secondary	Single	Indet.	Indet.	NW/SE Plane
250	50.8	36.5	1120	Primary	Single	Indet.	Indet.	N/S Plane
251	51.4	36.6	1098	Primary	Single	Indet.	Indet.	E/W Plane
260	59.5	26.7	356	Primary	Single	Indet.	Indet.	NE/SW Plane
261	59.1	25.9	324	Primary	Single	Indet.	Adult	NE/SW Plane
263	59.8	28.9	448	Secondary	Multiple	Indet.	Indet.	NW/SE Plane
264	59.4	28.4	394	Primary	Multiple	Multiple	Multiple	NW/SE Plane
265	59.7	25.7	388	Primary	Single	Indet.	Subadult	NW/SE Plane
267	54.3	31.1	464	Secondary	Multiple	Multiple	Multiple	E/W Plane
271	63.4	26.5	804	Primary	Single	Indet.	Indet.	NW/SE Plane
272	63.6	26.8	762	Primary	Multiple	Multiple	Multiple	NW/SE Plane
276	63.8	26.4	784	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
279	59.5	30.9	554	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
280	58.8	30.6	490	Primary	Single	Indet.	Subadult	NW/SE Plane
281	59.9	30.11	524	Multiple	Multiple	Indet.	Multiple	NW/SE Plane
282	59.95	30.4	548	Secondary	Single	Indet.	Subadult	NW/SE Plane
283	59.4	30.6	522	Primary	Single	Indet.	Yng Adult	NW/SE Plane
285	59.8	31.5	546	Secondary	Single	Indet.	Indet.	NW/SE Plane
286	59.9	30.9	580	Secondary	Single	Indet.	Indet.	Circular
289	65.39	26.41	938	Primary	Single	Indet.	Indet.	E/W Plane
290	59.3	33.8	824	Primary	Single	Indet.	Indet.	NW/SE Plane
291	59.3	34.4	856	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
295	60.8	19.2	922	Primary	Multiple	Multiple	Multiple	NW/SE Plane

Grave ID.No.	Grave Center-North	Grave Center-East	Distance (cm)	Treatment	Multiplicity	Sex	Age Group	Orientation
297	53.4	39.3	1292	Primary	Single	Indet.	Yng A/Adlt	NW/SE Plane
298	53.7	39.7	1326	Primary	Single	Indet.	Adult	NW/SE Plane
30	48.4	23.8	806	Primary	Single	Male	Adult	NW/SE Plane
300	60.2	19.9	788	Primary	Single	Indet.	Subadult	NE/SW Plane
301	60.3	19.3	850	Primary	Multiple	Multiple	Multiple	NE/SW Plane
303	52.7	16.4	1074	Primary	Single	Indet.	Subadult	NW/SE Plane
306	52.6	16.9	1028	Secondary	Single	Indet.	Indet.	NW/SE Plane
307	60.1	19.9	796	Secondary	Multiple	Indet.	Indet.	N/S Plane
309	58.3	23.1	424	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
31	50.2	22	740	Primary	Single	Male	Indet.	NW/SE Plane
311	58.5	24.7	388	Secondary	Multiple	Multiple	Multiple	E/W Plane
312	58.9	23.9	402	Secondary	Multiple	Multiple	Multiple	Circular
313	58.7	23.4	424	Primary	Single	Indet.	Indet.	N/S Plane
320	60.6	27.8	478	Primary	Single	Female	Subadult	NW/SE Plane
324	51.2	38.6	1262	Primary	Single	Female	Adult	NE/SW Plane
325	52.7	39.7	1284	Primary	Single	Female	Adult	NE/SW Plane
333	62.42	27.06	606	Primary	Single	Indet.	Subadult	NW/SE Plane
334	52.6	40.15	1302	Secondary	Multiple	Multiple	Multiple	NE/SW Plane
336	50.8	38	1248	Secondary	Single	Indet.	Indet.	E/W Plane
337	61.2	26.9	528	Primary	Single	Indet.	Indet.	NE/SW Plane
35F	49.5	23.6	712	Primary	Single	Male	Indet.	E/W Plane
3	50.2	21.15	796	Primary	Single	Indet.	Indet.	NW/SE Plane
41	51.6	23.4	544	Primary	Single	Male	Adult	NW/SE Plane
42	52.6	22.8	512	Primary	Single	Indet.	Subadult	NE/SW Plane
44	53.1	22.8	478	Secondary	Multiple	Multiple	Multiple	NE/SW Plane
45	52.8	22.8	468	Secondary	Single	Male	Adult	NE/SW Plane
46	52.2	23.5	492	Secondary	Single	Female	Subadult	E/W Plane
47	52.9	23.8	416	Secondary	Multiple	Multiple	Multiple	E/W Plane

Grave ID.No.	Grave Center-North	Grave Center-East	Distance (cm)	Treatment	Multiplicity	Sex	Age Group	Orientation
49	46.8	24.2	948	Primary	Multiple	Multiple	Multiple	NW/SE Plane
4	47.8	21.8	948	Primary	Single	Female	Indet.	E/W Plane
50	47.4	23.8	904	Primary	Single	Indet.	Indet.	NW/SE Plane
52	47.1	24.3	916	Primary	Single	Indet.	Subadult	E/W Plane
53	47.2	25.2	888	Primary	Multiple	Multiple	Multiple	NW/SE Plane
55	47.8	24.8	836	Primary	Single	Female	Adult	NW/SE Plane
57	48.9	25.1	722	Primary	Single	Female	Subadult	NW/SE Plane
58EL1	49.2	24.8	702	Primary	Single	Male	Adult	E/W Plane
59	48.7	25.5	738	Secondary	Multiple	Multiple	Multiple	N/S Plane
6	48.9	21.8	856	Primary	Single	Male	Adult	NW/SE Plane
62	49.2	25.1	694	Primary	Single	Indet.	Adult	NW/SE Plane
63	49.4	26.4	658	Primary	Multiple	Multiple	Multiple	NW/SE Plane
64	50.3	26.2	572	Primary	Multiple	Multiple	Multiple	NW/SE Plane
65	50.6	25.2	556	Primary	Single	Indet.	Subadult	NW/SE Plane
66	50.9	25.1	532	Primary	Single	Female	Yng A/Adlt	NW/SE Plane
68	51.1	25.1	512	Primary	Single	Female	Adult	NW/SE Plane
71	51.2	25.8	484	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
72	50.7	27.5	534	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
74	52.5	24.9	388	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
75	52.2	24.7	424	Secondary	Single	Indet.	Adult	NW/SE Plane
76	52.9	24.9	354	Primary	Single	Female	Yng Adult	NW/SE Plane
77	52.2	26.2	382	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
79	51.8	26.4	418	Secondary	Multiple	Multiple	Multiple	NW/SE Plane
80	51.9	27.6	420	Secondary	Multiple	Multiple	Multiple	E/W Plane
82	47.5	27.1	846	Primary	Single	Male	Indet.	NW/SE Plane
83	47.6	26.5	836	Primary	Single	Male	Adult	NW/SE Plane
85	47.9	26.5	806	Primary	Single	Female	Adult	NW/SE Plane

Grave ID.No.	Grave Center-North	Grave Center-East	Distance cm)	Treatment	Multiplicity	Sex	Age Group	Orientation
86	48.7	26.9	728	Primary	Single	Indet.	Indet.	NW/SE Plane
88	46.4	27.2	936	Multiple	Multiple	Multiple	Multiple	NW/SE Plane
89	46.6	26.9	936	Primary	Single	Female	Yng Adult	E/W Plane
90	46.6	27.5	938	Primary	Single	Male	Indet.	NW/SE Plane
91	46.8	28.2	928	Secondary	Single	Indet.	Subadult	NW/SE Plane
92	46.6	28.8	944	Primary	Multiple	Multiple	Multiple	NE/SW Plane
95	48.8	29.1	754	Primary	Single	Indet.	Adult	NE/SW Plane
96	49.1	27.9	698	Primary	Single	Female	Indet.	E/W Plane

Appendix B. Measurements Collected for Sex Estimation.

Measurement Key[1]:

Measurement Code	Description
IND. No.	Individual Interment Number
GOL	Cranial Maximum Length
BNL	Cranial Base Length
BBH	Cranial Basion-Bregma Length
XCB	Cranial Maximum Breadth
WFB	Cranial Minimum Frontal Breadth
ZYB	Cranial Bizygomatic Breadth
AUB	Cranial Biauricular Breadth
BPL	Cranial Basion-Prosthion Length
NPH	Cranial Upper Facial Height
NLH	Cranial Nasal Height
NLB	Cranial Nasal Breadth
MAB	Cranial Maximum Alveolar Breadth
MAL	Cranial Maximum Alveolar Length
MDH	Cranial Mastoid Length
OBB	Cranial Orbital Breadth
DKB	Cranial Interorbital Breadth
EKB	Cranial Biorbital Breadth
FRC	Cranial Frontal Chord
PAC	Cranial Parietal Chord
OCC	Cranial Occipital Chord
FOL	Cranial Foramen Magnum Length
FOB	Cranial Foramen Magnum Breadth
FMT	Cranial Upper Facial Breadth
CML-L	Clavicle Maximum Length – Left
CML-R	Clavicle Maximum Length - Right
CSD-L	Clavicle Sagittal Diameter at Midshaft - Left
CSD-R	Clavicle Sagittal Diameter at Midshaft - Right
CVD-L	Clavicle Vertical Diameter at Midshaft - Left
CVD-R	Clavicle Vertical Diameter at Midshaft - Right
SML-L	Scapula Maximum Height - Left
SML-R	Scapula Maximum Height - Right
SMB-L	Scapula Maximum Breadth - Left
SMB-R	Scapula Maximum Breadth - Right
HML-L	Humerus Maximum Length - Left
HML-R	Humerus Maximum Length - Right
MDS-L	Humerus Maximum Midshaft Diameter-Left
MDS-R	Humerus Maximum Midshaft Diameter-Right
MDM-L	Humerus Minimum Midshaft Diameter - Left
MDM-R	Humerus Minimum Midshaft Diameter - Right
MDH-L	Humerus Maximum Vertical Head Diameter - Left
MDH-R	Humerus Maximum Vertical Head Diameter - Right
EBR-L	Humerus - Epicondylar Breadth - Left
EBR-R	Humerus - Epicondylar Breadth - Right

[1] All Measurements in Millimeters.

Measurement Key (Continued):

Measurement Code	Description
RML-L	Radius Maximum Length - Left
RML-R	Radius Maximum Length - Right
RSD-L	Radius Sagittal Diameter of Midshaft - Left
RSD-R	Radius Sagittal Diameter of Midshaft - Right
RTD-L	Radius Transverse Diameter of Midshaft - Left
RTD-R	Radius Transverse Diameter of Midshaft - Right
UML-L	Ulna Maximum Length - Left
UML-R	Ulna Maximum Length - Right
UPL-L	Ulna Maximum Length - Left
UPL-R	Ulna Maximum Length - Right
UAD-L	Ulna Dorso-Volar Diameter - Left
UAD-R	Ulna Dorso-Volar Diameter - Right
UMD-L	Ulna Transverse Diameter - Left
UMD-R	Ulna Transverse Diameter - Right
ULC-L	Ulna Maximum Circumference - Left
ULC-R	Ulna Maximum Circumference - Right
SAL	Sacrum Anterior Height
SAB	Sacrum Anterior Breadth
INH-L	Innonimate Height – Left
INH-R	Innonimate Height - Right
ILB-L	Iliac Breadth - Left
ILB-R	Iliac Breadth - Right
PUL-L	Pubis Length - Left
PUL-R	Pubis Length - Right
ICL-L	Ischium Length - Left
ICL-R	Ischium Length - Right
FML-L	Femur - Maximum Length - Left
FML-R	Femur - Maximum Length - Right
FCL-L	Femur – Bicondylar Length - Left
FCL-R	Femur - Bicondylar Length - Right
APD-L	Femur A-P Subtrochanteric Length - Left
APD-R	Femur A-P Subtrochanteric Length - Right
MLD-L	Femur Transverse Subtrochanteric Diameter - Left
MLD-R	Femur Transverse Subtrochanteric Diameter - Right
APS-L	Femur A-P Transverse Midshaft Diameter - Left
APS-R	Femur A-P Transverse Midshaft Diameter - Right
MLS-L	Femur Transverse Midshaft Diameter - Left
MLS-R	Femur Transverse Midshaft Diameter - Right
VHD-L	Femur Maximum Head Diameter - Left
VHD-R	Femur Maximum Head Diameter - Right
FEB-L	Femur Epicondylar Breadth - Left
FEB-R	Femur Epicondylar Breadth - Right
FCS-L	Femoral Midshaft Circumference - Left
FCS-R	Femoral Midshaft Circumference - Right

Measurement Key (Continued):

Measurement Code	Description
TML-L	Tibia Condylo-Malleolar Length - Left
TML-R	Tibia Condylo-Malleolar Length - Right
BPE-L	Tibia Maximum Proximal Epiphysis Breadth - Left
BPE-R	Tibia Maximum Proximal Epiphysis Breadth - Right
BDE-L	Tibia Maximum Distal Epiphysis Breadth - Left
BDE-R	Tibia Maximum Distal Epiphysis Breadth - Right
APN-L	Tibia Maximum Diameter at Nutrient Foramen - Left
APN-R	Tibia Maximum Diameter at Nutrient Foramen - Right
MLM-L	Tibia Maximum Transverse Diameter at Nutrient Foramen - Left
MLM-R	Tibia Maximum Transverse Diameter at Nutrient Foramen - Right
CFL-L	Tibia Circumference at Nutrient Foramen - Left
CFL-R	Tibia Circumference at Nutrient Foramen - Right
BML-L	Fibula Maximum Length - Left
BML-R	Fibula Maximum Length - Right
FMD-L	Fibula Maximum Diameter at Midshaft - Left
FMD-R	Fibula Maximum Diameter at Midshaft - Right
CLL-L	Calcaneus Maximum Length - Left
CLL-R	Calcaneus Maximum Length - Right
CMB-L	Calcaneus Middle Breadth - Left
CMB-R	Calcaneus Middle Breadth - Right

IND. No.	GOL	BNL	BBH	XCB	WFB	ZYB	AUB	BPL	NPH	NLH	NLB	MAB	MAL	MDH	OBB
103	184.00		153.00	150.00	96.00		110.00							26.00	
104	152.00	96.00	149.00	158.00	96.00		131.00		88.00	57.00	23.00	70.00	56.00	33.00	37.00
105	167.42		138.89	108.00		76.00		108.11	78.74	57.38	24.62	62.63	55.86	37.78	
107	209.10	103.87		135.82										26.27	
108EL	165.00	88.70	158.00	153.00	88.00	129.00	109.63	90.19	62.65	44.00	26.00	60.06	49.38	26.37	
114	154.54			113.84							25.70	64.71		27.55	
131EL1	194.00	100.76	137.00	137.00	84.60	133.26	107.33	96.45	73.67	55.80	22.57	61.18	49.46	31.26	37.44
138	167.00			137.67										24.75	
230B	161.00	91.00												26.00	
24														23.00	
30	165.00			144.00	103.00		123.00							33.00	
31	181.00				93.00						25.00	69.00	55.00	31.00	
38									77.00	57.00	27.00	63.00	56.00		
333	159.00	96.00	126.00	146.00	87.00	132.00	128.00	98.00	67.00	49.00	24.00	59.00	48.00	19.00	40.00
53A	152.00			163.00	95.00		134.00					77.00	59.00	33.00	
53B			133.00	161.00	96.00		152.00							18.00	
55EL1	158.00				89.00	137.00			72.00	47.00	27.00	68.00	51.00	25.00	40.00
6		97.00	136.00									55.00	46.00	24.00	41.00
74C					92.60				58.29	43.20	24.00	22.58	60.36	50.55	38.82
79A					87.00							12.00			
83	169.00		135.00	118.00			119.00		70.00	55.00	24.00	67.00	47.00	26.00	43.00
88B	159.00			136.00	93.00		116.00							28.00	
89	159.00			145.00	96.00	134.00	120.00		74.40	50.73	24.20	70.00	59.00	30.00	38.76

IND. No.	DKB	EKB	FRC	PAC	OCC	FOL	FOB	FMT
103			124.00	112.00	102.00	39.80	29.20	
104			118.00	93.00	94.00	36.00	43.00	
105			113.74	115.07	110.39	44.42	34.96	110.09
107			106.64	105.09	93.04	39.39	28.19	111.90
108EL			108.27	92.75	94.62	33.83	60.64	100.00
114			115.68	110.73	107.7	37.38	30.00	
131EL1			110.35	106.79	91.33	40.19	35.18	94.62
138			108.25	100.59	98.15			
230B			100.00	84.00	107.00	33.00	35.00	96.00
24								
30			113.00	111.00	88.00			
31			121.00					
38	23.00	104.00						
333	23.60	96.00	110.00	85.00	106.00	34.00	28.00	
53A			116.00	99.00	84.00		35.00	
53B			103.00	103.00		34.00	28.00	
55EL1	29.00	98.00	115.00	99.00	97.00			
6			117.00			37.00	38.00	
74C	20.54	96.06	101.98					
79A			110.00					
83	17.63		108.00	110.00	91.00		29.00	
88B			107.00	92.00	108.00			
89	22.57	102.00	101.00	99.00	95.00	35.00	30.14	

IND.No.	Clavicle						Scapula				Humerus			
	CML-L	CML-R	CSD-L	CSD-R	CVD-L	CVD-R	SML-L	SML-R	SMB-L	SMB-R	HML-L	HML-R	MDS-L	MDS-R
100	152.67	162.00	11.36	11.12	9.58	8.43								
103														
104	152.00	155.00	9.72	11.40	8.55	9.78					321.00	320.00	23.19	24.74
133											342.00			
148														
149														
170														
171A													23.42	22.40
18														
20														
219														22.09
22				9.00		8.00								24.00
221														
226	154.00		11.00		12.00									
246														
30											327.00	330.00	21.38	22.60
35F														
38													22.00	23.00
44A														
45														
47A														
49A														
50														
53A	130.00		11.99	11.26	9.52	10.31							23.20	24.97
53B	135.00		9.60	9.85	9.05	8.78							20.96	23.80
55														
6	128.50		10.00		8.00						33.00			24.00
62														21.37

IND.No.	Clavicle						Scapula				Humerus			
	CML-L	CML-R	CSD-L	CSD-R	CDV-L	CVD-R	SML-L	SML-R	SMB-L	SMB-R	HML-L	HML-R	MDS-L	MDS-R
63A													20.90	
63B				10.61		7.47								
64B													19.40	
66		129.00	11.38	8.50	8.54	6.61								
68														
6EL1												320.00		22.00
71B														
74C														22.59
76											318.00	320.00	22.05	22.21
77A														
79A														24.01
79C														
79D														
80A														
80B														
82														
83													21.31	
88A														20.53
88B													19.27	18.13
89	152.40		8.48		7.77						319.00		20.47	
90		152.50	12.18	11.39	8.84	9.02								
92														
95	134.00		6.89		9.23									22.91

IND.No.	Humerus						Radius						Ulna	
	MDM-L	MDM-R	MDH-L	MDH-R	EBR-L	EBR-R	RML-L	RML-R	RSD-L	RSD-R	RTD-L	RTD-L	UML-L	UML-R
100														
103								234.00		10.01		11.92		
104	17.67	17.14	43.00	46.00	60.00	58.00	259.00	243.00	11.06	12.77	17.20	11.06		274.00
133			49.50		62.00			248.00					261.00	
148							252.00		13.00		15.00			
149														
170										9.65		12.05		
171A	18.50	16.64												
18														
20														
219		15.79								10.13		12.29		
22		15.00				52.00								
221							254.00		11.01	11.98	13.03	13.20		
226							270.00		12.00		13.00			
246														
30	19.56	18.25	45.36	45.37	63.70	54.70							271.00	
35F														
38	18.00	18.00	47.00	47.00						13.00		13.00		
44A														
45														
47A														
49A														
50														
53A	16.09	17.82				58.95			11.28	11.21	10.97	12.38	270.00	
53B	17.34	16.48	71.00				224.00	226.00	10.54	11.64	14.74	15.43		
55														
6		19.00				54.00			10.00	11.00	11.00	13.00		
62		16.70	39.55			45.03				9.45		12.02		

IND.No.	Humerus						Radius						Ulna	
	MDM-L	MDM-R	MDH-L	MDH-R	EBR-L	EBR-R	RML-L	MRL-R	RSD-L	RSD-R	RTD-L	RTD-R	UML-L	UML-R
63A	17.01		38.59											
63B										12.40		15.86		
64B	15.18								12.42		16.22			
66														
68														
6EL1		17.00		42.00		59.00								
71B														
74C		15.68												
76	20.93	19.04	44.00	41.00	52.00	63.05								
77A														
79A		18.77												
79C														
79D														
80A														
80B														
82														
83	18.85		45.00							12.24		12.35		
88A		15.98				55.00								
88B	15.83	14.28			50.78	51.00		222.00		9.27		11.00		
89	16.88		43.40		54.70									
90								280.00	12.08	12.11	14.08	15.06		
92			44.00			36.00	269.00		11.92		14.07			
95		17.82	43.96			54.20								

IND. No.	Ulna								Sacrum		Innominate			
	UPL-L	UPL-R	UAD-L	UAD-R	UMD-L	UMD-R	ULC-L	ULC-R	SAL	SAB	INH-L	INH-R	ILB-L	ILB-R
100						15.68								
103			13.32	15.23	8.09	9.43								
104				13.54		15.76	34.00							
133									106.00		205.00	210.00	138.00	147.00
148					15.00		38.00							
149														
170														
171A														
18									101.00	113.00				
20														
219														
22														
221														
226			12.00		13.00		31.00							
246														
30	244.50		14.48		12.90		33.00							
35F														
38			13.00		16.00									
44A				11.48		16.35								
45														
47A														
49A														
50														
53A	265.00	266.00	11.64	11.59	13.69	13.52	9.08	8.93			206.00	211.00	89.50	96.00
53B		247.00	10.07	11.65	13.24	15.85	30.00	32.00	102.67	90.79				
55														
6									116.00	114.00		196.00	143.00	134.00
62				9.02		12.85								

IND. No.	Ulna								Sacrum		Innominate			
	UPL-L	UPL-R	UAD-L	UAD-R	UMD-L	UMD-R	ULC-L	ULC-R	SAL-L	SAB-L	INH-L	INH-R	ILB-L	ILB-R
63A														
63B														
64B			9.62		15.64									
66														
68														
6EL1														
71B														
74C														
76														
77A														
79A														
79C			12.04		14.83									
79D														
80A														
80B														
82														
83														
88A														
88B				12.12		13.53		31.00						
89				9.81		16.49		40.00	114.00	128.00				151.00
90											213.00	200.00		
92							32.00							167.00
95														

	Innominate				Femur									
IND. No.	PUL-L	PUL-R	ICL-L	ICL-R	FML-L	FML-R	FCL-L	FCL-R	APD-L	APD-R	MLD-L	MLD-R	ASP-L	APS-R
100					441.00	423.00	441.00	421.00	27.16	26.55	35.71	34.80	31.09	28.61
103					431.00	416.00	426.00		23.27	22.03	31.27	22.03	23.55	20.36
104					459.00	451.00	457.00	449.00	25.49	26.89	32.65	33.79	32.19	32.23
133					456.00	454.00								
148														
149									21.00		31.00		26.00	
170									25.18	23.78	29.01	29.50	27.51	24.61
171A					404.00				25.03		31.38		25.52	
18									25.00		31.00		26.00	27.00
20									27.00	29.00	35.00	33.00	36.00	37.00
219										27.04		31.44		26.23
22														
221														
226									23.00	24.00	30.00	31.00		26.00
246														
30					449.00	437.00	442.00	435.00	28.00	27.80	31.00	37.30	30.00	28.60
35F									24.00	26.00	31.00	33.00	31.00	34.00
38									27.00	27.00	32.00	33.00	33.00	32.00
44A										25.40		33.29		30.59
45										27.89		38.35		31.47
47A									25.51		32.60		31.61	
49A													18.00	18.00
50														
53A		87.00		148.00	461.00	457.00	457.00	452.00	24.41	26.63	34.06	33.30	30.06	31.71
53B					434.00		431.00		23.84		30.55		27.00	
55														
6				77.00										
62							445.00	442.00	25.72	26.87	29.38	32.01	29.04	28.92

IND. No.	Innominate				Femur									
	PUL-L	PUL-R	ICL-L	ICL-R	FML-L	FML-R	FCL-L	FCL-R	APD-L	APD-R	MLD-L	MLD-R	APS-L	APS-R
63A														
63B														
64B									25.66		29.60		25.39	26.09
66									22.29	22.08	21.94	25.94	25.20	22.17
68					425.00				24.29	28.88	30.68	25.88	27.51	27.76
6EL1					390.00	384.00	389.00	383.00	21.00	23.00	34.00	33.00	26.00	25.00
71B										22.46		32.25		24.63
74C										30.25		29.47	25.07	21.92
76									20.79	20.61	24.97	26.49	24.59	23.97
77A									23.38	25.05	29.20	29.49	30.79	27.86
79A									27.48	23.85	30.09	33.10	31.61	26.98
79C									26.90		35.80		31.16	
79D														30.08
80A									19.75	19.72	28.61	26.68	20.44	21.64
80B									27.55	27.24	33.21	32.24	33.64	31.96
82										27.68		31.52	30.38	27.88
83										28.75		32.59	28.77	28.21
88A						417.00		417.00	22.30		29.80		27.58	
88B									23.21		29.41		22.41	
89			71.00		451.00	449.00	448.00	448.00	25.71	25.42	30.88	28.17	27.64	29.86
90			82.00	75.00	459.00	467.00	458.00	462.00	25.65	25.60	31.23	32.98	29.58	29.90
92									28.00	24.00	35.00	34.00	30.00	30.00
95						422.00		419.00		25.26		33.46		28.01

IND. No.	Femur								Tibia					
	MLS-L	MLS-R	VHD-L	VHD-R	FEB-L	FEB-R	FCS-L	FCS-R	TML-L	TML-R	BPE-L	BPE-R	BDE-L	BDE-R
100	28.82	31.37		46.27	65.14	76.00	97.00	92.00			71.67			
103	24.96	22.29	10.79	40.81			77.00	71.00						
104	25.94	25.07	41.00	47.00	72.00	80.60	91.00	90.00		385.00		77.00	48.00	49.00
133			46.00	47.00	78.50	77.00	91.00	87.00	381.00	386.00	70.00	76.00	46.25	50.00
148														
149	24.00		33.00				78.00							
170	24.87	24.15					82.00	78.00						
171A	24.82						85.00							
18	27.00	29.00			69.00			83.00	323.00		68.00		44.00	45.00
20	29.00	27.00			74.00		103.00	102.00						50.00
219		28.38				75.11		90.00		392.00		76.00		53.00
22														
221			46.19				92.00						46.00	50.00
226		30.00						88.00						
246										366.00				46.27
30	26.40	30.60	42.87	46.00	79.49	76.70	87.00	92.00				79.00	55.00	
35F	27.00	29.00					93.00						60.00	
38	28.00	27.00	46.00	43.00			98.00	93.00						
44A		28.09						91.00						
45		33.04						102.00						
47A	25.56						91.00				72.52			
49A	16.00	16.00					58.00		265.00		46.00		35.00	
50										381.00		82.00		56.00
53A	28.38	27.78	48.15	45.10	73.48	73.44	92.00	94.00	375.00	378.00	76.00	80.00	52.00	52.00
53B	26.43		42.85				82.00			342.00	70.43	70.44		44.86
55														
6														
62	27.18	27.92	46.77	45.28			92.00	92.00	372.00	380.00		76.00	50.00	51.00

IND. No.	Femur								Tibia					
	MLS-L	MLS-R	VHD-L	VHD-R	FEB-L	FEB-R	FCS-L	FCS-R	TML-L	TML-R	BPE-L	BPE-R	BDE-L	BDE-R
63A														
63B														
64B	23.37	25.30					78.00	78.00						
66	22.88	22.54					80.00	77.00						
68	23.42	23.77					81.00	81.00					44.59	
6EL1	28.00	26.00	42.00	42.00	73.00	72.00	82.00	81.00	362.00	363.00	72.00	74.00	47.00	48.00
71B		27.28						80.00						
74C	24.89	27.65					92.00	81.00						
76	21.90	22.46					72.00	74.00						
77A	22.63	25.33					85.00	82.00						
79A	26.92	26.43					95.00	83.00						
79C	28.44							94.00						
79D		25.38						102.00						
80A	23.29	22.02					70.00	71.00						
80B	28.33	27.29					96.00	95.00						
82	29.23	30.87					94.00	94.00	381.00				45.10	
83	26.24	27.51		45.00			88.00	93.00						
88A	24.48					69.42		82.50						
88B	25.84		39.00					76.50						
89	23.81	22.62	44.00	44.00	77.83	77.57	80.00	92.00	371.00	375.00	72.00	73.00	56.00	46.00
90	27.32	27.50	45.00	47.00	85.52	82.06	91.00	92.00	382.00		79.00	80.00	79.00	56.00
92	27.00	26.00	42.00	43.00			90.00	89.00					46.00	
95		28.39				76.29		89.00						

IND. No.	Tibia								Fibula				Calcaneus	
	APN-L	APN-R	MLM-L	MLM-R	CFL-L	CFL-R	PCN-L	PCN-R	BML-L	BML-R	FMD-L	FMD-R	CLL-L	CLL-R
100	33.70		25.48		117.11							16.64		68.33
103	31.22	29.01	22.27	21.53	112.22		87.00	82.00			14.21	14.83		71.94
104	35.08	36.10	23.72	22.28		126.00	92.00	93.00					75.35	
133							93.00	98.50						
148														
149														
170	29.36	25.92	23.36	22.98			85.00	84.00			11.40	11.89		11.36
171A	31.57	34.98	23.18	20.41			100.00	90.00						
18	33.00		12.00		114.00		81.00							
20		39.00		23.00				99.00						
219		37.45		22.15		132.00		95.00	372.00		17.40		76.12	
22														
221												13.30		
226														
246		34.24		24.89		98.00		93.00						67.00
30		39.00		23.00		104.00		97.00			15.60	14.00	78.55	76.91
35F	41.00		24.00				105.00					18.00		
38	40.00	26.00					104.00				17.00			
44A														
45											16.48			
47A	36.95	39.15	23.59	25.02			99.00	104.00				14.50		
49A	23.00		19.00		82.00		72.00		258.00		14.00			
50		38.00		26.00		110.00		123.00		379.00		25.00		74.00
53A	34.95	36.68	23.59	23.44	132.00	110.00	102.00	100.00	375.00	342.00	15.49	16.82		
53B	28.69	29.72	22.30	23.04	103.42	108.76	83.00	82.00	343.00		14.27			
55														
6														
62	35.96	37.49	24.30	22.98	128.00	124.00	94.00	93.00			13.91			84.54

IND. No.	Tibia								Fibula				Calcaneus	
	APN-L	APN-R	MLM-L	MLM-R	CFL-L	CFL-R	PCN-L	PCN-R	BML-L	BML-R	FMD-L	FMD-R	CLL-L	CLL-R
63A														
63B														
64B														
66														
68	31.36	32.86	21.86	21.86			90.00	89.00						
6EL1	35.00	36.00	24.00	24.00	117.00	116.00	95.00	96.00	297.00		16.00	17.00		
71B	27.49	25.48	19.61	20.61			78.00	75.00						
74C														
76	27.92		18.88				75.00							
77A														
79A														
79C														
79D		39.09		21.35				102.00						
80A		29.91	20.67					83.00						
80B														
82	35.90	33.79	21.91	23.01	132.00	142.00	96.00	94.00				14.86		69.60
83														
88A														
88B														
89	30.81	30.80	24.15	23.18	116.00	121.00	91.00	86.00	359.00	360.00	13.04	12.63	74.45	
90	52.00	35.65	24.23	22.44	130.00	125.00	98.00	96.00			18.34		79.75	
92	37.00	36.00	24.00	26.00			100.00	98.00						64.00
95							95.00							

IND. No.	Calcaneus CMB-L	CMB-R	Burial	Calcaneus CMB-L	CMB-R
100		32.09	63A		
103		27.69	63B		
104			64B		
133			66		
148			68		
149			6A		
170			74C		
171A			76		
18			77		
20			79A		
219	44.60		79C		
22			79D		
221			80A		
226			80B		
246			82		
30	42.22	41.62	83		
35F			88A		
38			88B		
44A			89	43.51	
45			90	46.11	
47A			92		46.00
49A			95		
50					
53A					
53B					
55					
6					
62		44.41			

Appendix C. Categorical Gender Assessments of Cranial Features.

IND.No.	Orbital Margin	Supraorbital Torus	Mastoid Process	Nuchal Form	Chin Form
102	Female	Female	Female?	Female	Female
103	Not Observed	Not Observed	Not Observed	Not Observed	Female
104	Male	Female	Female	Male	Male
105	Not Observed	Not Observed	Not Observed	Not Observed	Female
108	Female	Female	Female	Female	Female
112	Male	Male	Male	Not Observed	Male
114	Male	Male	Male	Female	Not Observed
122A	Female	Female	Female	Not Observed	Female
129	Not Observed	Not Observed	Female	Female	Not Observed
133	Female	Female	Male	Male	Male
134	Not Observed	Not Observed	Male	Male?	Male
138	Female	Female	Female	Female	Female
147A	Male	Female	Female	Female	Not Observed
17	Not Observed	Not Observed	Female?	Male	Not Observed
20	Not Observed	Not Observed	Not Observed	Male	Male
218A	Not Observed	Not Observed	Male	Male	Not Observed
230C	Female	Female	Female	Female	Not Observed
272	Female	Female	Female	Female	Female
30	Male	Male	Male	Male	Male
312C	Female	Female	Not Observed	Female	Not Observed
325	Female	Female	Not Observed	Not Observed	Female
41	Male	Male?	Male	Not Observed	Male
44B	Not Observed	Female	Female	Female	Not Observed
47B	Male	Female	Female	Not Observed	Female
53A	Male?	Male?	Male	Female	Male
53B	Female	Female	Female	Male?	Female
62	Not Observed	Not Observed	Female	Not Observed	Male
63A	Not Observed	Not Observed	Female	Not Observed	Female
64A	Not Observed	Not Observed	Male	Male	Male
74A	Not Observed	Not Observed	Not Observed	Not Observed	Male
74C	Female	Female	Female	Not Observed	Female
76	Not Observed	Not Observed	Female	Female	Female
79D	Female	Female	Female	Female	Not Observed
83	Male	Male	Male	Male	Female
85	Female	Not Observed	Female	Female	Female
88B	Female	Female	Female	Not Observed	Not Observed
89	Female	Female	Male	Female	Male
95	Female	Male?	Male	Male	Not Observed
96	Male	Female	Female?	Female?	Not Observed

Appendix D. Categorical Gender Assessments of Pelvic Features.

IND.No.	Sciatic Notch	Subpubic Concavity	Ventral Arc Shape	Ischio-Pubic Ramus Shape	Pre-Auricular Sulcus	Auricular Surface Height	Sacrum Shape
102	Female	Not Observed	Not Observed	Not Observed	Female	Not Observed	Not Observed
103	Female	Not Observed	Not Observed	Not Observed	Female	Female	Not Observed
104	Male	Male	Male	Male	Male	Male	Not Observed
105	Female	Not Observed	Not Observed	Not Observed	Female	Female	Female
107	Male	Not Observed	Not Observed	Not Observed	Female	Male	Male
108	Female	Not Observed	Not Observed	Not Observed	Male?	Female	Not Observed
112	Male	Not Observed	Not Observed	Not Observed	Male	Not Observed	Not Observed
114	Male	Not Observed	Not Observed	Not Observed	Male	Male?	Not Observed
118A	Male	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed
122A	Female	Not Observed	Not Observed	Not Observed	Female	Female	Not Observed
123	Male	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed
129	Female	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed
131	Male	Not Observed	Not Observed	Not Observed	Male	Male	Male?
133	Female	Not Observed	Not Observed	Not Observed	Female	Not Observed	Not Observed
134	Male	Not Observed	Not Observed	Not Observed	Female	Male	Male
137B	Male	Not Observed	Not Observed	Not Observed	Male	Male	Not Observed
141	Not Observed	Not Observed	Not Observed	Not Observed	Female	Not Observed	Male
147A	Not Observed	Not Observed	Not Observed	Female	Not Observed	Not Observed	Not Observed
148	Male	Not Observed	Not Observed	Male	Male	Male	Male
17	Male?	Not Observed	Not Observed	Not Observed	Male	Male?	Not Observed
18	Female	Not Observed	Not Observed	Not Observed	Female	Female	Female
221	Male	Not Observed	Not Observed	Not Observed	Female	Male	Male?
222	Male	Not Observed	Not Observed	Not Observed	Female	Not Observed	Not Observed
227	Male	Not Observed	Male	Not Observed	Not Observed	Male	Male
242	Male	Male	Not Observed	Not Observed	Not Observed	Male	Not Observed
243	Male	Not Observed	Not Observed	Not Observed	Male	Not Observed	Not Observed
244	Male	Not Observed	Not Observed	Not Observed	Female	Not Observed	Not Observed
30	Male	Not Observed	Not Observed	Not Observed	Female	Male	Male
322	Male	Not Observed	Not Observed	Not Observed	Female	Not Observed	Not Observed

IND.No.	Sciatic Notch	Subpubic Concavity	Ventral Arc Shape	Ischio-Pubic Ramus Shape	Pre-Auricular Sulcus	Auricular Surface Height	Sacrum Shape
324	Not Observed	Not Observed	Female	Not Observed	Female	Female	Female
38	Male	Not Observed	Not Observed	Male	Male	Male	Not Observed
4	Female	Not Observed	Not Observed	Not Observed	Female	Female	Not Observed
45	Male	Not Observed	Not Observed	Not Observed	Female	Male	Not Observed
53A	Male	Not Observed	Not Observed	Not Observed	Male	Male	Not Observed
53B	Female	Not Observed	Not Observed	Not Observed	Female	Female	Female
55	Female	Not Observed	Not Observed	Not Observed	Female	Female	Female
62	Male?	Not Observed	Not Observed	Not Observed	Female	Male	Not Observed
68	Female	Not Observed	Not Observed	Not Observed	Female	Female	Not Observed
76	Female	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed
83	Male	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed	Not Observed
85	Female	Not Observed	Not Observed	Female	Not Observed	Not Observed	Not Observed
88B	Female	Not Observed	Not Observed	Female	Female	Female	Not Observed
89	Female	Not Observed	Not Observed	Not Observed	Female	Female	Female
90	Not Observed	Not Observed	Not Observed	Not Observed	Female	Male	Not Observed
95	Female	Female	Not Observed	Not Observed	Female	Male	Female

Appendix E. Skeletal Age Estimators used on the Mound C Assemblage.

Observation Key[1]:

Observation Code	Observation Description
IND.No.	Individual Interment Number
EC	Ectocranial Suture Closure
AS	Auricular Surface
PS	Pubic Symphysis
ILC	Iliac Crest Fusion
CLA	Clavicular Epiphysis Fusion
PAL	Palatine Suture Closure
OCIP	Occipital Development
DEN	Dental Eruption
TD	Tooth Development
EPI	Epiphyseal Development
DIA	Diaphysis Length
LBD	Long Bone Deterioration

[1] X = Estimator Used in Age Estimation.

ID.No.	Age Range	EC	AS	PS	ILC	CLA	PAL	OCIP	DEN	TD	EPI	DIA	LBD
102	30-40	X	X	-	X	-	X	-	X	-	-	-	-
103	45-55	-	X	-	X	-	-	-	-	-	-	-	-
104	30-40	X	X	X	X	-	X	-	-	-	-	-	-
105	45-60	-	X	-	X	X	-	-	-	-	-	-	-
107	25-35	-	X	-	-	-	-	-	-	-	-	-	-
108	35-39	X	X	-	X	-	X	-	-	-	-	-	-
112	35-45	X	-	-	-	-	X	-	-	-	-	-	-
114	30-40	X	-	-	-	-	X	-	-	-	-	-	-
115	30-50	X	-	-	-	-	-	-	-	-	-	-	X
118A	30-60	-	-	-	-	-	-	-	-	-	-	X	X
122A	35-45	X	X	X	-	-	X	-	-	-	-	-	-
123	50-60	-	X	-	-	-	-	-	-	-	-	-	-
124A	17-21	-	-	-	-	-	-	-	X	-	-	-	-
125	1.5-3	-	-	-	-	-	-	-	X	-	X	X	-
129	30-50	-	-	-	-	-	X	-	-	-	-	-	-
131	40-50	-	X	-	X	X	-	-	-	-	-	-	-
133	20-30	X	-	-	-	-	X	-	-	-	-	-	-
134	25-35	X	X	-	X	-	X	-	-	-	-	-	-
137A	17-30	-	-	-	-	-	-	-	-	-	X	-	-
137B	50-60	-	X	-	-	-	-	-	-	-	-	-	-
141	35-45	-	-	X	-	-	-	-	-	-	-	-	-
146	15-20	-	-	-	-	-	-	-	-	-	X	-	-
147A	35-50	X	-	-	X	X	X	-	-	-	-	-	-
148	45-60	-	X	-	-	-	-	-	-	-	-	-	-
150	3-7	-	-	-	-	-	-	-	-	-	X	-	-
151A	6-9	-	-	-	-	-	-	-	X	-	-	-	-
151B	40-50	X	-	-	-	-	-	-	-	-	-	-	-
152	4-7	-	-	-	-	-	-	-	-	-	X	X	-
155	16-17	-	-	-	-	-	-	-	-	-	X	-	-
17	25-45	X	-	-	-	-	-	-	-	-	-	-	-
170	30-60	-	-	-	-	-	-	-	-	-	-	-	X
171A	11-18.5	-	-	-	-	-	-	-	-	-	X	X	-
18	50-60	-	X	-	X	-	-	-	-	-	-	-	-
20	32-42	X	-	-	-	-	-	-	-	-	-	-	-
207	20-35	-	-	-	-	-	X	-	-	-	-	-	-
208	14-18	-	-	-	-	-	-	-	-	-	X	X	-
209	>45	X	X	-	-	-	X	-	-	-	-	-	-
21	1-2.5	-	-	-	-	-	-	-	-	X	X	-	-
211A	34-52	X	-	-	-	-	-	-	-	-	-	-	-
211B	30-39	X	X	-	-	-	-	-	-	-	-	-	-
212	29-48	X	-	-	-	-	X	-	-	-	-	-	-
218A	40-50	X	-	-	-	-	-	-	-	-	-	-	-
218B	20-40	-	-	-	-	-	-	-	-	-	-	-	X
219	30-50	-	-	-	-	-	-	-	-	-	-	-	X
221	30-40	-	X	-	X	-	-	-	-	-	-	-	-
222	40-50	-	X	-	X	-	-	-	-	-	-	-	-
227	35-45	-	X	X	-	-	-	-	-	-	-	-	-

ID.No.	Age Range	EC	AS	PS	ILC	CLA	PAL	OCIP	DEN	TD	EPI	DIA	DJD
230A	31-42	X	-	-	-	-	-	-	-	-	-	-	-
230B	41-52	X	-	-	-	-	X	-	-	-	-	-	-
230C	20-40	X	-	-	-	-	X	-	-	-	-	-	-
234	40-50	-	X	-	-	-	-	-	-	-	-	-	-
240	30-40	-	X	X	-	-	-	-	-	-	-	-	-
242	50-60	-	X	-	-	-	-	-	-	-	-	-	-
243	17-30	-	X	-	X	-	-	-	-	-	-	-	-
244	30-39	-	X	-	-	-	-	-	-	-	-	-	-
258	30-40	X	-	-	-	-	X	-	-	-	-	-	-
261	30-40	-	-	-	-	-	X	-	-	-	-	-	-
264A	20-30	X	X	-	-	-	-	-	-	-	-	-	-
265	5-10	-	-	-	-	-	-	-	-	X	-	-	-
266A	30-40	X	-	-	-	-	X	-	-	-	-	-	-
266B	8-13	-	-	-	-	-	-	-	X	-	-	-	-
267A	0-17	-	-	-	-	-	-	-	-	-	X	-	-
269	25-35	X	-	-	-	-	X	-	-	-	-	-	-
270	0-2	-	-	-	-	-	-	-	-	-	X	-	-
272	40-50	-	X	-	X	X	X	-	-	-	-	-	-
276B	0-7	-	-	-	-	-	-	X	-	-	-	-	-
276C	35-45	-	X	-	X	X	-	-	-	-	-	-	-
277	35-50	-	-	-	-	-	X	-	-	-	-	-	-
278	21-36	X	-	-	-	-	-	-	-	-	-	-	-
280	10-12	-	-	-	-	-	-	-	X	-	-	-	-
281A	4-7	-	-	-	-	-	-	-	-	-	X	X	-
281B	20-30	-	-	-	-	-	-	-	-	-	-	X	X
281C	0-7	-	-	-	-	-	-	-	-	-	X	-	-
282	10-12	-	-	-	-	-	-	-	X	-	-	-	-
283	20-30	X	-	-	-	-	X	-	-	-	-	-	-
284	35-45	-	-	-	-	-	X	-	-	-	-	-	-
294	35-45	-	-	-	-	-	-	-	-	-	-	-	X
297	23-44	X	-	-	-	-	X	-	-	-	-	-	-
298	25-40	X	-	-	-	-	X	-	-	-	-	-	-
30	35-45	X	X	-	X	-	X	-	-	-	-	-	-
300	0-0.5	-	-	-	-	-	-	-	-	-	X	X	-
301	35-45	-	X	-	-	-	-	-	-	-	-	-	-
302	20-30	X	-	-	-	X	-	-	-	-	-	-	-
303	7.5-8.5	-	-	-	-	-	-	-	-	-	X	X	-
304	10-13	-	-	-	-	-	-	-	X	-	-	-	-
309A	30-52	X	-	-	-	-	-	-	-	-	-	-	-
311A	30-39	-	X	-	-	-	-	-	-	-	-	-	-
312A	17-25	-	-	-	-	-	-	-	-	-	X	-	-
312C	30-45	X	-	-	-	-	-	-	-	-	-	-	-
317	34-43	X	-	-	-	-	-	-	-	-	-	-	-
318	40-60	-	-	-	-	-	X	-	-	-	-	-	-
320	14-16	X	-	-	-	-	X	-	X	X	X	-	-
322	17-23	-	X	-	X	-	-	-	-	-	X	-	-
324	40-50	-	X	-	-	-	-	-	-	-	-	-	X
325	31-41	X	-	-	-	-	X	-	-	-	-	-	-

ID.No.	Age Range	EC	AS	PS	ILC	CLA	PAL	OCIP	DEN	TD	EPI	DIA	DJD
333	2-10	-	-	-	-	-	-	-	-	-	X	-	-
38	30-50	-	-	-	X	X	-	-	-	-	-	-	-
41	30-40	X	-	-	-	-	-	-	-	-	-	-	-
42	6-7	-	-	-	-	-	-	-	X	-	X	-	-
44B	32-46	X	-	-	-	-	-	-	-	-	-	-	-
44C	17-21	-	-	-	-	-	-	-	X	-	X	-	-
45	35-45	-	X	-	-	-	-	-	-	-	-	-	-
45EL1	0-2	-	-	-	-	-	-	-	-	-	X	-	-
46	13-17	-	-	-	-	-	-	-	X	-	X	-	-
47C	3-10	-	-	-	-	-	-	-	-	-	X	-	-
47E	<10	-	-	-	-	-	-	-	-	-	X	-	-
49A	9.5-11.5	-	-	-	-	-	-	-	-	-	X	X	-
52	1.5-2.5	-	-	-	-	-	-	-	X	X	-	-	-
53A	50-60	X	X	X	X	X	X	-	-	-	-	-	-
53B	50-60	X	X	-	X	X	X	-	-	-	-	-	-
55	25-40	-	-	X	-	-	-	-	-	-	-	-	-
57EL1	3.5-7	-	-	-	-	-	-	-	-	-	X	X	-
58EL1	40-50	X	-	-	X	-	X	-	-	-	-	-	-
59A	7-12	-	-	-	-	-	-	-	X	-	-	-	-
6	45-60	X	X	-	X	X	X	-	-	-	-	-	-
62	40-50	-	X	X	X	-	-	-	-	-	-	-	-
64A	30-39	X	-	-	-	-	X	-	-	-	-	-	-
64B	20-29	-	-	-	-	-	-	-	-	-	-	-	X
65	13-15	-	-	-	-	-	-	-	X	X	X	-	-
66	25-34	-	X	-	X	-	-	-	-	-	-	-	-
68	45-55	-	X	-	-	-	-	-	-	-	-	-	-
74A	35-50	X	-	-	-	-	-	-	-	-	-	-	-
74C	17-21	-	-	-	-	-	X	-	X	X	-	-	-
75	>30	-	-	-	-	-	-	-	-	-	-	-	X
76	18-25	X	-	-	-	-	X	-	X	-	-	-	-
79A	20-29	X	-	-	-	-	-	-	-	-	-	-	-
79B	10-11	-	-	-	-	-	-	-	-	-	X	-	-
79E	6-7	-	-	-	-	-	-	-	-	-	X	-	-
79G	0-3	-	-	-	-	-	-	-	X	-	-	-	-
80A	20-40	-	-	-	-	-	-	-	-	-	-	-	X
80B	20-40	-	-	-	-	-	-	-	-	-	-	-	X-
83	35-50	X	-	-	-	-	X	-	-	-	-	-	-
85	30-45	X	-	-	-	-	-	-	-	-	X	-	-
88B	30-40	X	X	-	-	-	-	-	-	-	-	-	-
89	20-24	X	X	-	-	-	X	-	-	-	-	-	-
91	14-17	-	-	-	-	-	-	-	X	X	-	-	-
92	30-40	-	X	-	-	-	-	-	-	-	-	-	-
95	30-49	X	X	X	-	-	-	-	-	-	-	-	-
99	30-49	-	X	-	-	-	-	-	-	-	-	-	-

Appendix F. Mound C Grave Attributes.

Observation Key[1]:

Attribute Code	Attribute Description
TMT-Pri/Sing	Primary Treatment - Single Interment
TMT-Pri/Mult	Primary Treatment - Multiple Interment
TMT-Second	Secondary Treatment
TMT-Multiple	Multiple Treatment
Single-Sec	Single (Secondary) Interment
Multiple Imt.	Multiplicity
Furn-Unlined	Unlined Grave
Furn-Wood	Wood Lined Grave
Furn-Stone	Stone Lined Grave
N-S	North/South Plane
E-W	East/West Plane
NE-SW	Northeast/Southwest Plane
NW-SE	Northwest/Southeast Plane
NE	Northeast Orientation
SE	Southeast Orientation
SW	Southwest Orientation
NW	Northwest Orientation
West	West Orientation
Unoriented	Unoriented Grave
3-3.99	3-3.99 Meters from Cemetery Center
4-4.99	4-4.99 Meters from Cemetery Center
5-5.99	5-5.99 Meters from Cemetery Center
6-6.99	6-6.99 Meters from Cemetery Center
7-7.99	7-7.99 Meters from Cemetery Center
8-8.99	8-8.99 Meters from Cemetery Center
9-9.99	9-9.99 Meters from Cemetery Center
10-10.99	10-10.99 Meters from Cemetery Center
11-11.99	11-11.99 Meters from Cemetery Center
12-12.99	12-12.99 Meters from Cemetery Center
Sex-Male	Male Individual
Sex-Female	Female Individual
Age-0/1.99	Skeletal Age at Death = 0-1.99 Years
Age-2/29.9	Skeletal Age at Death = 2-29.9 Years
Age->30	Skeletal Age at Death = >30 Years
Constant Resources	Resource Fixity
Stable Org.	Organizational Variability

[1] Observations Scored at Present or Absent.

Burial	TMT-Pri/Sing	TMT-Pri/Mult	TMT-Second	TMT-Multiple	Single-Sec	Multiple Imt.	Furn-Unlined	Furn-Wood	Furn-Stone
102	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
103	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
104	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
105	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
107	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
108	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
112	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
114	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
116	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
118	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
122	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
123	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
124	Absent	Absent	Present	Absent	Present	Absent	Present	Absent	Absent
125	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
129	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
131	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
133	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
134	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
137A	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
146	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
147	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
148	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
150	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
151	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
152	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
155	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
171	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
18	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent

Burial	TMT-Pri/Sing	TMT-Pri/Mult	TMT-Second	TMT-Multiple	Single-Sec	Multiple Imt.	Furn-Unlined	Furn-Wood	Furn-Stone
20	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
207	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
208	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
211	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
218	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
219	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
221	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
222	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
227	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
230	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
236	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
242	Absent	Absent	Present	Absent	Present	Absent	Present	Absent	Absent
243	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
245	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
262	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
263	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
264	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
265	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
267	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Present
272	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
276	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
278	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
279	Absent	Absent	Present	Absent	Absent	Present	Absent	Present	Absent
280	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
281	Absent	Absent	Absent	Present	Absent	Present	Absent	Present	Absent
282	Absent	Absent	Present	Absent	Present	Absent	Present	Absent	Absent
283	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
291	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent

Burial	TMT-Pri/Sing	TMT-Pri/Mult	TMT-Second	TMT-Multiple	Single-Sec	Multiple Imt.	Furn-Unlined	Furn-Wood	Furn-Stone
295	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
30	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
300	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
301	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
302	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
303	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
304	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
307	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
309	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Present
311	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Present
312	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Present
320	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
322	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
324	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
325	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
333	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
38	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
41	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
42	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
44	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
45	Absent	Absent	Present	Absent	Present	Absent	Present	Absent	Absent
46	Absent	Absent	Present	Absent	Present	Absent	Present	Absent	Absent
47	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
49	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
52	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
53	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
55	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
57	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent

Burial	TMT-Pri/Sing	TMT-Pri/Mult	TMT-Second	TMT-Multiple	Single-Sec	Multiple Imt.	Furn-Unlined	Furn-Wood	Furn-Stone
59	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
6	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
63	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
64	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent
65	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
66	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
68	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
71	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
72	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
74	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
76	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
77	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
79	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
80	Absent	Absent	Present	Absent	Absent	Present	Present	Absent	Absent
83	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
85	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
88	Absent	Absent	Absent	Present	Absent	Present	Present	Absent	Absent
89	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
91	Absent	Absent	Present	Absent	Present	Absent	Present	Absent	Absent
92	Absent	Present	Absent	Absent	Absent	Present	Present	Absent	Absent

Burial	N-S	E-W	NE-SW	NW-SE	NE	SE	SW	NW	West	Unoriented	3-3.99	4-4.99	5-5.99
102	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
103	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
104	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
105	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
107	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
108	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
112	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
114	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
116	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
118	Absent	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
122	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
123	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
124	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
125	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
129	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
131	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
133	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
134	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
137A	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
146	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
147	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
148	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
150	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
151	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
152	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
155	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
171	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
18	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent

Burial	N-S	E-W	NE-SW	NW-SE	NE	SE	SW	NW	West	Unoriented	3-3.99	4-4.99	5-5.99
20	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
207	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
208	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
211	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
218	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
219	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
221	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
222	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
227	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Present
230	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
236	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
242	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
243	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
245	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
262	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
263	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
264	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent
265	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Absent
267	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
272	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
276	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
278	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
279	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
280	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
281	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
282	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
283	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
291	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Burial	N-S	E-W	NE-SW	NW-SE	NE	SE	SW	NW	West	Unoriented	3-3.99	4-4.99	5-5.99
295	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
30	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
300	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
301	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
302	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
303	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
304	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
307	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
309	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
311	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
312	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent
320	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
322	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
324	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
325	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
333	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
38	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
41	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
42	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present
44	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
45	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
46	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
47	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
49	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
52	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
53	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
55	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
57	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent

Burial	N-S	E-W	NE-SW	NW-SE	NE	SE	SW	NW	West	Unoriented	3-3.99	4-4.99	5-5.99
59	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
6	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
63	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
64	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
65	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
66	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
68	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present
71	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
72	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
74	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
76	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent
77	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
79	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
80	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
83	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
85	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
88	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
89	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
91	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
92	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent

Burial	6-6.99	7-7.99	8-8.99	9-9.99	10-10.99	11-11.99	12-12.99	Sex-Male	Sex-Female	Age-0/1.99	Age-2/29.9
102	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
103	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Absent
104	Absent	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent
105	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
107	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
108	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Present
112	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
114	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
116	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
118	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
122	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
123	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
124	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
125	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
129	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
131	Absent	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent
133	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
134	Absent	Absent	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Present
137A	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
146	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
147	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
148	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
150	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
151	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
152	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
155	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
171	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
18	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent

Burial	6-6.99	7-7.99	8-8.99	9-9.99	10-10.99	11-11.99	12-12.99	Sex-Male	Sex-Female	Age-0/1.99	Age-2/29.9
20	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
207	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
208	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
211	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
218	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
219	Absent	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent
221	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
222	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
227	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
230	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
236	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
242	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
243	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Present
245	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
262	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
263	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
264	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
265	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
267	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
272	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
276	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
278	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
279	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
280	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
281	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
282	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
283	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
291	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Burial	6-6.99	7-7.99	8-8.99	9-9.99	10-10.99	11-11.99	12-12.99	Sex-Male	Sex-Female	Age-0/1.99	Age-2/29.9
295	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
30	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
300	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
301	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
302	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
303	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present
304	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present
307	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
309	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
311	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
312	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
320	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
322	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
324	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent
325	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent
333	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
38	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
41	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
42	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
44	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
45	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
46	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
47	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
49	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
52	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent
53	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
55	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
57	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present

Burial	6-6.99	7-7.99	8-8.99	9-9.99	10-10.99	11-11.99	12-12.99	Sex-Male	Sex-Female	Age-0/1.99	Age-2/29.9
59	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
6	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
63	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
64	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
65	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
66	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Present
68	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
71	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
72	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
74	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
76	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Present
77	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
79	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
80	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
83	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
85	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
88	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
89	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Present
91	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present
92	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Burial	Age->30	Constant Resources	Stable Org.	Burial	Age->30	Constant Resources	Stable Org.
102	Present	Present	Present	20	Absent	Present	Present
103	Present	Present	Present	207	Absent	Present	Present
104	Present	Present	Present	208	Absent	Present	Present
105	Present	Present	Present	211	Absent	Present	Present
107	Absent	Present	Present	218	Absent	Present	Present
108	Absent	Present	Present	219	Present	Present	Present
112	Present	Present	Present	221	Present	Present	Present
114	Present	Present	Present	222	Present	Present	Present
116	Absent	Present	Present	227	Present	Present	Present
118	Absent	Present	Present	230	Absent	Present	Present
122	Absent	Present	Present	236	Absent	Present	Present
123	Present	Present	Present	242	Present	Present	Present
124	Absent	Present	Present	243	Absent	Present	Present
125	Absent	Present	Present	245	Absent	Present	Present
129	Present	Present	Present	262	Absent	Present	Present
131	Present	Present	Present	263	Absent	Present	Present
133	Absent	Present	Present	264	Absent	Present	Present
134	Absent	Present	Present	265	Absent	Present	Present
137A	Absent	Present	Present	267	Absent	Present	Present
146	Absent	Present	Present	272	Absent	Present	Present
147	Absent	Present	Present	276	Absent	Present	Present
148	Present	Present	Present	278	Absent	Present	Present
150	Absent	Present	Present	279	Absent	Present	Present
151	Absent	Present	Present	280	Absent	Present	Present
152	Absent	Present	Present	281	Absent	Present	Present
155	Absent	Present	Present	282	Absent	Present	Present
171	Absent	Present	Present	283	Absent	Present	Present
18	Present	Present	Present	291	Absent	Present	Present

Burial	Age->30	Constant Resources	Stable Org.	Burial	Age->30	Constant Resources	Stable Org.
295	Absent	Present	Present	59	Absent	Present	Present
30	Present	Present	Present	6	Present	Present	Present
300	Absent	Present	Present	63	Absent	Present	Present
301	Absent	Present	Present	64	Absent	Present	Present
302	Absent	Present	Present	65	Absent	Present	Present
303	Absent	Present	Present	66	Absent	Present	Present
304	Absent	Present	Present	68	Present	Present	Present
307	Absent	Present	Present	71	Absent	Present	Present
309	Absent	Present	Present	72	Absent	Present	Present
311	Absent	Present	Present	74	Absent	Present	Present
312	Absent	Present	Present	76	Absent	Present	Present
320	Absent	Present	Present	77	Absent	Present	Present
322	Absent	Present	Present	79	Absent	Present	Present
324	Present	Present	Present	80	Absent	Present	Present
325	Present	Present	Present	83	Present	Present	Present
333	Absent	Present	Present	85	Present	Present	Present
38	Present	Present	Present	88	Absent	Present	Present
41	Present	Present	Present	89	Absent	Present	Present
42	Absent	Present	Present	91	Absent	Present	Present
44	Absent	Present	Present	92	Absent	Present	Present
45	Present	Present	Present				
46	Absent	Present	Present				
47	Absent	Present	Present				
49	Absent	Present	Present				
52	Absent	Present	Present				
53	Absent	Present	Present				
55	Present	Present	Present				
57	Absent	Present	Present				

Vita

Hugh Bryson Matternes was born in Houston, Texas in 1960. He grew up in Winston-Salem, North Carolina. In 1978, he graduated from West Forsyth Senior High School and spent the next four years serving with the U.S. Army in the vicinity of Nuremberg, Germany. In 1982, Matternes entered the University of North Carolina-Greensboro, where in 1987 he was awarded a Bachelor of Arts Degree in Anthropology. In 1989 he enrolled in graduate school in the Department of Anthropology, University of Tennessee, officially receiving a Master of Arts degree in 1992. The Fall Semester of 1993 marked his return to the University of Tennessee in order to obtain a Ph.D. This degree was awarded in December 2000.