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Issues of Commingling Within the Gold Mine Site (16RI13) Collection: Adult Human Humeri and Tibiae

Kinsey Brett Stewart
University of Tennessee - Knoxville, kstewa18@utk.edu

To the Graduate Council:

I am submitting herewith a thesis written by Kinsey Brett Stewart entitled "Issues of Commingling Within the Gold Mine Site (16RI13) Collection: Adult Human Humeri and Tibiae." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Dawnie W. Steadman, Major Professor

We have read this thesis and recommend its acceptance:

David Anderson, Amy Z. Mundorff

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

Issues of Commingling
Within the Gold Mine Site (16RI13) Collection:
Adult Human Humeri and Tibiae

A Thesis Presented for the
Master of Arts
Degree
The University of Tennessee, Knoxville

Kinsey Brett Stewart
December 2013

DEDICATION

To the people of Gold Mine, long-parted, and the donors of the William M. Bass Skeletal Collection, on whose bones I learned the infinite curiosities of the human body. In death you have taught me much, and it is my hope that this work can pass those teachings on to others.

ACKNOWLEDGEMENTS

My thanks and eternal gratitude to my family for all of their assistance, patience, good humor, and love. To my thesis advisor, Dr. Dawnie Steadman, who introduced me to the Gold Mine Site Collection and provided the equipment and laboratory space used in this research. Without her guidance throughout the evolution of this thesis I might still have been wandering through territories unknown. To all of the department members who provided consultation and guidance, but particularly the members of my committee: Dr. Amy Mundorff, for her inspirational work in how to best process and catalog large assemblages of human remains, and Dr. Dave Anderson—who indulged the more decomposition-oriented aspects of my bioanthropological research interests as well as provided moral, cultural, and nutritional support—for his insights on prehistoric archaeology and cultural development in the American Southeast.

With special consideration to Dr. Brad Adams for his advice on applying many of the analytical methods used in this thesis, and to Dr. Chip McGimsey for his generous loan of the Gold Mine Site Collection. Without his invaluable and remarkable efforts in reconstructing the history of the Gold Mine, its excavation, and all associated documents and collections, this thesis would not have been possible.

ABSTRACT

Gold Mine (16RI13) is a Troyville ossuary mound site (circa CE 825) in northeastern Louisiana. Approximately 10-20% of the primary mound (Mound A) was excavated over the course of three field seasons (1978-1980), yielding a host of human skeletal remains. Extensively commingled secondary burials make up the majority of interments. The number of individuals represented within the collection (*N*) has been estimated at 150+ (McGimsey 2004:214), but attempts to quantitatively determine *N* have produced varied results. Formal analysis of the skeletal collection is complicated by the loss of provenience for many remains as well as additional post-excavation fragmentation and commingling.

Adult humeral and tibial material was selected for study and extensively documented, including observations on pathology and instances of animal modification, resulting in the production of the Gold Mine Site (16RI13) Adult Humerus and Tibia Photographic Catalog. In order to quantitatively determine *N*, visual pair-matching (VPM) was attempted for both humeri and tibiae; osteometric analysis could not be performed due to the lack of a comparable reference sample, but osteometric data were taken using a combination of the standard Forensic Database Measurements and supplementary measurements for fragmentary remains (Byrd and Adams 2003).

The humerus VPM sample (MNI=53) proved inadequate for visual pair-matching due to the high degree of intra- and interobserver error. The less fragmentary and more morphologically distinct tibia VPM sample (MNI=38; author's MLNI=65, *r*=48.48%, CI=50-88) produced more statistically-validated results. Pathologies were observed in over one third of all tibial elements, including multiple cases of anterior bowing (saber shin) possibly linked to treponemal infections. MNI and MLNI for the adult tibiae was lower than previously reported for adult femora (Lans 2011), suggesting differential treatment of the tibia at Gold Mine that restricted its representation within the recovered assemblage. Study of animal modification also yielded new insights into mortuary behaviors at Gold Mine; multiple cases of rodent gnawing consistent with gray squirrel gnawing patterns indicate that skeletal remains were left exposed to the elements for a minimum of 12-30 months prior to final interment within the mound.

PREFACE

Technical Note: On Terminology

All of the individual osteological items pulled from the Gold Mine Site Collection for use in this thesis—be they a solitary fragment or a whole, intact bone—are referred to as "elements". This is in accordance with the terminology used in previous research with the collection, whereby any number or other non-numeric identifier meant to distinguish one whole bone or fragmentary bone from another was designated as its "element number". In order to avoid confusion with the use of "element" to designate a specific bone within the human body as a generalized concept as opposed to a whole or fragmented piece of bone from a specific individual, groups of humeri, tibiae, crania, etc. are referred to either by their anatomical name or "skeletal elements", collectively.

In common usage "bone"—when not in reference to osteological tissue in general—tends to carry with it a presumption of uniqueness. The body is composed of multiple bones, and each of those bones may respectively fracture into pieces. To refer to each of those pieces on their own as bones as opposed to elements would therefore imply that each originated from a separate individual. In order to avoid this implied inaccuracy, the term "bone" as an identifier is reserved for those cases where it has been previously established that none of the other left or right humeral or tibial material being discussed could have originated from the same individual. By this criteria, all of the components of the various visual pair-matching samples—all of which share a common identifying feature—might be referred to as bones, while all of the components of the humeral and tibial assemblages in total—which do not always share those same features—may not.

These distinctions may seem superficial, but they allow for a more precise distinction between the total number of elements and the total number of distinct bones (and therefore, distinct individuals) represented within this thesis and its accompanying catalogs and data sets.

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CHAPTER I
INTRODUCTION AND GENERAL INFORMATION

Background

1.1.1 The Gold Mine Site (16RI13)

In northeastern Louisiana, in the southwestern corner of Richland Parish, on a thumb of terraced land stretching out into the lowlands surrounding Hewitt Lake sits a pair of low, roughly circular mounds (Figures 1.1 and 1.2). At roughly 30-50 cm tall today they are barely distinguishable from the rest of the farmland surrounding them (Figure 1.3). Twelve hundred years ago, however, these mounds were appreciably higher a conspicuous part of the landscape, drawing the attention of anyone traveling up and down the Big Creek channel where Hewitt Lake now sits.

This is the Gold Mine site (16RI13)—so named after the historic Gold Mine Plantation that currently stands on the land—a pair of ossuary mounds designated "A" and "B" constructed circa CE 825[1] (McGimsey 2004:77). Though Mound A apparently originally stood nearly 1.5 meters tall—a noticeably significant rise given its prominent position and the flat expanses surrounding it—its current height can be attributed to a millennia's worth of erosion and at least two major construction projects from the much more recent past. A long-since demolished tenant farmhouse once stood on Mound A, but the most significant destruction occurred when approximately three feet of soil was bulldozed from the top of the mound to be used as landfill elsewhere on the property. The specific date of the bulldozing is unknown[2], but work was only halted when human remains were exposed and the mound was finally recognized as a human structure as opposed to a natural formation.

By the time of the site's formal discovery by avocational archaeologists[3] during an opportunistic surface survey in the spring of 1978, the top of the mound was home to a large cattle trough. Though the landowners report replacing much of the earth that had originally capped the mound, pulverized fragments of bone were observable across the surface of the trampled soil, and shovel tests uncovered intact human remains immediately below the surface. It is unknown whether the pulverized fragments observed on the surface were part of the

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[1] Mound B's status as an ossuary mound, however, is less certain, as is the date of its construction (see Chapter II).

[2] The landowners have since contested this history, claiming that the mound was never bulldozed but rather plowed using mules, but careful stratigraphic analysis supports the earlier report of bulldozing (McGimsey 2004; Belmont 1980a, 1984).

[3] All of the excavation work at Gold Mine was done by a mix of avocational and professional archaeologists, the latter of whom are identified in this thesis alongside their respective institutional affiliations. For a more detailed history of the site's excavation, see Chapter II.

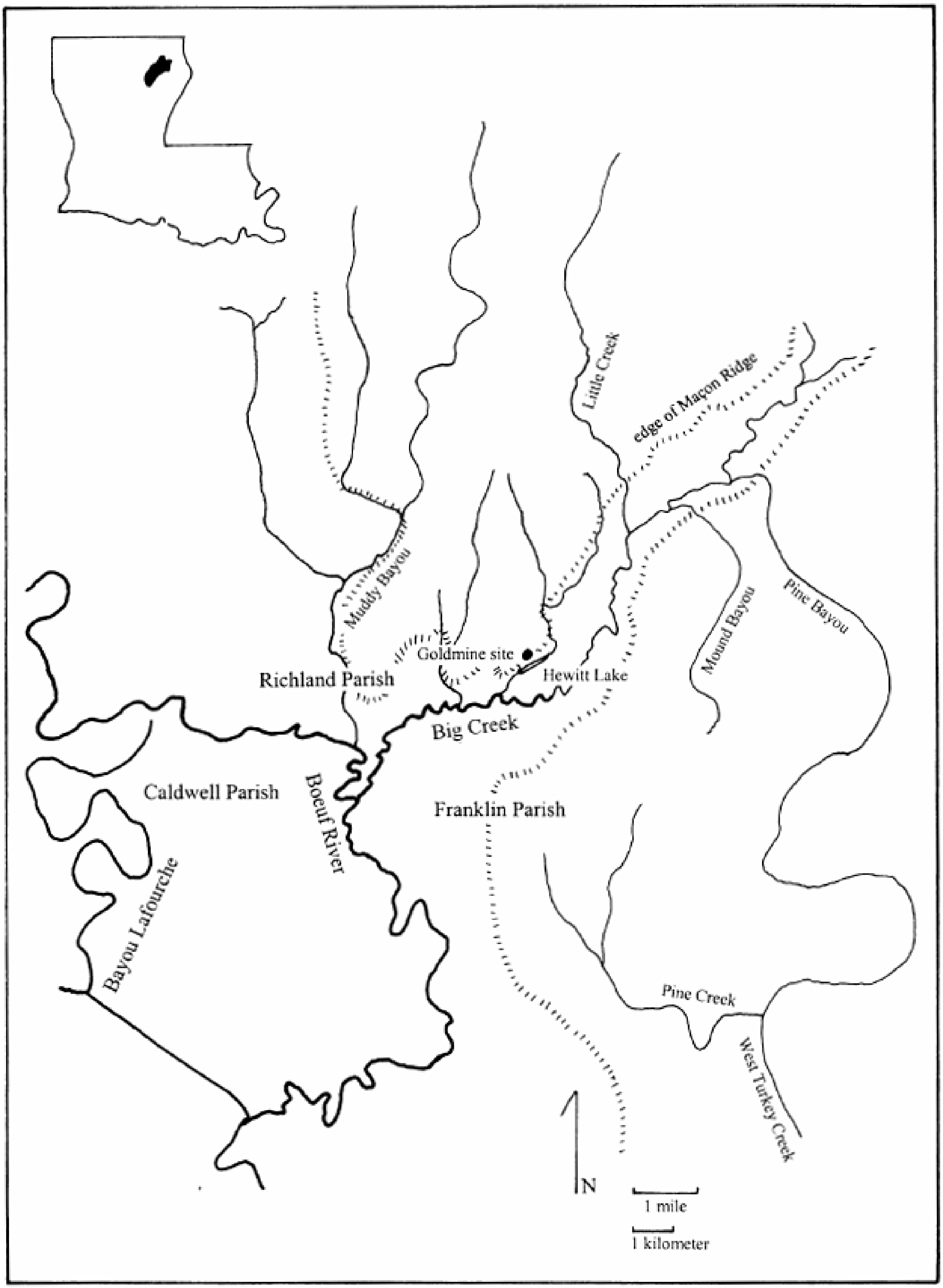

Figure 1.1. Location of the Gold Mine site in Richland Parish, Louisiana (McGimsey 2004:21).

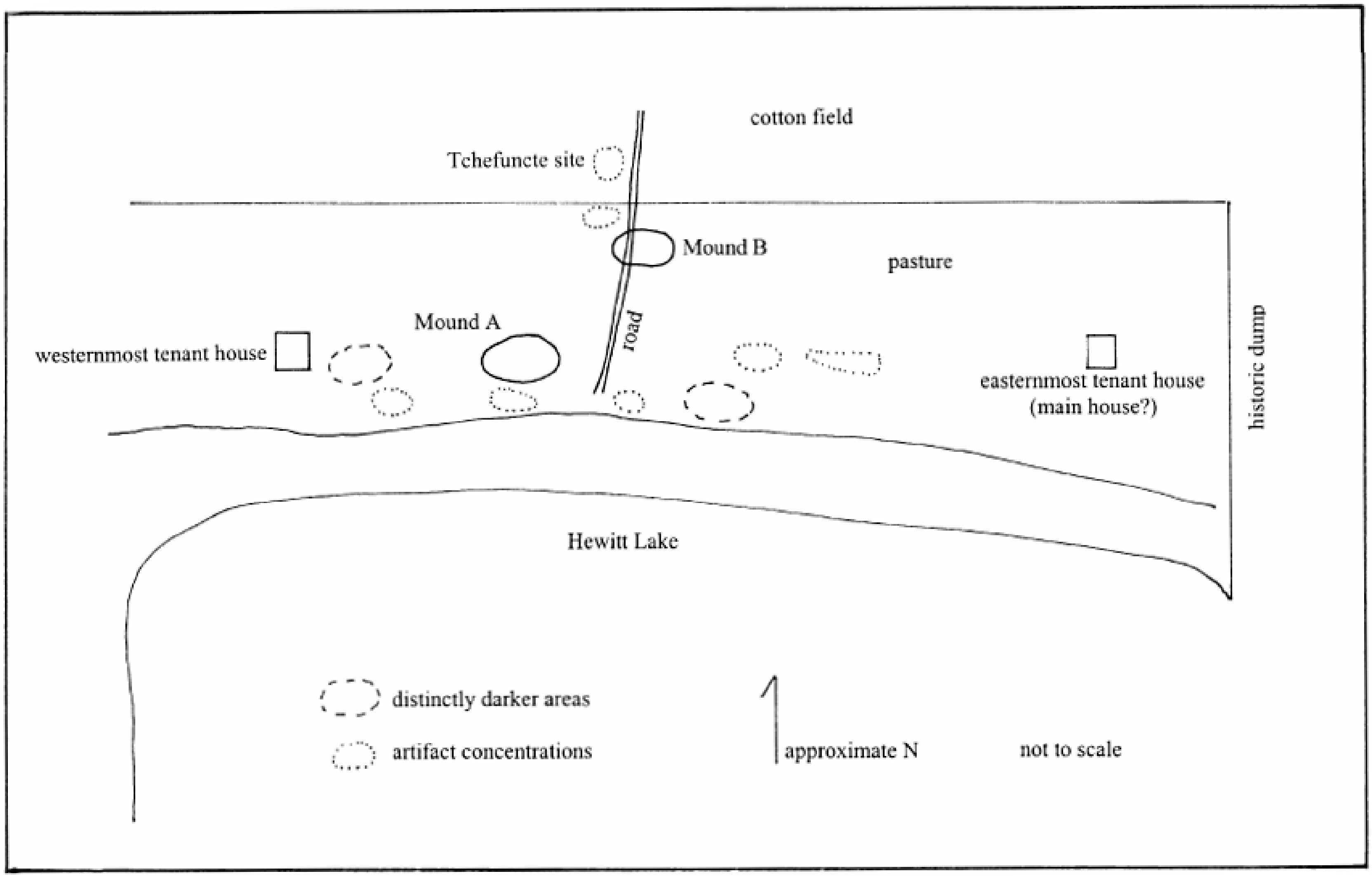

Figure 1.2. Sketch map of the Gold Mine site, author and date unknown (McGimsey 2004:25).

Figure 1.3. View of Mound A from the east during 1980 excavations, showing its position on the terrace edge (McGimsey 2004:26, photographer unknown).

scatter mixed in with the original moundfill matrix or whether they represent more formal burials churned up by modern activities.

Excavation of the mounds began in the summer of 1978 and extended for three field seasons, during which over one hundred field-identified burials—the majority holding the remains of several individuals—were unearthed. Digging was almost exclusively restricted to Mound A—of which only an estimated 10-20% was excavated—while the smaller Mound B located 200-300 m[4] to the north remains virtually unexplored with the exception of a single day's field work that yielded no human remains. Commingling and fragmentation was high *in situ* but taphonomic preservation was otherwise very good; osteological features, when present, are only minimally obscured by taphonomic damage, and multiple completely intact bones were recovered from among the heaps of fragmentary elements.

Ceramic material recovered from Mound A was used to date the mound to the Troyville culture of the Baytown period in the Lower Mississippi Valley (CE

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[4] This distance has been calculated by McGimsey based on photographs of the site. More precise measurements are not available, and the site has yet to be formally surveyed.

300-600) (Belmont 1984:78), but later radiometric dating methods placed the mounds' construction somewhat later, with a calibrated median age of CE 825 (CE 775-875)[5] (McGimsey 2004:77). This discrepancy is not unique to Gold Mine but observed throughout ceramic assemblages linked to the early and latter portions of the Baytown period, and may be indicative of a problem in the current cultural chronologies or an incongruity between the ceramic suites and the internal divisions of the period (Cusick et al. 1995; Lee 2010; Lee and Yakubik 2003; McGimsey 2004; Saunders and Jones 2004; cf. Bitgood 1989). The mortuary patterns and burial types observed within the mound are consistent with other Troyville-era ossuary sites, and as the best-documented Baytown mortuary structure in northeast Louisiana since its excavation it has helped supplement the largely destroyed Troyville itself (see Chapter II) as a "type site" for both the Troyville culture and the Baytown period as a whole (Jeter and Williams 1989b; Kidder 2002; McGimsey 2004; Walker 1936). Whether a cultural relationship can be tied between the people of Gold Mine and any of the five modern Native American tribes residing within Louisiana—the Sovereign Nation of the Chitimacha, the Sovereign Nation of the Coushatta Tribe of Louisiana, the Jenna Band of Choctaw Indians, the Tunica-Biloxi Indian Tribe of Louisiana, and the United Houma Nation[6]—or other tribes outside of the state is currently unknown.

1.1.2 The Gold Mine Site Collection

Gold Mine has yielded far more human remains than any other Troyville site to date[7] (most of which predate Gold Mine's discovery by nearly four decades). Yet study of the skeletal material recovered from the site has been complicated by: 1) inconsistencies in the excavation methodology and recording procedures from field season to field season; 2) the long delay in the production of the final formal site report; 3) the loss of excavation and curation records from the highly productive 1978 and 1979 field seasons; and 4) additional loss, fragmentation, and commingling of the collection as it was transferred from university to university for use in various research projects. Similar complications are also common within the ceramics and lithics collections, and significant portions of the recovered artifacts from the 1978 field season in particular have subsequently been lost (McGimsey 2004:32).

[5] This date is based on the results of five radiometric assays taken from four features within Mound A and one immature dog tibia , all of which consistently placed the period of the mound's construction between 1175-1065 BP (CE 775-885); for the ease of reporting, the midpoint of the 2-sigma overlap interval (CE 825) is cited as the mound's construction date, "give or take 50 years" (McGimsey 2004:77).

[6] At the time of this writing all but the United Houma Nation are federally recognized, though the United Houma Nation is recognized at the state level of government.

[7] The Troyville site (16CT7) itself, the type cite for the culture, was a much larger complex of mounds, but by the time of the WPA salvage excavation headed by Windlow Walker (1936) the site had suffered "catastrophic" damaged by road construction, urbanization, and looting (Lee 2010:143). While few human burials have been recovered from the site (see Chapter II, *Table 2.1*), it is unknown how many might have originally been interred within the mounds.

In its current state the osteological component of the Gold Mine Site Collection consists of several thousand whole bones and bone fragments stored in 93 numbered boxes (individual boxes henceforth referred to as GM#). Each box contains several plastic bags (with the exclusion of some intact long bones, which are either stored in canvas bags or currently tagged but otherwise left loose within the box) in which elements are further sorted by burial and skeletal element. During the author's initial inspection of the collection, however, it was determined that boxes commonly contained misidentified elements, elements with no recorded provenience, and inconsistencies between the counts and descriptions listed on the surviving field documentation as well as more recent attempts to tabulate the collection's contents.

Since Gold Mine's excavation there have been multiple attempts to sort and catalog the site's associated collections for varying research purposes, with all but the most recent attempts (Guthrie n.d.; Harmon 2004; McGimsey 2004; Tatchell 2010) going largely undocumented. As a result, the skeletal material has been further damaged and commingled, and it is unknown whether the current recorded burial context of the majority of elements accurately reflects their true provenience. The most successful and thorough attempt to organize the remaining paper records, photographs, artifacts, and human and faunal remains was the site report produced by Louisiana State Archaeologist Charles "Chip" McGimsey in 2004. Drawing heavily on an unpublished site report produced by one of the excavators of the 1980 field season (Belmont 1980b), surviving excavation notes and hand-drawn maps, published research using the Gold Mine materials, and the memories of various excavators, McGimsey was able to reconstruct an overview of the site and the technical aspects of its excavation.

All site photos and maps used in this thesis are drawn from to McGimsey's work, and though extremely helpful in establishing a spatial context for the recovered remains they must be recognized as imperfect and incomplete. While McGimsey was able to deduce the likely locations and depths of many of the burials and plot them accordingly (see Appendix A), some of the errors and inconstancies in the collection's records could not be resolved. Indeed, while McGimsey provides the only complete listing of all recorded burials and their contents, in many cases he was forced to designate burials using burial numbers that differed from those assigned by excavators in the field (a process that was frequently arbitrary in itself due to the lack of observable pit outlines). Finally, because McGimsey's emphasis in reporting on the site was archaeological as opposed to bioanthropological, a thorough inventory of all of the human osteological material was not produced[8]. Limited by the detail available within the original records, McGimsey was often restricted to the reporting of

[8] Inventories are available for both the 1978/1979 and 1980 artifact collections(McGimsey 2004:Appendix C and Appendix D), though by nature of the better documentation associated with that excavation season the 1980 inventory provides a more extensive list of provenience data, including the mound stage and stratum context for each artifact.

“skeletons” and “individuals” broadly characterized by age with occasional exceptions for notable pathological elements as opposed to a complete listing of all of the number, type, and characteristics of all of the elements present. As a result, while McGimsey’s report is crucial to understanding Gold Mine’s geocultural setting and excavation, much work is still needed in order to complete a thorough inventory of the site’s human osteological material, a long and multi-faceted process that is part of the emphasis of this and other current work with the Gold Mine Site Collection.

Research Focus

One of the most prevalent problems within the Gold Mine Site Collection is the frequent difficulty in differentiating between primary and secondary commingling. Primary commingling is commingling resulting from the actions of the builders of a site and other prehistoric agents, more recent historical activity, animal scavenging, and other taphonomic processes. Secondary commingling is commingling resulting from the actions of excavators, curators, and researchers. In the context of Gold Mine, this has made it difficult to provide a full accounting of all of its associated skeletal material and place each element within its proper burial context. It has also made it difficult to select and apply appropriate quantitative analytical methods to the collection’s study.

Without reliable records on the original state of the collection against which its current state can be compared, the effects of secondary commingling cannot be readily distinguished from the primary commingling of most interest to the study of mortuary practices of Gold Mine as a solitary site as well as a reflection of Troyville culture, which is distinctly characterized by the prevalence of mass secondary burials among its recognized ossuary sites (Belmont 1984: 93-94). It may be possible, however, to identify where secondary commingling has occurred by drawing on multiple lines of evidence from within the collection itself.

1.2.1 Research Aim

The aim of this thesis is to begin to address the complicated issues of commingling found within the Gold Mine Site Collection, beginning with a thorough documentation of the physical condition and current recorded burial context of the collection’s adult humeral and tibial remains. This documentation process not only establishes secondary lines of evidence that may be of use in establishing original provenience for individual elements but also immediately benefits the curation of the collection by inventorying and tagging all elements pulled for study. Finally, it also allows for the effects of fragmentation and commingling to be accounted for in the course of designing and implementing quantitative research with the Gold Mine skeletal material, as illustrated by this thesis’s attempt to determine the number of adult individuals represented within the humeral and tibial material.

1.2.2 Research Objectives

The primary objectives of this thesis are:

1) *Produce* a photographic catalog and corresponding database representing all of the skeletal material used within this thesis to be available for use in future;
2) *Accurately determine* the total number of adult individuals within the Gold Mine Site Collection (*N*) as represented by the adult humeri and tibiae recovered during the three years of excavation;
3) *Identify* the likely source of any complicating factors towards the determination of *N*, their impact on the reliability of the results, and how they might be resolved;
4) *Contextualize*, wherever possible, all results in terms of their impact on the understanding of the Gold Mine site, the lives and deaths of the people interred within it, the process of reconstructing each element's true provenience, and the utility of the collection for further bioanthropological research.

Value of Research

Troyville is among the least understood cultural periods in Louisiana history. Gold Mine is not only the largest collection of ossuary remains from any Troyville site but one of the largest human skeletal populations from the Lower Mississippi Valley region as a whole (McGimsey 2004:211, citing discussions in Rose and Harmon 1999). In the absence of significant ceramic and lithic artifacts, a nuanced understanding of burial practices and the makeup of the actual remains themselves becomes all the more important to our understanding of the mortuary practices—which includes the pre-burial treatment of the body—and lifeways of the Gold Mine people.

Despite the range of research that has been performed using Gold Mine (see Chapters II and III), the answers to many of the fundamental questions surrounding the site—how many people Mound A contains, whether those people represent a single Troyville community or many, how their mortuary practices intersect with the mound's construction, their overall health, and whether the placement and grouping of individual remains within the mound reflects a yet-unrecognized social ordering—remain unclear. Much of the early work with Gold Mine predates significant methodological advances in statistically-verified quantifiable analysis of commingled and fragmentary assemblages. Advances have also since been made in the field of understanding human decomposition, the role it plays in shaping mortuary practices, and how post-mortem interval and treatment of the body after death can be inferred from remains.

The brunt of the most recent work with the Gold Mine Site Collection has centered on the question of determining *N* (see Chapter III). In the case of a skeletal assemblage as large and complex as Gold Mine, different approaches

by different researchers are likely to produce a range of possible *N*s. It is therefore in desirable to expand upon that previous research and explore as many avenues as possible for determining *N*. Given the prevalence of secondary burials within the mound and the high degree of comingling and fragmentation, comparing the Minimum Number of Individuals (MNI) and Most Likely Number of Individuals (MLNI) calculated from multiple skeletal elements provides a more accurate and contextualized understanding of *N*. This approach also has the potential to highlight instances of differential treatment of skeletal elements as reflected both by differences in the number of those elements recovered and by their resulting *N*s, something otherwise easily overlooked in highly commingled assemblages. For these reasons the adult humeri and tibiae were selected for study; while both skeletal elements have previously been the subject of osteometrics-based demographic analysis (Tatchell 2010), neither has been the basis for a more extensive attempt to determine *N*.

Lastly, all of the data gathered over the course of this thesis has been made available for future research in the form of the Gold Mine Site (16RI13) Adult Humerus and Tibia Photographic Catalog, which includes copies of all of the inventories and osteometric measurements reprinted here in Appendices C-H. This thesis has been privileged in its access to the Gold Mine Site Collection during its temporary loan to the University of Tennessee, Knoxville, but as the collection is ultimately slated to return to the curation of Chip McGimsey in his capacity as Louisiana State Archaeologist, steps were taken to ensure that this research could continue well into the future. Data collection included the observance of several parameters (namely related to pathology and animal modification) to more specific research questions outside of those addressed within the objectives of this thesis. Though extensive osteometric analysis ultimately could not be performed due to the lack of an appropriate model against which the Gold Mine sample could be tested all of the relevant measurements were taken and reported. Once an appropriate comparative reference sample has been identified and thoroughly measured, including each of the supplementary measurements utilized by this thesis to compensate for the sample's fragmentary state, then it may prove possible to further refine the results of this thesis using the reported humeral and tibial osteometric data.

This thesis serves as an example of how large assemblages of remains or artifacts might be documented, managed, and made available to researchers who otherwise could not physically access them for study. The methods utilized here have been applied to Gold Mine *post facto*—expanding upon the available records, supplementing areas where data has been lost, and opening new avenues for research—but can easily be incorporated into the initial processing of all material recovered from a multitude of archaeological and bioanthropological contexts. Gold Mine is valuable not only as an avenue for understanding Troyville culture, but also as an opportunity to observe and understand the impact researchers themselves can have upon a collection.

Research Approach

In the pages that follow, Chapter II sets the framework for understanding the Gold Mine site by defining the archaeological characteristics of Troyville culture and outlining the geographical and historical context of the Baytown period. It also gives a brief history of the site's excavation and the curation and research history of the Gold Mine Site Collection. Previous research efforts focused on reconstructing the life and death of the Gold Mine people through their health, diet, and mortuary practices are also reviewed.

Chapter III explores how bioanthropologists attempt to quantifiably determine the number of individuals (*N*) represented by a skeletal assemblage, beginning with the minimum number of individuals (MNI) and on through the most likely number of individuals (MLNI). Other means of determining *N* are also discussed, including the process of osteometric sorting, Byrd and Adams's (2003) method of supplementing standard measurements in cases of commingled and fragmentary assemblages, spatial analysis, algorithmic approaches, and recent work on quantifying the size variation between homologous bones from single individuals. Finally, the results of previous attempts to determine the *N* of the Gold Mine Site Collection using a variety of quantitative and non-rigorous methods are summarized.

Chapter IV details the reasoning behind the selection of the adult humerus and tibia for focused study. The specific sampling and data collection criteria used in this thesis are detailed in addition to the process used to produce the Gold Mine Site (16RI13) Adult Humerus and Tibia Photographic Catalog and its accompanying inventories and data sets. The specific quantification methods selected for the determination of *N*—including the rationale behind visual pair-matching and the problems associated with its use in a fragmentary assemblage—are detailed along with the specific measurements taken for use in future osteometric research.

Chapter V gives a full summary of the contents of the Gold Mine Site (16RI13) Adult Humerus and Tibia Photographic Catalog along with a brief overview of the general state of the observed portions of the collection. The visual pair-matching results of the author and the second observer are detailed and compared. Due to frequent instances of intra- and interobserver conflict, particularly within the humeral sample, additional selection criteria were established in order to identify the maximum number of plausible pairs. The results of this theoretical "best case" scenario are compared against the results using a stricter definition of identified pairs in keeping with more rigorous bioanthropological methodology. *N* is given based on MNI and MLNI, with recovery probabilities (*r*) and 95% confidence intervals (CI) calculated for both the results of this thesis and those of previous visual pair-matching attempts using the collection.

Chapter VI expands upon the empirical results outlined in Chapter V by detailing the nature of the observed pathologies and instances of animal modification (i.e. rodent gnawing) within the sample and the impact of each upon

the state of the collection, the reliability of quantification methods, and their respective implications for the reconstruction of health and mortuary practices at Gold Mine. Possible contributing factors for the complications faced during visual pair-matching are explored, as is their impact on future research.

The thesis concludes with a summary of all empirical and interpretive findings, a review of the factors within the collection that complicate the determination of *N*, and recommendations for future research in order to further refine the calculated *N* and expand upon the issues of pathology and animal modification touched on briefly here. Chapter VII also provides details on how to access the Gold Mine Site (16RI13) Adult Humerus and Tibia Photographic Catalog and its accompanying inventories and data sets for use in further research as well as offers observations and insights on the use, handling, and documentation of both the Gold Mine Site Collection and other large skeletal and artifact assemblages.

CHAPTER II
GOLD MINE SITE AND REGIONAL HISTORY

Introduction

"…[T]here are known knowns; there are things we know we know. […T]here are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns—the ones we don't know we don't know."

-Donald Rumsfeld, Former United States Secretary of Defense
February 12, 2002

Because of the incomplete nature of all surviving records from the excavation of Gold Mine, the results many of the quantitative analyses performed with the recovered human skeletal assemblage are ultimately in question. With the exception of the inventories for the humeral and tibial material produced in this thesis, a full accounting of the exact contents of the Gold Mine Site Collection—their condition, locations, recorded proveniences, and respective relationships with other elements—is not currently available in a format of use to researchers. Without a thoroughly documented foundation it is difficult to incorporate the collection's resources into analyses of the site and Troyville culture collectively. This thesis demonstrates how many of the commingling-specific issues within an assemblage like Gold Mine can be overcome, focusing on the process of re-establishing documentation, identifying new lines of evidence, and placing quantitative analyses within their proper context.

In order to produce a data set of maximum utility not only to the specific interests of the author, but also the broader questions concerning Gold Mine as a loci of prehistoric mortuary behavior, it is important to thoroughly review all of the past work done on the site. One of the major limitations of the site and its varying collections is that while there is supporting evidence for some of the lost data—photos of burials for which no further notes exist, associations on paper that cannot be located in the collections' jumbled state—the true number and extent of the collection's gaps is difficult to determine. As McGimsey, the archaeologist who organized and inventoried the site's records and artifact assemblages over two decades after Gold Mine's excavation, summarized the collection's condition, "[w]ith only a few exceptions, we do not know what we do not know" (McGimsey 2004:22). The situation is further complicated by the fact that the decline in the integrity of the collection was not a singular event but rather a process spread out over time. Data once utilized by past researchers may no longer be available for reexamination in light of advancing anthropological methodologies or varying academic perspectives. For example, at least one specific tibia described in detail by McGimsey could not be located in this thesis's survey of the collection (see Chapter VI), and other fragmentary

humeral diaphyses bore pencil markings at midshaft, a point which cannot be conclusively determined without taking the length of the entire bone. In these circumstances the modern researcher is forced to rely on reports and interpretations, where available, that cannot easily be checked against the collection in its current state.

Faced with the task of reconstructing a conclusive *post facto* site report for Gold Mine, McGimsey relied heavily on five types of surviving primary sources: "1) a comprehensive [but undated and lacking indicators of depth and other stratigraphic detail] plan view map (referred to as the 1978-plan map), 2) a few square level forms, 3) some sketch maps made by one of the excavators (referred to as [the] Helfert sketch), 4) information obtained during interviews with the original excavators and 5) a limited number of photographs" (2004:78). By tracing the site's history[9] and comparing the information compiled from each of these sources, McGimsey was able to establish the agreements and incongruities within their narratives. This review adopts a similar approach. Fortunately, the Gold Mine Site Collection has been the source of much research since its excavation. By detailing all of the relevant prior research performed using the Gold Mine human osteological collection—the questions facing them, the methodologies and data sets utilized, how they fit their results into the interpretation of the site as a whole, and the questions left unanswered—it is possible to determine, at least in a broad sense, what is known and what is not known and make informed decisions on the types of analysis useful for further research.

This chapter begins by defining the archaeological characteristics of Troyville culture and placing both the site and the Baytown period at large within their broader geographical and historical contexts. It then gives a chronological history of research at the Gold Mine site and its accompanying collections, focusing on the many hands and transfers involved in the recovery, curation, and use of the human skeletal material.

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[9] McGimsey's efforts to locate the collection's missing artifacts and records—while ultimately uncovering only some of the missing material—were impressively extensive, including: "1) contacting the Peabody Museum at Harvard University to determine if any materials had been left there from the 1980s when John Belmont was working on the collection; 2) speaking with John Belmont about the same and many other related issues; 3) asking Joe Saunders, Regional Archaeologist at the University of Louisiana at Monroe (formerly Northeastern Louisiana University) to search the storage areas there for any materials from this site; 4) contacting Glen Greene and Lorraine Heartfield (who provided technical assistance during the first year of excavation […]; 5) with Lorraine Heartfield's assistance, tracking down Tom Talley who wrote a thesis on the 1978 materials while at Northeastern Louisiana; 6) asking Jerry Rose to search for the missing materials at the University of Arkansas; 7) contacting Murray Marks at the University of Tennessee to see if any of the missing materials were included with the human remains [on loan at the time to the university]; and 8) interviewing three of the original excavators (Dwain Kirkham, Reca Jones and Nina Helfert)" (McGimsey 2004:22).

Time Frame	Period	Sub-periods		Cultures	
CE 1700	Historic	American Colonial		Multicultural & Multiethnic	
CE 1500	Mississippi	Late Mississippi - Protohistoric		Missippian	Caddo
CE 1200		Middle Mississippi		Plaquemine	
CE 1000	Woodland	Late Woodland	Coles Creek	Coles Creek	
CE 700			Baytown	Troyville	
CE 400		Middle Woodland	Marksville	Marksville	Fourche Maine
CE 1		Early Woodland	Tchula	Tchefuncte	
BCE 800					

Figure 2.1. Selected cultural chronology for Louisiana (adapted from Rees 2010:12).

Baytown Period and Troyville Culture

The Baytown period is one of two major cultural periods—along with Coles Creek—that make up the Late Woodland period of the Lower Mississippi Valley (Figure 2.1) (Lee 2010). Named after the multi-mound Baytown site in east-central Arkansas, Baytown culture in Louisiana stretched from the Yazoo Basin northward; Baytown period sites in the southern and western portions of the state—particularly those in the Lower Red River region and Boeuf-Tensas River basins—are generally associated with Troyville culture, while those sites along the Mississippi Delta and gulf coastal regions are described as Coastal Troyville-Coles Creek Culture (Gibson 1984; cf. Jeter and Williams 1989a:147-152, 1989b; Kidder 2004:552-554; Lee 2010). Williams went so far as to paint the whole of the Late Woodland—Baytown included—as little more than the “good gray culture” of the Lower Mississippi Valley: relatively unremarkable, relatively indistinguishable, and of relatively little importance compared against the long history of sociocultural development of the pre-Columbian North American southeast (1963:297).

Baytown’s value as a period characterized not by passive transition from one stage to another but by growth and change has since been recognized, its

Table 2.1. Baytown [Troyville] Period Cemeteries in Northeast Louisiana.

Site	***Drainage basin***	***Number of individuals***	***Reference***
Gold Mine (16RI13)	Boeuf River	150+*	McGimsey 2004
Greenhouse (16AV2)	Red River	106	Ford 1951
Lac St. Agnes (16AV26)	Red River	5	Toth 1979
Troyville (16CT7)	Ouachita River	12	Walker 1936
Indian Bayou (16MA9)	Tensas River	44	Moore 1913
Mt. Nebo (16MA18)	Tensas River	40	Giardino 1984
Old Creek (16LA102)	Ouchita River	41	Gibson 1984
Reproduced from McGimsey 2004:214. *McGimsey's estimate.			

cultural, socioeconomic, and political advances providing the strong foundations of the subsequent Coles Creek societies (Belmont 1984; Bitgood 1989; Cusik et al. 1995; Jeter and Williams 1989a; Kidder 1992, 2002; Kidder and Wells 1994; Lee 2010; Ryan et al. 2004; Roe and Schilling 2010). Like the construction techniques of the earthen mounds that had long been used as sites for public ceremonies, civil events, and the communal interment of the dead (Gibson 1996:54-60; Lee 2010), Baytown period societies carried on the old traditions while creating their own unique cultures. Given the size of many of their respective recovered skeletal assemblages (Table 2.1), Baytown sites have proven a rich if incompletely-understood opportunity to study the impact of those continued traditions and new lifeways upon the bodies of the local peoples comprising this culture. As with many contexts where the artifact assemblages are either scarce or unclear, the morphology, number, placement, and associated demographics of the bones themselves provide many bioanthropological avenues of research and understanding.

Current theory holds sociopolitical structure within the Baytown period to be organized along tribal or local lines, with “leadership positions […] achieved by individuals rather than ascribed or inherited, and power […] only temporarily vested in these individuals” (Lee 2010:137; Morse 1977; Anderson 2002). The construction of mounds and mound stages—a process that may have been much shorter than previously hypothesized, measurable in months or even weeks as opposed to years (Muller 1997:271-275)—was likely “characterized by some form of ideological influence and ritual engagement of local societies and the surrounding population, rather than economic control” (Lee 2010:137; see also Anderson 2012; Cobb and Nassaney 2002:531; Knight 1986; Sherwood and Kidder 2011). The majority of the population likely lived in small and well-dispersed settlements, though there are few thoroughly investigated non-mound Baytown sites from Louisiana against which this interpretation can be checked (Jeter and Williams 1989:147-156; Kidder 2002:85; Lee 2010). To date the known ossuary sites from the period are also well-spaced, and a variety of

mortuary practices—including immediate burial following death, placement within a charnel structure, secondary interments, bundle burials, and cremation—are represented both among the whole Baytown period collective and within the boundaries of a single site or mound (Belmont 1984:85-86; Kidder 1992:152, 1993:18). There is, however, a great deal of variability among the site plans of all of the known Baytown sites (Table 2.1) with the apparent exception of each site's close geographical relationship to individual river drainages and some shared characteristics between sites of close proximity (i.e. Greenhouse and Fredericks, two sites with similar occupation dates and common ceramic assemblages, both located in the Lower Red River Valley and both featuring midden ridges bearing mounds) (Lee 2010:186).

Troyville culture is named after Troyville (16CT7), the largest mound site of the Baytown period in the southern Lower Mississippi Valley and the type site for the culture (Lee 2010; Belmont 1984; Kidder 2002, 2004; Walker 1936). Framed in time by the late Marksville (Issaquena) culture and the Coles Creek culture (see Figure 2.1) and bounded spatially by the Deasonville, Bayland, Coahoma, and other northern Baytown cultures (Belmont 1984), Troyville was initially considered a cultural-historical construct: not as a culture, but as a period. Ford (1951:13; Ford and Willey 1940:Figure 2, 1941:344-346) consistently classified Troyville as such—his Lower Red River chronology inserted it between the Marksville and Coles Creek periods— but Belmont's later review of the "Troyville Concept" and the Gold Mine site's stratigraphy, artifacts, and mortuary practices caused him to "somewhat reluctantly propose the overworked term *culture* for this unit" (Belmont 1984:75, emphasis original). "A *culture* in this sense," Belmont continues, "may be defined as a *set of phases, contiguous in space and time, sharing substantial similarities in artifact content, settlement pattern and adaptational systems, and differing in the same criteria from surrounding phases or cultures*. Troyville is not a period and not a phase, but may plausibly be considered a *culture* in this sense" (1984:75, emphasis original).

As defined by Belmont (1984:93-94), Troyville culture (as exemplified by Gold Mine) is distinctively characterized by:

1) platform mounds, primarily mortuary in function, built in stages as an apron on a pre-existing slope and lacking a central house structure;
2) mass burials, primarily secondary but including some primary extended burials and canine burials, in large pits into mound summits;
3) bathtub-shaped fire pits implicative of intercommunity feasting;
4) paucity of grave goods and apparently egalitarian social structures;
5) subsistence strategies centered on intensive collection of riverine resources, later diluted by increasing agricultural dependence;
6) arrow points in lithics and ceramic complexes that add red slipping, painting, and cord marking to the long-term Lower Valley tradition of incised decoration;

Figure 2.2. View of east-northeast of 1978 excavations in 1978-4S2E and 4S2E; Mike Helfert on left, Dwain Kirkham second from left, other participants unidentified (McGimsey 2004:33, photographer unknown).

7) interaction with early Weeden Island as reflected in decorated ceramics.

Gold Mine Site Excavation and Collection Curation History

Gold Mine was formally recognized as an archaeological site by Dwain Kirkham and Woodrow “Butch” Duke in February of 1978 during an opportunistic surface survey. Excavation of the site began in March of that same year and continued on through the remainder of the 1978 field season (Figure 2.2). The excavation, which consisted of 14 5x5 ft units (see Appendix A, Figure A.1) excavated to varying depths, was undertaken by Dwain Kirkham, Reca Jones, Nina Helfert, Woodrow Duke, and other volunteers, with technical assistance and consultation provided by Glen Greene of Northeastern Louisiana University (now the University of Louisiana at Monroe, ULM) as well as Lorrain Heartfield and Dennis Price of the private archaeological firm Heartfield, Price, and Green, Inc. (McGimsey 2004:27). Sixty percent of the human remains recovered over the whole of the three-year project were unearthed during that first summer. At least

90 cranial numbers were assigned in the field (Talley 1978), and two human ceramic figurines—two of the exceedingly few recognizable grave goods recovered from any of the burials—were also found during that first field season (McGimsey 2004:33).

Primary field documentation from this season is scarce. A field catalog recording all identified burials and assigned cranial numbers (for which there were some repeats) was apparently maintained but has since been lost, along with all of the field maps (McGimsey 2004:32). Human remains were exposed completely before being removed for bagging to await cleaning and labeling, and when possible remains identified in the field as originating from the same individual were bagged together, a process made more difficult by the complexity of the mass burials and the lack of a dedicated osteologist on-site. Stratigraphic information for this season is poor to non-existent, and the depth to which the excavation units were taken is unknown. At the end of the 1978 field season all of the recovered material was loaned by the principal excavators to Glen Greene at Northeastern Louisiana University. A master's thesis was produced soon after detailing excavation methods and a preliminary report on the number and general descriptive condition of the people represented by the excavated remains (Talley 1978). Talley's thesis also gives the locations for many of the 90 field-identified crania, though per McGimsey's (2004:78-104, 33) later analysis—which lists 80 individuals and 35 burials from this field season—these positions contradict other reports. Even in this early stage, the provenience information linking many individual crania to post-cranial elements had apparently already been lost (McGimsey 2004:33; Rose 1981:5).

In May of 1979 the 1978 skeletal material was transferred to the University of Arkansas at Fayetteville, where it was joined later in the summer by all of the skeletal material from the 1979 field season. Dwain Kirkham, Reca Jones, and Nina Helfert again served as the principal excavators of that season along with many volunteers, and the project was partially supervised by physical anthropology graduate student Eugenia (Jean) Kennedy (née Galatzan) under the direction of Jerry Rose, both of the University of Arkansas at Fayetteville (McGimsey 2004:27). Excavations were conducted on weekends, continuing in some of the 1978 units, with six new 5x5 ft units opened (see Appendix A, Figure A.2). Mound B—located in the northwest portion of the adjacent pasture, 200-300 m north of Mound A— was briefly explored along with another landscape feature thought to be a possible mound. Excavation consisted of the removal of sod from two swaths across Mound B using a tractor and pan scraper (i.e., "dirt buggy" cuts, see Appendix A, Figure A.5), but no osteological remains were recovered (McGimsey 2004:34).[10]

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[10] Some remains were reportedly observed on the ground surface 75 yards west of Mound A along with a small pinch pot (under 5 cm in diameter and 2-3 cm high), but the pot is no longer within the collection (McGimsey 2004:24, citing personal communication with Dwain Kirkham). A 2.5 m high mound of sand was reportedly located 300 m west of the Gold Mine Site (McGimsey 2004:24, citing personal communication with Dwain Kirkham and Nina Helfert) and another on the

In total, the 1979 Gold Mine excavations yielded 10-15 additional burials. John Belmont of Harvard University visited the site towards the end of the season to assist the excavation; it was his work with the ceramic artifacts from two of the units excavated to subsoil as well as with additional previously uncovered artifacts that provided the first dating and chronology sequence for the mound and its construction (Belmont 1984; McGimsey 2004). More documentation is available for the 1979 field season, including detailed level forms, notated maps, and some photographs. The 1979 burials shown on McGimsey's composite burial map (see Appendix A, Figure A.7) were taken from level maps and the field notebook maps. Unlike the 1978 burials, where even the recorded provenience is uncertain due to the loss of the relevant records, documentation for those excavated in 1979 is complete enough for the catalog number assigned to each burial in the field to be used in combination with the year as a burial identifier. How well those recorded burials and their recovered contents correspond to the current contents of the Gold Mine Site Collection is unknown.

From the fall of 1979 to the spring of 1980, the skeletal remains were washed by volunteers from the Northwest Arkansas Archaeological Society and other student volunteers from an osteology class at the University of Arkansas, supervised by Jerry Rose and Karen Robinson (McGimsey 2004:32, 34). Some elements appear to have escaped this and later cleanings, as soil may be found impacted in the exposed cavities and crevices of many remains and caked along the surfaces of others. It is during this time that Robinson also supervised the processing of the collection, including the labeling of human remains (McGimsey 2004:42). Many elements within the collection have also been reconstructed with glue or bear the residual evidence of past reconstruction attempts. The date of these reconstructions is unclear, but many likely coincide with this period of the collection's curation.

Funding procured by Jerry Rose (NSF Grant BNS 79-23438; Rose 1981) allowed fieldwork to extend into 1980—short of the additional three years' worth of funding, two of which were to have included fieldwork, that had originally been pursued, but enough to allow for an additional excavation season. John Belmont served as field director and Jean Kennedy as field osteologist, with Dwain Kirkha, Reca Jones, and Nina Helfert returning along with volunteers Robert Walker and Davis Bamberg, among others. The 1980 season saw three backhoe trenches dug into Mound A, numerous auger tests, five new units opened (see Appendix A, Figure A.4), and all of the older units reopened and excavated to the top of the subsoil (Figure 2.3). The majority of burials are mapped and extensively described in a detailed "burial book" (McGimsey 2004:40). Level forms were produced for each level of the excavation, with the documentation of burials and

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east side of Hewitt Lake, neither of which had been recorded with the state as of 2004. The formal relationship of these mounds to the Gold Mine Site, if any, is unknown.

Figure 2.3. View to the north of the completed excavation block at the end of the 1980 field season; John Belmont in back (McGimsey 2004:44, photographer unknown).

level floors supplemented by numerous photographs (McGimsey 2004:34). Belmont's addition to the excavation team greatly aided the identification of non-mortuary features within the mound, and 68 features were recognized, mapped, and described over the season (McGimsey 2004:42).

The conversion to the metric system (2x2 m grid) and a shifting of the 1980 datum point to the 1978-1W0E stake (both datum points are labeled 0N0E, resulted in a significant divergence in the grid coordinates (see Appendix A, Figure A.3) (McGimsey 2004:37). The 1980 field season also saw the implementation of a new cataloging system for the 1980 burials. "Provenience [was identified] with a 'K' followed by a sequential number, starting with K90, with each square level assigned a K number with quarter sections or individual artifacts given letter designations (i.e. K123a, K123b, etc.)" (McGimsey 2004:39); individual artifacts were not assigned unique catalog numbers in the laboratory. Artifact samples were washed on site (McGimsey 2004:40, Jensen 1980), and while water screening was performed for some units the identity of those specific units is not recorded. During the three years of excavation, approximately 83 m^3 of earth was excavated from Mound A and its immediate vicinity (65.0 m^3 from

the 59.75 m^2 of the excavation block, 17.1 m^3 of earth from 16 m of backhoe trenches, and 32 auger tests), roughly 10-20% of the mound's estimated total surviving area (McGimsey 2004:44).

In September of 1980, Stephen Williams of Harvard University became Principal Investigator for continuing study of the site, but further proposals to extend funding for the project were unsuccessful. Osteological material continued to be processed at the University of Arkansas, where it was the source of two honor theses—one looking at pathology and sexual dimorphism within the dental sample (Walker 1980) and another detailing aspects of the lab methodology used to process the remains (Robinson 1981)—and a master's thesis looking at osteological traits n selected long bones (Berg 1984). Eventually the lack of funding meant the collection was boxed for more long-term storage at the university. Unfortunately, no collections manager was on staff to help maintain the collection and its records or to document any additional handling or usage (McGimsey 2004). Segments of the collection and its records subsequently became disassociated from the main body and were lost. Portions of the ceramics collection remained out on loan with John Belmont, who maintained an active interest in the site despite circumstances preventing his completion of a final site report, occasionally travelling to Arkansas to continue work with the remainder of the ceramic assemblages. Unfortunately these, too, suffered post-excavation loss, with many artifacts becoming disassociated from their original proveniences, particularly among the 1978 assemblages (McGimsey 2004:32-33, 46). The current location of much of the non-osteological material recovered from the site is unknown.

Belmont and other volunteers, many of whom had assisted with the original excavation, periodically worked with the various Gold Mine assemblages through the mid-1980s. Belmont's detailed tabulation and analysis of the extant collections and the site's stratigraphy in particular would enable a more exact dating of the site. Further processing of the human skeletal remains may have been performed at this time, but as the lab work was not documented the full extent of the effort, if any, is uncertain. By the late 1980s, no work was being done with the collection. It stayed in storage at the University of Arkansas until 2002, when Jerry Rose loaned the human osteological material to Murray Marks of the University of Tennessee, Knoxville, where the dental portion was used as the basis for a two senior honors theses focusing on antemortem fracturing within the ulnae and other instances of pathology (Ward 2003) and instances of enamel hypoplasia (Thompson 2005). The collection was subsequently transferred to the State University of New York at Binghamton in 2009 under the care of Dawnie Steadman, where it was the subject of two senior honors theses that attempted visual pair-matching using adult femora (Lans 2011) and juvenile tibiae (Vázquez 2011). Two masters theses were also produced studying oral health (Nzingha 2011) and demographics (Tatchell 2010) within the site's recovered skeletal material. The collection returned to Knoxville when Steadman left Binghamton in 2011 to join the University of Tennessee's Anthropology Department as Professor and Director of the Forensic Anthropology Center. It is currently

scheduled to remain in storage in the Department of Anthropology until the fall of 2013, at which point it will be returned to the Louisiana Division of Archaeology.

Reconstructing Life and Death at Gold Mine

2.2.1 Mortuary Practices

Six burial types as classified by McGimsey (2004:98) were observed within the Gold Mine mound: single primary interments, multiple primary interments, single secondary interments, multiple secondary interments, isolated crania, and disarticulated remains scattered across surfaces and in moundfill. Purposeful interment was not restricted to humans alone, however, as the remains of multiple dogs of varying ages, at least one of which was mostly-whole and articulated at the time of placement, were recovered alongside human burials (McGimsey 2004:297-302, collecting unpublished manuscripts by Jurney and Belmont).

McGimsey's report does not recognize cremated remains among the osteological material recovered from the site. Though his report does make mention of hearths and pits at varying levels of the mound that appear to have at least some link to the mortuary activities [including a "bathtub-shaped" pit[11] similar to those found in other Troyville sites (Belmont 1984:86-87; Ford 1951:104-105), McGimsey dismisses the possibility of their use as crematory pits "based upon the lack of burnt human remains in their fill and the absence of cremated remains in the cemeteries" (2004:111). Bathtub-shaped pits in other Troyville contexts have been interpreted as communal cooking or barbeque pits, likely used during the large-scale, communal and intercommunal feasting rituals like those observed within Southeastern ethnography (Belmont 1984:88; Knight 2001).

Tatchell (2010:28), in contrast, reports "cremated adult, subadult, and probable nonhuman remains… present in nearly half of the boxes in the collection". While this thesis's author did not encounter such a high rate of cremated material during her own survey of the collection, at least one tibial shaft fragment (GM72 BUR0N4E Level 3 CAT126b 206) showed clear signs of thermal trauma, though due to the degree of fragmentation and the potential warping effect of the fire itself it is impossible to determine whether this fragment represents a juvenile or adult individual. It should be noted, however, that the

[11] Discovered during the 1980 excavation, Belmont describes it as a "large compound pit intrusive from the habitation level above Mound Stage I [and possibly one in a row of such pits, as with the Greenhouse site]. The pit consists of a lower subrectangular portion with heavily burnt walls centered transversely in a large oval upper portion whose flat floor forms a sunken deck or platform on either side. The lower pit ([…] Feature 101) is half filled with charcoal and ash, containing a few sherds and charred deer bones. Above the ash are silten lenses which are in part rain wash. The upper pit ([…] Feature 100) is filled with midden material, first a layer of shells, then a layer of rich midden including abundant faunal material and large vessel fragments" (1984:860.

presence of cremated bone is not necessarily indicative of the intentional burning of remains as a mortuary act. The prolonged post-mortem interval and subsequent lack of soft tissue also makes it difficult to assign a precise type classification of cremation according to the Crow-Glassman Scale (Glassman and Crow 1995).

These burial categories are consistent with those observed at other Troyville ossuary sites, as is the minimalistic, non-individualized inclusion of grave goods (Belmont 1984).[12] Most notable among the burials, however, are the frequent occurrences of what John Belmont (1984:84) refers to as "pseudo-extended" burials: "disarticulated bones… arranged with skull at one end, arm bones, ribs, vertebrae, and pelvis in rough anatomical order in the middle, and leg bones in a pile, tibias heaped with femora at the other end". It is a practice unseen among any of the other cultures bordering Troyville in time and space, evocative in the degree of handling and care required in the placement of the remains. It is these pseudo-extended burials, in addition to the canine burials [a practice seen also at Greenhouse, a Troyville-Coles Creek period site in Avoyelles Parish (Ford 1951:42-45, 106-108)], that caused Belmont to argue that Troyville represents a distinct culture as opposed to a phase, transitional period, or cultural outlier. As this form of burial was not recognized until later in the excavation, it is possible that some of the primary interments recorded during the 1978 and 1979 field seasons were actually convincingly arranged secondary interments. As photos and rigorous documentation are scarce from those seasons, it may be impossible to check this theory.

Belmont also describes some of the secondary burials as "[having] a circular cross section, as if the bones were wrapped in a mat prior to interment" (1984:84). Despite references to both bundle burials containing the remains of multiple individuals and multiple secondary interments containing at least one bundle burial, McGimsey(2004:102) appears to classify these remains as single secondary interments only. At least one unnamed excavator theorized in the site's excavation notes that the dead might have been laid out on cloths or mats and left to decompose for a period before being carried to the interment pit (McGimsey 2004:92). While no woven materials have been recovered from the burials [though some pieces of amorphous burnt soil carry grass and cane impressions, indicating the possible architectural use of thatching and cane mats or accidental impressions left during activities at the mound (McGimsey

[12] Conspicuous grave goods are limited to two human ceramic figurines, both placed with mass burials; all of the other artifacts recovered from the mound were either part of the moundfill itself or recovered from locations that could not be clearly assigned to any specific burial or mortuary activity (McGimsey 2004:104). One possible exception is a 1978 burial of a fully articulated, extended skeleton (Burial 78-13, 1978-4S1W by McGimsey's system) informally referred to as "Pebble", so-named because of a pink, oval stone recovered *in situ* directly over its left clavicle (McGimsey 2004:104). Echoing Nina Helfert's observation that many individuals were found with an additional mandible in close proximity to their shoulder or head, McGimsey speculates that the individual skulls and crania—the most common "object" found with other burials—might themselves qualify as grave goods (2004:104).

2004:158)], such a practice could explain the relative self-containment recorded in some multiple interments. No explanation has been offered as to how these mats could have retained their own structural integrity even as the bodies resting upon them succumbed to the more liquid processes of decay, but presumably the remains could have been transferred to a fresh shroud or mat before the final interment.

Attempting to make sense of the variety of interment styles, Belmont (1984:84) theorizes that each of the various burial categories represents a single stage of a single burial program, snapshots of a process by which the intact body of an individual would be reduced to disarticulated components within a collective commingled burial. In his reconstruction, the dead would first be placed within a charnel house or other repository for the deceased—possibly on mats—until by schedule or physical necessity all of the remains were removed for final, mass burial in the mound itself. The presence of what would appear to be post-holes for some sort of structure along the northern rim of Mound A appears to lend credence to this charnel house reconstruction (McGimsey 2004:72). Alternatively, Belmont proposes that individuals might first have been buried in temporary shallow graves in the extended position frequently noted among the primary burials, only to be exhumed for a secondary interment once enough time had passed to render the remains sufficiently skeletonized. The presence of several "caches" of grouped skeletal elements, large and small, (piled phalanges and patellae were found in close association with stacks of long bones) suggest at least a degree of decomposition prior to final burial (McGimsey 2004:83).

But this multi-stage single burial program requires time, even in the quick decay environment of Northeastern Louisiana, time that—according to McGimsey (2004:212)—simply doesn't fit the parameters of Mound A's construction. The mound was constructed in four stages [Mound Stages (MS) I-IV], each stage consisting of various sub-strata. Burials appear to have been limited to the second and third mound stages, with multiple and single interments present in each layer.[13] The construction of MS III—using a considerably harder and distinctively "purplish tint[ed]" earth of unknown origin (McGimsey 2004:197)—created a broad, flat mound surface that has largely been removed by historic activities; McGimsey finds no evidence for separate activity areas

[13] Per McGimsey, MS II Stratum 15 yielded one single burial and one burial with two individuals in the northeast corner of the excavation block. MS II Stratum 16/17 yielded eight human burials containing one to seven individuals, one dog burial, and two complete vessels on the stratum surface (2004). All burials were concentrated in the northern part of the block proximal to the hearth feature first observed in the same location in Stratum 15, and McGimsey interprets the presence of artifacts and possible postholes in the southern portion of the block as evidence of an activity area associated with mortuary events. The surface of MS III was largely removed by historical activities but yielded 22 human burials containing one to 25 individuals and one dog burial distributed across the entire level portion of the layer and multiple burials extending into northern and eastern walls of the block. Both of the ceramic human figurines were associated with mass burials from this layer.

devoted to anything other than the interment of the dead. Citing the lack of evidence for erosion, weathering, or wash on any of the mound surfaces for the first two mound layers (MSI and MSII) and slope wash contained to the southern exposure where the mound slips down the slope in layers MS III and MS IV, McGimsey asserts that the time from the beginning of the mound's construction and use to the placement of its final stage was relatively short, "probably within the span of a month or less" (2004:12).

Overlapping hearth features of various sections within the mound layers could also be evidence for a short construction period, granting the mound builders foreknowledge of the previous deposition layer's hearth placement (Belmont interprets this same evidence as a sequence of nested hearths indicative of continued occupation and use from one layer to the next). If this is the case then Belmont's alternate theory of a single multi-stage burial program where the primary interments within the mound were merely means towards a decomposed end is less plausible. Though rapid skeletonization of human remains left to decompose on the surface has been observed at the Anthropology Research Facility—the University of Tennessee, Knoxville's outdoor research facility devoted to the study of human decay—during the steamy summer months (Bass 1997; Jeong 2013), the decomposition process is slowed by even shallow burial compared to complete exposure (Simmons et al. 2010). If individuals were buried for any period preceding to or in specific preparation for their final burial within the mound, then those primary burials would have had to significantly predate the first stages of the mound's construction in order to account for the degree of disarticulation and commingling observed in nearly all of the uncovered secondary burials.

Whether all of the individuals interred within the mound represent the dead of a single community or a broader sociocultural network is also uncertain. To McGimsey it seems "intuitively" more likely that Gold Mine functioned as a regional cemetery for communities in Big Creek and accompanying regions of Boeuf and the Ouchita River Valleys (2004:213). The numbers are simply too great, McGimsey asserts, to be accounted for by a single village or settlement, especially since less than 10-20% of the mound has been excavated and burial areas are known to extend north and east of the exposed excavation block. Several hundred individuals may be interred within the mound. "[T]o accumulate [that] number of people, it must represent 1) the remains collected over a long time, perhaps a hundred years or more, by a single community, or 2) the remains from a series of communities collected over a shorter interval" (McGimsey 2004:213). If there is a structure to how individuals are grouped for interment, then it was "probably based on family, clan, or other social ties. Similarly, the choice of interment pattern, whether extended, bundle, or scatter, may reflect different community or social group beliefs/practices" (McGimsey 2004:213). Each stage in the mound could also represent the contribution of a given community or social group or—if construction and use of the mound was a prolonged process—a separate burial event altogether.

Based on the 1980 stratigraphic analysis, burials did not cut through from one mound layer (typically 40-50 cm thick) into another, though the lack of recognizable burial boundaries makes it difficult to discern whether or not burials frequently cut across each other (at least two such cases were recognized) (Belmont 1980a; McGimsey 2004:93). Some burials were so shallow or so packed with remains that skeletal material would undoubtedly have been visible protruding out from the mound's active surface. As with remains placed directly on the surface (intentionally or through accidental scatter), the deposition of the next mound layer would have served as the final act of completing the burial of remains interred in the preceding layer. No remains were found in what remained of the topmost mound layer (MS IV), and based on reports no skeletal material was exposed until the first three feet of the mound had been bulldozed. This final, capping layer was therefore the final act of all mortuary practices at Gold Mine, sealing all burials and closing the mound to further interment (McGimsey 2004:212).

2.2.2 Health and Diet

While faunal remains were recovered from the burial mounds, there is little direct evidence on the varieties and abundance of plants that would have been included in the Gold Mine people's diets. If any floral material was ever interred in the mounds it wasn't recovered during the site's excavation, where water screening was limited to select unknown units from the 1980 excavation. The diet and general health of the people of Gold Mine must therefore be inferred indirectly from the bones themselves.

Some of the earliest work using the Gold Mine Site Collection is focused on diet-related pathology. In his study of dental pathology, attrition, and sexual dimorphism within the Gold Mine Site Collection, Walker (1980:2) hypothesized that Gold Mine represents an incipient agricultural society (a proposal put forward by excavator Jean Kennedy in a 1979 communication with Walker). To test that hypothesis, he analyzed the degree and presentation of the pathologies within the dental remains of the collection to see if they were consistent with patterns seen in other indigenous populations of known period and subsistence base. Walker's study was limited to the 100 burials that had been excavated as of August 1979 and, due to fragmentation and commingling, he was forced to analyze individual teeth as opposed to complete dentitions for single individuals. The sample was also biased due to the types of teeth available for study, as many of the anterior teeth were absent due to ante- or postmortem loss. Combined with a high caries rate and the prevalence of abscesses—all features indicative of a high carbohydrate diet likely resulting from the consumption of agricultural food products—it would at first appear natural to assume that the people of Gold Mine practiced some degree of agriculture, but compared to known Mississippian and Caddoan agriculturalist societies from adjoining regions the Gold Mine rates of dental pathologies are notably lower (Berg 1978; Hynds and Powell n.d.). Dental pathologies and patterns of wear are not always easily interpreted or strictly associated with subsistence patterns, however, and while

incipient forms of agriculture were being practiced in the northern portions of Lower Mississippi valley there is little evidence from the last two decades' of research to support domestication of native cultigens among the Baytown or subsequent Coles Creek period people of Louisiana (Lee 2010; Fitz and Kidder 1993; Kidder 2002, 2004). Walker ultimately concluded that the cause of most of the Gold Mine dental pathologies lay in the degree of attrition observed. This attrition is more in keeping with a hunter-gatherer subsistence base due to the mastication forces necessary to break down unprocessed foodstuffs.

Early analysis of the morphological and osteometric characteristics of the recovered remains by Talley (1978) found the Gold Mine people to be tall, sexually dimorphic, and physically robust, narrow-hipped and square-chinned with large mastoid processes among females—which Talley attributed to balancing heavy loads carried on top of the head—higher cranial vaults, and widespread osteoarthritis (primarily restricted to the vertebrae). Talley's assessments were based on unconventional techniques, however, including the determination of biological sex based on dimensions of the nasal bones, orbits, palate, frontal breadth, and height of the mandibular symphysis (Tatchell 2010:131). His assessments would be undercut by Berg's 1984 study of the collection's humeri, femora, and tibiae, which concluded that the people of Gold Mine were relatively short by modern standards, with an average stature of 5'7".

Per Talley's report infectious bone disease and trauma rates were moderate—only 16% of the 1978 sample showed any pathological disorders, with 15% of recovered dentition bearing signs of dental decay—with no indications of malnutrition, though lower limbs were large and there were several cases of long bones seemingly deformed by strong muscle attachments (Nzingha 2011). Berg's own assessment of the rate and variety of pathology within the osteological material as a whole drew similar conclusions. He deemed the Gold Mine people to be of good health with low occurrence rates of most pathologies and traumas, though periostitis appeared to increase over time. Berg attributes this apparent increase to changes in subsistence and settlement patterns, assuming either long-term occupation and use of the mounds (Berg's interpretation) or the collection of several years or even generations worth of the dead to be interred in a shorter mound construction event in keeping with McGimsey's reconstruction. This reconstruction is problematic, however, both because it relies upon the poorly-established stratigraphy sequence assembled from 1978-1979 and because it assumes that placement within the mound directly associates with the post-mortem interval, with the most recent deaths represented in the mound's top-most strata. Without a systematic attempt to reassociate disarticulated remains there is no evidence that the remains of single individuals were as a rule contained within the same strata or layer of the mound, much less whether there is any specific order to their arrangement that reflects a continuous, unbroken chronology of the region. It is therefore unknown whether the multiple pathologies observed within the assemblage (see Chapter VI) occurred concurrently or are indicative of changes in environmental stressors and sociocultural practices over time.

During the collection's first visit to the University of Tennessee (2002-2009), the ulnae were used in a senior honors thesis that looked for evidence of interpersonal violence as recorded through parry fractures (Ward 2003). Because of the high degree of commingling that made it impossible to associate individual ulnae to other elements of a known individual skeleton, Ward was severely limited in his ability to compare the condition of the ulnae against the rest of the body for further evidence of interpersonal conflict. Ward had also intended to study gendered interpersonal conflict but was ultimately unable to determine the biological sex of any of his selected elements. He found it impossible to differentiate between accidental fractures and interpersonal trauma. What information on the frequency of ulnar fractures Ward was able to collect he compared to published data from prehistoric and contemporary populations, against which the rate at Gold Mine appeared to be slightly higher. From this limited evidence Ward conjectured that the people of Gold Mine lead a "harsh" lifestyle (Nzingha 2011:33, quoting Ward). Given the nature of the sample, such conclusions are problematic.

Conclusion

Troyville is a subsidiary culture of the Baytown period characterized by platform ossuary mounds built in stages on pre-existing slopes of land near rivers or other draining bodies of water. The mounds are notable for their mass burials—most of which represent secondary interments—minimal grave goods, and no readily apparent hierarchical structure defining the inclusion, placement, or grouping of individuals. While much is either unknown or uncertain about the Gold Mine site, its structure is consistent with other Troyville ossuary mounds. In the event that the original proveniences of the elements can be reconstructed through other lines of evidence beyond the problematic recorded burial contexts, the site should provide additional information useful to refining our understanding of Troyville mortuary practices.

While the three field seasons yielded an impressive amount of human skeletal remains, there were issues with the site's excavation and documentation even prior to the ultimate loss of most of the excavation records. Secondary commingling and damage was further compounded through various poorly documented attempts at resorting the collection and multiple transfers between institutions. Early conclusions on the physical makeup and demographic distribution of the Gold Mine people were frequently contradicted by later researchers, the majority of whom focused their research on attempts to quantify and tally the total number of individuals represented within the collection. Their research is detailed in full in the final portion of the following chapter.

CHAPTER III
DETERMINING *N*

Introduction

The initial number of individuals (*N*) represented by an assemblage is not a strictly defined concept. *N* may refer to "the living population from which the sample of bones originally derived, the fraction of the living population that died and was accumulated/deposited in the particular deposit sampled, the fraction of the accumulated population that was preserved and sampled, or the fraction of the sampled population that was recovered and analyzed" (Nikita and Lahr 2011:630).

For the purposes of this thesis, *N* is taken to represent the number of adult individuals within the Gold Mine Site Collection as represented by humeral and tibial elements. Because the collection represents only the 10-20% of the mound that was ever excavated, *N* cannot be assumed to incorporate all of the individuals interred within Mound A. Even with the extensive commingling observed within the assemblage, it is unlikely that every individual interred within the mound is represented by at least one element within the recovered assemblage. It is also unclear as to whether Mound B contains any human remains, though none were recovered during the single day's excavation devoted to the smaller mound. As a result, *N* can also not be calculated for the site as a whole based on the material currently available.

This chapter lays out the history of bioanthropological attempts to quantitatively determine *N*, highlighting the best-practices applications and limitations of each method in turn. It then focuses on the types of statistically-validated approaches that have been developed for use in significantly commingled assemblages and the attempts to account for and rectify the problems caused by fragmentation. The final section of this chapter details the results of previous attempts to determine an *N* for the Gold Mine site, highlighting any limitations in their approaches or selected samples and any instances where their results are contradicted by other evidence.

MNI and MLNI

3.1.1 MNI

The most basic method of quantifying *N* is to count the most commonly occurring unique skeletal element or identifying feature within an assemblage; as no individual can possess two right radii or two left pubic symphyses, this count must stand as the Minimum Number of Individuals (MNI). Elements without the selected identifying landmark—even if otherwise complete—cannot conclusively be identified as a unique bone and therefore should not be counted towards the MNI assemblage (Adams and Konigsberg 2008).

There are three variations in how the MNI may be calculated (let L equal the number of left bones, R the number of right bones, and P the number of pairs). The simplest method is the Maximum (*L,R*), where all bones in the sample are sorted into rights and lefts and the side with the greatest number is taken as the MNI (Adams and Konigsberg 2004). This is the method put forward by T.E. White (1953), who, in turn, adapted it from its first usage in paleontology (Stock 1929; Howard 1930)[14], and the method most widely used among archaeological contexts. Though easily understood and quantified, it is not without its biases, particularly in instances of lower recover rates. It treats the sample as if every bone from the least-represented side can be paired with one of the bones from the opposing side, with few to no unpaired bones. As recovery is rarely so complete, the Maximum MNI approach tends to significantly underestimate the actual *N*.

In the second variation of MNI, lefts and rights are averaged [($L + R$)/2] in an attempt to account for the possibility of paired bones, but unless L and R are equal this variation produces an MNI that is less than the total number of bones in the most-represented side, further compounding the underestimated *N* (Adams and Konigsberg 2004). The third variation ($L + R – P$)—deemed the Grand Minimum Total by Horton (1984)—produces the highest MNI estimate but also requires an additional step known as visual pair-matching in order to identify *P* (Adams and Konigsberg 2004).

Visual pair-matching (VPM) is the process by which all identified bones, left and right, are laid out and attempts are made—by the visual comparison of observable characteristics—to identify likely left-right pairs (Adams and Konigsberg 2008). Length, robusticity, muscle markings, epiphyseal shape, and general symmetry are among the morphological indicators that can be used to identify pairs. Taphonomic indications including the state of preservation (weathering and bone color), presence of burning, presence of cut marks, and presence of animal modification may also be taken into consideration, but these variables should not be weighted as heavily due to the breadth of potential taphonomic variation (Adams and Konigsberg 2008).

Visual pair-matching is easiest and most accurate when performed using well-preserved skeletal material; if attempted with more fragmentary or damaged remains, then it must be performed with caution and full recognition of any potentially biasing factors. When dealing with fragmentary remains of any kind, all attempts must first be made to reassociate or “conjoin” fragmented elements (Adams and Konigsberg 2008). Not only is it easier to assess the symmetry of whole and/or nearly whole bones as opposed to fragments of varying sizes, but also this step, in addition with strict adherence to a commonly-held identifying

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[14] W.R. Adams’s (1949) M.A. thesis was technically the first formal writing to apply the method to an archaeological site, but as this thesis went unpublished it is White who is largely responsible for seeding the idea into anthropology as a whole (Nikita and Lahr 2011).

feature in every bone included in the VPM assemblage, is crucial in ensuring that no single bone is mistakenly represented twice.

Errors in the counts of right and left bones as well as the identified number of pairs will skew the accuracy of any quantification method that makes use of them. When performed by experienced osteologists it is more likely that errors will consist of overlooking true pairs as opposed to pairing unrelated elements, though this tendency may not hold true for larger sample sizes (Adams and Konigsberg 2008). Smaller samples in general are more easily sorted than much larger assemblages, where the logistical scale of the sorting process itself (requiring both table space as well as time to carefully consider each possible pair, resources that can quickly become stretched when dealing with hundreds or thousands of individual bones) as well as the bell-curve tendency for minimal distinguishable variation in all but the extremes of the sample makes pair-sorting much more difficult and prone to error.

How much each MNI variation underestimates the true N will depend upon the recovery probability for the element in question. Unfortunately practical applications are not always as clean and orderly as the mathematical theory behind them, and recovery probability is unknown for most osteological assemblages, though the process by which it can be calculated is described in the following section. MNI is therefore prone to significant error except in cases where recovery nears 100% and preservation is excellent, and for this reason it should only be used with reservation with larger assemblages of human remains (Adams and Konigsberg 2004).

3.1.2 LI and MLNI

First developed for zoological applications and the study of wild fauna (Chapman 1951), the Lincoln Index (LI) evolved as a statistical solution to the problem of estimating the total population of wild fauna based on catch-and-release tagging programs. It is exceedingly rare for such programs to catch every individual animal within a region, even after multiple attempts, and the same previously-tagged animal may be caught a second time, leaving an unknown number of elusive animals never observed by researchers. In order to accurately estimate the true population, all of the individuals from the first observation are taken as group E_1, all of the individuals from the second observation as group E_2, and any individuals common to both as group S, so that

$$LI = \frac{E_1 \times E_2}{S}.$$

The LI can be easily adapted to non-zoological applications so long as the two "observations" have the potential for overlap. For skeletal assemblages where the goal is to estimate the original death assemblage ($\widehat{N}$), lefts and rights of a single skeletal element take the place of first and second observations, with paired bones occurring in both groups so that

$$\widehat{N} = \frac{L \times R}{P}$$

(Adams and Konigsberg 2004).

This approach is potentially biased in the case of small sample sizes and low recovery probability, however, first severely underestimating and then overestimating the true *N* until the recovery probability approaches 50%. As the problem of commingling is by no means limited to larger skeletal assemblages, the formula's utility is limited in many archaeological and forensic assemblages. Various modifications of the LI were produced and tested against known assemblages in order to increase the accuracy of the model. A simple modification to the LI first proposed by Chapman (1951) and later recommended by Seber (1973) as a means of accounting for potential sample bias was later shown by Adams and Konigsberg to yield the far more accurate maximum likelihood estimate (*N**), or Most Likely Number of Individuals (MLNI). Using the modified LI, MLNI is calculated as

$$N^* = \frac{(L+1)(R+1)}{(P+1)} - 1.$$

As with the LI, the resulting *N** is presented as an integer without rounding. As with the original LI this modification initially underestimates the true *N* in cases of low recovery probability (<20%), but afterwards the estimated *N* rapidly aligns with the true *N* and does not waver. Paired with the additional validation studies of VPM where Adams and Konigsberg (2004; 2008) showed that pair-matching could be accurately performed by trained observers based solely on gross morphology, particularly in cases with well-preserved commingled remains, the MLNI has since stood up within anthropology as a reliable means of determining the *N* of a commingled assemblage.

The primary difference between MNI and estimates based on LI or MLNI is that the latter two "estimate the *original* number of individuals represented by the osteological assemblage, while the MNI only estimates the *recovered* assemblage" (Adam and Konigsberg 2008, emphasis original). This makes LI and MLNI better suited for paleodemographic purposes, situations where the number of factors impacting the total recovery rate are more likely to be compounded. These factors and the resulting data loss must be random, however (Ringrose 1993). Any circumstances with non-random taphonomic loss and recovery error—for example, deferential treatment in mortuary practices of one bone or set of bones over all others, or the unintended but still-directed destruction of part of a burial site by later construction work—opens the estimated *N* to error. Even when all damage and loss is random, the accuracy of LI and MLNI estimates are also affected by the scale and general condition of the sample as a whole (Adams and Konigsberg 2008). When fragmentation is "extensive" or preservation "extremely" and systematically poor, then it is possible that none of the more sensitive quantification techniques can be meaningfully applied. In circumstances where the ability to reliably identify pairs through VPM is obscured by damage to the assemblage and non-random recovery of elements, MNI may be the more reliable quantification of *N* (Adams and Konigsberg 2008:253).

MLNI estimates are most accurate when recovery rates reach 50%, circumstances under which MNI provides typically low estimates, but shows significant improvement over the accuracy of the MNI with as low as 30% recovery (Adams and Konigsberg 2004). All MLNI calculations are based on the assumption that the counting of pairs is correct (Fieller and Turner 1982; Horton 1984; Chase and Hagaman 1986; Adams and Konigsberg 2004), though Robson and Regier (1964) suggest that any bias within the MLNI estimate will be negligible if there are more than seven identified pairs. An additional benefit of LI and MLNI estimates is that—unlike with MNI—it is possible to calculate a confidence interval (CI). Where variance (v^*) is calculated as

$$v^* = \frac{(L+1)(R+1)(L-P)(R-P)}{(P+1)^2(P+2)},$$

an approximate 95% CI for the MLNI would be calculated as

$$CI = N^* \pm 1.96\sqrt{v^*}$$

(Adams and Konigsberg 2008). The lower limit of the CI should never be reported as less than the MNI value of $L + R - P$.

The recovery probability (*r*), defined as "the probability that a bone will make its way into the sample being analyzed", may be preferable instead of an estimate of *N* (Konigsberg 2005:1). Assuming an equal probability of recovering left and right bones, the maximum likelihood estimate of *r* is

$$\hat{r} = \frac{2P}{(L+R)}$$

where the asymptotic standard error of the estimate is

$$s.e.\widehat{(r)} = \left[\frac{(\hat{r}-1)^2\ (\hat{r}-)^2\hat{r}^2}{\hat{r}^2(L+R)(3-2\hat{r}) + 2P(2-6\hat{r}+3\hat{r}^2}\right]^{\frac{1}{2}}$$

(Konigsberg 2005).

Osteometric Sorting

Osteometric sorting tests the statistical likelihood of pairs identified by two or more observers. The size and shape of each element from the assemblage being tested is quantified and sorted through a series of carefully-taken standardized measurements of length and girth as defined in the Forensic Data Bank (FDB). In typical osteometric sorting models, the difference (*D*) between all selected measurements (*i*) for right (*a*) and left (*b*) elements is then summed so that

$$D = \Sigma(a_i - b_i)$$

(Byrd 2008). By the null hypothesis, right and left elements from a pair are equal so that the value of *D* is "0" (no difference), but bilateral asymmetry, individual variation, and site-specific bone modification in response to stress means that this is often not the case even in elements originating from the same individual. It is therefore necessary to use a reference sample in order to establish what

values of *D* fall within the normal range for any given individual and which fall beyond the pre-set boundaries needed to reject the null hypothesis (and thus identify a pair as statistically unlikely to have originated from the same individual) as determined by the reference data standard deviation of *D*. The deviation from "0" in the assembled pairs being tested is divided by the reference data standard deviation and evaluated against a simple two-tailed *t*-distribution to obtain a *p*-value (Byrd 2008). "A low *p*-value provides a measure of the strength of evidence against the null, which can also be taken as evidence for how atypical the case specimens are assuming they originate in the same individual" (Byrd 2008:203). Byrd recommends a 0.10 significance level for most applications of the test, but this cut-off should be adjusted according to the needs of the investigation. Type I error (rejecting the null hypothesis when the paired elements in question did originate from the same individual) is possible in osteometric sorting but rare, occurring less than 3% of the time even when tested against a difficult subset of measurements (Adams and Byrd 2002).

The method should not be used as the sole line of evidence in identifying possible or likely pairs. While osteometric sorting can reject pairs with statistical confidence, attempting to use it in reverse—i.e., identifying possible pairs from an assemblage where no attempt has been made at VPM—increases the chance of Type II error (failing to reject the null hypothesis when the paired elements in question did not originate from the same individual). Osteometric sorting should therefore always be combined with other, independent lines of evidence when attempting to identify rather than exclude possible pairs.

Equally important to the successful application of osteometric sorting techniques is the selection of an appropriate skeletal assemblage to be used as a reference sample. Populations of human beings are not identical in their skeletal morphology, but some skeletal assemblages are much more similar than others. No statistical sorting model is strong enough to overcome a poor reference sample or a poorly preserved original sample (Byrd 2008). Optimally, the reference sample should be a close contemporary of the assemblage being sorted, of similar ancestral background, and subject to similar environmental and cultural stressors. Individuals with atypical presentations, as with the case of pathological conditions with radically-modified bone morphology, typically fall outside of the model's predicted parameters. Unless the reference sample exhibits those same pathologies in comparable rates and presentation, then the model established by the reference sample cannot reliably test the likelihood of any pathological pair.

Other Approaches

Means of quantifying *N* are not strictly confined to these approaches, however, particularly since assemblages frequently fail to conform to the parameters needed to best make use of MNI and MLNI. Similarly, no two assemblages are exactly alike, and their respective contexts and the aspects of their recovery and analysis that are given the greatest amount of priority will

govern the selection of the most appropriate analytical approach. This is especially true when comparing the priorities in recovering remains from forensic and archaeological contexts, or when approaching a yet-to-be excavated site with the foreknowledge of all of the methods available versus an assemblage like Gold Mine that must be analyzed many decades afterwards and with little to no reliable documentation.

3.3.1 Supplementary Osteometrics for Fragmentary Remains

One method of particular interest to this thesis was developed by Byrd and Adams (2003) as a means of matching disparate bones from the same individual from an assemblage of commingled remains even when those bones cannot be directly articulated. Roughly, the method holds that morphological characteristics related to size and shape observed in one bone will also be observable in another bone originating from the same individual, allowing the matching of long and slender with long and slender, short and thick with short and thick, and so on. The correlation between the lengths of long bones in particular has already been long established, but those measurements cannot be taken with more fragmentary remains. In order to open up their method to fragmentary and otherwise damaged remains, Byrd and Adams have incorporated a set of supplemental measurements to be taken in addition to the standard measurements defined by the FDB (see Chapter IV, Table 4.1). These supplementary measurements are focused on quantifying breadth and girth. All of the available measurements for an individual bone are summed, then the natural logarithm of this sum is used in regression models to test for possible matches in a stepwise process where each pair of bone specimens is tested to see whether they could have possibly originated from the same individual. Sums using two or more non-length measurements were found to be as statistically valid as sums that used length exclusively (2003).

Like all osteometric sorting methods this method requires a large reference sample, following the “data banking concept” (Jantz 1988; Byrd 2008). Because of the inclusion of the supplementary measurements, however, researchers adopting this method are limited to those reference collections that already have those measurements available (currently limited to the mostly-modern data set put together by Byrd and Adams themselves in order to test their method) or which the researcher can arrange access to in order to take the necessary measurements personally. The latter approach is of course preferable in *all* osteometric sorting methods, as it reduces the possibility for inter-observer error, but this ideal cannot always be followed thanks to limitations in time and funding for travel. There is no indication of how well pathological samples might fare using this method, as Byrd and Adams specifically excluded individuals who had died after a prolonged illness, citing the potential for extreme atrophy. Traumatized and pathological areas of bone were similarly excluded from testing.

3.3.2 Spatial Analysis

Spatial analysis—which hypothesizes that the disarticulated body part closest to the point on the body missing that part is the most likely correct match out of all possible matching body parts within a multiple burial—has also proven effective in cases where the potential for commingling is recognized in the field and the location of each element carefully documented throughout the excavation (Tuller et al. 2008). Unfortunately, it is unlikely that any of the commingling observed within the Gold Mine skeletal assemblage at the time of its excavation could have been resolved using spatial analysis even without the high degree of secondary post-excavation commingling. The pinpoint mapping techniques necessitated by Tuller et al.'s detailed computer models requires extremely careful plotting and recording techniques in the field, preferably aided by hand-held GPS units or other digitized mapping devices. Such precise coordinates are not available for any of the remains from the Gold Mine site, and some records feature contradictory position information for burials and other features (McGimsey 2004:78). Spatial analysis is also less successful when applied to secondary deposits, particularly in cases with previously disarticulated or skeletonized remains (Tuller et al. 2008). The intentional commingling and congregation of elements by bone type observed in the Gold Mine multiple interments would also make it difficult if not impossible to reassociate individual elements through spatial analysis, though the method may prove useful in determining larger-scale interment patterns between elements proven to originate from the same individual yet interred in separate parts of the mound.

3.3.3 Quantitative Algorithms

One approach put forward by Nikita and Lahr attempts to address the problem of misidentified pair totals in large assemblages through the use of two interconnected computer algorithms, "[one producing] a number of potential pairs between bilateral elements and the other [estimating] the number of individuals in a commingled sample by incorporating the percentages of lost and altered bones into the analysis" (2011:629). The first algorithm relies on quantified inputs of the types of characteristics more traditionally utilized in VPM. As in osteometric sorting, size and shape are represented by the metric measurements established by Bass's osteological field manual (1995), while the size of muscular attachment sites are scored following the system established by Marioti et al. (2004). The type and degree of the total surface affected by any observed pathology (currently limited to arthritis) are scored per Stewart (1958) and Ortner (1968). In the second algorithm those identified possible pairs are considered against known patterns and processes of taphonomic loss and alteration to estimate an initial number of individuals. All statistical parameters and acceptable maximum levels of analysis are user-defined.

Nikita and Lahr used hypothetical and actual skeletal samples[15] to validate this method and found it "more effective in comparison to any conventional estimators, particularly in cases where the elements are poorly preserved" (2011:629), but while it was similar in many aspects to the method ultimately employed within the study, as an approach it was deemed too cumbersome and redundant to what could be achieved through other means. Certainly future studies using the Gold Mine collection should consider using the respective scoring methods when recording and describing characteristics in the collection—and it may even be possible to utilize the photographic catalog produced here towards that end—but Nikita and Lahr's assertions that the method is a faster, more efficient approach to large, fragmentary assemblages is currently belied by the time needed to set up and tailor each of the aforementioned algorithms towards the specific assemblage under study (though both programs are available from the authors by request). Secondly, the algorithms still only produce a listing of all *potential* combinations of right and left, which still have to be checked visually before they can be confirmed as a plausible potential pair. Because it still relies upon the subjective input of a researcher to judge and code features and evaluate whether statistically-identified pairs should be included or excluded as plausible pairs, the method is not entirely objective. The probability for Type II errors described by Byrd is subsequently high. For the specific circumstances of this thesis, it was deemed no faster, no more efficient, and no less prone to bias and error than more traditional methods.

3.3.4 M

Most recently, Thomas et al. have advanced a quantitative technique to evaluate the null assumption that two homologous elements "found at different sites or at different times" originated from the same individual based on "the difference in values between left and right homologs as a proportion of the average value of the two bones" (2013:952, 954). Using both standard skeletal measurements and the supplementary measurements of Byrd and Adams (2004) described previously, Thomas et al.'s method pools the data of 108 adult females and 283 adult males selected from multiple skeletal collections of primarily 20th-century peoples[16] to create a measurement-by-measurement reference table

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[15] Conveniently, the skeletal sample used in these validation studies—153 human skeletons from Jebel Moya in southern Sudan—was comparative in its makeup of right and left tibiae and humeri to the Gold Mine sample reported here: 39 right humeri, 40 left humeri, 44 right tibiae, and 40 left tibiae (Gerharz 1994; Nikita and Lahr 2011). Identified pair were fewer, however, with only 12 for the humeri and 10 for the tibiae. Additionally, the dates assigned to each of the skeletons varies greatly, stretching from BCE 5000 to CE 100. The possible effect of this 5,000+ year gap and any morphological changes in human variation experienced by the population on the effectiveness of their sorting method is not addressed within their initial publication. Validation data from the Larson Cemetery as studied by Adams and Konigsberg (2004) was also utilized.

[16] The Forensic Data Bank and William M. Bass Donated Skeletal Collection at the University of Tennessee, Knoxville; the Robert J. Terry Anatomical Skeletal Collection at the Smithsonian

“designed to capture the range of variability between left and right elements within human individuals” as reflected through the measurement M (2013:952). M is defined as

$$M = \frac{|L - R|}{[(L + R)/2]},$$

with left and right homologs of equal measurement having an M-value of zero (Thomas et al. 2013). The table lists the 90th and 95th percentiles as well as the maximum M for each of the selected measurements of the clavicle, scapula, humerus, radius, ulna, os coxa, femur, tibia, fibula, and calcaneus. If the M of the two elements being tested exceeds the M value of the percentile previously selected as the threshold of significance, then the null hypothesis—and the possible pair-match—is rejected. As with all methods of metric evaluation of pair-matches, failure to reject the null hypothesis is not to be taken as sufficient evidence for a possible pair-match.

The results are displayed both respective to biological sex and with all individuals pooled. When the values between the two biological sexes were subjected to *t*-tests (α=0.05), only three measurements—the physiological length of the ulna, the anterior-posterior diameter of the clavicle at midshaft, and the anterior-posterior diameter of the femur at midshaft—showed any statistical significance between them (Thomas et al. 2013). It should be remembered, however, that when performing 51 separate *t*-tests where α=0.05, as was the case for Thomas et al., there is a greater than 80% probability of obtaining three significant results by sheer chance alone. The totality of evidence therefore supports the usage of the total combined M when evaluating elements of unknown or possibly mixed biological sex, a scenario highly reflective of the reality of many forensic and archaeological contexts.

Although this method would seem an ideal means of resolving many of the issues within the Gold Mine Site Collection (see Chapter V), there are multiple factors preventing its use here. The first is the question of whether Thomas et al.’s data set can accurately reflect any values of M within the Gold Mine assemblage. There are no Native Americans represented within the predominately white sample, and as will be established in greater detail in Chapter IV the people of Gold Mine are notably shorter than more modern populations. The method needs to be tested against a comparable Native American archaeological sample with known associations and biological sexes in order to determine whether or not the M-values are comparable with those gleaned from a modern white population. Additionally, this method is intended for use in resolving small-scale issues of pair-matching as opposed to much larger assemblages, and there is no indication as to how well it might perform

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Institution’s National Museum of Natural History Department of Anthropology; the Hamann-Todd Osteological Collection at the Cleveland Museum of Natural History; the International Commission on Missing Persons, Bosnia and Herzegovina; the Peabody Museum of Archaeology and Ethnology at Harvard University; and the Central Identification Laboratory, Joint POW/MIE Accounting Command (Thomas et al. 2013).

when applied to numerous conflicts distributed broadly throughout a sample as was the case of the humerus visual pair-matching attempt in this thesis (see Chapters V and VI). It is also uncertain what steps are to be taken in the case of multiple M-values of conflicting significance within a single possible pair, i.e. any case in which the null hypothesis is rejected in a minority of all of the measurements compared for those elements but not rejected in the remaining majority. It is unknown if the M-values for multiple measurements can be combined in any way that would allow for the comparison of the sum total of all measurements held in common by two elements or whether any combination of individual measurements performs better or worse than any others. Nevertheless, because of the promise it holds and the ease of its calculation, M is reserved for future research using the data sets collected in this thesis.

Previous Attempts to Determine *N* Using the Gold Mine Site Collection

The first attempts at identifying the number of individuals represented by the material recovered from Gold Mine were based solely on counts of the number of burials and individuals (be they individual crania or more complete skeletons) as defined in the field. By Talley's (1978) report of the 1978 excavations 84 crania numbers were assigned in the field (1978), but his estimated $N \geq 90$ is based on a sample of only 55 crania and 39 ilia and uses none of the previously described quantified methods. Talley reportedly reconciled his subsample of crania and ilia to ensure that there were no instances of duplication (a single individual represented by both elements), but given the extent of *in situ* commingling and the numerous secondary interments it is unlikely that these reassociations are valid. One hundred burials had been excavated by the end of the 1979 excavation, but Walker's 1980 report on dental pathologies within the recovered material did not formally estimate *N*.

Berg's 1984 analysis of the skeletal assemblage was the first to produce a quantifiable *N* for the site. By his count the most frequently represented adult element was the left femur, giving an adult MNI of 41.[17] The collection at this point was moved into long-term storage at the University of Arkansas until its 2002 transfer to the University of Tennessee. Recognizing the extensive secondary commingling within the collection and the research limitations imposed by the lack of a thorough inventory, the long process of recording the collection's present state and attempting to reconcile its errors began with a preliminary demographic survey of the material recovered from the 1980 burials (Harmon 2004).

After reassociating elements of discrete individuals (a process with few reported details and significant problems, as discussed in the following

[17] Later analysis by Tatchell found 50 left femoral heads in good enough condition that they could be measured for biological sex analysis.

paragraph) and separating adults from subadult remains, Harmon reports an *N* of 24 for the 1980 burials (Tatchell 2010). This number is not a true MNI or quantification of *N* as determined through any of the previously described methods, however, but rather the sum of the nine adult males, five adult females, and 10 subadults (≤15 years old) Harmon identified in her analysis. Biological sex for adult individuals was determined based on analysis of the pelvis, skull, and long bones, while subadult status was determined through dental development, diaphyseal bone length, and epiphyseal closure. While the collection showed no bias in terms of biological sex for adults, Harmon's analysis showed an overrepresentation of individuals aged 0-5 and 30-35, with no remains for the 15-20 and 20-25 age groups.

Given the secondary commingling, it is unclear whether any of the material used by Harmon originated from the 1978 and 1979 excavations or whether 1980 material went overlooked. In surveying the collection and attempting to reassociate fragmented elements for this thesis, the author discovered multiple instances of elements supposedly excavated in 1980 that were successfully reassociated with elements supposedly excavated in 1978 and 1979. Tatchell also noted labeling problems within the collection, but while Harmon did work with the whole of the collection, producing the first set of inventories for the human remains[18] and dividing the contents of storage bags when necessary, there is no indication that she went outside of the labeled 1980 storage bags in the sampling for her demographic survey. Indeed, according to Harmon "individuals were typically sorted easily in the lab… and boxed accordingly. No guesswork really" (Tatchell 2011, reporting 2006 personal communication between Harmon and McGimsey). This does not match the experiences of the author or other researchers who have since worked with the collection (Tatchell 2011:136; Guthrie n.d.), all of whom have noted multiple instances of mislabeling and the grouping of elements of diverse ages even in the post-reorganized portions of the collection. Additionally, only 42% of the total skeletal assemblage was assigned to a field-defined burial, calling into question the ease and certainty with which previous researchers have sorted elements for storage.

In addition to compiling and reconciling all surviving records for the Gold Mine excavation, McGimsey's 2004 report is also the first attempt to take a count of all of the recovered skeletal remains from the site. After grouping each of the 59 discrete burials identified for analysis by interment type and summing their respective *N*s, McGimsey places the "minimum number (…) of individuals" (adult, juvenile, and infant) at Gold Mine at 141 (2004:97). This *N* appears inconsistent

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[18] As part of the 2004 *post-hoc* site report, McGimsey and several student assistants organized and inventoried the surviving artifact and faunal assemblages within the collection. This process—nearly four full semesters in length, with two semesters devoted to the 1980 collections alone—was complicated by a prior sorting of the collection analytical categories rather than by provenience; though tabulation sheets were available, there were no definitions for any of the previously-sorted classes (McGimsey 2004:22).

with the burial descriptions given elsewhere in his report, which list 137 individuals. Of the six interment types reported by McGimsey, only five are used to determine *N*; disarticulated remains scattered across surfaces and moundfill appear to have either been excluded from the calculation or integrated into the counts of other interment types (2004:99, 102). In addition, McGimsey's *N* was not calculated using a consistent methodology across all cases but rather defined on a burial-by-burial basis (i.e., basing *N* on the number of different developmental ages observed in one burial and the number of crania in another). While this small-scale approach can be used to determine the *N* of some solitary multiple interments, it cannot be applied to a larger ossuary context such as Gold Mine. Summing multiple *N*s with inconsistent defining parameters assumes that the osteological remains of each individual are always contained within one of the defined burials, and Gold Mine as a site is partially defined by its primary commingling, secondary burials, and poor burial boundaries.

McGimsey's work, however—which attempts to make sense of the frequently contradictory remnants of the Gold Mine's excavation records and the reports and recollections of those who worked on the site—remains an exemplary example of the benefits of rescue archaeology. He is careful to note discrepancies between accounts, photographic records, and what was known to remain of the excavated artifacts and osteological material. Given these caveats, it is easy to understand the difficulty in establishing a consistent set of criteria when, in many instances, only rough sketches and broad descriptions of the remains and their positioning are available. Indeed, McGimsey's recognition of the multiple problems with his estimate was one of the prompting factors to extend the loan of the collection for methodologically-sound bioanthropological research.

Tatchell's master's thesis—which attempted to determine the correlation of various long bone breadth measurements with age in order to increase the representation of subadults in the demographic profile (2010:4)—was one such rigorous quantification of the Gold Mine Site Collection, though her conclusions may still be biased by her reliance on the Harmon-produced inventories of the collection (which the author found of limited use to identify the best-represented skeletal element and side among the collection's identified adults and juveniles). By Tatchell's tally, adult individuals were best represented by the left mastoid process of the cranium (*N*=59), a feature she also utilized in the estimation of biological sex, followed by the left os coxa (*N*=51). Fragmentary left ilia were included in the maximum MNI count only if more than 50% of the auricular surface was present. Juveniles were best represented by the proximal metaphysis of the left tibia (*N*=44; 11 were too fragmented to be measured for breadth), followed by the proximal femur (*N*=30). Combining adult and juvenile MNI gives a total MNI and *N* of 103 individuals. Tatchell deemed commingling within the collection too great for visual pair-matching, and so she did not make any systemic effort to reassociate fragmented elements. Though biological sex could not be determined in all cases, no statistically significant difference was found in the ratio of males to females (Tatchell 2010:144). Tatchell (2010:81-

106) also found no evidence of the “gaps” in the demographic profiles noted by Harmon.

Three additional student papers were produced using the Gold Mine Site Collection in 2011: one master’s thesis and two senior honor’s theses. Nzingha’s study of oral pathologies and caries frequencies by biological sex and age in the assemblage was limited to approximately a third of the dental elements present within the collection (342 teeth from 73 burials). Within this sample the mandibular left first molar and mandibular left canine were the most frequently identified adult tooth (16 each), while the maxillary left first molar and left first and second molars were the most frequently identified deciduous teeth (seven each). Lans’s study utilizes the adult femora within the collection, of which the proximal end of the femur (57 rights and 53 lefts) was chosen for visual pair-matching (2011). Together Lans and Steadman identified 32 possible pairs (27 by Lans, 17 by Steadman), 12 of which were identified by both observers. Subsequent osteometric sorting using the skeletal material from Orendorf—a Middle Mississippian site from central Illinois—as a reference collection found three of those pairs to be statistically unlikely. Because there were no conflicting pairs, Lans combined the results of both observers before calculating MLNI. Assuming all 32 identified pairs were true pairs, MLNI for adult femora of Gold Mine was 93. Assuming only 29 of the identified pairs were true pairs, MLNI for adult femora of Gold Mine was 103.

Vázquez’s study utilizes the juvenile tibiae within the collection, of which the proximal metaphyses (43 rights and 55 lefts) was chosen for visual pair-matching. Steadman also served as the secondary observer within this thesis. Vázquez identified 14 pair matches, with a resulting MLNI of 163. Steadman identified eight definitive pair matches and four additional possible matches, with a resulting MLNI of 185 based on a total of 12 pairs. Using only Steadman’s eight definitive matches, the resulting MLNI is 273. Seven pairs (all of which were among Steadman’s definitive pairs) were matched by both observers with no conflicting pairs identified by either observer. No osteometric sorting was performed.

As no recovery probabilities or confidence intervals were calculated for either the Lans or the Vázguez studies at the time of their publication the author calculated them for inclusion in this thesis. They are summarized in Table 5.1 in Chapter V.

Conclusion

Because of the highly fragmentary nature of the collection and the unknown extent and nature of loss within it, it is unknown how severely MNI might underestimate the *N* of the Gold Mine Site Collection. Given those same problems, however, the methodologically conservative MNI may ultimately prove the most appropriate method of determining *N*. MLNI is dependent upon the accuracy of the number of identified pairs, and while trained osteologists have proven highly successful at identifying pairs, more apt to overlook a true pair than

to incorrectly identify a false pair, that ability is compromised by poorly-preserved samples. Although Tatchell (2010) could not perform visual pair-matching due to the nature of her sample (which included select osteometric sampling of the humeral head, femoral head, and proximal tibial epiphysis for demographic analysis but used the mastoid process to determine *N*), two other attempts at VPM using the juvenile tibiae (Vázquez 2011) and adult femora (Lans 2010) of the Gold Mine Site Collection reported no issues in the identification of pairs. The total number of identified pairs in each of these studies exceeded the threshold established by previous researchers as the minimum necessary to overcome the potential biases resulting from misidentified pairs. Other methods under consideration would appear to better account for many of the known issues of fragmentation and commingling within the collection but require the identification of an appropriate reference sample or further testing in order to confirm the applicability of the method towards the assessment of Native American archaeological remains from sites such as Gold Mine.

Ultimately, a final selection of the most appropriate method for determining *N* for the adult humeral and tibial material could not be based solely on general knowledge of the collection's state and the theoretical best practices for each method. A review of the previous attempts to determine *N* for the Gold Mine Site Collection reveals that the brunt of those attempts' more problematic aspects can be traced back to an improper or incomplete assessment of the sample assemblage. As the limitations of the collection were not firmly established prior to the selection of an appropriate analytical method, more appropriate methods were overlooked and the full context of their results went unreported. Final selection of the most methodologically rigorous and contextually appropriate means of determining *N* was therefore delayed until a complete assessment and inventory of the material to be tested could be made, as detailed in the following chapter.

CHAPTER IV
MATERIALS AND METHODS

Introduction

Though the human osteological material recovered from Gold Mine has been used extensively in prior research, including various attempts to quantitatively determine *N* for the excavated portion of Mound A, this data could not be used directly to meet the research objectives of this thesis. The previously-produced inventories proved of limited practical use when it came to identifying, selecting, and locating specific humeral and tibial elements for inclusion in the photographic catalog. Still other research—while providing insight as to the underlying causes of many of the collection's issues and offering crucial context for the understanding and evaluation of this thesis's findings—did not go into significant depth on the adult humeral and tibial portions of the collection and/or predated the development of many of the more rigorous analytical methods detailed in the previous chapter. Independently collected data was therefore a crucial component of this thesis.

The first portion of this chapter explains the logistical reasoning behind the selection of the humeral and the tibial material from the Gold Mine Site Collection for focused study as well as details the process by which that material was identified within the collection and removed for further study. The second portion outlines the data-collection and photography standards that guided the construction of the Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog and its accompanying inventories and osteometric data sets, the primary data generated as a result of this research. The methodologies used to determine *N* and the varying complications that prompted the modification of their applications are the focus of the third portion of this chapter, which concludes with an acknowledgement of the limitations of this thesis's approach.

Sample Selection

4.1.1 Selection of Humerus and Tibia

Because of the overwhelming number of elements within the collection, many of them highly fragmented to the point that they cannot be readily identified and sided, this thesis could not review every individual element from Gold Mine. As one of the objectives of this thesis was to accurately determine *N*, bilateral bones that could readily be used in visual pair-matching (VPM) were best suited to that task. Larger, denser bones are more likely to survive varying taphonomic processes relatively undamaged than are more delicate elements (Adams and Konigsberg 2004; Brian 1976; Galloway et al. 1997; Lyman 1993, 1994; Waldron 1987; Willey et al. 1997). The femur, tibia, humerus, and os coxa are some of the bones most recommended for visual pair-matching, not only due to their high

survivability rates but also thanks to their distinctive morphologies and potential for use in age and sex determination and height estimation in the case of the long bones (Adams and Konigsberg 2004). Because of the highly fragmentary nature of the collection, it was known beforehand that standard measurements would not be sufficient for any osteometric sorting attempted with the collection. Byrd and Adams's supplementary measurements—described in further detail in Section 4.3.3—were specifically established with fragmentary commingled remains in mind, making them perfect for this thesis (2003). They are limited to the long bones, however, and so the os coxa was excluded from consideration.

McGimsey's descriptions of identified burials and their contents do not include a complete listing of the number and types of skeletal elements recovered, making them of limited utility when trying to identify the best-represented of the adult long bones. Harmon's inventories, where available, have since been supplemented by additional work done by students during the collection's time at Binghamton but still represent less than a third of the total boxes in storage. Tatchell's inventory of adult skeletal elements within the collection had previously identified 67 humeri, 45 radii, 51 ulnae, 92 femora, 90 tibiae, and 24 fibulae within the collection, of which only 25 humeri, 11 radii, 9 ulnae, 29 femora, 29 tibiae, and 4 fibulae were deemed measurable by her criteria (2011).[19] Tatchell ultimately deemed the collection too fragmentary for VPM, choosing to focus on metric analysis and morphological assessment of the adult humeri, femora, and tibiae, and so no attempt was made to reassociate fragmentary elements. It was therefore possible that at least some portion of the fragmented elements could be reassembled into bones with enough represented features to be used successfully in a VPM attempt. Adult femora have already been used in a subsequent VPM attempt, as have the juvenile tibiae (Lans 2011; Vázquez 2011). Of the remaining untested adult long bones, the humerus and the tibia were the best-represented among the sample and the skeletal elements with the highest percentage of elements that Tatchell was able to measure (37% and 32%, respectively).

While previous pair-matching attempts have focused on a single skeletal element, there are multiple benefits to examining more than one bone at a time, particularly when those bones represent different parts of the body (the upper limb and the lower limb). First, it expands the pool of data that can be used to calculate *N*, an important consideration given the high degree of commingling within the sample. Second, as both the humerus and the tibia typically have comparable taphonomic survival rates (Galloway et al. 1997), any significant differences in their resulting *N*s may be indicative of differences in the treatment of each skeletal element within the Gold Mine mortuary practices. Third, from McGimsey's report it was known that at least some of the tibiae within the collection exhibited a notable degree of pathology. Many disease processes affect different parts of the body differently, and by comparing the rate and

[19] All totals represent combined lefts and rights.

characteristics of any pathology observed in both skeletal elements it might be possible to more accurately identify the pathological processes at work than it would be on the sole basis of a single skeletal element. Finally, having metric data for two different skeletal elements collected by the same researcher allows for the collection to be the subject of various types of osteometric analysis, including the analysis for variations in relative proportions and robusticity between the upper and lower limb. Byrd and Adams's supplementary measurements are intended to aid the reassociation of non-articulating long bones in an assemblage of commingled remains (2003); though not attempted here, their method may prove of great use in the long-term goal of identifying and reassociating discrete individuals from out of the mass of Gold Mine fragments.

4.1.2 Preliminary Survey

Once the adult humeri and adult tibiae had been selected for focused study, a preliminary review of all of the labeled humeral and tibial material was undertaken. The primary function of this review process was to assess the general state of the collection and make note of any peculiarities or potential problems that would need to be addressed by the methodology. This review also served to check the accuracy of all available inventories.

All elements within the Gold Mine Site Collection are grouped according to their recorded burial numbers. Each burial is represented by one or more large plastic bags. In some cases the contents of each burial are so few and small as to be stored all together in a single bag regardless of their type or age, but in the majority of cases elements are sorted by skeletal element type (i.e. humeri, phalanges, cranial fragments, miscellaneous long bone fragments) and stored in smaller, embedded plastic bags.[20] An effort has also been made to separate juvenile and infant remains from those of adults. The exterior of each bag lists the burial number and category assigned to all of the elements contained within them, and most bags also list their respective element numbers. The inventories reflect this system, with each element listed as a separate "item"[21] and identified by type, side, and juvenile status when applicable. Brief descriptions of the represented features are included for some fragmentary remains, and the presence of some pathology are also occasionally noted.

Unfortunately these inventories proved to be of limited utility when attempting to locate specific elements within the collection. The language used to describe each element was too general, failing to differentiate between whole and partially represented identifying features and often omitting pathologies. A

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[20] There are some exceptions to this general rule. Larger elements such as intact femora might be tagged and stored in dedicated canvas bags or tagged and left loose in the box itself. Mostly-intact crania and a few other more delicate elements have mostly been removed to dedicated long boxes and are among the few elements not stored with the rest of the osteological material recovered from their recorded burial contexts.

[21] In the case of previously reassociated and glued fragmentary elements, the inventories list each fragment within the reconstruction as an individual item.

fragmentary humeral element might be listed as “shaft to complete distal end”, but specifics including the total length of the shaft present, the degree of completeness of the deltoid tuberosity, if present, and the presence/absence of taphonomic damage or animal scavenging were not recorded. Finally, individual elements were also listed without noting any of the identifying element numbers recorded on their surfaces, making it extremely difficult to match specific bones to the generalized descriptions provided on the itemized lists. This proved especially true in cases where multiple elements of the same side and bearing the same general characteristics were stored together in the same bag.

Ultimately, it was faster for the author to personally survey every bag believed to contain adult humeral and tibial elements. This included not only those bags labeled as containing humeri and tibiae, but also bags of miscellaneous long bone fragments and unknown fragments. While outside the specific parameters of this thesis, in the interest of the long-term process of resolving the collection as a whole, any cases of misidentified elements not already flagged in the collection were noted and flagged.

4.1.3 Sampling Criteria

In order to meet the objectives of this thesis it was necessary to utilize as much of the humeral and tibial material as possible. While the preliminary survey did provide some guidance in regards to what identifying features were most likely to be present within the sample, acting solely from the results of this survey was likely to severely bias the makeup of the final sample. This, in turn, would limit the accuracy of any calculated *N* as well as unnecessarily restrict elements from inclusion in the photographic catalog and database. The initial survey had also yielded multiple instances of elements—both juvenile and adult—with atypical morphologies possibly shaped by a as of yet unknown pathological process (see Chapter VI). To restrict the sample solely to elements of specific use to the calculation of *N* would be to cut out elements crucial to placing these empirical results into a broader anthropological framework, particular in regards to understanding the disease processes at work within the living population. The sampling criteria was therefore adjusted to be as broad as deemed feasible, favoring a liberal sampling method with the understanding that elements might be removed from the sample at a later date should evidence support a more conservative approach.

Under the criteria established for the initial sampling of the Gold Mine Site Collection, an individual skeletal element was selected for further study provided that:

1) the element could be positively identified as either humeral or tibial in origin (exception: fragmentary elements of unknown origin but otherwise consistent with material from known humeri and tibiae were also pulled until a positive identification could be made, at which point they were either added to the sample or returned to storage);
2) the element was ≥ 8 cm in length *and/or* included one of the identifying features under evaluation for use in calculating *N and/or* could be

readily associated with other fragmentary elements in the same storage context to form a section of bone ≥ 8 cm;

3) the element had no juvenile features.

Because of the high degree of fragmentation, the second criterion was implemented in an attempt to prevent the sample from swelling to unmanageable numbers. Following the first attempt to reassociate fragmentary elements, however, it appeared likely that many of the < 8 cm elements might have served to connect other, larger fragmentary elements. In order to ensure that the reconstruction process was as thorough as possible, a supplementary sampling was undertaken using expanded criteria that allowed for the selection of skeletal material where:

4) though < 8 cm, there was a likelihood an element might
    a. associate to two or more other fragmentary elements
    b. expand the ability to take various osteometric measurements.[22]

This supplementary sampling also proved useful in recovering individual elements that had been overlooked in the initial sampling despite meeting the set criteria. Other fragments were later identified as long bones not under consideration for this thesis and were removed. Exceptions to criteria three were made in the case of some juvenile elements which exhibited one or more pathologies consistent with those observed in skeletally mature individuals. These juvenile elements were not incorporated into any determination of *N*, but were photographed for inclusion in the photographic catalog on the basis that they might be of use in understanding the pathological processes observed within the adult sample. All of the elements used in the final sample are inventoried in Appendix C (Humeri), Appendix D (Tibiae), and Appendix E (Select Juvenile Humeri and Tibiae).

4.1.4 Reassociating Fragments

Over half (56.31%, 216 definitive cases, 7 possible cases) of the individual elements within the sample had at least one exposed fracture edge that was noticeably lighter in coloration than the rest of the element. This difference in coloration (coded in the database as “WHITE FX”) is not consistent with pre-interment damage or fracturing events that took place prior to the mound’s excavation. Had an individual bone been broken before it was placed within the mound or during the subsequent centuries then that exposed edge would have been subject to the same taphonomic forces that affected the rest of the element’s coloration (as is the case with many of the elements within the sample). This difference in coloration is therefore highly indicative of damage sustained during the excavation process or the subsequent three plus decades of storage, handling, and cross-country transportation.

[22] Such elements typically consisted of fragmentary humeral heads and portions of the tibial plateau. Diaphysis fragments <8cm were less common.

All fragmentary elements were tested for possible reassociations with other fragmentary elements, not merely those identified under the "WHITE FX" category. This is in keeping with the recommendations put forward by Adams and Konigsberg (2008) for any sample intended for use in visual pair-matching. Given the extensive secondary commingling in the sample this was also the crucial first step towards resolving that damage and identifying potentially misplaced fragments within the collection.

To facilitate the reassociation process, elements were separated by side and laid out according to the most commonly represented identifying feature: the medial epicondyle for the humerus and the nutrient foramen for the tibia (group 1). Any elements not bearing these features (group 2) were then sorted into proximal elements (proximal epiphyses), shaft elements (diaphyses), and distal elements (distal epiphyses) and arranged according to any shared identifying features. Each element from group 2 was taken in turn and compared against the elements of group 1. Reassociations were then attempted between the elements of group 2. Finally, all elements and reconstructed elements from group 2 were double-checked against group 1 for previously-missed reassociations as well as control for any elements that had been removed from group 2 before intra-group associations could be checked. Elements of known humeral or tibial origin for which a specific side could not be determined were checked against both right and left elements.

To qualify as a positive reassociation, a direct conjoin must be possible between two or more elements. In the case of many non-shaft elements, the exposed matrix of interior spongy bone has long-since crumbled, distorting the shape of the fractured edge and making them much more difficult to reassociate. Reassociated fragments were joined together using masking tape or stored together in plastic bags when a stable reassociation was not possible. The original paper tags remained with their respective fragmentary elements, and all tags are displayed in photographs of the reconstructed elements.

Two exhaustive attempts were made to reassociate fragmented elements in order to make certain that no possible reassociation was overlooked. Fifty-one individual humeral elements and 26 individual tibial elements were successfully reassociated, producing a total of 25 reconstructed humeral elements and 12 reconstructed tibial elements. These numbers do not include any reconstructed elements originating from the same storage context. Fourteen of these reconstructions resulted in a bone with complete or nearly complete representation of features. Among the fragmentary elements for which no reassociations could be made were many cases where there was reason to believe that a reassociation *should* have been possible. These included cases where—in addition to the stark contrast in color between the fractured surface and the rest of the element—glue residue was observed on the exposed fractured edge as well as pencil markings where midshaft measurements had once been taken, a point that cannot be determined without the whole of the bone's length represented. It is possible that the missing portions of these bones

have been misplaced elsewhere within the collection, but time constraints prevent the careful search needed to locate them.

Database and Catalog Construction

4.2.1 Data Recorded

As skeletal material was removed for study, the following quantitative data were recorded into Excel™:

- **BOX**: Number of the storage container from which the individual element originated (GM#).
- **BURIAL:** Burial identification number as recorded on storage bag. As a general rule these consist of a two digit number referring to the year followed by a dash and the specific burial number assigned to the burial (ex: 78-11), though some burials from the 1979 and 1980 field seasons are identified by a grid number and excavation level in place of or in addition to the more standard burial identification format. When both are present, the burial number with a year included is listed first. Burial numbers with a letter (ex: 78-121a) were assigned by previous researchers whenever it was necessary to separate the contents of a burial bag (78-121). It should be noted that individual burials were often difficult to discern in the field due to a lack of recognizable pit outlines; as a result, the assignment of skeletal elements to one burial or another is often arbitrary and based on inference rather than actual stratigraphic evidence (McGimsey 2004). "Burial" is also not used exclusively to refer to deliberate primary and secondary interments, but also includes instances of surface scatter that was covered by either natural sedimentary deposits or additional construction of the mound.
- **CATEGORY:** How this number was utilized in the field is uncertain. Per McGimsey, the 1980 excavation season started using a prefix "K" before category numbers, but this division does not appear to have been consistently followed in the labeling of storage bags. Some storage bags and preexisting paper tags for 1978 and 1979 burials use the K prefix to designate the category number while others use the abbreviation "Cat.". Only the number itself (typically three or four digits, sometimes with an accompanying letter a-d) were entered into the database.
- **ELEMENT:** Any identification numbers recorded on the bony surface of the element itself is taken as its element number. Elements that have been previously reconstructed and glued often bear multiple numbers for each respective fragment. In some cases no individual identification numbers were observable. These were recorded as "no

label" within the database.[23] When more than two such elements were present per burial each fragment was assigned a letter and recorded as "no label 'a'", "no label 'b'", etc., otherwise a brief descriptor such as "(NF)" for "nutrient foramen" or "(head)" was used to distinguish between fragmentary elements.

- **SIDE:** Right ("R") or Left ("L"). Fragments of known humeral or tibial origin for which a side could not conclusively be determined are indicated with a question mark ("?").
- **VPM:** This field serves to identify all elements that were selected for use in the determination of *N*, including visual pair-matching.

Steps were also taken to ensure that all of the skeletal material was ultimately returned to its original position within the collection. When not already present[24], paper tags were produced for each element listing the box it had been stored in, the burial and category number listed on any relevant storage bag, and any identification numbers inscribed across the bone's surface. Reassociated elements originating from the same storage bag (and thus containing the same burial and category number) were either reassociated with masking tape or stored together in a plastic baggie and assigned either a single tag or multiple tags bearing identical information.

It was deemed too impractical at this point to record the presence/absence and condition for every possible identifying feature for both the humerus and tibia, so it was decided to focus only on those features identified in the initial survey as occurring with noticeable frequency and/or of potential use for osteometric analysis. Features were selected from both the proximal and distal portions of both skeletal elements along with one prominent feature from their respective diaphyses. This allows the accompanying inventory to be used as a quick general reference on the portion of the whole original humerus or tibia represented by an element. In the case of the humerus, the presence/absence of the medial epicondyle, trochlea, capitulum, lateral epicondyle, deltoid tuberosity, and head were each recorded, with presence coded as "1" and absence coded as "0". In the case of the tibia, the presence/absence of the medial malleolus, nutrient foramen[25], tibial tuberosity, and tibial plateau were similarly recorded. Features that were damaged but still observable were

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[23] The majority of these cases stemmed from GM46 BURunassigned 1978 CAT1074, which seems to have served as a catch-all for fragmented elements that had become disassociated from their original contexts. Many of these elements were able to be reassociated with other elements in the sample.

[24] In at least one instance the paper tag attached to a bone did not match either the information recorded on the bag it was stored in or the labeling present on the bone itself. This is assumed to be an error on the part of a previous researcher who had reason to remove the tag but failed to reassociate it with the correct bone. Regardless, this contradictory tag was left in place with a note highlighting the error, and an additional tag was created bearing the correct identifying information.

[25] As multiple nutrient foramen may be found along the diaphysis, only the large, prominent nutrient foramen located inferolateral to the popliteal line was counted in this tally.

counted as present. Many humeri were broken roughly at midshaft, however, and so the deltoid tuberosity was only recorded as present if more than half of its length was represented. As it was not always possible to conclusively identify whether more than half of a feature was present, any presence/absence of questionable veracity are indicated with a question mark (i.e. “0?” and “1?”).

Presence/absence was also noted for instances of:

- **PATHOLOGY**: A description of the specific characteristics of the pathology in question is available in the accompanying notes for each element. Scores were not assigned at this time due to the variety of pathologies observed.
- **GNAWING**: Defined as evidence of postmortem animal modification. This data was gathered with the intention of using it in a future study on the possible correlation between observed scavenging and burial type in an attempt to resolve questions in the site records as to whether primary and secondary interments were reliably recorded. The location and a brief description of the type of animal modification (concentrated gnawing versus incised grooves typical of carnivore scavenging, etc) of any observed animal modification was recorded in the accompanying notes for each element.
- **WHITE FX:** Defined as any instance in which the exposed surface of a fracture (“FX”) or the exposed interior bony matrix appeared lighter in color than the surrounding bone, indicating damage accrued at some point during or following excavation from the mound. This data was gathered for use in reassociating fragments and highlighting elements for which additional reconstruction may be possible.

As with the questionable presence/absence of damaged features, any instance in which the identification of possible pathology or animal modification is in question has been indicated with a question mark. The final field represented in the database is dedicated to notes on each specific element, briefly describing its’ condition, degree of fragmentation, the nature of any reconstructions, any taphonomic damage that might impede more quantitative analysis, and the nature and location of any pathology, animal modification, or modern damage.

As they were not included in the determination of *N*, the presence/absence of individual features was not recorded for the juvenile elements selected for pathological reference. All other fields are available.

4.2.2 Treatment of Reassociated Elements

Whenever two or more fragments from the same recorded burial context have been reassociated (typically originating from the same storage bag and therefore easily reassociated at the time they were being pulled for further study), they have been treated as a single element. They are represented by a single entry within all accompanying catalog inventories and data sets and bear only one identification tag. Any surviving reconstructions of multiple fragments reassociated with glue are also treated as a single element.

Two or more reassociated fragmentary elements from different recorded burial contexts are referred to as "reconstructed elements". Each component of a reconstructed element retains its own original identification tag. In keeping with the pattern used to keep track of the sub-sample used to determine *N*, if any of the component elements includes either the medial epicondyle (humeri) or the nutrient foramen (tibiae)—the two identifying features ultimately selected to qualify an element for inclusion within the visual pair-matching sub-sample, as detailed later in this chapter—then that component element's identification tag is the one used to determine the reconstructed element's position within the inventory. If the humeral medial epicondyle or tibial nutrient foramen is not present on any component element, then the distal-most component element is used to determine the reconstructed element's position within the inventory.

All other component elements are listed on lines following the prioritized component element and designated with a "w/" (i.e. "with") preceding their recorded box number. Any lines associated with nested component elements have also been italicized to further distinguish them. All inventory fields as detailed in the preceding section are recorded for each component element. For many of the reconstructed elements, there are multiple signs indicating that the reconstructed element was once a single element that became fragmented at some point during its excavation and processing and its component elements inadvertently scattered throughout the collection. As one example, there are several instances where element numbers span the point where two component elements can be directly conjoined. To uniformly merge the component element data of all reconstructed elements risks obscuring any cases where component elements were legitimately disassociated within the mound's context and thus potentially subject to different taphonomic processes.

Because of this treatment, however, additional care is required when attempting to determine the percentages that require the treatment of the reconstructed element as a single element as opposed to multiple component elements. In those instances the associated data for component elements should be merged.

4.2.3 Photograph Parameters

Photographs of the anterior, posterior, medial, and lateral views were taken for each element. Additional views and detail shots were also taken on a case by case basis. Elements that had been reconstructed using masking tape had one anterior view shot with the tape in situ, but all subsequent views were taken with the tape removed and supports[26] used to hold the fragments in anatomical position.

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[26] These can be observed in some of the final photographs and include small balls of white masking tape used to keep the bone from rolling out of position and stacks of Post-It notes slid underneath the black background to raise the bone into a level position. The author's hands can also be observed in some instances where hands-free support proved insufficient.

Photographs were taken against a black cloth background with a metric scale for visual reference. Lighting was kept as consistent as possible, though in cases of pathology, animal modification, or other interesting morphological textures the light source was shifted to a 45 degree angle to give those features greater depth. Some photographs include a small paper arrow highlighting features of interest, but it was discovered later that the inclusion of this arrow often confused the camera's ability to focus and so they were not used consistently. Tags were removed from the elements before being photographed but were included in the shot for identification purposes.

All of the photographs were taken with a Canon DS126071 (58 mm lens) set to auto-focus with the flash enabled. Two photos were taken per view; following a review for quality and clarity some photographs were retaken. In order to reduce the ultimate size of the digital collection and streamline its utility to the researcher only the sharpest photographs were included, however a raw collection of all photographs taken is available for review if needed.

Juvenile elements were also photographed following the methodology utilized for adult individuals. These photographs, while not representative of all of the juvenile humeral and tibial elements present within the collection, are included in a subfolder of the catalog.

The resulting photographs are collected in the Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog, detailed further in Chapter V. For information on the curation of these photographs and accessing the photographic catalog for research purposes, see the end of Chapter VII.

Determining *N*

As established in Chapter III, *N*, or the number of individuals represented by a given osteological assemblage, is not a static concept. By the parameters of this thesis, *N* is defined as the number of individuals represented within the 10-20% of Mound A that was excavated, i.e. the human skeletal material of the Gold Mine Site Collection. Estimation of the total number of individuals within the excavated and unexcavated portions of the site falls beyond the aims of this research, which are focused on reconciling issues within the collection itself.

4.3.1 Sample Selection

Only adult remains were used to quantify *N.* While the line between childhood and adulthood is culturally drawn, within osteological study the label of "adult" is typically conferred to all skeletally mature individuals (i.e., individuals in which union of all epiphyses is complete), with immature individuals labeled as "juvenile," "infant," or "neonatal" depending upon their development. While the remains of very young children and infants are easily separated from those of full-grown adults, the distinction is not so easily made between adolescents and young adults, particularly in assemblages like Gold Mine where a mixture of very gracile adults and very robust juveniles can be observed. Whether these extremes in variation are reflective of sexual dimorphism, the result of the various

pathologies observed within the sample (see Chapter VI), or otherwise indicative of group divisions within the people of Gold Mine is currently unknown.

The highly fragmentary nature of the Gold Mine Site Collection excludes the possibility of using only whole bones to quantify *N*. Lans (2011) and Vázquez (2011) each used the proximal portion of their respective bones of study (femur, juvenile tibia) while Tatchell (2010) focused on individual identifying features (mastoid process). Based on notes from this thesis's initial survey of the collection, it was assumed that the deltoid tuberosity and the medial malleolus would be the most frequently represented features for the humerus and tibia, respectively, but after tallying the counts for all elements the latter proved not to be entirely true. While the deltoid tuberosity was the most frequently represented feature within the sample (55 definitive lefts; 57 definitive rights), additional scrutiny of all the humeri with a recorded deltoid tuberosity revealed that many of those elements lacked both of their proximal or distal epiphyses, making it difficult to establish their skeletal maturity.

Of the remaining features, the medial epicondyle was both the best represented and the best indicator for skeletal maturity it was surpassed by the close third, the medial epicondyle (49 definitive lefts, 52 definitive rights). While technically complete fusion of the proximal epiphysis is a better indicator for adulthood in the humerus (Table 4.1), the proximal portion of the humerus was not as well represented (29 definitive lefts, 43 definitive rights, 7 definitive but side unknown), with many elements consisting solely of heads broken at the anatomical neck. The medial epicondyle is the last portion of the distal epiphysis to fuse, and while reported ages of this fusion are relatively broad, restricting its usefulness as a specific indicator of age, complete fusion of the medial epicondyle tends to coincide with the mid to late teens.

While only those elements with fully-fused medial epicondyles were counted towards the MNI, it is possible that some juveniles were accidentally incorporated into the final sample. Attempts to determine age osteometrically were hampered by the lack of a comparable Native American reference sample on which to model metric trends in both age and biological sex. Nevertheless, as described later in this chapter, osteometric data was collected for all of the humeri within the humeral VPM sample. While maximum length could not be taken for all humeri within the VPM sample, where available it has been compared to data collected from a mid-twentieth century sample of white children in the United States (Table 4.2).

For tibiae the nutrient foramen was by far the most widely represented individual feature (42 definitive lefts, 50 definitive rights). As with the deltoid tuberosity in the humeral sample, however, many of these tibiae lacked both a proximal and distal epiphysis, making it difficult to determine their skeletal maturity. There is some slight variation in the age of complete fusion of the proximal and distal epiphysis, with fusion of the proximal epiphysis occurring slightly later, marking the end of an individual's vertical growth in the late teens to early twenties (Scheuer and Black 2000). There is significant enough overlap in the age range for both epiphyses, however (Table 4.3), that it was determined

Table 4.1. Age of Complete Fusion (Years) of Proximal and Medial Epicondyle Epiphyses of the Humerus.

Author	***Assessment***	***Sample***	***Proximal***		***Medial Epicondyle***	
			Female	***Male***	***Female***	***Male***
McKern and Stewart (1957)	Dry bone	American war dead from Korea (1951-1957)	--	≥23	--	--
Schaefer (2008)	Dry bone	Bosnian war dead from fall of Srebrenica (1995)	--	≥18	--	≥16
Coqueugniot and Weaver (2007)	Dry bone	Portuguese individuals born between 1904-1938 (Coimbra Collection)	≥20	≥20	≥14	≥16
Brodeur et al. (1981)	Radiographic	--	--	--	~15	~15
Hansman (1962)	Radiographic	American children (Denver, CO), upper middle socioeconomic status	--	--	11-16	14-19
Jit and Singh (1971)	Radiographic	Mid-twentieth century Indian students	≥15	≥16	--	--
Sahni and Jit (1995)	Radiographic	Northwest Indian students, middle socioeconomic status	--	--	≥13	--
Schaefer et al. (2009)	Morphological summary	--	14-19	16-21	13-15	16-18
Scheuer and Black (2000)	Morphological summary	--	13-17	16-20	13-15	14-16

Table 4.2. Comparing Length of the Humerus (mm) in the Gold Mine Humeral VPM Sample to Mid-Twentieth Century White Children in the United States: Best Match Within ± 5 mm*.

Gold Mine			***Maresh (1970)***			
			Females		***Males***	
			Age	***Mean (±SD)***	***Age***	***Mean (±SD)***
Left (n=21)	***Mean (±SD)***	317.38 (±21.70)	15.0 (n=57)	315.6 (±17.0)	14.5 (n=64)	321.4 (±17.6)
	Min.	284	12.0 (n=75)	287.5 (±18.2)	12.0 (n=76)	282.0 (±13.8)
	Max.	356	15.5** (n=12)	323.2 (±19.6)**	18.0 (n=28)	350.6 (±15.6)
Right (n=31)	***Mean (±SD)***	310.71 (±18.08)	14.0 (n=64)	311.7 (±16.1)	13.5 (n=69)	305.0 (±16.6)
					14.0 (n=69)	313.3 (±16.8)
	Min.	282	11.5 (n=75)	278.5 (±17.3)	12.0 (n=76)	282.0 (±13.8)
	Max.	349	15.5** (n=12)	323.2 (±19.6)**	18.0 (n=28)	350.6 (±15.6)

*When no best match available within ±5 mm, then the data for both the youngest and oldest most-closely matching age groups, where available, is displayed.
**Maresh's data does not includes mean humeral length and standard deviation data female children aged 16.5 (n=3) or 18.0 (n=4). While data is available for female children aged 16.0 (n=40) and 17.0 (n=18) both means are lower than that available for the 15.5 age group.
All non-Gold Mine data from tables adapted in Scheuer and Black (2000:289)

Table 4.3. Age of Complete Fusion (Years) of Proximal and Distal Epiphyses of the Tibia.

Author	***Assessment***	***Sample***	***Proximal***		***Distal***	
			Female	***Male***	***Female***	***Male***
Cardoso (2008)	Dry bone	Portuguese individuals buried between 1903 and 1975 (Lisbon Collection)	≥16	≥17	≥15	≥16
Coqueugniot and Weaver (2007)	Dry bone	Portuguese individuals born between 1904-1938 (Coimbra Collection)	≥19	≥19	≥17	≥16
McKern and Stewart (1957)	Dry bone	American war dead from Korea (1951-1957)	--	≥23*	--	≥20
Schaefer (2008)	Dry bone	Bosnian war dead from fall of Srebrenica (1995)	--	≥17	--	≥16
Crowder and Austin (2005)	Radiographic	American children (Ft. Worth, TX) born 1969-1991	--	--	≥12	≥14
Hansman (1962)	Radiographic	American children (Denver, CO), upper middle socioeconomic status			14.5	16.5
Pyle and Hoerr (1955)	Radiographic	Cleveland Study, North American children beginning in 1926, birth-21 years	14.5	17	--	--
Schaefer et al. (2009)	Morphological summary	--	14-18	16-20	14-17	16-18
Scheuer and Black (2000)	Morphological summary	--	13-17	15-19	14-16	15-18
*A groove may persist at the posteriomedial side, the last portion of the proximal epiphysis to fuse, until the age of 24.						

that the presence either was sufficient to identify an adult individual. Of the tibial elements with an observable nutrient foramen, 14 lefts and 12 rights were missing both their distal and proximal portions. While these shaft fragments appeared consistent in size with the diaphyses of known adults in the sample, they generally lacked the identifying features needed for accurate visual pair-matching. Additionally, the presence of multiple highly-robust juvenile pathological tibia meant that size alone could not serve as an indicator for adult status, particularly in the absence of a reference sample. Indeed, among the pathological juveniles pulled for further study were two particularly robust and anteriorly bowed cases with completely unfused proximal and distal epiphyses that were larger than many of the known adults (see Appendix B, Figures B.1 and B.2). For these reasons, only those tibial elements which had both a nutrient foramen and at least one of either the proximal or distal epiphysis present and fused were included in the sample.

As with the humeral VPM sample, osteometric data was collected for all of the tibiae within the tibial VPM sample. While maximum length could not be taken for all tibiae within the VPM sample, where available it has been compared to data collected from a mid-twentieth century sample of white children in the United States (Table 4.4). Given the complete fusion of the proximal and distal epiphyses in all of the Gold Mine tibiae for which length could be measured (all but four of which showed no indication of the lingering posteriomedial groove noted by McKern and Stewart), this disparity between the age indicated by epiphyseal fusion and the age indicated by total length supports previous assertions that the people of Gold Mine were relatively short in stature, particularly when compared against a modern sample. Taken with the similar disparity seen within the humeral sample, these comparisons further highlight the importance of establishing a comparable Native American reference sample.

4.3.2 Visual Pair-Matching

In light of the highly fragmentary nature of much of the sample, there is some debate as to the appropriateness of visual pair-matching in this thesis. Most quantification techniques are tested using artificially-imposed taphonomic loss on a collection with otherwise good preservation and known individuals with established pairs, but Adams and Kongisberg (2008) themselves do not provide any parameters for what might qualify as "extensive" fragmentation or poor preservation. It is also unclear as to whether the loss and damage sustained by the collection—either *in situ* at the mound or in the time since its excavation— is truly random. Both factors complicate the ability of observers to make reliable pair-matches and would therefore bias any quantification techniques that use those pairs in their calculations.

In the end, it was decided that attempting visual pair-matching was a justifiable course of action in this instance. While much of the sample is fragmentary, there are only 7 left and 8 right humeri that do not extend to at least the distal-most portion of the deltoid tuberosity. The selection criteria used for the tibiae also means that at least one of the tibial ends and a good portion of the

Table 4.4. Comparing Length of the Tibia (mm) in the Gold Mine Tibial VPM Sample to Mid-Twentieth Century White Children in the United States: Best Match Within ± 5 mm*.

Gold Mine			***Maresh (1970)***				***Anderson et al. (1964)***			
			Females		***Males***		***Females***		***Males***	
			Age	***Mean (±SD)***	***Age***	***Mean (±SD)***	***Age***	***Mean (±SD)***	***Age***	***Mean (±SD)***
Left (n=14)	***Mean (±SD)***	353.93 (±18.25)	11.5 (n=75)	350.4 (±23.2)	12.0 (n=76)	357.3 (±19.1)	18 (n=67)	346.5 (±21.61)	14 (n=67)	351.8 (±28.65)
	Min.	321	10.0 (n=83)	321.1 (±21.7)	10.0 (n=76)	320.0 (±15.7)	12 (n=67)	326.1 (±24.24)	12 (n=67)	317.5 (±25.36)
	Max.	380	13.5 (n=62)	379.0 (±21.8)	13.0 (n=69)	376.7 (±20.6)	18 (n=67)	346.5 (±21.61)	18 (n=67)	372.9 (±22.54)
Right (n=9)	***Mean (±SD)***	355.44 (±19.67)	11.5 (n=75)	350.4 (±23.2)	12.0 (n=76)	357.3 (±19.1)	18 (n=67)	346.5 (±21.61)	14 (n=67)	351.8 (±28.65)
	Min.	321	10.0 (n=83)	321.1 (±21.7)	10.0 (n=76)	320.0 (±15.7)	12 (n=67)	326.1 (±24.24)	12 (n=67)	317.5 (±25.36)
	Max.	382	14.0 (n=64)	384.3 (±21.4)	13.0 (n=69)	376.7 (±20.6)	18 (n=67)	346.5 (±21.61)	18 (n=67)	372.9 (±22.54)
					13.5 (n=69)	388.2 (±22.0)				

*When no best match available within ±5 mm, then the data for both the youngest and oldest most-closely matching age groups, where available, is displayed.
All non-Gold Mine data from tables adapted in Scheuer and Black (2000:416)

bone's shaft are available for comparison. Should the results prove unreliable they would be reported as such and weighted accordingly. Additionally, even if the results of the VPM process as a whole could not be used for any attempts to quantitatively determine *N,* the process of establishing possible pairs is important to the ultimate goal of understanding mortuary practices at Gold Mine. If two researchers identify the same two elements as a possible pair then that can be incorporated into a body of evidence supporting their eventual identification as a true pair. If the original burial proveniences of the various elements can ever be established, then it will be of interpretive interest to see whether the elements from a single individual were interred together or separately.

Per Adams and Byrd (2006), left and right elements were seriated by size and laid out shortest/most gracile to longest/most robust for easy comparison. While all left elements were compared against all right elements and vice versa in order to assure that every element was given an equal opportunity at being pair-matched, this arrangement greatly expedited the process by making it easy to exclude the extremes of the scale.

Though successfully employed in some commingling cases (Adams and Byrd 2006), similarities in taphonomic changes such as bone color, overall degradation, and degree of animal modification were not used as evidence towards a possible pair-match in this thesis as there was no indication proving or disproving the assumption that paired elements from the same individual were subject to the same taphonomic processes. Given the number of secondary burials with multiple individuals, the various caches of elements by type (long bones, patella, phalanges, etc.), and the presence of at least some long bone fragments amongst the surface scatter, unequal "treatment" among paired elements—even if unintentional—would not be a surprising find.

This thesis defines a possible pair-match as any two left and right elements in the VPM sub-sample that are consistent in their size (robusticity, length, and breadth), the appearance and alignment of their identifying features, and overall shape. As the sample is highly fragmentary there are few instances where bones can be compared by their full length, one of the easiest and fastest means of excluding possible pair-matches. In the absence of whole bones, length is judged by aligning common features of two elements, i.e. the distal-most point of the deltoid tuberosity, and examining the remaining features for any inconsistencies. The epiphyses, when present, are examined similarly: in the case of the humeri this involves the direct comparison of the alignment and appearance of the trochlea, capitulum, and greater and lesser tubercles; in the case of the tibiae this includes the direct comparison of the alignment and the appearance of the intercondylar eminence, medial and lateral condyles, proximal fibular articular facet, fibular notch, medial malleolus, and distal articular surface. Discrepancies in shape include a significant degree of bowing or twisting observed in only one of two elements otherwise consistent in size and the alignment of features and are grounds for the exclusion of a possible pair. While mirrored pathologies are taken as one indicator of a possible pair, they are given less weight than consistencies between the proximal and distal articulating

surfaces when present as the gross morphology of the epiphyses is less likely to be affected by pathological processes than that of the diaphysis. Similarly, many humeri included olecranon foramen, but as this feature is not always bilateral its presence/absence and overall shape are given less weight in identifying or excluding possible pairs than were the other criteria discussed.

If one possible pair-match stands out above all others then that is the sole possible match listed for the element in question. If multiple possible pair-matches cannot be excluded on the basis of the above criteria, then all are listed as possible pairs on the assumption that it may prove possible to exclude some or all on the basis of osteometric analysis at a future date. Unfortunately, this resulted in significant complications for the humeral sample as described in greater detail later in this chapter as well as in Chapters V and VI. A second set of test criteria were developed to identify both the maximum number of theoretically plausible pairs and the maximum number of conservatively-identified pairs. Further osteometric testing may be able to exclude some of those conflicting and problematic pairs.

4.3.3 Osteometric Analysis

The original intent for this thesis was to adapt Byrd and Adams's 2003 sorting method in order to identify statistically plausible and implausible left and right pairs, but after further research it was discovered that the method was not sensitive enough to distinguish between elements of the same type and similar morphology. The emphasis of the study was therefore shifted to focus more prominently on the variant success and statistical validity of each of the reported instances of visual pair-matching with the Gold Mine Site Collection.

Osteometric sorting could not be performed as part of this thesis due to the lack of an accessible and comparable reference collection. The University of Tennessee is home to a wide range of human skeletal collections, most prominent of which is the William M. Bass Donated Skeletal Collection. While an invaluable resource for any research where individuals of known age, biological sex, and self-reported race are needed, as a modern collection it cannot be compared with any statistical accuracy to Native American archaeological remains. The Native American assemblages currently housed at the McClung Museum are either too fragmented, too few, or too dissimilar to serve as a reliable reference study.

While it is always vastly preferable for the same researcher to collect the measurements for both the sample being tested and the reference sample in order to control for interobserver error, this is not always feasible. Unfortunately, even previously-published data sets are of little comparative use in this thesis, since by and large they lack the supplementary measurements needed to compensate for the degree of fragmentation. Byrd and Adams' original assembled data sets used to define those supplementary measurements are available by request, but as they are based on the skeletal remains of mostly modern, non-Native individuals their applicability here is limited.

Measurements were nevertheless taken for all of the elements selected for visual pair-matching in the anticipation that they could be utilized in future research (Appendices E and F). Wherever possible Byrd and Adams' supplementary measurements were taken in addition to the standard measurements defined in *Data Collection Procedures for Forensic Skeletal Material* (2003; Moore-Jansen et al. 1994). These measurements are listed and defined in Table 4.5.

4.3.4 Determining **N:** *Final Methodology*

Following a thorough review of the humeral and tibial material it was decided that visual pair-matching could be justifiably attempted. The reassociation of fragmentary elements yielded many whole or otherwise well-represented reconstructed elements, particularly within the sub-sample of established individual adults (as identified by the presence of the fused medial epicondyle for the humeral sample and the presence of the nutrient foramen in association with a fused proximal and/or distal epiphysis for the tibial sample) considered for visual-pair matching. Based on observations made with similar left and right elements from identical recorded burial contexts, pathologies and other atypical morphologies, when present, appeared likely to be bilateral in many instances, reducing their negative impact on the ability to identify pairs. It is therefore in keeping with this thesis's aims to at least attempt visual pair-matching, the results of which—even if they cannot be taken as accurate across the whole of the sample—may be used as an additional line of evidence towards the reconstruction of individual skeletons within the collection.

In the most conservative approach, *N* is represented by the MNI as calculated by the presence of common identifying features: the fused medial epicondyle of the humerus and the nutrient foramen of the tibia. Only those elements that have been established as deriving from adults using the criteria described in the preceding section are included in this count. Should evidence point towards potential error within the results of the VPM process, the MLNI is eschewed in favor of the MNI.

MLNI has also been calculated based on the results of the VPM process. Due to the frequent inability of both observers to conclusively eliminate multiple possible pair-matches for a single element and multiple instances of conflicting pairs both between observers (more so in the humeral sample than in the tibial), however, the number of pairs identified in the VPM process cannot be taken as an accurate representation of the number of true pairs within the sample. Normally many of these conflicts could be resolved by using a reference sample to construct a model of the osteometric variance between the right and left elements of known individuals. While these models cannot be used to conclusively identify possible pairs, any elements falling outside of the level of difference deemed statistically significant may be excluded as a possible pair.

In the absence of such an established model, MLNI has been calculated using two different definitions of successful pair-matches for each researcher. The first definition is based solely on the logistical plausibility of all identified

Table 4.5. Measurement Definitions.

#	***Measurement***	***Description****	***Measurement Guidelines***
40	Maximum Length of Humerus	The direct distance from the most superior point on the head of the humerus to the most inferior point on the trochlea.	Osteometric board. Place the humerus on the osteometric board so that its long axis parallels the instrument. Place the head of the humerus against the vertical endboard and press the movable upright against the trochlea. Move the bone up, down and sideways to determine the maximum distance (Bass 1971:114; Hrdlicka 1952:168; Martin 1957:532 #1; Olivier 1969:226).
41	Epicondylar Breadth of the Humerus	The distance of the most laterally protruding point on the lateral epicondyle from the corresponding projection of the medial epicondyle.	Osteometric board. Place the bone with its posterior surface resting on the osteometric board. Place the medial epicondyle against the vertical endboard and apply the movable upright to the lateral epicondyle (Martin 1957:532 #4).
41a	Capitulum-Trochlea Breadth	The breadth of the capitulum and trochlea at the distal humerus.	Sliding calipers. One end of the sliding calipers is positioned parallel to the flat, spool-shaped surface of the trochlea, and the other end is moved (Byrd and Adams 2003).
42	Maximum Vertical Diameter of the Head of the Humerus	The direct distance between the most superior and inferior points on the border of the articular surface.	Sliding calipers. Measure the vertical distance perpendicular to the transverse diameter of the head of the humerus. Do not include arthritic lipping which may be present on the perimeter of the joint surface. This diameter is not necessarily the maximum diameter overall (Martin 1957:533 #10).
42a	Anterior-Posterior Breadth of the Head of the Humerus	The maximum breadth of the humeral head taken in the anterior-posterior direction on the articular surface.	Sliding calipers. This measurement is taken perpendicular to the vertical diameter of the humeral head (Byrd and Adams 2003).

Table 4.5. Continued.

#	***Measurement***	***Description****	***Measurement Guidelines***
43	Maximum Diameter of the Humerus at Midshaft	--	Sliding calipers. Determine the midpoint of the diaphysis on the osteometric board and mark with a pencil. Where the ends are broken off, the midpoint may frequently be approximated by visual estimation. The midpoint is generally located a few millimeters below the inferior margin of the deltoid tuberosity. Turn the bone until the maximum diameter is obtained. This measurement is different in an anterio-posterior lane (Martin 1957:532-533 #5).
44b	Minimum Diameter of the Humeral Diaphysis	The minimum diameter of the humeral diaphysis taken in any direction perpendicular to the shaft.	Sliding calipers. This measurement should be taken on the oval part of the shaft, superior to the flattening observed around the olecranon fossa and the lateral supercondylar ridge. Often it is found near midshaft (Byrd and Adams 2003).
69	Length of the Tibia	The distance from the superior articular surface of the lateral condyle of the tibia to the tip of the medial malleolus.	Osteometric board. This measurement is much easier using a board with a hole for the intercondylar eminence. Place the tibia on the osteometric board resting on its posterior surface with the longitudinal axis of the bone parallel to the board. Place the lip of the medial malleolus on the vertical endboard and press the movable upright against the proximal articular surface of the lateral condyle (Bass 1971:187; Martin 1957:572 #1; Montagu 1960:72; Trotter and Gleser 1952:473).
70	Maximum Epiphyseal Breadth of the Proximal Tibia	The maximum distance between the two most laterally projecting point on the medial and lateral condyles of the proximal epiphysis.	Osteometric board. Place the tibia on the osteometric board resting on its posterior surface. Press the lateral condyle against the vertical endboard, and place the movable upright against the medial condyle. Tibiae exhibiting marked torsion may have to be rotated to obtain the maximum breadth, but do not include the occasionally prominent articular surface for the fibula (Martin 1957:572 #3).

Table 4.5. Continued.

#	***Measurement***	***Description****	***Measurement Guidelines***
71	Maximum Epiphyseal Breadth of the Distal Tibia	The distance between the most medial point on the medial malleolus and the lateral surface of the distal epiphysis.	Osteometric board. Place the two lateral protrusions of the distal epiphysis against the fixed side of the osteometric board and move the sliding board until it contacts the medial malleolus (Martin 1957:573 #6).
72	Maximum Diameter of the Tibia at the Nutrient Foramen	The distance between the anterior crest and the posterior surface at the level of the nutrient foramen.	Sliding calipers. Rotate the caliper arms around the bone to get a maximum reading (Bass 1971:187; Martin 1957:573 #8a).
73	Transverse Diameter of the Tibia at the Nutrient Foramen	The straight line distance of the medial margin from the interosseous crest.	Sliding calipers. This is taken perpendicular to #72 (Martin 1957:573 #9a).
74	Circumference of the Tibia at the Nutrient Foramen	The circumference measured at the level of the nutrient foramen.	Sliding calipers. (Martin 1957:574 #10a).
74a	Maximum Anterior-Posterior Diameter Distal to Popliteal Line	--	Sliding calipers. This measurement should be taken at the most distal point of the popliteal line. Note that the correct location may be difficult to determine in very gracile individuals (Byrd and Adams 2003).
74b	Minimum Anterior-Posterior Diameter Distal to Popliteal Line	--	Sliding calipers. Locate the smallest anterior-posterior distance at any point on the tibial shaft (Byrd and Adams 2003).
*With the exception of 41a, 44b, 74a, and 74b, all descriptions and measurement guidelines taken from *Data Collection Procedures for Forensic Skeletal Material, 3rd Edition* (Moore-Jansen, Ousley, and Jantz, 1994). All other descriptions taken from Byrd and Adams (2003).			

pairs. Using a set of deductive criteria described in full in Chapter V, the maximum number of plausible pairs identifies the maximum number of identified possible pairs that can exist without conflict. As it makes no claim as to the number of true pairs within the sample, the specific elements within these pairs are less important than the tabulation of the maximum number of pairs that either researcher could have *theoretically* identified correctly (i.e., in the case of one right humerus with multiple lefts identified as possible pairs, it is assumed that a successful pair-match is represented by one of those lefts). It must be stressed that the MLNI produced using the maximum number of identified pairs is likely *not* representative of the true *N*. It has been produced here solely as a basis of comparison for the MLNI produced by the second, more conservative approach to identifying the number of pairs within the sample, the minimum number of plausible pairs, where only those pair-matches without any intraobserver conflict are counted towards *P*.

Recovery probability (*r*) and 95% confidence intervals (CI) were calculated for both the maximum and minimum number of plausible pairs for both observers using the pre-programmed Excel™ spreadsheet for a single element provided by Kongisberg (2005). Recovery probabilities and 95% confidence intervals were also calculated for the published results of all previous attempts at VPM using the Gold Mine Site Collection so that the results of this thesis may be placed into a broader perspective. Previous validation studies by Adams and Konigsberg (2004) have shown MLNI to produce its most accurate *N* when recovery rates approach 50%, but recovery rates as low as 30% show significant improvement over the MNI. Any MLNI calculated using the most conservative definition and number of identified plausible pairs with a result of *r* ≥30% is therefore taken as a more accurate reflection of the true *N* than the MNI.

Osteometric assessments could not be performed due to the lack of an appropriate reference sample. The identification of an appropriate reference sample is further complicated in the case of the tibiae by the numerous instances of atypical morphologies associated with various pathologies (see Chapter VI). Any comparative assemblage would either need to exhibit similar rates of the same atypical morphologies or all of the aberrant tibiae elements would have to be excluded from the statistical assessment. Once an appropriate reference sample has been identified and many of the osteometric analysis methods detailed n the previous chapter have been validated using that sample, it may be possible to resolve many of the instances of intraobserver conflict, refine the number of identified pairs, and further test any instances of interobserver error. All of the data needed to make those assessments has been reported here n Appendices G and H.

Conclusion: Limitations of Methodology

Regardless of all the best efforts at a rigorous and appropriate methodology, it is likely that any resulting *N* produced by this thesis will underestimate the actual number of individuals represented within the Gold Mine

Site Collection. Despite extensive sampling and multiple attempts to reassociate fragments many of the bones utilized in the final VPM humeral and tibial samples were still highly fragmentary, limiting their ability to be compared effectively. Two humeral elements that would have been easily excluded as a possible pair on the basis of total length alone when whole might be similar enough in their distal morphologies to increase the possibility of a Type II error.   Adult humeri and tibiae might also be excluded from the VPM sample and MNI count because of damage to the medial epicondyle or distal and tibial epiphyses, respectively, making it possible to confirm their adult status. Once an appropriate reference sample for Gold Mine has been identified and measured using Byrd and Adams' supplementary measurements it may be possible to build an osteometric model to identify additional adults from among the excluded fragmentary elements and further refine the final *N*.

Attempts to contextualize the pathology within the sample are also limited to what is observable on each individual element as opposed to incorporating the whole of the skeleton into the differential diagnosis. Even in instances of apparent primary single interments any elements that cannot be directly associated or articulated with other elements from the burial cannot be assumed to originate from the same individual. The presence of pseudo extended burials within the mound raises the possibility of elements from multiple individuals being deliberately or mistakenly placed in a manner that mimics the skeleton of a single individual. Any attempt to evaluate the skeletal remains of a single individual should at minimum include strong osteometric-based evidence supporting the statistical likelihood of the relationship of all remains in question.

It should be noted that the selection criteria used within the two elements represented within this thesis are not without their respective biases. For example, by definition much smaller humeral fragments could qualify for study relative to tibial fragments, as only the medial epicondyle was required to establish side, individuality, and maturity in each case. In the case of tibiae, however, almost half of the original bone—a portion of the shaft stretching from nutrient foramen to either the proximal or distal epiphyses—was needed to meet the same criteria. As a result, the true MNI may be more accurately reflected in the humeral sample than in the tibial sample. Conversely, the true MLNI may be more accurately reflected in the tibial sample due to the overall greater representation of each individual bone selected for visual pair-matching.

CHAPTER V
RESULTS

Introduction

The two previous attempts to sort various long bone skeletal elements of the Gold Mine Site Collection using visual pair-matching reported few difficulties despite the fragmentary nature of their samples (Lans 2011; Vázquez 2011). As predicted by Byrd and Adams (2003), most of the few errors were Type I in nature, true pairs overlooked by one or both observers, and in the lone study to use osteometric sorting only two of the identified pairs were deemed to fall outside the range of statistical probability for variance between true pairs (Vázquez 2011). There were few instances where either observer was not confident in their pair-match and no reported instances of multiple possible pair-matches. There were also no cases of contradictory pairs—two observers matching the same common element to two different elements.

As previously stated, the objectives of this thesis are to: 1) produce a photographic catalog and corresponding database of all of the elements sampled for use in future research; 2) accurately determine *N* using the most statistically appropriate methods for the sample; 3) identify the likely source of any factors that negatively impact the ability to accurately determine *N*; and 4) contextualize all results in terms of how they impact our understanding of the Gold Mine site, its people, and the research potential of the collection as a whole. This chapter focuses on the production of the photographic catalog and the determination of *N*; the third and fourth objectives, being more interpretive in nature, are covered in-depth in Chapter VI.

The first section of this chapter summarizes the final contents of the photographic reference catalogs produced of all osteological material used in this thesis, hereafter known as the Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog; for information on how to access this catalog and all of its accompanying inventories and data sets please refer to the end of Chapter VII. The next two sections focus on the question of how many mature individuals are represented by the humeral and tibial remains of the Gold Mine Site Collection. Though all attempts were made to follow the methodology set in place in the previous chapter, there were some unforeseen complications and unresolvable errors; they are described here alongside the raw empirical results so that these results and the logic behind their calculation may be understood in their full context. All results are compared against those of Lans and Vázquez (2011; 2011), whose findings have been expanded using the statistical validation processes put forward by Adams and Konigsberg (2004; 2008).

For the sake of clarity, portions of this and succeeding chapters refer to the author by surname, particularly when comparing the author's own results against the other observer in this thesis and/or any previous researchers.

Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog

In its present form, the Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog consists of over two thousand separate photographs (Figure 5.1), representing nearly 400[27] whole and fragmentary adult humeral and tibial elements and six select pathological juvenile elements. The catalog also includes the original Excel™ versions of all of the inventories and data sets reprinted here in Appendices C-H. Because of ethical considerations and the large size of the catalog itself (see the end of Chapter VII), curation of the photographic catalog is currently restricted to the author, Dr. Dawnie Steadman, current Director of the Forensic Anthropology Center at the University of Tennessee, Knoxville, and Dr. Charles "Chip" McGimsey in his current capacity as State Archaeologist for Louisiana.

5.1.1 Catalog Organization

All of the basic identifying information for each element is included in the file name of each photograph, along with an indication of the anatomical view shown. Multiple photographs showing the same element and anatomical view are so numbered, and supplementary shots meant to highlight pathology or other morphological details also include a "DETAIL" designation in their file name as follows:

GM[#] BUR[#] CAT[#] [ELEMENT] [VIEW/DETAIL][#].

By including all of this information in the file name for each separate photo in addition to each element's respective folder any number of images can be easily compiled into a new folder for whatever purpose without the potential for duplicate file names. While there are a few repeated elemental numbers within the sampled collection, the only instances where those identically numbered elements also shared identical storage and recorded burial contexts appear to be cases of paired left and right elements. In each of these cases the left element also includes a (L) in its file name, identification tag, and inventory entry. Right elements are not designated with a (R) because many programs automatically interpret and format (R) as a registered trademark symbol.

In the case of reconstructed elements, photographs were taken for both the reconstructed element as a whole and all separate component elements. Photographs of the reconstructed element list the identifying information of the prioritized element (see Chapter IV) first, with all associated component elements listed subsequently in parenthesis as follows:

(with GM[#] BUR[#] CAT[#] [ELEMENT]) [VIEW/DETAIL][#].

---

[27] 207 individual humeral elements were pulled for study; after reassociation, those elements represent 181 entries into the catalog. 189 individual tibiae elements were pulled for study; after reassociation, those elements represent 174 entries into the catalog.

Figure 5.3. Sample photographs from Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog, showing anterior, posterior, lateral, and medial views of GM74 BUR80-9 0N0E Level 6 D1-3 CAT136 984, HRC_27.

Unfortunately, the identifying information for each component element could not be listed in both the containing folder and individual photographs of the full reconstructed element because to do so would exceed the 255 character limit of the file directory path. In these cases, a shortened version of the identifying information consisting only of the GM[#] and [ELEMENT] fields was used in the photograph file names. All information was included in the name of the containing folder.

5.1.2 Juvenile Elements in the Catalog

While not included in any of the calculations in this thesis, some juvenile elements (see Appendix E) were pulled from storage and documented. In some cases this inclusion was accidental—their juvenile status was not recognized until later, at which point any photographs and associated data were removed from the study and the elements returned to storage. Most of the juveniles pulled for additional study, however, were specifically selected because they appeared to exhibit many of the same pathologies observed within the adult population. As many of the conditions that could have caused the gross morphological changes observed in many of the adult tibiae frequently originate in childhood (see Chapter VI), the inclusion of these juvenile elements may prove useful in understanding the full sequence of stresses faced by the population. All of the juvenile elements are stored in a separate folder ("Gold Mine Select Pathological Juvenile Humeri and Tibiae"), and an additional protocol—JUV—is attached to the beginning of their file names.

5.1.3 General Condition of Sampled Elements

Although fragmentation was indeed prevalent throughout the collection, there were a surprising number of complete humeri and tibiae. Of the adult elements, 47 humeri and 23 tibiae are either wholly-represented or with minimal damage to non-identifying features. Few are "whole" in that they have not at one point or another been broken into multiple fragments, but most had either been previously reconstructed or were found with all of their components stored in the same storage context. Only 10 of the complete humeri and two of the complete tibiae were reconstructed from elements found in different storage contexts. Other elements—both reconstructed and otherwise intact—lack only one or two identifying features. The majority of the smallest elements within the sampled assemblage consist of the humeral heads, tibial plateau fragments, and featureless diaphysis fragments pulled during the second round of sampling with the hope that they might be reassociated with previously-pulled larger elements.

Visual Pair-Matching: Humeri

Eighty-four humeri (54 right, 50 left) and 66 tibiae (38 right, 28 left) were selected for pair-matching. All conformed to the criteria established in Chapter IV with the exception of one right (GM85 BUR0N4E Level 5 C1-9 Cat183C 478,

HRPM_1, HRD_16) and one left (GM32 BUR78-75 CAT960 1718, HLC_18; with GM31 BUR78-74 CAT959 75, 74-3; with GM24 BUR78-53 CAT940 74-3). The medial epicondyle is absent in both of these fragmented bones, yet the bones are otherwise nearly complete. The proximal epiphysis is completely fused in both cases, and the two bones are among the most robust humeri observed in the collection.

After consulting with Steadman prior to pair-matching, it was decided that the robusticity and high degree of completeness in these two specific instances supported the assumption that these bones were adult in origin, and they were not removed from the pair-matching sample. The most fragmentary bone included in the humeri sample—a left humerus fragment consisting solely of the medial epicondyle and the medial face of the trochlea (GM46 BURunassigned 1978 CAT1074 1261)—could not be associated with the left humerus in question, but as there is no damage to the trochlea of the left sans-medial epicondyle humerus described above, it can be assured that the two do not originate from the same individual. Per Adams and Konigsberg MLNI should not be utilized in cases of extreme fragmentation (2008), therefore the inclusion of this particular fragment may have been in error. The remainder of the humeral sample is not nearly as fragmentary as this lone medial epicondyle, however, so its individual impact on the bias within the humeri MLNI may be minimized. In recognition of their potentially problematic usage, however, neither (GM85 BUR0N4E Level 5 C1-9 Cat183C 478, HRPM_1, HRD_16) nor (GM32 BUR78-75 CAT960 1718, HLC_18; with GM31 BUR78-74 CAT959 75, 74-3; with GM24 BUR78-53 CAT940 74-3) are included in the final MNI count, which is based on the presence of the medial epicondyle.

5.2.1 Stewart Humeri

Of the 54 rights and 50 lefts, a total of 50 humeral pairs were possible. Stewart identified possible matches for 36 of the right humeri, five of which had multiple lefts listed as potential matches (four cases with two possible matches and one case with three possible matches). Those 36 matched right humeri cannot be taken to be an accurate reflection of the true number of pairs within the sample, however, as further review indicated eight left humeri that had been paired with various right humeri. Five had been paired with two separate rights, three had been paired with three separate rights, and one had been paired with five separate rights. It is, of course, impossible for the same element to belong to multiple established individuals, but through deductive reasoning it was possible to reduce the number of identified pairs to arrive at the maximum number of plausible pairs.

All deductive decisions were made independent of osteometric data with the intended purpose of maximizing the number of pairs. This results in a baseline number of theoretically plausible pairs against which later osteometric results can be compared. In order to achieve this maximized baseline, the following criteria were set:

1) Any case in which a right humerus is paired with a single left humerus and that left humerus has not been paired with any other right humeri is assumed to be a plausible pair.
2) Any case in which a right humerus is paired with multiple left humeri and none of those left humeri have been paired with any other right humeri is assumed to reflect only one plausible pair.
3) Any case in which a left humerus is paired with multiple right humeri and none of those right humeri have been paired with any other left humeri is assumed to reflect only one plausible pair.

While these three steps were not sufficient to resolve all instances of contradictory pairs, they served to identify the most obvious and easily resolved cases. The remainder primarily consists of pairs with multiple "solutions" as it were, but as the goal was to maximize the absolute *number* of plausible pairs as opposed to identifying the specific elements within any specific pair, the following steps were sufficient in resolving the remainder contradictory pairs:

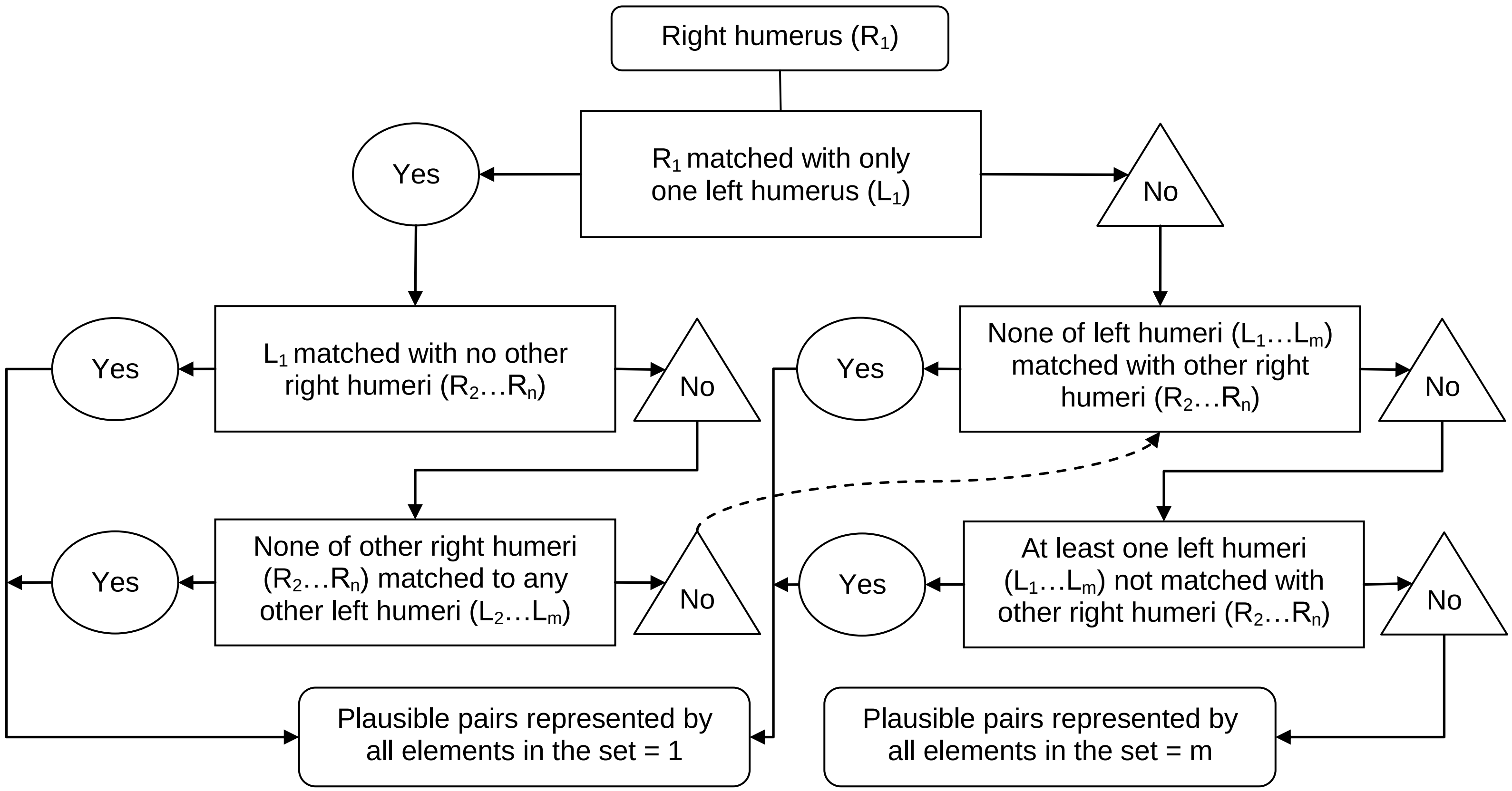
4) In any case in which a right humerus has been paired with multiple left humeri and one or more of those left humeri has not been paired with any other right humeri while the remainder *have* been paired with multiple right humeri, only one of the singularly-paired left humerus is assumed to reflect a plausible pair.
5) In any case in which a right humerus has been paired with multiple left humeri and all of those left humeri have in turn been paired with multiple right humeri, the total number of plausible pairs is limited to the total number of remaining left humeri.

These criteria are illustrated in a flowchart in Figure 5.2.

Only plausible pairs as defined by these criteria were counted towards the pair total. It should be reiterated that a "plausible pair" is not to be taken as a "true pair". Even in the face of osteometric evidence pairs can only be proven in the negative—i.e., beyond the pre-set statistical boundaries needed to reject the null hypothesis that both left and right elements did actually originate from the same individual. This is the theoretical framework of the osteometric analysis discussed later in this chapter.

By this logistical roadmap 25 plausible humeral pairs were identified among Stewart's VPM results. In order to maximize the number of plausible pairs it is important to apply each of these steps in turn. Obviously once a right has been paired with a single left all other possible pairings of that right are no longer valid and can be eliminated from the pool of plausible pairs, and as conflicts are resolved and elements eliminated from consideration it may be possible to return to earlier steps for deductive guidance. Deviating from the logistical path in the other direction, however, produced scenarios with fewer plausible pairs, though it may be advisable to draw up these alternate contingencies just to check that no plausible pair has been overlooked.

This model does not give priority to matches made by both observers. Firstly, just because observers agree on a possible match does not mean that that match will not fall into conflict with the above criteria. In this particular



Note: There were no cases in either Stewart's or Steadman's VPM results that corresponded with the path indicated by the dashed line. It is presented here as a hypothetical.

Figure 5.2. Conflict Resolution and Identification of Plausible Pairs: Humerus.

instance, for example, both Stewart and Steadman matched the same left humerus to the same two right humeri. Secondly, instances of interobserver agreement have less impact when those pairs are just one among a string of possible pairs. To use another model, had one observer drawn from a jar of 50 numbered balls completely at random, replaced her selection, and handed the jar to the second observer who also drew completely at random, the probability of Stewart drawing the same numbered ball as Steadman is far greater if both observers draw two balls apiece as opposed to one. It is therefore impossible to "weight" or prioritize all agreements equally and without bias.

Most importantly, however, giving priority to interobserver agreement is ultimately meaningless at this stage of analysis where the objective is to identify only the absolute number of plausible pairs, not the statistical likelihood of any one possible pair. Even adhering to the established logistical criteria can produce multiple conditions where varying possible pairs are selected to yield the same maximum number of 25 plausible pairs. In at least one scenario among Stewart's results, prioritizing matches made by both observers would reduce the total number of plausible pairs by one.

Using the strictest definition of successful pair-matching where only possible pairs with no potential conflicts are counted, Stewart's total number of plausible pairs is reduced to 13MLNI was calculated based on both scenarios (Table 5.1).

5.2.2 Steadman Humeri

From the records of her pair-matching attempt with the humeri it appears that Steadman overlooked one of the right humeri (GM18 BUR78-30 CAT923 1705, HRC_21; with GM37 BUR78-101 CAT985 101). Subsequently, Steadman's pair-matching sample deviates from Stewart's in that it consists of only 53 right humeri.

Of the 53 rights and 50 lefts, a total of 50 humeral pairs were possible. Steadman identified possible matches for 49 of the right humeri, 13 of which had multiple lefts listed as possible matches (eight cases with two possible matches, four cases with three possible matches, and one case with four possible matches). Those 49 matched right humeri cannot be taken to be an accurate reflection of the true number of pair within the sample, however, as further review indicated 18 left humeri that had been paired with various right humeri. Seven had been paired with two separate rights, seven had been paired with three separate rights, two had been paired with four separate rights, and two had been paired with five separate rights.

All of the logistical criteria established using Stewart's VPM results were repeated here, though the process of resolving conflicting pairs was much more arduous than that encountered using Stewart's VPM results due to Steadman's greater tendency to list multiple possible pairs when compared with Stewart. Multiple trials were conducted to test whether any other logistical approaches yielded differing results but none were found.

Using the strictest definition of successful pair-matching where only possible pairs with no potential conflicts are counted, Steadman's total number of plausible pairs is reduced to 11. There were two cases where Steadman identified two possible pairs but indicated her ultimate confidence in one match with an asterisk; if those cases are taken as intending to exclude the other element as a possible pair, then the total number of non-conflicted pairs is 13. MLNI was calculated based on all three scenarios (Table 5.1).

5.2.3 Humeri Interobserver Conflict

In hindsight it would have been preferable to treat the left humeri as the primary element, bringing them over to the rights in order to find a possible pair. As well as mirroring the approach used in the tibial sample, this would have potentially reduced the number of false matches by eliminating the unscientific urge to try and identify a match for every bone when it was known that at least four could not possibly be matched. As every bone (with the exception of Steadman's lone skipped right humerus) was compared against every other bone, however, all left humeri held up as possible matches to each right humeri in turn, it can be assured that no possible match went overlooked.

In contrast to Lans's experiences using the femora of Gold Mine, where none of the identifying pairs were in conflict, inter- and intraobserver conflicting pairs were a regular occurrence in this thesis's humeri sample.

In only two cases were Stewart and Steadman in agreement that no pair-matches could be made for the right humerus in question. There were 11 cases where Stewart and Steadman identified the same left humerus as a possible pair for a right humerus: in five of these cases that left humerus was the only possible pair identified by either Stewart or Steadman; in two cases Stewart identified at least one additional possible pair-match (one in one case, two in another); in two cases Steadman identified at least one additional possible pair-match (two in one case, one in another); and in two cases both Stewart and Steadman each listed two possible pair-matches, one of which was the same left humerus.

There were 15 cases where Stewart listed no possible matches while Steadman identified at least one possible pair-match (though in one of those cases Steadman recorded herself as being "uncertain"). There were two cases where Steadman listed no match while Stewart identified one possible match.

Though Type II error is supposedly infrequent between trained observers, Stewart and Steadman fell afoul of this assertion in no less than 20 cases. In 14 of these cases Stewart and Steadman each identified a separate single left humerus as a possible match for the right humerus in question. In five cases Stewart identified only one possible match while Steadman listed multiple left humeri as possible matches for the right humerus in question (two in two cases, three in one case, four in one case, and five in one case); in no cases did Steadman list only one possible pair-match while Stewart noted several. In only one case did Stewart and Steadman both identify multiple possible matches,

none of which were in agreement. Excluding the right humerus skipped over by Steadman (for which Stewart identified two possible matches), both observers made 53 pair-matching attempts in common. These 20 violations of Type II error therefore represent 37.74% of all humerus pair-matching attempts[28].

Visual Pair-Matching: Tibiae

Sixty-six tibiae (28 left, 38 right) were selected for pair-matching. All conformed to the criteria established in Chapter IV. Very few of the complications that plagued the humeral sample were also observed within the tibial sample.

5.3.1 Stewart Tibiae

Of the 28 lefts and 38 rights, a total of 28 tibial pairs were possible. Stewart identified possible matches for 16 of the left tibiae. There were no conflicts among any of the identified pairs and no instances of multiple rights being listed as possible matches for a single left tibia, therefore all 16 pairs are considered plausible pairs and counted towards the pair total.

As there were no conflicting pairs within Stewart's tibiae VPM results, a second comparative MLNI calculation was not needed.

5.3.2 Steadman Tibiae

Of the 28 lefts and 38 rights, a total of 28 tibial pairs were possible. Steadman identified possible matches for 20 of the left tibiae, five of which had multiple rights listed as potential matches (four cases with two possible matches and one case with three possible matches). Four right tibia had also been matched with two left tibiae apiece. As was the case with the humeri, the 20 matched left tibiae cannot be taken to be an accurate reflection of the true number of pair within the sample. The same deductive criteria employed with the humeri were also utilized here, though altered to reflect the fact that it was the left elements being given priority as opposed to the right. There were no cases among Steadman's results that necessitated the use of criteria #3, leaving the logistical criteria for maximizing plausible pairs among the tibial sample as follows:

1) Any case in which a left tibia is paired with a single right tibia and that right tibia has not been paired with any other left tibiae is assumed to be a plausible pair.
2) Any case in which a left tibia is paired with multiple right tibiae and none of those right tibiae have been paired with any other left tibiae is assumed to reflect only one plausible pair.

---

[28] Attempt is defined as the comparison of a single element (right in the case of humeri, left in the case of tibiae) against all other elements of the opposing side.

4) In any case in which a left tibia has been paired with multiple right tibiae and one or more of those right tibiae has not been paired with any other left tibiae while the remainder *have* been paired with multiple left tibiae, only one of the singularly-paired right tibiae is assumed to reflect a plausible pair.
5) In any case in which a left tibia has been paired with multiple right tibiae and all of those right tibiae have in turn been paired with multiple left tibiae, the total number of plausible pairs is limited to the total number of remaining right tibiae.

These criteria are illustrated in a flowchart in Figure 5.3.

Following these criteria, the maximum number of plausible pairs identified from Steadman's tibiae VPM results is 18. Using the strictest definition of successful pair-matching where only possible pairs with no potential conflicts are counted, Steadman's total number of plausible pairs is reduced to 12. MLNI was calculated based on both scenarios (Table 5.1).

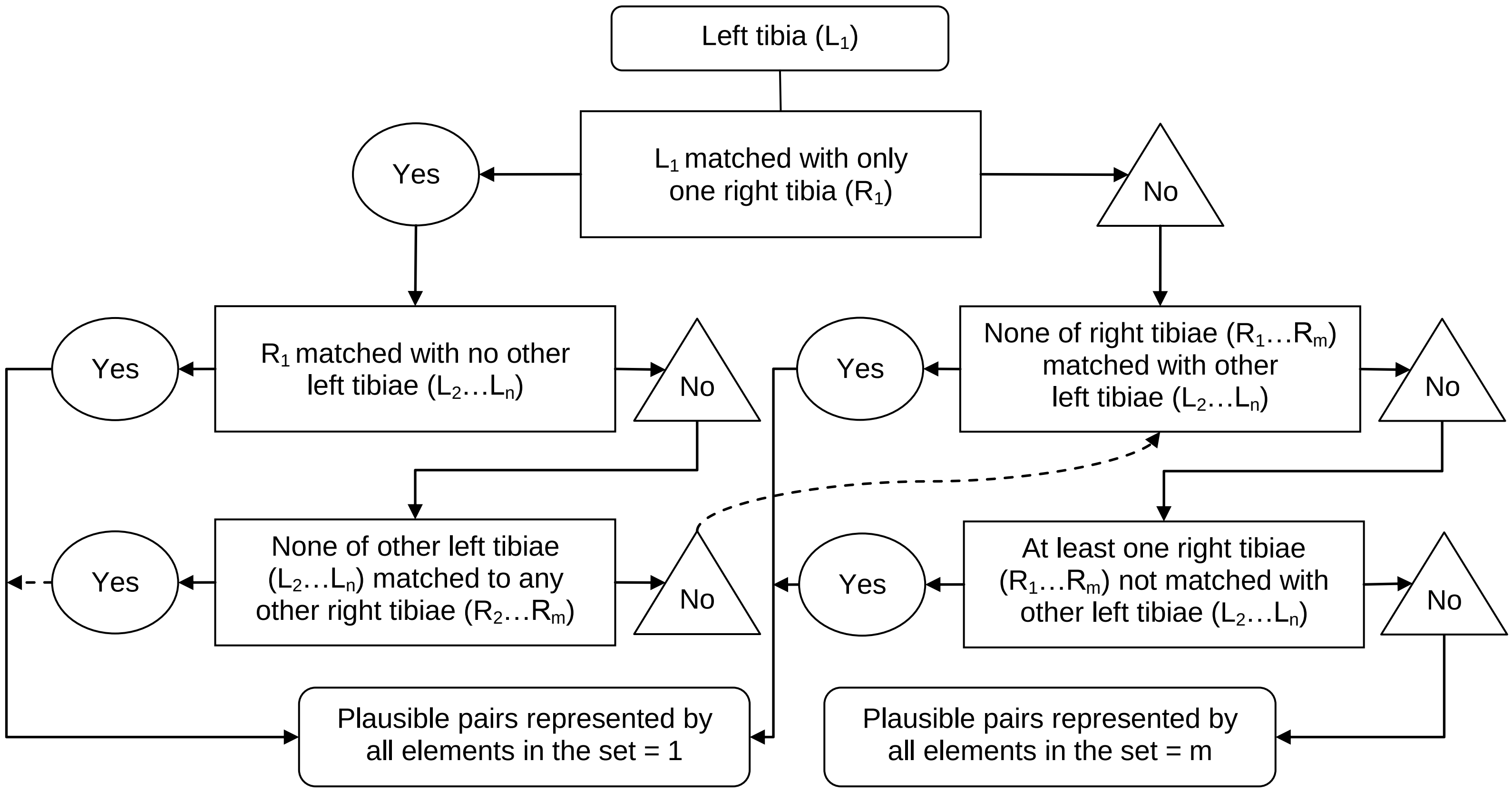
5.3.3 Tibiae Interobserver Conflict

Both observers were in much closer agreement for the tibial sample, for which 28 matching attempts were made. This may be simply an artifact of the smaller pool of bones to pair-match when compared against the humeral sample, allowing for fewer opportunities for intra- and interobserver conflict. It may be indicative, however, of a greater degree of morphological variability and bilateral pathology within the tibial sample, allowing for the more confident exclusion of possible pairs and identification of plausible pairs by both observers (see Chapter VI).

Stewart and Steadman agreed that no match could be made for seven of the left tibiae. For ten left tibiae Stewart and Steadman were also in agreement in identifying a single right tibia that could be paired with each respective left. While the total number of cases where Stewart and Steadman identified the same right tibia as a match for the same left tibia might more actually be reported as 13, in three of those cases Steadman listed two possible matching right tibiae. In only one instance did Stewart identify a possible pair where Steadman observed none, while Steadman listed matches in five cases where Stewart observed none. Of these five cases four listed only one possible match (one of which Steadman qualified with a "maybe" in her notes), while the fifth listed two possible matches. There were only two cases in which Stewart and Steadman identified pairs that were in disagreement, and no cases in which both observers listed multiple possible matches.

Conclusion: Determining *N*

While there were numerous intra- and interobserver conflicts within the humeral VPM sample, likely attributable both to the degree of fragmentation within the sample and the limited morphological variation between many bones in



Note: There were no cases in Steadman's VPM results that corresponded with the path indicated by dashed lines. They are presented here as hypotheticals.

Figure 5.3. Conflict Resolution and Identification of Plausible Pairs: Tibia.

the sample, pair-matching within the tibial VPM sample saw notably fewer complications, inspiring confidence in its potential use as a statistically reliable means of determining *N*. MLNI, recovery probabilities (*r*), and 95% confidence intervals were calculated for the adult humeral and tibial VPM sample based both on the maximum number and strictest definition of plausible pairs. As recovery probabilities and confidence intervals were not reported for either Lans or Vázquez, they were also calculated for the adult femora and juvenile tibial VPM samples using their available data. Lans and Vázquez both reported MLNIs based on the combined number of pairs identified by both researchers based on the assumption that all errors were Type I errors; both their compiled and individual observer data are recreated here. The distinction in Steadman's individual and combined results for Vázquez's juvenile tibia study reflect her total number of identified pairs (12) and the identified pairs she indicted confidence in (8). All results are reported in Table 5.1 and discussed in full in the succeeding chapter.

Table 5.1. Gold Mine VPM Results and Associated *N*s

Element	*Observer*	*Lefts*	*Rights*	*Pairs*	*MNI*	*MLNI*	*Recovery Probability*	*Confidence Interval**
Adult Humeri	Stewart	50	54	25	53	106	48.07%	79-134
		50	54	13	53	147	25%	91-147+
	Steadman	50	53	34	53	77	66.02%	69-88
		50	53	11	53	148	21.35%	92-148
		50	53	13	53	146	21.36%	92-148+
Adult Tibiae	Stewart	28	38	16	38	65	48.48%	50-88
	Steadman	28	38	18	38	58	54.55%	48-74
		28	38	12	38	86	36.36%	54-110+
Adult Femora	Lans	53	57	27	57	110	49.09%	83-137
	Steadman	53	57	17	57	149	30.91%	93-149+
	Lans & Steadman	53	57	32	57	93	58.18%	78-110
		53	57	29	57	103	52.73%	81-125
Juvenile Tibiae	Vázquez	43	55	14	55	140	28.57%	84-140+
	Steadman	43	55	12	55	142	24.49%	86-142+
		43	55	8	55	146	16.33%	90-146+
	Vázquez & Steadman	43	55	19	55	122	38.78%	79-135+
		43	55	15	55	139	30.61%	83-139+

*All confidence intervals taken to 95% (CummDist greater than 0.94 and less than 0.95) except when indicated by a +. In those cases the upper limit of the 95% confidence interval fell beyond the lower limit + 56 range pre-set by the program.

CHAPTER VI
DISCUSSION

Introduction

While the process of photographing, measuring, and noting the characteristics of each of the sampled humeral and tibial elements was in and of itself valuable as a means of re-establishing thorough documentation for the Gold Mine Site Collection, it also uncovered several trends within the collection that—when combined with further analysis of the results of previous work with Gold Mine—proved important for understanding and evaluating the results of the visual pair-matching process.

This chapter expands upon the empirical results outlined in Chapter V and places them within a broader interpretive context. In the first section the rate and types of pathologies observable within the humeral and tibial sample are selectively detailed; as the focus of this research was not pathology specifically this review should not be taken as a thorough accounting of disease processes in Gold Mine. The cases and trends highlighted here were selected more for their ability to impact—positively or negatively—the process of reconstructing the sample and the ability to accurately assess the sample through either visual pair-matching or osteometrics. The second section on animal modification is also preliminary; this discussion is primarily focused on the insights the observed patterns provide on the mortuary practices of the Gold Mine people in the years preceding the mound's construction. Finally, this chapter further details the meaning of the empirical results of the previous chapter's attempts to determine *N* by outlining the logic used to determine which of the multiple calculated *N*s is the most methodologically and statistically robust and offering potential explanations as to why the tibial VPM results did not incur the same problems as the humeral VPM results.

Preliminary Notes on Observed Pathologies

Various pathologies were observed on roughly twelve percent of the 181 humeral elements sampled (12.15%; 14 definitive cases, 8 possible cases[29]) and over a third of the 174 tibial elements sampled (38.51%; 49 definitive cases, 18 possible cases). The rate of pathology within the tibia more than doubles the 16% rate reported for the entirety of the 1978 sample (Talley 1978), though this percentage may be biased due to the frequent difficulty in distinguishing between taphonomic damage, well-healed periostitis, and normal variation in bone texture.

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[29] Coded as 1? within the inventories.

Definitive diagnoses could not be made in the vast majority of cases due to the numerous potential causes and the inability to consult other bones from the same individual in order to refine the differential diagnosis. In light of this, most of the pathological notations in the final databases are limited to broad descriptions as to the appearance and location of the pathology in question.

6.1.1 Saber Shin

Among the most striking of the observed pathologies were the multiple cases (#) of anterior tibial bowing combined in many cases with varying degrees of abnormal bone deposition to the anterior, posterior, and medial surfaces (referred to in literature varyingly as saber shin, saber tibia, and boomerang leg) (Ortner 2003). Indeed, the abnormal growth was so extensive in the case of two exceedingly robust and curved juvenile tibiae [GM25 BUR78-54b CAT942 54 and GM25 BUR78-54b CAT942 54 (L)] that they were at first mistaken by the author and several colleagues for non-human remains (see Appendix B, Figures B.1 and B.2). Some tibia also showed varying degrees of medial bowing (GM05 BUR78-13a CAT887 2413) (see Appendix B, Figure B.3).

The exact cause of this trend—if it *can* be attributed to one specific underlying cause for the whole population—is unknown. "True" bowing of the tibia is the result of abnormally-stimulated growth or increased strain on softened load-bearing bones as with rickets, but the tibia may also take on a bowed appearance through layered bone deposition on the anterior and medial surfaces ("pseudo-bowing") (Ortner 2003:294). Anterior bowing of the tibia is associated with various forms of syphilis (particularly latent congenital syphilis or advanced contracted tertiary syphilis and yaws) as well as rickets, osteomalacia, Paget's disease, osteomyelitis, and other conditions resulting in chronic periostitis of the tibia diaphysis.

Morphologically, anteriorly-bowed tibia within the Gold Mine sample fell into two broad categories: those with rounded or thickened shafts and those that that retained a definable anterior crest and a wedge-shaped cross-section[30]. This variation in morphology may be indicative of variances in underlying pathology. In congenital syphilis, anterior bowing of the tibia is the result of differential growth between the abnormally-growing tibia and the normally-growing fibula, to which the tibia is fixed at both ends by ligaments and tendons, resulting in "true" bowing (Jaffe 1972; Ortner 2003). Bowing in advanced acquired syphilis, however, is the result of buildup of nongummatous periostitis on the anterior surface of the tibia, allowing the posterior contour of the bone and the interroseous line to remain straight (Ortner 2003). Anterior bowing of the tibia linked with yaws appears very similar to that observed in congenital syphilis.

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[30] Both typologies can be seen in the few juvenile elements studied. GM03 BUR78-24a CAT898 24, GM25 BUR78-54b CAT942 54, and GM25 BUR78b CAT942 54(L)—the most gracile and the most robust of the known juveniles—were more rounded in their appearance, with many features lost under the degree of bone deposition, while GM39 BUR78-118 CAT1002 1445 retains most of its tibial shape.

Bowing is typically first observed prior to 15 years of age (Wilson and Mathis 1930). In its early stages disseminated radiologic lucencies can be observed in the anterior cortex of the bone followed by anterior cortical thickening and bending; late stages see the thickening of the posterior concave cortex while the anterior cortex begins to thin, similar to the deformities associated with late-stage rickets (Hackett 1936; Ortner 2003).

Radiographic studies are needed to determine which of these disease processes—if any—are most consistent with that observed in the anteriorly-bowed tibiae of Gold Mine. Based on visual pair-matching results and several instances in which similarly-bowed morphologies could be observed in left and right tibiae with identical recorded burial contexts, the root cause would appear—at least in some cases—to result in bilateral and relatively symmetrical presentation. If any bowed tibiae can be conclusively determined to have originated from the same individual, then the differential diagnosis can be extended to include type IX Ehlers-Danlos syndrome, enchondromatosis, fibrous dysplasia, and excess fluoride ingestion in pregnancy (Segen 2006).[31]

6.1.2 Trauma

Recognizable trauma was minimal within both humeral and tibial samples. Only two conclusive cases of healed antemortem fractures were observed: (GM66 BUR80-5 0N4E Level 3 CAT? 760) (see Appendix B, Figure B.15) and (GM01 BUR78-1 CAT870 1695) (see Appendix B, Figure B.16), a left and right humerus, respectively. Each was fractured along the distal shaft at a point approximately three centimeters proximal to the olecranon fossa. In both cases the distal end of the humerus healed at an angle medial to its proper anatomical position. Any perimortem fractures or antemortem fractures in early stages of healing were lost among the extensive fragmentation.

McGimsey describes a right tibia (associated with Skeleton 80-25 of Burial 80-H 1980-0N4E, by his numbering system) with "a small lithic flake in the front part of the bone about 4.5 inches above the articulating surface [entering] at a sharp angle from the distal direction" (2004:96). As extensive pathologies were recorded for this skeleton, including bilateral extensive periostitis and osteitis in the long bones of the leg, McGimsey hypothesized that the individual had sustained the injury while sitting cross-legged knapping lithic material, and that "[swelling at the area of the tibia] and considerable osteitis of the entire shaft warrants speculation that the infection could have spread to the rest of his body via the bone marrow and circulatory system" (2004:95-96). If this tibia is represented among those sampled in this thesis it has not been recognized, though based on the provided description (GM82 BUR0N4E Level 4 C1-14 CAT161c 425) (see Appendix B*,* Figure *B.11*) may be the matching left tibia. This

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[31] Anterior bowing is also associated with multiple forms of dwarfism and other conditions that significantly reduce stature, but while the people of Gold Mine are short when compared to modern populations there is nothing immediately abnormal in their proportions.

bone was not matched to any right tibiae by either observer during the visual pair-matching process.

6.1.3 Select Miscellaneous Pathologies

Possible cases of periostitis were the most frequently noted pathology, particularly among the tibial sample, though the variability of its presentation made it difficult to recognize. Most cases appeared well-healed, with no active periosteal bone or foci, and all were well-fused to the underlying cortex. The medial surfaces of many tibiae appeared consistent with diffuse inflammatory reactions across nearly the whole of the medial surface; whether this is in response to a pathological stressor or chronic strenuous activity is unknown. Reactive deposition of bone on the posterior surface also resulted in a depressed, canyon-like appearance to the popliteal line of some tibiae (see Appendix B, Figure B.12).

Lytic lesions were few—occurring occasionally on the medial surface of the tibial shaft but most frequently along the metaphysis or epiphysis—and small enough to be easily mistaken for focused areas of animal gnawing impacted with dirt (generally ovular in shape and under 1 cm across on their longest axis). No more than two lytic lesions were identified on any individual element. As no imaging studies were taken of the collection, study was limited only to those lesions visible on the surface. Only one possible non-lytic lesion was observed—a 2cm long oval lump on the lateral surface of (GM45 BUR78-210 CAT1087 1592) (see Appendix B, Figures B.4 and B.17)—but due to the degree of anterior deposition on the bone this growth may be periosteal in origin.

6.1.4 Impact on Data Collection

Varying degrees of twisting along the long axis of the tibia were also observed among both bowed and non-bowed tibia, resulting in misalignment of the distal tibia so that the interosseous line and fibular notch are prominent even in the posterior view (see Appendix B, Figure B.17). This made it difficult to correctly and consistently position tibiae for photographing. Many of the pathologies observed in this thesis proved difficult to capture digitally, particularly those cases characterized by subtle changes to the appearance and texture of the outer surface of the bone. The size and shape of other, more three-dimensional abnormalities such as abnormal projections along the popliteal line were not fully captured in the standard anatomical views. Many of the detail photographs included in the catalog are taken at non-standard views in order to better convey the characteristics of those abnormalities.

Much of the osteometric data taken for the tibial VPM sample has also been impacted by the presence of various pathologies. The anterior and posterior deposition of bone is likely to bias any anterior-posterior measurements, for example, and measurements of total length do not reflect the degree of anterior bowing seen in some tibiae. In other elements the gross pathology observed at the point where a measurement was to be taken was so extensive as to completely prohibit accurate measurement. In less severe cases

measurements were taken but may ultimately prove irrevocably biased; where taken, these measurements are indicated with an asterisk in the final osteometrics table (see Appendices G and H).

Summary and Implications of Observed Animal Modification

While not detailed in any of the major Gold Mine works to date, varying degrees of animal bone modification can be observed on a third of the 181 humeral elements (33.15%; 52 definitive cases, 8 possible cases) and over a third of the 174 tibial elements (37.93%; 57 definitive cases, 9 possible cases) reviewed in this thesis. In some instances gnawing is quite extensive, perforating into the medullary cavity at multiple points along the diaphysis so that the bone resembled a roughly-carved flute (see Appendix B, Figure B.18). In other cases evidence of animal modification is limited to a single scrape[32], or puncture mark (see Appendix B, Figure B.19). These are in the minority, however, with the brunt of the observed gnawing consisting of closely clustered parallel incisions (many with the placement of upper and lower teeth readily apparent) along a prominent edge of the diaphysis or other protruding feature with thick cortical bone (see Appendix B, Figures B.20 and B.21). This is consistent with the kind of tooth markings left behind by gray squirrels: "parallel, flat-bottomed grooves… with exposure of underlying spongy bone [and the cancellous bone removed] in a layered fashion to produce an incised, shaved effect with little variation in depth of penetration into the bone cavity" (Klippel and Synstelien 2007:766). Despite the presence of multiple dog burials within the mound, no cases of the kind of damage consistent with canid or other larger carnivore[33] scavenging—specifically the removal of the epiphyses and splintering of the diaphysis in order to access areas of the bone still rich in marrow—were observed within the sample. It is possible, however, that any canid scavenging patterns have been obliterated by further fragmentation of the thin, ragged bone of the exposed epiphyses.

6.2.1 Previous Research on Animal Modification

Animals have long been recognized as taphonomic agents, but the patterns of their scavenging behavior and how those patterns associate with the post-mortem interval were not quantitatively studied until the early 2000s (Klippel and Synstelien 2007). The behavior of rodents—the kinds of bone (weathered versus greasy) they are attracted to, the parts of an individual bone they are most likely to gnaw, the reasons behind their gnawing, and the time of year they are

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[32] These shallow grooves, some of them up to an inch in length, and notches along the flat surfaces and more prominent edges of the tibial and humeral shafts are consistent with modification patterns of some carnivorous species, but while they have been recorded here as animal modification it is possible that their origin is the result of human behavior.

[33] Mountain lion, bobcat, and bear were all represented within the Gold Mine faunal sample by one or two elements. Smaller, scavenging carnivores including mink, skunk, and raccoon are better represented within the assemblage (McGimsey 2004).

most likely to engage in the behavior—was especially subject to anecdotal and often conflicting reports. Combining multiple experiments using both human and non-human remains, Klippel and Synstelien (2007) were able to show that the presence of rodent gnawing—specifically, gnawing caused by the common North American gray squirrel[34]—was evidence of a prolonged post-mortem interval.

Three cattle ulnae and radii with varying postmortem intervals and decomposition environments (12-18 months in full sun, 30 months in shade, fresh but with external flesh and cartilage completely removed) were placed conspicuously in an area of rural Tennessee known to be frequented by gray squirrels and left for one year (Klippel and Synstelien 2007). While the two more heavily weathered specimens attracted squirrel activity within two weeks of their placement, the freshest remains went largely ignored until seven months into the experiment, after which they were only minimally modified. Previous observation of the shaded remains *in situ* at their original wooded decomposition site showed an even longer delay, with no evidence of gray squirrel modification until 18 months post-mortem.

In order to see whether the same prolonged intervals held true in human remains, 22 sets of human remains that had been laid out to decompose at the University of Tennessee's Anthropology Research Facility were examined for tooth marks consistent with gray squirrel gnawing (Klippel and Synstelien 2007). With the exception of one body set aside for extended exposure beyond advanced skeletonization, all of the remains were recovered no later than 18 months after initial placement, and no typical rodent tooth markings were found. After prolonged exposure the remaining body was largely covered with leaves with only a few fully-skeletonized elements visible, and no rodent modification was observed on those exposed elements until 31.5 months into the study. This was consistent with the results of an additional survey of 53 cases[35] from the William M. Bass Forensic Skeletal Collection, 10 of which showed modifications consistent with gray squirrel gnawing.[36] In only one of those cases had the

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[34] Klippel and Synstelien also studied bone modification patterns exhibited by the imported but now common brown rat, which was found to primarily target not the bone itself but any surrounding cartilage, fresh meat, and fat-laden cancellous bone. Stripping cartilage from the bone resulted in a characteristic crenulated, dentilled margin. While tempting to place the blame for some of the epiphyseal damage at the feet of the brown rat, the species was not introduced to the New World until late in the 18th century; even presuming they had been present and burrowing tunnels during the time of the historic tenant or sharecropper house that was once built atop the mound, the remains by that point would have been far too dry to be of much interest. Mice have been identified among the Gold Mine faunal remains along with muskrats, beavers, gophers, and squirrels (McGimsey 2004), but of these rodents only the squirrel has been extensively studied in terms of human bone modification.

[35] Cases significantly modified by fire or recovered from enclosed structures, burial contexts, or underwater were excluded from study. Cases were not excluded on the basis of completeness, so in some instances individuals are represented by only a single element.

[36] Another study at the ARF using a dry human clavicle that had previously been mounted as part of an old anatomical specimen and a human clavicle still golden-orange and sticky to the touch saw near-daily gnawing of the dry clavicle beginning in March after three months without

remains been discovered within 16 months of death; the remaining nine individuals had a post-mortem interval of >30 months (Klippel and Synstelien 2007). This study also looked at canid modification and found that of the 31 cases with canid modification 19 sets of remains (61%) had been discovered within a year of death.

6.2.2 Post-Mortem Interval for Interments at Mound A

Given the findings of Klippel and Synstelien, the presence of apparent gray-squirrel gnawing in the Gold Mine sample holds significant implications for the reconstruction of mortuary practices at the site, both in terms of the interval between death and final interment within the mound and how skeletal remains were treated during that interval. That remains would have been regularly buried—whether within the mound or at another location—for the majority of that time period, as suggested by Belmont, would appear unlikely in all but the most minimally modified elements, and even those would have had to have been left exposed to animal activity for some period before final interment. It is more likely that the remains were left exposed for a significant period of time (12-30 months at minimum), possibly under some sort of watch or housed within a protective structure to limit the access of dogs and larger scavengers until at least such time had passed that the skeletal remains were no longer greasy.

It can therefore be inferred that any elements showing signs of rodent gnawing would either have been completely disarticulated at the time they were prepared for placement within the mound or at least partially mummified with the gnawed region exposed to scavengers. Alternatively, should the short time intervals between mound layer construction of McGimsey's reconstruction prove incorrect, then the gnawed remains may have been scattered across the surface of the exposed layer or protruding from their shallow burials enough to grant access to interested rodents. While no obvious signs of sun bleaching were observed on any of the sampled elements, any such bleaching may have been obscured by long interment within the earthen mound and subsequent darkening of the exposed portions of bone.

6.2.3 Modern Damage

Observed within the sample were several instances of damage consistent with animal modification that exposed lighter-colored cortical bone (see Appendix B, Figures B.22 and B.23). This extreme difference in coloration is not consistent with scavenging damage sustained prior to the placement of Mound A's capping

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disturbance. Episodic gnawing remained steady through May, decreasing through June until little to no gnawing activity could be observed from July until August (Klippel and Synstelien 2007:767). Gnawing was not observed on the greasy clavicle until after 21 months of exposure. This cluster of springtime activity would appear consistent with previous hypotheses as to the nutritional motives of the gray squirrel—i.e., pregnant mothers gnawing bone for its mineral contents (calcium, phosphates, etc.)—but gnawing was observed year-round in the cattle study.

layer and subsequent long interment. Some of this damage may be not be the result of animal scavenging but rather human in origin, the result of scraping by bulldozer, shovel, trowel, or metal calipers. In other cases, however, it differs only in coloration from other instances of gnawing within the collection. If these episodes of animal modification are indeed modern in origin, then those elements may have been among the skeletal material exposed and churned by the mound's bulldozing, in which case it can be inferred that their original positions were likely within the mound's upper-most layers. It is also possible that these modern gnawing episodes date to the period of the excavation itself, possibly after the element was first uncovered but before it could be completely exposed and removed for cleaning and storage.

Animal modification may also be the cause of much of the fragmentation observed within the collection. Many of the fragmented elements, including those which were previously reconstructed with glue, show signs of gnawing at the point where the bone is fractured. Intriguingly, within the Gold Mine sample gnawing need not be extensive to lead to eventual failure of the bone's integrity (see Appendix B, Figure B.24). Much of this fragmentation is associated with fracture edges of a lighter color than the surrounding bone, suggesting that the point of failure came during the bone's excavation or while in storage. It is also thereby possible that additional instances of animal modification have been obscured by further fragmentation and flaking at the fracture site and/or the thick application of glue observed in some prior reconstructions.

Difficulties in Determining *N*

MLNI is most accurate when the recovery rate approaches 50%, but shows significant improvement over the accuracy of the MNI with recovery rates as low as 30%. Only 10-20% of Mound A was ever excavated, and per McGimsey there is strong reason to believe that the burials extended much further into the mound. Whether or not the recovery rate for any of the skeletal elements tracks closely with this total mound excavation ratio is difficult to ascertain. The mortuary practices at Gold Mine involved movement of remains from their prior exposed location (whether this itself was the primary internment of any respective set of remains is unknown) to their final position within the mounds as well as the selective grouping of some skeletal elements by type. For the majority of burials it cannot be assumed that both sides of a set of paired elements were interred together or even within the same general vicinity of the mound. It is also unknown whether any particular individual skeletal elements or groups of individuals were treated deferentially when placed within the mound. McGimsey has theorized that the abundance of crania found in many multiple burials can be explained by the objectification of the human head as a grave good, and miniature assemblages of skeletal elements by type show that the people who built the mound did actively sort the skeletal remains to one purpose or another. Taken together there is a high likelihood of non-random bias in terms

of what elements were ever available to be recovered from the plotted excavation squares, even without significant taphonomic loss.

Using the strictest means of identifying pairs, the calculated recovery probability (*r*) for the adult humeri was 25% (13 pairs) for Stewart and 21.35% (11 pairs) and 21.36% (13 pairs) for Steadman. Both observers reported difficulty in distinguishing between many of the humeri that fell towards the middle of the length and robusticity distribution. While the majority of the sample consisted of elements with at least 50% of the original bone represented (medial epiphysis to distal-most point of the deltoid tuberosity), the small size of some of the elements limited the number of features that could be used to recognize or exclude possible pairs, so Type I and Type II error are likely present within the sample. When MLNI was calculated using the maximum number of plausible pairs the recovery probability rose significantly [45.7% (25 pairs) for Stewart and 66.02% (34 pairs) for Steadman], but those pairs are based on the assumption that at least one of the identified possible pairs was in fact a true pair. Osteometric sorting may be able to reduce the need for such an assumption by eliminating some pairings from consideration, but this requires a comparable reference sample to calculate. Given all of the difficulties associated with the sample and the fact that none of the calculated recovery probabilities using the strictest definition of possible pairs met the 30% threshold, MNI is the more robust means of quantifying *N* for the humerus. Though the low recovery probability means that the MNI of 53 (right medial epicondyles) is likely to severely underestimate the true *N*, given the size of the assemblage the MLNI would likely overestimate the true *N* (Adams and Konigsberg 2008:248, Table 12.1).

For the tibiae the rate of Type II error was limited to two cases and Stewart and Steadman were much more confident in their identified pairs. Even using Steadman's most conservative number of pairs the recovery probability for adult tibiae exceeded the 30% threshold where it easily surpassed MNI, with Stewart's non-conflicting pairs corresponding to a recovery probability less than two points shy of the 50% ideal recovery rate outlined by Adams and Konigsberg (2004). The range of the 95% confidence intervals were also narrower (Stewart P= 16, MLNI=65, *r*=48.48%, CI=50-88; Steadman P=18, MLNI=58, *r*=54.55%, CI=48-74) with the exception of Steadman's most strictly-defined number of pairs (Steadman P=12, MLNI=86, r=36.36%, CI=54-110+), which exceeded the 56 point spread that can be calculated by Adams's program. It should be noted, however, that even the narrowest 95% confidence interval still has a 26 point spread for *N*, so there is room within each of these calculations to over- or underestimate the true *N*. The MNI of 38 (right adult tibiae) may be more robust given the still fragmentary nature of the sample, but there is enough overlap between the three produced MLNIs and their confidence intervals that MLNI may be taken as a plausible estimate of *N*.

Interestingly, neither the adult tibia sample used in this thesis nor the adult femur and juvenile tibia samples used by Lans and Vázquez (2011; 2011) had nearly the problems observed within the humeri, particularly in terms of

identifying pairs. Why weren't conflicting pairs an issue in these studies? Since Steadman served as the second observer in all four VPM attempts and experienced the same difficulties with the humeral assemblage, this allows experience as a possible influence to be largely excluded from consideration. It may be that the proximal portions used in each study were simply more morphologically distinct than the largely distal portions represented within the humerus assemblage. In the case of juvenile tibiae pair-matching also benefited from the wider ranges in size differences afforded by still-growing bones. A high degree of fragmentation within the humeral sample meant that possible pairs could not be judged on the basis of length, a factor that would allow for the quick sorting and assessment of possible pairs in more complete samples. Yet the poor calculated recovery probability within the juvenile tibiae sample (only when Vázquez's and Steadman's results are combined does the recovery probability exceed 30%) suggests that all is not as well as it would seem based solely on the lack of reported conflict. If held to the same criteria as this thesis, then neither Vázquez's nor Steadman's independently-produced MLNI could stand as an estimate of *N*. Given the size of the assemblage, the resulting *N* of 140 individuals and more are likely overestimates of the true *N*. In all cases the 95% confidence interval produced for the juvenile tibiae (Table 5.1) exceeded the maximum 56 point spread that can be calculated by Adams's program.

Another interesting trend to note is the difference in raw counts between adult tibiae (28 lefts, 38 rights) and adult femora (53 lefts, 57 rights) and how closely their respective recovery probabilities mirror the other. Based on their individual observances both Stewart and Lans show an associated recovery probability of roughly 49% (48.48% for Stewart; 49.09% for Lans). Steadman's recovery probabilities for adult tibiae were 54.55% (maximum plausible pairs) and 36.36% (strictest definition of pairs) and 30.91% for adult femora (when combined with Lans's pairs, of which no conflicting pairs were identified, recovery probability rose to 58.18%). While 95% confidence intervals are broader for all femora cases than is observed within any of the tibiae cases, all of these recovery probabilities are well within the range where MLNI would be a more accurate estimator of *N* than the MNI. Yet there is little overlap between the two skeletal elements' various MLNI estimates and their respective confidence interval. Of the long bones of the lower limb, adult femora outnumber adult tibiae. Either adult tibiae are more likely to suffer taphonomic damage, reducing their visibility in the collection, or the two skeletal elements received different mortuary treatments. The nature of this differential treatment could vary significantly. It may be that the missing tibiae are interred within another part of the mound, clustered together in a mass burial in the same manner as the "long bone piles" of McGimsey's Burial 80-B, 1980-0N4E (McGimsey 2004:93). It may be that they were never included in the burial assemblage at all, which would suggest different cultural significances placed on one or both skeletal elements, favoring the inclusion of the femur and/or favoring the deliberate exclusion of the tibia. It is also possible that the nature of the preparatory mortuary practices at

Gold Mine may have subjected the tibiae to a higher likelihood of loss prior to interment within the mound.

It is also noteworthy that the humerus is the only element subjected to visual pair-matching to date to not originate from the lower limb. In the first reports of the general morphology of the recovered remains Talley (1978) noted that the legs of all of the identified skeletons were large and robust with prominent muscle attachments. This thesis also noted a high degree of variation within the observed tibiae, particularly in terms of pathology. Anterior bowing, bony deposition to the anterior and posterior portions of the shaft, and instances of pathological growth along the popliteal line were all helpful in matching pairs where those features occurred bilaterally. Even in instances where only the only common elements to be compared between right and left tibiae were the diaphysis itself (made possible by the fact that both proximal-only portions of the tibia and distal-only portions of the tibia were allotted for in the selection criteria so long as there was a nutrient foramen present) the shape of the diaphysis was often distinguishable enough to be used to identify or exclude possible pairs. Whatever stresses or genetic influences shaped the lower limbs do not appear to have had the same impact upon the upper limb, at least as far as can be observed based on the humerus alone.

Conclusion

While previous VPM attempts reported none of the extensive issues with conflicting pairs and likely Type I and Type II error observed within the humeral sample, the calculated recovery probability for the juvenile tibiae did not meet the 30% threshold set by this thesis unless Vázquez's and Steadman's results were combined. Even then, the upper limits of 95% confidence interval exceeded the range that could be calculated by Adams' (2005) program. It is therefore likely that the previously published MLNI for the juvenile tibiae overestimates the true *N*.

Unlike both Lans's and Vázquez's studies, the pair-matches identified by Stewart and Steadman in this thesis have not been checked against a comparable reference sample in order to excluded statistically unlikely pairs. This could significantly alter both the most-strictly defined number of pairs and the maximum number of plausible pairs for the humeral and tibial samples.
In the adult tibial and adult femoral VPM samples, where all calculated recovery probabilities exceeded 30%, the upper limits of some confidence intervals (those with still relatively low *r*) also exceeded the range that could be calculated. Further experimentation is needed to determine what implications, if any, this holds for the VPM results using an assemblage like Gold Mine—which is composed of solitary fragmentary elements, reconstructed elements, and whole or mostly-whole intact elements—compared to an assemblage of whole or mostly-whole intact elements with a comparable number of lefts, rights, and identified pairs. In the case of Gold Mine and similar assemblages, however, it

may be that *N* is best reported as a range composed of multiple lines of evidence.

In this vein, the number of individuals (*N*) represented by the adult humeri sample of the Gold Mine Site Collection is currently best-determined by the more conservative MNI=53 (right medial epicondyle). The number of individuals (*N*) represented by the adult tibial sample of the Gold Mine Site Collection is most conservatively-determined using MNI=38 (right nutrient foramen; proximal and/or distal epiphysis must at least be partially represented in order to determine adulthood). *N* for the adult tibial sample is best-determined using Stewart's VPM results (P=16), which contained no intra-observer conflict; Stewart's MLNI=65, *r*=48.48%, CI=50-88. Steadman's initial VPM results contained multiple instances of intra-observer conflict. Using the strictest definition of identifying plausible pairs (P=12), Steadman's MLNI=86, *r*=36.36%, CI=54-110+. The wide spread of Steadman's 95% confidence interval, which exceeded the upper limits of Adams' (2005) ability to display, calls the plausibility of Steadman's MLNI into question. Stewart's MLNI is taken as the more likely estimate of *N* for the adult tibial sample.

CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

Introduction

The Gold Mine Site Collection offers a unique opportunity to study a little-understood segment of Native American history in the American Southeast. Even with only 10-20% of Mound A excavated, the human skeletal material represents the largest collection of recovered ossuary remains from the Troyville culture to date and one of the largest human skeletal assemblages from the Lower Mississippi Valley region. While the collection has been the subject of multiple avenues of research in the three and a half decades since the beginning of the site's excavation, much of that work either predates many of the most significant advances in quantifiable analysis of commingled and fragmentary assemblages or has produced contradictory and at times problematic results. The collection has also suffered loss further fragmentation and commingling since its excavation, and the lack of established provenience for the majority of the remains only further complicates any attempt to study the original structure and commingling present within the mound for patterns associated with the deliberate organization of individuals by group, the preferential treatment of skeletal elements by type, or the effect of post-mortem interval on interment type and location.

The most recent work with the Gold Mine skeletal material has focused on both the re-establishment of documentation for the collection—including ongoing attempts to tabulate all of the associated elements and their current locations—as well as establish the number of individuals represented within the collection and their demographic makeup. The available tabulations and inventories to date, however, have proven of limited use in identifying and locating specific elements within the collection or thoroughly documenting incidences of pathology and animal modification. Visual pair-matching had also been attempted only once for adults (using the proximal end of the femur; Lans 2011), with the most thorough review of adult and juvenile long bones concluding that the material was too fragmentary to attempt pair-matching (Tatchell 2010). Following an initial survey of the collection, however, the author determined that visual pair-matching could be justifiably attempted based on the number of whole or nearly-whole elements and reconstructed elements combined with many apparent instances of bilateral atypical morphology.

The broad research aim of this thesis, therefore, was to contribute not only to the empirically-backed knowledge of the makeup of Gold Mine Site Collection but also to the long-term goal of reconciling much of the post-excavation damage and commingling within the collection by reconstructing fragmented elements, reassociating bones originating from the same individual, and establishing multiple avenues of secondary evidence that might be used to verify or disprove

the recorded burial context of each element. Towards this end this thesis focused on the yet-unstudied adult humeri and tibiae with the objective of:

1) *Producing* a photographic catalog and corresponding database representing all of the skeletal material used within this thesis to be available for use in future research;
2) *Accurately determining* the total number of adult individuals within the Gold Mine Site Collection (*N*) as represented by the adult humeri and tibiae recovered during the three years of excavation;
3) *Identifying* the likely source of any complicating factors towards the determination of *N*, their impact on the reliability of the results, and how they might be resolved;
4) *Contextualizing*, wherever possible, all results in terms of their impact on our understanding of the Gold Mine site, the lives and deaths of the people interred within it, the process of reconstructing each element's true provenience, and the utility of the collection for further bioanthropological research.

This thesis was successful in meeting these objectives with some caveats. While the final *N* produced from the humeral material is the most methodologically robust possible based on the available evidence, as an MNI it is likely to underestimate the true *N* of the sample. As no comparable reference sample was available for osteometric analysis it is likely that a more accurate *N* can be calculated from that same evidence at a future date. Further refinement of the humeral VPM results through osteometric analysis may also provide further insights as to why both observers found it difficult to limit the number of identified possible pairs and why those same difficulties were not present within the tibial sample.

In recognition of the known problems of this research as well as the potential for overlooked "unknown unknowns", all of the data produced in this thesis is reproduced here in Appendices C-H as well as made available in their original Excel™ formats as part of the Gold Mine Site (16RI13) Adult Humerus and Tibia Photographic Catalog. This chapter summarizes all of the findings and conclusions made from that data as well as provides guided recommendations for a more extensive analysis. As a final point for this thesis, ethical considerations for use of the human osteological material from the Gold Mine Site Collection are discussed.

Summary of Findings and Conclusions

7.1.1 Producing Photographic Catalogs and Comprehensive Inventories for the Adult Humeri and Tibiae Osteological Material

A thorough survey was made of the collection in order to identify humeral and tibial elements of interest to this thesis. Two exhaustive attempts to reassociate fragmentary elements were made, including an expansion of the original selection criteria to account for the possibility that elements previously excluded on the basis of their size or lack of identifying features could be

reassociated with larger elements. Each element and reconstructed element was photographed extensively showing anterior, posterior, medial, and lateral views with the paper tag included in the photograph for identification. Proximal and distal views were taken on a case-by-case basis along with detail photos of notable pathologies and instances of animal modification. Selected juvenile elements exhibiting pathologies consistent with those observed within the adult sample were also photographed for inclusion in the catalog. The photographs were screened for quality, sorted by element, and assembled into the Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog. The catalog is available for research following the submission of a formal request, as detailed later in this chapter.

The adult humeri and tibiae of the Gold Mine Site Collection were found to be highly fragmentary and commingled, through preservation of individual features, when present, was otherwise quite good. Surprisingly, despite the degree of fragmentation many whole or nearly whole elements were represented within the sampled assemblage, including some which were reconstructed from elements found in disparate storage contexts. Two hundred and seven adult humeral elements, 189 adult tibial elements, and six juvenile humeral and tibial elements were pulled for study. After two reassociation attempts, the adult humeral and tibial samples were respectively condensed to 181 and 174 individual and reconstructed elements. It is likely, however, that some adult humeral and tibial elements are misplaced with other long bone skeletal elements elsewhere within the collection and thus have been overlooked by this thesis's sampling. A full inventory listing of all elements pulled for study is included within the photographic catalog along with notes on the presence/absence and characteristic appearance of multiple features evaluated for use in calculating *N*, pathology ("PATH"), animal modification ("GNAW"), and evidence of secondary fragmentation and commingling ("WHITE FX"). Copies of all of the osteometric data—which included the taking many supplementary measurements as defined by Byrd and Adams (2003)—gathered for each of the visual pair-matching samples are also included in the catalog.

Pathologies were observed in 12.15% of the humeral sample (14 definitive cases, 8 possible cases) and 38.51% of the tibial sample (49 definitive cases, 18 possible cases). Underlying causes of most of the observed pathology could not be determined due to the number of conditions resulting in similar presentations and the lack of other associated elements. The most striking of the observed pathologies was multiple instances of anterior bowing of the tibia ("saber shin") consistent both with true bowing (caused by abnormally stimulated growth of the diaphysis) and pseudo-bowing (caused the layered deposition of bone to the anterior and medial surfaces as a result of a periosteal reaction). Both types of bowing are consistent with various treponemal infections. Robust and developmentally abnormal growth observed in two anteriorly-bowed juvenile tibia was so extensive that overall size could not be used as a possible indicator of skeletal maturity within the tibia. Non-gummatous periostitis in various states of activity was observed in both humeral and tibial elements but occurred most

frequently on the anterior and medial surfaces of the tibiae. Lytic lesions were few and small, roughly 1 cm at their widest margin. Few cases of trauma were observed (limited to two fractured humeri), though at least one tibia known to have been unearthed with an embedded lithic flake could not be found in this survey of the collection.

Over one third (35.49%) of all of the elements pulled for this thesis showed signs of animal modification. Most of this modification is consistent with the gnawing behavior observed among gray squirrels, with multiple clustered parallel incisions focused along the diaphysis, producing a shaved effect that occasionally penetrated into the bone cavity. While frequently cited in modern cases of rodent gnawing, brown rats are not native to North America and were not imported until almost a thousand years after Mound A's construction, effectively excluding them as possible taphonomic agents. Despite the multiple dog burials within the mound, confirming their close association with the people of Gold Mine, no modification patterns consistent with canid attempts to access the rich marrow contained within fresh bone were observed within the sample, though any such evidence may be obscured by additional secondary fracturing at the epiphysis. Solitary puncture marks and occasional longer furrows across the surface of an element were noted, however, which are consistent with carnivore modification.

7.1.2 Accurately Determining N

Fifty left humeri and 54 right humeri were selected for visual pair-matching. With the exception of two cases (fragmentary but otherwise complete, robust, and likely adult left and right humeri) individual humeri were identified for visual pair-matching based on the presence of a fused medial epicondyle, the most frequently represented feature that could also be used as an indicator for age. Visual pair-matching was performed with two observers, both of whom found it difficult to identify a single possible pair-match in multiple cases. Due to the high number of conflicting pairs—a phenomenon not encountered in either the tibia pair-matching attempt or any of the previous visual pair-matching studies using the Gold Mine Site Collection—and the resulting high potential for both Type I (rejecting a possible match between two elements that originated from the same individual) and Type II (failing to reject a possible match between two elements that originated from different individuals) error the resulting number of identified pairs were deemed unreliable for a valid estimation of *N*. Counting only those elements with medial epicondyles, the MNI for the humerus is 53.

Twenty-eight left tibiae and 38 right tibia were selected for visual pair-matching. The most frequently represented feature among all tibial elements was the nutrient foramen, but in order to ensure that only adult tibiae were included in the sample only those tibial elements with both a nutrient formation and a fused proximal and/or distal epiphysis were included in the sample. MNI for the tibia is 38. Interobserver conflict was minimal compared to that seen in the humeral sample, and it was determined that the number of identified pairs could reliably be used to calculate MLNI. Stewart identified 16 pairs with

confidence and without conflict, resulting in an MLNI of 65 with a calculated recovery probability of 48.48% and a 95% confidence interval of 50-88. Steadman identified 12 pairs with confidence and without conflict, resulting in an MLNI of 86 with a calculated recovery probability of 36.36% and a 95% confidence interval of 54-110+. Because of the breadth of Steadman's confidence interval, Stewart's MLNI is taken as the more likely estimate of *N* for the adult tibial sample.

Given the variability in the quantitatively-determined *N* for the Gold Mine Site Collection produced by this thesis as well as previous visual pair-matching attempts and the high likelihood of MNI to under-represent the true number of individuals when recovery is not complete, it may be the case that *N* is better reported as a range for commingled and fragmentary ossuary assemblages.

7.1.3 Interpretation of Results

Though the results of the humeral visual pair-matching could not reliably be used to determine *N*, it was decided to calculate a hypothetical MLNI, recovery probability, and 95% confidence interval for variations of those results (one assuming a best case scenario of maximum number of plausible pairs from the possible pairs identified by both observers, one assuming a strict definition of pair-matching were only elements with one possible pair-match were counted). This enabled the humeral sample to be compared against other pair-matching attempts using the collection (adult tibiae, adult femora, and juvenile tibiae), which did not experience the same problems, in order to determine what was unique about the humeral sample. Recovery probabilities and confidence intervals had not been previously calculated for either the adult femur or juvenile tibia studies. The results of the statistical comparison were inconclusive, but based on observed trends within the humeral sample and the observations made by both observers it is appears that most of the visual pair-matching problems can be attributed to a higher rate of fragmentation (leaving fewer features and dimensions available for comparison) combined with a more limited range of morphological variation.

Recovery probabilities were similar for both adult tibiae and adult femora, yet the most methodologically conservative femoral MNI (Lans MNI=110; Steadman MNI=149; Lans & Steadman Combined MNI with 29 pairs=103) was nearly double that of the most methodologically conservative tibial MNI (Stewart MNI=65; Steadman MNI=58). By raw counts more adult femora (53 left, 47 right) were identified within the collection as a whole than were adult tibia (28 left, 38 right). This suggests a possible differential treatment of the long bones of the adult leg, resulting in lower representation of the tibia within the excavated portion of the mound. Whether the "missing" tibiae are interred elsewhere, possibly piled together in a cache not dissimilar to the long bone piles noted within the surviving field notes (McGimsey 2004:108), or whether they were never interred within the mound to begin with is unknown.

It is also possible that there are no "missing" tibiae at all, and that the difference is the result of a differential impact of fragmentation upon the two leg

bones. The distal portion of the femur may have simply survived the fragmentation process more intact than either the proximal or distal portions of the tibia, with the result that more individuals were represented within the femoral visual pair-matching sample than were within the tibial visual pair-matching sample. The number of tibia plateau fragments that could not be reassociated due to extensive crumbling of the underlying cortical bone would fall in line with this theory. Whatever pathological processes warped so many of the tibia within the sample may have also made the tibia more prone to extensive fragmentation. Alternatively, those bilateral pathological processes may have made the tibia more unique, enabling observers to confidently identify true pairs at a greater rate than within the femoral sample. If the rate of Type I error is higher within the adult femoral visual pair-match sample than it is in the adult humeral visual pair-match sample, then the resulting femoral MLNI may be higher than the true *N*.

The presence of rodent gnawing in the Gold Mine Site Collection—specifically, rodent gnawing patterns consistent with gray squirrel gnawing—has significant implications for the interpretation of mortuary practices and mound construction intervals at Gold Mine. Klippel and Synstelien (2007) have shown that gray squirrels are not attracted to fresh remains; in repeated experiments and reviews of case studies using both human and non-human remains, no signs of gray squirrel gnawing were found on remains with a post-mortem interval of less than 12 to 30 months. That such gnawing should occur so frequently within the Gold Mine ossuary sample contradicts Belmont's suggestion of primary and secondary interments within the mound representing a singular, multi-stage burial program. Any element with signs of rodent gnawing would have had to have been exposed and subjected to advanced skeletonization for some period before collection to be placed within the mound.

Alternatively, assuming a period of longer construction and use for Mound A than McGimsey's conclusion of a month or less based on erosion analysis of the different strata, those elements may have been partially exposed even after placement with the mound. Burials were typically shallow and did not cut through multiple MS layers, though some elements are recorded as protruding from one stratum into the next. If the time between the placement of remains within the mound and the deposition of the seceding layer of earth was long enough, leaving the skeletonized remains partially exposed at ground level, this might account for some of the observed instances of gnawing. Klippel and Synstelien's experiments showed gray squirrel gnawing activity on dry bone within as little as two weeks of deliberate placement (2007). This scenario still requires an extensive post-mortem interval prior to placement within the mound, however, in order to allow for the complete drying of the bone in question.

The minimal degree of recognizable canid modification when dogs and other large predators are represented within the faunal assemblage may also imply either that steps were deliberately taken to secure the remains from disturbance by larger animals or that any heavily-scavenged remains were handled differently than the remains recovered to date. It is also possible that subsequent damage to many of the epiphyseal ends of long bones within the

collection has obscured evidence of carnivore scavenging while the bones were still relatively fresh and greasy. Surviving excavation notes also make mention of remains that appear to have been at least partially articulated at the time of final interment. If any of the elements with signs of rodent gnawing can be tied to those partially articulated remains, then either those remains were partially mummified at the time of interment (with the gnawed regions exposed and dry) or those elements were deliberately placed in anatomical order in the same manner seen in the pseudo primary burials.

As supported by taphonomic evidence, Mound A of the Gold Mine site therefore appears to represent a concentrated gathering of individuals who had died at minimum of one to three years prior to the mound's construction. Variations within the gnawing patterns would suggest either different lengths of exposure between elements or differing levels of access to those elements by the rodent culprits (i.e., the piling of bones prior to interment, elements protruding above the surface of a shallow burial, or elements completely exposed as part of the surface scatter). Gnawing is also a possible contributing factor to the current highly fragmentary state of the remains, with many post-mortem fractures (many of those post-excavation, judging by their color) occurring concurrently with sites of animal modification. Some animal gnawing sites would also appear to be modern in origin, with the exposed cortical bone much lighter in color than the surrounding bone surface. If this damage is indeed animal in origin, then these elements may have been among those exposed by historical activities at the site.

Recommendations for Future Research

Given the limitations of time afforded by the thesis process, most of the data presented here was specifically gathered for use in future research. On its own this thesis cannot answer any of the most pressing questions surrounding Gold Mine. The true number of people recovered from Mound A remains unknown, though by comparing the overlap between the most methodologically conservative MNI and MLNI results of this thesis with those of previous researchers at minimum the count ranges from around 65 to over 100 mature individuals and roughly 140 juvenile individuals (though the juvenile N is likely an overestimate based on the low r and large sample size). It is also not known whether the mound contains the dead of a single community or those of a much larger sociocultural network, nor the number of generations and length of time represented in either scenario. The adult tibiae in particular have provided glimpses of the types of diseases faced by the Gold Mine people, but the origins of those diseases and their impact upon the community is still unclear.

Most intriguingly, however, is the potential raised by Gold Mine of using animal modification and other variations in taphonomic damage as an avenue for determining prehistoric mortuary behavior and inferring post-mortem interval patterns in the secondary placement of the dead. In this sense biological anthropology—particularly the experimental studies in decomposition that have formed the backbone of much of forensic anthropology—can provide valuable

insight to the understanding of a site beyond a quantitative accounting for the number of individuals represented or their physical condition in life.

7.2.1 Using the Gold Mine Site Collection: Observations and Applications for Other Large Collections

Beyond furthering archaeological understanding of Troyville culture, the Gold Mine site offers crucial lessons on the importance of a thorough and methodologically-consistent documentation process, both for the excavation of an archaeological site itself and the analysis and curation of all its accompanying remains and artifacts. Ideally this documentation should be processed and compiled as the excavation or analysis is in process or at least soon after, then curated in multiple formats in order to lessen the negative impact of the loss of any one part of the collection and its associated documents. A chain of custody should also be maintained for all components of a collection on loan for outside research, particularly in the case of human remains. The actions of the past cannot be changed, but while it may not always be possible to entirely undo resulting errors and inconsistencies within a collection, *post facto* documentation and analysis provides multiple lines of evidence that can be used to define the nature and extent of those errors. By establishing “known knowns” and “known unknowns”, more pointed questions can be asked of a collection using research and analytical methodologies best-suited to accommodate any problematic components.

One of the primary concerns of any researcher handling the Gold Mine Site Collection is the prevention of further commingling and loss. Any elements removed for study should be tagged with all of the information needed to return them to their original position in storage. Thorough records should also be maintained as to the number and identity of all elements removed from storage, under whose care, and for what purpose. During the course of this thesis any misidentified elements (i.e., juvenile femur shafts or fragmentary ulnae) found in bags purported to contain either humeri or tibiae were noted and a full list of those notations prepared for submission to the collection’s long-term curator. Slips of acid-free paper were also added to those bags to flag them as containing misidentified elements. Until such time as a thorough inventory has been completed and checked against the contents of each bag these indicators are one of the few means of alerting researchers to inaccuracies and issues within the collection.

As shown by the extensive degree of secondary fragmentation and commingling, the collection is vulnerable to unintended physical damage at the hands of researchers. Despite the cautions taken when handling the collection, one humerus element (GM66 BUR80-5 0N4E Level 3 CAT? 760) was broken during the course of this thesis when the glue used in a previous reconstruction failed and the distal portion of the element impacted against a hard surface, knocking off the lateral epicondyle. Given the frequency of unassociated fragmentary elements with remnants of glue on at least one of their fractured surfaces, the security of those past reconstructions is by no means certain.

Other elements have mineralized to the point where they are easily scratched and gouged by tightly placed calipers, and most bags are lined with a layer of fine flakes of bone that have broken off of the thin, ragged edges of the elements within. Many of the storage boxes themselves are packed to near-capacity with heavy long bones stacked on top of bags of fragile cranial and juvenile elements and minimal to no padding. These circumstances appear to have led to at least some of the secondary fragmentation observed within the collection. The collection is currently slated for repackaging in a more appropriate fashion prior to its return to the Louisiana Division of Archaeology.

In addition to further photographic documentation of the Gold Mine Site Collection specifically, extensive photographic documentation is recommended for any archaeological collection. This process is best begun in the field, recording the remains or artifacts in their original context and the process by which they are excavated. Once an element or artifact has been removed from its archaeological context, further documentation is also recommended prior to any cleaning or processing in order to document it in its original condition. This establishes a documented timeline by which any damage or loss sustained systemically or by an individual collection component can be identified, while also allowing researchers to incorporate the original condition of the collection into their analyses. Should a component ever become disassociated from its storage context or identifying tag, then this early documentation can help reestablish its identity and proper place within the collection. Photographic reference catalogs also allow for faster retrieval of individual components from storage when dealing with very large collections or multiple components kept in the same storage bags, as is the case with Gold Mine, by providing a visual reference which can be used to distinguish between multiple components that are otherwise similar or nearly identical on paper. Finally, while time-consuming in its initial production stages, once a collection has been thoroughly documented those photographs and accompanying data sets can and should be made available for other research, allowing for study of the collection even as it remains in storage or on loan to another institution. Should more extensive, hands-on analysis be called for, those photographs can be used to make directed, informed decisions on which collection components are best suited for further study.

As a student of biological anthropology with an interest in forensics, the process also provided excellent practice photographing skeletal remains, including the complexities involved in positioning and lighting elements in order to best capture morphological nuances and three-dimensional features and textures. The process also proved useful during visual pair-matching—particularly in the case of fragmentary elements with limited representation of traditional features—as the author became exceedingly familiar with the subtleties of individual elements as well as broad morphological and pathological trends within the collection. Photographing every sampled element proved time-intensive, however, as did sorting and renaming the resulting files into a useful catalog. If a full photographic record cannot be taken, the author recommends extended hands-on observation of the subsample in order to gain that familiarity.

A full survey of the material to be studied should also be undertaken so that issues specific to those elements (i.e., frequent pathological bowing of the tibia) can be noted and the experimental design adjusted accordingly.

7.2.2 Reconstructing Individuals and Determining N

As MLNI has proven inconsistently reliable as a means of determining *N* for Gold Mine, further research should focus on metric analysis that incorporates Byrd and Adams's (2003) supplementary measurements. For a highly fragmentary sample such as Gold Mine, these measurements—particularly when taken together—are an invaluable means of compensating for the loss of the length measurements that have traditionally made up the brunt of metric comparisons. As an additional benefit, these measurements were designed for the specific use of reassociation disparate, non-articulating elements from the same individual, one of the key priorities in advancing anthropological research at Gold Mine. The humeral and tibial osteometric data gathered over the course of this thesis may easily be applied towards this end.

Osteometric analysis also allows for a more statistically-directed elimination of the intra- and interobserver conflicting pairs identified in this thesis. Eliminating all statistically unlikely pair-matches may allow for greater clarity in identifying plausible pairs as well as the issues specific to those elements and the collection as a whole that makes visual pair-matching so difficult for the humeral sample. Should Thomas et al.'s method for comparing M be validated through controlled studies as a statistically valid method of comparing large assemblages of Native American remains from archaeological contexts (whether using the reference values of M established by Thomas et al. or Gold Mine-specific values drawn from an appropriate reference collection), it may also be incorporated into the refinement of the total number of identified pairs. Depending upon the final number of identified pairs (*P*), the calculation of *N* may be drastically altered.

7.2.3 Pathology

Until such time as whole individual skeletons can be reassembled from the Gold Mine remains, descriptions of disease patterns and other stressors affecting the population are primarily limited to what can be determined from individual elements. This thesis has briefly summarized how this focused view limits the ability to narrow the differential diagnostic process, but even without the luxury of known complete individuals it may be possible to refine the possible diagnoses based on patterns in pathologies observed in other elements. A congenital syphilis diagnosis would be bolstered, for example, by the confirmation of true bowing through the reassociation of non-bowed fibulae with bowed tibiae or the noted enlargement of the sternal end of the clavicle. Walker's review of dental pathologies makes no mention of the notched incisors characteristic of congenital syphilis, but their presence may be obscured by the high degree of anterior tooth loss.

Imaging studies including simple x-rays should also provide a quick, cost-effective means of refining the differential diagnosis for the various cases of saber shin as well as other pathologies. Tibiae with roughly similar surface morphology may have radically different patterns of cortical thickness and constriction of the medullary cavity. Radiographs may also reveal otherwise unnoticed antemortem fracturing, and study of the Harris lines of the tibia may yield further indicators of stress and variations in growth.

7.2.4 Animal Modification (Gnawing)

To the author's knowledge, this thesis is the only study to date to have highlighted the prevalence, impact, and implications of animal modification on part of the Gold Mine Site Collection. Animal modification appears to be the source of much of the fragmentation within the collection, as many reconstructed elements showed evidence of gnawing at the point where the element had fractured. Further evidence of animal modification may be uncovered as more humeral and tibial elements are located elsewhere in the collection, allowing for further reassociations.

A thorough accounting of all animal modification observed within the collection—particularly gnawing patterns consistent with the gray squirrel—has multiple potential analytical uses. Firstly, if the occurrence rates of animal modification should vary between different skeletal elements, then that may indicate variability in the treatment of different parts of the body prior to interment or differences in priorities when selecting which elements of the long-dead would be interned within the mound. Secondly, the presence of gnawing may also be used to check the interpretation of burial types; any primary burial with evidence of rodent gnawing would in fact be a secondary placement, perhaps an unrecognized pseudo primary burial, though inversely the absence of rodent gnawing is by no means a conclusive verification of a shorter post-mortem interval prior to interment. This has additional utility in reconstructing placement within the mound structure. As described earlier, any elements with evidence of more modern animal modification (as indicated by the presence of gnawing with lighter coloration of the exposed cortical bone) are likely to have come from burials in the upper layers of the mound that were disturbed by historical activity.

Final Note: Ethical Considerations for Usage and Accessing the Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog

While some photographic catalogs are more easily published in full due to their small size and/or subject matter, the sheer number of photographs in this thesis as well as the resolution size needed to best record subtleties in pathological presentation and animal modification complicates the distribution of the data. There are also ethical considerations to be observed given the nature of the collection itself. Though the remains of Gold Mine have not been linked to

any modern tribe, they are nevertheless human mortuary remains and so must be treated with utmost respect.

Given the wide potential the catalog holds not only to researchers with a specific focus on the Gold Mine site, but also the study of pre-Columbian pathological patterns, mound mortuary practices in the American southeast, the resolution of commingling within mass burials, and the documentation and curation of large osteological assemblages, the intellectual products of this thesis were always intended to be made accessible for use and consultation both within and without the field of anthropology. Blind distribution of this data, however, runs the risk of eventual improper and/or unethical use of what are—at their heart—detailed photographs of the remains of human beings. Unlike modern studies of human decomposition, these people and their descendants have had no opportunity to consent to the excavation of what was intended as their final interment, much less the use of their remains in formal research. Anthropological practice—both historically and today, despite actions within the field to recognize and work against these privileged tendencies—is too-frequently eager to ignore the agency and humanity of the people under its study.

In recognition of the possibility of any future repatriation of the Gold Mine Site Collection and the agency of the claimant under the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 to refuse consent to the continued use and distribution of these images for anthropological study, access to the Gold Mine Site (16RI13) Adult Humerus and Tibia Photographic Catalog is retained by the author and recognized curators to be granted in response to individual research use requests. As of this writing, recognized curators include Dr. Dawnie Steadman, current Director of the Forensic Anthropology Center at the University of Tennessee, Knoxville, and Dr. Charles “Chip” McGimsey in his current capacity as State Archaeologist for Louisiana.

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APPENDICES

APPENDIX A
GOLD MINE EXCAVATION PLANS

All images and accompanying text taken from McGimsey (2004). All plan views and burial distribution composites were reconstructed by McGimsey based on surviving excavation documents and are likely to contain inaccuracies. The placement and orientation of remains within each burial are particularly suspect. The bolded burial numbers in Figure A.7 are based on McGimsey's burial number system; it is unknown how well any of these burial numbers correspond with the burial numbers recorded on the collection's storage bags, much less how well the associating remains reported by McGimsey are reflective of the current contents of each storage bag.

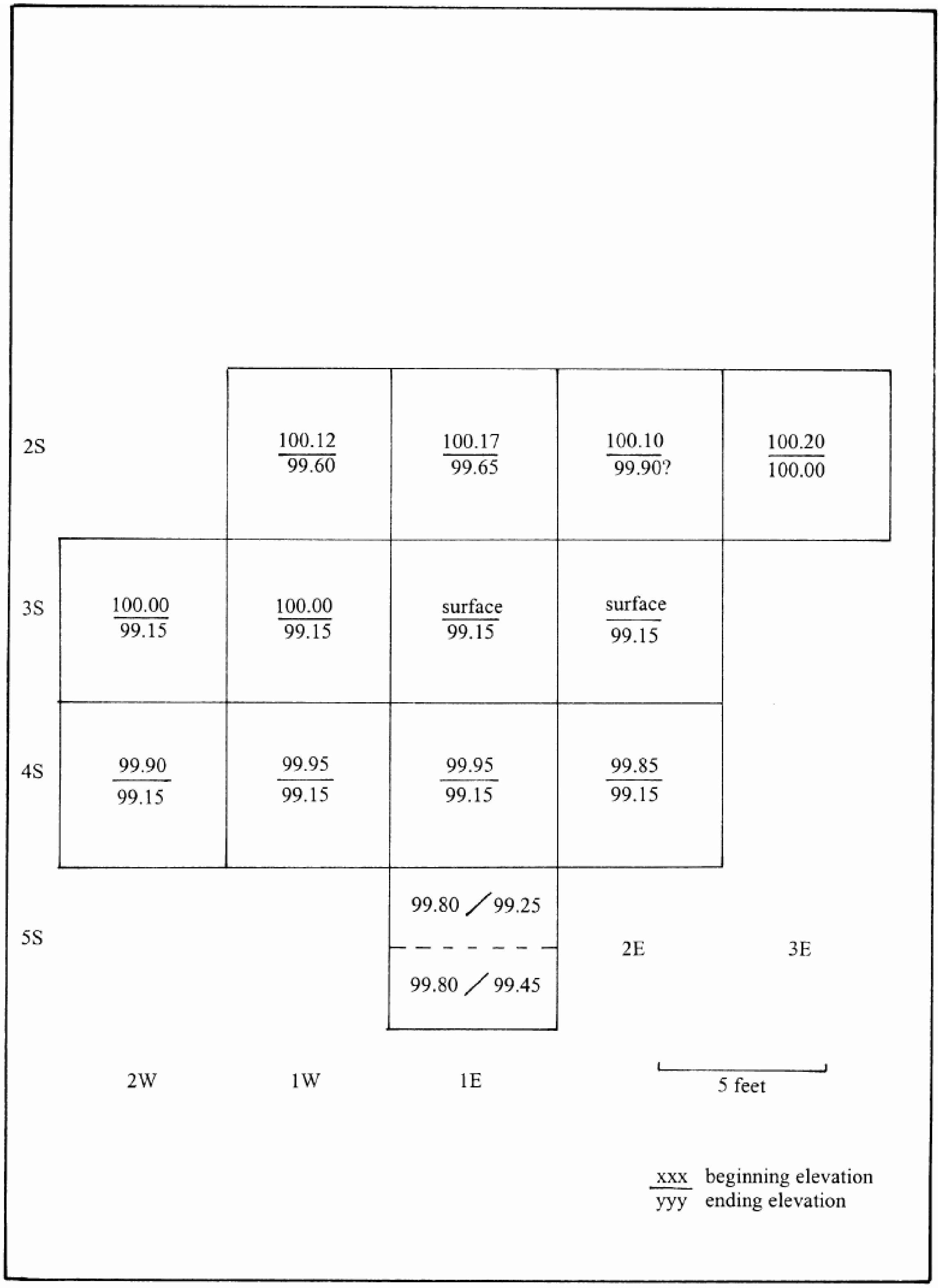

Figure A.1. Plan view of 1978 excavation units (McGimsey 2004:31).

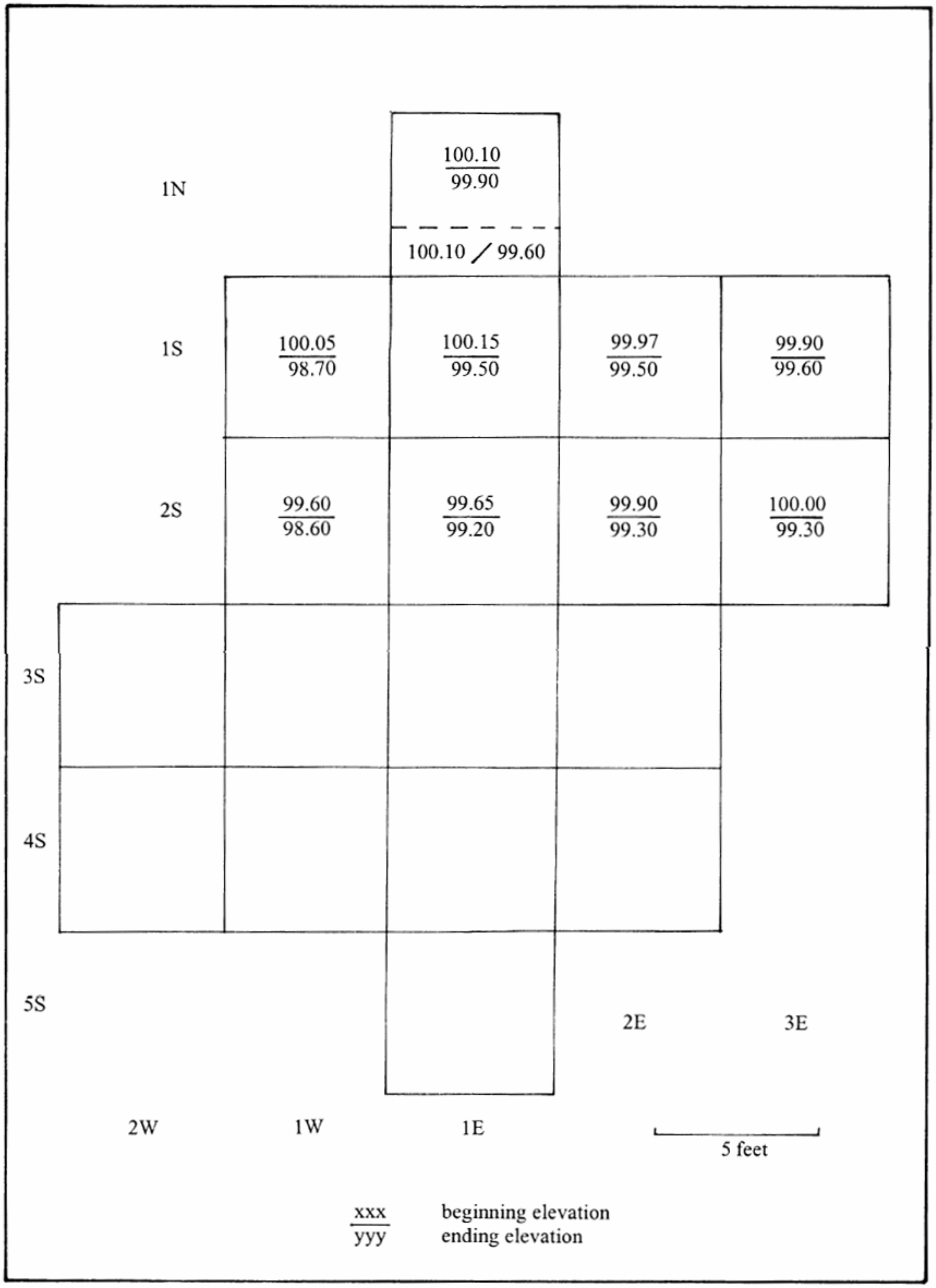

Figure A.2. Plan view of 1979 excavation units (McGimsey 2004:35).

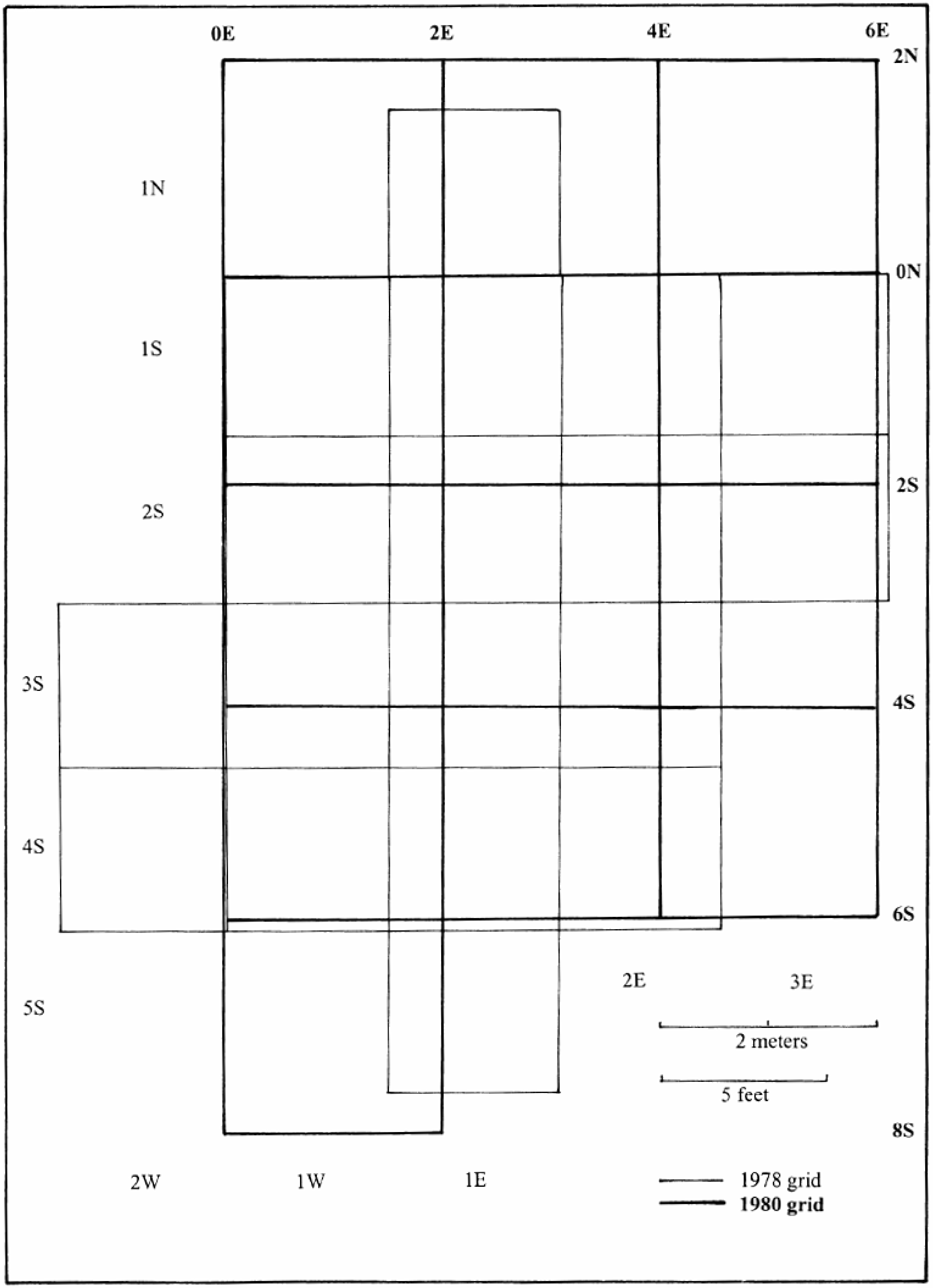

Figure A.3. The 1978 and 1980 excavation grids (McGimsey 2004:38).

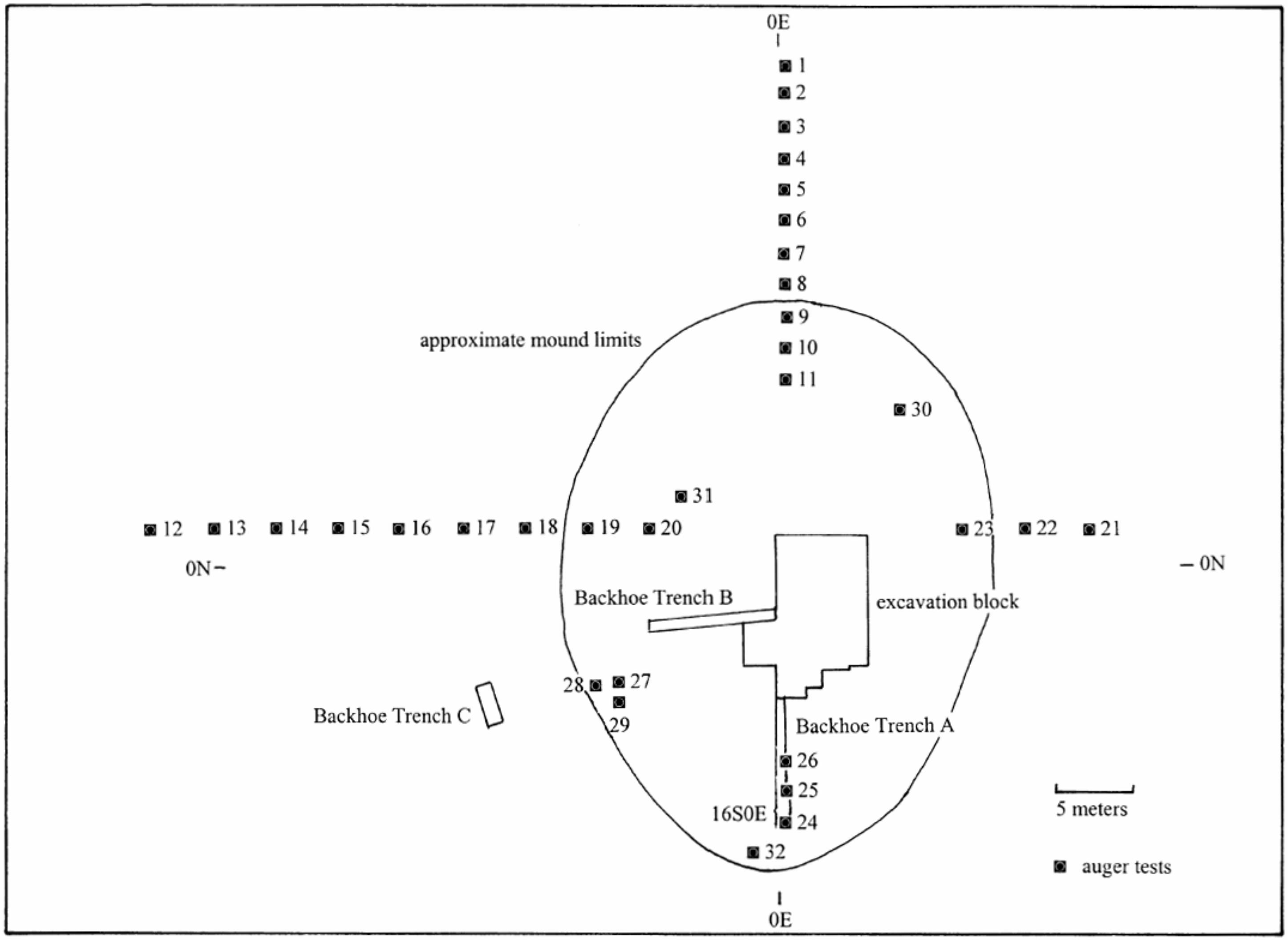

Figure A.4. Plan view of the 1980 auger test and backhoe trenches [in Mound A] (McGimsey 2004:41).

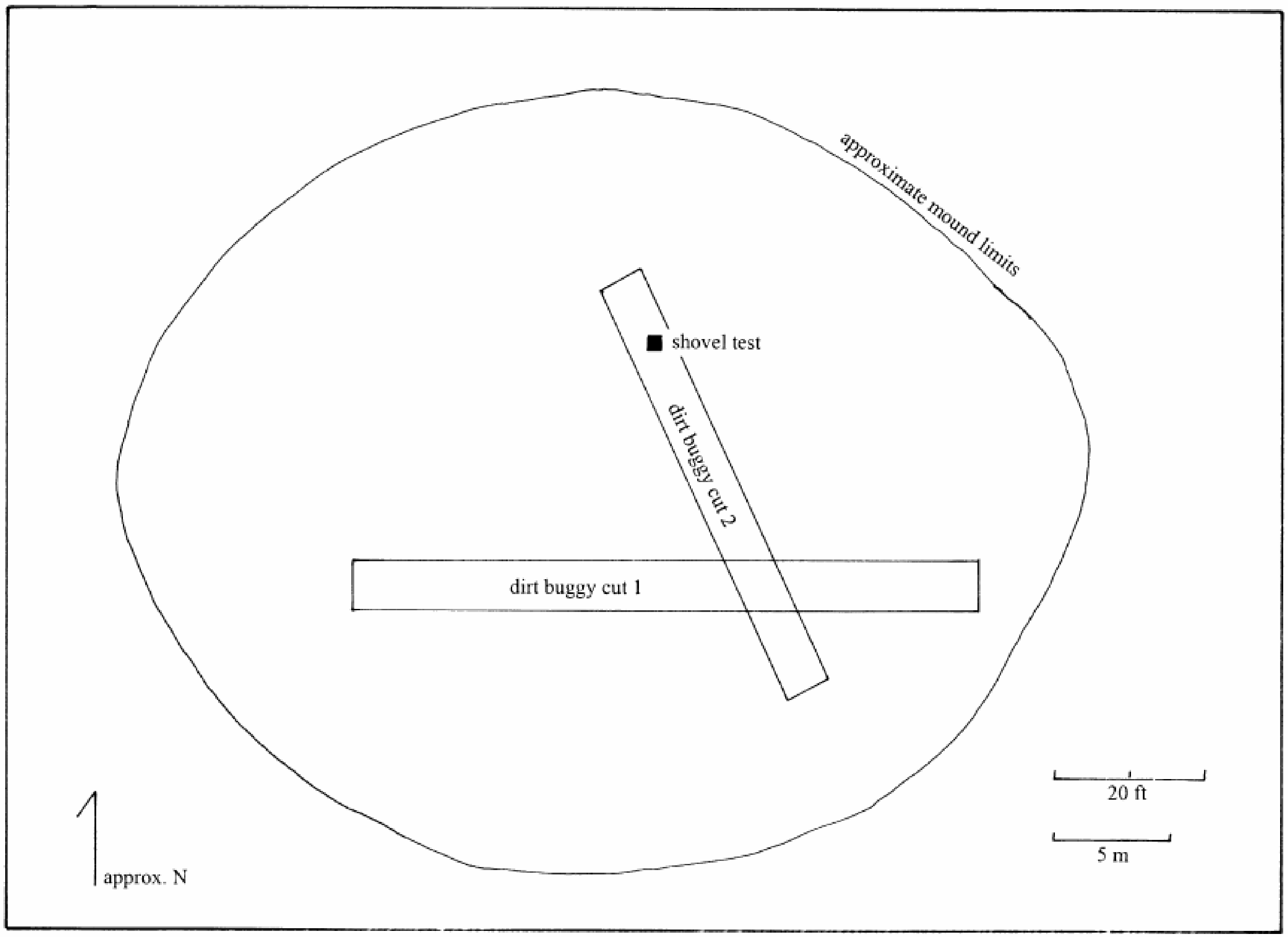

Figure A.5. Sketch map of Mound B (McGimsey 2004:36).

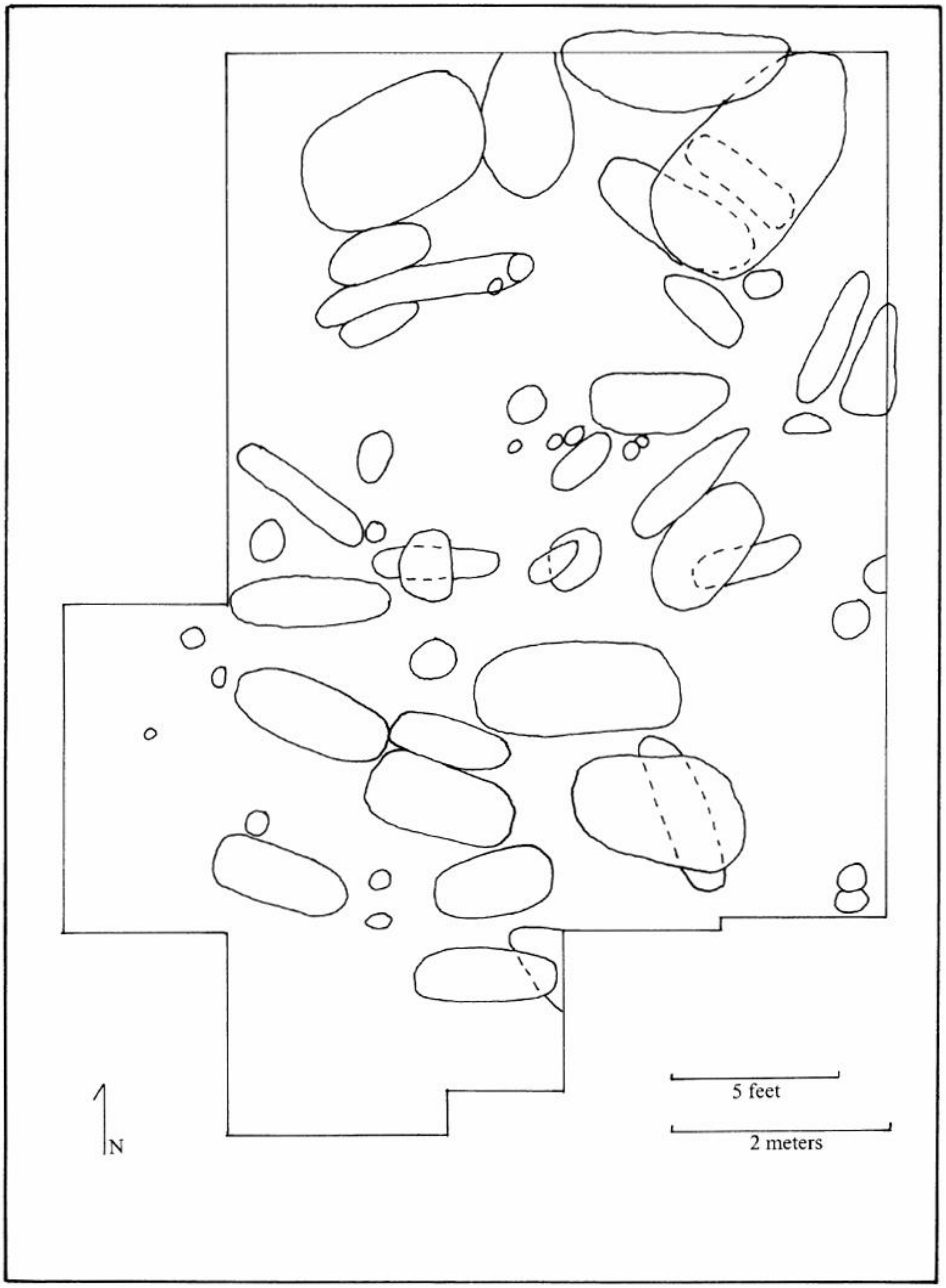

Figure A.6. Distribution of all burials in the excavation block (McGimsey 2004:45).

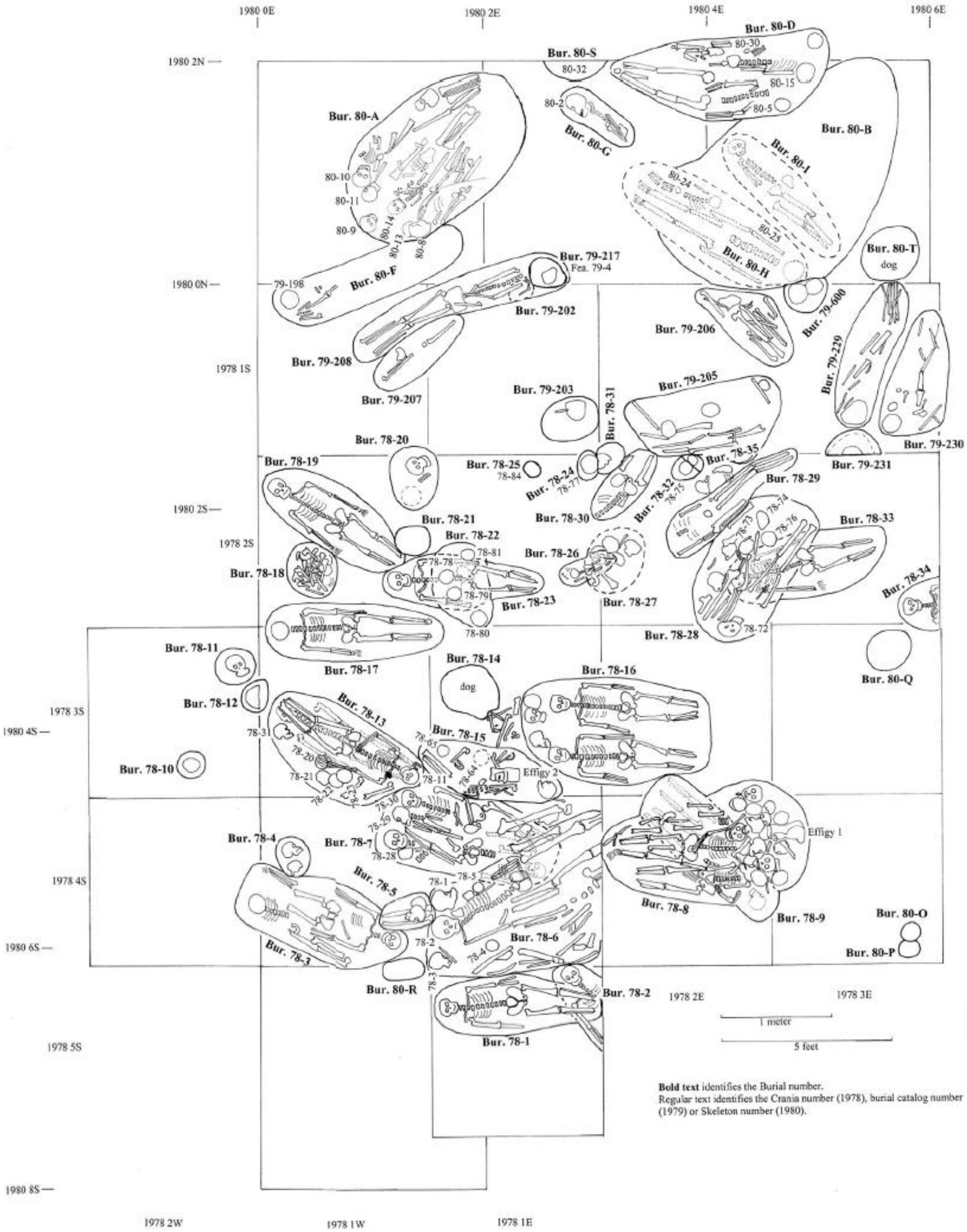

Figure A.7. Composite plan view map illustrating the distribution of burials in the excavation block (McGimsey 2004:80).

APPENDIX B
SELECTED IMAGES FROM GOLD MINE SITE COLLECTION: ANIMAL MODIFICATION AND PATHOLOGIES

All images and accompanying text original to the author. All images have been altered slightly from the original photographs as they appear in the Gold Mine (16RI13) Adult Humerus and Tibia Photographic Catalog. Most alterations (performed with the GNU Image Manipulation Program) were limited to cropping or slight shifts in contrast levels to better depict the characteristics of pathologies and sites of animal modification, but in some images the position of the metric scale has been shifted so that it can be better observed in the final images seen here. No alterations were made to the size of the metric scale or the element depicted.

Figure B.1. Right juvenile tibia with saber shin/anterior bowing and thickening of the diaphysis. Likely pair-match with GM25 BUR78-54b CAT942 54 (L) pictured in Figure B.2.

Figure B.2. Left juvenile tibia with saber shin/anterior bowing and thickening of the diaphysis. Likely pair-match with GM25 BUR78-54b CAT942 54 pictured in Figure B.1.

Figure B.3. Left tibia with saber shin/anterior bowing and possible medial bowing.

Figure B.4. Right tibiae with saber shin/anterior bowing. Possible case of “true” bowing in the tibia on the left, with “pseudo” bowing depicted in the tibia on the right.

Figure B.5. Right tibiae with saber shin/anterior bowing. Thickening of the distal diaphysis in the right-hand tibia.

Figure B.6. Possible bilateral presentation of saber shin/anterior bowing in left and right tibiae. Identified as a plausible pair by both VPM observers. Right-hand tibia also pictured in Figure B.5.

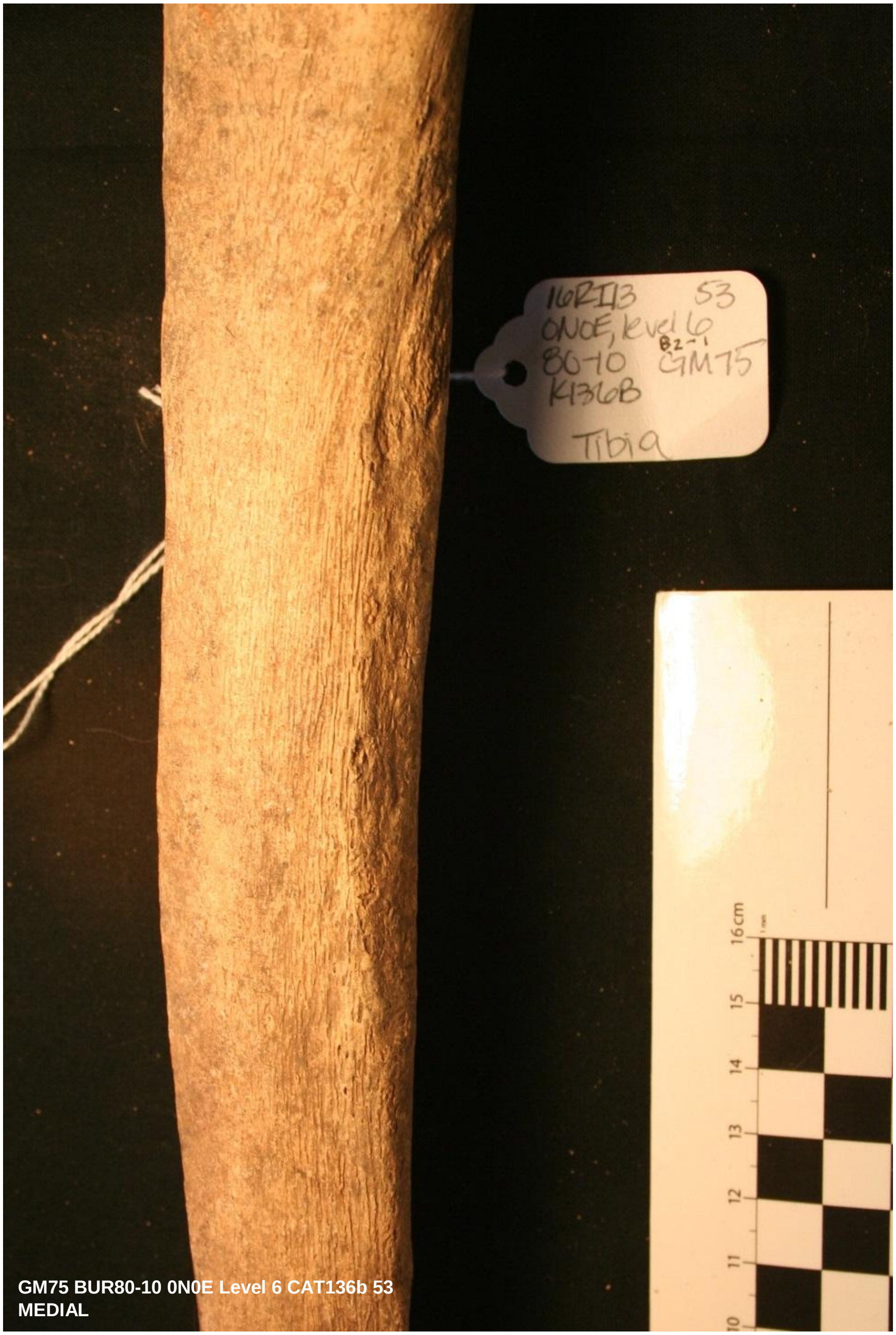

Figure B.7. Right tibia, periostitis on medio-posterior surface/posterior deposition of bone.

Figure B.8. Left tibia, possible saber shin/anterior deposition of bone. ~2 cm ovular growth on lateral surface.

Figure B.9. Right tibia, extensive periostitis in various states of healing on all surfaces, possible osteitis..

Figure B.10. Left humerus, periostitis on deltoid tuberosity. Possible site of modern animal modification immediately proximal to deltoid tuberosity.

Figure B.11. Left tibia, extensive periostitis and swelling of the diaphysis. Abnormal growth along popliteal line.

Figure B.42. Left tibia, abnormal growth along popliteal line, resulting in canyon-like appearance.

Figure B.13. Right tibia, microporosity (possible periostitis) and lytic depression along medial surface.

Figure B.14. Detail of lytic depression seen on right tibia in Figure B.4.

Figure B.15. Left humerus with healed fracture along distal diaphysis.

Figure B.16. Right humerus with healed fracture along distal diaphysis.

Figure B.17. Posterior “twisting” of tibia, resulting in misalignment of the distal portion of the tibia.

Figure B.18. Focused gnawing perforating into medullar cavity.

Figure B.19. Solitary incised groove, possible carnivore scavenging.

Figure B.20. Examples of clustered, parallel gnawing.

Figure B.21. Examples of rodent gnawing, placement of top and bottom teeth visible.

Figure B.22. Extensive gnawing exposing lighter cortical bone.

Figure B.23. Multiple gnawing episodes on a single element with variations in coloration of exposed cortical bone.

Figure B.24. Fracturing at site of gnawing.

APPENDIX C
HUMERAL SAMPLE INVENTORY

The following inventory is included as an Excel™ file in the digital catalog for greater ease of use; its formatting has been altered slightly here for publication. In the case of reassociated elements from different storage contexts and recorded burial provenience each element is listed and described separately. Component elements bearing a medial epicondyle are listed first (in their absence, the distal-most component element is listed first); all remaining associated component elements are listed subsequently in anatomical order—distal-most to proximal—and indicated both by italics and with a “w/[with]” in front of the GM box number. The “VPM” column indicates those elements which were part of the assemblage used in visual pair-matching.

For formatting reasons, names of features have been abbreviated within the column headers: medial epicondyle (“ME”), capitulum (“CAP”), trochlea (“TRO”), lateral epicondyle (“LE”), and deltoid tuberosity (“DT”). All feature names are spelled out in full within the accompanying notes.

Table C.1. Adult Humeri Inventory.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	ME	CAP	TRO	LE	DT	HEAD	PATH	GNAW	WHITE FX
GM01	78-1	870	1694, HLD_9	L	1	1	1	1	1	1	0	0	0	1
Missing head, fracture edges lighter in color.														
GM01	78-1	870	1695	R	0	0	0	0	0	1	0	1	1	1
Diaphysis fragment, missing head and broken off distally through olecranon fossa. Healed fracture at distal end, distal portion turned in medially. Healed fracture, missing distal and head. Small incised groove on medial surface.														
GM01	78-1	870	1700, HLD_9	L	0	0	0	0	0	1	0	0	1	1
Diaphysis fragment, deltoid tuberosity to just above olecranon fossa; all fracture edges lighter in color. Gnawing along medio-posterior surface.														
GM01	78-2	871	1696, 1699	R	1	1	1	1	1	1	1	0	0	0
Whole bone; two fragments reassocaited with glue. Possible slight lateral bowing?														
GM02	78-3a	872	1693, HLC_6	L	1	1	1	1	1	1	1	0	0	0
Whole bone; three fragments reassociated with tape.														
GM03	78-4	874	4	L	0	0	0	0	0	0	0	1	0	1
Diaphysis fragment, distal portion between deltoid tuberosity and proximal border of olecranon fossa; distal fracture edges lighter in color.														
GM03	78-4	874	1702, 4-1	L	0	0	0	0	0	0	0	0	1?	0
Diaphysis fragment, distal portion of deltoid tuberosity present. Possible gnawing on anterior surface.														
GM03	78-4	874	1702, 4-2	L	0	0	0	0	0	0	1	1?	0	0
Head fragment, posterior portion of neck. Possible pathology around anatomical neck, porosity.														
GM03	78-9	877	1686, HLMD_9	L	0	0	1	1	1	1	0	0	1	1
Missing head, fracture edge lighter in color; two fragments reassociated with tape. Extensive gnawing along anterior surface penetrating into medullary cavity, gnawing on medial supracondylar ridge, medial surface.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM03	78-9	877	169_, HRPM_2	R	0	0	0	0	0	0	0	0	1	1
Diaphysis fragment; broken off proximal of olecranon fossa. When combined with GM42 BUR78-125 CAT1011 125 makes element number 1690.														
w/ GM42	*78-125*	*1011*	*125*	*R*	--	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*
Proximal fragment, head and part of diaphysis.														
GM04	78-12	880	1688, 12, HLD_12	L	1	1	1	1	1	0	0	0	0	1
Distal fragment, very small portion of distal deltoid tuberosity present.														
GM04	78-14b	882	1689, HRC_34, 14-1	L	1	1	1	1	1	0	0	0	0	0
Distal fragment, evidence of glue at proximal fracture.														
w/ GM37	*78-102*	*986*	*102*	*R*	--	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*
Diaphysis fragment, missing head														
GM04	78-14b	882	1691, HCM_7	L	0	0	0	0	0	1	0	0	0	1
Diaphysis fragment; proximal and distal fracture edges lighter in color.														
GM05	78-13a	887	1558	R	--	0	0	0	0	0	1	0	0	0
Head fragment with portion of surgical neck; evidence of gluing.														
GM05	78-13a	887	1657, HRC_14	R	1	1	1	1	1	0	0	0	0	1
Distal fragment. When combined with GM41 BUR78-121b CAT109 121b forms whole bone.														
w/ GM41	*78-121b*	*1009*	*121b*	*R*	--	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*0*	*1*
Proximal fragment. Possible pathological bone deposition on tubercles														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM05	78-13a	887	1687, HRMD_7	R	1	1	1	1	1	0	0	0	0	1
Distal fragment; distal portion of deltoid tuberosity present; proximal fracture edge lighter in color.														
GM05	78-13A	887	1698, HLD_13	L	1	1	1	1	1	0	0	0	1	0
Distal fragment, evidence of gluing. Incised groove on medial surface.														
w/ GM03	*78-4*	*874*	*1701, HLM_6*	*L*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*1?*	*0*	*1*
Diaphysis fragment. Possible pathological growth along lateral surface?														
GM06	78-17a	888	1679, HRC_10	R	1	1	1	1	1	1	1	0	1	1
Whole bone, two fragments reassociated with tape. Gnawing along posterior surface and lateral supracondylar ridge.														
GM07	78-22a	894	3, HLM_8	L	0	0	0	0	0	1	0	0	1	1
Diaphysis fragment; proximal and distal fracture edges lighter in color. Gnawing along anterior surface, near point of fracture.														
w/ GM17	*78-36*	*919*	*168_*	*L*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*1*
Diaphysis fragment. Combined with GM07 BUR78-22a CAT899 3, HLM_8 forms element number "1683"														
GM08	78-24a	898	1680, HRD_8	R	1	1	1	1	1	0	0	0	0	1
Distal fragment, distal deltoid tuberosity present to distal epiphysis; two fragments reassociated with glue.														
GM08	78-24a	898	1682, HRM_6	R	0	0	0	0	0	1	0	1?	0	1
Diaphysis fragment; proximal and distal fracture edges lighter in color. Possible slight lateral bowing.														
GM08	78-24a	898	1684, HRD_18	R	1	1	1	1	1	0	0	0	0	1
Distal epiphysis, broken off proximal to olecranon fossa.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM08	78-24a	898	1685	R	0	0?	0	1?	0	0	0	0	0	1
Distal epiphysis fragment; medial epicondyle present but heavily damaged; only medial half of trochlea present.														
w/ GM18	*78-30*	*923*	*1672, HRMD_5*	*R*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*1*
Diaphysis fragment; missing head, proximal and distal fracture edges lighter in color. Line on epiphysis where someone appears to have taken midshaft measurements.														
GM13	78-29	910	1666, HRC_1	R	1	1	1	1	1	1	0	0	0	0?
Missing head, evidence of gluing at proximal break. Forms whole bone when combined with GM18 BUR78-30 CAT923 30, 30-1.														
w/ GM18	*78-30*	*923*	*30, 30-1*	*R*	*--*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0?*
Proximal fragment, head and part of diaphysis.														
GM13	78-29	910	1698, HLC_27	L	1	1	1	1	0	0	0	0	0	1
Missing head.														
GM14	78-31a	911	2370, HRC_5	R	1	1	1	1	1	1	1	0	1?	0
Whole bone, proximal epiphyseal line partially visible. Possible gnawing on distal portion of anterior surface.														
GM15	78-32	913	2369, HRC_31	R	1	1	0	1	1	0	0	0	0	0
Distal fragment, broken at midshaft, has distal portion of deltoid tuberosity.														
GM15	78-32	913	2373, 32-1	R	1	1	0	1?	0	0	0	0	0	0
Distal epiphysis fragment; medial epicondyle and medial half of trochlea.														
w/ GM24	*78-53*	*940*	*2399, HRC_36*	*R*	*--*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*1*
Missing distal epiphysis. Two fragments reassociated with glue at midshaft														
GM16	78-33a	914	2368, HLC_4	L	1	1	0	0	0	1	0	0	0	1
Mostly whole, missing lateral condyle; distal epiphysis reassociated with glue.														

Table C.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*SIDE*	*VPM*	*ME*	*CAP*	*TRO*	*LE*	*DT*	*HEAD*	*PATH*	*GNAW*	*WHITE FX*
GM16	78-35a	917	2374	R	0	0	0	0	0	0	0	0	1	1
Diaphysis fragment, distal portion; broken off above olecranon fossa; distal fracture edge lighter in color. Gnawing along anterior and medial surfaces, at point where broken proximally.														
GM16	78-35a	917	2375	R	0	0	1	1	0	0	0	0	0	0
Distal epiphysis fragment, distal surface of trochlea and capitulum only.														
GM17	78-36	919	2379, HLM_2	L	0	0	0	0	0	1	0	0	1	1
Diaphysis, two fragments reassociated with glue; distal fracture edge lighter in color. Gnawing on anterior surface at and near where diaphysis broken in two.														
GM17	78-36	919	2380	L	0	0	0	0	0	1	0	0	1	1
Diaphysis fragment, two fragments reassociated with glue, proximal fracture edge lighter in color. Gnawing along posterior surface.														
GM17	78-37a	920	1681, HRMD_41	R	0	0	0	0	0	0	0	0	1	0
Distal fragment, distal epiphysis broken proximal of olecranon fossa and portion of diaphysis; evidence of gluing. Gnawing at point where reassociates with GM07 BUR78-22 CAT894 22-1.														
w/ GM07	*78-22*	*894*	*22-1*	*R*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
Diaphysis fragment, proximal and distal fracture edges lighter in color														
GM17	78-37a	920	2376, HLC_29	L	1	1	0	1?	0	1	0	0	0	1
Diaphysis and medial portion of distal epiphysis; two fragments reassociated with glue; proximal fracture edge lighter in color.														
GM17	78-37a	920	2377, HRC_7	R	1	1	1	1	1	1	1	1?	0	0
Whole bone. Small singular whole on surface of capitulum, pathological?														
GM18	78-30	923	161_, HLC_2	L	1	1	1	1	1	1	1	0	0	0
Whole bone; two fragments reassociated with tape; can't read whole element number as last number has been obscured by the break.														
GM18	78-30	923	1667, HLC_1	L	1	1	1	1	1	1	1	0	0	0
Whole bone.														

Table C.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	ME	CAP	TRO	LE	DT	HEAD	PATH	GNAW	WHITE FX
GM18	78-30	923	1668, HRC_32	R	1	1	0	1?	0	1	0	0	0	1
Diaphysis and medial portion of distal epiphysis, two fragments reassociated with tape, evidence of gluing; trochlea only partially represented; proximal fracture edge lighter in color.														
GM18	78-30	923	1669, HLMD_2	L	1	1	1	1	1	1	0	0	0	0
Diaphysis and distal portion; broken above deltoid tuberosity.														
GM18	78-30	923	1671, HRC_33	R	0	0	0	0	0	1	0	0	1	1
Diaphysis, two fragments reassociated with tape; proximal and distal fracture edges lighter in color, evidence of gluging. Gnawing along greater tubercle.														
GM18	78-30	923	1673, HRD_11	R	1	1	1	1	1	0	0	0	0	1
Distal fragment, distal epiphysis and portion of diaphysis; fracture edge lighter in color.														
GM18	78-30	923	1674, HLMD_4	L	1	1	1	1	1	0	0	0	0	1
Distal portion, broken at deltoid tuberosity; fracture edge lighter in color, evidence of gluing.														
w/ GM19	*78-30*	*923*	*30-7*	*L*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*1?*	*0*	*1*
Diaphysis fragment with partial deltoid tuberosity; distal fracture edge lighter in color. Periostitis on medial surface.														
GM18	78-30	923	1675, HRP_11	R	0	0	0	0	0	0	1	0	0	1
Head fragment; broken off distal to surgical neck.														
GM18	78-30	923	1676, HLP_12, 30-10	L	0	0	0	0	0	0	1	0	0	1
Head fragment, broken at surgical neck, has tips of tubercles.														
GM18	78-30	923	1677, 30-13	R	0	0	0	0	0	0	1	0	0	0
Head fragment, broken along anatomical neck, has tip of greater tubercle.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM18	78-30	923	1677, HRP_9, 30-12	R	0	0	0	0	0	0	1	0	0	0
Head fragment, broken along anatomical neck with tips of tubercles.														
GM18	78-30	923	1705, HRC_21	R	1	1	1	1	1	1	0	0	0	1
Distal portion, broken proximal of deltoid tuberosity, evidence of gluing. When combined with GM18 BUR78-30 CAT923 1705, HRC_21 forms whole bone.														
w/ GM37	*78-101*	*985*	*101*	*R*	--	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*
Proximal portion, fracture edge lighter in color.														
GM21	78-41a	926	2383, HRC_15	R	1	1	1	1	1	1	1	0	0	0
Whole bone.														
GM21	78-41a	926	2384, HLP_4	L	0	0	0	0	0	0	0	0	0	1
Diaphysis fragment, from proximal portion distal of tubercles; fracture edges lighter in color.														
GM22	78-45	930	2390	R	0	0	0	0	0	1	0	0	1	1
Diaphysis fragment, two fragments reassociated with glue; proximal and distal fracture edges lighter in color. Extensive gnawing along anterior surface, including where fragment is broken.														
GM22	78-48	934	2386, HRC_11	R	1	1	1	1	1	1	1	0?	0	0
Whole bone. Slightly bowed laterally? Growth along posterior of greater tubercle?														
GM22	78-48	934	2387, HLD_11, 48-3	L	1	1	1	1	1	1	0	0	0	1
Missing head, two fragments reassociated with tape, broken midshaft; evidence of glue at proximal break, also lighter in color.														
GM22	78-48	934	2388, HRP_1	R	0	0	0	0	0	1	1	0	0	1
Proximal portion, broken along deltoid tuberosity; fracture edges lighter in color.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM22	78-48	934	2389, HRD_7	R	1	1	1	1	1	0	0	0	0	1
Distal fragment, distal epiphysis and part of diaphysis; fracture edge lighter in color.														
GM22	78-48	934	2391, HLP_10	?	0	0	0	0	0	0	1	0	0	0
Head fragment, broken at anatomical neck.														
GM23	78-52	939	1614, HLM_3	L	0	0	0	0	0	1	0	1	0	1
Diaphysis fragment, two fragments reassociated with glue; fracture edges lighter in color. Whole of bone surface oddly textured, microporous, healed periostitis? Hyperporosity, maybe anemia?														
GM23	78-52	939	2024, 52	R?	0	0	0	0	0	0	1	0	0	0
Head fragment with tips of tubercles.														
GM23	78-52	939	HLC_26	L	1	1	1	1	1	0	0	0	0	1
Distal fragment, distal epiphysis and very short portion of diaphysis; glue on break. Very gracile individual.														
w/ GM15	*78-32*	*913*	*2372, 32-1*	*L*	*--*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*
Diaphysis fragment, fracture edges lighter in color, evidence of glue on distal.														
GM24	78-53	940	2394, HRC_3	R	1	1	1	1	1	1	1	0?	0	0
Whole bone. Distal portion of greater tubercle very prominent.														
GM24	78-53	940	2395, HLC_17	L	1	1	1	1	1	1	1	1	1	0
Whole bone. Porosity along capitulum surface. Gnawing along medial surface/ridge.														
GM24	78-53	940	2396	L	0	0	0	0	0	1	1	0	0	1
Head and diaphysis, distal fracture edge lighter in color. Possible juvenile, can still see epiphyseal line.														
GM24	78-53	940	2397, HRC_26	R	1	1	1	1	1	1	1	0	0	0
Whole bone.														
GM24	78-53	940	2398, HLC_22	L	1	1	1	1	1	1	0	0	0	1
Missing head, fracture edge lighter in color.														

Table C.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	ME	CAP	TRO	LE	DT	HEAD	PATH	GNAW	WHITE FX
GM26	78-56	944	1729	R	0	1?	1	1	1	1?	0	0	0	1
Distal portion fragment, broken along deltoid tuberosity; fracture edge lighter in color. Base of medial epicondyle present but heavily damaged.														
GM28	78-70	953	1730	R	0	0	0	0	1	1	0	1	0	1
Distal portion, diaphysis and lateral distal epicondyle; parts of proximal fracture edge lighter in color. Healed periostitis along deltoid tuberosity.														
GM29	78-67	954	67-1	R	1	0	1	1	1	1	1	0	0	1
Mostly whole bone, missing capitulum and lateral condyle, fracture edge lighter in color.														
GM29	78-67	954	67-1 (L)	L	1	1	1	1	1	1	0	0	0	1
Missing head, two fragments reassociated with glue; fracture edge lighter in color, mark at midshaft were someone previously took measurements.														
GM30	78-71a	955	1727, HRC_19	R	1	1	1	1	1	1	1	0	1	0
Whole bone, two fragments reassociated with tape. Gnawing along posterior surface, medial epicondyle.														
GM31	78-72	957	1728, HRC_30	R	1	1	1	1	1	1	0	0	1	0
Missing head, gnawing on lateral surface, superior of deltoid tuberosity.														
GM31	78-74	959	HLC_8	L	1	1	1	1	1	1	0	0	1	1
Distal portion, two fragments reassociated with tape; proximal fracture edge lighter in color. Gnawing on posterior surface, alongside deltoid tuberosity. With GM46 BURunassigned 1978 CAT1074 1725 makes whole bone.														
w/ GM46	*unassigned 1978*	*1074*	*1725*	*L*	*--*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*
Proximal portion; fracture edge lighter in color.														
GM31	78-74	959	1731, HLC_3	L	1	1	1	1	1	0	0	0	0	0?
Distal portion; glue on fracture edge. With GM46 BURunassigned 1978 CAT1074 1726 makes whole bone.														
w/ GM46	*unassigned 1978*	*1074*	*1726*	*L*	*--*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*
Proximal portion, glue on fracture edge.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM32	78-75	960	1718, HLC_18	L	1	0	1	1	1	0	0	0	0	1
Distal fragment. When combined with GM24 BUR78-53 CAT940 74-3 and GM31 BUR78-74 CAT959 75, 74-3 makes whole bone, though missing medial epicondyle. Very robust.														
w/ GM31	*78-74*	*959*	*75, 74-3*	*L*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
Diaphysis fragment. Gnawing along posterior surface.														
w/ GM24	*78-53*	*940*	*74-3*	*L*	*--*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*
Head and proximal diaphysis.														
GM32	78-75	960	1720, HRC_8	R	1	1	1	1	1	1	1	0	1	1
Whole bone, three fragments reassociated with tape and glue. Very robust. Gnawing on medial surface beow head, at point below deltoid tuberosity where broken.														
GM32	78-75	960	1721, HLMD_12	L	1	1	0	0	0	1	0	0	0	1
Diaphysis and medial distal epicondyle. Fracture edges lighter in color, distally broken along olecranon fossa.														
GM32	78-75	960	1722, HRD_11	R	1	1	1	1	1	0	0	0	0	0
Distal fragment, two fragments reassociated with glue; distal epiphysis and part of diaphysis; fracture edge lighter in color.														
GM32	78-75	960	1723, HRP_2	R	0	0	0	0	0	0	0	0	0	1
Diaphysis fragment, from just under head; proximal and distal fracture edges lighter in color.														
GM32	78-75	960	1724, 75-4	L?	0	0	0	0	0	0	1	0?	0	0
Head fragment, broken off about anatomical neck. Depression/dent on surface of head, right next to the "4", short shallow groove.														
GM33	78-76	961	1719, HRC_18	R	1	1	1	1	1	1	1	0	0	0
Whole bone, very robust.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM34	78-78	963	1713, HLC_13	L	1	1	1	1	1	1	1	0	0	0
Whole bone.														
GM34	78-78	963	1714, HRC_17	R	1	1	1	1	1	1	1	0	0	0
Whole bone.														
GM34	78-78	963	1715, HRC_25	R	1	1	1	1	1	1	1	0	1	0
Whole bone. Gnawing on medial surface, around midshaft.														
GM34	78-78	963	1716, HLC_24	R	0	0	0	0	0	0?	0	0	1	1
Diaphysis fragment, distal part of deltoid tuberosity to midway through olecranon fossa; fracture edges lighter in color, evidence of gluing. Gnawing on lateral surface, distal of deltoid tuberosity.														
GM34	78-78	963	1717, HLC_21	L	1	1	1	1	1	1	1	1	0	0
Whole bone. Growth in olecranon fossa, lipping on medial edge of trochlea.														
GM35	78-80	965	1707, HRD_9	R	1	1	1	1	1	0	0	0	0	0
Distal portion, two fragments reassociated with tape, broken through olecranon fossa; glue at proximal break.														
w/ GM37	*78-105*	*989*	*105*	*R*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
Diaphysis fragment, proximal and distal fracture edges lighter in color. Gnawing along lateral surface.														
GM35	78-80	965	1710	R	0	0	0	0	0	0	1	0	0	0
Head fragment.														
GM35	78-80	965	1712, HRD_13	L?	0	0	0	0	0	0	0	0	0	1
Diaphysis fragment from distal portion of bone, just above olecranon fossa. Possible juvenile, but consistant in size with known adults.														

Table C.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*SIDE*	*VPM*	*ME*	*CAP*	*TRO*	*LE*	*DT*	*HEAD*	*PATH*	*GNAW*	*WHITE FX*
GM37	78-102	986	1708, HLMD_11	L	1	1	0?	1?	1	1	0	1	1?	1
Missing head; two fragments reassociated with tape, were once glued; fracture edge lighter in color. Healed periostitis along deltoid tuberosity. Gnawing along lateral surface, proximal of deltoid tuberosity, modern?														
GM37	78-104	988	1704, HRC_23	R	1	1	1	1	1	1	0	0	0	0
Distal portion, broken midshaft along deltoid tuberosity. When combined with GM18 BUR78-30 CAT923 30-4 makes whole bone.														
w/ GM18	*78-30*	*923*	*30-4*	*R*	*--*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*
Proximal portion, head and part of diaphysis.														
GM38	78-106	990	1703, HLC_7	L	1	1	1	1	1	1	1	0	1	0
Whole bone. Gnawing along anterior surface and medial supracondylar ridge.														
GM38	78-106	990	HLC_10	L	1	1	1	1	1	0	0	0	1	1
Distal fragment, distal epiphysis and part of diaphysis; damage to medial condyle; fracture edges lighter in color. Gnawing along medial supracondylar ridge.														
GM38	78-109	993	109	R	0	0	0	0	0	0	0	0	0	1
Diaphysis fragment, from just below deltoid tuberosity; nutrient foramen present to help orient.														
GM38	78-109	993	2064, 109	?	0	0	0	0	0	0	1	0	0	0
Head fragment, broken off at anatomical neck. Modern damage/scrapes along head's surface.														
GM38	78-112	996	1706, HLMD_5	L	1	1	0	1	0	1	0	0	0	1
Distal portion, broken along deltoid tuberosity, missing lateral epiphysis, damage to medial epicondyle; proximal fracture edges lighter in color.														
GM39	78-114	998	1709, HLP_3	L	0	0	0	0	0	0	1	0	0	1
Head fragment, broken distal to surgical neck; fracture edge lighter in color.														
GM39	78-118	1002	1661, HLC_15	L	1	1	1	1	1	1	1	0	1	0
Whole bone. Gnawing on lateral supracondylar ridge.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM40	78-119	1003	1711, HRP_8	R	0	0	0	0	0	0	1	0	0	1?
Head fragment, broken off at anatomical neck, tips of tubercles present.														
GM40	78-120	1004	1658, HLC_12	L	1	1	1	1	1	1	1	0	0	1
Whole bone, two fragments reassociated with tape, were once glued.														
GM40	78-120	1004	1659, HRD_5	R	1	1	1	1	1	0	0	0	1?	1
Distal fragment, distal epiphysis and part of diaphysis. Very robust. Gnawing along lateral supracondylar ridge, modern damage?														
GM41	78-121a	1008	1649, HRC_6	R	1	1	1	1	1	1	1	0	0	0
Whole bone, very gracile.														
GM41	78-121a	1008	1663, HLC_14	L	1	1	1	1	1	1	1	0	1	0
Whole bone. Very gracile. Gnawing along posterior surface. Very gracile bone.														
GM41	78-121b	1009	1664, HRMD_6	R	0	0	0	0	0	0	0	0	0	0
Distal diaphysis fragment, broken at olecranon fossa and roughly midshaft; evidence of gluing on proximal fracture.														
w/ GM42	*78-145*	*1025*	*145*	*R*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*1*
Proximal diaphysis fragment; proximal fracture edge lighter in color, broken along tubercles.														
GM41	78-121b	1009	1665, HRM_2	R	0	0	0	0	0	1	0	0	0	1
Diaphysis fragment; proximal and distal fracture edges lighter in color. Very prominent deltoid tuberosity.														
GM41	78-121b	1009	1660, HLMD_8	L	1	1	1	1	1	1	0	0	0	1
Missing head, proximal break lighter in color.														
GM41	78-121A	1008	1662	L	1	1	1	1	1	1	1	1	1	0
Whole bone; two fragments reassociated with glue. Ossified ridge/spur/muscle attachment along lateral ridge. Gnawing on medial surface distal to head.														

Table C.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	ME	CAP	TRO	LE	DT	HEAD	PATH	GNAW	WHITE FX
GM42	78-125	1011	1650, HRC_4	R	1	1	1	1	1	1	1	0	1	0
Whole bone; two fragments, reassociated with glue. Extensive gnawing along anterior surface, some older, some appears possibly modern?														
GM42	78-125	1011	1653, HLM_4	L	0	0	0	0	0	1	0	0	1	1
Diaphysis. Extensive gnawing along nearly all surfaces and at point of distal break.														
GM42	78-125	1011	1654, HLP_11	L	0	0	0	0	0	0	1	0	0	1
Head fragment, broken along anatomical neck, tip of greater tubercle present.														
GM42	78-125	1011	2391, HRP_12	R	0	0	0	0	0	0	1	0	0	0
Head fragment, broken distal to surgical neck, has about an inch of both tubercles and intertubecular groove.														
GM45	78-193	1070	1651, HLD_2	L	1	1	1	1	0	0	0	0	0	1
Distal epiphysis, whole of olecranon fossa represented; fracture edges lighter in color.														
GM45	78-193	1070	1652	L	0	0	0	0	0	0	0	0	0	1
Diaphysis fragment, between head and deltoid tuberosity, distal portions of greater and lesser tuberosities present but difficult to discern.														
GM45	78-193	1070	1655, HLD_4	L	0	0	0	0	0	0	0	0	0	1
Diaphysis fragment from distal portion; proximal fracture edge lighter in color.														
GM46	unassigned 1978	1074	1261	L	1	1	0	1?	0	0	0	0	0	1
Medial condyle and medial edge of trochlea only.														
GM46	unassigned 1978	1074	1261, HLC_9	L	1	0	0	0	0	1	0	0	1	1
Diaphysis, two fragments once reassociated with glue; head broken off above anatomical neck, broken distally through olecranon fossa; proximal and distal fracture edges lighter in color. Gnawing on lateral surface at point where bone later fractured.														
GM46	unassigned 1978	1074	2393	R	0	0	1	0	0	0	0	0	0	0
Distal diaphysis fragment, portion of capitulum and medial edge of trochlea.														

Table C.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	ME	CAP	TRO	LE	DT	HEAD	PATH	GNAW	WHITE FX
GM46	unassigned 1978	1074	HLC_31	L	0	0	0	0	0	1?	0	0	0	1
Diaphysis fragment, distal portion, broken along deltoid tuberosity (only an inch or so present) and olecranon fossa; glue along proximal fracture edge, distal fracture edge lighter in color.														
w/ GM70	*80-21 0N4E Level 4 C2-17*	*161c*	*323*	*L*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*1*	*0*	*1*
Diaphysis fragment, proximal portion. Possible periostitis along posterior surface.														
GM46	unassigned 1978	1074	HRC_	R	1	1	1	1	1	0	0	0	0	1
Distal fragment, distal epiphysis, broken off at olecranon fossa; fracture edges lighter in color. When combined with GM67 80-15 2N4E Level 1 D4-6 CAT126d 803 forms whole bone.														
w/ GM67	*80-15 2N4E Level 1 D4-6*	*126d*	*803*	*R*	*--*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*1*
Diaphysis and head; two fragments reassociated with glue.														
GM46	unassigned 1978	1074	HRC_2	R	1	1	1	1	0	0	0	0	0	1
Distal fragment, distal epiphysis; fracture edge lighter in color. When combined with GM17 BUR78-36 CAT919 2378 forms whole bone.														
w/ GM17	*78-36*	*919*	*2378*	*R*	*--*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*1*
Diaphysis and head; fracture edge lighter in color.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM46	unassigned 1978	1074	HRM_1	R	0	0	0	0	0	0	0	0	1	1
Diaphysis fragment, from distal portion, was once glued. Gnawing along anterior surface, including point where proximally reassociates.														
w/ GM16	*78-34*	*916*	*2371*	*R*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*1*
Diaphysis fragment, from proximal portion; proximal fracture lighter in color. Gnawing along anterior surface.														
GM46	unassigned 1978	1074	HRMD_1	R	1	1	1	1	1	0	0	0	0	0
Distal fragment, distal epiphysis and part of diaphysis; evidence of gluing at proximal break.														
GM46	unassigned 1978	1074	HRP_7	R	0	0	0	0	0	0	1	0	0	1
Head fragment, broken at surgical neck, tips of tubercles present; evidence of glue along the bottom?														
GM46	unassigned 1978	1074	no label “d” (combined with no label "b")	L	1	1	1	1	1	1	0	0	1	1
Whole bone, two fragments reassociated with tape. No element number written on the bone. Gnawing on anterior and posterior surfaces. Light blue paint on medial surface, near neck?														
GM55	79-212-1	212-1	2847	L	1	1	1	1	1	0	0	0	1	1
Distal portion, two fragments reassociated with tape. Gnawing along lateral supracondylar ridge.														
GM55	79-231-2	231	HLD_3, 79-231-2	L	1	1	1	1	1	0	0	0	0	1
Distal fragment, distal epiphysis and ~8cm of diaphysis; two fragments reassociated with tape.														
GM56	79-205-2	205	2775, HRMD_4	R	1	1	1	1	1	1	0	0	0	0
Missing head; three fragments reassociated with tape and glue; fracture edges lighter in color.														

Table C.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*SIDE*	*VPM*	*ME*	*CAP*	*TRO*	*LE*	*DT*	*HEAD*	*PATH*	*GNAW*	*WHITE FX*
GM56	79-205-4	205	1643, HLMD_1	L	1	1	1	1	1	1	0	0	1	0
Distal portion, broken proximal to deltoid tuberosity. Gnawing along posterior surface of medial epicondyle and anterior surface of diaphysis.														
GM59	79-208	208	2234, HRC_28	R	1	1	1	1	1	1	0	0	0	1
Missing head, proximal break lighter in color.														
GM59	79-208	208	2235, HLC_19	L	1	1	1	1	1	1	1	0	1	0
Whole bone, three fragments reassociated with tape and glue. Gnawing along anterior-lateral surface, at point where distal fragment broken off.														
GM60	79-229-14	229	HLD_6	L	1	1	1	1	1	1	0	0	1	1
Distal fragment, broken midshaft; two fragments reassociated with tape and smaller fragment reassociated with glue, proximal fracture edge lighter in color. Gnawing at point where two fragments reassociated and along deltoid tuberosity.														
GM61	79-230-22	230	HRM_3	R	0	0	0	0	0	1	0	0	0	1
Diaphysis fragment reconstructed with glue; proximal fracture edges lighter in color.														
GM61	79-230-22 1S3E Level 6/7	230	3740	?	0	0	0	0	0	0	1	0	0?	1
Head fragment, broken along anatomical neck. Incised groove (possible modern cut/damage? slightly lighter in color) along posterior of head's surface.														
GM61	79-230-41	230	HLM_10	L	0	0	0	0	0	1?	0	0	1	1
Diaphysis fragment; proximal and distal fracture edges lighter in color; deltoid tuberosity partially represented, ~2cm in length.														
GM61	79-230-45	230	HRMD_2	R	1	1	1	1	1	0	0	0	0	1
Distal fragment, distal epiphysis and ~10cm of diaphysis; fracture edge lighter in color.														
w/ GM61	*79-230-44*	*230*	*79-230-44*	*R*	*--*	*0*	*0*	*0*	*0*	*1*	*0*	*1?*	*0*	*1*
Diaphysis fragment. Possible periostitis on proximal portion of medial surface?														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM61	79-230-47	230	HRD_2, HRM_7	R	0	0	0	0	0	1	0	0	1	1
Diaphysis, two fragments reassociated with tape; all fracture edges lighter in color. Gnawing at edge of proximal fracture.														
GM61	79-230-47 1S3E Level 6/7	230	?, 79-230-47	R	0	0	1	1?	1	0	0	0	0	0
Distal epiphysis fragment, lateral epicondyle, capitulum, and lateral border of trochlea.														
GM61	79-230-53	230	HLMD_12	L	0	0	0	0	0	0	0	0	1	1
Diaphysis fragment, from distal portion. Gnawing on medial surface.														
GM61	79-230-54	230	HLP_2, HLD_10	L	1	1	1	1	1	1	1	0	1?	1
Whole bone; two fragments reassociated with tape, missing small wedge of diaphysis anteriorly at point where reassociated. Diamond-shaped scrape to distal part of anterior bone, ~3cm in length, uniform in color with surrounding bone; possible animal damage, or human in origin?														
GM62	0N0E Level 3 D2-7; "extra adult bone in Bur 80-3/4 pile"	103	885, HRD_1	R	1	1	1	1	1	0?	0	0	0	1
Distal portion, broken halfway along deltoid tuberosity; fracture edges lighter in color. "Extra adult bone in Bur 80-3/4 pile" written on storage bag.														
GM62	0N2E Level 2 C2-14	124	1100, HLM_9	L	0	0	0	0	0	1	0	0	1	0
Diaphysis fragment. Incised grooves along medial surface, possible gnawing puncturing into medullary cavity?														

Table C.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	ME	CAP	TRO	LE	DT	HEAD	PATH	GNAW	WHITE FX
GM62	0N4E Level 2 C1-12 (3A-12)	118	1166 (1 of 2)	L?	0	0	0	0	0	0	0	0	1	0
Diaphysis fragment, distal portion of greater and lesser tubercles present. Cannot associate with GM62 1166 (1 of 2).														
GM62	0N4E Level 2 C1-12 (3A-12)	118	1166 (2 of 2)	L	0	0	0	0	0	0	0	0	0	0
Fragment of tubercles; fragment with tubercles from just below head/neck; cannot associate with other fragment "1166"														
GM66	80-5 0N4E Level 3	?	760	L	1	1	1	1	1	1	1	1	1	1
Mostly whole bone; two fragments reassociated with glue; highly fragmented head left in bag. Healed antemortem fracture at distal end of diaphysis. Gnawing on lateral surface. Lateral epicondyle broken off when glue failed and distal portion fell while handling.														
GM66	80-5 0N4E Level 3 A1-2	126	756	?	0	0	0	0	0	0	1	0	0	1
Head fragment, broken at anatomical neck.														
GM66	80-5 0N4E Level 3 A1-13	?	757, HRD_19	R	1	1	1	1	1	1	1	1	1	1
Whole bone though missing some diaphysis fragments, highly fragmented, reassociated with glue and tape. Gnawning at midshaft on medial surface.														
GM66	0N4E Level 2SW	118c	1160	L	0	0	0	0	0	1	0	1?	1	0
Diaphysis fragment, ~5cm in length. Medullary cavity impacted with dirt. Possible pathological bone deposition on medial surface?														

Table C.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*SIDE*	*VPM*	*ME*	*CAP*	*TRO*	*LE*	*DT*	*HEAD*	*PATH*	*GNAW*	*WHITE FX*
GM66	0N4E Level 2 Upper Scatter A area	118	1157	L?	0	0	0	0	0	0	0	0	0	0
Diaphysis fragment, distal to tubercles, ~3cm in length. Medullary cavity impacted with dirt.														
GM67	80-15 0N4E Level 3 A1 A2-12	126a	790, HLMD_3	L	1	1	1	1	1	0	0	0	1	1
Distal portion, evidence of gluing at proximal fracture edge. Gnawing on lateral surface, possibly modern.														
GM69	80-17 0N4E Level 3 A2-19	126a	74, HLMD_7	L	1	1	1	1	1	1	0	0	1?	1
Diaphysis and distal epiphysis; two fragments reassociated with glue. Possible gnawing on medial supracondylar ridge? Incised groove.														
GM69	80-26 0N4E Level 3 A3-28	183a	581, HRMD_8	R	1	1	1	1	1	1	0	0	0	1
Missing head.														
GM70	80-21 0N4E Level 4 C2-0	161c	329, HRD_15	R	1	1	1	1	1	0	0	0	0	1
Distal fragment, distal epiphysis and portion of diaphysis; fracture edge light in color. Very robust.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM71	80-22 0N4E Level 3	126b	"?"	L	0	0	0	0	0	0	1	0	0	1
Head fragment, no element number; evidence of gluing.														
GM71	80-22 Level 4 C2-5	161c	126, HRDC_22	R	1	1	1	1	0	1	1	1?	0	0
Whole bone. Diaphysis thickened distally, possible posterior bowing/curvature?														
GM72	0N4E Level 3 (not 80-17)	126a	79	L?	0	0	0	0	0	0	0	0	1?	1
Diaphysis fragment from distal portion of bone; proximal and distal fracture edges lighter in color. Damage at point where fractured proximally, possible gnawing?														
GM72	0N4E Level 3 A1 A2-12	126a	790	L	0	0	0	0	0	0	0	0	0	1
Diaphysis fragment, with distal portion of tubercles present, gluing at distal fracture edge. Very gracile, possibly juvenle?														
GM72	0N4E Level 3 A4-4	126a	251	R	0	0	1	1	0	0	0	0	1	1
Distal fragment, distal epiphysis and portion of diaphysis. Damage to condyles. Possible cut mark connecting olecranon foramen and trochlea on anterior surface? Gnawing on posterior surface.														
GM73	80-8 0N0E Level 6	136d	4, HRC_12	R	1	1	1	1	1	1	1	0	0	0
Whole bone.														
GM73	80-8 0N0E Level 6	136d	5, HLD_8, HLP_5	L	1	1	1	1	1	1	1	0	0	1
Whole bone, two fragments reassociated with tape.														

Table C.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	ME	CAP	TRO	LE	DT	HEAD	PATH	GNAW	WHITE FX
GM74	80-9 0N0E Level 6 D1-1	136d	991, HLC_5	L	1	1	1	1	1	1	1	0	0	0
Whole bone, three fragments reassociated with tape, were once glued.														
GM74	80-9 0N0E Level 6 D1-3	136	984, HRC_27	R	1	1	1	1	1	1	1	0	0	0
Whole bone.														
GM75	80-10 0N0E Level 6	136b	46, HLC_11	R	1	1	1	1	1	1	1	0	0	0
Whole bone.														
GM75	80-10 0N0E Level 6	136	46, HRC_24	L	1	1	1	1	1	1	1	0	0	0
Whole bone.														
GM77	80-23 0N4E Level 4	161	140, HLD_5	L	0	0	0	0	0	0	0	1	0	0
Diaphysis fragment, distal portion of deltoid tuberosity to just proximal of olecranon. Spur of bone/ossification of soft tissue on medial supracondylar ridge. Postmortem fracture along olecranon fossa.														
GM78	2S4E E Wall	159	387	L?	0	0	0	0	0	0	0	0	1	1
Distal fragment, just above olecranon fossa, medial supracondylar ridge? Gnawing along the posterior surface of the medial supracondylar ridge. May have had olecranon foramen.														

Table C.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*SIDE*	*VPM*	*ME*	*CAP*	*TRO*	*LE*	*DT*	*HEAD*	*PATH*	*GNAW*	*WHITE FX*
GM79	80-17 0N4E Level 3 A4-20	126a	75, HRMD_9	R	0	0	0	0	0	1	0	0	0	0
Diaphysis fragment, broken off at deltoid tuberosity. Some plant roots in medullary cavity.														
GM79	80-26 0N4E Level 5	183c	612, 613, HLC_28	L	1	1	1	1	1	1	0	0	0	1
Missing head, though there were some fragments too small and fragmentary in bag to be reassociated; two fragments reassociated with tape; fracture edges lighter in color.														
GM80	80-32 2N2E Level 1 C4-13	253a	835, HRC_16	R	1	1	1	1	1	1	1	0	1?	0
Whole bone; two fragments reassociated with tape, were once glued; distal epiphysis reassociated with glue. Damage (gnawing?) on anterior surface at point where fractured.														
GM80	80-33 0N4E Level 4 C2-6	161c	315, HFC_13	R	1	1	1	1	1	1	1	0	0	0
Whole bone; two fragments reassociated with tape, were once glued. Some damage to posterior of medial epicondyle.														
GM82	0N4E Level 4 C1-16	161c	427, HLP_1	L	0	0	0	0	0	1	0	0	0	1
Diaphysis fragment, from proximal portion; fracture edges lighter in color.														
GM82	0N4E Level 4 C2-0	161c	330, HLD_7	L	1	1	1	1	1	0	0	0	0	1
Distal fragment; distal epiphysis and ~8cm of diaphysis; proximal fracture edge lighter in color.														

Table C.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	ME	CAP	TRO	LE	DT	HEAD	PATH	GNAW	WHITE FX
GM82	0N4E Level 4 C2-4	161c	431, HRC_29	R	1	1	1	1	1	1	0	0	0	0
Missing head, broken along anatomical neck.														
GM82	0N4E Level 4 C2-5	161	314, HLMD_6	L	1	1	1	1	1	1	0	0?	0	1
Missing head and some of proximal diaphysis; fracture edge lighter in color. Diaphysis very thick distally.														
GM82	0N4E Level 4 C2-12	161c	316, HLMD_10	L	1	1	1	1	1	1	0	1	1	0
Missing head. Microporosity along the surface of the trochlea, degradation of articulating surface. Gnawing on proximal portion, medial and posterior surfaces, near where head broken off.														
GM82	0N4E Level 4 D3-1	161d5	415	L	0	0	0	0	0	0	0	0	0	0
Diaphysis fragment, contains distal portions of tubercles.														
GM82	0N4E Level 4 SW	161c	441	R	0	0	0	0	0	1	0	0	1	1
Diaphysis fragment; distal fracture edge lighter in color. Gnawing along anterior, posterior, and distal of lateral surface, at point where broken distally.														
GM85	0N4E Level 5 C1-9	183c	478, HRPM_1, HRD_16	R	1	0	1	1	1	1	1	0	1	1
Whole bone, two fragments reassociated with tape, missing medial epicondyle and a wedge of diaphysis. Extensive gnawing along distal anterior surface.														

Table C.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***ME***	***CAP***	***TRO***	***LE***	***DT***	***HEAD***	***PATH***	***GNAW***	***WHITE FX***
GM85	0N4E Level 5 C3-25	183c	517	?	0	0	0	0	0	0	1	0	0	1
Head fragment, broken at anatomical neck.														
GM85	0N4E Level 5 C3-49	183c	536, HRD_12	R	1	1	1	1	1	0	0	0	0	0
Distal fragment, distal epiphysis and ~8cm of diaphysis.														
GM85	0N4E Level 5 C4-12	183c	555, HRC_35	R	1	1	0	1	1	1	0	0	0	1
Distal portion, diaphysis broken along deltoid tuberosity to distal epiphysis; proximal fracture edge lighter in color, evidence of gluing.														
w/ GM46	*unassigned 1978*	*1074*	*no label "a"*	*R*	*--*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*
Diaphysis fragment, proximal, includes distal portion of tubercles; fracture edges lighter in color.														
GM85	0N4E Level 5 C4-12	183c	555, HRP_11	R	0	0	0	0	0	0	1	0	0	0
Head fragment with tips of tubercles. Possibly associates with GM31 BUR78-72 CAT957 1728, HRC_30?														
GM85	0N4E Level 5 C4-12	183c	568, HRD_17, HRM_5	R	1	1	1	1	1	1	0	0	1	1
Missing head; fracture edge lighter in color; two fragments reassociated with tape. Gnawing along lateral surface.														
w/ GM46	*unassigned 1978*	*1074*	*no label (head)*	*R*	*--*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*
Head fragment with portion of posterior neck.														

Table C.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*SIDE*	*VPM*	*ME*	*CAP*	*TRO*	*LE*	*DT*	*HEAD*	*PATH*	*GNAW*	*WHITE FX*
GM90	1S2E Level 4	205	none	L	0	0	0	0	0	1	0	0	1	1
Diaphysis, broken off above olecranon fossa; two fragments reassociated with tape; proximal and distal fracture edges lighter in color. No writing on bone, "5/13/79" written on bag. Gnawing along lateral supracondylar ridge.														

APPENDIX D
TIBIAL SAMPLE INVENTORY

The following inventory is included as an Excel™ file in the digital catalog for greater ease of use; its formatting has been altered slightly here for publication. In the case of reassociated elements from different storage contexts and recorded burial provenience each element is listed and described separately. Component elements bearing a nutrient foramen are listed first (in their absence, the distal-most component element is listed first); all remaining associated component elements are listed subsequently in anatomical order—distal-most to proximal—and indicated both by italics and with a "w/" ("with") in front of the GM box number. The "VPM" column indicates those elements which were part of the assemblage used in visual pair-matching.

For formatting reasons, names of features have been abbreviated within the column headers: medial malleolus ("MED MAL"), nutrient foramen ("NF"), tibial tuberosity ("TIB TUB"), and tibial plateau ("TIB PLAT"). All feature names are spelled out in full within the accompanying notes.

Table D.1. Adult Tibiae Inventory

BOX	BURIAL	CAT	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM01	78-2	871	2400	L	1	1	1	1	1	1	1	0
Whole bone, two fragments reassociated with tape, damage to lateral condyle. Medial bowing. Gnawing along anterior crest.												
GM01	78-2	871	2403, 2-1	R	1	1	1	1	0	1	1?	0
Missing tibial plateau, some evidence of glue proximally? Slight bowing anteriorly and medially. Some small incised grooves on lateral surface of anterior crest, running horizontally. Possibly lipping along edges of proximal-most groove?												
GM03	78-4	874	2409	R	0	0	1	0	0	1	1	1
Diaphysis fragment, slight bulge on shaft. Gnawing on anterior crest where fragment broken distally.												
GM03	78-4	874	2412	L	0	1	0	0	0	0	0	1
Distal fragment, epiphysis and ~2cm of diaphysis; damage to medial malleolus.												
GM03	78-9	887	2406	L	0	0	0	0	1	0	0	0
Two reassociated fragments of tibial plateau, no tibial tuberosity, intercondylar eminence present along with superior fibular articular facet.												
GM03	78-9	887	2407, 9-1	0	0	0	0	0	0	0	0	0
Lateral condyle fragment; can't associate with GM03 BUR78-9 CAT887 2407, 9-2.												
GM03	78-9	887	2407, 9-2	L	0	0	0	0	1?	0	0	0
Medial condyle fragment with intercondylar eminence, can't associate with GM03 BUR78-9 CAT887 2407, 9-1.												
GM03	78-10	878	2404	R	1	0	1	1	1	0	0	1
Missing distal epiphysis and lateral portion of tibial plateau. Both fracture edges lighter in color.												
GM04	78-11	879	3565, 11	?	0	0	0	0	0	0	0	1
Fragment from just below proximal epiphysis.												
GM04	78-14b	882	2418, 14-3	R?	0	0	0	0	1?	0	0	0
Medial? condyle fragment and intercondylar tubercle.												
GM04	78-14b	882	2419, 14-2	L	0	0	0	0	0	0	0	1
Distal fragment with fibular notch.												
GM04	78-14b	882	14-1	R	0	0	1	0	1	1	0	0
Diaphysis fragment; possible juvenile but consistent in size with some known adults. Possible periostitis/anterior deposition.												

Table D.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***MED MAL***	***NF***	***TIB TUB***	***TIB PLAT***	***PATH***	***GNAW***	***WHITE FX***
GM05	78-13a	887	2401	L	1	0	1	1	0	1	0	1
Missing tibial plateau and medial malleolus, fracture edges light in color, evidence of glue at proximal end. Saber shin/anterior bowing, anterior deposition of bone.												
GM05	78-13a	887	2413	L	1	1	1	0	1	1	0	0
Diaphysis broken in two and reconstructed with glue, damage to unglued tibial plateau, fractured edges at tibial plateau light in color. Saber shin/anterior bowing, anterior deposition of bone. Medial bowing. Possible periostitis to medial surface?												
GM05	78-13a	887	2415	R	1	1	1	1	1	1	0	1
Diaphysis and tibial plateau reconstructed with glue, warping of reconstruction prevents complete reassociation. Some anterior and medial bowing, possible periostitis?												
GM05	78-13a	887	2416, 2418	R	1	0	1	0	1?	1	1	1
Lateral condyle fragment and diaphysis fragment. Gnawing to anterior crest. Shaft fragment, gnawing on anterior crest. Periostitis/anterior bone deposition.												
GM11	78-27a	903	2424	L	1	1	1	1	1	0	0	0
Whole bone, some damage to anterior of tibial plateau.												
GM12	78-28e	908	2414	R	1	1	1	1	0	1	1	0
Missing tibial plateau, evidence of glue, damage to medial malleolus. Saber shin/anterior bowing, anterior deposition of bone, periostitis on distal medial surface? Incised lines/grooves on lateral surface of anterior crest.												
GM12	78-28e	908	2420	R	0	0	0	0	0	0	0	1
Diaphysis fragment with damaged distal epiphysis, distal portion reassociated with glue; proximal fracture edge lighter in color.												
GM13	78-29	910	1636	R	1	0	1	1	1	0	0	1
Proximal portion and diaphysis; midshaft highly fragmented and partially reconstructed with glue; most visible fracture edges lighter in color.												
w/ GM46	*unassigned 1978*	*1074*	*no label "d"*	*R*	*--*	*1*	*0*	*0*	*0*	*0*	*0*	*1*
Distal epiphysis, missing fibular notch; fracture edge lighter in color, once glued to GM13 BUR78-29 CAT910 1636.												
GM13	78-29	910	1638	L	0	0	1	0	0	1	1	1
Diaphysis only, portions of proximal and distal fracture edges lighter in color; possible juvenile but consistent in size with known adults. Possible anterior deposition of bone, curving of anterior crest; lump/possible healed periostitis on medial surface of anterior crest, next to a "32-2" that's been crossed out.												

Table D.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***MED MAL***	***NF***	***TIB TUB***	***TIB PLAT***	***PATH***	***GNAW***	***WHITE FX***
GM15	?	913	1634	R	1	1	1	1	1	1	0	0
Whole bone, damage to anterior portion of tibial plateau. Saber shin/anterior bowing, anterior deposition.												
GM16	78-33a	914	1639	R	0	0	1	0	0	0	1	1
Diaphysis fragment, reconstructed with glue; proximal and distal fracture edges lighter in color. Gnawing on anterior crest, on posterior surface at point where element is broken/reconstructed.												
GM16	78-33a	914	1639 (L)	L	0	0	1	0	0	1?	0	0
Diaphysis fragment, possibly juvenile but consistent in size with known adults. Possible anterior and posterior deposition.												
GM17	78-37a	920	1635	L	1	0	1	1	1	0	1	0
Missing medial malleolus, otherwise whole. Gnawing along distal portion of popliteal line, posterior-lateral surface.												
GM17	78-37a	920	1637	R	1	0	1	1	1	0	1	1
Missing distal epiphysis, fracture edges lighter in color. Incised line on distal lateral surface.												
GM18	78-30	923	1564	R	0	1	0	0	0	1	?	0
Distal element fragment, broken mid-diaphysis. Extensive periostitis on all surfaces. Incised groove on lateral surface.												
GM18	78-30	923	1594	R	0	0	0	1	1	1	0	1
Tibial plateau fragment, tibial tuberosity only partially represented. Possible arthritis; prominent intercondylar tubercles and lytic activity along condyle surfaces.												
GM18	78-30	923	1597	R	1	0	1	1	1	1	1?	1
Proximal portion, broken roughly midshaft, distal fracture edges lighter in color. Posterior deposition of bone; possible periostitis on medial surface? Damage to anterior crest, exposing lighter cortical bone; excavation damage or modern gnawing?												
GM18	78-30	923	1598	R	1	1	1	1	0	0	0	1
Gracile diaphysis fragment reconstructed with glue; missing tibial plateau, medial malleolus broken off; proximal fracture edges lighter in color.												
GM18	78-30	923	1600	L	0	0	1	0	0	0?	0	0
Diaphysis fragment, distal fracture edges lighter in color. Possible saber shin/anterior bowing, anterior deposition of bone?												
GM18	78-30	923	2422	L	0	0	1	0	0	0	1	1
Highly fragmented diaphysis fragment, evidence of glue distally, fragment edges lighter in color. Gnawing on medial and posterior surfaces.												

Table D.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*SIDE*	*VPM*	*MED MAL*	*NF*	*TIB TUB*	*TIB PLAT*	*PATH*	*GNAW*	*WHITE FX*
GM18	78-30	923	2425	R	1	1	1	1	0	1	1?	1
Missing tibial plateau, fragment edges lighter in color. Saber shin/anterior bowing, anterior deposition of bone. Incised grooves on medial and lateral surfaces, roughly midshaft.												
GM18	78-30	923	2425, 30-6	R	0	0	0	0	1?	0	0	0
Lateral condyle.												
GM18	78-30	923	2426	R	0	0	1	0	1	1	1	1
Diaphysis. Saber shin? Anterior and posterior deposition of bone; periostitis on posterior surface, near popliteal line. Incised groove on anterior crest.												
GM18	78-30	923	2427	L	0	0	0	0	1	1?	0	1
Diaphysis fragment, might have nutrient foramen right at point of anterior break? Proximal and distal fracture edges lighter in color, evidence of glue. Possible anterior and posterior bone deposition?												
GM18	78-30	923	2428, 30-4	L	0	0	0	0	1	0	0	1
Tibial plateau fragment, damage to medial condyle.												
GM18	78-30	923	2428, 30-11	L	0	0	0	0	0	0	0	1
Distal epiphysis fragment; fibular notch only.												
GM18	78-30	923	2429, 30-14	L	0	0	0	0	1?	0	0	1
Medial? condyle fragment; distal fracture edge lighter in color.												
GM18	78-30	923	2430	R	0	1	0	0	0	0	0	0
Distal epiphysis.												
GM18	78-30	923	2431	R	0	0	0	0	0	0	1	1
Diaphysis fragment, fracture edges lighter in color. Incised groove along posterior surface. Damage to anterior crest, exposing lighter bone.												
GM22	78-47/48	933	2421	R	0	0	1	1	0	1	1	1
Diaphysis, two fragments reassociated with glue, proximal and distal fracture edges lighter in color, missing portion of anterior crest. Saber shin, anterior and posterior deposition of bone. Gnawing on posterior portion, extensive gnawing on anterior crest.												
GM22	78-47/48	933	2423 (L)	L	0	0	0	0	0	0	1	1
Diaphysis fragment, fracture edges lighter in color. Possible juvenile but consistent in size with known adults. Gnawing on lateral surface.												

Table D.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*SIDE*	*VPM*	*MED MAL*	*NF*	*TIB TUB*	*TIB PLAT*	*PATH*	*GNAW*	*WHITE FX*
GM22	78-47/48	933	2423	R	0	0	0	0	0	1	1	1
Diaphysis fragment, fracture edges lighter in color. Possible periostitis on medial surface, anterior deposition? Gnawing on medial surface.												
GM22	78-49	935	1639	L	0	0	0	0	0	0	1	1
Diaphysis fragment, possible juvenile? Gnawing on anterior crest.												
GM23	78-51a	937	1632	R	1	1	1	0	0	1	1	0?
Diaphysis and distal epiphysis, evidence of gluing. Very heavy, possible periostitis on medial surface, medial malleolus. Saber shin/anterior bowing, anterior deposition of bone. Gnawing on posterior surface.												
GM23	78-51a	937	1633, 51-2	R	0	0	0	0	1?	0	0	0
Medial condyle fragment.												
GM23	78-51a	937	1633, 51-3	R	0	0	0	0	1?	0	0	0
Lateral condyle fragment, has superior fibular articular facet.												
GM23	78-52	939	1619	R	0	1	0	0	0	0	0	0
Distal epiphysis.												
GM23	78-52	939	1620	L	0	1	0	0	0	0	0	0
Distal epiphysis.												
GM23	78-52	939	1623	R	1	1	1	0?	0	0	1?	1
Diaphysis and distal epiphysis, reconstructed with glue. Possible gnawing distal of nutrient foramen?												
GM23	78-52	939	1625	R	1	0	1	0	0	0	1	1
Diaphysis fragment, evidence of glue at proximal fracture, lighter in color. Gnawing at point of proximal break on anterior crest, incised groove along lateral surface of anterior crest.												
w/ GM46	*unassigned 1978*	*1074*	*no label "a"*	*R*	*--*	*0*	*0*	*1*	*1?*	*0*	*0*	*0*
Proximal epiphysis and portion of diaphysis, tibial plateau only partially represented by lateral condyle.												
GM23	78-52	939	1631	R	1	0	1	1	1	0	0	0
Missing medial malleolus, otherwise whole. Slight lateral bowing? May be normal variation.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM25	78-54a	941	1615	L	0	0	1	1	0	0	0	0
Diaphysis fragment, evidence of glue at proximal fracture.												
w/ GM23	*78-52*	*939*	*52-10*	*L*	*--*	*0*	*0*	*1*	*0*	*0*	*0?*	*1?*
Tibial tuberosity only, glue on distal portion where joins diaphysis fragment. Damage at portion where joined.												
GM25	78-54a	941	1618	R	0	0	0	1?	1	0	0	0
Proximal epiphysis, tibial plateau only partially represented.												
GM25	78-54a	941	1621	L	0	0	0	0	0	0	0	0
Distal epiphysis, no medial malleolus, ~6cm of diaphysis.												
GM25	78-54a	941	1624	R	1	0	1	1	1	1	1	0
Proximal epiphysis and diaphysis, reconstructed with glue. Extensive gnawing along distal portion of anterior crest, small amount of gnawing on medial surface at point where element is fractured. Possible saber shin/anterior bowing, anterior deposition of bone, periostitis along anterior crest, possibly periostitis on medial surface?												
GM25	78-54a	941	1626	L	0	0	1	0	0	1	1	1
Diaphysis only. Incised grooves along lateral surface. Possible saber shin/anterior bowing, thickening of diaphysis and anterior crest ("puffy" as opposed to a sharper crest), anterior deposition of bone.												
GM25	78-54a	941	1627	R	1	0	1	0	0	0?	0	1
Diaphysis and distal epiphysis, missing medial malleolus.												
GM25	78-54a	941	1628	L	0	0	1	0	0	0	0	1
Diaphysis fragment.												
GM26	78-57	945	2402	L	1	0	1	1	1	0?	1	0
Proximal epiphysis and diaphysis. Came with tag labeling it GM53 BUR78-57 CAT945 2402. Gnawing along distal portion of anterior crest. Possible anterior deposition of bone?												
GM26	78-57	945	2408	R	0	0	1	0	0	0	1	0
Diaphysis fragment. Gnawing along interosseous crest on lateral surface and along anterior crest, just distal of proximal break. Small pit/single point of gnawing on medial surface.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM27	78-61	947	1566	L	1	1	1	1	0	0?	0	1
Diaphysis and distal epiphysis, multiple fragments reconstructed with glue.												
w/ GM46	*unassigned 1978*	*1074*	*no label "h"*	*L*	*--*	*0*	*0*	*0*	*1*	*0*	*0*	*0*
Proximal epiphysis. Whole bone when joined with diaphysis, though missing a portion medial of tibial tuberosity.												
GM27	78-62/63	948	1601	R	0	0	0	0	0	0	0	1
Diaphysis fragment, possible juvenile? Proximal fracture edge lighter in color, evidence of glue where small fragment reattached.												
GM28	78-65	950	1584	R	1	1	1	0	0	0	1	0
Diaphysis and distal epiphysis. Gnawing on posterior surface.												
GM29	78-67	954	1611, 1617	L	1	1	1	1	1	0	0	0
Whole bone, two fragments reassociated with glue.												
GM29	78-67	954	1613	R	1	0	1	1	1	0?	0	1?
Missing distal portion, evidence of glue. Excavation damage to anterior crest? Looks like bone was scraped.												
GM30	78-71a	955	1587	R	0	1	0	0	0	0	0	1
Distal epiphysis fragment.												
GM30	78-71a	955	1589, 71-4	?	0	0	0	0	1?	0	0	1
Condyle fragment (possible medial?).												
GM31	78-54	959	1570	L	0	0	1	0	0	0	1	1
Diaphysis, two fragments taped together. Gnawing along anterior surface and interosseous crest.												
GM31	78-54	959	1572	R	0	0	1	0	0	0	1	1
Diaphysis, two fragments reassociated with glue. Possible juvenile, but consistent in size with known adults. Focused gnawing on medial, lateral, and posterior surfaces.												
GM31	78-74	959	74	L	0	0	1	0	0	0	1?	1
Diaphysis fragment, ~7cm, possible juvenile but consistent in size with known adults.												
w/ GM41	*78-121b*	*1009*	*1573*	*L*	*--*	*0*	*0*	*0*	*0*	*0*	*1?*	*0*
Diaphysis fragment, ~ 8cm. Incised groove on medial surface? Gnawing at point where joins with associated proximal diaphysis fragment.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM32	78-75	960	1591	L	1	1	1	1	1	0	1	0
Whole bone, 1cm section cut out from anterior crest, modern sampling. Gnawing on posterior surface and anterior surface approx. 2cm anterior of cut portion.												
GM33	78-76	961	1642	L	0	0	0	0	1?	0	0	0
Medial? condyle fragment.												
GM34	78-77	962	1588, 77-3	L	0	0	0	0	0	0	0	1
Distal epiphysis fragment; fibular notch only.												
GM34	78-77	962	1589, 77-1	R	0	0	0	0	1	0	0	0
Tibial plateau; medial condyle broken off, once glued but can still be associated. Has superior fibular articular facet.												
GM34	78-77	962	1589, 77-2	L?	0	0	0	0	1?	0	0	0
Lateral? condyle fragment.												
GM35	78-79	964	1581	L	1	1	1	1	0	1	1	1
Diaphysis and distal epiphysis, multiple fragments reassociated with glue. Saber shin/anterior bowing, anterior deposition of bone; possible periostitis on medial surface? Gnawing along anteiorior, posterior, and medial surfaces.												
w/ GM34	*78-78*	*963*	*1585*	*L*	--	*0*	*0*	*0*	*1*	*0*	*0*	*1*
Proximal epiphysis, damage to anterior portion. When joined with GM35 BUR78-79 CAT964 1581 forms nearly whole bone.												
GM35	78-79	964	1582, 1590	R	1	1	1	1	0	1	0	1?
Diaphysis and distal epiphysis, multiple fragments. Saber shin/anterior bowing; periostitis along distal portion?												
GM35	78-79	964	1583	L	1	1	1	0	0	0?	1	0
Missing proximal portion; two fragments reassociated with glue. Gnawing or some other form of pre-excavation damage along lateral surface at point where element is fractured in two; additional gnawing along proximal portion of anterior crest, near point of proximal fracture edge.												
GM36	78-93	977	1586	L	0	1	0	0	0	0	0	0
Distal epiphysis fragment.												
GM36	78-93	977	1588, 93-2	R	0	0	0	0	0	0?	0	0
Distal epiphysis fragment; fibular notch only. Bore hole from previous unknown sampling.												

Table D.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***MED MAL***	***NF***	***TIB TUB***	***TIB PLAT***	***PATH***	***GNAW***	***WHITE FX***
GM38	78-110	994	1567, 1577	L	1	0	1	0	0	1?	1	1
Missing proximal portion; two fragments reassociated with glue together. Possible saber shin/anterior bowing, anterior deposition of bone. Gnawing along posterior surface.												
GM38	78-110	994	1575	R	0	0	1	0	0	0	1	0
Diaphysis fragment; possible juvenile but consistent in size with known adults. Gnawing on posterior and medial surfaces.												
GM38	78-112	996	1579	R	0	1	0	0	0	0	0	1
Distal portion of medial malleolus only.												
GM39	78-11	1002	1569, 118	R	0	0	0	0	1	0	0	0
Tibial plateau/proximal epiphysis fragment, no intercondylar eminence.												
GM39	78-118	1002	1580	L	0	1	0	0	0	0	0	0
Distal portion/distal epiphysis fragment.												
GM41	78-121b	1009	1568	R	1	0	1	0	0	0	1	1
Diaphysis fragment, glue along distal fracture edge. Gnawing on anterior surface near distal fracture; incised groove along lateral surface.												
w/ GM31	*78-74*	*959*	*74 (distal)*	*R*	*--*	*1*	*0*	*0*	*0*	*0*	*1*	*0*
Distal portion, glue along proximal fracture edge. Gnawing on anterior surface; some gnawing possibly modern												
GM41	78-121b	1009	1571	L	0	1	0	0	0	1?	0	0
Distal portion fragment. Possible pathological depression/macroporotic reaction proximal to fibular notch.												
GM41	78-121b	1009	1576, 121b-7	R	0	0	0	0	1?	0	0	1
Lateral condyle fragment with later intercondylar tubercle and superior fibular articular facet.												
GM41	78-121b	1009	1576, 121b-8	L	0	0	0	0	1?	0	0	0
Lateral condyle fragment with intercondylar tubercle lateral and part of superior fibular articular facet.												
GM41	78-121b	1009	1576, 121b-9	R	0	0	0	0	1?	0?	0	1
Tibial plateau fragment, lateral condyle and intercondylar eminence. Fracture along condylar surface, likely postmortem.												
GM41	78-121b	1009	1576, 121b-12	?	0	0	0	0	1?	0	0	1
Condyle fragment.												
GM42	78-125	1011	1574, 125	L	0	0	0	0?	1?	0	0	1
Tibial plateau/proximal epiphysis fragment, medial condyle only.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM43	78-158	1037	3565	?	0	0	0	0	0	0	1?	1
Diaphysis fragment, lateral surface only, can't orient. Possible gnawing along one of the fracture edges?												
GM44	78-187	1065	1563	R	1	0	1	1	1	0	1	0
Proximal epiphysis and diaphysis, broken at midshaft. Gnawing along anterior crest and medial and posterior surfaces.												
GM44	78-187	1065	1607	R	1	0	1	1	1	1	1	1
Proximal epiphysis and diaphysis, broken at midshaft. Growths along the popliteal line; very robust, possible anterior deposition of bone. Gnawing along anterior crest.												
GM44	78-187	1065	1608	L	1	1	1	0?	0	1?	1	1
Diaphysis and distal epiphysis; two fragments reassociated with tape; portions of proximal fracture edge lighter in color. Possible anterior deposition of bone. Gnawing along proximal portion of anterior crest.												
GM45	78-193	1070	1656	L?	0	0	0	0	0	0	1	1
Diaphysis fragment, ~7cm in length; fracture edges lighter in color. Gnawing along interosseous ridge near distal fracture and anterior crest.												
GM45	78-193	1070	1609, 193-2	R	0	0	0	0	0	1	0	1
Diaphysis fragment, ~9cm in length. Periostitis/possible lytic activity/macroporosity; growths along posterior surface												
GM45	78-193	1070	1609, 193-3	R	0	0	0	0	0	0	1	0
Distal diaphysis fragment. Gnawing along anterior crest at point of fracture and posterior surface.												
GM45	78-196	1073	1599	R	1	1	1	1?	0	1?	1?	1
Missing proximal portion; fracture edge lighter in color. Very gracile. Depressed portion on medial malleolus. Anterior bowing?												
GM45	78-196	1073	1603	L	1	1	1	1	1	1?	1	0
Whole bone; 1cm section cut out of anterior crest. Flake on distal articular surface? Gnawing on posterior surface.												
GM45	78-209	1086	1593	L	1	0	1	0	0	1	1	1
Diaphysis. Very heavy with thick anterior crest; anterior deposition of bone, possible healed periostitis. Gnawing above distal fracture edge on posterior surface.												
w/ GM46	*unassigned 1978*	*1074*	*no label "g"*	*L*	--	0	0	1	1	0	0	0
Proximal portion/tibial plateau. Evidence of gluing.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM45	78-210	1087	1592	L	0	0	1	0	0	1	0	0
Diaphysis. Very heavy; saber shin/anterior deposition of bone. ~2cm long oval-shaped bump (possible osteoid osteoma?) on lateral surface of anterior crest.												
GM45	78-211	1088	1595	L	0	0	0	0	0	0	0	0
Diaphysis fragment, possible juvenile but consistent in size with known adults.												
GM45	78-214	1089	1596, 212	R	0	0	0	0	0	0	0	1
Tibial plateau fragment; medial condyle and intercondylar eminence. Portion of epiphyseal line still visible posterior-medially.												
GM45	78-214	1090	1596, 213	L	0	0	0	0	1?	0	0	0
Medial condyle fragment.												
GM45	78-214	1091	1596, 214	R	0	0	0	0	1?	0	0	1?
Lateral condyle fragment, has superior fibular articular facet.												
GM45	78-215	1092	1596, 215	?	0	0	0	0	1?	0	0	1?
Condyle fragment.												
GM46	unassigned 1978	1074	794	R	0	0	0	0	1?	0	0	1
Medial condyle fragment.												
GM46	unassigned 1978	1074	794 (NF)	L	0	0	1	1	0	1	0	1
Diaphysis fragment; proximal and distal fracture edges lighter in color. Bump/growth along the anterior crest.												
GM46	unassigned 1978	1074	794 (distal)	L	0	1	0	0	0	0	1	0
Distal epiphysis and portion of diaphysis; proximal fracture edge lighter in color. Gnawing along lateral surface and interosseous crest.												
GM46	unassigned 1978	1074	1622	R	0	0	0	0	0	0	1	1
Diaphysis fragment. Gnawing along anterior crest.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM46	unassigned 1978	1074	3814	R	1	0	1	1	1	1?	1	1
Diaphysis fragment; distal fracture edge lighter in color. Posterior deposition of bone? Gnawing along the anterior crest; possible gnawing/incised grooves along posterior surface.												
w/ GM62	*0N2E Level 2 B1 Area*	*111b*	*852*	*R*	*--*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Tibial plateau, two fragments reassociate by hand.												
GM46	unassigned 1978	1074	no label "b"	R	0	0	0	0	0	1?	1	0
Diaphysis fragment; two fragments reassociated with glue. Possible slight saber shin/anterior deposition of bone, but difficult to tell with amount of diaphysis present. Gnawing along anterior crest medial surface, distal portion of popliteal line. Lots of modern damage to medial surface.												
GM46	unassigned 1978	1074	no label "c"	L	0	0	0	0	0	0	1	0
Diaphysis fragment. Gnawing along posterior surface at point of proximal fracture edge; puncture marks on lateral surface (possible modern damage).												
GM46	unassigned 1978	1074	no label "e"	L	0	1	0	0	0	0	0	0
Medial malleolus fragment.												
w/ GM82	*0N4E Level 4C1-18*	*161c*	*429*	*L*	*--*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Distal epiphysis fragment; missing medial malleolus.												
w/ GM86	*0N4E Level 5 C1-1*	*183*	*471*	*L*	*--*	*0*	*0*	*0*	*0*	*0*	*1*	*0*
Diaphysis fragment. Gnawing on medial surface												
GM46	unassigned 1978	1074	no label "f"	L	0	0	0	0	0	0	0	1
Diaphysis fragment.												

Table D.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***MED MAL***	***NF***	***TIB TUB***	***TIB PLAT***	***PATH***	***GNAW***	***WHITE FX***
GM46	unassigned 1978	1074	no label (2 tib plat frags)	L	0	0	0	0	1	0	0	1
Tibial plateau/proximal epiphysis fragment; two fragments reassociated by hand, were once glued.												
GM55	79-199	199	3246	L	1	0	1	1	1	0	1	0
Missing distal portion. Gnawing on distal portion anterior crest and adjacent to distal fracture. Look for distal shaft												
GM55	79-199	199	3247	R	1	0	1	1	1	0	0	1
Proximal portion, broken at midshaft; fracture edge lighter in color.												
GM55	79-227	227	3488	R	1	1	1	1	1	1	0	0
Whole bone, damage to medial malleolus Saber shin/anterior bowing, anterior deposition of bone; possible periostitis on medial surface.												
GM55	79-227	227	3491	L	1	0	1	1	0	1	0	1
Diaphysis fragment; proximal and distal fracture edges lighter in color. Growths along popliteal lines.												
w/ GM03	*78-4*	*874*	*2405*	*L*	*--*	*1*	*0*	*0*	*0*	*1*	*0*	*0*
Distal epiphysis and portion of diaphysis; two fragments reassociated with glue. Very narrow medullary cavity?												
GM57	79-206	206	3358	R	1	0	1	1	1	1	0	0
Missing distal epiphysis; two fragments reassociated with tape. Posterior deposition of bone.												
GM57	79-206, 1S3E Level 6/7	206	3373, 79-206-12 (condyle)	?	0	0	0	0	1?	0	0	1?
Condyle fragment.												
GM57	79-206, 1S3E Level 6/7	206	3373, 79-206-12 (lat condyle)	L	0	0	0	0	1?	0	0	0
Lateral condyle fragment; has intercondylar tubercle and superior fibular articular facet.												
GM58	79-207	207	2912	L	1	0	1	1	1	0	0	1
Missing distal epiphysis fracture edge lighter in color.												
GM58	79-207	207	2914	L	0	1	0	0	0	0	0	0
Distal epiphysis.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM59	79-208	208	2232	R	1	1	1	1	1	1	1	0
Whole bone. Abnormal growth along either side of popliteal line giving it a creased or canyon-like appearance towards distal end; anterior deposition of bone. Gnawing along anterior crest.												
GM59	79-208	208	2233	L	1	1	1	1	1	1	0	0
Whole bone. Abnormal growth along either side of popliteal line giving it a creased or canyon-like appearance; anterior deposition of bone.												
GM60	79-229	229-20	3423, 79-229-17	L	0	0	0	0	0	0	0	1
Diaphysis fragment ~7cm in length; distal fracture edge lighter in color. Postmortem fracturing along medial surface.												
GM60	79-229	229-40	3446	L	0	0	0	0	0	0	1	0
Diaphysis fragment. Gnawing along anterior crest and medial surface.												
GM60	79-229 1S3E Level 6/7 Area B, 51.68	229-18	3484	L	0	0	0?	1	0	0	1?	1
Diaphysis fragment from just below tibial tuberosity; nine shard-like fragments reassociated with tape; proximal and distal fracture edges uniform in color. Possible gnawing along distal surface but difficult to determine due to high degree of fragmentation. Possible juvenile but consistent in size with known adults.												
GM61	79-230 1S3D Level 6/Area C	230	3765	L	0	0	0	0	1?	0	0	0?
Lateral condyle fragment, posterior portion with superior fibular articular facet.												
GM62	0N2E Level 3NE	?	772	R	1	1	1	1	1	1	0	0
Whole bone; two fragments reassociated with glue. Lytic depression on medial surface of tibial tuberosity.												
GM63	80-2	111	1081, 1092	L	0	0	0	0	0	0	0	1
Diaphysis fragment; multiple fragments reassociated with glue. Gracile, possible juvenile, but consistent in size with most gracile known adult.												

Table D.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***MED MAL***	***NF***	***TIB TUB***	***TIB PLAT***	***PATH***	***GNAW***	***WHITE FX***
GM65	0N2E Level 4 D2-7	130d	691	R	0	0	0	0	0	1?	0	1
Diaphysis fragment, distal portion, distal fracture edge lighter in color. Possible periostitis on medial surface. Fracture along anterior crest, postmortem.												
GM65	0N2E Level 4 D2-7	130d	691 (distal)	R	0	1	0	0	0	0	0	0
Distal epiphysis fragment, just distal and tip of medial malleolus.												
GM65	0N2E Level 4 D2-10	130d	692	L?	0	0	0	0	1?	0	0	0
Condyle fragment, possible lateral condyle?												
GM65	0N2E Level 4 D2-10	130d	692, 457	L	1	0	1	0	0	1?	1	1
Diaphysis fragment; two fragments reassociated with glue; proximal and distal fracture edges lighter in color. Possible saber shin/anterior bone deposition, very subtle curve. Gnawing along posterior ridge, possibly along lateral surface where bone later fractured (glue makes difficult to discern).												
w/ GM69	*80-17 0N4E Level 3 A2-38*	*126a*	*71*	*L*	*--*	*0*	*0*	*0*	*0*	*0*	*0*	*1*
Distal epiphysis and portion of diaphysis; missing medial malleolus.												
w/ GM86	*0N4E Level 5 C4-18*	*183c*	*564*	*L*	*--*	*0*	*0*	*1*	*1*	*0*	*0*	*0*
Proximal portion/proximal epiphysis; missing most of anterior portion, tibial tuberosity broken off but can associate												
GM65	0N2E Level 4 D4-9	130d	701	R	1	0	1	1	1	0	0	0
Proximal portion, broken at midshaft; multiple fragments reassociated with tape, diaphysis reconstructed with glue.												
GM66	80-5 0N2E Level 3	126	775	L	1	1	1	1	1	1	1	1
Whole bone; two fragments reassociated with tape. Growth along popliteal line resulting in canyon-like appearance; lytic activity along proximal medial surface. Incised grooves along anterior crest.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM67	80-15 2N2E Level 3	254	804	R	1	1	1	1	1	1	1	0
Whole bone; two fragments reassociated with tape. Saber shin/anterior bowing; anterior crest curved laterally. Lytic depression proximal to fibular notch; possible periostitis along medial surface/medial malleolus. Gnawing on anterior crest at point where bone later fractured.												
GM69	80-17 0N4E Level 3 A2-21	126a	81	R	0	0	1	1?	0	1	0	1
Diaphysis fragment; proximal and distal fracture edges lighter in color. Bag is labeled "78" but elment number is 81. Anterior deposition of bone as well as posteriorly, along popliteal line; anterior bowing?												
GM69	80-17 0N4E Level 3 B1-12B	126b	83	L	0	0	1	0	0	1	0	1
Diaphysis fragment; multiple fragments reassociated with glue, proximal and distal fracture edges lighter in color and glue residue on proximal. Posterior deposition of bone, healed periostitis. Possible lytic depression on distal medial surface? Possible saber shin/anterior deposition of bone.												
GM70	80-21 0N4E Level 3	126b	177	R	0	0	1	0	0	1	0	1
Diaphysis fragment; multiple fragments reassociated with glue; all exposed fracture edges lighter in color, many with glue residue. Porosity along posterior and anterior surfaces, widespread periostitis? Medial bowing.												
GM70	80-21 0N4E Level 3	126b	178	L	0	0	1	0	0	1	0	1
Diaphysis fragment; distal fracture edge lighter in color, glue residue. Periostitis/anterior bonde deposition, porosity along anterior and posterior surface.												
GM71	80-22 0N4E Level 3	126b	161 (facet)	R	0	0	0	0	1?	0	0	1
Lateral condyle, has superior fibular articular facet.												
GM71	80-22 0N4E Level 3	126b	161 (lateral)	R	0	0	0	0	1?	0	0	0?
Lateral? condyle fragment, has intercondylar eminence.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM71	80-22 0N4E Level 3	126b	190	R	0	1	0	0	0	0	0	1
Distal epiphysis; fracture edge lighter in color.												
GM71	80-22 0N4E Level 3 B3-9	126b	161	R	0	0	0	0	0	1?	0	0?
Diaphysis fragment, posterior portion with popliteal line, three fragments reassociated with glue. Possible pathological growth along popliteal line.												
GM72	0N4E Level 3	126b	206	?	0	0	0	0	0	0	0	0
Heavily burned diaphysis fragment, 4cm in length. Possible juvenile, but size may be distorted by the fire.												
GM72	0N4E Level 3	126c	226	R	1	0	1	1	1	1	1	0
Proximal epiphysis and diaphysis; two fragments reassociated with glue. Healed periostitis on medial surface adjacent to tibial tuberosity; microporosity along whole of medial surface; ovular lytic depression .5cm across on medial surface; possible saber shin/anterior deposition of bone. Incised groove along anterior crest/lateral surface.												
GM72	0N4E Level 3 B1-3	126b	176 (H)	L	0	1	0	0	0	0	1	0
Distal portion, distal epiphysis and portion of diaphysis; two fragments reassociated with glue, evidence of gluing along proximal break. Gnawing along posterior surface, at point where fractured and glued.												
w/ GM46	*unassigned 1978*	*1074*	*176*	*L*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*
Diaphysis fragment. Gnawing along anterior crest.												
GM72	0N4E Level 3 B2-4	126?	191	L	0	0	1	0	0	1	0	1
Diaphysis fragment; fracture edges lighter in color, glue residue along proximal break. Periosteal? reaction/growths along posterior surface. Slight growth along popliteal line?												
GM72	0N4E Level 3 B2-5	126b	190	R	0	0	0	0	0	1?	1	0
Diaphysis; evidence of glue. Possible anterior bowing. Gnawing on lateral surface of anterior crest.												

Table D.1. Continued.

BOX	BURIAL	CAT.	ELEMENT	SIDE	VPM	MED MAL	NF	TIB TUB	TIB PLAT	PATH	GNAW	WHITE FX
GM72	0N4E Level 3 B2-12	126b	181	R	0	1	0	0	0	0	0	1
Distal portion only, epiphysis and ~9cm of diaphysis. Gnawing along anterior crest.												
GM72	0N4E Level 3 C3-1	126c	223	L	0	1	0	0	0	0	0	1
Distal epiphysis only, fracture edge and cortical bone lighter in color.												
GM72	0N4E Level 3 B3-6	126b	162	R	0	0	0	1	1	0	0	0
Proximal portion/tibial plateau and proximal portion of tibial tuberosity.												
GM72	0N4E Level 3C4-21	126c	221	R	0	1	0	0	0	1	1	0
Missing proximal portion. Saber shin/anterior bowing. Bowed anteriorly? Gnawing along anterior crest, exposed bone lighter in color so likely modern damage.												
GM73	80-8 0N0E Level 7 A3-4 A3-2	179a	8, A3-2	R	1	1	1	1	1	1?	0	0
Whole bone. Possible periostitis along medial surface and anterior/posterior deposition of bone.												
GM73	80-8 0N0E Level 7 A3-4	179a	9, A3-4	L	1	1	1	1	1	1?	0	0
Whole bone. Possible saber shin/anterior and posterior deposition of bone; interosseous crest appears curved.												
GM74	80-9 0N0E Level 6 ½	136?	893	L	1	1	1	1	1	0	0	0
Can't read category, possibly 136d? Whole bone.												
GM74	80-9 0N0E Level 6 D1-27	136?	894	R	1	1	1	1	1	0?	1?	0
Can't read category, possibly 136d? Damage to anterior tibial plateau/proximal portion of tibial tuberosity. 1cm oval depression on medial surface immediately distal of tibial tuberosity (focused gnawing instead of pathological in origin?).												

Table D.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***MED MAL***	***NF***	***TIB TUB***	***TIB PLAT***	***PATH***	***GNAW***	***WHITE FX***
GM75	80-10 0N0E Level 6	136	53 (L)	L	1	1	1	1	1	1	1	0
Whole bone. Periostitis/deposition of bone along posterior edge of medial malleolus and posterior and medial surfaces of diaphysis. Incised lines/gnawing parallel of posterior ridge.												
GM75	80-10 0N0E Level 6 B2-1	136b	53	R	1	1	1	1	1	1	1	0
Whole bone. Swelling at midshaft; healed periostitis on medial and posterior surfaces; pathological growth in fibular notch?; round depression on distal articulating surface. Incised horizontal groove on lateral surface.												
GM78	0N2E Level 5 D2-13	158d	719 (shaft)	L	1	1	1	0	0	1	0	1
Missing proximal portion; two fragments reconstructed with glue, modern damage to anterior crest. Saber shin/anterior bowing.												
GM78	0N2E Level 5 D2-13	158d	719 (proximal)	L	0	0	0	1	1	1?	0	0
Proximal portion/tibial plateau only, reconstructed with glue; some of the epiphyseal line still visible on posterior-lateral surface; possibly associated with the 719 shaft fragment but cannot directly associate. Possible pathological degradation of lateral edge of lateral condyle; possible periosteal reaction/pitting along lateral surface of tibial tuberosity?												
GM78	0N2E Level 6 LBP	160	731	R	1	0	1	1	1	1	1	0
Missing distal portion, two fragments reassociated with tape. Periosteal reaction across whole of medial surface with macroporotic appearance; possible depression on lateral surface of tibial tuberosity. Focused gnawing along distal portion of posterior and lateral surfaces.												
GM79	80-26 0N4E Level 5	183c	599	R	1	1	1	1	1	1?	0	0
Whole bone; tibial plateau reassociated with glue. Possible saber shin/anterior bone deposition? Very subtle.												
GM79	80-26, 0N4E Level 5	183c	601	L	1	1	1	1	1	1	0	1
Proximal end/tibial plateau damaged, missing lateral portion, fracture surface lighter in color. Possible that some fragments in same storage bag not pulled for study may have once articulated with this element. Dark patch on medial surface and two unhealed (postmortem?) fracture lines along medial surface. Healed periostitis on medial and posterior surfaces.												

Table D.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***SIDE***	***VPM***	***MED MAL***	***NF***	***TIB TUB***	***TIB PLAT***	***PATH***	***GNAW***	***WHITE FX***
GM82	0N4E Level 4 C1-14	161c	425	L	1	0	1	1	1	1	1	1
Missing distal portion, fracture edge lighter in color. Thickening of bone at midshaft, healed periostitis and posterior bone deposition; abnormal growth along popliteal line. Focused gnawing resembling a pit on distal portion of popliteal line.												
GM86	0N4E Level 5 C3-39	183c	3883	L	1	0	1	0	0	1?	0	0
Diaphysis and distal epiphysis, medial malleolus broken off. Possible pathology (healed periostitis?) along medial surface.												

APPENDIX E
SELECT JUVENILE HUMERI AND TIBIAE SAMPLE INVENTORY

Table E.1. Selected Juvenile Humeri and Tibiae Inventory

BOX	*BUR.*	*CAT.*	*ELEMENT*	*TYPE*	*SIDE*	*PATH*	*GNAW*	*WHITE FX*
GM03	78-24a	898	24	TIBIA	R?	1	0	1
Small diaphysis. Saber shin/anterior bowing, porosity across entire surface, "puffy" appearance, difficult to discern interosseous crest. Has gnawing along proximal portion of anterior surface. Possible periostitis/posterior deposition of bone.								
GM25	78-54b	942	54 (L)	TIBIA	L	1	0	1
Loose inside all elements bag". Large, very robust diaphysis, very heavy, likely paired with right diaphysis listed below. Two fragments reassociated with glue. Saber shin/anterior bowing, anterior deposition of bone. Missing both epiphyseal surfaces.								
GM25	78-54b	942	54	TIBIA	R	1	0	
Loose inside all elements bag". Large, very robust diaphysis, very heavy, likely paired with right diaphysis listed below. Two fragments reassociated with glue. Saber shin/anterior bowing, anterior deposition of bone. Both epiphyseal surfaces, unfused.								
GM37	78-102	986	2498	HUMERUS	L	1	0	0
Robust diaphysis and distal epiphysis, medial epicondyle completely broken off. Proximal epiphyseal surface present and unfused. Two fragments reassociated with glue. Fine, microporous texture across most of bone surface. Gnawing on medial edge. Consistent in size with known adults.								
GM39	78-118	1002	1445	TIBIA	R	1	1	0
Immature diaphysis. Beginnings of saber shin/anterior bowing? Features rounded out but discernible. Gnawing along anterior ridge.								
GM77	0N4E Level 3 B4 (in box with 80-23)	126b	200	TIBIA	R	1	1	0
Immature diaphysis fragment. Microporosity along medial and anterior surfaces; on close examination possible to see edges of periosteal deposition of bone, tightly adhered to bone structure. Extensive gnawing along anterior crest and distal fracture.								

APPENDIX F
VISUAL PAIR-MATCHING RESULTS

“KS” indicates the author (Stewart) while “DS” indicates the second observer (Steadman). In the case of multiple identified possible pairs, all pairs are listed in the original order noted by the observer. Matches Steadman felt particularly strongly about are indicated with a double asterisk (**). As osteometrics have already been taken for all of the bones within both VPM samples, all measurements (reported in millimeters) shared by both bones in an identified possible pair have been summed (SUM_1, SUM_2… SUM_n). Any resulting sum that uses at least one possibly problematic measurement as detailed within the notes of Appendix G and Appendix H are indicated with a single asterisk (*).

Table F.1. Visual Pair-Matching Results: Humeri.

OBS	*BOX*	*BURIAL*	*CAT.*	*ELEMENT*	*COMMON MEAS.*		*SUM_1*	*SUM_2*	*SUM_3*	*SUM_4*	*SUM_5*
	GM01	78-2	871	1696, 1699		KS	52.08	--	--	--	--
						DS	430.48	52.08	--	--	--
KS_1	GM24	78-53	940	2398, HLC_22	41a, 44b		51.93*	--	--	--	--
DS_1*	GM18	78-30	923	16__, HLC_2	40, 41a, 42, 43, 44b		429.28*	--	--	--	--
DS_2	GM18	78-30	923	1699	41, 41a, 44b		--	116.92	--	--	--
	GM04	78-14b	882	1689, HRC_34, 14-1		KS	102.75*	--	--	--	--
	w/GM37	*78-102*	*986*	*102*		DS	102.75*	90.1*	102.75*	--	--
KS_1	GM67	80-15 0N4E Level 3 A1, A2-12	126a	790, HLMD_3	41, 41a, 44b		105.47*	--	--	--	--
DS_1	GM18	78-30	923	1674	41, 41a, 44b		105.18*	--	--	--	--
	w/GM19	*78-30*	*923*	*30-7*							
DS_2	GM55	79-231-2	231	HLD_3, 79-231-2	41, 41a		--	90.42*	--	--	--
DS_3	GM41	78-121b	1009	1660	41, 41a, 44b		--	--	104.91*	--	--
	GM05	78-13a	887	1657, HRC_14		KS	--	--	--	--	--
	w/GM41	*78-121b*	*1009*	*121b*		DS	123.47	--	--	--	--
KS_1	No match										
DS_1	GM60	79-229-14	229	HLD_6	41, 41a, 44b		117.33*	--	--	--	--
	GM05	78-13a	887	1687, HRC_14		KS	--	--	--	--	--
						DS	116.30	--	--	--	--
KS_1	No match										
DS_1	GM34	78-78	963	1713, HLC_13	41, 41a, 44b		117.25*	--	--	--	--

Table F.1. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM_1***	***SUM_2***	***SUM_3***	***SUM_4***	***SUM_5***
	GM06	78-17a	888	1679, HRC_10		KS	495.33*	--	--	--	--
						DS	--	--	--	--	--
KS_1	GM61	79-230-54	230	HLP_2, HLD_10	40, 41, 41a, 42, 44b		484.64	--	--	--	--
DS_1	No match										
	GM08	78-24a	898	1680, HRD_8		KS	37.60	--	--	--	--
						DS	--	--	--	--	--
KS_1	GM18	78-30	923	1674	41a		37.59	--	--	--	--
	w/GM19	*78-30*	*923*	*30-7*							
DS_1	No match										
	GM08	78-24a	898	1684, HRD_18		KS	99.29	--	--	--	--
						DS	99.29	99.29	99.29	99.29	--
KS_1	GM34	78-78	963	1713, HLC_13	41, 41a		101.15*	--	--	--	--
DS_1	GM56	79-205-4	205	1643, HLMD_1	41, 41a		94.20	--	--	--	--
DS_2	GM04	78-12	880	1688, 12, HLD_12	41, 41a		--	99.55	--	--	--
DS_3	GM55	79-212-1	212-1	2847	41, 41a		--	--	91.73	--	--
DS_4	GM18	78-30	923	1669	41, 41a		--	--	--	95.78	--
	GM13	78-29	910	1666, HRC_1		KS	525.60	117.75	--	--	--
	w/GM18	*78-30*	*923*	*30, 30-1*		DS	525.60	--	--	--	--
KS_1	GM02	78-3a	872	1693, HLC_6	40, 41, 41a, 42, 43, 44b		521.21	--	--	--	--
KS_2	GM60	79-229-14	229	HLD_6	41, 41a, 44b		--	117.33*	--	--	--
DS_1	GM02	78-3a	872	1693, HLC_6	40, 41, 41a, 42, 43, 44b		521.21	--	--	--	--

Table F.1. Continued.

OBS	*BOX*	*BURIAL*	*CAT.*	*ELEMENT*	*COMMON MEAS.*		*SUM₁*	*SUM₂*	*SUM₃*	*SUM₄*	*SUM₅*
	GM14	78-31a	911	2370, HRC_5		KS	105.11	401.04	--	--	--
						DS	401.04	50.95	--	--	--
KS_1	GM41	78-121b	1009	1660	41, 41a, 44b		104.91*	--	--	--	--
KS_2	GM41	78-121a	1008	1663	40, 41a, 42, 43, 44b		--	396.78*	--	--	--
DS_1	GM41	78-121a	1008	1663	40, 41a, 42, 43, 44b		396.78*	--	--	--	--
DS_2	GM24	78-53	940	2398, HLC_22	41a, 44b		--	51.93*	--	--	--
	GM15	78-32	913	2369, HRC_31		KS	16.04*	--	--	--	--
						DS	78.53*	--	--	--	--
KS_1	GM16	78-33a	914	2368	44b		17.34	--	--	--	--
DS_1	GM37	78-102	986	1708, HLMD_11	41, 44b		80.50	--	--	--	--
	GM15	78-32	913	2373, 32-1		KS	13.23	--	--	--	--
	w/GM24	*78-53*	*940*	*2399, HRC_36*		*DS*	--	--	--	--	--
KS_1	GM01	78-1	870	1694, HLD_9	44b		14.28	--	--	--	--
DS_1	No match										
	GM17	78-37a	920	2377, HRC_7		KS	101.41	101.41	--	--	--
						DS	46.29	101.41	--	--	--
KS_1	GM41	78-121b	1009	1660	41, 41a, 44b		104.91*	--	--	--	--
KS_2	GM67	80-15 0N4E Level 3 A1, A2-12	126a	790, HLMD_3	41, 41a, 44b		--	105.47*	--	--	--
DS_1	GM24	78-53	940	2398, HLC_22	41a, 44b		51.93*	--	--	--	--
DS_2	GM41	78-121b	1009	1660	41, 41a, 44b		--	104.91*	--	--	--
	GM18	78-30	923	1668, HRC_32		KS	--	--	--	--	--
						DS	19.02	--	--	--	--
KS_1	No match										
DS_1	GM31	78-74	959	HLC_8	44b		18.23	--	--	--	--
	w/GM46	*unassigned 1978*	*1074*	*1725*							

Table F.1. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM$_1$***	***SUM$_2$***	***SUM$_3$***	***SUM$_4$***	***SUM$_5$***
	GM18	78-30	923	1673, HRD_11		KS	--	--	--	--	--
						DS	55.94	--	--	--	--
KS$_1$	No match										
DS$_1$	GM22	78-48	934	2387, HLD_11	41		54.75	--	--	--	--
	GM18	78-30	323	1705, HRC_21		KS	490.6*	--	--	--	--
						DS	--	--	--	--	--
KS$_1$	GM31	78-74	959	HLC_8	40, 41, 41a, 43, 44		501.09	--	--	--	--
	w/GM46	*unassigned 1978*	*1074*	*1725*							
DS$_1$	Skipped this bone										
	GM21	78-41a	926	2383		KS	--	--	--	--	--
						DS	--	--	--	--	--
KS$_1$	No match										
DS$_1$	No match										
	GM22	78-48	934	2386, HRC_11		KS	459.71	--	--	--	--
						DS	103.25	103.25	103.25	--	--
KS$_1$	GM38	78-106	990	1703, HLC_7	40, 41, 41a, 42, 43, 44		454.45*	--	--	--	--
DS$_1$	GM18	78-30	923	1674	41, 41a, 44b		105.18	--	--	--	--
	w/GM19	*78-30*	*923*	*30-7*							
DS$_2$	GM29	78-67	954	67-1 (L)	41, 41a, 44b		--	102.82*	--	--	--
DS$_3$	GM41	78-121b	1009	1660	41, 41a, 44b		--	--	104.91*	--	--
	GM22	78-48	934	2389, HRD_7		KS	--	--	--	--	--
						DS	55.41	--	--	--	--
KS$_1$	No match										
DS$_1$	GM22	78-48	934	2387, HLD_11	41		54.75	--	--	--	--

Table F.1. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***	***SUM$_1$***	***SUM$_2$***	***SUM$_3$***	***SUM$_4$***	***SUM$_5$***
	GM24	78-53	940	2394, HRC_3	KS	539.76	--	--	--	--
					DS	539.76	--	--	--	--
KS_1	GM24	78-53	940	2395, HLC_17	40, 41, 41a, 42, 43, 44b	527.13	--	--	--	--
DS_1	GM31	78-74	959	HLC_8	40, 41, 41a, 42, 43, 44b	550.02	--	--	--	--
	w/GM46	*unassigned 1978*	*1074*	*1725*						
	GM24	78-53	940	2397, HRC_26	KS	103.11*	--	--	--	--
					DS	386.87	--	--	--	--
KS_1	GM23	78-52	939	HLC_26	41, 41a, 44b	106.37*	--	--	--	--
	w/GM15	*78-32*	*913*	*2372, 32-1*						
DS_1	GM41	78-121a	1008	1663	40, 41a, 42, 43, 44b	396.78*	--	--	--	--
	GM29	78-67	954	67-1	KS	330.43	--	--	--	--
					DS	13.07	330.43	13.07	--	--
KS_1	GM38	78-106	990	1703, HLC_7	40, 43, 44b	326.30	--	--	--	--
DS_1	GM29	78-67	954	67-1 (L)	44b	12.68	--	--	--	--
DS_2	GM38	78-106	990	1703, HLC_7	40, 43. 44b	--	326.30	--	--	--
DS_3	GM24	78-53	940	2398, HLC_22	44b	--	--	13.77	--	--
	GM30	78-71a	955	1727, HRC_19	KS	103.54	90.49	--	--	--
					DS	397.58	103.54	--	--	--
KS_1	GM67	80-15 0N4E Level 3 A1, A2-12	126a	790, HLMD_3	41, 41a, 44b	105.47*	--	--	--	--
KS_2	GM55	79-231-2	231	HLD_3, 79-231-2	41, 41a	--	90.42*	--	--	--
DS_1	GM41	78-121a	1008	1663	40, 41a, 42, 43, 44b	396.78*	--	--	--	--
DS_2	GM56	79-205-4	205	1643, HLMD_1	41, 41a, 44b	--	109.29	--	--	--

Table F.1. Continued.

OBS	BOX	BURIAL	CAT.	ELEMENT	COMMON MEAS.		SUM_1	SUM_2	SUM_3	SUM_4	SUM_5
	GM31	78-72	957	1728, HRC-30		KS	113.41	--	--	--	--
						DS	113.41	--	--	--	--
KS_1	GM46	unassigned 1978	1074	no label “b”, “d”	41, 41a, 44b		115.91*	--	--	--	--
DS_1	GM29	78-67	954	67-1 (L)	41, 41a, 44b		102.82*	--	--	--	--
	GM32	78-75	960	1720, HRC_8		KS	441.82*	--	--	--	--
						DS	441.82*	--	--	--	--
KS_1	GM32	78-75	960	1718, HLC_18	40, 41a, 43, 44b		439.41	--	--	--	--
	w/GM31	*78-53*	*940*	*75, 74-3*							
	w/GM24	*78-74*	*959*	*74-3*							
DS_1*	GM32	78-75	960	1718, HLC_18	40, 41a, 43, 44b		439.41	--	--	--	--
	w/GM31	*78-53*	*940*	*75, 74-3*							
	w/GM24	*78-74*	*959*	*74-3*							
	GM32	78-75	960	1722, HRD_11		KS	--	--	--	--	--
						DS	104.63	43.74	--	--	--
KS_1	No match										
DS_1	GM34	78-78	963	1713, HLC_13	41, 41a		99.68	--	--	--	--
DS_2	GM13	78-29	910	1698, HLC_27	41a		--	42.03*	--	--	--
	GM33	78-76	961	1719, HRC_18		KS	--	--	--	--	--
						DS	468.04*	--	--	--	--
KS_1	No match										
DS_1	GM61	79-230-54	230	HLP_2, HLD_10	40, 41, 41a, 42, 44b		484.64	--	--	--	--
	GM34	78-78	963	1714, HRC_17		KS	--	--	--	--	--
						DS	475.37	--	--	--	--
KS_1	No match										
DS_1	GM18	78-30	923	1667	40, 41, 41a, 43, 44b		471.60	--	--	--	--

Table F.1. Continued.

OBS	*BOX*	*BURIAL*	*CAT.*	*ELEMENT*	*COMMON MEAS.*		*SUM_1*	*SUM_2*	*SUM_3*	*SUM_4*	*SUM_5*
	GM34	78-78	963	1715, HRC_25		KS	119.23*	--	--	--	--
						DS	119.23*	--	--	--	--
KS_1	GM34	78-78	963	1713, HLC_13	41, 41a, 44b		116.30	--	--	--	--
DS_1	GM34	78-78	963	1713, HLC_13	41, 41a, 44b		116.30	--	--	--	--
	GM35	78-80	965	1707, HRD_9		KS	107.02*	--	--	--	--
	w/GM37	*78-105*	*989*	*105*		DS	107.02*	--	--	--	--
KS_1	GM41	78-121b	1009	1660	41, 41a, 44b		104.91*	--	--	--	--
DS_1	GM41	78-121b	1009	1660	41, 41a, 44b		104.91*	--	--	--	--
	GM37	78-104	988	1704, HRC_23		KS	--	--	--	--	--
	w/GM18	*78-30*	*923*	*30-4*		DS	112.79	56.78	--	--	--
KS_1	No match										
DS_1	GM34	78-78	963	1713, HLC_13	41, 41a, 44b		116.30	--	--	--	--
DS_2	GM13	78-29	910	1698, HLC_27	41a, 44b		--	59.11*	--	--	--
	GM40	78-120	1004	1659, HRD_5		KS	--	--	--	--	--
						DS	108.58*	--	--	--	--
KS_1	No match										
DS_1	GM31	78-74	959	HLC_8	41, 41a		112.66	--	--	--	--
	w/GM46	*unassigned 1978*	*1074*	*1725*							
	GM41	78-121a	1008	1649, HRC_6		KS	390.75	--	--	--	--
						DS	105.16	--	--	--	--
KS_1	GM41	78-121a	1008	1663	40, 41a, 42, 43, 44b		396.78*	--	--	--	--
DS_1	GM18	78-30	923	1674	41, 41a, 44b		105.18	--	--	--	--
	w/GM19	*78-30*	*923*	*30-7*							

Table F.1. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM₁***	***SUM₂***	***SUM₃***	***SUM₄***	***SUM₅***
	GM42	78-125	1011	1650, HRC_4		KS	--	--	--	--	--
						DS	101.18*	--	--	--	--
KS_1	No match										
DS_1	GM82	0N4E Level 4 C2-12	161c	316, HLMD_10	41, 41a, 44b		99.68*	--	--	--	--
	GM46	unassigned 1978	1074	HRC_		KS	104.52	--	--	--	--
	w/GM67	*80-15 2N4E Level 1 D4-6*	*126d*	*803*		DS	104.52	104.52	92.17	49.55	67.32
KS_1	GM67	80-15 0N4E Level 3 A1, A2-12	126a	790, HLMD_3	41, 41a, 44b		105.84*	--	--	--	--
DS_1	GM29	78-67	954	67-1 (L)	41, 41a, 44b		102.82*	--	--	--	--
DS_2	GM41	78-121b	1009	1660	41, 41a, 44b		--	104.91*	--	--	--
DS_3	GM55	79-212-1	212-1	2847	41, 41a		--	--	91.73	--	--
DS_4	GM01	78-1	870	1694, HLD_9	41a, 44b		--	--	--	49.14	--
DS_5	GM22	78-48	934	2387, HLD_11	41, 44b		--	--	--	--	70.97
	GM46	unassigned 1978	1074	HRC_2		KS	37.71	--	--	--	--
	w/GM17	*78-36*	*919*	*2378*		DS	50.79	--	--	--	--
KS_1	GM82	0N4E Level 4 C2-0	161c	330, HLD_7	41a		35.09	--	--	--	--
DS_1	GM67	80-15 0N4E Level 3 A1, A2-12	126a	790, HLMD_3	41a, 44b		50.46*	--	--	--	--
	GM46	unassigned 1978	1074	HRMD_1		KS	44.66	--	--	--	--
						DS	44.66	--	--	--	--
KS_1	GM32	78-75	960	1718, HLC_19	41a		46.43	--	--	--	--
	w/GM31	*78-53*	*940*	*75, 74-3*							
	w/GM24	*78-74*	*959*	*74-3*							
DS_1	GM16	78-33a	914	2368	41a		42.00	--	--	--	--

Table F.1. Continued.

OBS	*BOX*	*BURIAL*	*CAT.*	*ELEMENT*	*COMMON MEAS.*		*SUM_1*	*SUM_2*	*SUM_3*	*SUM_4*	*SUM_5*
	GM56	79-205-2	205	2775, HRMD_4		KS	--	--	--	--	--
						DS	106.05	--	--	--	--
KS_1	No match										
DS_1	GM23	78-52	939	HLC_26	41, 41a, 44b		106.37*	--	--	--	--
	w/GM15	*78-32*	*913*	*2372, 32-1*							
	GM59	79-208	208	2234, HRC_38		KS	123.43	--	--	--	--
						DS	123.43	--	--	--	--
KS_1	GM59	79-208	208	2235, HLC_19	41, 41a, 44b		120.08	--	--	--	--
DS_1	GM18	78-30	923	1667	41, 41a, 44b		121.73	--	--	--	--
	GM61	79-230-45	230	HRMD_2		KS	129.79	--	--	--	--
	w/GM61	*79-230-44*	*230*	*79-230-44*		DS	84.33	--	--	--	--
KS_1	GM61	79-230-54	230	HLP_2, HLD_10	41, 41a, 44b		126.20	--	--	--	--
DS_1	GM37	78-12	986	1708, HLMD_11	41, 44b		80.50	--	--	--	--
	GM62	0N0E Level 3, D2-7	103	855, HRD_1		KS	126.27*	--	--	--	--
						DS	63.21*	--	--	--	--
KS_1	GM31	78-74	959	HLC_8	41, 41a, 44b		130.89	--	--	--	--
	w/GM46	*unassigned 1978*	*1074*	*1725*							
DS_1	GM16	78-33a	914	2368	41a, 44b		59.34	--	--	--	--
	GM66	80-5 0N4E Level 3 A1-13	?	757, HRD 19		KS	498.33*	--	--	--	--
						DS	44.07	--	--	--	--
KS_1	GM75	80-10 0N0E Level 6	136	46, HRC_24	40, 41, 41a, 42, 43, 44b		490.57*	--	--	--	--
DS_1	GM45	78-193	1070	1651, HLD_2	41a		45.06*	--	--	--	--
	GM69	80-26 0N4E Level 3 A3-28	183a	581, HRMD_8		KS	105.49	--	--	--	--
						DS	105.49	--	--	--	--
KS_1	GM79	80-26 0N4E Level 5	183c	612, 613, HLC_28	41, 41a, 44b		107.21*	--	--	--	--
DS_1	GM46	unassigned 1978	1074	no label “d”, “b”	41, 41a, 44b		115.91*	--	--	--	--

Table F.1. Continued.

OBS	BOX	BURIAL	CAT.	ELEMENT	COMMON MEAS.		SUM_1	SUM_2	SUM_3	SUM_4	SUM_5
	GM70	80-21 0N4E Level 4 C2-0	161c	329, HRD_15		KS	--	--	--	--	--
						DS	--	--	--	--	--
KS_1	No match										
DS_1	No match										
	GM71	80-22 Level 4 C2-5	161c	126, HRDC_22		KS	57.68	--	--	--	--
						DS	57.68	--	--	--	--
KS_1	GM82	0N4E Level 4 C2-5	161	314, HLMD_6	41a, 44b		56.32	--	--	--	--
DS_1	GM82	0N4E Level 4 C2-5	161	314, HLMD_6	41a, 44b		56.32	--	--	--	--
	GM73	80-8 0N0E Level 6	136d	4, HRC_12		KS	--	--	--	--	--
						DS	494.04	--	--	--	--
KS_1	No match										
DS_1	GM73	80-8 0N0E Level 6	136d	5, HLD_8, HLP_5	40, 41, 41a, 42, 43, 44b		487.35*	--	--	--	--
	GM74	80-9 0N0E Level 6 D1-3	136	984, HRC_27		KS	--	--	--	--	--
						DS	530.85*	--	--	--	--
KS_1	No match										
DS_1	GM74	80-9 0N0E Level 6 D1-1	136d	991, HLC_5	40, 41, 41a, 42, 43, 44b		529.79	--	--	--	--
	GM75	80-10 0N0E, Level 6	136b	46, HLC_11		KS	500.84	--	--	--	--
						DS	500.84	--	--	--	--
KS_1	GM75	80-10 0N0E Level 6	136	46, HRC_24	40, 41, 41a, 42, 43, 44b		490.37*	--	--	--	--
DS_1*	GM75	80-10 0N0E Level 6	136	46, HRC_24	40, 41, 41a, 42, 43, 44b		490.37*	--	--	--	--

Table F.1. Continued.

OBS	*BOX*	*BURIAL*	*CAT.*	*ELEMENT*	*COMMON MEAS.*		*SUM$_1$*	*SUM$_2$*	*SUM$_3$*	*SUM$_4$*	*SUM$_5$*
	GM80	80-33 0N4E Level 4 C2-6	161c	315, HFC_13		KS	84.07	--	--	--	--
						DS	97.37	84.07	--	--	--
KS$_1$	GM82	0N4E Level 4 C2-0	161c	330, HLD_7	41, 41a		84.76*	--	--	--	--
DS$_1$	GM82	0N4E Level 4 C2-12	161c	316, HLMD_10	41, 41a, 44b		99.68*	--	--	--	--
DS$_2$	GM82	0N4E Level 4 C2-0	161c	330, HLD_7	41, 41a		--	84.76*	--	--	--
	GM80	80-32 2N2E Level 1 C4-13	253a	835, HRC_16		KS	--	--	--	--	--
						DS	507.64	--	--	--	--
KS$_1$	No match										
DS$_1$	GM31	78-74	959	HLC_8	40, 41, 41a, 42, 44b		521.82	--	--	--	--
	w/GM46	*unassigned 1978*	*1074*	*1725*							
	GM82	0N4E Level 4 C2-4	161c	431, HRC_29		KS	--	--	--	--	--
						DS	112.64*	--	--	--	--
KS$_1$	No match										
DS$_1$	GM18	78-30	923	1667	41, 41a, 44b		121.73	--	--	--	--
	GM85	0N4E Level 5 C1-9	183c	478, HRPM_1, HRD_16		KS	--	--	--	--	--
						DS	403.47*	--	--	--	--
KS$_1$	No match										
DS$_1$	GM31	78-74	959	HLC_8	40, 42, 43, 44b		437.36	--	--	--	--
	w/GM46	*unassigned 1978*	*1074*	*1725*							
	GM85	0N4E Level 5 C3-49	183c	536, HRD_12		KS	102.03*	--	--	--	--
						DS	102.03*	102.03*	--	--	--
KS$_1$	GM75	80-10 0N0E Level 6	136	46, HRC_24	41, 41a		107.01*	--	--	--	--
DS$_1$	GM73	80-8 0N0E Level 6	136d	5, HLD_8, HLD_5	41, 41a		101.88*	--	--	--	--
DS$_2$	GM18	78-30	923	1669	41, 41a		--	95.78	--		--

Table F.1. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM_1***	***SUM_2***	***SUM_3***	***SUM_4***	***SUM_5***
	GM85	0N4E Level 5 C4-12	183c	555, HRC_35		KS	63.56	--	--	--	--
	w/GM46	*unassigned 1978*	*1074*	*no label "a"*		DS	63.56	--	--	--	--
KS_1	GM82	0N4E Level 4 C2-12	161c	316, HLMD_10	41, 44b		63.56	--	--	--	--
DS_1	GM82	0N4E Level 4 C2-12	161c	316, HLMD_10	41, 44b		63.56	--	--	--	--
	GM85	0N4E Level 5 C4-12	183c	568, HRD_17, HRM_5		KS	141.71*	37.22	103.29	--	--
	w/GM46	*unassigned 1978*	*1074*	*no label (head)*		DS	103.29	--	--	--	--
KS_1	GM38	78-106	990	1703, HLC_7	41, 41a, 42, 44b		141.11*	--	--	--	--
KS_2	GM38	78-106	990	HLC_10	41a		--	37.64*	--	--	--
KS_3	GM67	80-15 0N4E Level 3 A1, A2-12	126a	790, HLMD_3	41, 41a, 44b		--	--	105.47*	--	--
DS_1	GM67	80-15 0N4E Level 3 A1, A2-12	126a	790, HLMD_3	41, 41a, 44b		105.47*	--	--	--	--

Table F.2. Visual Pair-Matching Results: Tibiae.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM$_1$***	***SUM$_2$***
	GM01	78-2	871	2400		KS	104.76	--
						DS	104.76	227.76
KS$_1$	GM18	78-30	923	1598	72, 73, 74a, 74b		108.45*	--
DS$_1$	GM18	78-30	923	1598	72, 73, 74a, 74b		108.45*	--
DS$_2$	GM45	78-196	1073	1599	71, 72, 73, 74a, 74b		--	200.72
	GM05	78-13a	887	2401		KS	--	--
						DS	--	--
KS$_1$	No match							
DS$_1$	No match							
	GM05	78-13a	887	2413		KS	255.86*	--
						DS	255.86*	--
KS$_1$	GM05	78-13a	887	2415	71, 72, 73, 74, 74a, 74b		259.97*	--
DS$_1$	GM05	78-13a	887	2415	71, 72, 73, 74, 74a, 74b		259.97*	--
	GM11	78-27a	903	2424		KS	637.91*	--
						DS	637.91*	--
KS$_1$	GM15	unknown	913	1634	69, 70, 71, 72, 73, 74, 74a, 74b		635.82*	--
DS$_1$	GM15	unknown	913	1634	69, 70, 71, 72, 73, 74, 74a, 74b		635.82*	--
	GM17	78-37a	920	1635		KS	--	--
						DS	158.21*	--
KS$_1$	No match							
DS$_1$	GM18	78-30	923	1597	72, 73, 74, 74a		157.66	--

Table F.2. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM$_1$***	***SUM$_2$***
	GM26	78-57	945	2402		KS	--	--
						DS	--	--
KS$_1$	No match							
DS$_1$	No match							
	GM27	78-61	947	1566		KS	--	--
	w/GM46	*unassigned 1978*	*1074*	*no label "h"*		DS	--	--
KS$_1$	No match							
DS$_1$	No match							
	GM29	78-67	954	1611/1617		KS	222.57*	--
						DS	222.57*	--
KS$_1$	GM29	78-67	954	1613	70, 72, 73, 74, 74a		224.54*	--
DS$_1$	GM13	78-29	910	1636	70, 72, 73, 74, 74a		229.59	--
	w/GM46	*unassigned 1978*	*1074*	*No label "d"*				
	GM32	78-75	960	1591		KS	--	--
						DS	638.13*	--
KS$_1$	No match							
DS$_1$	GM15	unknown	913	1634	69, 70, 71, 72, 73, 74, 74a, 74b		635.82*	--
	GM35	78-79	964	1581		KS	30.03	--
	w/GM34	*78-78*	*963*	*1585*		DS	30.03	--
KS$_1$	GM35	78-79	964	1590	74b		30.14	--
DS$_1$	GM35	78-79	964	1590	74b		30.14	--

Table F.2. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM$_1$***	***SUM$_2$***
	GM35	78-79	964	1583		KS	182.62*	--
						DS	182.62*	--
KS$_1$	GM28	78-65	1584	1584	71, 72, 73, 74, 74b		184.56*	--
DS$_1$	GM28	78-65	1584	1584	71, 72, 73, 74, 74b		184.56*	--
	GM38	78-110	994	1567/1577		KS	26.76	--
						DS	26.76	26.76
KS$_1$	GM18	78-30	923	2425	74b		27.15	--
DS$_1$	GM18	78-30	923	2425	74b		27.15	--
DS$_2$	GM59	79-208	208	2232	74b		--	25.27
	GM44	78-187	1065	1608		KS	--	--
						DS	284.57	284.57
KS$_1$	No match							
DS$_1$	GM18	78-30	923	2425	71, 72, 73, 74, 74a, 74b		277.84*	--
DS$_2$	GM59	79-208	208	2232	71, 72, 73, 74, 74a, 74b		--	272.26
	GM45	78-209	1086	1593		KS	196.05*	--
	w/GM46	*unassigned 1978*	*1074*	*no label "g"*		DS	274.05*	--
KS$_1$	GM25	78-54a	941	1624	72, 73, 74, 74a		198.37	--
DS$_1$	GM78	0N2E Level 6 LBP	160	731	70, 72, 73, 74, 74a		281.13*	--

Table F.2. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM$_1$***	***SUM$_2$***
	GM45	78-196	1073	1603		KS	194.30*	--
						DS	87.30*	194.30*
KS$_1$	GM45	78-196	1073	1599	71, 72, 73, 74, 74a, 74b		200.72	--
DS$_1$	GM18	78-30	923	1598	72, 73, 74a, 74b		108.45*	--
DS$_2$	GM45	78-196	1073	1599	71, 72, 73, 74, 74a, 74b		--	200.72
	GM55	79-199	199	3246		KS	--	--
						DS	--	--
KS$_1$	No match							
DS$_1$	No match							
	GM55	79-227	227	3491		KS	--	--
	w/GM03	*78-4*	*874*	*2405*		DS	201.15*	--
KS$_1$	No match							
DS$_1$	GM44	78-187	1065	1607	72, 73, 74, 74a		225.95*	--
	GM58	79-207	207	2912		KS	--	--
						DS	--	--
KS$_1$	No match							
DS$_1$	No match							
	GM59	79-208	208	2233		KS	720.22	--
						DS	720.22	--
KS$_1$	GM59	79-208	208	2232	69, 70, 71, 72, 73, 74, 74a, 74b		721.26	--
DS$_1$**	GM59	79-208	208	2232	69, 70, 71, 72, 73, 74, 74a, 74b		721.26	--

Table F.2. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM$_1$***	***SUM$_2$***
	GM65	0N2E Level 4 D2-10	130d	692, 457		KS	181.47	--
	w/GM69	*80-17 0N4E Level 3 A2-38*	*126a*	*71*				
	w/GM86	*0N4E Level 5 C4-18*	*183c*	*564*		DS	--	--
KS$_1$	GM65	0N2E Level 4 D4-9	130d	701	72, 73, 74, 74a		186.22*	--
DS$_1$	No match							
	GM66	80-5 0N2E Level 3	126	775		KS	540.09	--
						DS	540.09	--
KS$_1$	GM62	0N2E Level 3NE	unknown	772	69, 72, 73, 74, 74a, 74b		544.82	--
DS$_1$**	GM62	0N2E Level 3NE	unknown	772	69, 72, 73, 74, 74a, 74b		544.82	--
	GM73	80-8 0N0E Level 7 A3-4	179a	9, A3-4		KS	714.09*	--
						DS	714.09*	--
KS$_1$	GM73	80-8, 0N0E Level 7 A3-2	179a	8, A3-2	69. 70, 71, 72, 73, 74, 74a, 74b		709.31*	--
DS$_1$	GM73	80-8, 0N0E Level 7 A3-2	179a	8. A3-2	69. 70, 71, 72, 73, 74, 74a, 74b		709.31*	--
	GM74	80-9 0N0E Level 6 ½	136	893		KS	748.83	--
						DS	748.83	--
KS$_1$	GM74	80-9 0N0E Level 6 D1-27	136	894	69. 70, 71, 72, 73, 74, 74a, 74b		757.21	--
DS$_1$	GM74	80-9 0N0E Level 6 D1-27	136	894	69. 70, 71, 72, 73, 74, 74a, 74b		757.21	--

Table F.2. Continued.

OBS	***BOX***	***BURIAL***	***CAT.***	***ELEMENT***	***COMMON MEAS.***		***SUM$_1$***	***SUM$_2$***
	GM75	80-10 0N0E Level 6	136	53 (L)		KS	675.52*	--
						DS	675.52*	--
KS$_1$	GM75	80-10 0N0E Level 6	136	53	69. 70, 71, 72, 73, 74, 74b		679.27	--
DS$_1$**	GM75	80-10 0N0E Level 6	136	53	69. 70, 71, 72, 73, 74, 74b		679.27	--
	GM79	80-26 0N4E Level 5	183d	601		KS	535.02	--
						DS	535.02	--
KS$_1$	GM79	80-26 0N4E Level 5	183c	599	69, 71, 72, 73, 74, 74a, 74b		544.47*	--
DS$_1$**	GM79	80-26 0N4E Level 5	183c	599	69, 71, 72, 73, 74, 74a, 74b		544.47*	--
	GM78	0N2E Level 5 D2-13	158d	719		KS	--	--
						DS	151.26	--
KS$_1$	No match							
DS$_1$	GM41	78-121b	1009	1568	72, 73, 74, 74b		143.52	--
	w/GM31	*78-74*	*959*	*74 (distal)*				
	GM82	0N4E Level 4 C1-14	161c	425		KS	--	--
						DS	--	--
KS$_1$	No match							
DS$_1$	No match							
	GM86	0N4E Level 5 C3-39	183c	3833		KS	--	--
						DS	--	--
KS$_1$	No match							
DS$_1$	No match							

APPENDIX G
HUMERUS VISUAL PAIR-MATCHING SAMPLE: OSTEOMETRICS

All measurements taken by the author and reported in millimeters. Measurements 41 (Epicondylar Breadth of the Humerus), 42 (Maximum Vertical Diameter of the Head of the Humerus), and 43 (Maximum Diameter of the Humerus at Midshaft) taken as defined by Moore-Jansen et al. (1994), while 41a (Capitulum-Trochlea Breadth), 42a (Anterior-Posterior Breadth of the Head of the Humerus), and 44b (Minimum Diameter of the Humeral Diaphysis) were taken as defined by Byrd and Adams (2003). For full descriptions of these measurements see Table 4.3.

“NA” indicates measurements that could not be taken due to absence of or extensive damage to the feature in question. Any measurements followed by an asterisk could be taken but may be biased due to damage to the feature in question or other difficulties in stabilizing the element for measurement.

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Table G.1. VPM Sample: Right Humeri Osteometrics.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***40***	***41***	***41a***	***42***	***42a***	***43***	***44b***
GM01	78-2	871	1696, 1699	313	55.53	38.06	41.59	NA	19.8	14.02
Two fragments reassociated with glue. Damage to anterior and posterior of head.										
GM04	78-14b	882	1689, HRC_34, 14-1	NA	53.79*	36.31	NA	NA	NA	12.65
w/GM37	*78-102*	*986*	*102*							
Two fragments reassociated with tape, tape removed for 44b. 44b immediately proximal to break, evidence that two fragments were once reassociated with glue. Some damage to posterior surface of medial epicondyle so may ned to take 41 with caution. No head.										
GM05	78-13a	887	1657, HRC_14	303	60.79	44.48	43.2	NA	22.84	18.2
w/GM41	*78-121b*	*1009*	*121b*							
Two fragments reassociated with tape, damage to anterior and posterior of head. Were at one point reassociated with glue, removed tape and held two fragments flush to take 40.										
GM05	78-13a	887	1687, HRC_14	NA	56.9	42.78	NA	NA	NA	16.62
Roughly midshaft to distal. Proximal break much lighter in color.										
GM06	78-17a	888	1679, HRC_10	324	64.98	43.39	44.93	42.36	NA	18.03*
Broken midshaft, reassociated with tape. Can reassociate flush. Couldn't take 43 because it's too close to where shaft is broken, and there are some chips missing. 44b taken proximal of the midshaft break, at point where there were no missing chips. Use 44b with caution as couldn't measure at the chipped region.										
GM08	78-24a	898	1680, HRD_8	NA	NA	37.6	NA	NA	NA	NA
Two fragments reassociated with glue, edges appear flush but there is a chip missing. Distal end only. Fractured end lighter in color. Damage to medial epicondyle, so couldn't take 41. Not enough of shaft to be able to take 44b (at point of fracture is 13.42).										
GM08	78-24a	898	1684, HRD_18	NA	59.11	40.18	NA	NA	NA	NA
Distal end only, break much lighter in color.										
GM13	78-29	910	1666, HRC_1	337	60.05	40.48	48.27	NA	22.98	17.22
w/GM18	*78-30*	*923*	*30, 30-1*							
Two fragments reassociated with tape. Distal fragment also two fragments, reassociated midshaft with glue, edges flush. Proximal/head fragment was once reassociated with glue. Held elements together flush to take 40. Damage to anterior of head so can't take 42a.										

Table G.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***40***	***41***	***41a***	***42***	***42a***	***43***	***44b***
GM14	78-31a	911	2370, HRC_5	290	54.16	37.86	40.68	38.71	19.41	13.09
--										
GM15	78-32	913	2369, HRC_31	NA	62.49	NA	NA	NA	NA	16.04*
Distal fragment only. Evidence of glue along the break and previous attempts. Use 44b with caution as no shaft present proximal to midshaft to check. Lateral of capitulum too damaged to take 41a.										
GM15	78-32	913	2373, 32-1	310	NA	NA	NA	NA	19.83	14.28
w/GM24	*78-53*	*940*	*2399, HRC_36*							
Three fragments. Two shaft fragments reassociated with glue. Distal fragment can be reassociated manually but not enough there to tape. Take 40 with caution as had to hold distal fragment by hand in order to take. Damage to head, no capitlum and damage to medial and lateral epicondyle.										
GM17	78-37a	920	2377, HRC_7	302	55.12	33.74	36.63	NA	18.24	12.55
Damage to anterior and posterior of head, so can't take 42a.										
GM18	78-30	923	1668, HRC_32	NA	NA	NA	NA	NA	NA	19.02
Two fragments reassociated with tape. Chunk missing around midshaft, evidence of past attempts to glue. Missing most of trochlea, all capitulum, and lateral epicondyle, and head.										
GM18	78-30	923	1673, HRD_11	NA	55.94	38.87	NA	NA	NA	NA
Distal fragment only, not enough shaft to determine 44b. Break much lighter in color.										
GM18	78-30	323	1705, HRC_21	338	63.13*	44.73	NA	NA	26.5	17.7
Two fragments reassociated with tape, had been reassociated with glue, edges appear flush. Damage to anterior, posterior, and distal of anatomical neck. Some damage to medial epicondyle, so take 41 with caution.										
GM21	78-41a	926	2383	322	65.91	45.12	NA	NA	25.35	17.66
Head glued back on, damage around anatomical neck so can't take 42 and 42a.										
GM22	78-48	934	2386, HRC_11	297	53.3	37.5	40.66	NA	18.8	12.45
Damage to anterior and posterior of head, so couldn't take 42a.										
GM22	78-48	934	2389, HRD_7	NA	55.41	39.12*	NA	NA	NA	NA
Distal fragment only, not enough shaft to determine 44b. Some damage to lateral of capitulum, so use 41a with caution.										
GM24	78-53	940	2394, HRC-3	343	62.76	46.04	46.02	NA	24.43	17.51
Damage to posterior of head.										

Table G.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*40*	*41*	*41a*	*42*	*42a*	*43*	*44b*
GM24	78-53	940	2397, HRC_26	282	52.81*	37.27	38.21	36.4	16.36	13.03
Some damage to medial epicondyle, so may need to use 41 with caution.										
GM29	78-67	954	67-1	299	NA	NA	NA	NA	18.36	13.07
Missing capitulum and lateral condyle. Damage to head.										
GM30	78-71a	955	1727, HRC_19	290	54.16	36.33	39.49	NA	18.71	13.05
Two fragments reassociated with tape. Were once reassociated with glue. Tape removed and fragments held flush to take 40. 43 just distal to point where broken. Damage to posterior of head so can't take 42a.										
GM31	78-72	957	1728, HRC-30	NA	57.82	40.91	NA	NA	NA	14.68
Missing head. Some damage to medial epicondyle but still able to take 41.										
GM32	78-75	960	1720, HRC_8	349	NA	44.88	NA	NA	27.71*	20.23*
Two fragments reassociated with tape, was once reassociate with glue. Damage to medial epicondyle and posterior of head. Shaft fractured at midshaft, so be cautious with 43 and 44b.										
GM32	78-75	960	1722, HRD_11	NA	60.89	43.74	NA	NA	NA	NA
Distal end only. Two fragments reassociated with glue, edges appear flush. Not enough shaft for 41b.										
GM33	78-76	961	1719, HRC_18	317	61.19	43.53	45.72	NA	25.7	17.93
Damage to posterior of head.										
GM34	78-78	963	1714, HRC_17	331	65.03	41.1	45.22	NA	21.69	16.55
Some damage to anterior and posterior of head, can't take 42a.										
GM34	78-78	963	1715, HRC_25	308	60.01	41.81*	46.96	NA	22.35	17.41
Some damage to lateral of capitulum, so use 41a with caution. Damage to posterior of head.										
GM35	78-80	965	1707, HRD_9	NA	54.58*	38.29	NA	NA	NA	14.15
w/GM37	*78-105*	*989*	*105*							
Three fragments, two shaft fragments reassociated with tape, had been reassociated with glue, distal end broken off but can be reassociated manually. Missing head, this break much lighter in color. Distal end is broken off through olecranon fossa, down through medial epicondyle, so use 41 with caution.										
GM37	78-104	988	1704, HRC_23	303	56.01	40.42	42.50*	NA	22.53	16.36
w/GM18	*78-30*	*923*	*30-4*							
Two fragments, evidence of past attempts to glue together. Reassociated with masking tape, held together flush for 40. Damage to anterior and posterior of head, can't take 42a, use 42 with caution.										

Table G.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***40***	***41***	***41a***	***42***	***42a***	***43***	***44b***
GM40	78-120	1004	1659, HRD_5	NA	65.26	43.32*	NA	NA	NA	NA
Distal fragment only. Not enough of shaft present to take 44b. Damage to posterior of medial epicondyle, but doesn't appear to affect 41. Also use 41a with caution due to damage to lateral edge of capitulum.										
GM41	78-121a	1008	1649, HRC_6	284	57.23	34.67	39.01	NA	19.81	13.26
Damage to anterior and posterior of head, so couldn't take 42a.										
GM42	78-125	1011	1650, HRC_4	301	51.16*	36.64	37.09	NA	18.4	13.38
Two fragments reassociated with glue, edges appear flush. Extensive gnawing along the shaft which limited ability to take 43 and 44b, though there was no gnawing at midshaft where took 43. Damage to lateral epicondyle so use 41 with caution. Damage to anterior of head so couldn't take 42a.										
GM46	unassigned 1978	1074	HRC_	294	54.97	37.2	40.13	NA	17.35	12.35
w/GM67	*80-15 2N4E Level 1 D4-6*	*126d*	*803*							
Three fragments. Distal fragment reassociated with tape, proximal shaft fragments reassociated with glue. Distal end held flush to take 40. Damage to anterior of head cannot take 42a.										
GM46	unassigned 1978	1074	HRC_2	311	NA	37.71	39.65	NA	19.64	13.08
w/GM17	*78-36*	*919*	*2378*							
Two fragments associated with tape, damage to lateral epicondyle.										
GM46	unassigned 1978	1074	HRMD_1	NA	NA	44.66	NA	NA	NA	NA
Distal portion only, not enough of shaft to take 44b. Damage to medial epicondyle, so can't take 41. Evidence of glue along where shaft is broken.										
GM56	79-205-2	205	2775, HRMD_4	NA	53.73	38.03	NA	NA	NA	14.29
No head, where broken off much lighter in color. Three fragments: distal reassocaited to shaft with tape, two shaft fragments reassociated with glue, edges appear flush.										
GM59	79-208	208	2234, HRC_38	NA	63.36	43.8	NA	NA	NA	16.27
Missing head.										
GM61	79-230-45	230	HRMD_2	NA	64.67	45.46	NA	NA	NA	19.66
w/GM61	*79-230-44*	*230*	*79-230-44*							
Two fragments reassociated with tape. Was once reassociated with glue. Missing head. Removed tape to take 44b.										

Table G.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***40***	***41***	***41a***	***42***	***42a***	***43***	***44b***
GM62	0N0E Level 3, D2-7	103	855, HRD_1	NA	63.06	44.29	NA	NA	NA	18.92*
"Extra adult bone in Bur 80-3/4 pile." Use 44b with caution because missing proximal half of bone, so couldn't check past midshaft.										
GM66	80-5 0N4E Level 3 A1-13	?	757, HRD 19	303*	62.27	44.07	47.89	NA	23.76*	17.69
Broken into three pieces, reassociated with tape. Distal fragment had previously been associated with glue, not completely flush, about .5mm gap. Some of the fragments of the head reassociated with glue, flush. Use 40 with caution, had to hold the head flush in order to take. Same with 43, had to hold pieces together by hand. Damage to posterior of head, can't take 42a.										
GM69	80-26 0N4E Level 3 A3-28	183a	581, HRMD_8	NA	52.77	38.38	NA	NA	NA	14.34
Missing head.										
GM70	80-21 0N4E Level 4 C2-0	161c	329, HRD_15	NA	67.63	46.16	NA	NA	NA	NA
Distal portion only, one fragment reassociated with glue. Not enough shaft present to take 44b.										
GM71	80-22, Level 4 C2-5	161c	126, HRDC_22	305	NA	40.98	43.65	39.12	22.81	16.7
Damage to lateral epicondyle.										
GM73	80-8 0N0E Level 6	136d	4, HRC_12	309	60	42.88	45.61	NA	20.9	15.65
Damage to posterior of head.										
GM74	80-9, 0N0E Level 6 D1-3	136	984, HRC_27	327	66.82	45.59*	50.48	NA	23.03	17.93
Some damage to lateral of capitulum, use 41a with caution. Damage to anterior of head, can't take 42a.										
GM75	80-10 0N0E Level 6	136b	46, HLC_11	305	64.38	43.83	46.43	42.37	24.22	16.98
GM80	80-33 0N4E Level 4 C2-6	161c	315, HFC_13	286	48.68	35.39	37.28	NA	17.98	13.3
Two fragments reassociated by tape, was once reassociated with glue so this might affect 40. Midshaft just distal of where bone broken. Damage to anterior and posterior of head, so can't take 42a.										

Table G.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***40***	***41***	***41a***	***42***	***42a***	***43***	***44b***
GM80	80-32 2N2E Level 1 C4-13	253a	835, HRC_16	339	63.35	43.88	46.31	NA	NA	15.1
Two fragments reassociated with tape, had been reassociated with glue, edges appear flush. Distal fragment with medial epicondyle, trochlea, and capitulum reassociated with glue, edges appear flush. Held together to take 40. Broken at midshaft, can't take 43 because missing chip where broken. Damage to posterior of head, couldn't take 42a.										
GM82	0N4E Level 4 C2-4	161c	431, HRC_29	NA	57.37*	40.08	NA	NA	NA	15.19
Two fragments reassociated with glue, reassociation flush. Missing head. Some damage to medial epicondyle so use 41 with caution.										
GM85	0N4E Level 5 C1-9	183c	478, HRPM_1, HRD_16	310*	NA	NA	50.69	45.55	24.36	18.42
Two fragments can be reassociated, but not stable using just tape. Had to hold together to take 40, so use with caution. No medial epicondyle. Damage to lateral edge of capitulum and medial of trochlea so cannot take 41a. Damage to ant of head but was still able to take 42a.										
GM85	0N4E Level 5 C3-49	183c	536, HRD_12	NA	60.88	41.15*	NA	NA	NA	NA
Distal fragment, not enough of shaft to take 44b. Damage to medial epicondyle so take with caution. Damage to lateral capitulum so use 41a with caution.										
GM85	0N4E Level 5 C4-12	183c	555, HRC_35	NA	51.23	NA	NA	NA	NA	12.33
w/GM46	*unassigned 1978*	*1074*	*no label "a"*							
Two fragments reassociated with tape, no head. Damage to capitulum.										
GM85	0N4E Level 5 C4-12	183c	568, HRD_17, HRM_5	NA	53.73	37.22	38.42*	NA	NA	12.34
w/GM46	*unassigned 1978*	*1074*	*no label (head)*							
Two fragments reassociated with tape, has a head fragment loose that can manually reassociate but not secure enough to take 40. Damage to anterior and posterior of head so can't take 42a, may need to use 42 with caution because head broken at anatomical neck.										

Table G.2. VPM Sample: Left Humeri Osteometrics.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***40***	***41***	***41a***	***42***	***42a***	***43***	***44b***
GM01	78-1	870	1694, HLD_9	NA	NA	35.91	NA	NA	NA	13.23
Damage to medial epicondyle.										
GM02	78-3a	872	1693, HLC_6	339*	58.55	39.32	47.65	NA	20.45	16.24
Broken into three pieces, reassociated with tape. Seams appear flush, but may need to take 40 with caution. Did not need to remove tape for 44b.										
GM04	78-12	880	1688, 12, HLD_12	NA	59.73	39.82	NA	NA	NA	15.46
Broken off midshaft, along deltoid tuberosity, so not able to check above DT for 44b.										
GM05	78-13a	887	1698	NA	59.3	40.3	NA	NA	NA	16.82
w/GM03	*78-4*	*874*	*1701, HLM_6*							
Two fragments reassociated with tape. Evidence that was once glued together. Missing proximal end, exposed edges lighter in color.										
GM13	78-29	910	1698, HLC_27	NA	NA	42.03	NA	NA	NA	17.08
Damage to lateral epicondyle. Bone reconstructed with glue, seam appears flush. No head.										
GM16	78-33a	914	2368	316	NA	42	47.43	44.49	21.97	17.34
Damage to lateral epicondyle.										
GM17	78-37a	920	2376	NA	NA	NA	NA	NA	NA	14.08
Missing capitulum and lateral epicondyle. Missing proximal end, exposed edge is much lighter in color and evidence that someone attempted midshaft at some point, so may be a head somewhere loose. Two fragments reassociated with glue, edges appear flush.										
GM18	78-30	923	1667	329	61.67	43.84	NA	NA	20.87	16.22
Damage to head.										
GM18	78-30	923	1669	NA	55.93	39.85	NA	NA	NA	16.11
Broken off above deltoid tuberosity.										
GM18	78-30	923	1674	NA	53.64	37.59	NA	NA	NA	13.95
w/GM19	*78-30*	*923*	*30-7*							
Two fragments reassociated with tape, tape removed and fragments held flush while determining 44b. 44b below level of fracture. Missing head.										

Table G.2. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***40***	***41***	***41a***	***42***	***42a***	***43***	***44b***
GM18	78-30	923	16__, HLC_2	311	NA	39.45	41.2	NA	21.14	16.49
Two fragments reassociated with tape. Tape removed to take 44b. 44b proximal to fracture. Damage to anterior and posterior of head. Damage to lateral epicondyle.										
GM22	78-48	934	2387, HLD_11, 48-3	NA	54.75	NA	NA	NA	NA	16.22
Two fragments reassociated with tape. Missing proximal end. Damage to lateral edge of capitulum so can't take 41a.										
GM23	78-52	939	HLC_26	NA	56.75	37.1	NA	NA	NA	12.52
w/GM15	*78-32*	*913*	*2372, 32-1*							
Two fragments reassociated with tape, removed tape to take measurement 44b. Broken along deltoid tuberosity, so could not check above DT for 44b.										
GM24	78-53	940	2395, HLC_17	337	62.06	42.13	46.18	45.5	22.43	17.33
--										
GM24	78-53	940	2398, HLC_22	NA	NA	38.16	NA	NA	NA	13.77
Missing head. Damage to lateral epicondyle.										
GM29	78-67	954	"67-1"	NA	51.89	38.25	NA	NA	NA	12.68
No head. Two fragments reassociated with glue, seams appears flush.										
GM31	78-74	959	1731, HLC_3	356	60.53*	44.41*	48.62	NA	24.83	18.16
w/GM46	*unassigned 1978*	*1074*	*1726*							
Two fragments reassociated with tape. 41a is taken right at the fracture, so use with some caution. Was glued at one point. Some damage to medial epicondyle so use 41 with some caution.										
GM31	78-74	959	HLC_8	342*	65.35	47.31	48.93	NA	28.2	18.23
w/GM46	*unassigned 1978*	*1074*	*1725*							
Broken into three pieces. Was once reassociated with glue, now reassociated with tape. Very small gap in seams due to residual glue. Treat 40 with caution. Damage to anterior and posterior of head.										
GM32	78-75	960	1718, HLC_18	348*	NA	46.43	50.09	NA	25.8	19.18
w/GM24	78-53	940	74-3							
w/GM31	78-74	959	75, 74-3							
Broken in three places, reassociated with tape so use 40 with some caution. Reassociated as best as possible, holding edges flush. Damage to medial epicondyle (absent?), couldn't take 41. Damage to posterior anatomical neck.										

Table G.2. Continued.

BOX	BURIAL	CAT.	ELEMENT	40	41	41a	42	42a	43	44b
GM32	78-75	960	1721, HLMD_12	NA	NA	NA	NA	NA	NA	13.95
Missing proximal end and trochlea/capitulum/lateral epicondyle.										
GM34	78-78	963	1713, HLC_13	304	61.04	40.11	46.79	NA	21.78	16.1
Damage to posterior of head.										
GM34	78-78	963	1717, HLC_21	334	66.95	46.12	46.58	NA	22.81	18.15
About 5mm of lipping on medial edge of trochlea, may affect 41a. Damage to anterior of anatomical neck.										
GM37	78-102	986	1708, HLMD_11	NA	63.23	NA	NA	NA	NA	17.27
Two fragments reassociated with tape. Tape removed to take 44b. 44b just distal to fracture. Missing head, fracture there much lighter in color. Damage to trochlea and capitulum so can't take 41a. head. Some damage to medial epicondyle but still able to take 41.										
GM38	78-112	996	1706, HLMD_5	NA	NA	NA	NA	NA	NA	14.27
Broken at deltoid tuberosity, so couldn't check above DT for 44b.										
GM38	78-106	990	1703, HLC_7	295	52.32	36.1	39.73	NA	18.34	12.96
Damage to posterior of head.										
GM38	78-106	990	HLC_10	NA	NA	37.64	NA	NA	NA	NA
Damage to medial epicondyle. Not enough shaft to measure 44b.										
GM39	78-118	1002	1661, HLC_15	296	57.46	38.98	41.91	NA	19.77	12.68
Some damage to medial edge of trochlea, so may affect some measurements, including 40, 41a. Damage to anterior of head.										
GM40	78-120	1004	1658	330	62.15	43.4	49.72	NA	24.39	17.71
Two fragments reassociated with tape. Was glued at one point, residual glue still present, may affect 40. Damage to posterior of head.										
GM41	78-121a	1008	1662	284	54.61	36	38.56	35.51	18.92	13.33*
Three fragments reassociated with glue, seams appear flush. There's a bony growth along lateral edge that might affect 44b.										
GM41	78-121a	1008	1663	287	NA	37.26	40.85	NA	18.56	13.11
Damage to anterior and posterior of head.										
GM41	78-121b	1009	1660	NA	57.20*	39.42	NA	NA	NA	12.79
Some damage to capitulum, may not be able to use 41a. Missing head, fracture there much lighter in color.										
GM45	78-193	1070	1651, HLD_2	NA	NA	45.06	NA	NA	NA	NA
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Table G.2. Continued.

BOX	BURIAL	CAT.	ELEMENT	40	41	41a	42	42a	43	44b
GM46	unassigned 1978	1074	1261	NA	NA	NA	NA	NA	NA	NA
Just a fragment with the medial epicondyle and medial edge of trochlea, so cannot take any measurements.										
GM46	unassigned 1978	1074	no label “d”, "b"	285	59.18	42.78	43.97	39.89	19.6	13.95
Two fragments reassociated with tape, tape removed while taking 44b. 44b superior to fracture point.										
GM55	79-212-1	212-1	2847	NA	55.01	36.72	NA	NA	NA	NA
Two fragments reassociated with tape. Shaft broken off before deltoid tuberosity, not enough to reliably take 44b.										
GM55	79-231-2	231	HLD_3, 79-231-2	NA	53.76	36.66	NA	NA	NA	NA
Two fragments reassociated with tape, no need to remove tape to take measurements. Not enough shaft to take 44b.										
GM56	79-205-4	205	1643, HLMD_1	NA	56.55	37.65	NA	NA	NA	15.09
Broken midshaft. Not able to check above deltoid tuberosity for 44b.										
GM59	79-208	208	2235	325	61.74	43.16	44.95	43.16	21.65	15.18
Broken midshaft, reassociated with tape. Distal end reassociated with glue. Seams appear flush, glued and tape. Tape removed to take 43 and 44b.										
GM60	79-229-14	229	HLD_6	NA	57.43	43.14	NA	NA	NA	16.76
Two fragments reassociated with tape. Tape removed to take 44b. 44b proximal of fracture. Another small fragment reassociated with glue, seams appear flush. Missing proximal portion of bone, couldn't check above deltoid tuberosity for 44b.										
GM61	79-230-54	230	HLP_2/HLD_10	313	63.92	44.32	45.44	NA	NA	17.96*
Broken midshaft, gnawing present along break. 44b may need to be taken with caution, 44b just distal of missing chunk, further measurements on bone that is there proximally does appear to show that the shaft is getting larger again. Reassociated with tape to take 41, seams appear flush. Couldn't take 43 because of missing chunk of bone. Damage to anterior and posterior of head.										
GM66	80-5 0N4E Level 3	?	760	NA	61.48	43.31	NA	NA	NA	16.93
Two fragments reassociated with tape. Was once reassociated with glue, glue residue still present. Missing proximal portion. Healed fracture along shaft. Lateral edge of capitulum and lateral epicondyle broken off but available, can be held flush and measurements taken. 44b immediately proximal of the fracture, tape removed for this measurement.										
GM67	80-15 0N4E Level 3 A1, A2-12	126a	790, HLMD_3	NA	55.01	37.59	NA	NA	NA	12.87*
Broken midshaft. Also gnawing present, which may affect 44b, though point where took no gnawing present.										

Table G.2. Continued.

BOX	BURIAL	CAT.	ELEMENT	40	41	41a	42	42a	43	44b
GM69	80-17 0N4E Level 3 A2-19	126a	74, HLMD_7	NA	NA	40.10*	NA	NA	NA	15.64
Missing proximal end. Two fragments reassociated with glue. Damage to lateral epicondyle. Damage to medial edge of trochlea and some of lateral capitulum, so take 41a with caution.										
GM73	80-8 0N0E Level 6	136d	5, HLD_8, HLP_5	307*	59.4	42.48	43.83	NA	19.84	14.8
Two fragments reassociated with tape. May need to take 40 with caution, though edges appeared flush. Tape removed to take 44b, 44b distal to fracture. Damage to anterior portion of head, unable to take 42a.										
GM74	80-9 0N0E Level 6 D1-1	136d	991, HLC_5	329	64.6	47.41	49.22	NA	21.52	17.74
Broken into three pieces, reassociated with tape. Evidence that was once reassociated with glue, so this may affect 40. Damage to posterior of the head. 44b taken proximal to fracture midshaft-ish. 43 well proximal of that fracture.										
GM75	80-10 0N0E Level 6	136	46, HRC_24	298*	64.46	42.55*	45.28	NA	22.97	17.11
Damage to anterior and posterior of head. Damage to medial edge of trochlea, so may need to use caution with 41a and 40.										
GM79	80-26 0N4E Level 5	183c	612, 613, HLC_28	NA	52.36	38.88	NA	NA	NA	15.97
Two fragments reassociated with tape, removed tape to take 44b. 44b not at level of fracture. Missing head.										
GM82	0N4E Level 4 C2-0	161c	330, HLD_7	NA	49.67	35.09	NA	NA	NA	NA
Distal fragment, not enough shaft to determine 44b.										
GM82	0N4E Level 4 C2-5	161	314, HLMD_6	NA	53.92	39.76	NA	NA	NA	16.56
Missing head.										
GM82	0N4E Level 4 C2-12	161c	316, HLMD_10	NA	51.05	36.12	NA	NA	NA	12.51
Missing head.										

APPENDIX H
TIBIAL VPM SAMPLE OSTEOMETRIC DATA

All measurements taken by the author and reported in millimeters. Measurements 69 (Length of the Tibia), 70 (Maximum Epiphyseal Breadth of the Proximal Tibia), 71 (Maximum Epiphyseal Breadth of the Distal Tibia), 72 (Maximum Diameter of the Tibia at the Nutrient Foramen), 73 (Transverse Diameter of the Tibia at the Nutrient Foramen), and 74 (Circumference of the Tibia at the Nutrient Foramen) were taken as defined by Moore-Jansen et al. (1994), while 74a (Maximum Anterior-Posterior Diameter Distal to Popliteal Line) and 74b (Minimum Anterior-Posterior Diameter Distal to Popliteal Line) were taken as defined by Byrd and Adams (2003). For full descriptions of these measurements see Table 4.3.

"NA" indicates measurements that could not be taken due to absence of or extensive damage to the feature in question. Any measurements followed by an asterisk could be taken but may be biased due to damage to the feature in question or other difficulties in stabilizing the element for measurement. The distal-most point of the popliteal line was frequently difficult to determine even in robust tibiae. In many cases it was most easily identified by touch, but even then there were some cases where it appeared to merge with the medio-posterior ridge of the tibia. Due to the degree of anterior bone deposition and apparent twisting/misalignment of the diaphysis observed in some tibia, the true anterior-posterior orientation was sometimes difficult to determine. In those cases anterior-posterior measurements as taken (tibia held vertically and braced against the table with the lateral surface and fibular notch facing the observer, calipers held parallel to the table's surface and perpendicular to the lateral surface) may be biased.

Table H.1. VPM Sample: Right Tibiae Osteometrics.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***69***	***70***	***71***	***72***	***73***	***74***	***74a***	***74b***
GM01	78-2	871	2403, 2-1	NA	NA	42	34.07	19.33	85	31.77	23.08
Missing tibial plateau.											
GM03	78-10	878	2404	NA	NA	NA	29.82	20.32	77	29.66*	NA
Missing distal epiphysis, damage to tibial plateau. Not enough of distal portion of shaft present to confirm 74b. Difficult to determine distal end of popliteal line.											
GM05	78-13a	887	2415	NA	76	44	36.07	21.52	95	37.73*	26.65
Multiple fragments reassociated with glue; tibial plateau can't be notched into place because of distortion in glued reconstruction. Use 74a with caution because of that reconstruction.											
GM05	78-13a	887	2416, 2418	NA	NA	NA	38.34	22.93	97	38.69	NA
Missing distal end. Tibial plateau mostly absent. Two fragments reassociated by hand. Difficult to discern end of popliteal line.											
GM12	78-28e	908	2414	NA	NA	NA	40.67	21.39	101	38.37*	27.43
Missing tibial tuberosity and damage to medial malleolus. Difficult to determine end of popliteal line. Saber shin.											
GM13	78-29	910	1636	NA	71	NA	29.75	20.16	80	28.68	NA
w/GM46	*unassigned 1978*	*1074*	*no label "d"*								
Multiple fragments reassociated with glue and tape. Bone significantly deformed due to previous reconstruction.											
GM15	?	913	1634	346	69	43	28.87	20.28	78	28.57*	22.1
Very gracile.											
GM17	78-37a	920	1637	NA	65*	NA	28.03	20.27	76	27.17	NA
Missing proximal end, damage to tibial plateau. Not enough of distal portion present to take 74b.											
GM18	78-30	923	1597	NA	NA	NA	30.78	20.16	79	27.72	NA
Damage to lateral condyle; distal half missing.											
GM18	78-30	923	1598	NA	NA	NA	33.67*	17.91*	NA	32.75*	24.12
Damage to lateral condyle; distal half missing.											
GM18	78-30	923	2425	NA	NA	45*	40.65	25.38	104	35.66*	27.15
Distal epiphysis reassociated with tape, was once reassociated with glue. Missing tibial plateau. Popliteal line very long? Difficult to discern.											
GM23	78-51a	937	1632	NA	NA	51	39.47	29.51	109	37.22	29.14
Missing proximal end, evidence that was once glued.											

Table H.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***69***	***70***	***71***	***72***	***73***	***74***	***74a***	***74b***
GM23	78-52	939	1623	NA	NA	47	35.57	23.02	94	33.76	25.69
Missing tibial plateau.											
GM23	78-52	939	1631	NA	66*	NA	28.42	20.09	80	27.65*	22.77
Missing medial malleolus. Some damage to lateral condyle, so use 70 with caution. Very gracile individual, use 74a with caution as difficult to discern popliteal line.											
GM23	78-52	939	1625	NA	NA	NA	34.86	21.21	91	34.97	NA
w/GM46	*unassigned 1978*	*1074*	*no label "a"*								
Two fragments reassociated with tape, were once reassociated with glue. Missing distal poriton, most of tibial plateau.											
GM25	78-54a	941	1624	NA	NA	NA	37.15	24.5	100	36.72	26.45
Two fragments reassociated with glue. Missing distal portion, damage to lateral condyle.											
GM25	78-54a	941	1627	NA	NA	NA	31.52	21.68	86	30.7	23.75
Missing proximal end and medial malleolus.											
GM28	78-65	950	1584	NA	NA	41*	27.99	18.62	75	NA	21.95
Two fragments reassociated with glue; missing proximal end. Damage to one of the lateral protrusions on the distal epiphysis.											
GM29	78-67	954	1613	NA	68	NA	29.69	19.39	78	29.46*	NA
Missing distal end, evidence of glue on break. Difficult to discern end of popliteal line, 74a taken about on level with NF.											
GM35	78-79	964	1582, 1590	NA	NA	49	NA	NA	NA	NA	30.14
Multiple fragments reassociated with tape; main shaft composed of three fragments reassociated with tape. Missing proximal end. Unable to take 72-74a due to fragmentation.											
GM41	78-121b	1009	1568	NA	NA	42	27.97	19.15	76	26.71	20.4
w/GM31	*78-74*	*959*	*74*								
Two fragments reassociated with tape. Were once reassociated with glue. Missing proximal portion.											
GM44	78-187	1065	1563	NA	72	NA	30.93	19.66	85	29.9*	NA
Missing distal end. Difficult to discern end of popliteal line.											
GM44	78-187	1065	1607	NA	NA	NA	47.30*	24.07*	114*	40.58	NA
Missing distal end, damage to lateral condyle. Use 72-74 with caution as there's a pathological-appearing growth to popliteal line at that point.											

Table H.1. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***69***	***70***	***71***	***72***	***73***	***74***	***74a***	***74b***
GM45	78-196	1073	1599	NA	NA	37	26.94	18.18	73	24.81	20.79
Missing proximal portion; damage to two lateral protrusions of the distal epiphysis.											
GM46	unassigned 1978	1074	3814	NA	NA	NA	38.38	21.8	95	38.31*	NA
Missing distal end, tibial plateau in multiple fragments. Posterior deposition, might affect 74a.											
GM55	79-199	199	3247	NA	69	NA	31.03	21.21	84	30.07*	NA
Missing distal half. Popliteal line may extend beyond where bone is broken, so use 74a with caution											
GM55	79-227	227	3488	359	74	46	37.52	25.28	99	35.75	25.91
Two fragments reassociated with glue; edges flush.											
GM57	79-206	206	3358	NA	76	NA	34.36*	23.49	88	32.05*	25.19
Two fragments reassociated with tape, were once glued. Missing distal end. Chipping where nutrient froamen is, right at break, use 72 with caution. Distal point of popliteal line difficult to discern, taken about 1cm distal of NF.											
GM59	79-208	208	2232	370	79	47	39.02	22.59	101	37.38	25.27
Some gnawing at about same level as nutrient foramen, was able to take 72-74 just distal to gnawing. Popliteal line abnormal growth.											
GM62	0N2E Level 3NE	?	772	331	79	NA	36.72	22.07	95	33.7	26.33
Two fragments reassociated with glue, edges appear flush. Damage to medial malleolus.											
GM65	0N2E Level 4 D4-9	130d	701	NA	NA	NA	35.11*	22.88	93*	35.23	NA
Missing distal portion of bone, damage to tibial plateau. Chip missing on anterior ridge level with nutrient foramen, so use 72 and 74 with caution.											
GM67	80-15 2N2E Level 3	254	804	355	70	43	28.76	19.89	76	28.43	23.66
Two fragments reassociated with tape.											
GM72	0N4E Level 3	126c	226	NA	67*	NA	37.48	23.17	97	34.94	NA
Two fragments reassociated with glue. Missing distal portion. Damage to medial condyle, so use 70 with caution. Not enough of distal end present to take 74b.											
GM73	80-8 0N0E Level 7 A3-4 A3-2	179a	8	367	77	45	36.45	24.27	98	36.17*	25.42
Possible anterior and posterior deposition, altering 74a?											

Table H.1. Continued.

BOX	*BURIAL*	*CAT.*	*ELEMENT*	*69*	*70*	*71*	*72*	*73*	*74*	*74a*	*74b*
GM74	80-9 0N0E Level 6 D1-27	136d?	894	382	83	52	40.7	27.37	108	37.39	26.75
--											
GM75	80-10 0N0E Level 6 B2-1	136b	53	368	80	51	38.35*	20.24*	94*	NA	27.68*
Use all the shaft measurements with caution, because of possible growth along posterior surface. Could not determine end of popliteal line.											
GM78	0N2E Level 6 LBP	160	731	NA	81*	NA	38.66	24.12	99	38.35*	NA
Two fragments reassociated with tape, were once reassociated with glue, missing distal end. Damage to medial condyle. Use 74a cautiously because taken at point where shaft is fractured. Fragment of bone missing just distal of 74a, so popliteal line might actually extend further.											
GM79	80-26 0N4E Level 5	183c	599	321	66	41	30.74	19.33	81	28.95*	22.45
Tibial plateau reassociated with glue. Very gracile individual, difficult to determine end of popliteal line.											

Table H.2. VPM Sample: Left Tibiae Osteometrics.

<table>
<tr><th>BOX</th><th>BURIAL</th><th>CAT.</th><th>ELEMENT</th><th>69</th><th>70</th><th>71</th><th>72</th><th>73</th><th>74</th><th>74a</th><th>74b</th></tr>
<tr><td>GM01</td><td>78-2</td><td>871</td><td>2400</td><td>343</td><td>NA</td><td>41</td><td>32.21</td><td>19.73</td><td>82</td><td>30.72</td><td>22.1</td></tr>
<tr><td colspan="12">Distal end reassociated wit tape, was once reassociated with glue, damage to tibial plateau. Use 69 with caution as had to hold distal piece in place by hand.</td></tr>
<tr><td>GM05</td><td>78-13a</td><td>887</td><td>2401</td><td>NA</td><td>NA</td><td>NA</td><td>38.99</td><td>23.3</td><td>98</td><td>38.45</td><td>27.58</td></tr>
<tr><td colspan="12">Missing tibial tuberosity and medial malleolus.</td></tr>
<tr><td>GM05</td><td>78-13a</td><td>887</td><td>2413</td><td>350*</td><td>NA</td><td>43</td><td>36.5</td><td>21.85</td><td>94</td><td>33.56*</td><td>26.95</td></tr>
<tr><td colspan="12">Two fragments reassociated by hand, shaft fragment reassociated with glue. Take 69 with caution as had to hold it by hand to measure and not very stable. Damage to condyles. Difficult to determine distal to popliteal.</td></tr>
<tr><td>GM11</td><td>78-27a</td><td>903</td><td>2424</td><td>347</td><td>70</td><td>45</td><td>28.26</td><td>20.13</td><td>78</td><td>27.32*</td><td>22.2</td></tr>
<tr><td colspan="12">Very difficult to determine distal of popliteal line. Use 74a with caution.</td></tr>
<tr><td>GM17</td><td>78-37a</td><td>920</td><td>1635</td><td>NA</td><td>NA</td><td>NA</td><td>29.31*</td><td>20.81</td><td>80</td><td>28.09*</td><td>20.64</td></tr>
<tr><td colspan="12">Medial malleolus gone, damage to anterior and medial of tibial plateau. Gnawing to the posterior surface at level of nutrient foramen, so take 72 with caution. Very gracile, difficult to determine popliteal line, so take 74a with caution.</td></tr>
<tr><td>GM26</td><td>78-57</td><td>945</td><td>2402</td><td>NA</td><td>NA</td><td>NA</td><td>41.42</td><td>30.45</td><td>112</td><td>36.96*</td><td>NA</td></tr>
<tr><td colspan="12">Missing distal portion. Damage to medial condyle. Popliteal line very long, may have taken 74a too far down.</td></tr>
<tr><td>GM27</td><td>78-61</td><td>947</td><td>1566</td><td>360</td><td>68</td><td>42*</td><td>30.85*</td><td>20.07*</td><td>83*</td><td>27.64*</td><td>21.73</td></tr>
<tr><td>w/GM46</td><td>unassigned 1978</td><td>1074</td><td>no label "h"</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12">Two fragments reassociated with tape, were once reassociated with glue. Shaft portion made up of multiple fragments reassociated with glue, might affect accuracy of 71-74a, so use with caution.)</td></tr>
<tr><td>GM29</td><td>78-67</td><td>954</td><td>1611/1617</td><td>336</td><td>69</td><td>42</td><td>29.38</td><td>18.85</td><td>76</td><td>29.34*</td><td>21.66</td></tr>
<tr><td colspan="12">Two fragments reassociated with glue. Popliteal line difficult to discern along its full length, 74a taken approx. 1cm distal of NF.</td></tr>
<tr><td>GM32</td><td>78-75</td><td>960</td><td>1591</td><td>342</td><td>72*</td><td>43</td><td>30.09</td><td>18.84</td><td>80</td><td>29.24</td><td>22.96</td></tr>
<tr><td colspan="12">Some damage to lateral condyle, use 70 with caution.</td></tr>
<tr><td>GM35</td><td>78-79</td><td>964</td><td>1581</td><td>378</td><td>NA</td><td>NA</td><td>38.17</td><td>25.13</td><td>101</td><td>NA</td><td>30.03</td></tr>
<tr><td>w/GM34</td><td>78-78</td><td>963</td><td>1585</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12">Two fragments reassociated with tape, shaft in two pieces reassociated with glue; missing lateral condyle. Gnawing at point of distal popliteal line, so couldn't take 74a.</td></tr>
</table>

Table H.2. Continued.

BOX	BURIAL	CAT.	ELEMENT	69	70	71	72	73	74	74a	74b
GM35	78-79	964	1583	NA	NA	40*	28.22	17.7	75	27.33*	21.7
No proximal end. Two fragments reassociated with glue. Some damage to one of the lateral protrusions, so take 71 with caution. Very gracile individual, difficult to determine distal of popliteal line so take 74a with caution (taken at point approx. 2cm distal to NF).											
GM38	78-110	994	1567/1577	NA	NA	NA	NA	NA	NA	NA	26.76
Missing proximal half, medial malleolus. Two fragments reassociated with glue, edges appear flush. Missing anterior ridge around NF, so can't take those measurements.											
GM44	78-187	1065	1608	NA	NA	50	41	24.7	104	37.19	27.68
Two fragments reassociated with tape, were once reassociated with glue, missing proximal portion. Missing one of the lateral protrusions. Some gnawing just distal to nutrient foramen but not at point where measured 72. Fracture at point where 74a taken, measurement seemed to "straddle" the fracture so may not have affected, but use with caution.											
GM45	78-209	1086	1593	NA	78*	NA	37.14	24.37	99	34.54	NA
w/GM46	*unassigned 1978*	*1074*	*no label "g"*								
Two fragments reassociated with tape, were once reassociated with glue, missing distal portion. Not sure I did 70 correctly here? It's not true medial-lateral.											
GM45	78-196	1073	1603	355	62	37*	25.56	17.31	70	24.25	20.18
Damage to lateral protrusions of distal epiphysis, use 71 with caution.											
GM55	79-199	199	3246	NA	69	NA	30.97	20.22	92	30.18	NA
Missing distal portion.											
GM55	79-227	227	3491	NA	NA	47	39.43	23.92	101	36.80*	25.18
w/GM03	*78-4*	*874*	*2405*								
Two fragments reassociated with tape, tibial tuberosity and distal epiphyses reassociated with glue no proximal end. Additional growth along popliteal line but didn't appear to affect measurements.											
GM58	79-207	207	2912	NA	73	NA	30.51	23.66	82	28.88	22.85
Missing distal portion.											
GM59	79-208	208	2233	370	79	50	38.93	23.27	98	35.54	25.48
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Table H.2. Continued.

BOX	***BURIAL***	***CAT.***	***ELEMENT***	***69***	***70***	***71***	***72***	***73***	***74***	***74a***	***74b***
GM65	0N2E Level 4 D2-10	130D	692, 457	NA	74	NA	35.29	21.72	90	34.46	NA
w/GM69	*80-17 0N4E Level 3 A2-38*	*126a*	*71*								
w/GM86	*0N4E Level 5 C4-18*	*183a*	*564*								
Four fragments reassociated with tape, shaft fragment two fragments reassociated with glue. Missing anterior of tibial plateau and medial malleolus. Missing chunk of shaft near distal epiphyses.											
GM66	80-5 0N2E Level 3	126	775	332	NA	47	35.72	20.63	92	32.76	26.98
Two fragments reassociated with tape. Damage to lateral condyle.											
GM73	80-8, 0N0E Level 7 A3-4	179a	9, A3-4	373	78	45	36.94	22.65	97	36.25*	25.25
Posterior deposition may affect 74a. Popliteal line wrapped around.											
GM74	80-9 0N0E Level 6 ½	136	893	380	82	54	39.54	25.8	105	35.54	26.95
GM75	80-10 0N0E Level 6	136	53 (L)	368	78	53	37.88	20.13	92	36.7*	26.51
Medial malleolus very thick. Posterior deposition may affect multiple measurements, including 74a. Popliteal line wraps around posterior ridge.											
GM79	80-26 0N4E Level 5	183C	601	321	NA	42	28.74	17.85	74	28.15	23.28
Missing medial condyle.											
GM78	0N2E Level 5 D2-13	158D	719	NA	NA	NA	28.63	20.93	78	NA	23.7
Missing proximal end. Two fragments reassociated with glue, reassociation slightly askew. 74b taken below the level f reassociation. Lateral protrusions of distal epiphysis too damaged to take 71.											
GM82	0N4E Level 4 C1-14	161C	425	NA	71	NA	35.63	22.3	93	35.72*	25.39
Missing distal epiphyses, lots of pathological growth so use all these measurements with caution. Took 74a at spot level with NF, one spot where not a lot of growth, butut so much pathology on distal that swallows most of NF.											
GM86	0N4E Level 5 C3-39	183C	3833	NA	NA	NA	37.32	22.58	93	37.38*	26.75
Missing proximal end and medial malleolus. Difficult to determine end of popliteal line so use 74a with caution. 74a made difficult to discern due to possible pathology on medial surface?											

VITA

Kinsey Brett Stewart was born in Sulphur, Louisiana, on the 28th of December, 1985, to her parents Drs. Garry and Carolyn Stewart. After completing her secondary education at Conway West High School in Conway, Arkansas, she went on to Dartmouth College in Hanover, New Hampshire. Majoring in Classical Archaeology with a minor in Creative Writing, she received her Bachelor of Arts degree in June of 2008. After moving to Knoxville, Tennessee, in December of 2008, she was accepted for fall enrollment into the Department of Anthropology's Master's Program at the University of Tennessee, Knoxville, where she focused on Biological Anthropology with an emphasis on Forensic Anthropology. As a graduate research assistant under Dr. Lee Meadows Jantz from August of 2010 to July of 2012, she worked for the Forensic Anthropology Center as correspondence coordinator, managing donor inquests and application paperwork as well as assisting in the transportation, placement, and recovery of donated human remains at the FAC's Anthropology Research Facility. She also helped clean skeletal remains for inclusion in the William M. Bass Donated Skeletal Collection as a volunteer processor as well as assisted in summer short courses on field recovery methods and commingling. She was admitted into the American Academy of Forensic Sciences as a student member in the spring of 2013. She graduated with a Master of Arts degree in Biological Anthropology in December of 2013.