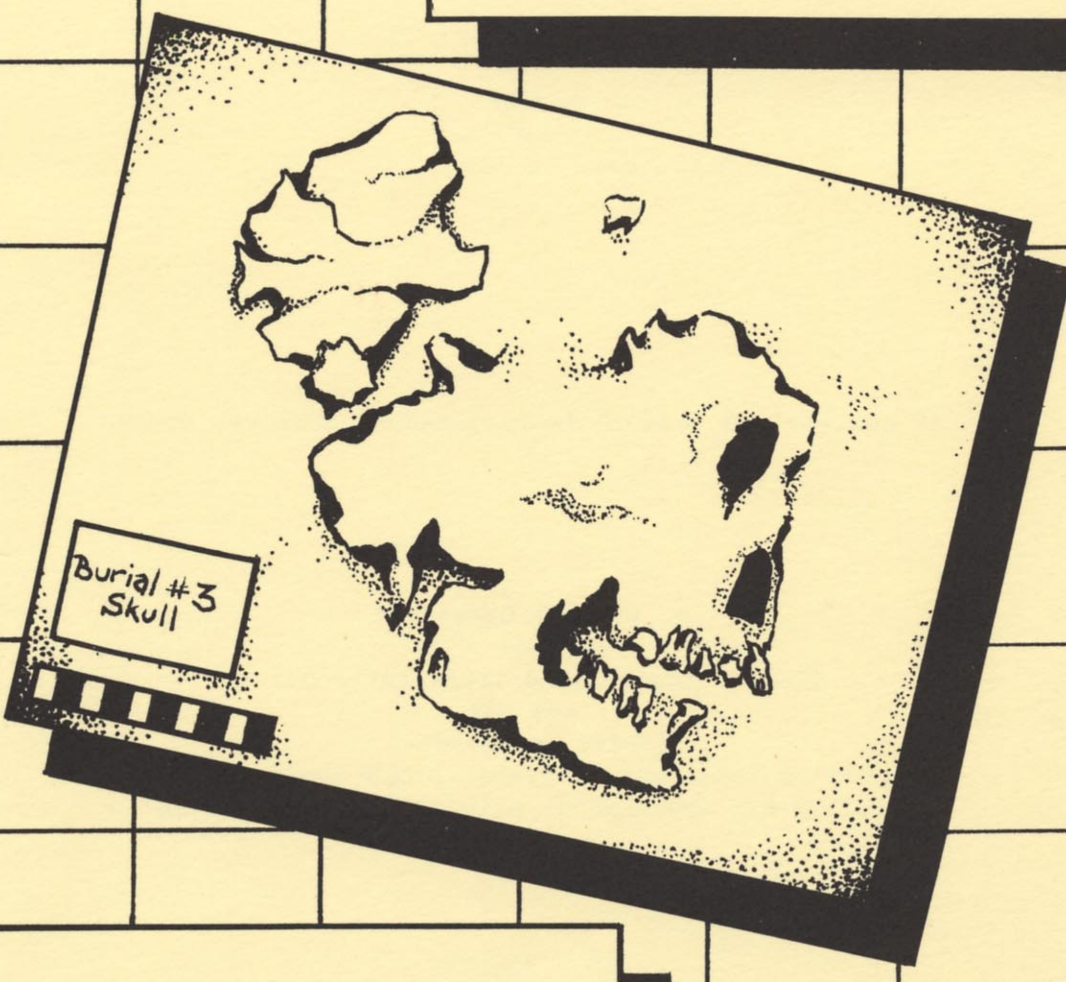
SKELETAL ANALYSIS IN SOUTHEASTERN ARCHAEOLOGY

Janet E. Levy, Editor



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Edited
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Janet E. Levy

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PREFACE

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This volume originated in the spring, 1984, meeting of the Archaeological Society of North Carolina. At that meeting, four North Carolina anthropologists presented "Case Studies in Physical Anthropology and Archaeology" to an audience of both professionals and nonprofessionals, and Dr. Robert Blakely, of Georgia State University, presented a paper on the physical anthropology of the King site. Early the next fall, I began plans for expanding the meeting presentations into a larger and more formal presentation. As things turned out, only one presentation from the ASNC meeting is published here (Wilson). Two other participants in that meeting contributed different papers (Burke, Reichs) and I am happy to include papers by other anthropologists from the Southeastern region.

Even with the mass of archaeological research being conducted in the Southeast, there is relatively little published on osteological analysis of archaeologically-recovered human skeletal remains (although a substantial number of theses and dissertations on the topic exist). This is particularly true of North and South Carolina. With dramatically expanding analytical techniques available in the field of human osteology, these skeletal remains have a great potential for contributing to our investigation of numerous archaeological problems, including subsistence practices, social organization, health, migration patterns, and so forth. These topics were included in two earlier collections on skeletal analysis in archaeology, particularly in the Southeast, edited by Blakely (1977) and by Willey and Smith (1980). After six years, it is worthwhile to present a new collection.

Most of the papers in this volume are discussions of prehistoric skeletal series, largely dating to the Woodland and Mississippian periods, but Rathbun contributes valuable notes on several historic period skeletal series. Analyses are included of material from North Carolina, South Carolina, Virginia, Tennessee, Kentucky, and Alabama.

There are four particularly important themes in this volume. First, several papers (particularly those by Reichs, Rathbun, Boyd, and Powell) provide overviews of analytical methods and research areas in human osteology with emphasis on areas of study beyond traditional description, ageing, and sexing; e.g., disease and health status, social stratification, demographic change. The bibliographies of these papers provide excellent coverage of the technical literature and applications in the Southeast and adjacent areas.

Second is a strong focus on the interrelationships of health, disease, and subsistence practices, with emphasis on the impact of maize agriculture on health status of prehistoric Southeastern populations.

Robbins, Boyd, and Powell all discuss some of the negative effects of heavy reliance on maize, including caries and anemia. Hancock's paper is complementary to these because she proposes some additional influences of subsistence practices on health status, especially the influence of food preparation techniques. Rathbun briefly discusses health status of historic period samples in relation to both diet and work activities.

The third important theme of this volume is the importance of both small and/or fragmented skeletal samples and those samples excavated some time ago possibly under poor conditions. Reichs, in particular, deals with a small fragmented prehistoric sample while Rathbun discusses recovery and analysis of some very fragmented historic samples. Wilson discusses research on fragmented samples excavated 20 years ago and never analyzed. In some cases, documentation and contextual information are less than ideal, and often many traditional measurements cannot be taken. However, the authors agree on the significance of these samples. As analytical techniques expand and as the regional perspective in archaeology is strengthened, these small, fragmented, or poorly documented samples are important for our research. They provide data to fill in the gaps in regional culture histories and they can provide data on diet and health through chemical and other analyses. Obviously, this is not justification for poor excavation in the present, but it is an important reminder of the value of less than perfect data--and a reminder of the need for competent curation. Both Boyd and Powell present analyses of large, well-known skeletal series, at least parts of which have been stored for some years and previously analyzed. But reanalysis contributes new information; thus, the possibility of reanalysis also requires good quality curation for both large and small series.

The fourth important theme of this volume is presented by Burke in his discussion of North Carolina's "Burial Law" regulating excavation, analysis, and curation of human skeletal remains. Rathbun touches briefly on some of the ethical and legal concerns associated with recovering and studying human skeletal material. Modern Native American groups, in particular, are vigorously concerned with the fate of prehistoric skeletal material, although other modern populations take a similar interest from time to time. In parts of the United States, concerns of Native Americans have led to confrontational politics with archaeologists and osteologists. These are critical issues for the community of archaeologists and physical anthropologists (Dincauze 1985). North Carolina took a lead in dealing with these issues when it instituted, in 1981, the Unmarked Human Burial and Unmarked Skeletal Remains Protection Act, aimed at reconciling the goals of archaeologists, physical anthropologists, Native Americans, and other interested parties. Burke reviews the development, early implementation, and emerging problems with the law. This information should be essential for others in the Southeast (and elsewhere) contemplating these issues. Reichs discusses the analysis of a skeletal series recovered under the auspices of the law.

Although these four themes are significant in the volume,they do not encompass all the authors' topics. Analyses of age, sex, and pathology are included in most of the papers. Both Wilson and Reichs address the issue of determining minimum number of individuals in fragmented material. Powell discusses evidence of treponemal infections in the Moundville population. Wilson and Boyd both discuss analyses of genetic affiliation of skeletal samples. Together, all these papers are contributions to the understanding of both regional culture history and biocultural adaptation in different areas of the Southeast.

Let me finish by thanking all the authors for their hard work and patience. Kathy Reichs of University of North Carolina at Charlotte also provided assistance in planning the volume. Enormous thanks are also due to Dee Nelms of the Archaeology Branch, North Carolina Division of Archives and History for producing the final manuscript and to Mark Mathis, also of the Archaeology Branch, for layout and production of the volume. Cathi Ripley of UNCC helped in proofreading the manuscript.

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THE CONTRIBUTIONS OF SKELETAL BIOLOGY TO SOUTHEASTERN ARCHAEOLOGY*

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Abstract

The importance of human remains as a significant archaeological and historical resource increasingly is being recognized. This paper, originally written for non-physical anthropologists, reviews the major points of consideration for human remains in archaeological contexts, provides some examples of osteological research conclusions, and indicates some of the major works available for further reference. A final section provides brief description of analyses of South Carolina skeletal series.

INTRODUCTION

The scientific analysis of human remains can help document the structure of the group, reflect subsistence activities, illustrate cultural change processes through demography and pathology, and record the interaction of cultural and biological factors of human development. A data base of the biosocial nature of past groups should be a vital aspect of cultural resource management and preservation, as should archaeological research.

The mortuary practices of a group also reflect the ideological component of the cultural system. Documentation of settlement patterns, population growth, and pressure on a particular habitat, resource utilization, migration, and contact are of mutual interest to the archaeologist--traditional and "new"--and the osteologist. Ubelaker (1980) presents a clear, concise argument for human remains as a valuable archaeological resource. An edited volume by Brown (1971) illustrates numerous regional applications of mortuary data, and the collections by Blakely (1977b) and Willey and Smith (1980) document biocultural adaptation in the Southeast through a range of new techniques. The following material briefly reviews the major points of consideration for human remains in archaeological context, provides some examples of osteological research conclusions, and indicates some of the major works available for further reference.

RECOGNITION AND TREATMENT OF HUMAN REMAINS

Bone is often encountered at sites of human activity. Recognition of the nature of the bone is relatively easy if the bone is intact and carries particular landmarks. Skulls are easily identified, but other

*A slightly different version was originally published as "Human Remains as an Archaeological Resource" in **South Carolina Antiquities**, Vol. 13, pp. 17-39, 1981. The final section has been added for this publication.

parts of the skeleton can be identified as well. Observation of the teeth is especially important in the determination of humanness, and the joints and muscle attachment areas are important for correct diagnosis. Animal bone appears more ivory-like and compact than human bone, and in cross section, animal bone appears more laminated or layered. If the animal bone is relatively complete, it can be examined against a comparative collection to determine the variety of the specimen. If comparative collections are not available, several published works have drawings and descriptions to aid identification. Cornwall's (1956) **Bones for the Archaeologist** is still useful and Olsen (1964, 1979) is especially useful for mammal and bird remains in the Southeast. Gilbert (1973) should be consulted for mammals in North America. Highly fragmented bone material can be a real challenge, even for the professional osteologist (see Reichs, this volume). All bone should be retained since many new techniques of trace element analysis depend upon base line data drawn from the chemical composition of bones of herbivores as well as carnivores. No preservative should be applied unless absolutely necessary.

Because the disturbance or exhumation of human remains may have legal ramifications, once it has been established that the bones are human, the local medical examiner should be contacted if the bone appears **recent**. This public official is charged with determining the manner, mode, and cause of death of all medically unattended deaths. If the remains are undoubtedly and obviously of prehistoric origin, the State Archaeologist should be contacted for advice. Although South Carolina has no official legal policy concerning prehistoric archaeological human remains, the possibility of complications from possible descendants of the past groups should be considered. North Carolina's legal framework is described below in the paper by Burke. Not only are native Americans increasingly concerned with **prehistoric** remains, but the descendants of **historic** groups--black, white, and red--may have sensitivities that must be considered. A number of these problems and alternative policies have been documented (Cybulski et al. 1979; Burke and Hall 1981; Bastian 1981; Ferguson 1971; Zimmerman and Alex 1981; Anderson et al. 1978; Stump 1981; Talmage 1982). Some of the ethical problems and proposed guidelines for legal and less formal agreements among groups concerned with human remains are examined by Rosen (1980).

EXHUMATION/EXCAVATION

Once the proper clearance for excavation/exhumation has been obtained, the human remains should be treated as an archaeological feature in recovery strategy. Although general archaeological principles of scientific excavation apply, special considerations for human remains are documented by Bass (1971) and Brothwell (1963). The film, "Where Man Lies Buried," which is available through Instructional Services of the University of South Carolina, illustrates excavation and removal of burials in a number of contexts. Special techniques for the recovery and interpretation of ossuary deposits are documented by Ubelaker (1974, 1978). Even forensic specialists have recognized the importance of archaeological techniques in these special circumstances (Morse, Crusoe and Smith 1976). A more detailed treatment of methods of forensic archaeology is available (Morse, Dailey, Stoutamire and Duncan 1984), and Brooks and Brooks (1984) discuss the techniques for historical burials in the West.

The poor preservation of bone from acidic soils and moist conditions often found in the Southeast presents the excavator with numerous problems. Special care must be taken when the bone is first exposed. It should be very lightly brushed since the outer covering frequently flakes away. The bone should be allowed to dry naturally out of direct sunlight. Cloth frames over the excavation allow the bone to dry slowly and provide shade for the excavator. Although preservative can sometimes be applied to consolidate crumbly bone, at least half of the skeleton should remain untreated if at all possible. Many of the new techniques for determining diet rely upon trace elements, and preservatives may chemically alter the bone. Special attention should be given to the skull, pelvis, and ends of long bones since they are critical for later analysis. Hogue (1977) summarizes many of the techniques and problems for skeletal material in the Southeast.

Too often a skeleton exposed in the field and then photographed has disintegrated by the time it reaches the laboratory. As much care should be given to the removal, packing, and transportation of the material as went into its excavation. Bone should be allowed to dry, removed as a unit, wrapped in newsprint or soft paper, placed in a labeled bag (indicate left, right, part of body, etc.), and then boxed as a unit. Most of the dirt should be removed from the skull and not be allowed to dry into a hard ball which will further the destruction of the bone in transit. Small bones of the hands and feet should also be bagged together and labeled by anatomical side.

LABORATORY PROCEDURES

In many respects, human bone can be processed with the same techniques used for other archaeological specimens. Each skeleton should be treated individually and special care given to prevent mixing of the individuals. If preservation allows it, the bone should be dry-brushed and if dirt must be washed off, use only cool clear water and not soap. Use a shallow pan or place a screen over the drain of a deep sink since small fragments can be lost easily when the water is dumped. Any breaks should be noted and inspected to see if they are recent or old breaks. Breaks that occurred during burial or in the ground will have the same coloration as the exterior of the bone, but fresh breaks usually appear lighter in color. Old breaks may indicate that the skeleton was a secondary burial. Never scrape the bone since such scratches may be interpreted as cut, "scalping," or dismemberment marks by later investigators. Patterns of bone breakage and skeletonization may indicate cultural processes.

If deterioration is severe and preservation necessary, small units of the skeleton can be dipped into a solution of gelva and alcohol and then air dried. Do not use plastic cups dissolved in acetone or white glue. Always save some of the bone untreated and mark them as such. Although restoration should be left to a professional, if a bone should break during processing, glue the broken pieces together with Duco cement after the bone has dried. Each fragment of bone should be labeled with water proof ink. Loose teeth should not be glued into the sockets, because examination of the root tip may indicate age of the individual. The tooth can be placed into the socket and kept with the bone. Bass (1971) provides a very good summary of the most important laboratory procedures.

INDIVIDUAL ANALYSIS

Each individual skeleton deserves analysis. The collective features of a population are derived from individuals and are only as good as the analysis of each individual skeleton. Although the maximum amount of information will come from a complete skeleton, even fragmentary remains will provide data to expand our knowledge of a group. The procedures and techniques used in osteological, archaeological, and forensic work are similar but have different intents. The best guides for basic analysis include Bass (1971), Ubelaker (1978) and Stewart (1970, 1979). New techniques are continually being developed are are published in the **American Journal of Physical Anthropology, Human Biology, Journal of Forensic Sciences,** and other journals.

In preparation for analysis, the bones should be laid out in anatomical order. Bass (1971) is the best guide for this because he provides descriptions and drawings of each individual bone and lists the criteria for determining side. Reference can also be made to anatomical drawings. The analysis of the individual skeleton should include determinations of sex, age, race, and specific features, as well as pathology. The composite description of the group can then be used to document population dynamics of past populations.

Determination of Sex

Humans, as well as many other species of animals, are sexually dimorphic; that is, the male and female attributes are expressed differently in the skeleton. The main differences are in size and robusticity of the different bones and the different architecture of the female pelvis which is adapted for both erect posture and child birth. Unfortunately, sex can be determined reliably only for adults. No single factor indicates sex, but the general pattern is for males to be larger and to have more highly developed crests and areas for muscle attachment. Because there is always a degree of overlap in the range of expression of characteristics, diagnosis of the morphological characteristics of the skull is accurate at approximately the 80% level of reliability. Bass (1971) and Stewart (1979) summarize the major characteristics. If the skull and mandible are complete, sex can be determined on the skull by applying discriminant function statistics to as few as 3 to 9 metric dimensions. This technique yields an accuracy of 83% to 88% (Giles 1970). Even fragmentary skulls can indicate sex with a reasonable, but varying, degree of certainty when morphological features are evaluated.

The female pelvis is distinctive because the birth canal must be wide enougth to accommodate the birth of an infant. The width and depth of the female pelvis are produced by a long narrow pubic portion, a wide subpubic angle, and a wide sciatic notch. Phenice (1969) documents this evaluation from observations of the morphological characteristics with an accuracy of above 90%. Ubelaker (1978), Bass (1971), and Stewart (1979) illustrate the characteristics with drawings and photographs. Special care should be given to the intact recovery of the pelvis since it is so critical for both sex and age determinations.

If the skeleton is extremely fragmented, other characteristics can indicate the sex of the skeleton. Even on complete, well-preserved skeleton, the additional features should be evaluated and measured for corroborative evidence. Most of the features follow the general pattern of males being larger and females relatively smaller. Stewart (1979) and Bass (1971) summarize studies that show the usefulness of the following for sex diagnosis: length of the clavicle or collar bone, scapula (shoulder blade) height, and height of the glenoid fossa (oval articulation for the humerus at the shoulder), humerus head diameter, sacrum (tail bone) curvature, and femur length and femur head diameter. Giles (1970), Steele (1970), Black (1978), and DiBennardo and Taylor (1979) provide statistical formulae for sex diagnosis based on measurements of different bones, including long bones and ankle and heel bones. These different formulae have accuracy rates of 79% to 98%. Although the statistical formulae are generally applicable, they are most accurate when they are standardized for a particular population, which means that enough of the skeletons of a group must be relatively complete to establish the normal range of variation for each sex. Many of the techniques and features for both the morphological and statistical analysis were determined by physical anthropologists through studies of skeletal populations in anatomical collections of known demographic features and have been applied to archaeologically derived groups and forensic cases.

Determination of Age

Age at death determinations from the skeleton are based on the biological progression of appearance, growth, and then deterioration of specific anatomical features of bone. Although there is individual variation in the rate of these changes, there is enough commonality for general standards to be developed for age categories. The teeth, long bones, and the pubic symphysis of the pelvis are the major areas of importance for morphological examinations. Ubelaker (1978) illustrates many of these changes with photographs.

From birth to two years of age the eruption of the deciduous or baby teeth provide an indication of age. From three to six years of age, x-rays are necessary to evaluate the development of the permanent tooth buds in the bone, but the diaphyses or shafts of the long bone can also be measured to give an approximate age based on length. Although the standards for comparison may be generally applicable, the lengths of the long bones are really only appropriate for a specific group with a determinable growth rate. Johnston (1962) developed standards from birth to age 6 for the Indian Knoll population; this would be most applicable to populations in the Southeast. Merchant and Ubelaker (1977) developed standards for the Arikara of the Plains. Maresh (1955) has published standards for recent whites. These standards should be applied to the appropriate group, but can give a general estimate of age if the variability is recognized. The latter two studies include material on children through age 16.

The formation and eruption of the permanent dentition provide the best estimates of age at death between 6 and 12 years. Although there is some individual and population variability, standard charts (see Ubelaker 1978:47) are consulted to determine the age of individual skeletons. Age is always expressed within a range of months and the sexes are combined because immature skeletal material provides no indication of sex of the individual. When the dentition is lacking, the standards of long bone shaft lengths, mentioned previously, can be used for general age categories.

Age during the teen years is evaluated by examination of the ends of the long bones. In childhood the major tubular bones consist of shaft (diaphysis) and end section (epiphyses). The epiphyses develop from cartilage, ossify, and then finally attach during the teens. the examination of those epiphyses which have united can be correlated with age when compared to standard union tables. The basic texts mentioned earlier contain charts which can be consulted. The degree of union must be evaluated and, again, the age is presented within a range.

In contrast to immature skeletal material, the sex of the individual adult must be determined for a reliable age estimate. The most widely used method involves changes of the areas where the two hip bones meet in the front. This section of bone changes from a highly ridged configuration from around age 20 to 25, through a low mound phase from age 25 to 30, and then an irregularly nodulated appearance in later adult life. The method is unreliable after about 55 years of age. Todd (1920) combined the sexes when he established ten stages of aging. The newer male standard (McKern and Stewart 1957) and the female standards (Gilbert and McKern 1973) may require comparison with plastic casts. Photographs and drawings of the various stages of remodeling for all three systems appear in Bass (1971), Stewart (1979), and Ubelaker (1978a).

Since the pelvis often deteriorates in burials, other aging methods frequently are necessary in archaeological specimens. Because bone is living tissue and is continually being remodeled through life, microscopic examination of thin sections of the long bones can be used to determine age. As age increases there are more areas of bone resorption and remodeling (osteons), which appear as oval holes filled with concentric circles. These and other features are counted and regression formulas applied (Kerley 1965). Ubelaker (1978:65) has revised the formula for the cortex of the femur, tibia, and fibula. The procedure involves destruction of some of the bone and fairly elaborate laboratory materials. Microscopic examination of the internal structures of the teeth can also be used to determine age. Gustafson (1950) developed the technique and it has been tested and refined by Burns and Maples (1976). These methods involve considerable training and laboratory experience, but are becoming increasingly important in physical anthropology.

A very general idea of age at death can be indicated by the degree and location of degenerative changes such as arthritic lipping of the vertebrae and joint disease with stress or arthritic changes (Stewart 1958). Other changes to be considered include thinning of the parietal bone with advanced age, or fusion of the ribs to the sternum (Kerley 1970), and the amount of dental attrition or wear on the teeth. It should be noted that dental attrition by itself is very unreliable in estimating age because it depends upon diet and genetics of the particular population being examined.

Determination of Stature

Estimation of stature, besides individualizing the skeleton, can provide indications of group adaptation and, perhaps, social differentiation. Although final adult height is under genetic control, the potential can be modified by non-genetic factors such as diet, stress, social position, and individual histories. The techniques for estimating adult stature rests on the relation of individual bone lengths to overall body height. The basic, most widely used and tested formulae were developed by Trotter and Gleser (1952, 1970). The formulae are most accurate for the tibia and femur, but even fragments of some long bones can be used to estimate the length of the original bone and skeletal living stature (Steele 1970). The procedures are most accurate for American Whites and Blacks, but since most archaeological specimens in our area are of Asian (American Indian) ancestry, the Mongoloid and Mexican formulae by Trotter and Gleser (1958), or the Mesoamerican Indian ones by Genoves (1967), are more appropriate. The original data bases of both of these studies, however, may differ from our local populations. The works by Bass (1971), Ubelaker (1978a), and Stewart (1979) illustrate the correct measurement procedures, bones, and formulae to be used.

Besides the individual information to be derived from the stature of an individual, population concerns include the relative difference between males and females in the group as an indicator of potential work capacity and dietary access, structural changes as an individual changes (Wolanski and Kasprazak 1976), and subsistence base (Nickens 1976). Hatch and Willey (1974) also have correlated stature differences with probable social standing in Tennessee skeletal material.

POPULATION ANALYSIS - METRIC DATA

Osteologists have a long tradition of taking measurements of bones for descriptive and analytical purposes. Because standardization of technique and repeatability of study are central to much of science, numerous landmarks, measurements, and instruments for quantifiable data have been developed through the years. Although they were initially developed to aid in standardized description, many of the measurements can now be used in more sophisticated statistical analyses. Size is an important aspect of human variation expressed in the skeleton, but shape is also important. Numerous indices, which are basically ratios, were developed to express shape. These indices have since been categorized into descriptive units such as broad or long-headed skulls. Although these categories can be useful, it should be remembered that they are essentially arbitrary and do not adequately account for the range of variation within a group. Although size and shape of skeletal parts are under strong genetic control, external factors can modify the final expression. The standard comprehensive reference for both measurement and formulae for indices are to be found in Martin (1928), but Bass (1971) and other basic texts include a selection that are commonly used. Especially useful, because it includes landmarks, instruments, measurements, and indices with descriptive titles, is the article by Vallois (1965). Howells (1973) is a very comprehensive work for method and analysis of cranial variation of populations around the world.

Although the individual skeleton and its parts can be important in understanding developments in a geographical area, the basic unit of analysis for both evolutionary change and comparative studies is the population. Numerous statistical tools have been developed to characterize the ways a group may vary, and the number of statistical tests and manipulations seems to increase yearly. The main information to be derived from characterizing skeletal collections as representatives of a population is the number in the population sample, the arithmetic mean for each measurement or character, an indication of the amount of variation as expressed by the standard deviation or variance, and an indicator of normal or skewed distribution. Although the symbols and language of statistics often can be intimidating for the uninitiated, basic arithmetic often may suffice. One of the most useful and easy to understand treatments of basic statistics for skeletal data can be found in Appendix A of the basic physical anthropology text by Bennett (1979). A somewhat more comprehensive treatment is provided by Welkowitz et al. (1971), and the volume by Sokal and Rohlf (1969) is widely used by professionals. These works also provide good discussions of tests for comparisons and manipulations for hypothesis testing.

Skeletal data as an archaeological resource can most often be used in asking questions about descent of particular populations, change within a group over time, and the degree of affinity of associated groups in a geographical area. Although a particular piece of research may require a special type of analysis, a sample of five individuals is the smallest that can be treated statistically. The analysis of similarity among populations may use a single measure at a time for comparison (univariate analysis) if the measure is thought to be significant. A more complex, and also frequently more fruitful approach, uses a number of measures at the same time and evaluates the relative degree of affinity of the mosaic. This multivariate analysis is then used to give a measure of "biological" distance and can be used to depict graphically the relationship of groups over time. Many of the techniques are discussed by Weiner and Huizinga (1972) and Constandse-Westermann (1972), and new approaches appear frequently in the major journals of physical anthropology. If the sample sizes are large enough, it is often important to compare the sexes separately, since gene flow between groups may depend on cultural factors (Rathbun 1974). Berryman (1980) documents the relationship of Late Mississippian groups in Eastern Tennessee in this way.

NON-METRIC DATA

Measurements and their analysis traditionally have been the major means of dealing with skeletons in an archaeological context. Because the skulls and other body features must be relatively complete for such treatment, fragmentation of bones often precludes thorough metric analysis. The use of non-metric or discrete traits such as various foramina (holes), crests, ridges, and forms of anatomical features have been used productively in a number of circumstances for investigation of archaeological problems. Although the analysis of these characters usually are recommended to be done in conjunction with metric work, animal studies as well as human studies have shown that a strong genetic component may be modified by environmental "noise."

A variety of trait lists have been developed and used. This approach was first shown to be useful by Berry and Berry 1967). Since then, a number of studies have illustrated their importance. Finnegan and Faust (1974) have developed a large bibliography pertaining to traits, and Ossenberg (1976) and Corruccini (1974) discuss the various traits and their meaning with suggestions for types of analysis.

As with metric data, adequate sample size is essential for meaningful statistical analysis. After each individual skeleton has been examined and the traits to be used have been scored as present, absent, or data missing, the group is characterized by statements of trait frequency, usually as a percentage. Because these data are discontinuous in contrast to the continuous metric data, different descriptive and analytical statistics are necessary. Frequencies of occurrence of a particular trait in a population can be expressed simply by the number of occurrences, but there should always be concern with the type of distribution which is expressed by distribution curves. The significance of difference between two groups can be tested by various statistics. As with the metric data, the larger the sample size, the higher the confidence of interpretation. Bennett (1979) presents one of the more easily understood discussions of these techniques and formulas that can be used.

Frequencies of discrete traits can be used much like metric data for determining the degree of affinity among populations to be compared, either at one time or historically. Many of the same sources mentioned in the discussion of metric data also are applicable to non-metric data. However, the choice of the correct statistic to be used is under debate. Currently, the most widely used statistic is the Mean Measure of Divergence (MMD). It is a multivariate statistic and it can be used to analyze the composite picture of all traits under consideration. Although many of the arguments are esoteric to most, Green and Suchey (1976) and Finnegan and Cooprider (1978) review numerous statistical procedures for analysis of non-metric traits and make recommendations for data treatment. Once population distances have been determined, they can be used to construct a cluster analysis which will graphically express the population's biological closeness.

Analysis of non-metric traits has proved useful in a number of archaeological contexts. Lane and Sublett (1972) use cranial traits to suggest patrilocal residence among New York Indians by showing that there was much less variation among males at the site than among females, who varied more widely among themselves and probably came from different groups. Turner (1980) hypothesizes the migration of populations into the Tennessee River Valley with the advent of the Mississippian culture in North Alabama on the basis of discrete traits of the temporal bone. Wolf (1977), using both metric and discrete data, however, finds that migration was not a major factor in the distribution of Mississippian populations in Arkansas, Missouri, and Illinois. Buikstra (1976) also uses this kind of data analysis to compare Middle Woodland communities in Illinois which she found to be relatively stable local groups. Discrete trait frequencies have been collected from South Carolina skeletal material at Daws Island (38BU9), Mulberry Mound (38KE12), Scotts Lake Bluff (38CR35), and the Allen site (38AL2), but the analysis is not complete. Larger and more complete skeletal samples are needed before a regional synthesis can be attempted.

PALEODEMOGRAPHY

The reconstruction of the demographic structure of past populations has developed into a subfield within physical anthropology in recent years. Archaeologists, as well, have developed a major interest in the role of demographic variables in the functioning and variation of cultural systems. Both subdisciplines share an interest in the interaction of subsistence, settlement, techno-culture, and social organization in relation to demography. Ecological concerns are another common meeting ground, and numerous theoretical models have been developed. Hassan (1979) reviews the current literature on the interaction of demography and archaeology. His statement (1979:138) is noteworthy: "In addition to theoretical models, demographic explanation in archaeology must be based on empirical data."

This empirical foundation rests on adequate, systematic recovery of human remains. The basic procedures for determining sex and age at death, reviewed previously, are applicable here. Once these basic determinations have been made, the group can be characterized in a number of ways. The basic descriptive tools include the allocation of all individuals, no matter how fragmentary, into five-year periods and summarizing the number and percentage of the population in each category. These basic data can then be used to determine mortality and survivorship curves, and the construction of a life table which expresses percentages of deaths, survivors, probability of death, and life expectance, for those individuals in each age category. Ubelaker (1978) reviews the rationale and necessary procedures for using these methods with skeletal samples. Weiss (1973) provides model life tables for numerous types of groups with specific technocultural development. Although these models were generated from both ethnographic and archaeological data, they provide important ways of interpreting demographic information. Swedlund and Armelagos (1976) review most aspects of demographic anthropology and provide many basic sources. Acsadi and Nemeskeri (1970) also have gathered extensive data on the mortality and life expectancy of past groups.

Regardless of the promise of demographic interpretation for unraveling the cultural processes of the past, the reliability of the reconstruction rests on the accuracy of the age and sex estimates and the representativeness of the skeletal sample. The latter is directly related to archaeology because errors can enter by undetected differential disposal of the dead, inadequate archaeological sampling of a cemetery, and excavator selection for recovery of only the more complete and preserved specimens. Differential preservation, especially of infants and children, also may distort the demographic reconstruction.

The special problems encountered in ossuaries are reviewed by Ubelaker (1974) and the analysis should serve as a model for others considering reconstruction and interpretation of paleodemographic data. Such material also has been used in attempting to determine population pressure and estimates of total population size among North American Indians. Lovejoy et al. (1977) document a large group of Late Woodland individuals at the Libben Site in Ohio. Both of these works illustrate the utility of analyzing adult females and males separately to discover patterns of differential access to resources and the various features contributing to mortality which can be related to socio-cultural dynamics. Blakely (1971) examines the mortality profiles of Archaic, Middle Woodland, and Middle Mississippian populations, showing relative adjustment to different sorts of cultural conditions. His work at Etowah (1977b) also illustrates social divisions within a society as reflected by demographic events.

PALEOPATHOLOGY

Like paleodemography, the study of disease conditions in past populations has had a resurgence of interest lately due to its potential for illustrating many of the ecological features affecting a particular group. Numerous models have been developed, especially in relation to medical anthropology (Wellin 1978), ecology (Armelagos et al. 1978), and hypothesis testing (Hunt 1978). The basic premise is that the health of a group can be taken as an indicator of ecological adjustment.

Although the skeletal system does not reflect all of the disease conditions experienced by an individual, those diseases that affect the individual during growth, near death, or are of a chronic nature may leave traces in the bones. The patterns of pathology within the populations often can attest to the subsistence base, cultural practices, and demographic structure. Because the skeleton is a living system, nutrients or their absence from the subsistence base can be documented by growth rates and, in some instances, by gross anatomical defects or trace elements incorporated into the bone. Differential access to food resources can be detected by analyzing segments of the society or by analysis of the sexes separately. The demographic structure of the group will influence the incidence rates of particular diseases associated with the different age categories. Populations with a high infant mortality rate will have higher numbers of infants with pathologies, and older populations will have higher rates of degenerative diseases associated with the aging process.

The major categories of disease that frequently appear in the skeleton include trauma, arthritis, infections, tumors, endocrine and nutritional deficiencies, and dental pathologies. Some pathologies cannot be linked to a specific causative agent and differential diagnosis may be difficult even for medical experts. A number of general works that should interest archaeologists have been published. Steinbock's (1976) basic textbook has good general coverage and ilustrations. Brothwell and Sandison (1976) edited a large volume that covers the planetary distribution of diseases in antiquity and includes a wide range of medically related topics. Morse (1969) surveys paleopathologies and their distribution among Midwest populations, and the extensively illustrated catalogue of the Hrdlicka paleopathology collection (Tyson and Alcauskas 1980) serves as an excellent reference for unusual bones encountered from archaeological sites. Ortner and Putscher (1981) have published an excellent, illustrated atlas of skeletal pathologies with discussions of process and frequency.

Because the disease process alters the normal structure of bone, excavated bones should be examined individually for variations in size, texture, lesions, or swelling. In some instances, X-ray, chemical, or other tests may be necessary. The suspected pathology should not be submitted for analysis as an isolated piece of bone. Just as the single artifact is difficult to appreciate correctly out of context, the single bone or tooth, even if it appears "funny," is difficult to diagnose out of its systemic location. Differential diagnosis often can depend upon comparison with the other skeletal components.

Although the clinical approach to individual pathologies is useful, more valuable information in relation to biocultural process can be determined from analysis of the patterns of occurrence under an epidemiological perspective, which can then be tested with empirical data. Buikstra and Cook (1980) critically review the advances in the collection, analysis, and interpretation of pathologies in recent research. The continuing theme is one of the biocultural contexts and collaborative efforts. This is reflected as well by the continued growth of the Paleopathology Association and the utility of the **Paleopathology Newsletter** which contains reviews of current publictions and serves as a clearing house to form common interest study groups.

The nutritional aspect of pathology has been especially productive in the analysis of cultural change and subsistence base. A general review is provided by Wing and Brown (1979). Periodic deprivation can be detected in dental defects and interruption of growth of the long bones during development. Other indirect indicators of nutritional adequacy, for example infection rates and the relationship of iron deficiency anemia with heavy maize reliance during the Late Woodland, have been documented in many areas. Parham and Scott (1980) illustrate the relationship of heavy maize reliance and anemia for the late Mississippians in eastern Tennessee, and Rathbun, Sexton and Michie (1980) provide hypotheses concerning the carrying capacity of the South Carolina coastal ecotone as reflected by the disease patterns. Larsen (1980) documents the decrease in size of the skeleton and the dramatic increase in dental caries rates that accompanied the shift to maize agriculture along the Georgia coast. Blakely (1980) illustrates the differing sociocultural implications of pathology among the Etowah skeletal samples from the village and Mound C. He finds indications of ranking within both the elite and general populations. See also articles by Robbins, Hancock, and Powell in this volume.

The analysis of trace elements such as strontium, magnesium, copper, etc., in relation to the amount of calcium in bone promises to help document the relative role of meats and cereal grains in the diet. Gilbert (1977) reviews the major elements and the application of their analysis to problems in archaeology. Because the concentration of various elements differs with types of food in the diet, a higher concentration of an element will be found in the human bone if the individual consumed higher amounts of a particular type of food. For example, because strontium is more concentrated in cereals like maize than it is in animal flesh, populations with high-level dependence upon maize and less dependence on meat in their diet would have higher levels of strontium in their bones. Numerous researchers have applied strontium analysis as well as other trace element analyses to study of the agricultural transition. Analyses of differential acccess to meat resources by sex and class categories have been attempted with mixed results.

Cultural features can also affect the relative amounts of trace elements found in bone. Auferheide et al. (1981) report high levels of lead in the skeletons of a planter and his family at the colonial Cliffs Plantation in Virginia, while the skeletons of indentured servants and slaves have lower levels of lead. This difference probably is due to the differences in exposure to lead caused by differential ownership of cooking and eating utensils, storage containers, and access to luxury items. Comparative data for the remains from South Carolina's Colonial Belleview Plantation are intermediate between the two Virginia groups, although two individuals have very high levels of skeletal lead (Aufderheide 1981).

HUMAN REMAINS IN SOUTH CAROLINA

The recovery and analysis of human remains in South Carolina can contribute significantly to our understanding of past populations and document more recent cultural heritages. The study of ecological adaptations at different prehistoric and historic periods is especially illustrative. The three major physiographic zones in the state (Coastal Plain, Fall Line and Piedmont) provide different adaptive potentials as well as limitations. The dietary, pathological, and demographic patterns provided by human remains will supplement archaeological information on local and systemic adaptations. Measures of population affinities from metric and discrete trait data should reflect the degree of population stability and contact within and beween the major zones.

Diachronic studies of human remains have been shown to the valuable in several adjacent states (see Blakely 1977, Larsen 1981, Parham and Scott 1980, and papers in this volume). Documentation of biosocial changes that occurred with the agricultural transition should be especially productive. Population affinities, as well as demographic, dietary, and pathological patterns, should be investigated both within and between areas to extract data on the processual changes. Of special interest are the indications of a social change from an egalitarian to a ranked society. To date, few prehistoric human remains in South Carolina have been recovered and fully analyzed. The samples have been small and the information spotty due to poor preservation and recovery. The Daw's Island (38BU9) coastal population of the Formative (Archaic) period has been analyzed (Rathbun et al. 1980; Brockington 1971; Michie 1974), and collections of Mississippian period skeletal material have been described from the

Mulberry and Scott's Lake Bluff sites (Carter and Chickering 1973, 1974). Isolated or small groups of human remains also have been reported from around the state. No regional or large scale synthesis of South Carolina human remains from the prehistoric past has been attempted. A rather similar stage in analysis and publication exists in North Carolina.

Although archaeologists studying prehistoric periods increasingly realize the importance of burial information in their attempt to interpret the past, the analysis of human remains from the historic period has been less frequent. Understanding of the rich colonial and antebellum history of South Carolina can be supplemented with osteological data. Diet, demography, and disease patterns for the colonial period could extend the chronicle of traditional historical sources such as diaries, journals, and church records. Since these records quite frequently chronicle only certain segments of society, the data base could be extended by including osteological information from all levels of society. The same argument can be made in reference to later antebellum and circumbellum groups. Thirteen individuals, who may represent the Edward Croft family from the colonial Belleview Plantation (Scurry 1980), are currently being analyzed. The basic osteologtical data have been collected and are in preparation for publication. The analysis of the lead content of the bone reveals a somewhat different pattern than that at Cliff's Plantation in Virginia where high levels of lead in the elite were attributed to dietary practices.

The contact between native South Carolinians and populations of European and African ancestry has produced a complex biological structure. Because these three major groups often had to adapt to different social as well as physical environments, comparative studies of genetic composition, as well as adaptive features, can broaden our understanding of the recent and distant pasts.

RECENT RESEARCH IN SOUTH CAROLINA

Since the initial publication of this article, a number of skeletal samples have been excavated in South Carolina. Although a few additional skeletons have been inadvertently located during archaeological excavation for other research purposes, the majority of the human remains have been excavated and analyzed by the author as part of the bioarchaeology orientation in research and student training.

Historic Period Samples

A major historical sample was added to the record through a cemetery relocation project in Mt. Pleasant, S.C. (38CH778). The analysis of 35 human skeletons provides data on health and disease for a 19th century sample of Afro-Americans. The majority of the group date from 1840-1870, but some freed Blacks are probably included.

The sample includes eight subadults, 13 adult males, and 15 adult females. Gender differential in mortality is evident with the average age at death for males at 34 and females at 40. Females, besides living longer, had more missing and carious teeth, but fewer abscesses. Both genders expressed developmental stress as seen by linear enamel hypoplasias. Males, however, had a higher incidence (92%) of hypoplasias than did females (70%). Age at occurrence was more widely distributed for females, but ages 2-4 were most critical for both genders. Post-cranial indications of stress, Harris lines, were also more frequent for males with 45% having lines in contrast to 18% of the females.

Anemia, probably both genetic and acquired, was a significant health problem. No gender difference is noted with 35% of both sexes expressing cribra orbitalia. Of subadults, however, 80% had lesions. Diploic expansion was relatively common in the sample. Infection also was frequent. Sixty-nine percent of the males, 60% of the females, and 80% of the subadults had some sort of infection.

Ubiquitous skeletal changes are those associated with demanding physical labor. The shoulder and hip are especially affected with arthritic changes, the cervical vertebrae frequently express osteophytosis, and males show a preponderance of Schmorl's herniations and hypertrophy of the supinator crest of the ulna. Skeletal trace elements indicate a relatively moderate exposure to lead, but lead occurs at a higher level than for Colonial samples. Bone strontium is relatively elevated and zinc and copper are relatively low.

The analysis is continuing with this group for genetic affinities, remodeling of tubular bones with osteoporosis, and related human biological research. The health and disease patterns analysis was presented as part of a larger symposium, "Afro-American Biohistory: the Physical Evidence," at the annual meetings of the American Association of Physical Anthropologists in 1984 and is awaiting publication in the journal of that organization. Such historically related research has been applied to other groups in Arkansas, Louisiana, Pennsylvania, the Mid-Atlantic states, and Barbados. A number of social and economic historians have been using biological data of this sort in their own research.

Another sample of 19th century South Carolinians was examined for one week when they became available during renovation of a church crypt in Charleston. This sample included approximately 30 individuals of which only 13 were examined. The opportunity to compare health and disease patterns from elite and slave groups in the same area is unique. Trace element analysis is currently under way and other findings are tentative. The elite sample included both more children and aged individuals than did the slave group. Infection rates also appeared less, but dental pathology was equally represented. One aged female exhibited one of the first attempts in S.C. of dental restoration (filling) with gold foil. The dentition was examined by a professional dentist. Metric and discrete trait data were collected and await analysis.

Five extremely deteriorated 18th century burials were accidently discovered during excavations of a plantation site in Berkeley Co. (38BK202). This sample is a good example of the importance of field participation by an osteologist. The remains were in such decomposed condition that only **in situ** measurements were possible. Laboratory analysis was only possible with the dental crowns which consisted only of the outer shell. Gender, age, stature, and a few indicators of health could be determined. Linear enamel hypoplasias were common and most likely occurred at weaning times of 1-2 years. Racial ancestry was determined by limb proportions and the recovery of hair which was found sandwiched between layers of collapsed skull bones. Three females, one male, and one child aged 4-6 years were recovered. On female was 25-35 and another was 35-40 at death. Only adult status could be determined for the other female and the male appeared young, but more precise diagnosis as impossible. The complete analysis will appear as part of the contract report to the S.C. Department of Highways and Public transportation prepared by Carolina Archaeological Services and the Charleston Museum.

Skeletal remains were recovered from the Wachesaw Landing site, north of Georgetown, S.C. (Trinkley et al. 1983). These were discovered in the 1930's and 1940's during building activities. Most of the material was removed by archaeologists from the Charleston Museum where it was stored. In conjunction with 1982 excavations at the site by personnel from the Research Laboratories of Anthropology of the University of North Carolina, the skeletal material was analyzed and reported in the site report (Trinkley et al. 1983:59-72). The grave goods, including beads, metal spoon and bracelets, suggest an 18th century date. These skeletal remains probably represent the historic Waccamaw Indians. At least eight adults of both sexes and one subadult are represented, although in varying degrees of completeness. Examination of the teeth suggested a mixed diet of agricultural products and wild foods. The investigators also suggest a similarity in cranial form of the Wachesaw series to skeletal remains of Siouan-speaking populations in North Carolina.

Prehistoric Samples

Single burials or small samples continue to come to light with prehistoric archaeological research along the coastal plain and the Savannah River. A 6-9 month old child was discovered in a vessel at 38AL23; a Deptford phase adult male 20-24 was recovered under a substantial rock deposit at 38AK228; and a Mississippian male 25-35 was excavated on Callawassie Island (38BU398). These late period burials vary in particular mortuary practices, but share a marked robusticity, cranial deformation, relatively low caries rates, frequently missing and abscessed teeth, and extensive occlusal attrition. Infection rates, particularly of the lower limbs, are indicative of localized as well as systemic involvement. Pathologies associated with anemia are relatively rare. Morphology suggests a stronger connection to late groups in Georgia rather than to other areas of South or North Carolina. Two individuals (1 adult male, 1 adult female) have recently come to light in the northern portion of South Carolina (38DA66) and appear to be quite late. They were found in a flexed position with the male having shell ornaments and beads in the grave. He had lost all mandibular molars and most of the maxillary right anterior teeth prior to death during his late 4th decade of life. Both individuals reflect cranial deformation, medium robusticity with wide faces, no anemic indicators, but marked infection of the limbs. Some lesions on the skull of the male are suggestive of treponemal involvement, but the diagnosis is not conclusive. The younger female (25-30) was considerably shorter and less robust. Dental disease was less advanced, but both exhibit considerable occlusal attrition.

One last prehistoric site has been investigated in the inner coastal/riverine ecozone that suggests mortuary practice similarity with portions of North Carolina. The site (38HR36) is located on a relic dune at the edge of a swamp approximately 1/2 mile from the Little Pee Dee River. No habitation area has yet been located, but ceramics and lithics on the dune range from early through very late Woodland times. Although some testing, potting, and surface collection had been done earlier on the site by a number of parties, controlled excavation produced seven features with small ossuaries that included at least 42 individuals. Burial preparation included cremation, disarticulation, and semi-articulated skeletons in the same feature. The number of individuals in one ossuary ranged from 3-15 individuals. Unfortunately, no diagnostic cultural materials were included in the ossuaries for dating association and funds for radiometric dating of the bones themselves have not been forthcoming. This pattern of interment is similar to that described by early researchers along the Cape Fear River and is similar to the Cold Morning site near Wilmington, N.C. and to one excavated on Camp LeJeune (see also Wilson, this volume).

At 38HR36 one feature included a semi-circular arrangement of skulls of which plowing had removed the upper portions. Other skeletal elements were randomly distributed through the feature. An adjacent feature, however, was highly compact and appeared to reflect a stacking of bundle burials. It could not be determined if this placement represented simultaneous deposition or if the process was serial. Heavy leaching of fine sand had obliterated any indication of pit outlines, or perhaps the remains had been placed on the original surface and covered over with sand. The deposited bone was exposed at 30-35cm. below the current surface.

Although both genders are represented, males predominate and very few subadult skeletal elements wrre present. Analysis of the sample is currently underway. Health and disease, as well as genetic features, should add to our understanding of past cultural and biological processes in the area.

Although the potential value of human remains as an archaeological resource has been reviewed here, a number of steps remain to be taken to fulfill this potential. Not only is additional, better preserved skeletal material needed, but knowledge of and access to previously excavated material is necessary. A survey of burial remains from South Carolina that have been reported to the Institute of Archaeology and Anthropology (University of South Carolina) is being compiled. It should be emphasized that this will include only those burials that have been reported. Not all of the material has been analyzed nor have all finds been reported. The availability of skeletal resources is indeed a problem when the material is kept in private collections, or when the material recovered in the state is sent to other areas for analysis and, sometimes, curation. A central repository for excavated human remains should be established within South Carolina and provisions should be made for professional conservation and curation. This process of centralization will be even more critical if the current trend of widespread contract archaeological projects continues. Although reports are usually filed with the University and collections are frequently deposited there, a strong antiquities law with curation provisions needs to be developed. Such a law should address skeletal remains of prehistoric and historic origin. Provisions for professional, timely analysis of human remains also should be included in all contract and grant-supported archaeological activities.

If anthropology is to retain its holistic perspective, continued cooperation of subdisciplinary specialists and utilization of the full range of data from the past must be invoked. South Carolina has a rich cultural heritage. The resources and information from her past can be expanded through multidisciplinary cooperation.

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2

THE ARCHAEOLOGY AND PALEODEMOGRAPHY OF THE MCFAYDEN BURIAL MOUND (31Bw67)

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This paper presents the results of the analysis of the skeletal remains from the McFayden Mound, a sand burial mound located on the Cape Fear River in Brunswick County, North Carolina. An overview of the archaeological investigations of sand burial mounds in North Carolina is provided. The analysis of the skeletal material from the McFayden Mound considers the spatial distribution of the remains within the mound, the minimum number of individuals present, the demographic profile of the sample population, skeletal morphology, stature estimates, and the pathologies present.

INTRODUCTION

In February of 1962, the Lower Cape Fear Chapter of the Archaeological Society of North Carolina, under the supervision of Stanley South, began exploratory work on a small sand burial mound situated on the Cape Fear River. This archaeological site, designated 31Bw67 and known as the McFayden Mound (Figure 2.1), had previously been disturbed by relic hunters. The archaeological investigation planned for the mound was important, first, as a salvage project to recover information before it was completely lost. It also provided an opportunity to educate the members of the Lower Cape Fear Chapter in the methods of field archaeology, and in the techniques of preserving, analyzing, and curating the excavated materials.

Originally, work on the mound was undertaken with the expectation that the members would participate in all phases of the investigation, from data retrieval through processing to the final analysis. Unfortunately, interest in the project quickly diminished and the mound was only partially excavated (South 1962). The artifacts and skeletal material recovered during the project were processed, but not analyzed, by members of the Chapter. All these remains were then stored at the Research Laboratories of Anthropology in Chapel Hill.

In 1980, some 18 years after the excavations, analysis of the skeletal remains was initiated. Topics addressed included the minimum number of individuals present, demographic profiles of the population (i.e., age, sex, and health), morphological traits of the population, the spatial distribution of the bone, stature estimation, and identification of pathologies in the population. These analyses are reported in full in Wilson (1982).

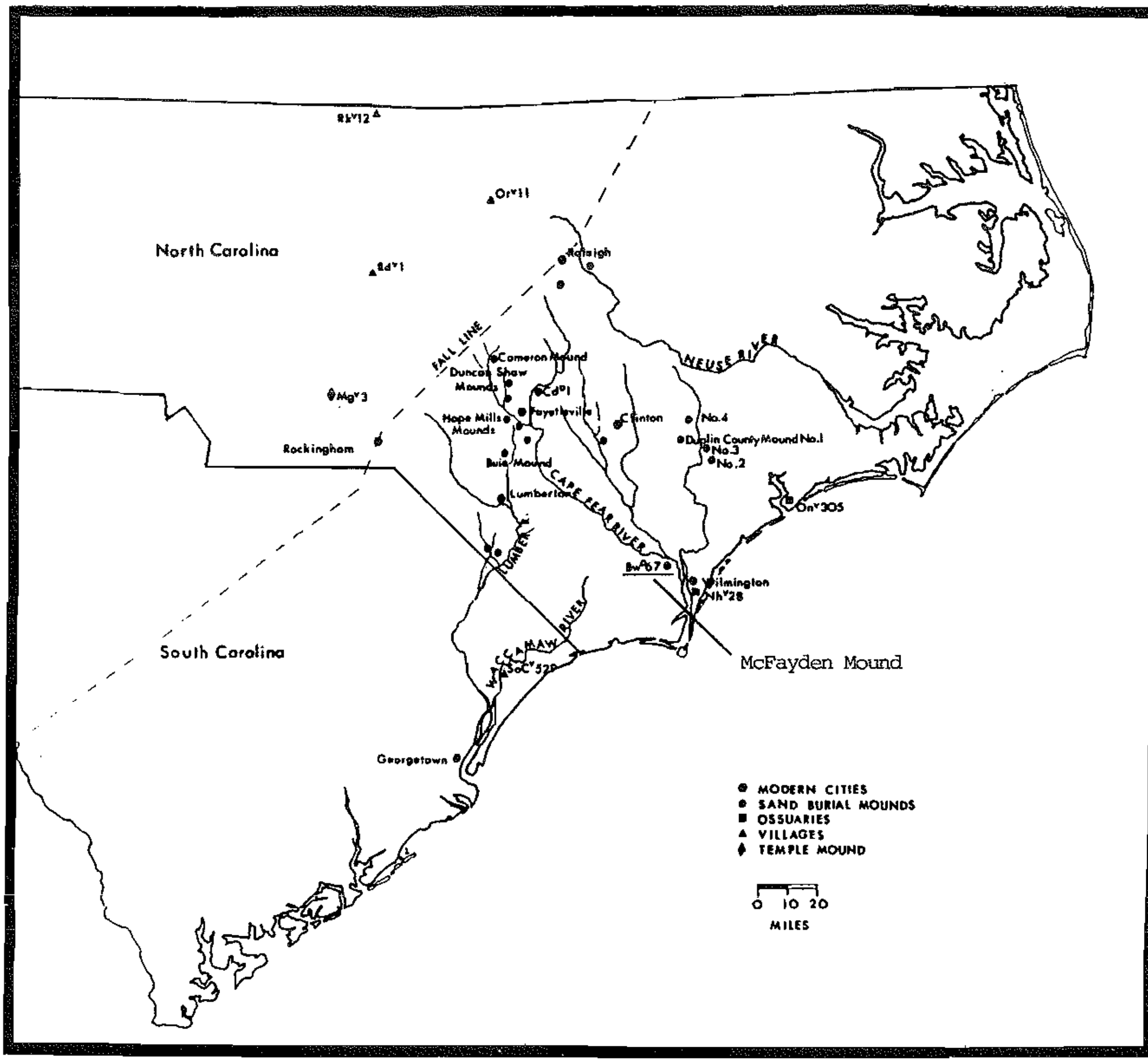

Figure 2.1. Location of Sites Mentioned in Text.

SAND BURIAL MOUNDS IN NORTH CAROLINA

Sand burial mounds are typically found in the Coastal Plain of North Carolina, east of the fall line (which extends from Rockingham to Raleigh), and south of an imaginary line drawn from Raleigh to Cape Hatteras. This type of mound constitutes a widespread cultural trait that is found from the Neuse River south into Florida (Moore 1897, 1898, 1901, 1902; Willey 1949; Willey and Woodbury 1942). Although some doubt exists as to the actual temporal association of the sand burial mounds in North Carolina, they probably date to between A.D. 800 and A.D. 1300 (Wilson 1982:160-161). The sand burial mound complex is marked by a pattern of compound disposals, generally referred to as secondary burials. The archaeological evidence suggests that a compound disposal involved at least two processes: (1) a reduction phase; and (2) the disposal or final interment stage.

The reduction process was used to remove the flesh from the bone by one or more of the following methods: (1) burial and disinterment; (2) exposure to air; (3) exposure to animals; (4) mechanical defleshing; (5) cremation; or (6) decomposition with chemicals (Sprague 1968:480). An examination of the skeletal remains from the McFayden Mound suggest that at least two procedures for reduction were employed. Cremation can be positively identified as one process, as burned human bone (584 pieces) was present. The other process, or processes, employed cannot be positively identified. However, the most likely candidates are exposure to air, burial and disinterment, and/or mechanical defleshing. That a reduction process other than cremation occurred in indicated by the disarticulated state of the bones within the mound.

After the reduction process was completed, the final interment occurred when the defleshed remains were placed on a chosen piece of ground and covered with sand. Additional skeletal remains were brought at various times to the same area and covered, until a substantial mound was raised. The cremations at the McFayden Mound were either placed on the mound and covered, or, possibly, were placed in pits dug into the mound (South 1962:26).

The earliest known "scientific" study of the sand burial mounds of North Carolina was conducted by a geologist, Dr. J.A. Holmes, in the 1880s. Although he was not a trained archaeologist, his records reflect a scientific attitude with much emphasis on detail. Holmes excavated 13 burial mounds in Duplin, Sampson, Robeson, Cumberland and Wake counties. His depictions of skeletal placement are surprisingly detailed, showing evidence for secondary burials in cremated, disarticulated, and bundled forms, in addition to primary flexed burials (Holmes 1916:19-24).

In 1910 Charles Peabody, accompanied by his daughter and some local laborers, excavated two mounds in the Hope Mills area, which is located about 12 miles from Fayetteville in Cumberland County. One of these mounds was undisturbed, and contained great quantities of human bone. Cremations and secondary bundle burials were present, and represented about 60 individuals. The skeletal remains were in poor condition, being friable and broken, which effectively prevented measurements of both cranial and post-cranial remains (Peabody 1910:428-437).

The next recorded excavation of a sand burial mound in North Carolina is in a letter written by Charles MacCauley to the Museum of Anthropology at Ann Arbor, Michigan. During the 1920s, MacCauley collected materials form the Cameron Mound in Harnett County. He notes that the mound had been opened in the 1870s by railroad surveyors and "off and on ever since by every Tom, Dick, and Harry in the country." Although the mound had been disturbed, MacCauley (1966:46) estimates that it contained around 100 skeletons, most of which were in flexed positions.

After MacCauley's excavation in the 1920s, there is no recorded account of sand burial mound excavation in North Carolina until the early 1960s. In 1961 Howard MacCord excavated a portion of the McLean Mound located near the Cape Fear River in Cumberland County. A total of 268 burials, including 25 cremations, a tightly flexed inhumation, and 242 bundle burials, were recovered (MacCord 1966:8-11). Analysis of the skeletal remains by T. Dale Stewart of the Smithsonian Institution indicated that the burial population totaled 500 individuals (Stewart 1966).

Between 1971 and 1974 the Buie Mound, situated near Richland Swamp in Robeson County, was partially excavated by several college classes from St. Andrews Presbyterian College and Pembroke State University. The skeletal material recovered from the mound were described as being in poor condition. However, observations of the placement and deposition of the remains suggest that primary flexed burials, multiple secondary burials, and cremations were present in the mound (Wetmore 1978:34-39).

The only other sand burial mound to be scientifically excavated, and from which the remains have been analyzed and a report prepared, is the McFayden Mound of Brunswick County. This site is located near the Cape Fear River about 20 miles northwest of Wilmington, North Carolina (Figure 2.1). Work has concentrated in the northern sections of the mound, which were the least disturbed areas (Figure 2.2). Approximately 800 square feet of the mound was excavated. Artifacts recovered from the mound include a snake head stone effigy, a stone pipe fragment, 18 shell disc beads, two triangular projectile points, and six Cape Fear Fabric Impressed potsherds (South 1962:20-24). The stone pipe fragment is similar to those manufactured by Piedmont Indians of the Uwharrie Phase, dating to the early Late Woodland period around A.D. 1200 to A.D. 1300 (Jack Wilson, personal communication). Also, two potsherds and a shell earpin were later found during the analysis of the skeletal material (Wilson 1982:31-32). One of these two potsherds was subsquently identified as Adam's Creek, which dates to the late Middle Woodland, or about A.D. 800 to A.D. 1000 (Anderson and Trinkley 1981:5). Such earpins were made using the columella or central spine of the conch shell, which was roughed out, ground on stones and then polished (Brain 1979:252). An early eighteenth-century account of the use of earpins states that

> The women ornament themselves with earrings made of the core of a great shell called "burgo" of which I have spoke. The ear pendant is large as the little finger and at least as long. They have a hole in the lower part of each ear large enough to insert this ornament. It has a head a little larger than the rest to prevent it from falling out (Swanton 1911:55).

Similar earpins are known from Late Woodland sites in the North Carolina mountains, such as the Peachtree site (Brain 1979:252), and protohistoric/historic Siouan villages of the North Carolina Piedmont

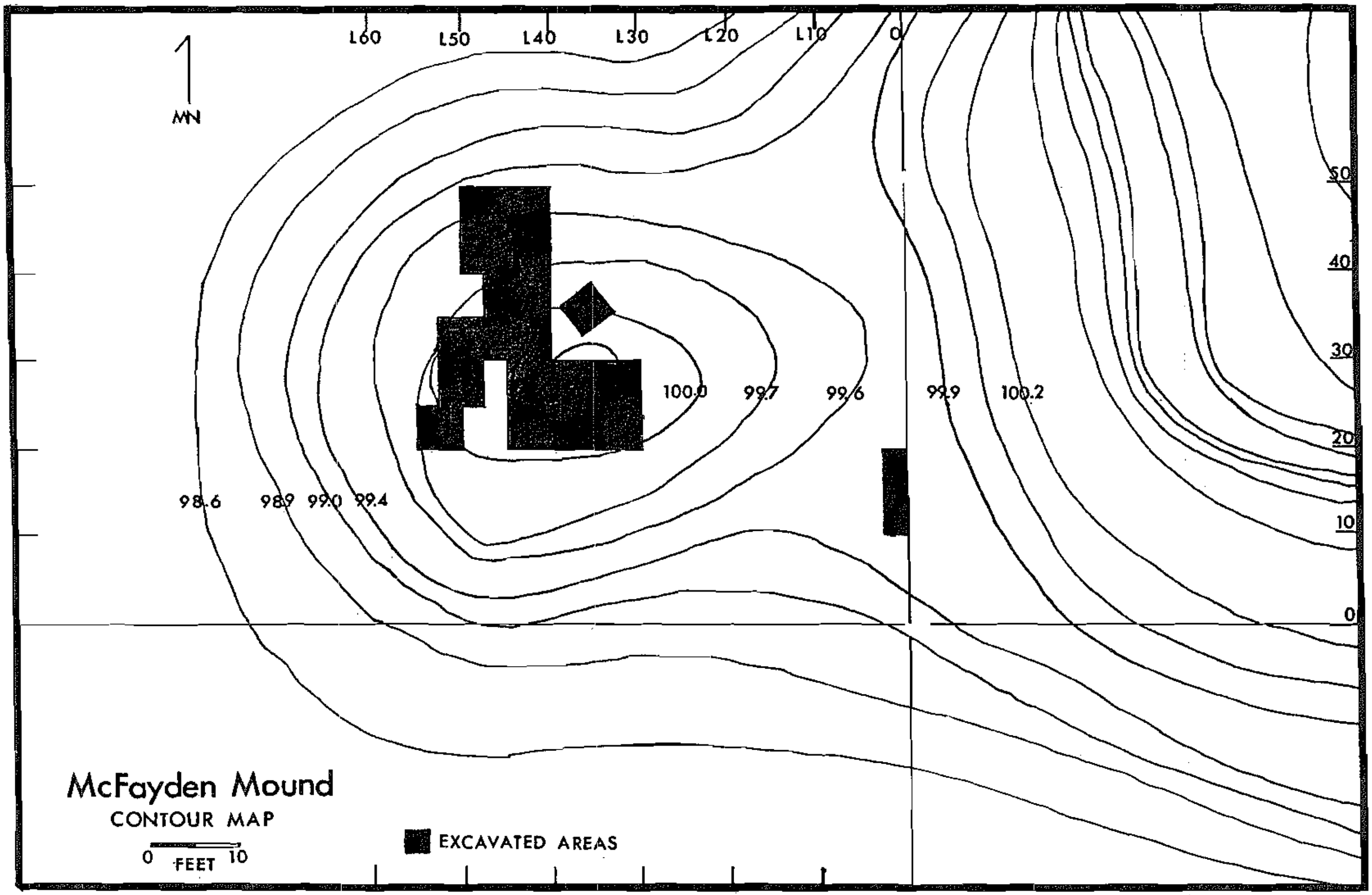

Figure 2.2. Contour map of the McFayden Mound showing the excavated areas.

(Jack Wilson, personal communication, 1982). None has been retrieved from any other sand burial mound in North Carolina. Given the crossdates of the associated artifacts, it appears that the McFayden Mound dates to sometime between A.D. 800 and A.D. 1300.

The most important materials recovered from the mound were, of course, the skeletal remains. A total of 38 clusters of bone was identified and given burial numbers. In addition, skeletal material was recovered from the fill of the individual squares. Cremated remains were found within the squares, features, and burials uncovered at the site. No articulated, flexed, or extended burials were found in the McFayden Mound.

ANALYTICAL TECHNIQUES AND RESULTS

Minimum Number of Individuals

The first step in studying the skeletal remains from the McFayden Mound was to determine the number of individuals represented by the more than 796 identified human bones. This was achieved by compiling a bone-by-bone inventory of left and right bone elements of both adults and subadults present. A total of 41 adults, represented by 41 right temporal bones (Table 2.1), and six subadults (under the age of 15 years), identified through dental remains, are present (Table 2.2). This provides a sample population of 47 individuals.

Variability in Bone Representation

The "bone-by-bone" inventory of the skeletal remains retrieved from the McFayden Mound not only reveals the minimum number of adults and subadults present, but also shows the variability in the quantity of each bone type. In the adult listing, 41 individuals are represented by right temporal bones, whereas only three individuals are indicated by the entire number of hand bones. In many cases, only one adult was represented by specific hand and foot bones. Although the presence of six subadults is indicated by dental remains, no subadult hand bones and very few miscellaneous and foot bones were recorded. Tables 2.3 and 2.4 clearly document the variation in adult and subadult bone representation. These tables rank the bones in the order of the number of individuals they represent. Thus, according to Table 2.3, 41 adults are represented by right temporals, 32 adults by left femurs, etc. Also illustrated are the percentages of unrepresented individuals by each bone element. Tibias from 16 adults were recovered, which represents 39% of the total number of adults, whereas 25 tibias (61%) were missing. This differential representation probably can be attributed to sample bias, as the mound was only partially excavated. It is not unreasonable to suggest that missing bones were placed elsewhere in the mound. Other factors may also have contributed to the variability of bone types present. Probably the most destructive was the heavy disturbance of the mound by relic

Table 2.1. Number of Individuals Represented by Each Type of Adult Bone, McFayden Mound.

Type	Single	Right	Left	Type	Single	Right	Left
Cranial							
Frontal	20						
Parietal		24	23				
Occipital	24						
Temporal		41	32				
Sphenoid	3						
Maxilla	8						
Mandible	25						
Dental Remains	20						
Postcranial							
Humerus		21	16	Metacarpals:			
Radius		9	9	1		0	0
Ulna		8	9	2		0	0
Femur		31	32	3		0	1
Tibia		11	15	4		0	0
Fibula		5	5	5		1	1
Clavicle		7	9	Phalanges:			
Scapula		8	9	Proximal	2(17)		
Innominate		9	3	Middle	1(2)		
Patella		5	5	Distal	0		
Rib	4(103)						
Vertebrae:							
Cervical				Foot Bones:			
1	0			Calcaneus		5	6
2	6			Talus		4	9
3-7	4(22)			Cuboid		1	1
Thoracic				Cuneiforms:			
1-12	2(27)			1		2	3
Lumbar				2		0	1
1-5	2(7)			3		0	1
Hand Bones:				Metatarsals:			
Navicular		0	0	1		3	6
Lunate		1	3	2		2	3
Triquetal		2	0	3		3	5
Pisiform		0	1	4		3	1
Greater Multangular		0	0	5		5	5
Lesser Multangular		0	0	Phalanges:			
Capitate		0	0	Proximal	2(16)		
Hamate		0	0	Middle	1(6)		
				Distal	1(2)		

Table 2.2. Number of Individuals Represented by Each Type of Subadult Bone, McFayden Mound.

Bone Type	Single	Right	Left
Cranial			
Frontal	2		
Parietal		1	1
Occipital	1		
Temporal		5	4
Sphenoid	1		
Maxilla	1		
Mandible	3		
Dental Remains	6		
Postcranial			
Long Bones:			
Humerus		2	3
Radius		1	2
Ulna		0	1
Femur		1	0
Tibia		2	1
Fibula		2	1
Irregular Bones:			
Scapula		1	1
Patella		1	0
Foot Bones:			
Calcaneous		1	0
Talus		2	0

hunters, as evidenced by numerous potholes and surface bone scatters. South (1962:4) states that "there is hardly a spot on the slight rise of the mound that has not a hole dug into it."

In addition to the post-deposition disturbance, bone could have been lost prior to interment through animal disturbance or by human error while transporting the skeletal remains to the mound for final interment. Selection by the aborigines of particular bones, such as the skull, for disposal may also have biased the sample. Further loss through erosion and decomposition could account for the noticable absence of smaller adult bones and infant remains. Finally, potential loss and destruction of skeletal remains during and after excavation should be recognized as a distinct possibility (cf. Ubelaker 1974:33). Most of the skeletal material recovered from the McFayden Mound had

Table 2.3. Order of Representation of Adults as Indicated by Bone Types.

Bone Type	Represented No.		Absent No.	%
Temporal	41	100	0	0
Femur	32	78	9	22
Mandible	25	61	16	39
Parietal	24	58	17	42
Occipital	24	58	17	42
Humerus	21	51	20	49
Frontal	20	49	21	51
Dental Remains	20	49	21	51
Tibia	16	39	25	61
Radius	9	22	32	78
Ulna	9	22	32	78
Clavicle	9	22	32	78
Scapula	9	22	32	78
Innominate	9	22	32	78
Talus	9	22	32	78
Maxilla	8	20	33	80
Cervical Second Vertebrae	6	15	35	85
Calcaneous	6	15	35	85
Metatarsals First	6	15	35	85
Fibula	5	12	36	88
Patella	5	12	36	88
Metatarsals Third	5	12	36	88
Metatarsals Fifth	5	12	36	88
Ribs	4	10	37	90
Cervical (3-7)	4	10	37	90
Sphenoid	3	7	38	93
Lunate	3	7	38	93
Navicular	3	7	38	93
Cuneiform First	3	7	38	93
Metatarsals Second	3	7	38	93
Metatarsals Fourth	3	7	38	93
Thoracic	2	5	39	95
Lumbar	2	5	39	95
Triquetral	2	5	39	95
Phalanges (Prox. Hand)	2	5	39	95
Phalanges (Prox. Foot)	2	5	39	95
Capitate	1	2	40	98
Metacarpals Third	1	2	40	98
Metacarpals Fifth	1	2	40	98
Phalanges (Mid. Hand)	1	2	40	98
Cuneiform Second	1	2	40	98
Cuneiform Third	1	2	40	98
Phalanges (Middle Foot)	1	2	40	98
Phalanges (Distal Foot)	1	2	40	98

Table 2.4. Order of Representation of Subadults as Indicated by Bone Types.

Bone Type	Represented No.	Represented %	Absent No.	Absent %
Dental Remains	6	100	0	0
Temporal	5	83	1	17
Mandible	3	50	3	50
Humerus	3	50	3	50
Frontal	2	33	4	67
Radius	2	33	4	67
Tibia	2	33	4	67
Fibula	2	33	4	67
Talus	2	33	4	67
Parietal	1	17	5	83
Occipital	1	17	5	83
Sphenoid	1	17	5	83
Maxilla	1	17	5	83
Ulna	1	17	5	83
Femur	1	17	5	83
Scapula	1	17	5	83
Patella	1	17	5	83
Calcaneus	1	17	5	83

not been cleaned and washed prior to its 18 years of storage. The sand and salt still adhering to the bone caused much splintering and warping, expecially of long bones. This damage restricted the number of bones that could be reconstructed and included in the inventory. Most of the bone loss, however, probably occurred through natural and human agents before the mound was excavated in 1962.

Interestingly, more foot bones are present in the sample than hand bones. Eleven individuals, or 23% of the minimum number of individuals, are represented by tali (foot bone), whereas only three are indicated by lunates (hand bone). This difference probably reflects the greater tendency for foot ligaments to resist decomposition, which allows the foot bones to remain articulated during interment (Ubelaker 1974:35).

It is also interesting that, after teeth, the temporal bone is the second most common bone in the subadult category and the most prevalent in the adult category. Because the temporal bone is part of the skull, it is possible that the skull, more often than any other bone, was placed in the mound to represent an individual. Furthermore, because the temporal bone is especially resistant to decomposition (Ubelaker 1974:35), it is not surprising that it appears frequently.

Bone Deposition and Patterning

Because horizontal and vertical locations of the skeletal remains were recorded by the archaeologists, it was feasible to investigate the possible patterning exhibited in the placement of the remains in the mound. Most of the bone was found, as one would expect, in the central portion of the mound, and the presence of bone decreased as one moved toward the periphery. Cremated bones appeared to be concentrated west of mound center, whereas other, non-cremated bundles were located at mound center and to the east. The central portion of the mound also contained adult and subadult remains and cremations. After the center, the north and east sections of the mound seem to have been preferred for placement of adult remains. The south and west areas appear to have been the second choice for the deposition of subadults, along with the cremations (Wilson 1982:40-55).

Age at Death

Establishing the age at death of the individuals proved difficult given the absence of articulated, primary skeletons. Techniques used include dental eruption and development, dental attrition, and suture closure. The 24 individuals that could be aged range from around three to over 40 years. These include 6 subadults (15 years and under), 6 young adults (15-25 years), 8 adults (26-40 years), and 4 old adults (over 40 years).

Sex of Adult Individuals

Determining the sex of the skeletal remains from this secondary burial complex also was difficult. The best results for sexing individuals are obtained when complete skeletons are available, which is not usually the case with sand burial mounds where disarticulated and fragmented bone is the rule. Therefore, the several techniques available for sexing the McFayden mound skeletal material were applied to discrete adult bone categories, such as the femurs, innominates or pelvis bones, and mandibles. The largest sample available for sexing were the femurs. Measurements of femur circumference indicated that at least 13 males and 14 females were present. Taking into consideration sampling error and the different techniques used to sex the materials, the sex ratio for the adult population was probably balanced, as indicated by the femur circumferences. Such a balance between males and females in the population approximates what some researchers (Funkhouser 1978:23; Weiss 1972, 1973) feel to be an accurate reflection of adult populations in general.

PATHOLOGIES

A major feature of this study was the examination of the overall health and fitness of the population. Pathologies were identified, and techniques of paleodemography were used to construct population profiles. A striking trait is the low percentage of dental caries in the overall McFayden Mound population, when compared with aboriginal populations from other areas of North Carolina and the Southeast (Graham 1973; Larson 1980; Navey 1982; Sorohan 1985; Wilson 1985). Of the subadult teeth in the McFayden Mound population sample, 3 out of 21 (14%) deciduous teeth evidence occlusal caries (Wilson 1982:138). In the McFayden Mound adult population sample, about 13% of the teeth show evidence of caries (Wilson 1982:138). Larson (1980:197) notes that the incidence of caries in pre-maize-agricultural subadult populations of the Georgia coast is 0.00%, in pre-maize-agricultural adult populations is 8.87%, in maize-agricultural subadult populations is 48.2%, and for maize-agricultural adult populations the percentage is 64.90.

A pattern of low caries occurrence, like that found in the McFayden Mound population, has been interpreted by Pfeiffer (1979) and Larson (1980) to be indicative of a pre-maize-agricultural population with a mixed subsistence base of hunting, gathering, and possibly cultivation of some plants, but without maize as an important or dominant food resource. Unfortunately, little comparative data concerning plant food subsistence are available for the populations of this region during the late Middle Woodland and early Late Woodland periods (Phelps 1983:36, 48-49). The low incidence of caries in the McFayden Mound population sample can only be used at this time to construct a hypothesis that maize apparently played a minor role in the overall subsistence adaptation of the Indian groups of the area during the late Middle Woodland and early Late Woodland periods. It is left to future researchers to determine the validity of this hypothesis.

Pathological problems identified in the population include evidence of infectious trauma in the left ulna of a subadult and on the right innominate fragment of an adult female. Three mandibles, all from adults, also exhibited signs of enamel hypoplasia, which is evidence of childhood disease or nutritional deficiencies (Wells 1967). Overall, the few pathologies seem to indicate that the population represented by the McFayden Mound burials was healthy.

DEMOGRAPHIC PROFILES

Demographic profiles, which include life expectancy, death rates, population reconstruction, etc., are derived from the age and sex determinations of the skeletal material. Life expectancy at birth for the entire McFayden population was around 20 years (Table 2.5). This is comparable to the life expectancy for other prehistoric Indian populations (cf. Owsley and Bass 1979:150; Ubelaker 1974). The crude mortality rate (the number of individuals per thousand that die within a year) is a direct reflection of the overall life expectancy, and is useful evidence of population decline, equilibrium, or expansion (Ubelaker 1974:65), when suitable comparative data are available. For the McFayden Mound, the crude mortality rate was determined to be 50.12 individuals per thousand per year.

Table 2.5. Life Table Reconstructed for the McFayden Mound Population.

(x) Age Interval	No. Deaths (Dx)	% Deaths (dx)	% Survivors (1x)	Probability of Death (qx)	Total No. Yrs Between x and x+10 (Lx)	Total No. Yrs Lived After Lifetime (Tx)	Life Expectancy (e x)
0	0	0	100.00	.0000	891.30	2021.70	20.21
10	5	21.74	78.26	.2174	652.15	1130.40	14.44
20	6	26.09	52.17	.3333	347.80	478.25	9.17
30	8	34.78	17.39	.6666	108.70	130.45	7.50
40	3	13.04	4.35	.7498	21.75	21.75	5.00
+	1	4.35	0.00	1.0000	0.00	0.00	0.00

Using the crude mortality rate, it is possible to reconstruct the size of the original population that contributed to the burial sample. Important in this calculation is the value "T", the number of years represented by the burials in the sample. In our case, T is the number of years burials were deposited in the McFayden Mound.

Unfortunately, T cannot be accurately assessed for the McFayden Mound. Instead, a table can be constructed that calculates possible population sizes for different time periods from six months to 15 years (Table 2.6). Based on ethnographic evidence of the Cape Fear Indians that covers the years A.D. 1600 and A.D. 1715 (Milling 1940:222; Mooney 1894:6), one can estimate that deposition occurred every four to five years, which would yield a reconstructed population between 187 to 234 individuals.

Table 2.6. Population Reconstruction with N=23 and N=47.

Time in Years of Death Represented by Mound Interments [Possible Time Intervals for Use of Mound] (T)	Population Size Reconstructed With N=23 (P)	Population Size Reconstructed With N=47 (P)
0.5	918	1875
1.0	459	938
2.0	229	469
3.0	153	313
4.0	115	234
5.0	92	187
6.0	76	156
7.0	66	134
8.0	57	117
9.0	51	104
10.0	46	94
11.0	31	62

METRICAL DATE

Two other general features of the study population that could be compared to similar traits exhibited by other skeletal remains from nearby sites are cranial indices and stature estimates. The various cranial measurements (Table 2.7) recorded resemble those calculated for the Piedmont Siouan populations of North Carolina, as well as the posited Siouan groups of the North and South Carolina Coast (Coe et al. 1982:67; Hogue 1977:5; Stewart 1966:74; Trinkley and Hogue 1977:15). Compared with Algonkian crania from sites along the northern North Carolina Coast, the McFayden Mound population appears extremely gracile. Morphologically, the skulls are small with a medium to high vault and medium parietal eminences for the female remains. Little muscle marking is evidenced by the skulls, and the brow ridges are small to medium in size. These characteristics and the cranial measurements of the McFayden Mound population sample indicate a population morphologically similar to the Iswanid physical type and the known historic Siouan populations, rather than the Lenapid physical type and the Coastal Algonquian Indians (cf. Coe et al. 1982; Neumann 1952).

Stature estimates for the McFayden population are, as usual, fraught with error, as the techniques used to estimate length of the long bones are derived from the study of white and negro skeletal populations (cf. Steele 1970). Nevertheless, the McFayden population stature estimates range from 5'1" - 5'4" for the adult females, and from 5'2" - 5'5" for adult males, using Genoves' (1967) formula for Mesoamericans. These estimates are similar to the stature estimates for other Indian groups from the southeastern coast of North Carolina (cf. Coe et al. 1982).

SUMMARY AND CONCLUSION

In summary, the McFayden population resembles in morphology (general appearance) other Siouan populations from the Piedmont and southern coast of North Carolina, and the northern coast of South Carolina. There are also indications that maize was not an integral part of the diet of the McFayden population.

That these general conclusions could be reached, and the other information presented earlier could be documented, is a tribute to the cooperative venture initiated some two decades ago by the Lower Cape Fear Chapter of the Archaeological Society of North Carolina and Stanley South, then of the North Carolina Department of Archives and History with an association to the Research Laboratories of Anthropology at the University of North Carolina. It is hoped that future endeavors involving cooperation between amateur and professional, as for example in the excavations conducted in the summer of 1984 at Town Creek Indian Mound State Historic Site that involved members of the Archaeological Society of North Carolina and archaeologists from the Historic Sites Section of the North Carolina Department of Cultural Resources, can be conducted in which the

Table 2.7. Comparison of Mean Cranial Indices from the McFayden Mound (31Bw67) and Selected Skeletal Populations

Population	Sex	No.	Cranial Index	No.	Cranial Module	No.	Cranial Length/Height Index	No.	Cranial Breadth/Height Index	Mean Height No.	Mean Height Index	Fronto-Parietal No.	Fronto-Parietal Index	Total Facial No.	Total Facial Index	Upper Facial No.	Upper Facial Index	Maxillo-Alveolar No.	Maxillo-Alveolar Index
Iswanid	M	33	76.25	33	150.23	33	78.27	33	102.89	33	89.00	–	–	33	87.09	33	52.14	–	–
31Bw°67	M	2	74.72*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	110.47
	F	7	75.77*	4	150.00*	4	72.74*	4	97.30*	7	83.23	3	74.89*	–	–	1	50.56	1	105.26
	?	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	105.35
31Nh^{V}28[2]	M	2	67.67*	1	148.83	1	79.08	1	102.98	2	89.47	–	–	–	–	–	–	–	–
	F	1	75.00*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Duplin Co.	?	1	78.23	1	162.66	1	74.61	1	95.36	–	–	–	–	–	–	–	–	–	–
Mounds No.	?	1	77.32	1	147.00	1	79.06	1	102.25	–	–	–	–	–	–	–	–	–	–
1 and 2[3]	?	1	76.11	1	154.66	1	81.66	1	107.29	–	–	–	–	–	–	–	–	–	–
31Cd°1	M	6	72.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	F	5	74.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
31Rk^{V}12[2]	F	1	76.86	1	149.83	1	80.00	1	104.09	1	90.47	1	65.43	2	90.54*	2	55.82*	2	123.97*
31Or^{V}11[2]	M	2	83.86	2	149.25	2	81.50	2	97.16	2	88.63	2	66.42	1	86.89*	2	52.19*	1	117.12
31Rd^{V}1[2]	M	1	73.77	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	F	1	86.90	–	–	–	–	–	–	–	–	1	64.73	–	–	–	–	–	–
Soc^{V}529	M	1	84.21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	110.00
	F	–	–	–	–	–	–	–	–	–	–	1	72.66	–	–	–	–	–	–
Lenapid[4]	M	24	75.39	24	153.50	24	77.76	24	103.65	–	–	–	–	24	89.65	24	54.88	–	–
Munsee[5]	M	4	73.90	7	155.60	4	73.10	4	98.98	–	–	–	–	7	87.60	7	51.50	8	120.70
	F	5	75.80	9	147.50	5	73.10	5	96.40	–	–	–	–	4	90.50	5	54.10	5	120.50
Onslow Co.[2]	M	1	66.84	1	157.50	1	74.23	1	111.07	1	88.99	1	71.76	1	89.55	1	56.72	1	108.06
Pender Co.[2]	M	1	70.00	1	145.83*	1	73.06	1	104.37	1	85.95	1	76.19	–	–	–	–	–	–

*—Estimated 1—Neumann (1952:17-19, 32) 2—Coe et al. (1982:69) 3—Hogue (1977:5) 4—Neumann (1952:23-24, 37) 5—Hrdlicka (1916:21, 22, 26, 31)

enthusiasm of the amateur and the patience and skill of the professional can be combined in the study of the past cultures of North Carolina.

NOTE ON CURATION

All of the artifacts, skeletal material, analysis notes, photographs, drawings and other records obtained form the McFayden Mound excavations are curated at the Research Laboratories of Anthropology, University of North Carolina, Chapel Hill.

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3

ANALYSIS OF NINE BURIALS FROM THE LEATHERWOOD CREEK SITE (44Hr1), HENRY COUNTY, VIRGINIA

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This paper presents the results of an osteology study directed by George R. Holcomb and Homes H. Wilson during the spring of 1984. Nine burials from a collection contributed to the Research Laboratories of Anthropology by R.P. Gravely are analyzed. Information concerning the age, sex, pathologies, stature, and cranial indices of each of the burials is summarized.

INTRODUCTION

The Leatherwood Creek site (44Hr1) is located in the southern Virginia Piedmont on a tributary of the Smith River, which is part of the Dan River drainage system (Figure 3.1). The site, first reported by Evans (1955:19), is a small Dan River phase prehistoric vilage, that probably dates between A.D. 1450 and A.D. 1600 (Gravely 1971:12). In the late 1960s a salvage excavation was conducted at the site by R.P. Gravely, Jr. and the Patrick Henry Chapter of the Archaeological Society of Virginia. This excavation led to the discovery of four house groupings which had seven clearly distinguishable house patterns, numerous refuse pits, and nine burials. Three of the houses were rectangular and four were circular in outline. Approximately 20 per cent of the site was excavated (Gravely 1971:11).

In 1983, the archaeological collections and field records from the Leatherwood Creek site were donated to the Research Laboratories of Anthropology at the University of North Carolina at Chapel Hill. The nine burials were analyzed by the authors as one requirement of a course on human osteology taught by Holcomb and Wilson in the spring of 1984. Following preservation and reconstruction, the skeletal material was examined to determine the age at death, sex, and stature of each individual. Metrical measurements of the crania and pathologies were also recorded. This study begins with a description of the burials as they were recorded **in situ**, as well as their age at death and sex.

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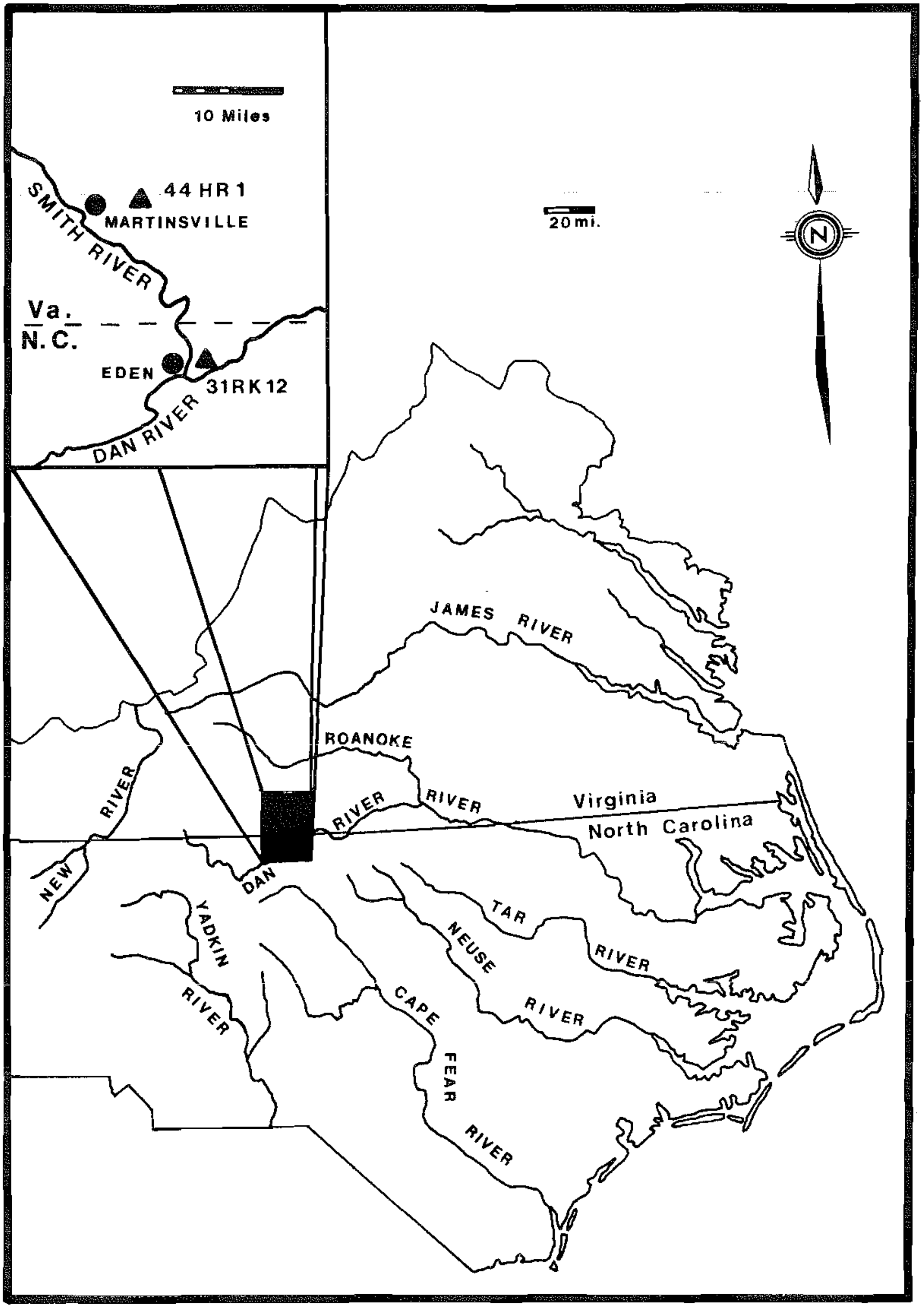

Figure 3.1. Location of the Leatherwood Creek Site.

BURIAL DESCRIPTION

The burial descriptions and grave associations (Table 3.1) presented here are based primarily on Gravely's field records. Aging of the subadults (individuals less than 15 years of age at the time of death) is based on dental development and eruption (Ubelaker 1978) and epiphyseal closure (Bass 1971). Adults (those individuals 15 years and older at the time of death) are aged by using the degree of suture closure (Krogman 1978) and dental attrition (Molnar 1971; Murphey 1959a, 1959b; Bass 1971:239). Sex of an individual is determined only for the adult individuals, since subadults cannot be accurately sexed (Ubelaker 1978). Techniques used to determine sex include examination of the morphological characteristics of the crania, mandibles, and hip bones (Bass 1971; Krogman 1978), and metrical analyses of selected skeletal elements. Discriminant function analysis is utilized for mandibles (Giles 1964), crania (Giles and Elliot 1963), and the talus and calcaneus (Steele 1974). Also recorded are the circumferences of the mid-shaft of the femora (Black 1978), the diameters of the femoral heads (Bass 1971:174), the humeral head diameters (Bass 1971:117), and the ischium-pubis index of the hip bone (Bass 1971:154). Not all techniques are used for each specimen due to the incompleteness of the skeletal collection. Because several techniques are used for each individual in the sample, the age and sex identifiers presented are assumed to be accurate.

Burial 1 was a subadult aged around seven to eight years at the time of death. Because of the young age of this individual, its sex could not be determined. The burial was positioned on its left side in a tightly flexed position with the head to the northeast. Burials 1 and 2 were noted to have been part of a double burial, as both shared a common pit.

Burial 2 was an adult aged between 35 and 40 years. The sex of Burial 2 was difficult to determine as the pelvis was incomplete, but, based on its cranial morphology, it was probably a male. This individual lay on its right side in a flexed position with its head to the northeast. Strung around the neck of Burial 2 were 11 olivella shell beads. Burials 1 and 2 were placed in a simple pit within a structure.

Burial 3, a female aged 25 to 35 years, was found in a shaft-and-chamber pit. The individual lay on her back with the knees flexed in a vertical position, with her head to the east-northeast. Burial 3 contained a number of ornamental grave associations. These included five shell gorgets around the neck, over 350 marginella shell beads in the neck and chest area, two columella beads beneath the skull, and a marginella shell bead bracelet on the left wrist. Four of the shell gorgets were plain with a single, small central hole. The other shell gorget was also plain but had one large central hole, an adjacent smaller hole, and another small hole along a broken edge.

Table 3.1. Summary Description of the Leatherwood Creek Burials.

Burial	Age	Sex	Deposition of Body*	Head Orientation	Pit Type	Grave Goods
1	7–8	?	left side	NE	S	–
2	35–40	M?	right side	NE	S	O
3	25–35	F	supine	ENE	SC	O
4	7–8	?	supine/legs to right	NE	S	O/T
5	3–4	?	left side	SE	SC	O
6	30–35	F	supine/legs to left	SE	S	–
7	35–45	F	supine/legs to left	SE	SC	–
8	6–7	?	supine/legs to left	ENE	SC	–
9	20–25	F	left side	ESE	S	O

* All individuals are flexed

? Sex cannot be determined
M Male
F Female
S Simple pit
SC Side-chambered pit
– No artifacts present
O Ornamental shell and/or bone artifacts
T Technological artifacts

Burial 4 was a subadult aged around seven to eight years at death. This burial was found in a simple pit,and had been placed in a supine position with semi-flexed legs positioned to the right. The head was oriented to the northeast. This individual had a small, plain ceramic ladle with an up-curving handle and four small ceramic vessels placed near the skull. One plain shell gorget with three drill holes was removed from the neck area; and two columella beads were found just left of the shoulder. The remains of a garment embroidered with thousands of marginella shell beads was found in the chest area of the burial. The small ceramic vessels consisted of a cob-impressed, molded toy jar; a net-impressed jar with a cob-impressed neck; a shallow, knotted-net impressed bowl; and a shallow rough-smoothed bowl.

Burial 5 was also a subadult aged three to four years at death. This individual had been placed in a shaft-and-side-chambered pit with its head to the southeast. The legs were tightly flexed, and the burial lay on its left side. Around the neck of Burial 5 was a necklace comprised of a central ornament made from a drilled section of polished columella 1.75 inches in length, together with 26 columella shell beads and four perforated elk deciduous teeth.

Burial 6 was a female aged 30 to 35 years at death. The individual was placed in a simple pit, and was positioned on her back with the legs flexed to the left. The skull was oriented to the southeast. No grave associations were noted for this burial.

Burial 7 was also a female aged 35 to 45 years, and had no grave accompaniments. The burial was in a side-chambered pit, and lay on its back with the legs flexed to the left. The head was placed to the southeast.

Burial 8 was a subadult aged six to seven years. This individual was found lying on its left side with the head to the east-northeast in a side-chambered pit. No grave goods were recovered with this burial.

Burial 9 was a female aged 20 to 25 years that had been interred in a simple pit. The individual was tightly flexed, and lay on her left side with her head oriented east-southeast. Grave associations were ornamental, and consisted of six columella shell beads in the area of the wrists.

The first observation to be made concerning these burials is that they comprise a very biased sample of a normal population. Of the adults, 80% (four of five) are females ranging in age from 20 to 45 years. One of the adults is tentatively sexed as a male and aged 35 to 40 years at the time of death. Normal populations have an equal number of males and females, which the sample from the Leatherwood Creek site obviously does not.

There is another bias in the subadult population present. Of the four subadults present, one is aged three to four years, another is aged six to seven years, and two are aged seven to eight years at the time of death. Population samples usually have more subadults aged less than five years old. This phenomenon is due to the fact that subadults between zero and five years old generally have a very high mortality rate in prehistoric populations (Droessler 1981:48).

Given the small sample size and the inherent sample bias, only a few patterns of mortuary behavior can be suggeted for the inhabitants of the Leatherwood Creek site. All individuals have their legs flexed and their skulls are generally oriented to the east. Both of these traits have been documented for other prehistoric (Benthall 1969:43) and historic (Navey 1982:166) Piedmont Siouan groups. Of the nine burials, six (67%) are positioned on their left side or have their legs flexed to the left. The one possible adult male had been placed on its right side, and is also part of a multiple burial.

METRICAL ANALYSES

Measurements were taken on the adult crania to obtain cranial indices, and on long bones to obtain stature estimates. The various cranial indices calculated for the population are listed in Table 3.2. The cranial index expresses the ratio of the breadth of the skull to the

Table 3.2. Cranial Indices for Adult Burials.

	Leatherwood Creek Burials							31Rk12 Burial
	2	3	6	7	9	X	S.D.	#1
Index	76.63	79.31	87.12	75.00	75.14	78.64	5.05	76.86
Module	-	149.67	145.33	148.33	155.00	149.58	4.04	149.83
Length-Height	-	78.74	80.37	77.84	84.53	80.37	2.96	80.00
Breadth-Height	-	99.27	92.25	103.79	112.50	101.95	8.48	104.09
Mean Height	-	87.82	85.90	88.96	93.01	88.92	2.60	90.47
Fronto-Parietal	65.96	67.39	61.27	71.21	-	66.46	4.11	-
Total Facial	-	107.41	88.28	-	-	97.85	13.53	-

S.D.--Standard Deviation

length (Bass 1971:63). the mean index for the Leatherwood Creek population is 78.64 indicating that the shape of the skull ranges from mesocrany (an average or medium shaped skull) to brachycrany (broad or round headed). It should be noted, however, that one individual, Burial 6, has a very broad (hyperbrachycrany) skull when compared with the other three. The cranial length-height (X=80.37), the cranial breadth-height (X=101.95), and mean height (X=88.92) indices all suggest a population characterized by high skulls (cf. Bass 1971:64-65). The mean fronto-parietal index, which expresses the relationship between the minimum breadth of the frontal bone and the maximum breadth of the cranial vault (Bass 1971:67), is 66.46. This fronto-parietal index is indicative of a narrow skull. Finally, the total facial index (Bass 1971:68) of 97.85 signifies a narrow face.

The mean cranial indices calculated for the Leatherwood Creek population sample are remarkably similar to that of a female adult burial from 31Rk12, a Dan River phase site located on the Dan River in Rockingham County, North Carolina, fourteen miles south and directly downstream from the Leatherwood Creek site. This finding suggests that in addition to the close geographic, temporal, and cultural relationships of these two sites, there is also a high degree of genetic similarity, as indicated by the similar cranial indices. However, given the small samples available for study from both sites, such comparisons can only be considered preliminary.

The other technique of metrical analysis reported here is the estimation of stature based on long bone lengths. Accurate measurements could be taken on two complete femora (from Burials 3 and 6), two complete tibiae (from Burials 6 and 7), and two complete humeri (from Burials 3 and 7). An estimated length for a femur from Burial 9 could be calculated using Steele's (1970) regression formula for "Segment 2" of fragmented long bones. All of these lengths, both measured and calculated, are listed in Table 3.3.

Stature for the male population at the Leatherwood Creek site is estimated using Genoves (1967) formulas for Mesoamerican females (cf. Bass 1971:242). Only tibia and femur formulas are used, and the results are given in Table 3.3. The mean stature (in centimeters) for the Leatherwood Creek skeletal sample derived using the femur measurements is 158.73 $\pm$ 3.82. This provides a height that ranges from 154.91 cm (5'1") to 162.55 cm (5'4"). The two tibiae produce a stature range from 154.93 cm (5'1") to 161.95 cm (5'4"). Although no formula for estimating stature for Native North American populations are available, and some bias is present in the derived figures, the estimates for the females from this site do not seem unreasonable.

PATHOLOGIES

Pathologies present in the skeletal population from the Leatherwood Creek site include dental caries, degenerative arthritis, and osteitis. Dental caries are the most frequently observed pathology with eight of the nine individuals exhibiting them. The one exception is Burial 5 the subadult aged three to four years at death. The majority of the caries present are on the molars (n=30), with the fewest being found on the lateral incisors (n=1). Such a pattern of

Table 3.3. Long Bone Lengths and Stature Estimates.

Long bone lengths in millimeters.

	Burial 3	6	7	9
Femur	425 (L)	424 (R)	-	421.1* (L)
Tibia	-	348 (L)	348 (R)	-
Humerus	305 (L)	-	300 (R)	-

Stature in centimeters using Genoves (1967) for female Mesoamericans.

	Burial 3	6	7	9
Femur	159.82±3.82	159.56±3.82	-	156.8±3.82
Tibia	-	158.44±3.51	158.44±3.51	-

L Left
R Right
* Estimated using Steele 1970

high caries incidence is consistent with the findings of Pfeiffer (1977:37) and Larson (1980:192), who note that horticultural populations exhibit a higher percentage of caries and less excessive dental attrition than non-horticultural populations. Table 3.4 summarized the location of caries in the dentition sample present.

Evidence of degenerative arthritis is found on the bodies of the lumbar vertebra (in the form of minor lipping) of Burial 6, a female aged 30 to 35 years. Brothwell (1981:151) notes that this type of degenerative change (minor lipping of the distal surface) develops progressively, appearing first in an individual as a young adult. Ortner and Putschar (1981:430) state that both erosion and marginal osteophyte development are associated with degenerative change of the vertebral bodies. Erosion and eburnation of the bodies occurs rarely. Extreme lipping of the distal surfaces usually does not occur until after the age of 35 years.

Osteitis is present on the lateral distal surface of both femora and the lateral proximal border of the right humerus of Burial 5, a subadult aged three to four. This condition is characterized by an erosion of the cortical bone, and its cause is currently unknown. An osteitic condition is also present on several bones from Burial 7, a female aged 35-45 at death. Both femora exhibit bone reconstruction

Table 3.4. Dental Caries.

Burial	Maxillary Right	Maxillary Left	Mandibular Right	Mandibular Left	Total # of Teeth
1 (D)	–	–	–	C,M2	2
2 (P)	–	PM2,M1,M2,M3	–	–	4
3 (P)	–	–	M1,M2,M3	M1,M2	5
4 (D)	–	M1,M2	M1,M2	M1,M2	6
5 (D)	–	–	–	–	0
6 (P)	I1,I2,M1	I1	M1,M2,M3	PM1	8
7 (P)	I1,M1,M2	PM1,PM2,M3	C	–	7
8 (D)	–	–	M1,M2	M1,M2	4
9 (P)	M2	PM2,M2	PM2	M1,M2	6
TOTAL	7	12	12	11	42

D Deciduous dentition
P Permanent dentition

		No. w/ Caries
I1	central incisor	3
I2	lateral incisor	1
C	canine	2
PM1	first premolar	2
PM2	second premolar	4
M1	first molar	12
M2	second molar	14
M3	third molar	4
TOTAL		42

along the linea aspera and proximal shaft. The right femur also shows signs of inflammation on the neck and portions of the femoral head. Osteitis can be observed on the right humerus located along the shaft near the groove for the radial nerve.

One possible fracture is located on the sternal articulation of the left clavicle of Burial 7. Evidence of healing is denoted by the presence of bone formation.

CONCLUSION

In this paper, we have presented the results of an examination of skeletal remains from nine burials at the Leatherwood Creek site in Virginia. This information includes data on the age, sex, stature, and pathologies of the population. Further analyses, such as examination of the teeth for evidence of dental hypoplasia and the bones for trace elements, would provide additional information concerning the demography, nutrition, health, and status of the inhabitants of the site. Such analyses will have to await future research. The data presented here provide a corpus of comparative osteological information, and a modest contribution to the physical anthropology of the Native American populations of the Atlantic Piedmont region.

NOTE ON CURATION

All of the artifacts, skeletal material, field notes, field drawings, and other information obtained by R.P. Gravely, Jr. from the Leatherwood Creek site are currently being curated by the Research Laboratories of Anthropology of the University of North Carolina at Chapel Hill.

ACKNOWLEDGEMENTS

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4

THE DICKERSON SKELETAL SERIES: BITS AND PIECES OF CAROLINA PREHISTORY

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ABSTRACT

Osteological analysis of archaeologically recovered materials is aimed at broad understandings of prehistoric cultural systems. Regional mortuary behaviors, demography, biological variability, health, diet, and cultural practices can be clarified with even very small skeletal collections. The Dickerson skeletal series, composed of eight fragmentary burials, is analyzed with these goals in mind. Suggestions are made with regard to cultural affiliation (Cashie Phase, Late Woodland), diet, demography, and environmental stresses.

INTRODUCTION

The recent emphasis in archaeology upon an integrated approach has created new roles for the osteologist. While descriptive analysis of human burials has been a traditional part of archaeological research, this is no longer the primary goal. Recognition of the interdependence of biological, cultural, and environmental variables now requires close interaction between the archaeologist and the biological anthropologist in any comprehensive research design. These cooperative efforts are resulting in a better understanding of factors influencing and shaping prehistoric cultural systems.

Today the integration of archaeological and osteological data allows us to ask questions of a much broader scope concerning prehistoric populations. Statements are possible about dietary habits, activity patterns, response to disease, injury or stress, and cultural and geographic influences on genetic frequencies. Interest now focuses on the variability both within and between populations. Recent analyses have addressed questions of social organization, demography, population interactions or isolation, and temporal changes due to the effects of environmental and cultural variables. While one must beware of stretching the data beyond its limits by overly ambitious research designs, even small burial collections can contribute to the picture of adaptation and change within specific regions. Recoveries containing only small numbers of individuals can help fill in gaps, either spatial or temporal, in a regional picture. Recent techniques, requiring less emphasis on measurement, permit the recovery of data from bony remains which are fragmented, incomplete, or cremated. Small skeletal series can contribute to each of the following aspects of a regional research design.

The Regional Burial Program

The first step in a systematic approach must be the definition of the total prehistoric burial pattern for a region. Before conclusions can be drawn about biocultural adaptation and change at various points in the prehistoric past, cultural factors which could bias the composition of skeletal samples must be understood. The systematic exclusion of certain categories of individuals from aspects of a prehistoric burial program could result in the recovery of skeletal series unrepresentative of the populations from which they were drawn. Similarly, prehistoric spatial distinctions in burial practices might lead to the recovery of skeletal series with certain categories of individuals either under- or over-represented. Paleodemographic studies are meaningful only when based on truly representative skeletal populations. Even very small skeletal series can be valuable, therefore, in clarifying the full range of burial procedures in existence for a given period in a region. One could argue, in fact, that small and fragmented series are just those which have not been generally analyzed and may represent a specifically under-represented segment of the population.

Demography

Estimates of population density, group composition and life expectancy can be generated if adequate burial information is recovered and temporal associations established for a region (Lovejoy et al. 1977; Howell 1982). Such demographic models may be based on data from both excavated and unexcavated sites. Estimates of numbers of burials for a period, mean age at death, and site density and distribution can be used in the construction of demographic models which may serve as barometers of adaptive success for prehistoric groups (Ubelaker 1974).

Analysis of Biological Variability

An important dimension of any archaeological population is variability, both within and between groups. Analysis of heritable attributes of skeletal morphology can shed light on patterns of genetic heterogeneity or homogeneity. Both metric (Howells 1972; Blakely 1976; Owsley et al. 1982), and non-metric (Buikstra 1976; Wolf 1977; Reichs 1975; 1983) skeletal and dental (Greene 1982) data have proven useful as indicators of biological relationships within and between prehistoric groups. Biological distance studies have recently been directed toward questions of migration vs. indigenous development (Wolf 1977; Reichs 1983), lineality (Lane and Sublett 1972; Buikstra 1976), geographic distribution (Sciulli and Schneider 1985), and heritability of status (Buikstra 1976; Blakely 1977; Reichs 1975). Factors such as migration and marriage patterns can significantly affect demographic interpretations. Biological relationships within and between groups can also influence disease states and the frequencies of non-specific disease indicators. For example, the presence or absence of gene flow or differential access to food sources would have affected the health environment in a region in the past. Analysis of small series can clarify the distribution of traits and their occurrence through time and space.

Health

Bony remains are our best source of information on prehistoric health environments. Skeletal lesions can indicate the impact of infectious disease and stress, either acute or chronic (Cook and Buikstra 1973; Buikstra 1977; Robbins 1977; Blakely 1977; Corruccini et al. 1982; Hummert 1983; Jantz and Owsley 1984). Similarly, dental features are good indicators of disease and nutritional stress (Perzigian 1977; Robbins 1977; Cook and Buikstra 1979; Goodman 1980; Blakely and Armelagos 1985). While specific diseases cannot always be diagnosed from dry bone, the analysis of lesions and their patterning can provide information concerning the pressures to which prehistoric peoples were subject. Patterns of movement and biomechanical stress may also be better understood through analysis of activity-induced pathology (Merbs 1983). Even very small series may provide data with regard to such conditions.

Diet

Osseous material can also aid in the determination of prehistoric subsistence patterns. Trace elements in the skeleton are proving good indicators of diet (Brown 1973; Gilbert 1977; Schoeninger 1979; Lambert et al. 1982). Additionally, the general health state of a population can be useful in demonstrating changes in subsistence activities, especially those involving a shift to maize agriculture (Robbins 1977; Sciulli 1977; Goodman et al. 1980; Blakely and Armelagos 1985). Data from only a few individuals can suggest the presence of certain dietary patterns.

Cultural Practices

Finally, specific cultural practices such as infanticide (Robbins 1975), intergroup violence (Perino 1973a; 1973b), medical treatments, patterns of trauma, tooth mutilation, or pipe smoking (Corruccini et al. 1982) can be demonstrated, often with very small burial populations.

The analysis of prehistoric cultural systems relies on total data recovery. No skeletal series should be considered too unimportant for investigation. Within the general research framework described above, even small burial populations can be valuable. While no broad statements concerning population functions will be possible and no statistically significant analysis should be undertaken with only a few individuals, small samples of recovered burials can contribute to the overall picture in a regional archaeological program. These small series, often from small sites, provide an important supplement to the better-known large samples from large sites such as Moundville (see

Powell, this volume) or Tennessee Mouse Creek and Dallas phase materials (see Boyd, this volume). The burials recovered from the Dickerson Site (31Br91) represent such a sample.

DICKERSON SITE (31Br91), BERTIE COUNTY, NORTH CAROLINA

The Dickerson skeletal material consists of eight burials recovered from a sand borrow pit. The site is located in western Bertie County, North Carolina on an ancient primary terrace of the Roanoke River. In the spring of 1983, several unmarked burials were uncovered as a result of earth moving activities. The site was examined and later excavated by personnel under the direction of a staff archaeologist from the Archaeology Branch of the state of North Carolina. Few artifacts were recovered (n=428), probably due largely to continuous disturbance of the site in the past. Those artifacts found represent the Late Archaic, and Early, Middle and Late Woodland periods. Most appear to be associated with the Late Woodland occupation. Few artifacts were found with the burials themselves. Burial #5 contained two shell beads, 1 cut marginella, and 1 columella. Three Cashie simple stamped sherds were recovered from burial #6. In all, eight burials were excavated between May and July, 1983, each thought to represent an individual interment. All burials were tightly flexed and lay in round to oval pits. At the time of excavation, no definite temporal assignment could be given the remains. It was thought most likely, however, that they are associated with the Late Woodland period, since Cashie phase ceramics (c. A.D. 800-1715; Phelps 1983:47) predominated at the site. It was hoped that skeletal analysis might clarify the temporal position of the burials. For a complete description of the site and its excavation see Oliver 1983.

Skeletal Analysis: Procedure

The remains were received in the Physical Anthropology laboratory of the Department of Sociology and Anthropology at the University of North Carolina at Charlotte in April of 1984. Their condition was poor. In addition to severe deterioration due to natural processes, the skeletons also showed evidence of recent breakage and crushing, probably due to the action of heavy earth-moving equipment. Only minimal cleaning had been accomplished since removal from the site. Both skulls and many of the post-cranial fragments remained encased in hard-packed clay (see Figure 4.1). Four burials were represented by nearly complete skeletons, one by portions of the lower limbs. The remainder consisted of fragments only. Cleaning of the material was extremely difficult due to several factors. Primary among these were the fragmented and deteriorated nature of the bones, the cement-like quality of the surrounding clay matrix, and the existence of extensive root growth throughout the bony materials. Several techniques were tested including dry sorting, dry screening, water screening, and flotation. Any cleaning with water was abandoned because it led to total deterioration of bone fragments. All burials were dry-sorted and screened. Only fragments of 1/4 inch or larger were retained.

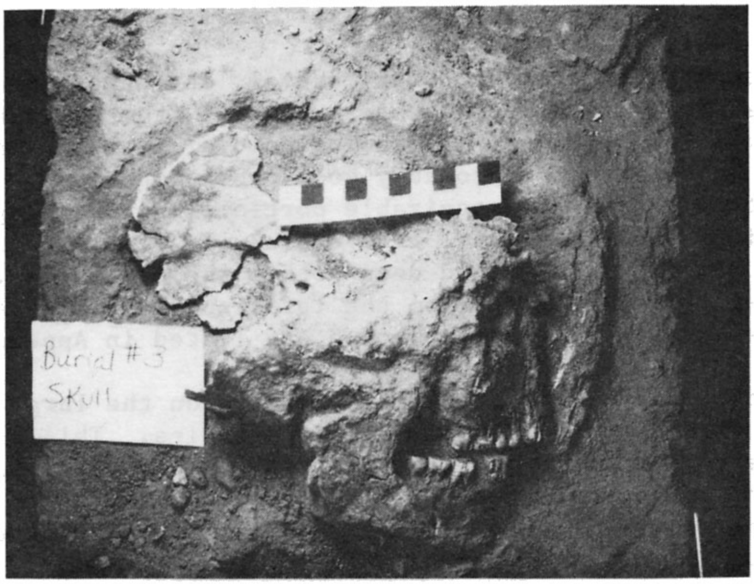

Figure 4.1. Cranium Encased in Clay Matrix.

Portions of some burials crumbled to bone meal upon attempts at removal and were left intact in dirt. Both skulls (burials #2 and #3) were photographed, measured where possible, and removed in pieces. The surrounding dirt was completely screened and samples retained. Restoration was not possible on either cranium.

After cleaning, each burial was laid out and sorted into individual bones or categories of bone fragments. Each burial was examined and recorded on skeletal inventory sheets. Observations of age, sex, pathology, dental features, discrete traits, and preservation condition were recorded. Anomalies were photographed and/or radiographed. Measurements were taken where possible. The burials were then wrapped, packaged, and returned to the Chief Archaeologist for disposition under the North Carolina Unmarked Human Burial and Unmarked Human Skeletal Remains Protection Act.

Description of Burials

Burial 1 consists of cranial, post-cranial, and dental fragments in very fragile condition. Total removal from the soil matrix was impossible. With the exception of some portions of femur and tibia, all fragments measure 2 inches or less. Recognizable portions of femur and tibia predominate, along with small portions of the vertebrae and innominate. Cranial remains include parts of the left occipital condyle area, with the hypoglossal canal and foramen magnum border intact, portions of the left petrous temporal area and numerous parietal and occipital fragments. Five molars, probable lower, are in very fragile condition. No determination of sex was possible. No measurement should be taken or pathology or trauma observed. Age is estimated at 20 to 25 years based on the absence of significant wear on either third molar. The hypoglossal canal is bridged.

Burial 2 consists of cranial, post-cranial, and dental fragments and teeth. Most analysis was done before removal from the clay matrix due to disintegration problems. Following removal from the matrix, 19 teeth were recovered in reasonably good condition along with fragments of enamel from others. Recognizable portions include fragments of femur, radius, ulna, clavicle, rib, and skull. The petrous temporal portion of the skull was found deep within the clay block. All three ear ossicles were recovered from the left inner ear. Some cranial and dental measurements were possible and are listed in Appendix A.

Sex is tentatively established as male based on the large size of the teeth as compared to other burials in the series. This could, however, be a result of the fact that this is a younger individual whose teeth show very little wear. The absence of attrition could be contributing to their overall larger appearance. The determination as male must be taken with extreme caution.

Age is estimated at approximately 14-15 years based on dental development. Apical root closure is almost, but not totally, complete on both maxillary and mandibular second molars. Enamel formation is complete but root formation is in the early stages for third molars. The right maxillary M3 was observed in position, unerupted.

No skeletal pathology or evidence of trauma could be observed. A small tympanic dihescence remains on the left tympanic plate of the temporal. The left maxillary M3 has 2 small enamel pearls on the root near the gumline.

The dental condition of this individual is poor. Large occlusal caries cavities can be seen on the right mandibular M1 and left maxillary P2. Occlusal pitting can be seen on the right mandibular M2. A moderately large neck caries cavity has developed on the buccal surface of the right maxillary M1.

Hypolastic enamel development (in the form of horizontal lines of arrested growth) are visible on the buccal surfaces of the incisors and lower left canine. This would suggest periods of nutritional deprivation or systemic stress in early childhood (Blakely and Armelagos 1985).

Burial 3 is the most complete of the series. It consists of reasonably large, though broken, portions of crania, post-crania, and dentition. Recognizable post-cranial fragments represent the humeri, right radius and ulna, left ulna, first left metacarpal, left clavicle, vertebrae, ribs, innominates, sacrum, femora, left tibia, and assorted long bone fragments. Both mastoids, parietal, occipital, sphenoid, palatine, and frontal portions of the skull were recovered along with an almost complete, though fragmented, mandible.

The sex is established as female based on the presence of moderately sized supra-orbital tori, a moderate to small nuchal crest, small mastoid processes, and a gracile post-cranial skeletal structure. The diameter of the head of femur measures 41 mm.

Age is estimated at 35-40 years based on several features. Dental attrition was advanced with exposure of dentine on incisors, canines, premolars, M1, M2, and, (minimally) M3 (Brothwell 1981, stages 4-5). Alveolar resorption appeared "considerable" (Brothwell 1981:155). The lambdoid suture appears fused and obliterated; the masto-occipital remains distinct.

The dental condition of this individual is poor. A very large occlusal-interproximal caries cavity exists in the left mandibular M1. A large interstitial neck caries cavity perforates the left mandibular P1 (see Figure 4.2). The total dentition exhibits advanced enamel attrition.

The dentition is anomalous in that it includes at least two and, possibly, more supernumerary teeth. On small bicuspid-like tooth lies between the left mandibular P2 and M1 (see Figure 4.2). This has caused crowding and may have contributed to the carious condition in this location. P2 is quite small, particularly compared to the maxillary premolars. A similar condition may have existed on the right, but breakage prevented definite determination. A peg-like supernumerary tooth, with root, protrudes from the maxilla between the left canine and P1. Here too, the condition may have existed on the right (see Figure 4.3). This condition is similar to one described by Weaver and Hancock (1984) for a burial of an adult female recovered from site 31Gs55 in Gaston County, North Carolina. This individual had fully developed supernumerary teeth present in each maxilla positioned lingual to the interstitial space between the canine and the premolar. Here too, the crowding resulted in the formation of large caries in the neighboring dentition. (The only other burial recovered from this Gaston County site shows no evidence of the condition [Reichs 1985].)

The mandible shows evidence of severe periodontal disease. No observation was possible on the maxilla. The right maxillary M3 was probably lost ante-mortem.

The left mastoid process suggests the presence of a healed inflammatory process, possible mastidis. The only observable discrete variant was the existence of both a foramen and a notch on the left supra-orbital torus. Measurements are listed in Appendix A.

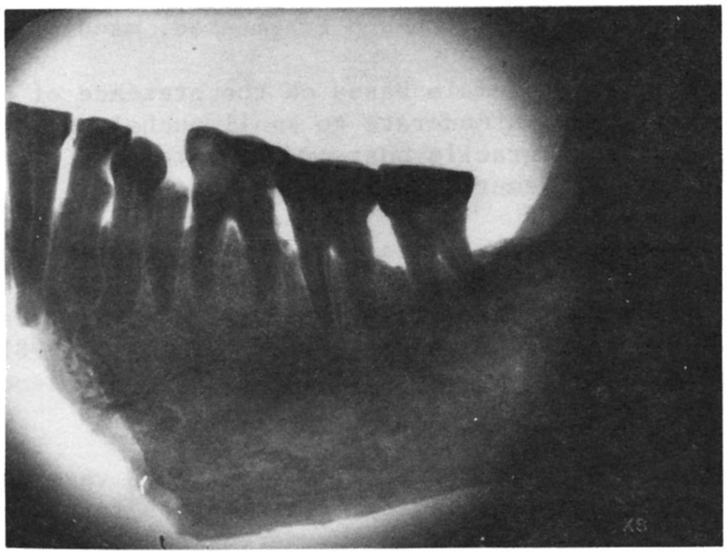

Figure 4.2. Radiograph of dentition, burial 3. Note caries in first premolar and first molar. Note also supernumerary tooth between P2 and M1.

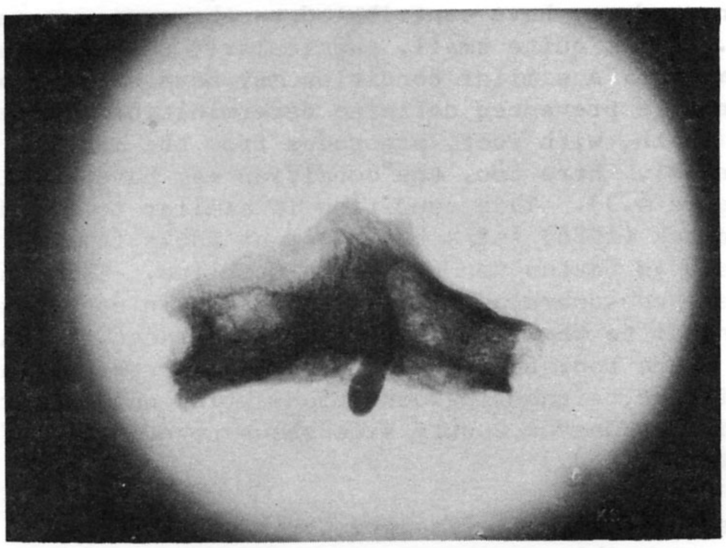

Figure 4.3. Radiograph of peg-like maxillary supernumerary tooth, Burial 3.

Burial 4 is extremely fragmentary. Recognizable portions include fragments of humeri, femora, scapulae, clavicles, innominates, tibiae, tarsals, metatarsals, and vertebrae. Cranial remains include both left and right petrous portions of the temporal bone, parietal and occipital fragments.

A tentative determination as female is based on the presence of small mastoids, a small nuchal crest, and a very gracile post-cranial skeleton. Age can be established only as adult. There is no observable pathology or trauma. There are no observable discrete traits. Measurements are listed in Appendix A.

Burial 5 consists of small fragments of crania and long bone (mostly femur). Dental fragments indicate this is an adult individual. There is full apical root closure. Cortical bone thickness also supports a diagnosis as adult.

Burial 6 was found to consist of two individuals. These were subsequently designated 6 and 6a. Burial 6 is represented by cranial, post-cranial (humerus, rib, vertebra, femur, tibia, fibula, and metatarsal), and dental fragments. The other, younger individual, 6a, is represented by two mandibular right molars (M2 and M3), and was probably included as a result of mixture due to the action of earthmoving equipment (Oliver: personal communication). Burial 6 was primary interment, therefore, with some minor redeposition of another burial during grading of the trench in which the burials were discovered.

No sex determination was possible for either individual. Age is estimated at 35-45 years for burial 6 based largely on dental wear. Burial 6a is estimated to be 15-20 years of age. M2 shows little wear. M3 appears to have been unerupted with incomplete root closure (breakage of roots complicated this observation).

Both individuals exhibit carious lesions in the dentition. Extremely large caries cavities are evident in both the premolar and molar of burial 6. Both lesions are occlusal and were probably adjacent to each other. Both teeth show advanced wear. The M2 from burial 6a shows little wear but has an occlusal pit, evidence of early caries development.

Burial 6 is characterized by an unusual discoloration pattern. The tibial and femoral shafts are marked by bands of violet tint on the external and internal margins of the subcortical bone. The discoloration areas continue longitudinally throughout the bone shaft. Each band appears quite distinct and is marked by a greater degree of density toward its center. No other burials in the series exhibit this discoloration.

The bone of the femoral shaft is somewhat dense and the medullary cavity is small. While this could be suggestive of a parathyroid disorder, (Ortner and Putschar 1981:307), no other skeletal indicators are present to support such a diagnosis. Similarly, there are no suggestions elsewhere in the skeleton of fluorosis. The localized patterning of the discoloration is not consistent with any systemic metabolic disorder or chronic exposure to toxicity. It appears more likely that the staining occurred post-mortem as a result of contact with an inorganic agent in the region of the lower extremities in the burial situation. The banding effect most likely resulted from the percolation of an inorganic agent through the less dense subcortical bone with subsequent concentration upon contact with the denser internal and external cortical bone.

In an attempt to determine the nature of the staining agent, samples of the femur were subjected to several tests. Several microgram samples of heavily stained cortical bone was placed in an Amray 1200 scanning electron microscope with an Edax 707A (energy dispersive system) capability. The apparatus utilizes X-ray emission to detect the presence of elements equal to or heavier than sodium. The sample was seen to contain primarily calcium and phosphorous with traces of silicon, aluminum, and iron. This would suggest that if the contaminating agent is of an inorganic nature, its presence is very dilute,probably less than 100 parts per million. Elements such as manganese are known to have staining properties in such minute amounts.

Several tests of solubility were done using both high and low polarity solvents to detect the presence of organic agents. The sample did not dissolve when mixed with methanol, dichloromethane, acetone, ethyl acetate (high polarity), or hexane (low polarity). No significant reactions were observed.

Next, a sample was dissolved in a weakly acidic solution of hydrochloric acid (1/20 normal) and placed in a Beckman spectrophotometer (model 25). Since most organic substances absorb ultraviolet light, it was hoped their presence in the sample could be detected in this way. The sample exhibited no significant absorption, however. Similar results were obtained when the test was run using a basic solution of sodium hydroxide.

Finally, two sensitive chemical tests for manganese were performed on a small poriton of the purple colored material. The first is a test by catalytic oxidation to permanganate in acid solution. Its stated limit of identification is 0.1 microgram manganese. The second is a test with silver ammine salts; its stated limit of identification is 0.05 microgram manganese (Feigl 1958). Both tests gave positive results.

All of these tests, along with the absence of skeletal indicators of a systemic ante-mortem disorder, suggest that the purple banding is, in all probability, the result of precipitation of an inorganic staining agent directly in contact with burial 6. This agent, in all likelihood, was a weak solution of manganese. No other evidence of pathology or trauma was observed. Measurements are listed in Appendix A.

Burial 9 consists of fragments of skull, long bone and ribs from an adult individual. No other observations were possible.

Surface finds included an isolated upper M3 marked "surface find" which most likely belongs to burial 2. It was unerupted (shows no wear or contact facet) and root formation had just begun. It comes, therefore, from an individual who was approximately 14-15 years of age. Measurements are listed in Appendix A.

DISCUSSION

The Dickerson skeletal series is composed of adolescent and adult individuals. Both males and females are probably represented. While no children were found in the burial population, this could be due to poor preservation conditions and should not be taken as indicative of prehistoric demography or burial practices. Even the adult bones in this series are extremely fragile, many reduced to little more than bone meal. Survival of the skeletal remains of young children or infants would be most improbable.

While ceramic evidence suggests a Cashie association, the Dickerson burial pattern is somewhat unusual for this phase. Cashie burials are typically ossuary deposits, containing from two to five individuals. Unlike the contemporary Colington burials from the northeast coast of North Carolina, these are seen as family, not community, secondary bundle burials (Phelps 1983:46). Primary inhumation is not unknown for the Cashie phase, however. One burial was reported at the Jordan's Landing site involving a primary, extended interment in an oval pit (Phelps 1983). According to Phelps (1983), Cashie phase burials always contain high frequencies of marginella beads, quantities ranging from 200 to 2,000. The Dickerson burials contained only two beads, one of which was marginella. Phelps (1983) sees these differences as possible indicators of rank or status. Assuming a Cashie affiliation can be established, the Dickerson series, although small, will elucidate the total range of funerary practices utilized during this phase in North Carolina. Primary interment and egalitarian treatment appear to have been the rule at this site.

Age estimates were possible for several individuals. In two cases these were based on dental development, in three cases on dental attrition. Without adequate knowledge of diet and food preparation techniques, however, the latter must be taken as tentative. Nevertheless, we have a picture of a population which includes both males and females, adolescents and adults of varying ages, all interred in similar manner. Burial was simple, involving few grave goods and primary inhumation in all cases.

Both metric and discrete trait information was collected on each burial. While insufficient numbers exist for statistical comparison, some interesting anomalies were observed which show similarities to other North Carolina prehistoric skeletal material. Burial #3 exhibits at least two and possible more supernumerary teeth. This situation is similar to that described by Weaver and Hancock (1984) for a burial recovered from Gaston County, North Carolina. While their usefulness for population comparisons is limited without more complete dental samples, and there is no particular pathological significance to supernumerary teeth, their presence in this series is of interest since the occurrence of this condition is relatively uncommon.

Several examples of pathology were observed. Of particular interest was burial #2, exhibiting enamel defects in the incisors and canine teeth. Dental hypoplasias are developmental defects which appear as transverse lines or pits, probably resulting from arrested calcium deposition in the initial phase of enamel and development (Blakely and Armelagos 1985). Such defects in the dental enamel are good indicators of ideopathic stress in both living and archaeological populations. They result from nutritional or disease disturbance during the growth period. Those appearing on the permanent dentition probably reflect episodes of disease or malnutrition between birth and seven years of age.

Several studies indicate a correlation between incidences of enamel hypoplasis in populations and dietary base. In studying the deciduous dentition, Sciulli (1977) found that a post-Hopewellian population of intensive agriculturalists from Ohio had three times the frequence of defects evident in a combined population of Glacial Kame hunter-gatherers, Adena hunter-gatherers with auxiliary horticulture, and Hopewell agriculturalists from the same region. Goodman et al. (1980) observed the permanent dentition in burials from Dickson Mounds, Illinois, comparing Late Woodland hunter-gatherers, Mississippian-Acculturated Late Woodland horticulturalists, and Middle Mississippian agriculturalists. The frequencies of enamel defects reflect the shifting dietary patterns, increasing from 45% to 60% to 80% respectively. These authors hypothesize that increasing reliance on protein deficient maize agriculture in combination with population growth may have intensified stresses from malnutrition and infectious disease. The presence of enamel hypoplasias in the dentition of burial #2 suggests that this indvidual experienced periods of nutritional deprivation or systemic stress in early childhood. Such a pattern would not be inconsistent with a cultural adaptation based on the intensive utilization of maize.

The dental condition of the Dickerson individuals is generally poor. Most of the burials which contain dental remains show evidence of caries. This, too, may suggest dietary patterns which included high carbohydrate components. The introduction of maize agriculture has been shown to be correlated with an increase in caries, abscesses, and alveolar bone destruction (Buikstra 1977; Robbins 1977). The existence of these dental conditions among the Dickerson burials, along with the presence of enamel hypoplasia in one individual, may argue for a subsistence pattern based on the growing of maize and other domesticates. This would support the hypothesis of Late Woodland affilliation as suggested by the archaeological record.

CONCLUSION

The Dickerson burial population is an example of the type of small skeletal series which might have been ignored in the past. Yet, despite its limited size and fragmentary condition, it has yielded valuable information concerning local burial practices, group composition, health, and diet. The people burying their dead at Dickerson gave equal treatment to males and females, adults and adolescents. None received elaborate treatment; each was interred with a minimum of grave goods. Ossuary reburial was not practiced, in contrast to most known Cashie phase burial practices in the same region.

The dental condition of these individuals suggests a group under some stress, very possibly subsisting on a diet high in carbohydrates. This finding is consistent with a hypothesis of Late Woodland affiliation and maize agriculture.

While the Dickerson material permits no broad comparisons or estimates of biological affinity, knowledge of this group at a particular point in time on the Carolina piedmont helps clarify our understanding of the total archaeological spectrum in this area. The Dickerson burials provide a few more bits and pieces, all of which will eventually come together to form an accurate picture of our prehistoric past.

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NOTE ON CURATION

The Dickerson skeletal materials are curated at the Archaeology Branch of the North Carolina Division of Archives and History, Raleigh, North Carolina.

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APPENDIX A
Cranial, Post Cranial and Dental Measurements

Burial #2

Cranial

Maximum Length 141 mm (?) (taken in dirt matrix)

Dental

Right Maxillary	Mesial-Distal Breadth	Buccal-Lingual Breadth
P_2	9.9 mm	12.8 mm
M_2	11.6 mm	13.1 mm
M_3	7.8 mm	10.5 mm
Left Maxillary		
P_1	11.7 mm	10.5 mm
P_2	7.5 mm	10.3 mm
M_1	9.4 mm	12.0 mm
M_2	11.3 mm	11.5 mm
Right Mandibular		
C	7.5 mm	8.0 mm
P_1	7.6 mm	--
P_2	7.4 mm	8.4 mm
M_1	--	12.0 mm
M_2	12.5 mm	10.2 mm
M_3	11.5 mm	10.0 mm

Burial #3

Post Cranial

Humerus (left)	
Transverse diameter (at level of nutrient foramen)	21 mm
Ulna (right)	
Transverse diameter (distal to olecranon process)	11 mm
A-P diameter	11 mm
Transverse diameter (midshaft)	10 mm
Clavicle (left)	
A-P diameter	11 mm
Cranial-Caudal diameter (midshaft)	10 mm
A-P diameter	11.4 mm
Cranial-Caudal diameter (distal end)	9.7 mm
Fibula (left)	
Transverse diameter (level of nutrient foramen)	10 mm
Femur (right)	
Head diameter	41 mm
A-P diameter	25 mm
Transverse diameter (distal to lesser trochanter)	28 mm
A-P diameter	26 mm
Transverse diameter (nutrient foramen level)	25 mm
Transverse diameter (at point of divergence of linea aspera in distal one third of shaft)	27 mm

Vertebrae

C_2	Height	31 mm
L_5	A-P breadth	28 mm
Sacrum	A-P breadth (body only)	28.5 mm
	Transverse breadth (body only)	48.5 mm

Appendix A (Continued)

Mandible

Height below M_1 (right)	34	mm
(left)	35	mm
Breadth of condyle	19	mm

Dental

Right Mandibular	Mesial-Distal Breadth	Buccal-Lingual Breath
C	6.6 mm	6.6 mm
M_2	9.8 mm	9.9 mm
M_3	--	9.5 mm
Left Mandibular		
C	6.5 mm	7.7 mm
P_1		8.0 mm
P_2		6.6 mm
M_1		10.1 mm
M_2	10.0 mm	10.1 mm
M_3	9.7 mm	10.8 mm
Right Maxillary		
P_1	6.2 mm	9.6 mm
M_1	8.2 mm	10.2 mm
M_2	9.4 mm	10.0 mm
Left Maxillary		
C	--	8.0 mm

Burial #4

Post Cranial

Clavicle (Right)	Anterior-Posterior Diameter	10.8 mm
	Cranial-Caudal (midshaft) Diameter	9.8 mm
	A-P diameter (distal end)	8.3 mm

Vertebrae

Height	C_2 (total)	27 mm
	C_3 (body only)	11 mm

Burial #6 (older individual)

Post Cranial

Femur	A-P diameter	26 mm
	Transverse	28 mm
	Circumference (just distal to nutrient foramen)	8.5 mm

Burial #6a (younger individual)

Dental

M_2	Mesial-Distal	11.2 mm
	Buccal-Lingual	10.2 mm
M_3	Mesial-Distal	11.5 mm
	Buccal-Lingual	9.6 mm

Surface Tooth

	Mesial-Distal Breadth	10.0 mm
	Buccal-Lingual Breadth	12.1 mm

5

FOOD PREPARATION AND CONSUMPTION PRACTICES AS POSSIBLE CONTRIBUTORS TO POROTIC HYPEROSTOSIS IN SOUTHEASTERN U.S. LATE WOODLAND INDIANS

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Porotic hyperostosis associated with iron deficiency is frequently attributed to diets high in maize. Following the suggestion of Ortner and Putschar (1981) to consider ethnohistoric data in specific etiologies, ethnohistories of the southeastern United States, particularly piedmont Carolina, are examined for alternate causes of iron deficiency for late Woodland Indians. Combining dried flesh and plant foods with other foods in cooking pots to boil for extended periods would negatively affect various nutrients essential to dietary iron absorption. The result of these food preparation procedures could have been chronic iron deficiency, especially dangerous in nursing mothers and weaning infants. A late Woodland skeletal sample evidencing a high frequency of porotic hyperostosis in the virtual absence of archaeological evidence for maize is used to examine the likelihood of a food preparation etiology.

INTRODUCTION

Literature on prehistoric skeletal lesions has frequently focused on porotic hyperostosis. This class of lesions has been established by Angel (1967) as a symptom of iron deficiency anemia experienced by an individual. It is evidenced by widening of the diploic space between the tables of the cranium, "hair on end" appearance on x-ray, and pitting primarily on the outer surface of the parietal and occipital bones and sometimes the orbital roof (cribra orbitalia) (Steinbock 1976; Ortner and Putschar 1981). Macadam (1985) suggests that the adult lesions are the incompletely remodeled manifestations of childhood, not adult, episodes of anemia. These anemias, however,may reflect a general condition within a population with skeletal manifestation only in the infant and juvenile stages of life.

In cases of anemia, the bone changes are thought to occur as a response to pressure on the bone by expanding red marrow compensating for tissue hypoxia. This pressure eventually produces an enlarged marrow-containing space (diploe) and erosion of adjacent compact bone. Bone of children has more plasticity than adult bone and, therefore, is more likely to alter due to this pressure. Longitudinal studies of anemia note changes occurring in infancy and no indication of bone changes after puberty even with the onset of adult anemia. Although remodeling does occur, clinical studies have shown that reparative changes in the skull, spine, and pelvis are slower than elsewhere and lesions of porotic hyperostosis can persist well into adulthood (Macadam 1985).

Often, chronic anemia has been attributed to maize consumption based on analogy to medical criteria for modern populations and addressing primarily southwestern United States prehistoric skeletal material (El Najjar 1976). This argument has been generally accepted by paleopathologists even though the consideration of multiple causal factors has been urged (Armelagos, Goodman and Jacobs 1978); until recently (Goodman and Armelagos 1985) many have used this etiology in studies of porotic hyperostosis in other geographic and environmental locations without considering possible alternative etiologies (Lallo & Rose 1979, Parham & Scott 1980).

The appropriateness of analogy can be based on three grounds: cultural continuity, comparability of environment, and similarity of cultural form (Sharer and Ashmore 1979). In the Southwest, archaeological and ethnohistorical data have provided valid analogies based on these grounds. Maize has been demonstrated to have been a major food source prehistorically and historically in the adult diet and used as weaning food (Kunitz and Euler 1972; Hawley, Pijoan, and Elkin 1943; Palkovich 1980). In the East and particularly the Southeast, valid analogs to the Southwestern studies based on the three grounds cannot be established. Neither has there been a determination of what constitutes major reliance on maize, except by the circular argument based on porotic hyperostosis lesions. Reliance on maize agriculture is assumed based on unquantified amounts of maize residue not related to specific population sizes and/or population subsistence requirements (Parham and Scott 1980; Blakely 1980). Cowgill (1975) warns about the fallacy of continued use of the many assumptions about population size, growth, and subsistence pressures of sedentary food producing prehistoric populations.

Nor has maize as a major component of weaning food been established in the East. Unfortunately, little is known about weaning practices especially in the Southeast. Among the early historic Huron, considered an agricultural group, Trigger (1969:65) relates that children were weaned on meat masticated by the mother and only on maize gruel when the mother died prior to weaning.

Therefore, without efforts to verify analogies using the three criteria for validity and without establishing some means of quantifying maize use in relation to population size, analogy for other geographic areas to the Southwestern studies is a misapplication.

Ortner and Putschar (1981) suggest that variables such as ethnohistoric data on diet are important in specific diagnosis and etiology of porotic hyperostosis. Using ethnohistoric sources, I will offer some alternative causes for porotic hyperostosis as it is found in Late Woodland skeletal material from the Piedmont of North Carolina. Both Swanton (1946) and Griffin (1952) indicate that the people visited by John Lawson in 1701 were cultural descendants of people occupying the Piedmont region of North Carolina in Late Woodland times.

DATA

The human skeletal material for this study comes from the Late Woodland Donnaha site, in Yadkin County, North Carolina, dated by radiocarbon to A.D. 1000-1500. The living environment contained rich and diverse flora and fauna including riverine resources (Woodall 1984). Prior to disturbance by timbering and farming in the 18th century, the Donnaha area probably supported a climax oak-hickory forest. The understory contained small numbers of other tree species among them sassafras, persimmon, and black cherry. Fifteen genera of herbs known to have been used by the Indians have also been identified in this area (Woodall 1984).

There has been no specific study of the botanical remains from Donnaha. However, remains of hickory nuts, black walnuts, persimmon seeds, and one complete charred maize cob have been recognized (Woodall 1984). Recovered faunal remains indicate access to a wide variety of animals. Early stages of analysis have identified three major environmental zones available for subsistence exploitation: the uplands, floodplain, and the Yadkin River. The most important fauna appear to be white-tailed deer and turkey. Also found were raccoon, gray squirrel, beaver, otter, gray fox, elk, skunk, and the domestic dog. Several species of fish, turtle, frog, snakes, and birds occur. Freshwater mussel remains (genus **Elliptio**) are abundant. This site may represent a year round location or a seasonal site, or some combination of activities (Woodall 1984).

Skeletal remains of fifty-two individuals have been recovered as of 1985. Of these, twenty-eight have cranial remains complete enough for analysis of cranial lesions. Six are sub-adults, seven are adult males, seven are adult females, and eight are adults of undetermined sex. Sexing of adults is based on criteria as described in Bass (1981) using the pelvis, characteristics of the skull, and measurements of maximum diameter of the femoral head as in Bass (1981) and Krogman (1962). Sub-adult remains were not complete enough for accurate sexing. Of the twenty-eight individuals with cranial remains, twenty-two show some degree of cranial lesions of porotic hyperostosis including cribra orbitalia. This is 38% of the total sample and 79% of the sample that includes cranial remains.

This frequency (79%) is extremely high when compared to 51.5% for Dickson Mounds Middle Mississippian phase (A.D. 1200-1300; Lallo and Rose 1979), 24% at the late Mississippian Toqua site in eastern Tennessee (Parham and Scott 1980), and 7.1% at the Etowah Village site (A.D. 1000-early historic; Blakely 1980).

The time period of Donnaha, A.D. 1000-1500, is consistent with the known occurrence of horticulture and maize agriculture in the Southeast. Therefore, porotic hyperostosis at Donnaha has been atrributed to maize agriculture (Weaver 1984). However, in piedmont North Carolina little archaeological evidence of maize has been found (Claggett and Cable 1982, Ward 1983). What evidence does occur in the region consists of only a few corn cobs and minimal examples of cob impressed ceramics.

A chemical technique found useful in dietary reconstruction is that of testing for carbon isotope ratios from bone collagen. Maize is the only known example of a tropical cultigen of significance in the prehistoric Piedmont. Plants from hot and dry environments fix carbon through the C4 pathway; these C4 plants discriminate less than C3-fixing plants against the heavier carbon isotopes during photosynthesis. Thus, the ratios of C13/C12 will vary in these two categories of plants. These differences will be retained in the tissues of animals that eat the plants (van der Merwe 1982).

Using this technique, van der Merwe and Vogel (1978) have established the introduction of maize into eastern North America in the later Woodland, c. A.D. 400-1000. Among other uses of C13/C12 analysis have been identifying weaning age and composition of weaning diet, possible socioeconomic differences as reflected in dietary differences, and probable seasonal movement of groups (Buikstra and Cook 1980).

Because this test is not amenable to bone treated with preservatives only a small sub-sample of untreated skeletal material from Donnaha has been tested for C13/C12 ratios by van der Merwe (1979). Results indicate a C4 dietary contribution in various degrees (Table 5.1). The high upper values for C4 taken from ribs, 43% in a two year old and 59% in an adult male over twenty five years old who exhibits extensive premortem tooth loss, are consistent with age or health status of people most likely to have been fed a diet containing maize or disproportionate amounts of maize (van der Merwe 1979; El Najjar, Lozoff, and Ryan 1975). Since none of the other individuals from Donnaha were tested, the implications of results in this sub-sample can only be extended to the whole sample with caution.

The meaning of the C13/C12 test results are not well established in any event. Van der Merwe (1979) believes the figures represent percentage of total dietary intake while others like Buikstra and Cook (1980) and Bumsted et al. (1983) suggest the figures represent percentage of the carbon component of the diet. It is also possible that other factors may contribute to C13 ratios (Lazenby and McCormack 1985).

Table 5.1. Donnaha Sub-Sample C13/C12 Ratio Results. (Percentages of C4 plants are subject to an error of ± 5% on the basis of individual metabolic variation.)

Burial	Age	Sex	of 13C%	% C4
34-144	2	M	-15.3	approx. 43
36-19	12	?	-17.3	approx. 29
34-56	25+	M	-13.1	approx. 59
40-12	16	F	-16.9	approx. 32
39-5	30-35	?	-16.1	approx. 38
34-143	14-20	M	-17.8	approx. 26

ADDITIONAL ETIOLOGIES

If the archaeological data do not directly support maize as a major dietary factor in the area, what other factors might have contributed to iron deficiency anemia and led to porotic hyperostosis?

One cause would be hemolytic conditions which are usually hereditary disorders affecting hemoglobin production. Hemolytic disorders are not considered to have been an important factor in prehistoric anemias in the New World (El Najjar and Robertson 1976).

Another consideration might be parasitic infestation resulting in chronic blood loss. There is little reason to expect a common human parasite, hookworm, to have existed in the Piedmont environment of the Late Woodland time period (Phillips and Weaver 1979). However, it should be noted that Rathbun, Sexton and Michie (1980) found evidence of the presence of hookworm in a coastal South Carolina shell midden site dating between 1700 and 1300 B.C.

Another group of parasites, ascarids, may have been present. Its presence in parts of the New World is well documented (Helvy et al. 1979; Fry & Moore 1969; Stiger 1977; Samuels 1965) and some species are believed to have accompanied the migrations of people from Asia into the New World (Reinhard 1982). Densmore (1974), Vogel (1973), and Moore (1979) all argue that the dietary presence of **Chenopodium** acts as a control on these parasites. **Chenopodium** contains an anti-helminthic compound, ascaridole, that controls the impact of parasitic infestation by purging the body of some gravid female pinworms (Reinhard 1982). Domesticated chenopodia have been identified in prehistoric sites in the Ozarks (Fritz 1984), Kentucky, lower Illinois Valley, Tennessee (Yarnell 1983), and Alabama (Smith 1984). Even though ethnohistoric accounts cite some species of **Chenopodium** in the diet of historic piedmont Indians (Lawson 1934), sufficient ethnobotanical studies have not yet been conducted in the area to determine the presence of wild or cultivated chenopods in order to evaluate their anti-helminthic potential (Gardner 1985).

ETHNOHISTORIC DATA

Having considered the etiologies with which iron deficiency anemia and porotic hyperostosis are usually associated, what other model might be appropriate for Donnaha? Early ethnohistories of the region are sparse, but one account, that of John Lawson published in 1709, may provide the earliest clue. Lawson describes aboriginal foods and the methods of processing and preparation. Lawson's accounts are supported by other regional accounts by Hariot (1553), Catesby (1731), Strachey (1849), and Beverley (1705). Swanton's classic work on the Southeast (1946) comments on the universality of cooking methods in the region. Linton (1944) discusses the formal elements of the basic Woodland pot and its suitability over other forms for boiling and suggests from this that boiling was the primary means of food preparation prehistorically.

As mentioned earlier, the floral and faunal resources of the Donnaha Woodland environment were abundant. Lawson verifies that this environment prevailed into the early 18th century. He also noted that the Indians of the area exploited the abundant wild resources as well as agricultural resources (Lawson 1934).

Boiling is the most frequently described method of food preparation mentioned by Lawson (1934). He describes the preparation of medleys, which are combinations or mixtures of ingredients (Murray et al. 1933), and loblollys, which were thick porridges, broths, or soups boiled in a pot, often with meat and vegetables combined (Murray et al. 1933). His observations are supported by an earlier writer, Thomas Hariot, describing the coastal Carolina and Virginia Indians (de Bry 1966) as well as by Bartram (1958), Catesby, Beverley, Adair (Swanton 1946), and Strachey (1849).

Another form of food processing frequently mentioned is barbecuing or roasting. According to the Oxford English Dictionary (Murray et al. 1933), in the early 18th century barbecue most commonly meant to dry or smoke meat over or by a fire. Roasting is also associated with a drying and preserving process. Other foods, including fish, molluscs, and fruit were included in one of the above mentioned loblollys or medleys after barbecuing or roasting (Lawson 1934).

Some meats were boiled whole without being first gutted or skinned. Fetal deer, a delicacy, was prepared in this way (Lawson 1934). Molluscs were boiled for five or six hours to make them tender (Lawson 1934). Overcooking, especially of meat, is commented upon by Lawson (1934), Adair, Du Pratz, Swanton (Swanton 1946), and Timberlake (Williams 1927). Cooking pots are described as boiling continuously from morning until night with people eating at will any time of day or night. Foods were added to the pot as needed (Lawson 1934).

Also of note is the inclusion of plant foods in this boiling process. Various nuts, including acorns (Lawson 1934; de Bry 1966), and vegetables, including maize (Lawson 1934; de Bry 1966; Strachey 1849; Bartram 1958; Swanton 1946) are cited. We know maize was being grown in the Piedmont by the time Lawson wrote his account of the Indians (Lawson 1934). It must be remembered, however, that every mention of corn by Lawson and his contemporaries must not be considered to mean maize. The word corn was being used by the English of the 18th century to mean any grain and grain to mean any seed (Murray et al. 1933).

An interesting addition to Lawson's ethnohistoric accounts of food preparation is historic recollections by Cherokee women, some born in the 1880's, of traditional cooking methods and recipes. These are important as indicators of continuity of Indian traditions over time and also for the possible widespread use of the Piedmont cooking methods discussed here over the Southeast. A Cherokee recipe for barbecued meat describes turning skewered strips of meat over a fire until they stop dripping and then hanging the strips until future use. At that time the meat can be stewed or pounded until soft and cooked as soup (Ulmer and Beck 1951). Fish are also barbecued and then boiled in this manner (Ulmer and Beck 1951). Instructions for preparing specified meats are the same as above. Exceptions occur for some meats such as raccoon and opossum where boiling first and then roasting until brown is recommended. Corn mush was usually included as an accompaniment to these dishes (Ulmer and Bech 1951).

DISCUSSION

What emerges from the ethnohistory is a picture of a widespread practice of food preparation by drying with heat followed by long, continuous boiling. In modern processes of drying and smoking meat nearly 50% of the water may be removed (Sinclair & Hollingsworth 1969). Substantial amounts of water-soluble minerals, among them iron, may be lost from meat during this process. Flesh iron, or heme, is more readily absorbed by the body than plant, or non-heme, iron and is not affected by phytates. Excessive exposure to heat, as in extended boiling, reduced the nutritive value of proteins due to the destruction of several essential amino acids, particularly lysine. An essential amino acid is one that is not synthesized by the body but must be acquired through dietary means (Guyton 1976). Deficiency in an essential amino acid inhibits the absorbability of iron (Beutler 1980). Thus, preserving flesh by heat drying and processing by boiling can seriously reduce the quality of nutrients due to differential destruction of some amino acids and amounts of heme iron available through loss of significant amounts of water soluble iron salts when drying.

Mixes of proteins and carbohydrates can be damaged because of the combination of free amino groups in lysine and acids of carbohydrate groups that form complexes that resist digestive enzymes. Proteins damaged in this matter become indigestible (Sinclair and Hollingsworth 1969). The ethnohistoric data show that such mixes were commonplace in the Piedmont.

Plants retain the fewest nutrients, including iron, when cooked in large quantities of water at high temperatures (Wing and Brown 1979). If the broth is then consumed as it would be in a loblolly or medley these nutrients are still available (Sinclair and Hollingsworth 1969). However, some vitamins, among them ascorbic acid, are heat and oxygen sensitive (Sinclair & Hollingsworth 1969). It has been established that ascorbic acid is essential to non-heme (vegetable) iron absorption (Shah 1981). Ascorbic acid is oxidized when exposed to air and heat accelerates its destruction (Arlin 1977). Foods most likely containing large amounts of this vitamin, for instance fruits, are described as being dry heat processed, or barbecued, or sun/air dried before later being added to the cooking pots (Lawson 1934). Storage, even for only a day or two, results in loss of ascorbic acid from plants. Wilting, bruising, and exposure of cut surfaces to air also decrease ascorbic acid content (Sinclair and Hollingsworth 1969). Therefore, it is likely that little of this vitamin, which is essential to non-heme iron absorption, remained in the foods to be ingested. Add to ascorbic acid loss by exposure to air and heat drying and cooking the loss of heme iron salts while barbecuing flesh and we see the probability of substantial nutrient losses during cooking. If heme-iron salts, ascorbic acid, and amino acids were lost or broken down through the drying and smoking processes while the remaining protein was compromised by combination with carbohydrates and the remaining ascorbic acid was subjected to further breakdown due to high temperatures for extended cooking periods, all food values would be greatly diminished. Even multiple and plentiful food resources would suffer nutritionally under these conditions.

We know that maize was being grown in the Piedmont when Lawson traveled through. If it was being grown in even small amounts in the Late Woodland, as appears likely, and was included in the diet periodically it would have had further harmful impact on the nutritional adequacy of the diet.

Maize is low in iron and contains phytates which bind non-heme iron in the intestine preventing its absorption into the blood (El Najjar and Robertson 1976). If maize, with its iron binding properties, were added to the boiling pot or were eaten at the same time in another form this binding action could further reduce the amount of available dietary iron, especially during the summer and fall when green maize was available.

The two unusually high C13/C12 ratio frequencies in the Donnaha subsample, a two year old and an older adult with extensive premortem dentition loss, could indicate a general and extensive use of maize in the diet. As mentioned earlier, however, this interpretation is not consistent with the archaeological findings for the area or the ethnohistory. Alternately, these ratios may indicate that certain individuals, weanlings and older or infirm individuals, were subject to higher dietary amounts of maize. The seasonality of Donnaha has not been established and it may have been a seasonal agricultural site. Catesby (Swanton 1946:259) and Swanton (1946:256) note that the Indians of the area did not grow large excesses of maize for winter storage. Therefore, the high C13/C12 ratios could reflect a seasonal diet. in addition, the two individuals could represent a special health class, weanling and old and/or ill, who would be more likely to receive a special diet. If maize were substituted for, or added in seasonally large quantities to, an already iron deficient diet the C13/C12 ratios and childhood porotic hyperostosis would increase. Therefore, we see that the isotopic ratios do not necessarily have to reflect a general year round maize diet as previously suggested (Weaver 1984).

Acorns, which contain tannin are known to have been a significant part of the early historic diet (Lawson 1934). Tannin will bind with dietary protein making protein indigestible (Singleton and Kratzer 1973). Acorns contain phytates and exhibit the same iron binding properties as maize (Lynch et al. 1984). Even though the Indians took measures to remove much of the tannin because of the bitter taste associated, it is possible that sufficient amounts of phytates remained in this fall and winter food source to provide alternate seasonal iron binding effects in the diet making phytates a year-round negative dietary factor.

SUMMARY

I have looked briefly at factors which could have resulted in iron deficiency in pre-Columbian populations in Piedmont North Carolina. They include hemolytic disorders which, based on modern Indian studies, are not thought to have been an important factor prehistorically; parasitic infestations, the effects of which can not be determined with present data; primary maize subsistence, which archaeologically and ethnohistorically seems not to have been the case; and finally food preparation involving drying, over-cooking, and, probably, consumption of this over-processed food with maize and/or acorns with their iron binding properties. The high observed frequency of porotic hyperostosis in the Donnaha skeletal sample seems most likely to have been primarily due to food preparation techniques, perhaps combined with the other presently considered etiologies.

The suggestion of a cultural contributor to iron deficiency anemia does not eliminate other possible causes, nor argue for a single cause. Rather it widens the range of contributors to consider and demonstrates the interactions of multiple factors. Identification, through appropriate analogy, of additional factors which may have contributed to the observed iron deficiency anemia is important, due to the apparent lack of analogies in modern medical literature appropriate for use with prehistoric southeastern Woodland populations. All maize analogies as well as many others made by osteologists and paleopathologists need to be reevaluated critically. Existing and/or new analogies must be carefully and constantly examined for their applicability.

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NOTE ON CURATION

Donnaha site skeletal material is at the Physical Anthropology Laboratory, Wake Forest University, Winston-Salem, North Carolina. It is available to any qualified investigator.

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6

BIOSOCIAL MALADAPTATION AMONG PREHISTORIC MAIZE AGRICULTURALISTS: THE ROLE OF TRACE ELEMENTS

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ABSTRACT

Maize was the subsistence staple of late prehistoric Amerind populations in the Southeast. Nutritional problems associated with heavy reliance on maize are discussed, with particular reference to lack of trace elements such as zinc and manganese.

INTRODUCTION

Maize agriculture holds a position of prominence in studies of prehistoric Amerind populations. In North, Central, and South America archaeologists look intently for the earliest site in which maize appears. Distinctive cultural time categories reflect the presence or absence of agriculture. For example, the Midwest Archaic period is considered a pre-agricultural temporal period (despite limited evidence of horticultural practice; Chomko and Crawford 1978), while Woodland, Hopewell, Adena, and Middle Mississippi are indicative of a temporal range in which agriculture influenced the life way of the people. By the same token, one does not think of a Middle Mississippian population as having pre-, or even non-, agricultural subsistence base. Apparent in the emphasis placed upon maize, agriculture is viewed as a progressive cultural revolution in prehistoric America. With agriculture came a proliferation of sedentary villages of various sizes and degrees of cultural and social complexity, ceramic forms and their functional specializations, population explosions with resultant burial mounds and cemeteries. Investigators of these phenomena have tended to focus on the positive features of societies adapting from hunting and gathering to agricultural subsistence patterns, features like a more reliable food source, development of permanent villages, interpopulation trade and such. We impart our own value system of what is good, beneficial, or progressive to the prehistoric populations.

Let us examine the biosocial contribution of agriculture from another direction. Could the adaptation to an agricultural way of life subject the people to factors detrimental to them, both in terms of their culture and their physical health? In the course of excavating prehistoric village sites, archaeologists frequently encounter stratigraphic evidence of palisades or fortifications surrounding the village, a cultural feature not encountered in Archaic shell mound communities in Kentucky, Tennessee, and Alabama. Hence, safety of self, property, and food supplies was a problem with which the people had to contend. The physical anthropologist also becomes mindful of the importance of the peoples' safety when he or she observes the results of violent injuries in the skeletal remains from the site.

The outline of house patterns in the site stratigraphy supplies evidence of changes wrought in the physical environment by the presence of the sedentary population. At the Powers Phase site in Missouri, Price (personal communication; see also Price & Griffin 1979) found that 110 trees were used to construct the frame of one house. When the quantity of grass needed to thatch such a house was calculated, Price found that approximately 11 acres of grass would be required to waterproof the house adequately. Extensive cutting of trees and grass can contribute to soil erosion, loss of soil, fertility, and/or loss of wild animal habitat, all of which may have the effect of degrading food resources.

Sedentary people, with close living quarters and inattention to human waste disposal, were also targets for disease vectors as demographic analyses of burial populations often indicate. Given more time we could extend the list of disadvantageous features of an agricultural life way, but I want to focus on a particularly important maladaptive consequence of sedentary peoples relying on maize as a major food source.

Archaeologists examine the impact of environments on past cultures, letting the physical anthropologist investigate the environmental effects on prehistoric human biology, or more accurately, skeletal biology. Having examined a number of skeletal populations from the Archaic, Woodland, Mississippian, and protohistoric time periods, I find some revealing trends with regard to the general state of health of people from different temporal periods. Lallo and Rose (1979) observed a similar trend in two prehistoric populations from Illinois.

Mature adults from the Archaic, Woodland, and Mississippian periods invariably exhibit a moderate to pronounced degree of arthritis. Some individuals from each time period also suffered fractured and/or broken bones that subsequently healed. Beyond these general similarities, the health of the people in the different time periods differs greatly. Skeletal pathology is present in Archaic and early Woodland populations, but it is distributed less widely and is in a lower frequency than in Middle Mississippian, Late Woodland, and Fort Ancient people. For example, Neumann (1967) found osteoarthritis in most of the Modoc (Archaic period, Illinois) people with dental pathology and fractures ranking second, and third, respectively, in terms of pathological frequencies. Snow (1948) reports a high incidence of osteoarthritis and osteoporosis symmetrica among the mature Indian Knollers (Archaic period, Kentucky) and dental pathology is notable in a related Kentucky population (Robbins 1977). A Louisiana Poverty Point (Archaic period, Louisiana) group I am currently studying reveals similar types of dysfunctional pathologies.

The dentition of Archaic people rarely contains deep caries although abscesses of alveolar bone are present. The teeth may be worn down several millimeters into the pulp cavity, whose composition is much softer than enamel or dentine, yet caries are absent. The abscesses seem to be associated with extreme dental attrition, in most individuals, which causes nerve necrosis and subsequent apical infection (Robbins 1977). Tooth loss in mature adults, however, need not represent dental pathology. It may result from alveolar bone resorption with age whereby the retreating bone in and around the root socket fails to provide adequate support for the tooth.

TRACE ELEMENTS AND PATHOLOGIES AMONG MAIZE FARMERS

After examining numerous skeletal series, I have finally come to expect a high incidence of dental and bone pathology in adults, adolescents, and children who are maize agriculturalists in contrast to the condition of the Archaic period series cited above. For a long time when studying such a series, I thought the particular group was unique in its frequency and range of pathology. It has taken some time, and the examination of populations from different geographic regions, to accumulate the evidence that there is a noticeable increase in dysfunctional pathology among prehistoric maize farmers. A striking example is the skeletal series from the Buckner site, a Fort Ancient site in the Inner Blue Grass region of Kentucky. In a series of 78 individuals of all ages, every individual showed evidence for some bone or tooth pathology (Robbins 1977:17-20). No disease vectors readily explain these phenomena. If the populations were localized in one geographic region, the germ theory might have credence. However, the populations are scattered from Oklahoma to Mississippi and eastward through Kentucky and Ohio to Virginia.

Working on the assumption that the disease pathogens were not causing the pathologies, I directed the investigation to the nutritional aspects of the maize plants and to the soils in which the plants were grown. Because soils provide a medium for plant growth, and because soils potentially contain elements necessary for health and well being, they are an important correlate in human nutrition. Duffield (1970) used soil characteristics to explain the differential distribution of prehistoric village farmers in Texas and Oklahoma. Information on deficiency diseases in humans is not readily available although it is a part of a rapidly expanding area of research. There is, however, a fairly large body of literature on deficiency diseases in plants and animals and some of information is applicable to man (see Gilbert 1977, 1985; Wing & Brown 1979).

We know that soils deficient in iron negatively influence normal bone development in children (Abbott **et al** 1957) and that soils deficient in fluorine contribute to osteoporosis (Leone **et al** 1960 cited in Hegsted 1967: 105-113). We also know that soils must contain a sufficient, but not an excessive, amount of numerous trace minerals such as copper, zinc, manganese, and others for normal skeletal growth and general good health in animals and in humans. Two of the trace minerals listed above play a vitally important role in maize agriculture--zinc and manganese.

The human body requires specific minute quantities of zinc and manganese for the correct operation of a number of processes ranging from protein formation by RNA to hardening of enamel in teeth, and including normal development and maintenance of bone and soft tissue (Gilbert 1977:92). Soils throughout much of the North American continent are deficient in zinc for plant uptake (Berger 1962). Maize, or corn, planted in those soils will be zinc deficient also, especially in the kernels. Whatever zinc is available to the plant remains in the stem and leaves and is not passed on into the kernel. Humans or animals who eat the maize receive a deficient amount of zinc in their diet which can interfere with normal metabolic processes (Pories and Strain 1971: 73-95). As important as the mere presence of a sufficient quantity of zinc in the body is its ability to "tie-up" or bind other vital trace minerals, thus preventing their normal functions. Zinc interferes with the normal activities of manganese and of copper in this precise way. Zinc-deficient maize plants inhibit the transport of manganese to the kernel of the plant and into the maize diet of man. Zinc does this through the "binding" process. Utilization of zinc by the body is further complicated by the binding effect of phytate, a chemical found mainly in husks of cereal crops, including maize (Gilbert 1977:90; Wing & Brown 1979:42).

Small amounts of manganese are essential for several mechanisms of the body, with several enzymes depending on manganese for their proper functioning. If an insufficient amount of manganese is available for normal body processes, marked skeletal malformations occur. For example, Neher and his co-workers (1956) at Purdue University found that a manganese-deficient diet caused abnormal skeletal development of cortical and cancelleous bone of pigs. There is a striking resemblance between the pathology of the manganese-deficient pig bones and that found in prehistoric maize agriculturalists.

The skeletal series from the Buckner site in Kentucky was examined for trace mineral deficiencies (Robbins 1977). The population was selected because, as noted above, nearly every member exhibited some degree of dental and/or bone pathology. Ages of the people ranged from newborn to around fifty-five years. The skeletal remains of each individual were tested with the neutron activation analytic technique so there would be no destruction of the bones. The results of the tests were somewhat unexpected. Excessive manganese levels were localized in the diseased sections of bone shafts, with minimal to normal (3 to 10 ppm) levels being found in nondiseased proximal and distal ends of the bones. If joint areas were diseased, manganese levels there were excessively high. There was a positive correlation between the amount of manganese and the degree of pathology; that is, as the manganese level increased so did the degree of pathological destruction. Zinc levels, on the other hand, were distinctly subminimal in the bones and teeth, being lowest or absent in the most serious carious tooth areas. The information provided by the test results does not answer all of the questions, but it provides clues to many of them. Skeletal pathologies can occur from mineral deficiencies, but mineral excesses also cause pathologies. Thus, a zinc-deficient maize diet upset a metabolic equilibrium between copper and manganese, binding some manganese and localizing other amounts in bone-producing cells. The localized manganese upset the normal processes of formation and maintenance of bone. It is still unclear why excessive manganese tends to localize in the long bones of man and animals before appearing in other parts of the skeleton.

Populations from other geographic regions have not been tested yet for comparative information. We need to check further, in other agricultural skeletal series who exhibit the same kinds of disease processes, to see whether or not the same trace minerals are deficient. We must also extend our investigations to the analysis of non-agricultural skeletal series from tested regions, seeking their characteristic patterns of trace mineral levels. For late prehistoric populations, or segments of populations, in the eastern U.S., this could be a significant factor. Other complications are introduced at the stage of laboratory analysis. The conditions under which skeletal remains were buried and the choice of bones for analysis may influence the amount of different trace elements in a sample (Gilbert 1985: 350-51). Trace elements may also be differentially metabolized by males and females. The role of trace elements in the health of prehistoric populations will be a complex one to elucidate. Availability and absorption of trace elements is influenced by not only growing conditions and staple foods, but by combinations of food and food preparation practices. In the case of maize, some of these interactions have been examined, such as the soaking of maize in alkali solutions and combining with beans to provide adequate niacin and amino acids (Wing & Brown 1979:59,66). Other interactions are only now being examined (see Hancock, this volume). For example, the presence of animal protein in the diet apparently enhances absorption of zinc (Wing and Brown 1979:43).

NOTE ON CURATION

The Buckner skeletal series is stored at the Department of Anthropology, University of Kentucky, Louisville.

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7

A COMPARISON OF MOUSE CREEK PHASE TO DALLAS AND MIDDLE CUMBERLAND CULTURE SKELETAL REMAINS

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The Late Mississippian Mouse Creek Phase skeletal series from the Ledford Island, Rymer, and Mouse Creek sites are compared to those of the Toqua (Dallas), and Averbuch (Middle Cumberland) sites in terms of demography, stature, paleopathology, and craniometrics. Mouse Creek Phase demographic stress is very low in comparison to that of the Toqua and Averbuch populations. Much overlap in stature means is noted; however, the above-average Averbuch female and below-average Ledford Island female stature means represent exceptions. Higher frequencies of porotic hyperostosis and cribra orbitalia at Toqua, compared to the other two groups, are related to possible differential maize utilization across the three populations. A similar result in the periostitis frequency comparison is explained in terms of settlement patterning differences between the sites. The cranial comparison indicates no close genetic association of Mouse Creek Phase and Averbuch individuals. Based on these results, in combination with available archaeological data, the author strongly questions the Mouse Creek-Middle Cumberland connection proposed by Lewis and Kneberg.

INTRODUCTION

In this paper, I examine, from a biological perspective, the skeletal remains from three Mouse Creek Phase sites (Ledford Island, Rymer, and Mouse Creek) in southeast Tennessee. Using the interrelated dimensions of demography, stature, paleopathology, and craniometrics, I compare this skeletal series to other Late Mississippian Tennessee skeletal populations from the Toqua and Averbuch sites. This is done in order to assess the biological relationships between the Mouse Creek Phase and the Dallas and Middle Cumberland cultures, represented by the Toqua and Averbuch skeletal samples, respectively. While these samples may not be representative of the entire Dallas and Middle Cumberland populations, they are the largest and most complete skeletal series available for these cultures. These skeletons have been extensively described by Parham (1982) and Berryman (1981, 1984a, 1984b).

The Mouse Creek Phase

The Mouse Creek Phase represents a Late Mississippian complex in eastern Tennessee. It was originally defined by Lewis and Kneberg (1941) as a "Focus" on the basis of their Works Progress Administration-associated investigations in the Chickamauga Basin of southeastern Tennessee in the late 1930s. It was later redefined as a "Phase" by Faulkner (1972). Lewis and Kneberg (1941:7), on the basis of ethnohistorical inferences, proposed a relatively late and brief time span for the Phase--between A.D. 1540 and 1714. A recently obtained radiocarbon age of 450 +/- 50 years (A.D. 1500 [A 3342]) with a corresponding calibrated date range (Damon et al. 1974) of A.D. 1420-1470 (Peters 1984) indicates a similar, although somewhat earlier, time period.

Three of the four originally excavated Mouse Creek Phase sites, all located near the confluence of North and South Mouse Creeks with the Hiwassee River (Figure 7.1), are the "type" sites for the Phase: Ledford Island (40BY13), Rymer (40BY11), and Mouse Creek (40MN3). The skeletal material from these three sites is utilized in the following analysis. A fourth Mouse Creek Phase skeletal series from the site of Ocoee is not included in this study due to poor preservation and small sample size. Limited descriptions of these Mouse Creek Phase skeletal populations have been compiled by Lewis and Kneberg (1946, 1955), Lewis (1943) and Kneberg (1952), as well as Berryman (1975, 1980); however, no thorough examination of the skeletal remains recovered from the Mouse Creek Phase sites has been conducted. Thus, this study represents the first attempt to document the heretofore unknown biological variability of this skeletal series.

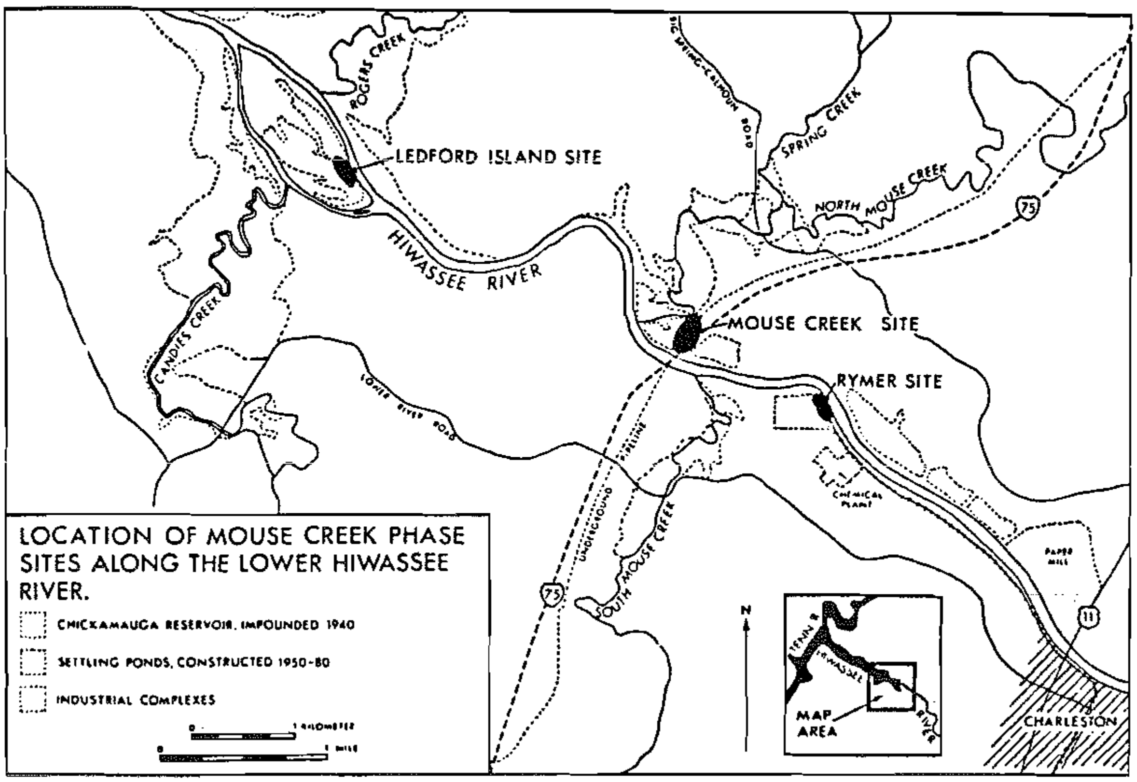

Figure 7.1. Location of the Mouse Creek Phase Sites Along the Lower Hiwassee River.

Because of the restricted distribution of the Mouse Creek Phase sites mainly along the Hiwassee River, Lewis and Kneberg (1941) differentiate the Phase from the more prominent Dallas manifestations. The Mouse Creek culture is seen as consisting of small enclaves of people living contemporaneously with, but peripheral to, the larger Dallas populations. Lewis and Kneberg (1941) note significant variability in the two cultures in trait lists of the following four archaeological categories: community plan, architecture, mortuary pattern, and ceramic industry. Based on these supposed differences, Lewis and Kneberg (1941, 1946; Lewis 1943; Kneberg 1952) hypothesize that the Mouse Creek Phase individuals represent a distinct, intrusive ethnic group--the Yuchi--having origins in the Middle Cumberland culture in Middle Tennessee. While a multivariate analysis of selected crania from Mouse Creek Phase, Dallas, and Middle Cumberland cultures by Berryman (1975, 1980) generally supports this Middle Cumberland connection, other findings are less congruent. For example, Mason (1963:550-551) notes the closer association of Mouse Creek with the Dallas culture as a result of her archaeological comparison of an Alabama Yuchi site with Mouse Creek. Also, a preliminary analysis of Mouse Creek Phase archaeological and social dimensions by Peters (1984) suggests the original differences in Mouse Creek and Dallas outlined by Lewis and Kneberg are not as distinct as once thought.

MATERIALS AND METHODS

The Skeletal Data Base

The Mouse Creek Phase sample consists of 771 individuals: Ledford Island--462 skeletons, Rymer--170 skeletons, and Mouse Creek--139 skeletons. Preservation of the remains is quite variable; however, the majority of the individuals are on the average to poor end of the preservation spectrum. The comparative data set includes 887 individuals from Averbuch and 439 individuals from Toqua.

Aging and Sexing Techniques

Although all of the Mouse Creek Phase specimens had been previously aged and sexed by Lewis and Kneberg, their reliance, at times, on unsound aging criteria such as cranial suture closure necessitated a reanalysis of the skeletons. Subadult age estimates are derived from dental eruption and calcification sequences and long bone growth, while adult ages are based primarily on pubic symphysis morphology, osteoarthritis, and dental attrition and loss. Sex estimations are based on visual observation of morphological features of the innominate and cranium. Sexing criteria are not applied to subadults (below 15 years). See Boyd (1984) for further aging and sexing details, including references.

Demographic Methodology

The demographic methodology utilized in this analysis follows the life table approach outlined by Acsadi and Nemeskeri (1970) and is based on a population's age distribution at death. In order to use this approach, however, numerous population-specific, demographic preconditions, such as knowledge of the completeness of the sample, archaeological associations of the sample, and the length of time the sample represents, must be met. In addition, assumptions that the sample represents the population, is reflective of one generational cohort, and is stationary in terms of birth and death rates must also be made. Finally, no **net** in or out migration is assumed to have occurred. Overall, these preconditions and assumptions are met for the Mouse Creek Phase samples (Boyd 1984).

Table 7.1 presents abridged life table values based on the combined sexes of the Ledford Island Individuals. The variables include x (the age category), Dx (the number dying in each category), dx (the percent dying in each category), lx (the percent surviving in each category), qx (the probability of dying in each category), Lx (the total number of years lived in each category), Tx (the total number of years lived after each category), and ex (life expectancy). Because the Rymer and Mouse Creek site demographic results are generally very similar to those of the larger sample from Ledford Island (Boyd 1984), only the

Table 7.1. Abridged Life Table Values Calculated Using the Age Distribution of the Ledford Island Individuals (Combined Sex).

x	Dx	dx	lx	qx	Lx	Tx	ex
0-1	77.78	17.21	100.00	.172	86.23	2247.03	22.47
1-4	47.08	10.42	82.79	.126	333.36	2160.80	26.10
5-9	33.78	7.47	72.37	.103	343.17	1827.44	25.25
10-14	16.38	3.62	64.90	.056	315.45	1484.27	22.87
15-19	8.22	1.82	61.28	.030	301.85	1168.82	19.07
20-24	45.89	10.15	59.46	.171	271.92	866.97	14.58
25-29	56.00	12.39	49.31	.251	215.57	595.05	12.07
30-34	43.65	9.66	36.92	.262	160.45	379.48	10.28
35-39	53.73	11.89	27.26	.436	106.57	219.03	8.03
40-44	24.01	5.31	15.37	.345	63.57	112.46	7.32
45-49	24.01	5.31	10.06	.528	37.02	48.89	4.86
50+	21.48	4.75	4.75	1.000	11.87	11.87	2.50
Total	452.01	100.00	-	-	2247.03	-	-

Ledford Island data are presented here. Similar abridged life table data from Toqua and Averbuch, obtained from Parham (1982) and Berryman (1981), respectively, are presented in Tables 7.2 and 7.3. While a slight difference exists in the Averbuch aging categories compared to the other two populations (for example, a 0-1.5 age category as opposed to 0-1), this discrepancy does not affect the general relationships between the demographic curves. Proportional values are obtained by distributing individuals with unknown age over all of the age categories.

Stature Analysis

Stature estimates of skeletons from the Mouse Creek Phase sites are compared by an Analysis of Variance regression procedure which determines the relationship between one dependent Y variable (stature) and independent X variables (site). A Duncan's Multiple range test is employed to analyze the main effect means of a group of observations (stature estimates) and separates these observations into distinct groups based on the classification variable(s) used (in this instance, site; Ray 1982:151). Both procedures are accomplished with the PROC:GLM analysis of SAS (Ray 1982:139-199). The pooled Mouse Creek Phase long bone length data are then compared in similar analyses to those from Toqua and Averbuch (see Parham 1982 and Berryman 1981, respectively). Only the femur is used in the stature comparison. The stature analysis is performed on males and females separately, and only adults older than 20 are included in the study.

Pathological Comparison

Porotic hyperostosis is a general descriptive term for osteoporotic lesions occurring mainly on the cranial vault and eye orbits (Angel 1966, 1967), while cribra orbitalia is a more specific term referring to "bilateral pitting of the orbital portion of the frontal bone" (Steinbock 1976:213). In the New World, both disease manifestations are linked to nutritional deficiencies, especially those of iron. These deficiencies, in turn, are often related to prolific maize consumption by New World prehistoric groups (El-Najjar et al. 1975, 1976). Not only is maize naturally low in iron, but it also contains phytic acid which binds to available body iron to prevent its absorption and use. Zimmerman and Kelley (1982:75) note the higher prevalence of iron-deficiency anemia in young children (particularly of weaning age) and adults regularly experiencing blood loss (young females). Because the specific relationship between porotic hyperostosis and cribra orbitalia is unclear (Ortner and Putschar (1981) note that they can occur independently), their frequencies are tabulated and compared across Toqua (Parham 1982), Averbuch (Berryman 1984b) and the Mouse Creek Phase separately.

Periostitis is a non-specific infectious inflammation commonly attacking the periosteum of long bones (Steinbock 1976:60), especially tibiae. In terms of disease etiology, periostitis cannot generally be attributed to one particular disease process (Ortner and Putschar

Table 7.2. Abridged Life Table Values Calculated Using the Age Distribution of the Toqua Individuals (Combined Sex) (from Parham 1982:39).

x	Dx	dx	lx	qx	Lx	Tx	ex
0-1	99.00	22.55	100.00	.226	81.96	1611.96	16.12
1-5	57.00	12.98	77.45	.168	305.06	1530.00	19.75
5-10	37.00	8.43	64.47	.131	301.28	1224.94	19.00
10-15	24.00	5.47	56.04	.098	266.53	923.66	16.48
15-20	41.00	9.34	50.57	.185	229.50	657.13	12.99
20-25	61.00	13.90	41.23	.337	171.40	427.63	10.37
25-30	35.00	7.97	27.33	.292	116.73	256.23	9.38
30-35	36.00	8.20	19.36	.424	76.30	139.50	7.21
35-40	26.00	5.92	11.16	.530	41.00	63.20	5.66
40-45	15.00	3.42	5.24	.653	17.65	22.20	4.24
45+	8.00	1.82	1.82	1.000	4.55	4.55	2.50
Total	439.0	100.00	-	-	1611.96	-	-

Table 7.3. Abridged Life Table Values Calculated Using the Age Distribution of the Averbuch Individuals (Combined Sex) (from Berryman 1981:57).

x	Dx	dx	lx	qx	Lx	Tx	ex
0-1.5	276.22	22.43	100.00	.224	82.06	1661.22	16.61
1.5-5.5	238.51	19.36	77.57	.250	287.78	1579.16	20.36
5.5-10.5	61.30	4.98	58.21	.086	278.60	1291.38	22.18
10.5-15.5	28.93	2.35	53.23	.044	260.28	1012.78	19.03
15.5-20	89.92	7.30	50.88	.143	212.54	752.50	14.79
20-25	176.75	14.35	43.58	.329	182.03	539.96	12.39
25-30	109.10	8.86	29.23	.303	124.00	357.93	12.25
30-35	76.14	6.18	20.37	.303	86.40	233.93	11.48
35-40	55.90	4.54	14.19	.320	59.60	147.53	10.40
40-45	35.01	2.84	9.65	.294	41.15	87.93	9.11
45-50	35.01	2.84	6.81	.417	26.95	46.78	6.87
50-55	24.47	1.99	3.97	.501	14.88	19.83	4.99
55-60	24.47	1.99	1.98	1.005	4.95	4.95	2.50
Total	1231.73	100.00	-	-	1661.22	-	-

1981). Not only do several different disease processes result in periostitis manifestations, traumatic injuries to the skeleton are correlated with it as well (Ortner and Putschar 1981). Frequencies and percentages of tibial and femoral periosteal reactions are tabulated for the Mouse Creek Phase sites and compared to those from Toqua (Parham 1982) and Averbuch (Berryman 1984b).

Craniometric Analysis

Finally, due to poor preservation, only 43 Mouse Creek Phase crania could be analyzed for eight selected cranial measurements. Further, because of extensive incidences of cranial deformation, these measurements are restricted to regions of the splanchnocranium. The measurements utilized are: Minimum Frontal Breadth (MFB) (Hrdlicka 1952), Orbital Height (OBH) and Orbital Breadth (OBB) (Howells 1973:175), Nasal Height (NLH) and Nasal Breadth (NLB) (Howells 1973:175-6), External Alveolar Breadth (EAB) (Hrdlicka 1952; Bass 1971:70), Mandibular Symphysis Height (MSH) and Height of Ascending Ramus (HAR) (Bass 1971:72). Comparative data from Toqua and Averbuch are obtained from Parham (1982) and Berryman (1984b), respectively. Measurements from all of the sites had been taken using the same criteria with only one exception: Height of Ascending Ramus. Standardization was achieved by remeasuring this attribute for the Averbuch series following Bass (1971).

A Multiple Analysis of Variance (MANOVA) procedure, involving the interaction between several dependent variables with the independent variables (Ray 1982:175), is first used to examine the relationship between the individual Mouse Creek Phase sites and the cranial means data. Canonical discriminant analyses are then used to compare the male and female crania from the combined Mouse Creek Phase sites to those from Averbuch and Toqua. The Canonical Discriminant analysis, accomplished via the SAS CAN. DISC program (Ray 1982:369-380), is a type of discriminant analysis very much like principal-components. It is used in the craniometric study primarily as a data reduction technique, reducing the total set of information into **canonical variables:** "Linear combinations of the quantitative variables which summarize between-class variation" (Ray 1982:369). The correlations of these variables are then tested for significance using primarily an F approximation. Results of these relationships are plotted on graphs to aid in interpretation. While this analysis is similar to Berryman's (1975) in its use of cranial measurements and multivariate statistics in the determination of Mouse Creek Phase affiliations, important differences exist. These relate to the sites and skeletal samples used (the large samples from Toqua and Averbuch were not yet available) as well as the cranial measurements employed in the discriminant analysis.

RESULTS

Demography

Mortality curve comparisons for the combined sexes of the Ledford Island, Toqua, and Averbuch site individuals are presented in Figure 7.2. Throughout the curve, Ledford Island generally shows a lower (healthier) mortality rate in the subadult and early adult years (with the only exception being the lower Averbuch rate in the 10.5–15.5 age ranges) and a higher mortality in the older adult (30+) years. Toqua and Averbuch mortality curves both reflect much greater stress in the subadult range, particularly in the first highly stressed 0–1 (or 0–1.5) age category. However, in the next cagtegory (1–5 or 1.5–5.5), Averbuch mortality still remains quite high, while Toqua mortality begins a rapid descent. The late teen years (15–20) represent the time period of the greatest difference between the two sites, with Toqua teenagers experiencing a much greater mortality in comparison with Averbuch. Otherwise, the mortality curves of the two sites are remarkably similar. No pronounced differences are noted in the separate sex comparisons of the three groups (Boyd 1984:111–112); however, the Toqua males do show a slightly higher mortality rate in the late teen category.

Figure 7.3 represents a comparison of the survivorship curves for the three sites (combined sexes). Once again, the considerably better health status of the Ledford Island population is dramatically reflected throughout the curve. Averbuch survivorship is slightly higher than at Toqua (the only exception being in the 10–15 or 10.5–15.5 age range); however, there is an overall similarity between the two survivorship curves. The same general patterns are seen in the individual male and female survivorship curve comparisons (Boyd 1984:115–116).

Comparisons of probability of dying curves (combined sexes) (Figure 7.4) also reflect a pattern of less stress for Ledford Islanders. Averbuch's elevated mortality pattern in the 1.5–5.5 age range is reflected in the relatively high probability of dying value for that category. The Averbuch curve compares favorably with that of Toqua in the adult years, with the exception of the older adult (30+) categories. In these age categories, Toqua probability of death ascends rather abruptly. However, much of the difference in the two curves is a function of the necessary truncation of the Averbuch curve at 45 years to promote comparability of samples. Although some slight sex differences are noted in regard to this statistic, none are pronounced (Boyd 1984:118–119).

As is illustrated in Figure 7.5, the life expectancy at birth value of 22.47 years for the Ledford Island (combined sexes) individuals contrasts with the similar statistics of 16.12 and 16.61 years for Toqua and Averbuch, respectively. These figures dramatically indicate the higher stress conditions to which the Averbuch and Toqua populations are subjected. Ledford Island life expectancy values

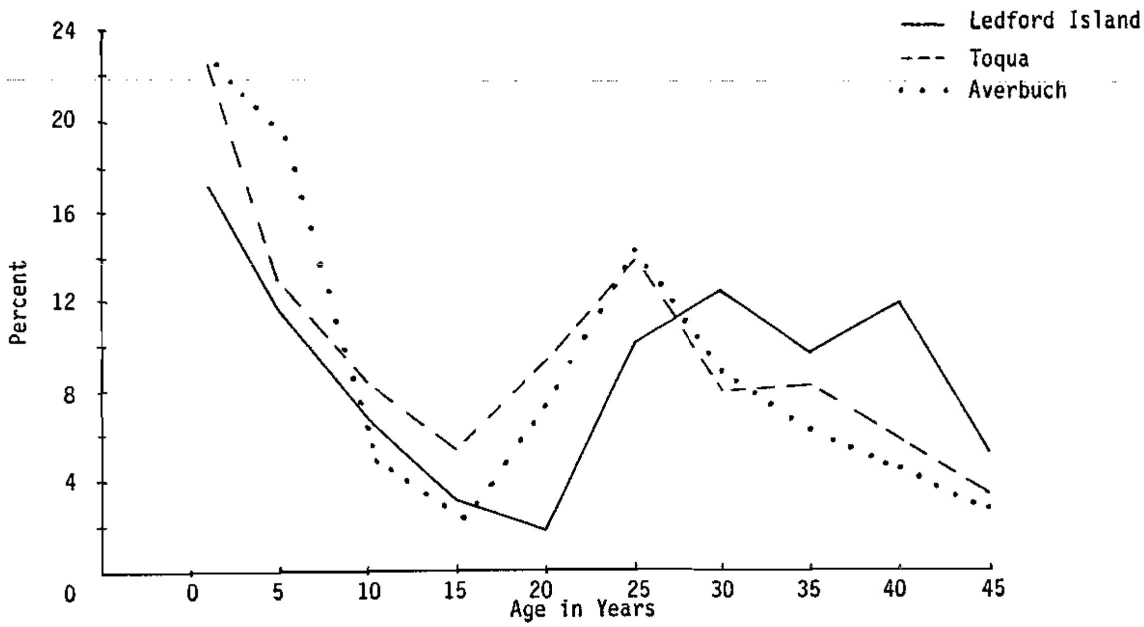

Figure 7.2. Mortality Curve Comparisons for the Ledford Island, Toqua, and Averbuch Populations (Combined Sex).

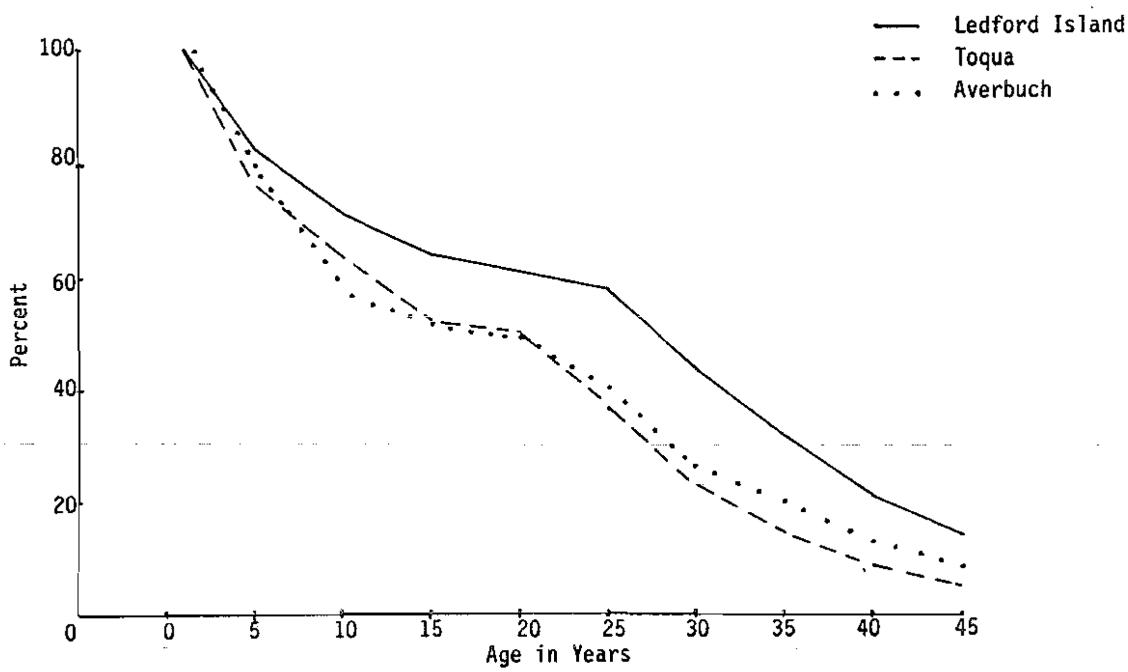

Figure 7.3. Survivorship Curve Comparisons for the Ledford Island, Toqua, and Averbuch Populations (Combined Sex).

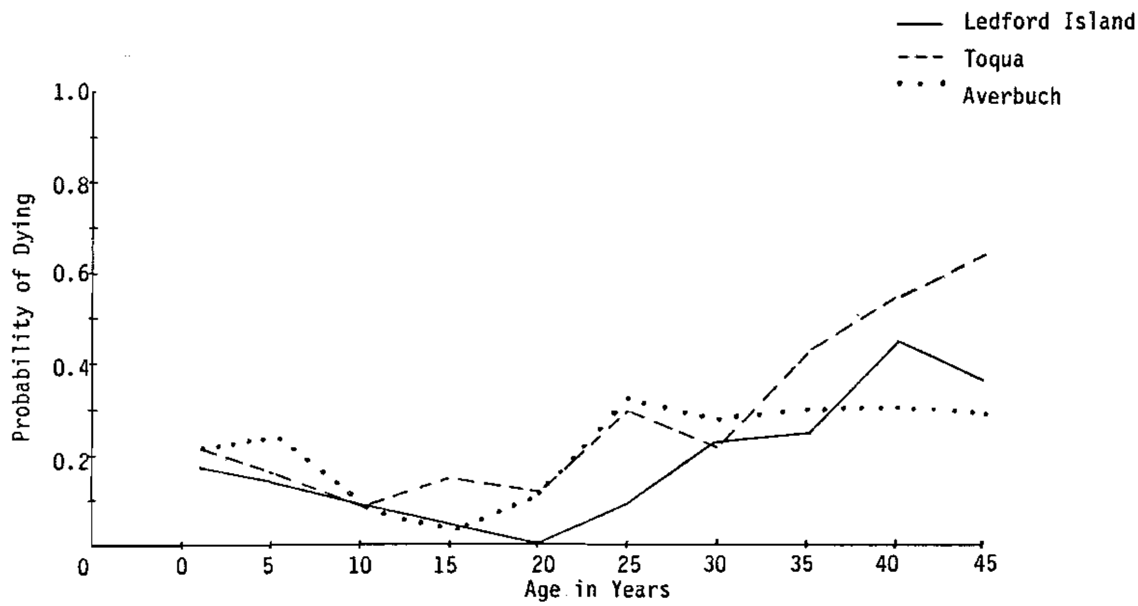

Figure 7.4. Probability of Dying Curve Comparisons for the Ledford Island, Toqua, and Averbuch Populations (Combined Sex).

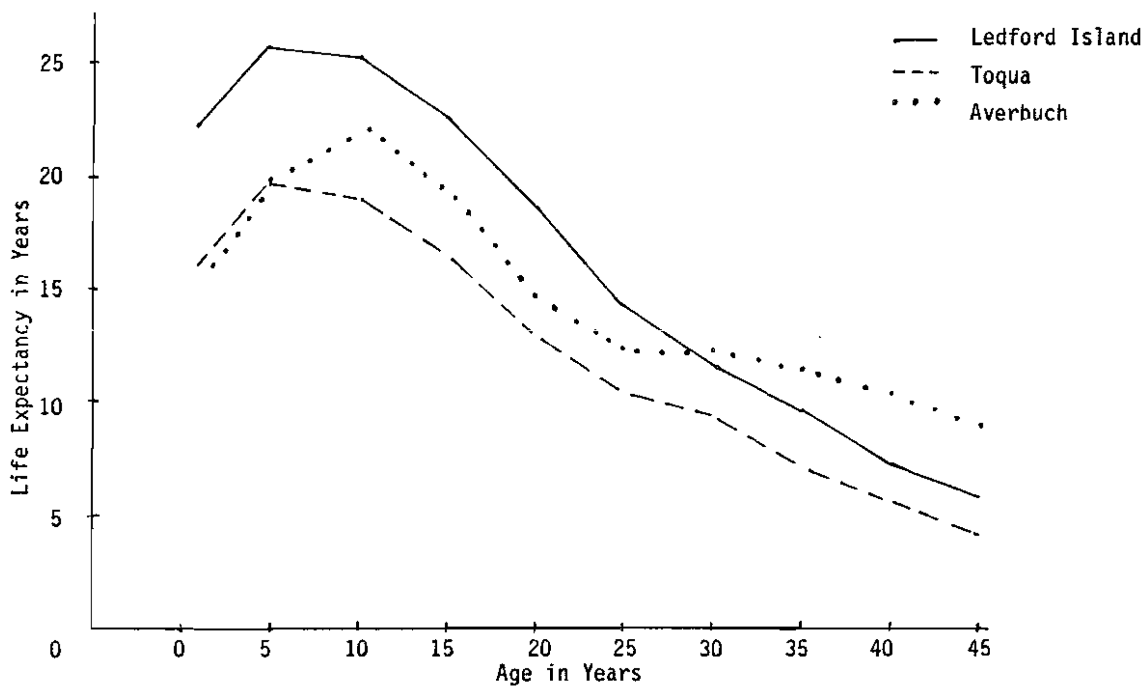

Figure 7.5. Life Expectancy Curve Comparisons for the Ledford Island, Toqua, and Averbuch Populations (Combined Sex).

continue to exceed those from the other two sites throughout most of the curve until Averbuch values supersede them in the late adult years (probably also a result of the truncation and subsequent compression of data here). Toqua life expectancy exhibits the lowest slope throughout the curve comparison. The same general pattern is noted in the separate sex curve comparison as well (Boyd 1984:122-123).

Stature

Table 7.4 presents maximum femur mean lengths (in mm) for Mouse Creek Phase, Averbuch, and Toqua males and females, as well as several other archaeological populations. The Mouse Creek Phase males from all three sites fall within the range of variation noted for the other archaeological populations (although on the upper, higher end of the stature scale). The Ledford island females, however, exhibit a rather low mean stature estimate. Conversely, Averbuch males show one of the highest stature means of any Amerindian skeletal series (Berryman 1981:143).

Because an analysis of variance procedure indicates no differences between the three Mouse Creek Phase sites in terms of their stature estimates (Boyd 1984:132), these values are pooled in the comparison with Toqua and Averbuch. Sexual variation in relation to the stature measurements is standardized by setting the mean for the femur variable equal to zero via the SAS PROC:STANDARD procedure (Ray 1982:493). The analysis of variance between the comparative stature

Table 7.4. A Comparison of Stature Estimates Across Several Archaeological Populations.*

	Male				Female			
	Femur Mean		Stature		Femur Mean		Stature	
Population	cm	n	cm	in	cm	n	cm	in
Arnold	42.80	14	164.59	64.80	42.90	2	160.06	63.02
Arikara	44.68	164	168.63	66.39	41.50	159	156.61	61.65
Averbuch	44.81	105	168.91	66.50	42.30	73	156.20	61.50
Brown	43.52	6	166.14	65.41	41.57	3	154.54	60.84
Dallas	–	117	168.38	66.29	–	94	157.89	62.16
Ganier	44.06	6	167.30	65.87	41.80	4	157.35	61.95
Indian Knoll	43.71	263	166.68	65.62	41.27	192	156.04	61.43
Ledford Island	44.38	39	168.00	66.14	40.82	41	152.83	60.17
Mouse Creek	44.72	8	168.73	66.43	41.24	9	153.79	60.55
Rymer	44.63	21	168.52	66.35	41.56	15	154.52	60.83
Toqua	44.30	43	167.60	65.98	41.50	37	156.50	61.61

*Modified from Berryman (1981); Arnold and Ganier = Ward (1972), Arikara = Bass et al. (1971), Averbuch = Berryman (1981), Brown = Boyd et al. (1983), Dallas = Hatch and Willey (1974), Indian Knoll = Snow (1948), Toqua = Parham (1982).

samples denotes a significant difference in the relationship of femur lengths and the samples (Table 7.5). This sample-specific stature differential is also reflected in the Duncan's Multiple Range test (Table 7.6), wherein the source of this variability is revealed. Once again, sexual variation is held constant. The test shows much overlap in stature means for the Averbuch males, Toqua males and females, and Mouse Creek Phase males. However, the Averbuch female and Mouse Creek Phase female femur means remain isolated and distinct. This most probably reflects the substantially higher Averbuch female and lower Ledford Island female stature mean estimates noted previously in Table 7.4.

Table 7.5. Analysis of Variance for Femur Lengths for Both Sexes for Toqua, Averbuch, and the Combined Mouse Creek Phase Sites (n = 391).*

Source	DF	Sum of Squares	F Value	P F
Model	5	6449.88	4.05	.0015
Error	385	122539.41		
Corrected Total	390	128989.29		
Type I SS				
Site	5	6449.88	4.05	.0015
Type III SS				
Site	5	6449.88	4.05	.0015

*R-Square = .050003

Table 7.6. Duncan's Multiple Range Test of Femur Lengths Between Toqua, Averbuch, and the Comined Mouse Creek Phase Sites (Sexes Combined).

Bone	Site/Sex	Standardized Mean	n	Grouping*
Femur	Averbuch F	6.3771	73	A
Femur	Averbuch M	1.9710	105	A/B
Femur	Toqua M	3.0132	43	B/C
Femur	Toqua F	1.7185	37	B/C
Femur	Mouse Creek M	1.1381	68	B/C
Femur	Mouse Creek F	6.1837	65	C

*Means with the same letter are not significantly different.

Paleopathology

Table 7.7 compares frequencies and percentages of both calvarial porotic hyperostosis and cribra orbitalia across Toqua (Parham 1982:106-7), Averbuch (Berryman 1984b), and Mouse Creek Phase site subadults below 10 years. Toqua individuals exhibit the highest percentages of both disease states. Averbuch individuals with calvarial porotic hyperostosis and cribra orbitalia outnumber all of the Mouse Creek Phase individuals with the corresponding disease state. However, it should be noted that sample sizes of these disease states from the Mouse Creek Phase sites are small.

Table 7.8 compares frequencies and percentages of periosteal reactions for both femora and tibiae across Toqua (Parham 1982:122), Averbuch (Berryman 1984b), and the Mouse Creek Phase sites (combined sex and age).

Table 7.7. Comparison of Frequencies and Percentages of Calvarial Porotic Hyperostosis and Cribra Orbitalia Across Toqua, Averbuch, and the Mouse Creek Phase Site Subadults (Below 10 Years).

	Calvarial P. H.			Cribra Orbitalia		
Population	n	N	%	n	N	%
Toqua	74	86	86.05	55	71	77.46
Averbuch	58	121	47.93	41	93	44.09
Ledford Island	5	54	9.26	17	68	25.00
Rymer	5	28	17.86	4	28	14.29
Mouse Creek	5	20	25.00	8	21	38.10
Mouse Creek Phase Total	15	102	14.71	29	117	24.79

Table 7.8. Comparison of Frequencies and Percentages of Tibial and Femoral Periosteal Reactions for Toqua, Averbuch, and the Mouse Creek Phase Sites.

	Tibia			Femur		
Population	n	N	%	n	N	%
Toqua	164	371	44.2	89	394	22.6
Averbuch	221	1060	20.8	68	1138	6.0
Mouse Creek	0	9	0.0	1	17	5.9
Rymer	9	26	24.6	7	36	19.4
Ledford Island	15	75	20.0	2	80	2.5
Mouse Creek Phase Total	24	110	34.8	10	133	7.5

Once again, the Toqua site individuals exhibit the highest prevalence of periosteal infection for both the tibiae and femora. Thereafter, the pattern becomes less clear. Averbuch individuals show a higher incidence of periostitis compared to all of the Mouse Creek Phase site individuals except those of Rymer. Individuals from this site show significantly higher periostitis percentages compared to the other Mouse Creek Phase skeletons. The proportionately higher amount of fractures per total individuals at Rymer compared to Ledford Island and Mouse Creek (Boyd 1984) perhaps accounts for the observed greater incidences of periostitis at Rymer.

Multivariate Craniometric Comparison

Before the comparative cranial analysis can be conducted, the relationship among the crania from Ledford Island, Rymer, and Mouse Creek must be investigated. This is done by means of a Multiple Analysis of Variance (MANOVA) examining the relationship between the eight measurements and the three Mouse Creek Phase sites. Any major differences found among crania from the three sites will prevent these cranial samples from being combined in the comparison with Toqua and Averbuch. The Wilks' Lambda **F** approximation of 2.32 (Probability F = .0022) indicates significant differences at the .05 level in the cranial measurements from the three Mouse Creek Phase sites. However, when the small Mouse Creek site cranial sample (female n=2; male n=4) is deleted from the combined sample, the MANOVA Wilks' Lambda **F** approximation of 1.73 (Probability F = 0.1340) indicates **no** significant differences at the .05 level between the Rymer and Ledford Island crania. It is these crania, then, which are utilized in the combined site comparison with Toqua and Averbuch. The canonical analysis is conducted for male and female crania separately (with sexual variation standardized).

Males. Mahalanobis distances between each of the three samples utilized (Ledford Island/Rymer=1BY; Averbuch=8DV; and Toqua=9MR) are found in Table 7.9 along with estimation of the significance of these values (Probability >Mahalanobis). The rather large Mahalanobis cranial distance of 2.1903 between Mouse Creek Phase and Averbuch males is also reflected in the significant Probability >Mahalanobis statistic (utilizing the .05 level of significance). The Wilks' Lambda value of 4.02 indicates significant differences in the overall site/cranial measurement relationship. At the .05 level, **both** canonical components are significantly responsible for the observed differences, accounting for approximately 100% of the total variance. The CAN1 Total Canonical Structure (accounting for 76.81% of the total variation) shows relatively high loadings on upper facial breadth-associated measurements (Minimum Frontal Breadth, Orbital and Nasal Breadth). A high **negative** loading occurs on the lower facial External Alveolar Breadth measurement. Conversely, Orbital Height loads highly on CAN2 (accounting for 23.19% of the total variation), with Nasal Breadth exhibiting a rather high negative loading. These results are illustrated in Figure 7.6. The first canonical variate (CAN1) primarily separates out Averbuch and Mouse Creek Phase male crania on

Table 7.9. Canonical Discriminant Analysis Results for the Combined Mouse Creek Phase, Toqua, and Averbuch Males.

MAHALANOBIS DISTANCES BETWEEN CLASSES

SITE*	1BY	8DV	9MR
1BY		2.1903	1.7371
8DV	2.1903		1.8945
9MR	1.7371	1.8945	

CANONICAL DISCRIMINANT ANALYSIS

PROB > MAHALANOBIS DISTANCE

SITE*	1BY	8DV	9MR
1BY		0.000000	0.200297
8DV	0.000000		0.430679
9MR	0.200297	0.430679	

CANONICAL CORRELATIONS AND TESTS OF H0: THE CANONICAL CORRELATION IN THE CURRENT ROW AND ALL THAT FOLLOW ARE ZERO

	CANONICAL CORRELATION	ADJUSTED CAN CORR	APPROX STD ERROR	VARIANCE RATIO	CANONICAL R-SQUARED	LIKELIHOOD RATIO	F STATISTIC	NUM DF	DEN DF	PROB>F
1	0.701411121	0.630290192	0.064004811	0.9684	0.491977561	0.393126317	4.0156	16	108	0.0000
2	0.475566481	0.360509350	0.097494238	0.2923	0.226163478	0.773836522	2.2963	7	55	0.0398

MULTIVARIATE TEST STATISTICS AND F APPROXIMATIONS

STATISTIC	VALUE	F	NUM DF	DEN DF	PROB>F
Wilks' Lambda	0.3931263	4.015587	16	108	0.0000062242
Pillai's Trace	0.718141	3.851609	16	110	0.0000114081
Hotelling-Lawley Trace	1.26068	4.176001	16	106	.00000349128
Roy's Greatest Root	0.968417	6.657867	8	55	.00000463782

Note: F Statistic for Roy's Greatest Root is an Upper Bound
F Statistic for Wilks' Lambda is exact

TOTAL CANONICAL STRUCTURE

	CAN1	CAN2
WFB	0.4142	0.4897
OBH	0.2843	0.8163
OBB	0.4258	0.3837
NLH	-0.2193	0.2646
NLB	0.4340	-0.3321
EAB	-0.6650	0.1834
MSH	-0.4635	-0.2247
HAR	0.1509	-0.2205

* 1BY = Mouse Creek Phase (Ledford Island and Rymer), 8DV = Averbuch and 9MR = Toqua.

the horizontal axis. Toqua males are found in the middle (with some overlap with the Mouse Creek males). The vertical CAN2 dimension separates Toqua from the other two samples based on the aforementioned high CAN2 positive loadings.

Females. Table 7.10 contains similar canonical discriminant statistics for the comparative sample of female crania. The greatest D^2 distances are between Averbuch and Toqua females ($D^2 = 3.0469$); however, all of the Probability > Mahalanobis figures are significant at the .05 level. The overall Wilks' Lambda F approximation of 6.41 also indicates significant variation in the crania. Once again, both CAN1 and CAN2 are significant, accounting for 83.14% and 16.86% of the total variation, respectively. CAN1 high loadings are associated with Orbital Height and Breadth. Height of Ascending Ramus exhibits a high negative loading. High positive loadings are found on the Orbital Breadth measurement of CAN2. In Figure 7.7, it can be seen that CAN1

Table 7.10. Canonical Discriminant Analysis Restuls for the Combined Mouse Creek Phase, Toqua, and Averbuch Females.

MAHALANOBIS DISTANCES BETWEEN CLASSES

SITE*	1BY	8DV	9MR
1BY	.	1.9386	2.0125
8DV	1.9386	.	3.0469
9MR	2.0125	3.0469	

CANONICAL DISCRIMINANT ANALYSIS

PROB > MAHALANOBIS DISTANCE

SITE*	1BY	8DV	9MR
1BY	.	0.000000	0.003983
8DV	0.000000	.	0.000054
9MR	0.003983	0.000054	

CANONICAL CORRELATIONS AND TESTS OF HO: THE CANONICAL CORRELATION IN THE CURRENT ROW AND ALL THAT FOLLOW ARE ZERO

	CANONICAL CORRELATION	ADJUSTED CAN CORR	APPROX STD ERROR	VARIANCE RATIO	CANONICAL R-SQUARED	LIKELIHOOD RATIO	F STATISTIC	NUM DF	DEN DF	PROB>F
1	0.781743165	0.739469055	0.046479766	1.5715	0.611122377	0.294918499	6.4157	16	122	0.0000
2	0.491544685	0.389607835	0.090644204	0.3186	0.241616177	0.758383823	2.8218	7	62	0.0128

MULTIVARIATE TEST STATISTICS AND F APPROXIMATIONS

STATISTIC	VALUE	F	NUM DF	DEN DF	PROB>F
Wilks' Lambda	0.2949185	6.415703	16	122	3.10782E-10
Pillai's Trace	0.8527386	5.760434	16	124	3.50791E-09
Hotelling-Lawley Trace	1.890097	7.087862	16	120	2.91188E-11
Roy's Greatest Root	1.571503	12.17915	8	62	2.79063E-10

NOTE: F Statistic for Roy's Greatest Root is an Upper Bound
F Statistic for Wilks' Lambda is Exact

TOTAL CANONICAL STRUCTURE

	CAN1	CAN2
WFB	0.2400	-0.3105
OBH	0.6749	-0.3050
OBB	0.6388	0.5399
NLH	-0.0643	0.3272
NLB	0.1961	0.3389
EAB	-0.4208	-0.0669
MSH	-0.3020	0.0162
HAR	-0.6634	-0.1005

* 1BY = Mouse Creek Phase (Ledford Island and Rymer), 8DV = Averbuch and 9MR = Toqua.

primarily differentiates Toqua and Averbuch females horizontally, with Mouse Creek Phase crania falling in the middle. The less important CAN2 vertically separates Mouse Creek Phase and Toqua females.

DISCUSSION

The mortality, survivorship, probability of death, and life expectancy demographic curve comparisons for Ledford Island, Toqua, and Averbuch dramatize the substantially greater amount of demographic stress occurring at Toqua and Averbuch. Had the relatively "healthier" Rymer and Mouse Creek site populations been included in the comparison this difference would have been magnified even further (Boyd 1984). One factor possibly involved in this discrepancy is the greater percentages of deaths in the highly stressed 0-1 (or 0-1.5) age range at Averbuch and Toqua as opposed to the lower percentages for Ledford Island (and the rest of the Mouse Creek Phase sites). In contrast,

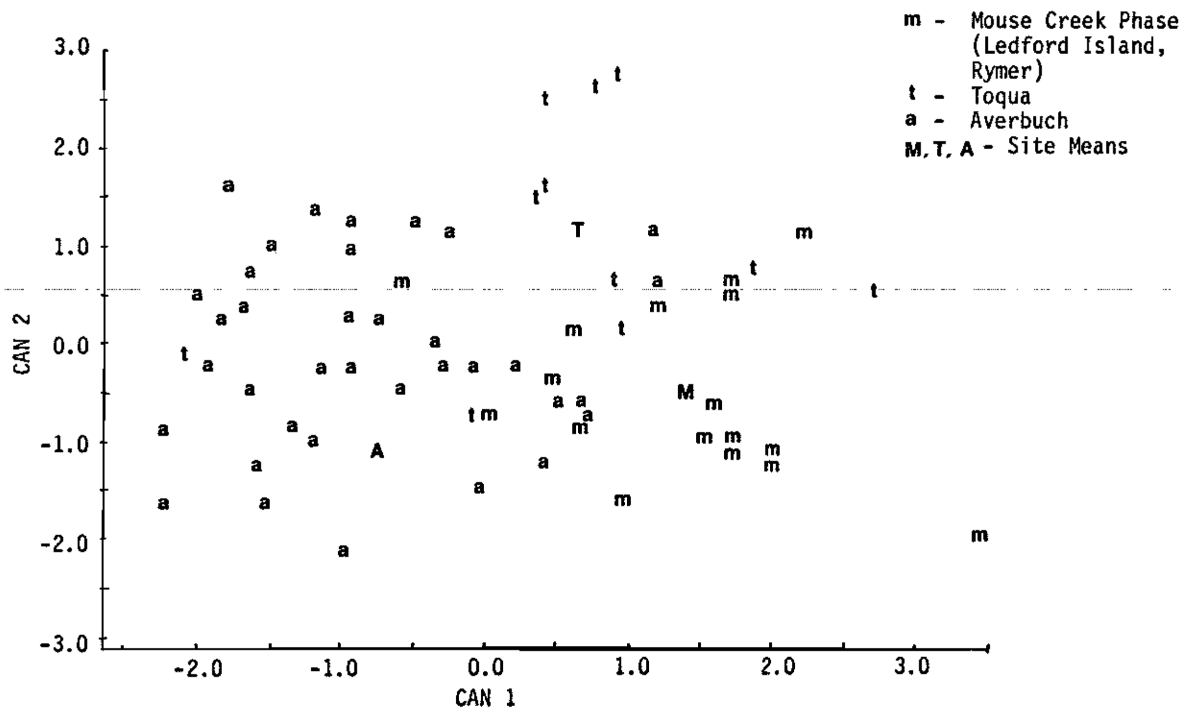

Figure 7.6 Graphic Representation of the Canonical Discriminant Analysis Results for the Mouse Creek Phase (Combined Site), Toqua, and Averbuch Males.

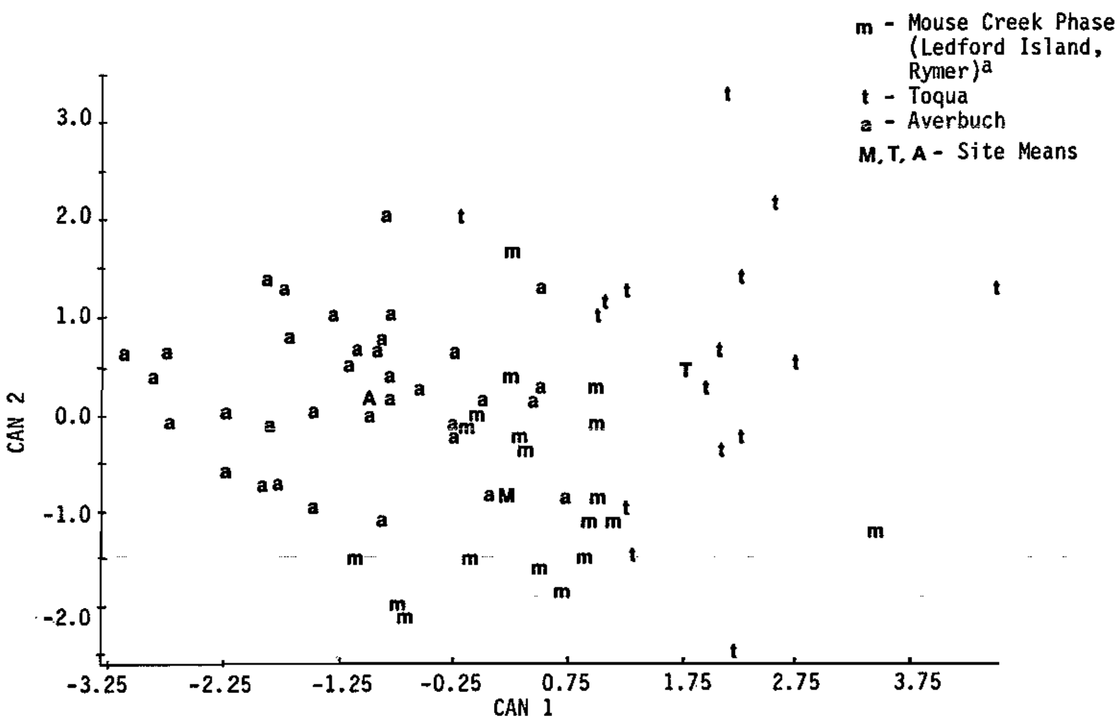

Figure 7.7. Graphic Representation of the Canonical Discriminant Analysis Results for the Mouse Creek Phase (Combined Site), Toqua, and Averbuch Females.

mortality is higher for Ledford Islanders in the late adult years. Two alternative explanations can be proposed for these results. While it is conceivable that biasing inherent in the Mouse Creek Phase site samples (relating to variable preservation and archaeological recovery of infants, for example) and analyses (aging and sexing techniques, demographic preconditions and assumptions) could produce the above picture, this is not likely. As much control as possible was maintained over these variables throughout the analysis. I feel that biasing resulting from any of the previously mentioned factors is minimal. Weiss (1975:56) states that "...even if we suspect that our estimated vital rates are all as much as 10% in error, we can determine a reasonable life table and get a fair idea of the ecological circumstances under which primitives live." Therefore, these data provide good evidence that the demographic scenario noted above represents an accurate estimate of the health status of these populations.

The above-average stature manifested by the majority of the Mouse Creek Phase skeletons supports the previous demographic suggestion of a low stressed (healthy) environment for these individuals. However, both environmental and genetic factors play a vital role in the attainment of adult stature and the appropriate weighting of each set of factors in the interpretation of long bone length variability remains unclear. As Milner (1982:206) states, "...the variation one would like to attribute to different environments could be attributable to genetic differences among populations that are widely separated in time and space (and vice versa)." Thus, the importance of the above results is uncertain. But it can be said that no significant evidence of reduced stature and, therefore, stress was observed in the Mouse Creek Phase populations. Interpretation of the separation of Averbuch and Ledford Island females from each other and the remainder of the samples on the basis of stature is problematic.

The high incidence of calvarial porotic hyperostosis and cribra orbitalia at Toqua led Parham (1982:105) to state: "On a population basis both of these relatively high frequencies attest to probable endemic proportions of iron-deficiency anemia at this site." The large quantity of maize remains recovered in paleobotanical samples from this site supports this claim. For the Averbuch site, very few floral remains were recovered in spite of the extensive flotation conducted; both frequency of occurrence and diversity of species were low (Klippel 1984: 14.4). No paleobotanical evidence exists from the Mouse Creek Phase, since systematic flotation was not conducted during excavation. However, some corn, beans, and squash remains are noted by Lewis and Kneberg (1941:7) as being generally present. Thus, paleobotanical evidence from the three populations is unequal. Two alternatives can be offeied in explanation of the observed porotic hyperostosis/cribra orbitalia frequency variation. First is the possibility that some type of differential maize consumption does, in fact, exist across these three groups. Second is the possibility that porotic hyperostosis and cribra orbitalia are not as directly correlated with iron deficiency anemia and intense maize consumption as is currently thought. Owsley (1984:127), in his comparison of calvarial porotic hyperostosis and cribra orbitalia frequencies in Dallas (Toqua) and Historic Overhill Cherokee crania, suggests the latter interpretation. However, an assumption of **increased** dependence on maize through time (Dallas to Cherokee) may not be the case, based on palynological studies by Cridlebaugh (1984). Trace element analyses of bone remains from all three groups would help resolve this issue.

Periostitis comparisons of these groups can provide information concerning the relative susceptibility of each population to general infection. Milner (1982:36) suggests a consideration of archaeological settlement data in relation to pathology occurrence, particularly in reference to infectious diseases. The length of occupation of an area, as well as the total population size and density, can have a significant effect on the relative contamination of available soil and water in the area. This can subsequently affect the bioavailability of enteric parasites and bacteria. Given the estimated 300 years of occupation at Toqua (Parham 1982:51), along with a relatively dense settlement mode, it is not surprising that general infection susceptibility was greater at this site than at the others considered. Although the calculated population size of Averbuch is greater (Berryman 1981:73), the time interval of occupation is estimated at only 15-25 years. In addition, in contrast to the more mainstream Middle Cumberland occupations, Averbuch settlement patterning is more diffuse. Mouse Creek Phase site occupation size is estimated as intermediate between Toqua and Averbuch (Boyd 1984), with settlement patterning generally consisting of moderately sized palisaded villages. Less propensity toward infectious disease possibly resulted within the Averbuch and Mouse Creek Phase groups than at Toqua.

Finally, the investigation of the genetic relationships among the three groups (via the canonical discriminant analysis) generally indicates a slightly closer relationship between Mouse Creek Phase and Toqua **male** individuals as compared to the more distant Averbuch males, while the **females** from the three groups are all dissimilar. Berryman (1975:60) suggests possible matrilineal kinship systems, resulting in matrilocal residence structures, within the three cultures as a feasible explanation for the sexual differences observed in his study. Also, Wright (1974) encounters a similar relationship in her multivariate comparison of Dallas and Historic Cherokee crania. Swanton (1922) notes such a kinship system for many early historic Indian groups in the Southeast. While the matrilocal residence system may explain the observed differences between the Mouse Creek Phase, Toqua, and Averbuch females, many factors complicate this picture. For example, length of time and frequency of male exogamy, trade, or migration may cause variabilty in the resultant skeletal population.

No support is found for a **close** Mouse Creek-Middle Cumberland biological association. None of the Mouse Creek Phase, male or female crania, are closely aligned with the Averbuch crania, while many exhibit a slightly closer biological similarity to the Toqua crania instead. These results lead me to question the Lewis and Kneberg hypothesis of a direct Middle Cumberland-Mouse Creek connection. Clearly, archaeological comparisons are needed to evaluate the hypothesis fully, but no comparative synthesis of recent archaeological data on the three cultures is yet available. However, preliminary results of a reanalysis of the three Mouse Creek Phase site archaeological collections (Peters 1984), in conjunction with existing information on the Toqua and Averbuch sites, support the results of the biological analysis presented here.

In conclusion, the use and intercorrelation of many avenues of skeletal biological evidence, as exemplified in this paper, can produce important information concerning the biological status and relationships of prehistoric groups. In this study, previous hypotheses suggesting a close relationship between the Mouse Creek and Middle Cumberland cultures are not substantiated.

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NOTE ON CURATION

Materials discussed in this paper are currently curated at the Frank H. McClung Museum and the Department of Anthropology, the University of Tennessee, Knoxville.

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8

LATE PREHISTORIC COMMUNITY HEALTH IN THE CENTRAL DEEP SOUTH: BIOLOGICAL AND SOCIAL DIMENSIONS OF THE MISSISSIPPIAN CHIEFDOM AT MOUNDVILLE, ALABAMA

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ABSTRACT

A sample of 564 late prehistoric Amerindians from the site of Moundville are examined for evidence of infectious disease, nutritional deficiencies, trauma, and dental pathologies, for the purposes of general health assessment and elucidation of possible biological correlates of social differentiation. Previous mortuary analysis by C.S. Peebles of 2034 burials spanning five centuries (A.D. 1050 - 1550) of Mississippian occupation at Moundville had partitioned the community into a series of hierarchical clusters which crosscut key biological dimensions of age and sex. Analysis of the distribution of observed pathologies indicates statistically significant differences in prevalence and severity between subadults and adults, and to a lesser degree, between adult females and males. With these biological parameters held constant, however, such distributions do not differ significantly along the social dimensions outlined by Peebles, suggesting that disease and developmental experience (as measured by the features examined) did not vary consistently by social rank. The rarity of cribra orbitalia and severe enamel hypolasia suggests that nutrition was generally adequate for normal skeletal and dental development. Trauma is rarely noted, and evidence of serious skeletal involvement from infection of specific or non-specific etiology is uncommon. However, the prevalence of lesions considered specifically characteristic of treponemal disease lends support to arguments by earlier researchers that such a syndrome was present in the pre-Columbian Southeast.

INTRODUCTION

In recent decades, biocultural research on archaeological populations has often focused upon the success of adaptation to a variety of social and ecological environments (Armelagos 1968; Cassidy 1972; Cook 1981; Hoyme and Bass 1962; Kelley 1980; Lallo 1973; Larsen 1982; Milner 1982). One critical measure of adaptational success - normal growth and development - reflects not only the genetic substrate of a given population but also the nutritional adequacy of its subsistence regime (Acheson 1960; Albanese and Orto 1964; Dubos 1965; Garn 1966). Differential exposure to pathogens provides initial opportunities for differential disease experience between and within populations. However, the nutritional status of the threatened hosts determines to an important extent the strength of immunoresistance exhibited and therefore the ultimate success or failure of adaptation to stress of pathologic origin, a second important measure (Deo 1978; Hoeprich 1977; Scrimshaw, Gordon and Taylor 1968). In this paper, I report on a recent assessment of health, including both measures, in the Mississippian population at Moundville, a large prehistoric community located on the Black Warrior River in west central Alabama (Figure 8.1).

The study has three goals: (1) examination of a selected sample of skeletal individuals for evidence of infectious disease, nutritional deficiencies, traumatic injuries, dental pathology, and developmental stress; (2) analysis of intra-sample patterning of pathological manifestations along the dimensions of age, sex, and social rank; and (3) comparison of the health status at Moundville with similar data from other Mississippian populations. Extensive discussion of the project is impossible within the scope of this paper, and the reader is referred to the complete report (Powell 1985a) for further information.

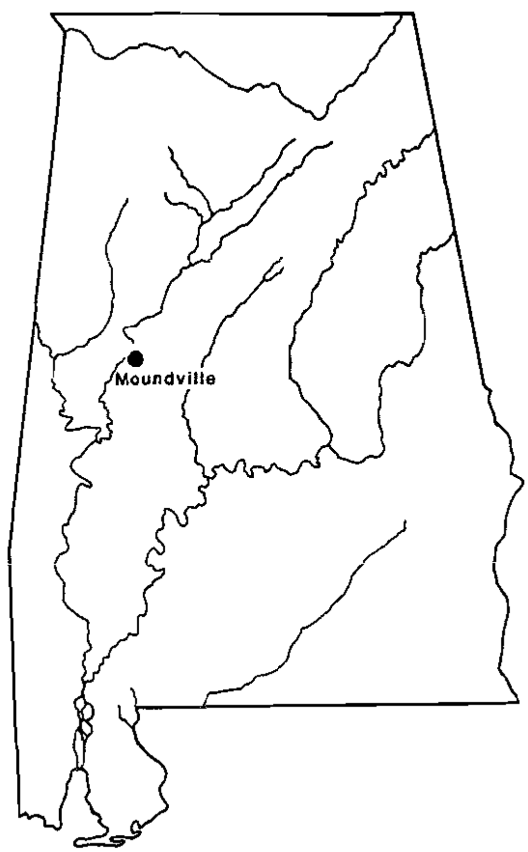

Figure 8.1. Location of Moundville in Alabama.

The Sample

Explorations at Moundville by C.B. Moore in 1905 and 1906 uncovered approximately 800 human burials within and around the mounds (Moore 1906, 1907). Moore donated 70 pathological bones from an unidentified number of individuals to the Army Medical Museum, a single uncrushed cranium to Dr. Alex Hrdlicka of the National Museum of Man, Smithsonian Institution, and an unspecified amount of skeletal material to the Academy of Natural Sciences of Philadelphia, the latter along with an extensive collection of artifacts. When Moore's collections of Southeastern cultural materials wre transferred from Philadelphia to the Museum of the American Indian (Heye Foundation) in New York, the accompanying skeletal material was apparently deaccessioned, and attempts to locate it for study have been unsuccessful (personal communications, C.S. Peebles; M.J. Schoeninger). Excavations by the Alabama Museum of Natural History (AMNH) from 1929 to 1941 uncovered some 2400 additional interments, all from non-mound locales, for a total of 3200 reported burials at the site (Peebles 1979). Approximately 1500 individuals are presently represented by skeletal material from these later excavations. Beacuse skeletal material from Moore's excavations at the site is no longer available, only material from the AMNH collections is analysed in the present study.

During the five centuries from A.D. 1050 to 1550, the Mississippian community at Moundville developed from a small village with a single mound (Mound O) into a major palisaded regional center including at least 20 mounds and numerous clusters of houses and other structures arranged over 100 hectares (Figure 8.2). By the mid 14th Century,

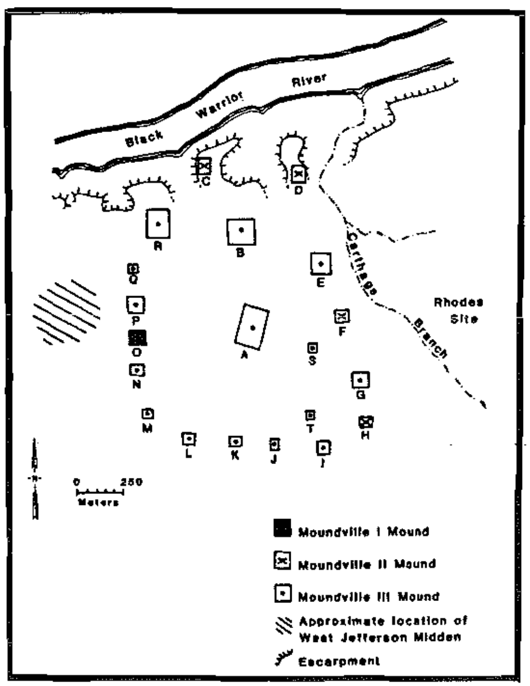

Figure 8.2. Schematic Plan of the Moundville Site

Moundville comprised the second largest known Amerindian population concentration north of Mexico, exceeded only by the American Bottom metropolis of Cahokia (Peebles 1979). This trend was reversed for unknown reasons in the late 15th Century, however, and the following Protohistoric period (A.D. 1550 - 1770) witnessed a halt in mound construction and dispersal of the concentrated population into smaller settlements scattered throughout the surrounding region (Steponaitis 1983).

Peebles' analysis of mortuary data (Peebles 1974; Peebles and Kus 1977) from the Moore and AMNH excavations divides a sample of almost 2000 burials into a series of hierarchical clusters on the basis of associated grave goods and burial location (Table 8.1). He interprets these groupings as representing different socio-political aggregates: (1) an "elite" sector, distinguished by access to certain artifacts, design motifs, exotic materials, and restricted burial precincts primarily within mounds (Segment A); and (2) a "non-elite" sector, interred near mounds or village areas (Segments B and C), with the majority of individuals (Cluster XI) lacking any reported associated artifacts. The association of "elite" items with both sexes and all ages (including infants) suggests to Peebles that social rank was to some degree ascribed, although achievements in adult life probably played an additional role.

Ethnographic evidence from historic chiefdoms of the Southeast indicates that, in some circumstances, elite individuals enjoyed varying degrees of preferential access to selected foods as well as to other material items and ceremonial privileges (Bourne 1904; Du Pratz 1972; Swanton 1911, 1946; Varner and Varner 1954). Whereas the first goal of the project described here is a general assessment of health and disease in the Moundville community at large, the second goal was to seek evidence for biological consequences of such preferential access to nutritionally essential foods, particularly protein of high biological value, in this complex chiefdom. Preliminary analysis of strontium levels in bone samples from Moundville (Schoeninger and Peebles 1981) suggests dietary differentiation with respect to consumption of meat along biological and social dimensions. These dietary differences, however, may have caused no consequent significant differences in actual physical health, if the general levels of nutrition were adequate for the majority of individuals to buffer prevalent stresses.

The skeletal sample selected for analysis consists of 140 subadults (23%) and 424 adults (77%), reflecting the proportion of these two broad age categories in the total available series. Only those individuals with well-documented intra-site provenience are included, to minimize the probability of including individuals from the pre-Mississippian West Jefferson phase occupation (Figure 8.2). Of the 564 individuals, 80 (12%) meet Peebles' criteria for "elite" burials (Peebles and Kus 1977). This group unfortunately does not, for reasons stated above, include any "elite" individuals actually interred in mounds. Of the remainder, 190 (33% of the total) were

Table 8.1. Mortuary Analysis of Moundville Burials (after Peebles and Kus 1977).

Cluster	Ages	Characteristic Artifacts	Burial Locations	Segment	% of Sample
Ia	A	Copper axes Pearl beads	Mounds	A	5.92
Ib	A,C	Copper earspools Bear teeth Stone discs Pigments	Mounds, Cemeteries near mounds	A	
II	A,C,I	Shell beads Galena cubes Oblong copper	Mounds, Cemeteries near mounds	A	
III	A,C,I	Effigy vessels Animal bone Shell gorgets Freshwater shell	Cemeteries near mounds	B	13.21
IV	A,C,I	Discoidals Bone awls Projectile points	Cemeteries near mounds		
V,VI	A,C,I	Bowls Jars	Cemeteries near mounds, village areas	C	80.87
VII, VIII,IX	A,C	Water bottles	Cemeteries near mounds, village areas	C	
X	A,C,I	Sherds	Village areas	C	
XI	A,C,I	No artifacts	All locations	C	

interred with "non-elite" grave goods. For the final 294 (55% of the total), no artifacts are reported. This last group is placed in a "residual" category, corresponding to Peebles' Cluster XI (Table 8.1) to differentiate them from the other "non-elite" burials, but no assumptions are made concerning the relative social rank of these two "non-elite" groups. The respective proportions of these three skeletal sub-samples, termed "elite," "sub-elite," and "residual" in the present study, do not correspond with the proportions delineated by Peebles' analysis (Table 8.1) because the "elite" group has been deliberately increased in size relative to the two other groups for analytic purposes.

Each individual has been scored for degree of skeletal completeness. Of the 564 individuals, 144 (26%) are represented solely by cranial elements, and 98 (17%) by post-cranial elements alone. One-fifth (119, or 21%) are scored as "poorly represented" (by less than one fourth of the skeleton), leaving only 203 (36%) considered "fair to good" (more than one-fourth of the skeleton). Subadults are generally more completely represented than are adults, a difference assessed by chi square analysis as significant at the .05 level of confidence, but no significant differences in skeletal representation by sex or status are indicated. Examination of burial records suggests that policies of burial recovery contributed more strongly to these patterns of unequal representation than did aboriginal mortuary practices, as the great majority of burials were apparently primary interments of extended articulated individuals (Peebles 1979).

RESULTS OF ANALYSIS

Demography

Peebles noted (1974) that young subadults were seriously under-represented in the burial population, according to the field estimates of age available to him. The present skeletal sample reflects this deficiency (Figure 8.3): individuals 15 years or younger comprise only 19.5% (110/564), in contrast to 30% to 50% in the anthropological population samples utilized by Weiss (1973) in his construction of model life tables. Infant (aged less than one year) mortality at 4.4% (25/564) is well below expectations, compared with proportions reported for other Amerindian samples, e.g., 22% for Dickson Mounds Middle Mississippians (Lallo 1973) and 20% (165/813) for Indian Knoll, 38% (193/506) for the Mobridge Arikara and 21% (131/618) for Grasshopper Pueblo (Kelley 1980). The next oldest portion of the curve, however, does approximate "the general shape of human juvenile mortality ... declining from ages 1 to 5, then decreasing steadily until those from 10 to 15 years have the lowest mortality" (Weiss 1973:26).

Within the adult segment of the curve, females outnumber males 221 to 172. The former predominate in the younger adult age categories until the middle of the fourth decade, a differential distribution assessed as significant at the .01 level of confidence by chi-square analysis.

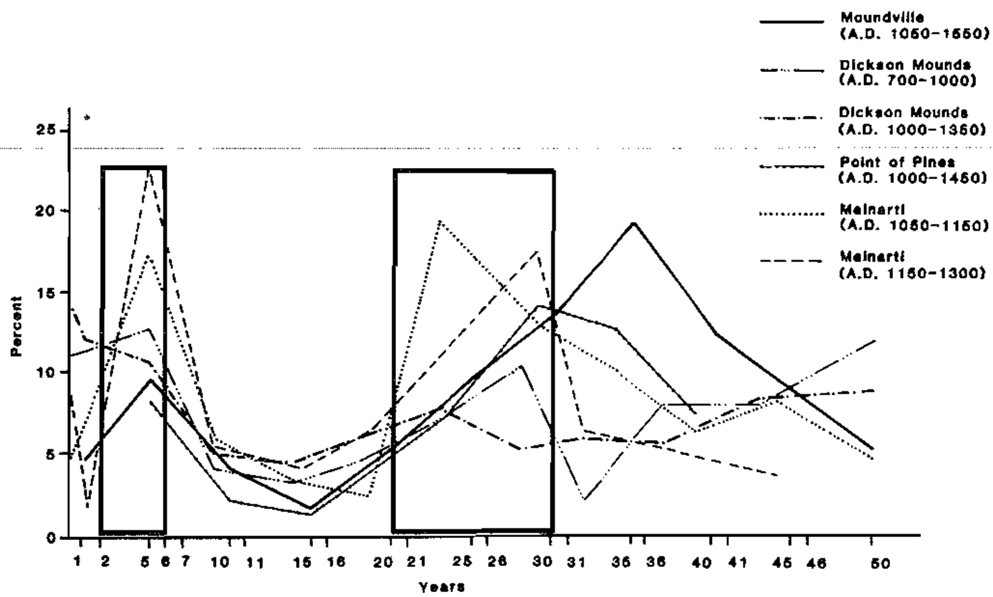

Figure 8.3. Mortality Curves: Comparative Data

This low tertiary sex ratio (172/224 x 100 = 77.83) lies below the range considered typical of human populations (Teitelbaum 1972). The almost identical pattern of sex estimates by the present researcher with those of a previous researcher (M.J. Schoeninger) for approximately one third of the sample suggests that observer error is not responsible for so large a discrepancy between expected and observed sex ratios. Factors possibly contributing to this problem may include disproportionate representation of younger males and older females in mound burials not available for analysis and additional loss of younger males to the sample through mortality in warring raids.

Age and sex differences among the three sample segments designated by status were not assessed by chi-square analysis as significant at the .05 level of confidence. No conclusions regarding differential mortality experience, and, by extension, differential adaptive success, of the two sexes or of "elite" and "non-elite" at Moundville could be reached, however, because of the substantial deviations from "normal" age and sex profiles noted above.

Skeletal Metrics

Data on six skeletal measurements (maximum diameter of humerus and femur head, femur midshaft circumference and anterior-posterior diameter, and maximum length of femur and tibia) were collected from intact bones of adult females and males. Analysis of sexual dimorphism by Student's t-test and one-way analysis of variance indicated differences significant at the .001 confidence level within each status subgroup. Separate comparisons by sex across status boundaries using the same analytic methods, however, revealed no differences significant at the .05 level of confidence. On the average, elite males were slightly larger than non-elite males in all but humerus head diameter, and elite females slightly exceeded non-elite females in that single measurement alone. This general pattern of greater physical size of elite individuals, though not statistically significant, parallels the findings of Buikstra (1976) for Illinois Middle Woodland burials, of Hatch and Willey (1974) for Dallas phase Mississippians, and of Robinson (1976) for late Mississippians at Chucalissa in Tennessee.

Dental Pathology

Three macroscopic dental features were observed: occlusal molar wear, dental caries, and linear enamel hypoplasia. Dental wear is not an inherently pathological condition, but the features of the diet which produce occlusal abrasion (e.g., grit or rough-textured foods) may also influence other aspects of dental health through irritation of adjacent soft tissues. Scott's (1979b) system of quantification of occlusal molar wear was employed on all undamaged teeth of that type in adult dentitions. Wear is generally moderate, with little dentine exposure evident prior to the fourth decade. This pattern agrees well with archaeological evidence from the site suggesting that plant foods were processed in wooden rather than in stone utensils (C.S. Peebles, personal communication). The Moundville sample resembles other Mississippian population samples in this respect (e.g., Lubbub Creek, Middle and Upper Nodena, Campbell, and Hardin; Table 8.2), all of whom typically display considerably less advanced wear than samples from populations with differing diets or methods of food preparation (e.g., in the same table, the Archaic Indian Knoll population and the Late Woodland samples from Mississippi, 22Le530 and 22It537, representing populations transitional between hunting/gathering and agriculture).

The prevalence and patterning of dental caries provide a valuable index to the proportionate representation of soft-textured high-carbohydrate foods in a population's diet (Powell 1985c, Turner 1979). Moundville adults display an average of 3.5 carious lesions and sub-adults an average of 1.8 lesions (in permanent teeth), with an overall average of 2.3 lesions per dentition. The majority of these lesions (65%) are located in occlusal pits and fissures of the premolars and molars. These patterns of prevalence and location more closely resemble those reported for other Mississippian tradition populations (e.g., in Table 8.3, the samples from Lubbub Creek, Nodena, and several Caddo sites in southwestern Arkansas) and for traditional agriculturalists in general (Turner 1979) than patterns observed in non-agriculturalists (e.g., in the same table, the Fourche Maline of eastern Oklahoma).

Table 8.2. Molar Occlusal Wear.

	M1			M2		
	N	X	SD	N	X	SD
Maxilla						
Moundville	147	16.5	5.7	136	12.7	4.5
Lubbub Creek[1]	25	15.1	2.2	24	13.0	1.5
Middle Nodena[2]	54	17.9	4.6	42	13.6	3.3
Upper Nodena[2]	125	17.3	4.3	123	13.5	3.3
22L0530[3]	30	26.0	8.3	32	22.0	8.3
22It537[3]	13	16.6	7.6	17	22.1	6.7
Indian Knoll[4]	58	26.7	5.3	58	19.2	5.7
Campbell[4]	64	19.3	4.1	64	15.1	2.2
Hardin[4]	60	15.4	2.7	60	13.2	2.4
Mandible						
Moundville	131	16.9	5.9	150	13.7	5.8
Lubbub Creek[1]	12	18.0	5.7	18	15.0	4.6
Middle Nodena[2]	57	16.4	3.5	55	13.9	3.0
Upper Nodena[2]	102	16.5	3.6	101	13.9	3.0
22Lo530[3]	29	25.6	7.2	28	23.1	6.8
22It537[3]	11	28.4	5.9	11	24.0	5.5
Indian Knoll[4]	48	27.4	4.3	48	20.1	5.1
Campbell[4]	68	17.6	2.8	68	14.6	2.2
Hardin[4]	38	17.4	3.8	38	15.1	2.4

N = Number of teeth, X = Mean wear score, SD = Standard deviation

[1] Powell 1980
[2] Powell 1985b
[3] Rose 1981
[4] Scott 1979a

Table 8.3. Dental Caries In Amerindian Population Samples.

Sample	%I	XI	%T	XT
Moundville	54.1 (192/355)	2.30 (816/355)	18.7 (630/3375)	0.24 (816/3375)
Lubbub Creek[1]	50.0 (15/30)	2.17 (65/30)	12.5 (59/472)	0.14 (65/472)
Nodena[2]	77.4 (120/155)	3.50 (453/155)	18.3 (426/2331)	0.19 (453/2331)
Caddo[3]	90.6 (48/53)	7.60 (403/53)	25.3 (235/928)	0.43 (403/928)
Fourche Maline[4]	30.4 (21/69)	1.12 (77/69)	7.8 (68/874)	0.09 (77/874)

%I=% of carious individuals
%T=% of carious teeth
XI=mean number of lesions per individual
XT=mean number of lesions per tooth

[1]Powell 1980 [2]Powell 1985b (Upper and Middle Nodena combined)
[3]Powell and Rogers 1980

Intra-sample comparisons by Student's t-test of mean molar wear scores and mean number of carious lesions revealed no differences statistically significant at the .05 level of confidence among the three status subgroups. Within each group, males display slightly heavier occlusal wear that females but breakdown of mean wear scores indicates a strong age effect. Inter- and intra-group comparisons reveal almost identical mean caries rates for both sexes between and within status subgroups.

The patterning of non-specific developmental stress experienced by the Moundville Mississippians was assessed through observation of linear enamel hypoplasia. This condition results from short-term episodes of arrested enamel development initiated by a variety of stimuli, including malnutrition, infection, and psychological stress (Goodman, Armelagos, and Rose 1980). Although determination of the specific etiology of any particular lesion-forming episode is not possible, the developmental age of the affected individual at the time of the lesion's formation may be calculated by comparison of the lesion location on the tooth crown with standarized charts of enamel development. Three levels of lesion severity, visible at 10x magnification, were scored on all undamaged permanent incisors and canines in the series. To eliminate "false positive" scores from idiosyncratic developmental errors on single teeth, only cases in which synchronous lesions were observed on two or more teeth in a dentition were scored as positive instances of systemic developmental disturbance.

Only 1% of the 170 Moundville dentitions display lesions classified as "severe." "Moderate" lesions appear in 38%; 20% bear "mild" lesions and 41% are unaffected at the observed level. The great majority of lesions reflect acute growth arrest episodes during the third and fourth years of post-natal life (Figure 8.4). Similar patterns are reported by other researchers of Mississippians from Dickson Mounds (Goodman, Armelagos, and Rose 1980), and in the Lubbub Creek population contemporaneous with Moundville (Powell 1980). Contributory factors undoubtedly include weaning from a protein-rich diet to one less able to meet the physiological needs of the developing organism, greater exposure to environmental pathogens (including parasites) due to increased mobility of the child, and to some degree, the heightened sensitivity of the certain portions of the dental enamel to systemic insults during that particular developmental period (Condon 1981).

Skeletal Pathology

All skeletal remains were examined for macroscopic evidence of pathology. All skeletal lesions were initially described as "resorptive" or "proliferative", according to whether local bone loss or bone increase resulted. They were then classified in the following etiological categories: (1) nutritional disorders, (2) traumatic

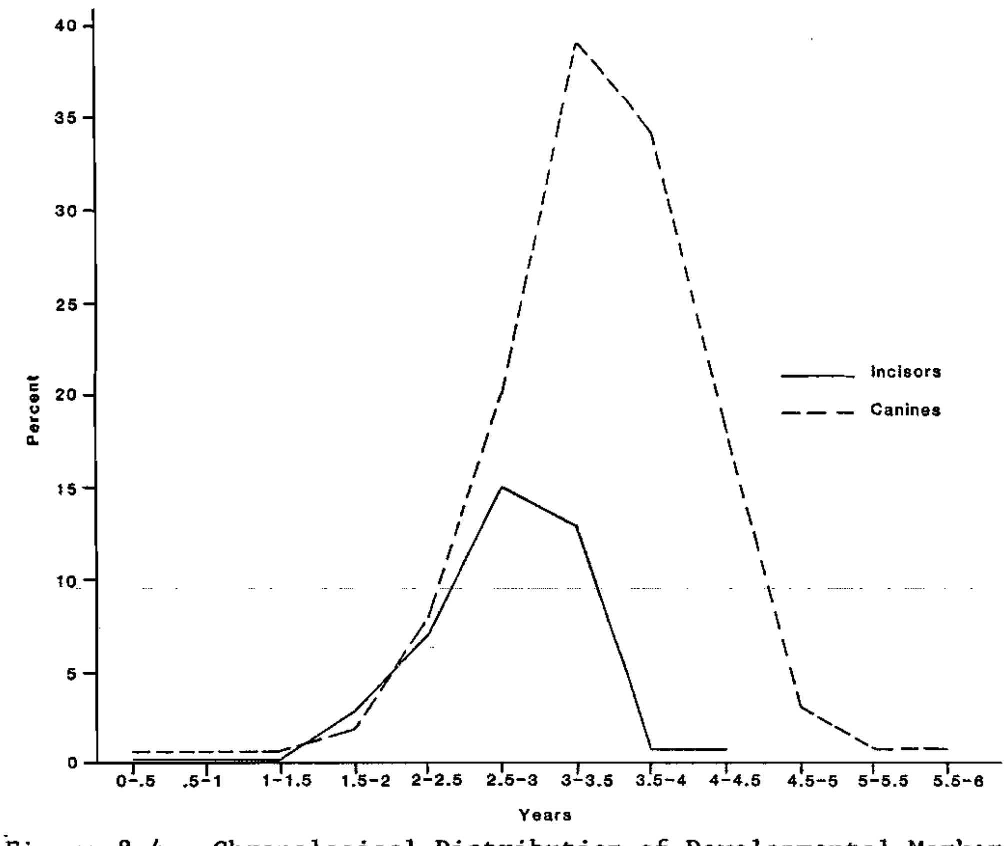

Figure 8.4. Chronological Distribution of Developmental Markers of Systemic Stress: Enamel Hypoplasia.

injuries, (3) infectious reaction, or (4) other. The intra-sample prevalence of the first three categories was subsequently analyzed by age, sex and status.

In the first category, skeletal evidence of anemia is rarely observed. No cases of porotic hyperostosis are noted, but ten young children and five adults exhibit remodeled lesions of **cribra orbitalia**, a condition generally considered to represent a mild skeletal response to iron deficiency anemia (Hengen 1971; Ortner and Putschar 1981; Steinbock 1976). The subadult prevalence, 21% of cases observed, is higher than that reported for the contemporaneous population of Lubbub Creek on the Tombigbee river to the west of the Black Warrior Valley (Powell 1980), but is considerably lower than that reported (Hill 1981) for late Mississippian and Protohistoric populations along the Alabama River to the south. No evidence of rickets or other nutritional disorders is present.

Reparative proliferation of bone at fracture sites in long bones is the most common traumatic injury observed, found in 34 adults but no subadults. Ribs, hands, feet, radii, and ulnae are most often broken. The overall fracture rate for the major long bones (clavicle, humerus, radius, ulna, femur, tibia, and fibula) is 0.4% for females (6/1433) and 0.6% for males (7/1109). The combined-sex rate of 0.5% (13/2542) is slightly below that reported by Donisi (1982) for Mississippians in the Tennessee River Valley in north Alabama (0.8%, 50/6379), and considerably below the fracture rates for the same seven bones reported by Lovejoy and Heiple (1981) for the Woodland Libbin population in Ohio. In contrast to the almost identical fracture rates for females and males in those two large series, Moundville male prevalence (1% of observed individuals) is almost double that of females (0.4%). However, the greatest differences by sex in the present sample are noted in the rates for fractured ribs (9.4% of males vs. 1.3% of females) in observed individuals and hands (4.0% of males vs. 2.1% of females), regions not reported by those researchers. Elite males appear less often affected than non-elite males, a reversal of the pattern observed in the Late Mississippian population at Chucalissa (Lahren and Berryman 1984), and elite females exhibited no trauma, unlike non-elite females. This pattern may owe in part to the less complete representation by long bones of elite than non-elite adults, and to the absence of elite mound interments, in the Moundville sample.

In skeletal pathology categorized as infectious reaction, focal resorptive lesions are uncommon. Vermiculate furrows (Schmorl's nodes) or crescentic lesions (intervertebral osteochondropsis) in vertebral bodies reflecting severe mechanical stress to the spinal column appear in 29 adults, but no subadults. One young adult male exhibits extensive destruction of vertebral bodies suggestive of disseminated blastomycosis or, possibly, of the pre-Columbian analog of a related mycobacterial disease, tuberculosis, reported in Illinois Mississippians (Buikstra and Cook 1981). Small circular or oval resorptive lesions of the cranial vault are noted in 23 individuals of all ages, affecting almost exclusively the outer table and appearing well remodeled at death.

Far more common is proliferative osseous reaction (periostitis) typically affecting the subperiosteal surface of lower long bone shafts and rarely appearing on flat bones, the mandible, or the vertebrae. Periostitis is a non-specific osseous response which may be provoked by infection or by trauma and is not, in itself, diagnostic of any particular disease (Hoeprich 1977; Ortner and Putschar 1981; Steinbock 1976). The anterior tibia shaft was most often affected, with a prevalence rate of 51%. The next highest rate, 26%, was calculated for the fibula shaft, followed by the shafts of the femur (15%), humerus (5%), and the radius, ulna, and clavicle (all 4%). Subadult prevalence is half that of adults (27% vs. 58%) for the most affected bone but 63% of the subadult cases display unremodeled proliferation active around the time of death, compared with 9% of the adult cases. This pattern indicates that more subadults than adults died while infection was active, although not necessarily as a direct result of the infection responsible for the osseous response. The high prevalence of well healed periosteal lesions suggests that the majority of affected individuals survived whatever pathologic or traumatic insults stimulated this response.

The majority of affected elements display localized involvement, typically affecting only a small area of cortex. Analysis by chi-square of associations between presence of proliferative reaction and age, sex, or status indicates no significant differences at the .10 level of confidence. Rates of prevalence and anatomical patterns of involvement are almost identical for adult females and males, and for the members of all three status subgroups (controlled for age, sex and differences in skeletal representation). The high prevalence, generally minor degree of bone destruction, lack of association with early mortality, and non-random anatomical distribution of this type of lesion in the sample suggests an endemic etiology, some pathological entity which affected many members of each generation but was not often a direct cause of death.

Careful comparison of the observed anatomical and demographic patterning of cranial lesions and post-cranial periostitis with a variety of disease models that include post-cranial periostitis as a prominent symptom, coupled with a lower prevalence of resorptive cranial lesions, suggests that the Moundville pattern of skeletal involvement resulted from an endemic treponematosis (Figure 8.5, Table 8.4). Speculation concerning the presence of "syphilis" among prehistoric American Moundbuilders was initiated by Dr. Joseph Jones's 1876 diagnosis of pathological skeletal material from Tennessee stone box graves (Jones 1876). C.B. Moore sent a sampling of Moundville pathologies to the Army Medical Museum in 1906 and received an identification of "syphilis" for the majority of them (Moore 1907). Drs. Haltom and Shands (1938) note that this earlier diagnosis matched their own for other pathologic specimens excavated at Moundville in

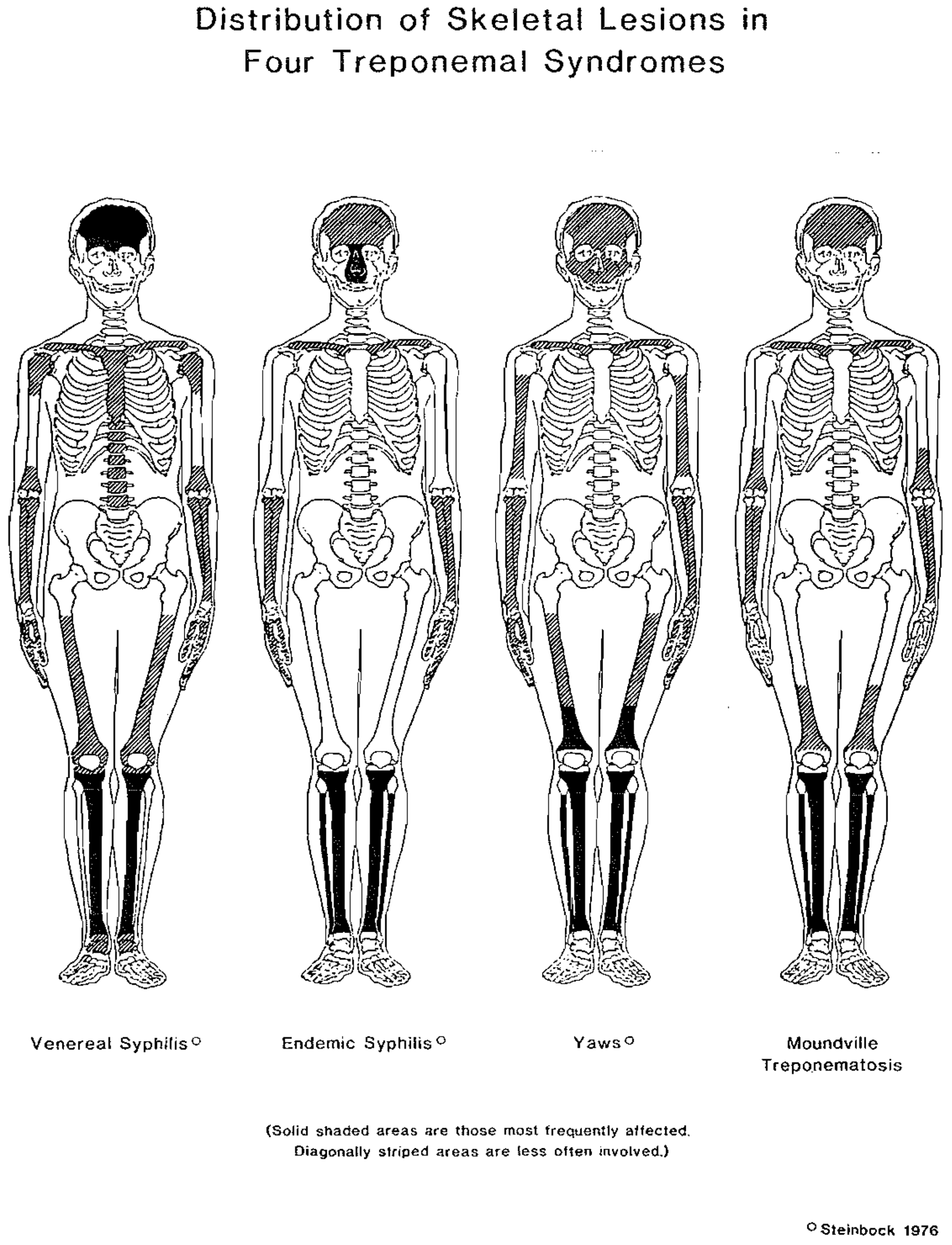

Figure 8.5. Distribution of skeletal lesions in four treponemal syndromes.

Table 8.4. Epidemiology and Pathology of Treponemal Infections.

	Modern Treponemal Syndromes				
Pathology	Veneral Syphilis	Endemic Syphilis	Yaws	Pinta	Moundville Infective Syndrome
Skin and Subcutaneous Involvement (papules, gummas)	Common	Common	Very Common	Very Common	Unknown
Oronasal Muconcutaneous Involvement (rhinopharngitis multilans)	Uncommon	Occasional	Occasional	Rare	Occasional?
Cardiovascular Involvement (aoritis, aneurysm)	Common	Rare	Never	Rare?	Unknown
Central Nervous System Involvement (meningitis, peresis, tabes dorsalis)	Common	Rare	Rare	Never	Unknown
Visceral Involvement (Hepatitis, nephrosis)	Occasional	Rare?	Never	Never	Unknown
Skeletal Involvement Joints	Occasional	Rare	Rare	Never	Rare
Osteochondritis	Congenital	Never	Never	Never	Unknown
Osteoperiostitis	Occasional in adults, Common congenitally	Very Common	Very Common	Never	Very Common
Nasal-palatal destruction (gangosa)	Occasional	Common	Occasional	Never	Rare
Cranial vault lesions	Occasional	Rare	Rare	Never	Occasional
Dental deformation (Hutchinson's signs)	Congenital	Never	Never	Never	Absent

the 1930's. Other diagnoses of treponematosis in pre-Columbian skeletal material from the Southeast include Bullen's (1972) analysis of Weeden Island period burials from Florida, Cassidy's (1972) description of bone lesions at the Hardin Village site in Ohio, and Robbins's (1978) discussion of a disease syndrome evident in bones from Morton Shell Mound, Louisiana. The most detailed diagnosis of treponematosis in pre-Columbian Amerindian skeletal material is Cook's (1976) explicitly epidemiological evaluation of skeletal pathology in Illinois Woodland samples.

Until recent reconsiderations of the medical terminology applied to treponemal infection (Hudson 1958, 1965; Steinbock 1976; Ortner and Putschar 1981), "syphilis" referred to the venereal form of treponematosis, which primarily affects adults (except for congenitally transmitted cases). The bone lesions which may occur in the tertiary stage of venereal treponematosis are typically both less prevalent and more severely destructive than those observed at Moundville. The patterning of the latter suggests a closer correspondence with late secondary and teriary skeletal lesions of the modern non-venereal treponemal syndromes, yaws and endemic syphilis.

Moundville lies within the northern subtropical zone (Lineback 1973), a climatic region hospitable in the Old World to treponematosis clinically intermediate between "classic" yaws and endemic non-venereal treponematosis (Hudson 1965; Jelliffe 1970). In these two syndromes, young children typically are exposed at an early age by playmates or, more rarely, by adults, through skin-to-skin contact with infectious lesions. Physicians in Colonial North America from Louisiana to Maryland were familiar with non-venereal treponematosis as distinct from venereal syphilis, and some aboriginal groups (e.g., the Santee of South Carolina) claimed that the non-venereal form had existed among them "for many ages" before the introduction of venereal "contagion" by Spanish soldiers and English traders (Parramore 1970). The minimal protection provided by clothing, the low levels of personal sanitation, and the abundant behavioral opportunities for infection at Moundville probably closely resembled those in modern subtropical regions where the two modern syndromes flourish.

SUMMARY

The overall impression gained from this project is of an aboriginal agricultural population who enjoyed generally good health, apart from widespread but minor developmental disturbances in early childhood and the inevitable encounters with minor trauma and endogenous pathogens. Infectious reaction was restricted in the majority of cases to localized, non-life-threatening involvement. Nutritional deficiencies are not widely evident, although the high-carbohydrate Mississippian diet may have promoted anemia in some young children. This diet produced moderate dental wear and substantial rates of dental caries, identical to pattterns reported for other comparable Amerindian agriculturalists. Linear enamel hypoplasia is widely prevalent but generally mild in expression, matching Milner's description of the pathology as a 'trace condition' in his Kane Mounds sample from the American Bottom (Milner 1982:193).

Comparisons of prevalence of the pathological conditions selected for observation clearly show the basic homogeneity of the three status-defined population segments with respect to these features. Subadults and adults differ more markedly than do adult females and males. Analyses of occlusal molar wear and dental caries suggest that all three status subgroups consumed foods similar in texture and in cariogenic properties. The lack of statistically significant differences in skeletal metrics by status may be due, in part, to the absence in the sample of the most highly ranked individuals, those buried in mounds. No consistent differences were evident among the non-elite population segments which are presumably completely represented, suggesting that status differentiation at Moundville brought no substantial biological benefits, nor did it exact any heavy penalties.

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NOTE ON CURATION

The skeletal material analyzed in this project is currently curated at the Laboratory for Human Osteology, University of Alabama, Tuscaloosa.

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9

NORTH CAROLINA'S BURIAL LAW: RECONCILABLE DIFFERENCES?

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Both the historical development leading to the 1981 enactment of North Carolina's burial law and its implementation since then are considered. The law was stimulated largely by expressed concerns of Native Americans about treatment of the prehistoric dead. Many aspects of discussions between North Carolina archaeologists and Indians mirror similar problems and themes found elsewhere in the United States and abroad. The review of implementation suggests that the law works fairly well. Consultations with the North Carolina Commission of Indian Affairs generally have been successful as shown by their flexible attitudes toward destructive analysis, permanent retention, and extended curation periods. There is some problem with extended (or long-term) research projects which remains unresolved. There has been an unexpectedly high demand for archaeological services in relation to burials of the historic period. A burial house for Native American remains is suggested as the best alternative to reinterment. Archaeologists and physical anthropologists should increase efforts to inform and involve the public, especially Native Americans, about the goals and progress of research.

HISTORICAL PERSPECTIVE

Introduction

In 1981, new legislation was approved in North Carolina which protects unmarked human burials and human skeletal remains ("The Unmarked Human Burial and Human Skeletal Remains Protection Act," North Carolina General Statutes 70, Article 3). In many ways, the development of this state law can be seen as a microcosm of a national concern and controversy. The debate is primarily between archaeologists and their principal objects of study, the Native Americans.

Disputes over treatment of burials have many facets, including academic freedom, professional obligations to the people who serve as study groups for the archaeologist and anthropologist, diminishing resources, political action, and law, among others (Cheek and Keel 1984, Meighan 1984, Trigger 1980, Rosen 1980, Johnson et al. 1977, Johnson 1973). This is a pressing issue outside the United States as well (Lewin 1984, Cybulski et al. 1979). All these issues were brought in at one time or another during development of the North Carolina law. A deep division resulted among archaeologists over the

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need for and nature of such a law. But the process leading to enactment did serve to bring the state's Indians and archaeologists to the same table for discussion with the result that confrontation which might have had dire results for archaeological investigations was avoided.

Stimulus and Development

The concern of North Carolina's Indians for the bones of their ancestors can be traced back to at least September, 1974, when an article appeared in the newspaper **Carolina Indian Voice** which focused on the mortuary house display at Town Creek Indian Mound State Historic Site. Native American burials were displayed within the structure in the positions they had been found by archaeologists. Shortly after the critical newspaper article appeared, the windows of the mortuary house were covered. The display did not open again until mannequins were substituted for the skeletons.

Some 65,000 persons comprise the Indian population of North Carolina. About 5,000 are among the federally and state recognized Eastern Band of Cherokee Indians. The balance are recognized by the state. A number of local Indian tribes and organizations exist, while the North Carolina Commission of Indian Affairs (NCCIA) is the lead administrative agency at the state level. In 1973, the North Carolina General Assembly recognized the mutual interests of archaeologists and Indians when it approved a new law (North Carolina General Statute 143B-66, or NCGS 143B-66) which established the Archaeological Advisory Committee. The committee's charge is to review existing statutes, to make legislative recommendations regarding programs and statutes, and to advise the Department of Cultural Resources on the development of its archaeological programs. Committee membership comprises interested citizens, two legislators, an archaeologist, the Secretary of the Department of Cultural Resources, and two Indians, appointed respectively by the Eastern Band of Cherokee Indians and the Commission of Indian Affairs.

In 1978 and early 1979, new appointments were secured for the committee in light of perceived legislative needs. Legislative interest in protection of archaeological resources goes back to 1935 when "Indian Antiquities" (NCGS Chapter 70, Article 1) was enacted (see Appendix B). This law urges preservation of Indian sites on private land and commits state, county, and municipal agencies to report and preserve relics and sites of the same genre. The law makes it a misdemeanor to destroy or sell artifacts or other contents of Indian sites found on non-federal public property. By 1978, it was apparent that NCGS 70 was no longer adequate for the purposes it was intended. For example, there was no consideration of historic, non-Indian sites. There was no provision for maintaining confidentiality of archaeological site locations held by state agencies. Further, there was no institutionalized mechanism by which concerns of Native Americans could be addressed.

The intervening thirty-eight years had seen many changes which brought these kinds of issues to the attention of archaeologists. Laws about freedom of information were perceived to jeopardize the existence of archaeological sites if locational files were made public. Modern development, artifact collecting, pothunting, and erosion had all seriously depleted the publicly and privately held archaeological resources in the state. The discipline of archaeology had undergone drastic changes in theory, method, philosophy, as well as in the numbers of practitioners and their various settings of employment. The North Carolina Archaeological Council was established as a forum for discussion within the professional community. It was also in the 1960s and early 1970s that ethnic groups, particularly the American Indian, began asserting themselves. Direct challenges were presented nationally to archaeologists on a number of issues, particularly on the excavation and subsequent handling of Indian burials.

The Archaeological Advisory Committee (AAC) convened in March, 1979, to review existing legislation and to ponder needed changes. Also in that month, the North Carolina Archaeological Council (NCAC) established a legislative committee to work with the AAC. In May, 1979, the AAC again convened to consider more specific recommendations on site vandalism, public access to archaeological site information, artifact sales, and Native American burials, among other topics (Archaeological Advisory Committee 1980). Legislation from other states was reviewed in consideration of possible new North Carolina laws.

Policies, guidelines, and statutes have been enacted in other states and by the National Park Service, United States Department of the Interior. According to Oregon Revised Statutes 97.740 to 97.750, archaeologists may excavate Indian burials after prior written notification to the State Historic Preservation Office and to an appropriate Indian organization. All remains must be reinterred after analysis. In Santa Cruz County, California, a 1977 ordinance could result in construction delays for up to 75 days in order to excavate and remove burials of "cultural significance." Accidental discovery results in work stoppage within 200 feet of the discovery. Bones are disposed of in a fashion satisfactory to local Native American groups. In Iowa, Chapter 305A of the state statutes gives the state archaeologist authority to deny excavation of burials. That person is also given responsibility for reinterment of remains more than one hundred fifty years old.

In 1979, the federal government issued an interim policy on human remains (United States Department of the Interior 1979) which reflected the increasing concern of Native Americans and others. The federal policy contained wording which would appear in discussions about North Carolina legislation; namely, consultation was required with groups when burials were determined to have "...scientifically demonstrable ethnic affinity to specific living groups...." (U.S. Department of the Interior 1979: 1). Consultation was also to be afforded to groups who claimed some less clear affiliation. However, it was the responsibility of any group to document and validate its claims of affinity. The interim policy was formally adopted as guidelines in 1982 (United States Department of the Interior 1982). The guidelines in use today retain virtually identical standards for consultation and identification of related groups.

Decisions about Native American burials in North Carolina were deferred until a joint Indian/archaeologist meeting was held on November 13, 1979. The meeting was attended by two physical anthropologists and six archaeologists from academic institutions, the chairman of the Archaeological Advisory Committee, four staff members of the Division of Archives and History (including the author), four staff members of the NCCIA, and three representatives from the Indian community at large. Indians affirmed their recognition of the value of archaeology to the study of their own history. They also expressed their desire to fulfill obligations to their Indian ancestors. Burial excavation was discussed by some Indians as a sacrilege as was the display of skeletal remains. They expressed a desire for reinterment of Indian burials.

Archaeologists and physical anthropologists discussed the contributions each field could make to the study of the Indian past. Specific issues that were addressed included the destruction of sites by development and pothunters, the uncertainties of identifying biological linkages between Indians of the past and present, the vagaries in discovery of skeletons, and the necessity for long-term or permanent curation of skeletal remains because of insufficient funds for analysis, the need for comparative studies, or the application of new analytical techniques. At least one archaeologist wanted to avoid legislating a consultation process. It was agreed that a committee of Indians and archaeologists would be established to develop means of consultation and cooperation. However, this committee never convened, apparently because no agreement could be reached on how many persons would participate from each interest group. It was decided in the Division of Archives and History that the Archaeology Branch would consult with the NCCIA to define objectives, priorities, and to develop a statement for distribution to the archaeological community.

By June, 1980, staff from both the NCCIA and the Archaeology Branch were selected and were instructed to re-establish their respective positions and to work toward mutually satisfactory middle ground. The primary Indian concerns were: protection of Indian burials equal to that afforded marked, non-Indian burials; consultation with archaeologists when Indian remains were excavated; and, reinterment of Indian remains after analysis. For the archaeologists, analysis and reinterment were the major issues. The values of skeletal research were emphasized and re-emphasized. The nature of osteological research, especially the reanalysis of collections and the adaptation of new and ever more informative techniques (e.g., Buikstra and Gordon 1981) was emphasized even more in an effort to deter any absolute requirements for reinterment.

These initial meetings focused on informal mechanisms which could achieve the desired objectives. This included a proposed committee of Indians, archaeologists, and physical anthropologists that would serve as a forum for consultation and would settle questions about the analysis and retention of Indian bones. However, it had also become clear that archaeologists had no clear legal authority to excavate or remove Indian or other burials at all. By virtue of excavating burials, archaeologists may have been violating state laws against desecration (NCGS 14-149; also Talmage 1982). However, the wording of NCGS 14-149 is more clearly intended for marked burials. To my knowledge, the issue of burial excavation by archaeologists had never been tested in the courts because of this law. Further, other persons (non-archaeologists) were clearly authorized to remove graves under terms of another state law (NCGS 65, Article 5). By October, 1980, efforts were redirected to legislation in order to overcome these two potential obstacles to the excavation of burials by archaeologists. The development of the phrases "unmarked human burial" and "unmarked human skeletal remains" was important since these apparently included all prehistoric burials of concern to the Indians as well as other burials of potential interest to archaeologists. The "unmarked burial" also produced something of a useful and distinctive niche among several vague state statutes.

In a long series of meetings, this committee argued and re-argued many points. The Indians were pushing for legislation requiring reinterment. The archaeologists opposed this and preferred less definite wording giving the Executive Director of the NCCIA ultimate authority and flexibility in regard to final disposition. This procedure eventually was adopted and provides for the possibility of permanent retention of skeletal remains. One Indian proposal expressed a desire for legislation prohibiting excavation of burials unless they were threatened by natural or other means of destruction, as well as a two year limit on analysis, with no allowance for destructive skeletal analysis. Finally, the archaeologists argued for and obtained proposed wording to eliminate any chance that previously recovered and stored skeletal collections could be subject to requests for reinterment.

In December, 1980, divisions in the Indian community threatened the success of any legislative development. The Eastern Band of Cherokee Indians did not feel their interests were represented adequately, primarily because they did not accept the authority of the NCCIA to speak for them. The Cherokee further demanded that they be consulted directly for any skeletal remains recovered in a vast expanse of western North Carolina, using a definition of tribal boundaries put forth by Charles E. Royce (1887). Finally, they desired wording to allow Indians to halt an excavation in progress, if they so desired.

Another, lesser, problem surfaced in January, 1981, in the form of concerns raised by the Division of Health Services and the office of the Chief Medical Examiner. This was overcome relatively easily by replacing general wording about the role of law enforcement officers with more specific terms addressing appropriate statutes and the role of county medical examiners.

In March, 1981, differences of opinion within the community of professional archaeologists became more pointed. The proposed burial law was cited as posing interference to basic research, as an infringement upon academic freedom, and as investing too much control with the Chief Archaeologist and with the Executive Director of the NCCIA. The dichotomy between Indians and archaeologists was characterized as that between two conflicting propositions of equal moral weight. Another commentary portrayed the proposed burial law as being anti-scientific, trendy, and an unfortunate precedent.

Legislative language for a burial law was introduced on April 2, 1981, as House Bill 715. In a lengthy letter dated April 13, 1981, to the House bill's sponsor, Representative Bertha Holt, a number of archaeologists formally expressed opposition to the proposed law, except in cases of accidental or isolated instances of discovery. The familiar objections were raised, as were the issues of the legal standing of Indians given vague descent from prehistoric ancestors, requirements for a large bureaucracy, lack of a sufficient number of skeletal analysts, and a charge that legislation was developed with inadequate input from those archaeologists most affected.

Resolution of these issues took place primarily in legislative subcommittees from this point on, given that a bill had been introduced. But committee resolution was preceded by other discussions. The NCAC met in April, 1981, to try to solve problems in wording. The NCAC Executive Committee eventually endorsed the burial law. Other NCAC communiques pointed out that archaeology had become politicized and that, further, the NCCIA would push for legislation prohibiting burial excavation if the proposed bill were stymied. It was further pointed out that this was very much an emotional and political issue for Indians and that they could muster 2,000 Indian opinions for every archaeologist's in the State. It was time for cooperation, not for confrontation, and the NCAC action would be a basis for developing rapport with the Indian community.

The final formal objections of the archaeological community were overcome during the first two days in June, 1981. First at a meeting of a legislative committee and, subsequently, at a meeting of Indians, physical anthropologists, and archaeologists, language was developed providing separate procedures for Native American burials recovered during "long-term" research projects conducted by accredited colleges or universities in the state. This open-ended procedure removed some of the major obstacles, such as too much control by the Chief Archaeologist, but retained the consultation process between the Executive Director of NCCIA and the archaeologist.

The Eastern Band of Cherokee Indians one week later reiterated their dissatisfaction with the NCCIA fulfilling any role on their behalf. However, some specific wording about direct notification of the Eastern Band by the Executive Director apparently satisfied the Cherokees. A revised bill was introduced on June 12, 1981. It was approved by the legislature on July 7, 1981, to take effect on October 1, 1981.

IMPLEMENTATION

Chapter 70, Article 3 ("Unmarked Human Burial and Human Skeletal Remains Protection Act") of the General Statutes of North Carolina has been applied with reasonable effectiveness relative to the stated purposes for its enactment: namely, to avert vandalism and destruction, to provide protection, to obtain scientific information about the skeletal remains, and to establish procedures for interested persons to make known their concerns about disposition. The law further outlines procedures and penalties (Appendix).

Discovery of skeletal remains prompts one of two courses of implementation. Under the first, skeletons recovered during surveys or test excavations are to be dealt with by the Chief Archaeologist, Archaeology Branch, after notification of discovery by the field archaeologist. The Chief Archaeologist in turn notifies the Chief Medical Examiner. The Executive Director, NCCIA, is notified if, in the opinion of the excavating archaeologist, the bones are Native American. If non-Indian, and if in his or her jurisdiction, the Chief Archaeologist must attempt to locate next of kin or to identify the deceased. Under this first option, the field archaeologist, a skeletal analyst, and the Chief Archaeologist consult to develop a proposal for analysis, if such will provide scientific information. This forms the basis for negotiations between the Executive Director and the Chief Archaeologist, for example, as to who will conduct analysis, how it will be accomplished, and a timetable.

The second, or long-term, archaeological research project option eliminates the role of the Chief Archaeologist, if the field archaeologist so desires. The minimum definition of "long-term research" is a project of four or more weeks' duration continuing for one or more field seasons. After fieldwork is completed, the archaeologist and the Executive Director determine a schedule for skeletal analysis.

Under the first option, negotiations between the Executive Director, NCCIA, and the Chief Archaeologist have been mutually very satisfactory. The NCCIA has shown considerable flexibility regarding skeletal analysis. For example, in the first negotiated case (late

Summer, 1982), it was agreed that three years would be allowed for skeletal research on five burials. From each skeleton, twenty grams of rib fragments are to be retained permanently for future analysis. That agreement also provides for retention of pathological or unique bóne specimens. In another case, ten grams of bone are being retained from each burial, in addition to two 200 gram samples from the same set of burials. In no case has the NCCIA opposed any form of non-destructive analysis. In one instance, a request for retention of a bone sample was denied after analysis was completed. In December, 1984, the NCCIA approved an agreement providing for ten years' curation of a skeletal collection. In a few instances, the Chief Archaeologist has not requested any curation period given the condition of the skeletal remains and the extremely limited amounts of potential scientific information. By the end of February, 1985, the Chief Archaeologist and the Executive Director, NCCIA, had negotiated a total of eleven cases.

In early 1984, the NCCIA clarified its stance on "destructive" osteological analysis. It is presently the policy of that office to allow bone preservation (i.e., treatment to halt deterioration) and reconstruction as part of the curation process so long as such practices are not destructive to the bone tissue. Consultation with the NCCIA prior to preservation or reconstruction is not necessary.

On several occasions, consultations have resulted from salvage excavations or site inspections conducted by the Archaeology Branch. This is a function anticipated during development of the burial law. However, that law provided no extra funds or staffing to accommodate any such contingencies. To date, projects have been handled using normal operating budgets. This creates some considerable strain given reduced funding levels in recent years. Funds have been applied to hire temporary field personnel, although professional and supervised non-professional volunteer labor have also been extremely helpful. Also, skeletal remains removed by the Archaeology Branch are normally investigated by a skeletal analyst under a contractual services agreement.

Although the Archaeology Branch is not necessarily involved formally in consultations under the second (or long-term research) option, the Chief Archaeologist usually is made aware of discoveries. It seems the NCCIA is accommodating these requests for analysis in essentially the same vein as when dealing with the Chief Archaeologist. However, the open-ended nature of the long-term research option presents distinctive problems. This has become apparent in consideration of a burial recovered in a western North Carolina county. The NCCIA notified the Eastern Band of Cherokee Indians and asked them to serve as the appropriate consulting group. The field archaeologist proposed to conduct destructive analysis and asked for a retention period of five years after completion of the project. The Cherokee objected to the destructive analysis and stated their opposition to indefinite phrases in the proposal linking curation to the duration of project fieldwork. They proposed a retention period of four years from the date of excavation and requested the return of almost sixty burials recovered prior to enactment of the burial law. It is important to note that the archaeologist's proposal was considered by the same Cherokee committee which dealt with the Tennessee Valley Authority on the issue of skeletons recovered from the Tellico Reservoir project in Tennessee. While the Tellico issue has been resolved, the North Carolina skeleton has brought to the surface what could be an ongoing problem for long-term research projects, despite what seems to be a fairly clear intent in the language of the state's burial law. This case remains unsettled as of February 28, 1985.

Educational efforts have been directed to the Native American and general publics to help resolve such problems. In the case of the Eastern Band of Cherokee Indians, archaeologists and a physical anthropologist later met with the Indians to discuss general research orientations and problems in the mountain area. In another instance, a physical anthropologist presented an extensive discussion of osteological research to the staff of the NCCIA. Archaeology Branch staff participated in a program on the new laws during an annual Indian Unity Conference. Finally, a brochure was printed and distributed which summarizes both the burial law and the Archaeological Resources Protection Act (NCGS 70, Article 2), also enacted in 1981.

Non-Indian burials have been treated under the terms of the new burial law as well. The frequency of involvement by the Archaeology Branch in such cases is on a much higher level than anticipated. In one instance, in Forsyth County, an unmarked historic cemetery was determined to be present in an area slated for residential development. Historic research about the property suggested names of several possible families who might have used the cemetery. Advertisement in accordance with terms of the law produced no descendants. The developer arranged for removal and analysis of the burials (Woodall et al. 1983).

The Archaeology Branch and other institutions have also participated in numerous other episodes involving unmarked burials of the historic period. At least two have involved searches for graves at former county homes for the indigent. In these cases, the question has been whether graves are present. The Archaeology Branch has restricted the scope of its investigations to making such determinations, rather than proceeding to actual removal. Funding limits and available staff time are the biggest constraints. Further, in the case of county homes, the county commissioners are authorized to remove contents of cemeteries (NCGS 65, Article 3). In general, we have found ourselves in the position of determining the presence/absence of graves in an effort to avoid unintentional disturbances.

In two cases, illegal display of unmarked burial remains has been halted. In a third case, skeletons were displayed but could not be proved to be from North Carolina. In such cases, the burden of proof as to origins falls to the state, according to an opinion from the Office of the Attorney General.

No prosecutions have been pursued for illegal excavations of unmarked burials. To date, no sufficient amounts of information have been gathered which would make prosecution feasible. The biggest difficulty, of course, is catching a perpetrator in the act, locating an eyewitness, or collecting other kinds of suitable evidence. Beyond that point, the local district attorney determines whether to prosecute. However, even in the absence of such evidence, the burial law has been used to deter possible vandalism. The Peachtree site in western North Carolina (31Ce6) has been preyed upon for years by pothunters with probes and shovels. Numerous burials have been disturbed. With cooperation of local law enforcement agencies, the site is now patrolled. Collectors have been encountered on site and informed of the law. But no one has actually been caught disturbing burials.

CONCLUSIONS

North Carolina's burial law has, in a large part, accomplished the aims for which it was designed; i.e., archaeologists may continue to recover burials, Native Americans are consulted, scientific analysis is allowed, and unmarked burials are protected by clear negative sanctions.

However, from the perspectives of archaeologists and physical anthropologists, there are obvious drawbacks inherent in the legislation. There must be a commitment of administrative time to notify and negotiate with the Native American community. There can be limitations on the scope of analytical procedures applied to the skeletal remains. Most significantly, there is the threat to an irreplaceable and valuable scientific data base if the Native Americans choose to reinter skeletons. This potential has been realized by the American Association of Physical Anthropologists (in 1982) and by the Society for American Archaeology (in 1983), both of whom have condemned laws like North Carolina's which allow skeletal remains to be removed from the laboratories and collections of archaeologists and physical anthropologists except when lineal descendancy can be demonstrated. However, late in 1984, the Society for American Archaeology rescinded its stance. Instead, the organization plans to develop guidelines for consideration by the various states as to how Native American skeletal remains should be handled (Don D. Fowler, personal communication, March, 1985).

This threat to the data base need not be irresolvable. In the Canadian province of British Columbia, Native American bones have been placed in a burial house subsequent to archaeological and osteological investigations (Cybulski 1975, 1977). The burial house is under control of the Indian groups. The bones are not reburied and could be reanalyzed in the future, if agreed to by the Indians. The burial house concept has been suggested to the NCCIA and to the Eastern Band of Cherokee Indians. As already stated, the NCCIA is aware of the importance and potential of osteological analysis and its contributions to understanding the heritage of North Carolina's Indians. Therefore, it would seem that a redoubled effort is in order to convince the Native Americans in the state that their concerns and those of archaeologists and physical anthropologists can be addressed mutually and satisfactorily if the burial house concept is adopted.

There are other needs as well. The Archaeology Branch needs funds and staff to deal with its increased workload generated by the law. This could include a position for an osteologist or increased funds to support contractual services for analysis. The same needs probably exist in the university system.

Finally, contact between Native Americans and archaeologists (and physical anthropologists) should be increased. As long as prehistory remains the major focus of the state's archaeologists, the Native Americans are potentially one of the strongest advocates of archaeological research. Their advocacy for archaeology needs to be clearly established, broadened in numbers, and coalesced into plans for action. Our focus should be on education about the progress and goals of archaeological and osteological studies related to North Carolina's past. Indian students can be invited to field schools or other excavations. Archaeological research programs could be directed to various areas of the state to simultaneously increase knowledge and to expand interest and opportunities for Native Americans.

Such needs exist with or without a burial law. The burial law removed an obstacle to realizing the potential within the Indian community. Further steps by archaeologists and physical anthropologists are necessary to achieve such goals.

EDITOR'S EPILOGUE*

Since this chapter was finished in February, 1985, the issues of excavation, analysis, and curation of prehistoric Native American skeletal remains have become more critical and potentially divisive within the archaeological community. A conference on reburial, sponsored by the Society for American Archaeology and the Society of Professional Archaeologists was held in June, 1985. A summary report of the conference indicates that the subject remains very controversial and will require much further work to resolve to the satisfaction of archaeologists, physical anthropologists, Native Americans, and other interested parties (Dincauze 1985). As this volume was going to press, a plenary session was held at the annual

*Portions prepared through personal communications with Mark A. Mathis, Archaeology Branch, NC Division of Archives and History, April, 1986.

meeting of the Society for American Archaeology on the issues surrounding excavation of human remains generally and Native American skeletal remains in particular.

Also in the past year, archaeologists in North Carolina have had further experience with the state burial law. Anyone who is interested in or involved in developing such laws should be aware of some of the practical results of the North Carolina legislation.

First, since passage in 1981, there has been a dramatic increase in the number of reports of skeletal remains discoveries. Whereas previous discoveries (e.g., during construction activities) were often reported only to local authorities, if at all, those reports are now being channeled to the Chief Archaeologist, North Carolina Division of Archives and History. As knowledge of the law spreads through the law enforcement community and into the general public, the numbers of cases grows. In fiscal year 1984-85, for example, approximately 10 cases required investigation, involving 15-20 individual burials. In fiscal year 1985-86 the number grew to 20 cases and 40 individuals, including one ossuary. Even though some cases turn out to involve non-human remains, all cases must be investigated.

The net effect of the law in this regard has been an increasing fiscal drain on the Archaeology Branch budget. Each case costs a minimum of $100-$200, and may run as high as $3000 for multiple burials (e.g., an ossuary), including all wages, travel and skeletal analysis.

Second, the law does not distinguish between unmarked historic and prehistoric burials. Under a recent letter opinion from the Attorney General's office, any grave or cemetery for which no records exist may be assumed under the unmarked burial law (G.S. 70). This could include any graves marked only with rough fieldstones or unreadable headstones. Thus, the law may pertain to abandoned pauper cemeteries, slave cemeteries and small family plots for which no identity can be established. Given the widespread presence of undocumented and abandoned cemeteries in North Carolina, the ramifications of G.S. 70 in this respect are clearly significant.

As urban areas expand, more and more abandoned historic cemeteries are discovered. Under G.S. 70, the responsibility for treatment of these burials lies solely with the Chief Archaeologist. While the physical anthropological value of these sites is undeniable, the potential costs of treatment--all of which must be borne by the office of the Chief Archaeologist--could easily and **have** exceeded viable budgetary limits. Under other existing laws (specifically G.S. 20), developers wishing to move cemeteries simply contract with a professional grave-mover who, at a cost ranging from $200-$300 per grave, quickly disinter all remains, place them in small boxes and reinter them elsewhere. The cost-per-grave is effectively similar to archaeological excavation; the major difference, aside from the data recovery, is the time required to do the job. Thus, developers may opt for a grave-mover to get the cemetery "problem" out of the way quickly, rather than postpone development while the slower archaeological excavations are conducted. At this writing, no final policy decisions have been reached regarding the treatment of abandoned historic cemeteries.

Efforts are now underway to clarify legal obligations and to secure the funding necessary to adequately deal with the growing number of burial discoveries, most of which occur during construction activities. Discussions also continue with the North Carolina Commission of Indian Affairs on the issue of reburial. No decision has been reached to date and no remains have been reburied. The process of notification and consultation between the Commission and the archaeological community has matured however, resulting in a viable system of cooperation and interaction.

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I am obliged to point out that I resisted some of Dr. Levy's requests to provide more specific details on the sources of information used in recounting the development of the burial law. I have chosen to do so because of my perception that divisions created between archaeologists, and between archaeologists and Indians, have not healed and may never be. I believe the protagonists and antagonists of the burial law were acting in the best interests of their respective positions. To "name names" would likely rekindle hostilities which are better put behind us. If I am subsequently accused of being less scholarly or somewhat cowardly, so be it. While I certainly accept responsibility for any errors contained herein, I do vouch for the accuracy of the reactions and positions as described.

Finally, I thank Ms. Dee Nelms whose determination, fastidiousness, and patience in use of a distantly located word processor reflected a typical above-average performance.

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Appendix B. Chapter 70, Article 3, North Carolina General Statutes.

ARTICLE 3.

Unmarked Human Burial and Human Skeletal Remains Protection Act.

§ 70-26. Short title.

This Article shall be known as "The Unmarked Human Burial and Human Skeletal Remains Protection Act." (1981, c. 853, s. 2.)

Editor's Note. — Session Laws 1981, c. 853, s. 6, makes the act effective Oct. 1, 1981.

§ 70-27. Findings and purpose.

(a) The General Assembly finds that:
(1) Unmarked human burials and human skeletal remains are subject to vandalism and inadvertent destruction at an ever-increasing rate;
(2) Existing State laws do not provide adequate protection to prevent damage to and destruction of these remains;
(3) There is a great deal of scientific information to be gained from the proper excavation, study and analysis of human skeletal remains recovered from such burials; and
(4) There has been no procedure for descendants or other interested individuals to make known their concerns regarding disposition of these remains.

(b) The purpose of this Article is (i) to provide adequate protection from vandalism for unmarked human burials and human skeletal remains, (ii) to provide adequate protection for unmarked human burials and human skeletal remains not within the jurisdiction of the medical examiner pursuant to G.S. 130-198 that are encountered during archaeological excavation, construction, or other ground disturbing activities, found anywhere within the State except on federal land, and (iii) to provide for adequate skeletal analysis of remains removed or excavated from unmarked human burials if the analysis would result in valuable scientific information. (1981, c. 853, s. 2.)

§ 70-28. Definitions.

As used in this Article:
(1) "Chief Archaeologist" means the Chief Archaeologist, Archaeology Branch, Archaeology and Historic Preservation Section, Division of Archives and History, Department of Cultural Resources.
(2) "Executive Director" means the Executive Director of the North Carolina Commission of Indian Affairs.
(3) "Human skeletal remains" or "remains" means any part of the body of a deceased human being in any stage of decomposition.
(4) "Professional archaeologist" means a person having (i) a postgraduate degree in archaeology, anthropology, history, or another related field with a specialization in archaeology, (ii) a minimum of one year's experience in conducting basic archaeological field research, including the excavation and removal of human skeletal remains, and (iii) designed and executed an archaeological study and presented the written results and interpretations of such study.
(5) "Skeletal analyst" means any person having (i) a postgraduate degree in a field involving the study of the human skeleton such as skeletal biology, forensic osteology or other relevant aspects of physical anthropology or medicine, (ii) a minimum of one year's experience in conducting laboratory reconstruction and analysis of skeletal remains, including the differentiation of the physical characteristics denoting cultural or biological affinity, and (iii) designed and executed a skeletal analysis, and presented the written results and interpretations of such analysis.
(6) "Unmarked human burial" means any interment of human skeletal remains for which there exists no grave marker or any other historical documentation providing information as to the identity of the deceased. (1981, c. 853, s. 2.)

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§ 70-29. Discovery of remains and notification of authorities.

(a) Any person knowing or having reasonable grounds to believe that unmarked human burials or human skeletal remains are being disturbed, destroyed, defaced, mutilated, removed, or exposed, shall notify immediately the medical examiner of the county in which the remains are encountered.

(b) If the unmarked human burials or human skeletal remains are encountered as a result of construction or agricultural activities, disturbance of the remains shall cease immediately and shall not resume without authorization from either the county medical examiner or the Chief Archaeologist, under the provisions of G.S. 70-30(c) or 70-30(d).

(c) (1) If the unmarked human burials or human skeletal remains are encountered by a professional archaeologist, as a result of survey or test excavations, the remains may be excavated and other activities may resume after notification, by telephone or registered letter, is provided to the Chief Archaeologist. The treatment, analysis and disposition of the remains shall come under the provisions of G.S. 70-34 and 70-35.
(2) If a professional archaeologist directing long-term (research designed to continue for one or more field seasons of four or more weeks' duration) systematic archaeological research sponsored by any accredited college or university in North Carolina, as a part of his research, recovers Native American skeletal remains, he may be exempted from the provisions of G.S. 70-30, 70-31, 70-32, 70-33, 70-34 and 70-35(c) of this Article so long as he:
a. Notifies the Executive Director within five working days of the initial discovery of Native American skeletal remains;
b. Reports to the Executive Director, at agreed upon intervals, the status of the project;
c. Curates the skeletal remains prior to ultimate disposition; and
d. Conducts no destructive skeletal analysis without the express permission of the Executive Director.

Upon completion of the project fieldwork, the professional archaelogist, in consultation with the skeletal analyst and the Executive Director, shall determine the schedule for the completion of the skeletal analysis. In the event of a disagreement, the time for completion of the skeletal analysis shall not exceed four years. The Executive Director have authority concerning the ultimate disposition of the Native American skeletal remains after analysis is completed in accordance with G.S. 70-35(a) and 70-36(b) and (c).

(d) The Chief Archaeologist shall notify the Chief, Medical Examiner Section, Division of Health Services, Department of Human Resources, of any reported human skeletal remains discovered by a professional archaeologist. (1981, c. 853, s. 2.)

§ 70-30. Jurisdiction over remains.

(a) Subsequent to notification of the discovery of an unmarked human burial or human skeletal remains, the medical examiner of the county in which the remains were encountered shall determine as soon as possible whether the remains are subject to the provisions of G.S. 130-198.

(b) If the county medical examiner determines that the remains are subject to the provisions of G.S. 130-198, he will immediately proceed with his investigation.

(c) If the county medical examiner determines that the remains are not subject to the provisions of G.S. 130-198, he shall so notify the Chief Medical Examiner. The Chief Medical Examiner shall notify the Chief Archaeologist of the discovery of the human skeletal remains and the findings of the county medical examiner. The Chief Archaeologist shall immediately take charge of the remains.

(d) Subsequent to taking charge of the human skeletal remains, the Chief Archaeologist shall have 48 hours to make arrangements with the landowner for the protection or removal of the unmarked human burial or human skeletal remains. The Chief Archaeologist shall have no authority over the remains at the end of the 48-hour period and may not prohibit the resumption of the construction or agricultural activities without the permission of the landowner. (1981, c. 853, s. 2.)

§ 70-31. Archaeological investigation of human skeletal remains.

(a) If an agreement is reached with the landowner for the excavation of the human skeletal remains, the Chief Archaeologist shall either designate a member of his staff or authorize another professional archaeologist to excavate or supervise the excavation.

(b) The professional archaeologist excavating human skeletal remains shall report to the Chief Archaeologist, either in writing or by telephone, his opinion on the cultural and biological characteristics of the remains. This report shall be transmitted as soon as possible after the commencement of excavation, but no later than two full business days after the removal of a burial.

(c) The Chief Archaeologist in consultation with the professional archaeologist excavating the remains, shall determine where the remains shall be held subsequent to excavation, pending other arrangements according to G.S. 70-32 or 70-33.

(d) The Department of Cultural Resources may obtain administrative inspection warrants pursuant to the provisions of Chapter 15, Article 4A of the General Statutes to enforce the provisions of this Article, provided that prior to the requesting of the administrative warrant, the Department shall contact the affected landowners and request their consent for access to their land for the purpose of gathering such information. If consent is not granted, the Department shall give reasonable notice of the time, place and before whom the administrative warrant will be requested so that the owner or owners may have an opportunity to be heard. (1981, c. 853, s. 2.)

§ 70-32. Consultation with the Native American Community.

(a) If the professional archaeologist determines that the human skeletal remains are Native American, the Chief Archaeologist shall immediately notify the Executive Director of the North Carolina Commission of Indian Affairs. The Executive Director shall notify and consult with the Eastern Band of Cherokee or other appropriate tribal group or community.

(b) Within four weeks of the notification, the Executive Director shall communicate in writing to the Chief Archaeologist, the concerns of the Commission of Indian Affairs and an appropriate tribal group or community with regard to the treatment and ultimate disposition of the Native American skeletal remains.

(c) Within 90 days of receipt of the concerns of the Commission of Indian Affairs, the Chief Archaeologist and the Executive Director, with the approval of the principal tribal official of an appropriate tribe, shall prepare a written agreement concerning the treatment and ultimate disposition of the Native American skeletal remains. The written agreement shall include the following:

(1) Designation of a qualified skeletal analyst to work on the skeletal remains;

(2) The type of analysis and the specific period of time to be provided for analysis of the skeletal remains;

(3) The timetable for written progress reports and the final report concerning the skeletal analysis to be provided to the Chief Archaeologist and the Executive Director by the skeletal analyst; and

(4) A plan for the ultimate disposition of the Native American remains subsequent to the completion of adequate skeletal analysis.

If no agreement is reached within 90 days, the Archaeological Advisory Committee shall determine the terms of the agreement. (1981, c. 853, s. 2.)

§ 70-33. Consultation with other individuals.

(a) If the professional archaeologist determines that the human skeletal remains are other than Native American, the Chief Archaeologist shall publish notice that excavation of the remains has occurred, at least once per week for four successive weeks in a newspaper of general circulation in the county where the burials or skeletal remains were situated, in an effort to determine the identity or next of kin or both of the deceased.

(b) If the next of kin are located, within 90 days the Chief Archaeologist in consultation with the next of kin shall prepare a written agreement concerning the treatment and ultimate disposition of the skeletal remains. The written agreement shall include:

(1) Designation of a qualified skeletal analyst to work on the skeletal remains;

(2) The type of analysis and the specific period of time to be provided for analysis of the skeletal remains;

(3) The timetable for written progress reports and the final report concerning the skeletal analysis to be provided to the Chief Archaeologist and the next of kin by the skeletal analyst; and

(4) A plan for the ultimate disposition of the skeletal remains subsequent to the completion of adquate skeletal analysis.

If no agreement is reached, the remains shall be handled according to the wishes of the next of kin. (1981, c. 853, s. 2.)

§ 70-34. Skeletal analysis.

(a) Skeletal analysis conducted under the provisions of this Article shall only be accomplished by persons having those qualifications expressed in G.S. 70-28(5).

(b) Prior to the execution of the written agreements outlined in G.S. 70-32(c) and 70-33(b), the Chief Archaeologist shall consult with both the professional archaeologist and the skeletal analyst investigating the remains.

(c) The professional archaeologist and the skeletal analyst shall submit a proposal to the Chief Archaeologist within the 90-day period set forth in G.S. 70-32(c) and 70-33(b), including:

(1) Methodology and techniques to be utilized;

(2) Research objectives;

(3) Proposed time schedule for completion of the analysis; and

(4) Proposed time intervals for written progress reports and the final report to be submitted.

(d) If the terms of the written agreement are not substantially met, the Executive Director or the next of kin, after consultation with the Chief Archaeologist, may take possession of the skeletal remains. In such case, the Chief Archaeologist may ensure that appropriate skeletal analysis is conducted by another qualified skeletal analyst prior to ultimate disposition of the skeletal remains. (1981, c. 853, s. 2.)

§ 70-35. Disposition of human skeletal remains.

(a) If the skeletal remains are Native American, the Executive Director, after consultation with an appropriate tribal group or community, shall determine the ultimate disposition of the remains after the analysis.

(b) If the skeletal remains are other than Native American and the next of kin have been identified, the next of kin shall have authority concerning the ultimate disposition of the remains after the analysis.

(c) If the Chief Archaeologist has received no information or communication concerning the identity or next of kin of the deceased, the skeletal remains shall be transferred to the Chief Archaeologist and permanently curated according to standard museum procedures after adequate skeletal analysis. (1981, c. 853, s. 2.)

§ 70-36. Financial responsibility.

(a) The provisions of this Article shall not require that the owner of the land on which the unmarked human burials or human skeletal remains are found, bear the cost of excavation, removal, analysis or disposition.

(b) If a determination is made by the Executive Director, in consultation with an appropriate tribal group or community, that Native American skeletal remains shall be reinterred following the completion of skeletal analysis, an appropriate tribal group or community may provide a suitable burial location. If it elects not to do so, it shall be the responsibility of the North Carolina Commission of Indian Affairs to provide a suitable burial location.

(c) The expense of transportation of Native American remains to the reburial location shall be borne by the party conducting the excavation and removal of the skeletal remains. The reburial ceremony may be provided by an appropriate tribal group or community. If it elects not to do so, the reburial ceremony shall be the responsiblity of the Commission of Indian Affairs. (1981, c. 853, s. 2.)

§ 70-37. Prohibited acts.

(a) No person, unless acting under the provisions of G.S. 130-198 through G.S. 130-201, shall:

(1) Knowingly acquire any human skeletal remains removed from unmarked burials in North Carolina after October 1, 1981, except in accordance with the provisions of this Article;

(2) Knowingly exhibit or sell any human skeletal remains acquired from unmarked burials in North Carolina; or

(3) Knowingly retain human skeletal remains acquired from unmarked burials in North Carolina after October 1, 1981, for scientific analysis beyond a period of time provided for such analysis pursuant to the provisions of G.S. 70-32, 70-33 and 70-34, with the exception of those skeletal remains curated under the provisions of G.S. 70-35.

(b) Other provisions of criminal law concerning vandalism of unmarked human burials or human skeletal remains may be found in G.S. 14-149. (1981, c. 853, s. 2.)

§ 70-38. Rule-making making authority.

The North Carolina Historical Commission may promulgate rules and regulations to implement the provisions of this Article. (1981, c. 853, s. 2.)

§ 70-39. Exceptions.

(a) Human skeletal remains acquired from commercial biological supply houses or through medical means are not subject to the provisions of G.S. 70-37(a).

(b) Human skeletal remains determined to be within the jurisdiction of the medical examiner according to the provisions of G.S. 130-198 are not subject to the prohibitions contained in this Article. (1981, c. 853, s. 2.)

§ 70-40. Penalties.

(a) Violation of the provisions of G.S. 70-29 is a misdemeanor.

(b) Violation of the provisions of G.S. 70-37(a) is a Class H felony. (1981, c. 853, s. 2.)