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The Interrelationship of Status and Health in the Tellico Reservoir: A Biocultural Analysis

Tracy K. Betsinger
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Tracy K. Betsinger entitled "The Interrelationship of Status and Health in the Tellico Reservoir: A Biocultural Analysis." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Richard L. Jantz, Major Professor

We have read this thesis and recommend its acceptance:

Faye Harrison, Charles Faulkner

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

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

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THE INTERRELATIONSHIP OF STATUS AND HEALTH IN THE TELLICO RESERVOIR: A BIOCULTURAL ANALYSIS

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

Tracy K. Betsinger
August 2002

DEDICATION

This thesis is dedicated to my parents, Gary and Judith Betsinger, whose love and support has surpassed all my hopes and expectations; their guidance and encouragement has helped me to set and achieve my goals. This thesis is also dedicated in loving memory of my grandparents, Warren and Signa Betsinger and George and Pelegia Eckert, who could not be here to share in this milestone.

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I wish to thank all those who have helped me in completing this thesis. First and foremost I would like to thank Dr. Maria Smith, who, although she could not be an official member of my thesis committee, offered suggestions and assistance throughout this process. I owe a great debt of gratitude to the members of my committee: Dr. Richard Jantz, who chaired the committee and aided in the statistical analysis, Dr. Faye Harrison, who offered insightful biocultural questions, and Dr. Charles Faulkner, who assisted in the archaeological background. Their guidance and comments have been invaluable.

I would also like to thank members of the staff at McClung Museum for access to the skeletal collections and archaeological field notes, including Dr. Lynne Sullivan, Bob Pennington, and Kristina Arnold. I am indebted to several other graduate students, especially Nicole Kuemin-Drews for sharing her time and knowledge, Jennifer Synstelien for assisting me with the statistical analysis, and Jennifer Barber and Robyn Miller for commenting on drafts of this thesis. Finally, I would like to thank my family and friends for their suggestions and encouragement.

ABSTRACT

Anthropologists have been interested in the interaction of health and status in prehistoric populations for many years. Utilizing a biocultural perspective, this paper will investigate how social stratification affected health at sites from the Tellico Reservoir in eastern Tennessee. These sites, Citico (40MR7), Toqua (40MR6), and Tomotley (40MR5), were occupied in the late Mississippian period in Tennessee, during the Dallas phase (A.D. 1300-1600) (Schroedl, 1998). Skeletal indicators of stress were used to determine the health of the people interred at the three sites, and burial location was utilized to establish the status of these people.

Intra-site and inter-site analyses were conducted on the data collected from 649 skeletal remains from the three sites. The intra-site analysis compared the occurrence of stress markers between mound burials and village burials at Citico and at Toqua, while the inter-site analysis compared stress indicator incidence between the two mounds, among the three villages, and between combined mound data and combined village data. A comparison of stress marker occurrence was also performed between males and females to determine whether gender differences affected the amount of stress endured.

The determination of status was another area of focus for this paper. Analyses were conducted in order to ascertain whether classes of burial goods based on raw material were correlated in any manner with the stress indicators. Positive and negative correlations could then be used to establish the status of an individual. Correlation tests were also used to analyze the association between periostitis and anemia. The two are

thought to have a synergistic relationship, in which the presence of one stress increases the susceptibility to the other stress.

The results of these various analyses indicate that there are differences in the incidence of stress markers based on status; individuals buried in mounds were less affected than individuals buried in villages. This outcome is probably due to differential distribution of food. Individuals in the Toqua mound were more stressed than those in the Citico mound, which may be the result of population size, and, therefore, food availability. Toqua village had the most stress of the three villages, which is possibly a function of political structure and food distribution. The results of the gender analysis suggest that both females and males were comparably stressed.

The correlation tests reveal that no significant relationship exists between stress markers and the classes of burial goods. As a result, the class of burial goods based on raw material cannot be used to determine the status of an individual. Finally, the correlation tests indicate that there is, indeed, a synergistic relationship between anemia and periostitis.

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CHAPTER I: INTRODUCTION

Biological anthropologists have long been interested in skeletal manifestations of nutritional deficiencies and stress in prehistoric populations. Various methods have been employed by researchers to determine whether a group was nutritionally stressed. A few studies have focused on long bone growth, especially of children (Armelagos et al., 1972; Hummert and Van Gerven, 1983; Humphrey, 2000; Jantz and Owsley, 1984; Johnston, 1962; Mensforth, 1985; Saunders, 1992), while others looked at more specific signs of stress, such as enamel hypoplasias, cribra orbitalia, and porotic hyperostosis (Goodman and Armelagos, 1988; Goodman et al., 1980; Martin et al., 1985; Mittler and Van Gerven, 1994). During the 1980s, when the use of life tables was quite popular, a number of studies employed them in order to demonstrate the correlation of stress indicators and mortality (Hummert and Van Gerven, 1983; Parham, 1982; Van Gerven et al., 1981). A continuing trend is "...toward the use of multiple indicators, systematically analyzed to provide an understanding of nutritional stress" (Goodman et al., 1988:178). This type of multi-focal analysis attempts to offer a more complete and, hence, accurate picture of life in prehistoric times. Biological anthropologists, studying a range of populations, have taken on this approach to facilitate a more comprehensive study of the group in question (Armelagos et al., 1981; Armelagos et al., 1984; Cook, 1984; Goodman et al., 1984; Goodman et al., 1988; Parham, 1982).

Another area of interest for anthropologists, in general, is status. It is especially applicable when an archaeological site is dated to the Mississippian period, during which social stratification is believed to have been a common occurrence (Chapman, 1994;

Hudson, 1976; Parham, 1982; Powell, 1988). Researchers have studied status in conjunction with a number of different elements, including distribution of food (Bogan, 1980; Davenport, 1999; VanDerwarker, 1999), mortuary patterning (Hatch, 1974; Scott, 1983), and trade networks (Sabol, 1977). Some biological anthropologists examine the relationship between nutritional stress and status (Hatch and Willey, 1974; Hatch et al., 1983; Parham, 1982; Powell, 1988; Robb et al., 2001). Their research questions usually focus on whether higher status individuals were healthier than lower status community members.

This comparison of the health of high and low status individuals can offer insights into the interactions among various social entities within a prehistoric population. While this type of study has been carried out to a limited degree, it is evident that there is a need for more comprehensive investigations of health and status at multiple sites within the Mississippian complex. The study to be undertaken here will examine the skeletal expressions of status at three Dallas phase sites, Citico (40MR7), Toqua (40MR6), and Tomotley (40MR5). The Dallas phase is a manifestation of the late Mississippian period in eastern Tennessee, approximately A.D. 1300-1600 (Schroedl, 1998). A select group of health indicators will be used to assess whether one status group was more stressed than another. A number of inter- and intra-site comparisons will also be conducted.

Throughout this thesis, a biocultural perspective is utilized in order to produce a more complete analysis of the sites. A biocultural approach "...incorporate[s] the diversity of knowledge and approaches in anthropology and...provide[s] an effective framework for analysis of how the processes of inequality and social change interact with human biologies" (Goodman and Leatherman, 1998:4). In other words, this type of perspective offers cultural insights as well as biological insights into the lives of past peoples. By combining these viewpoints into one synthetic approach, more profound questions can be asked and researched. Traditionally, biological anthropology is interested in how humans came to possess certain physical conditions. For example, a biological anthropologist may be interested in why a certain segment of a society has growth retardation. The researcher may come to the conclusion that the slowed growth was the result of malnutrition, and that this social entity had limited access to food. However, he/she may not go any further with the investigation. A biocultural approach takes into account this type of information and asks why, i.e., why does this group have restricted access to food resources?

A biocultural synthesis integrates two main areas of cultural or sociocultural anthropology: political ecology and political economy. Political ecology focuses on the effects of environment, power, and interaction of the local and the global on communities and individuals. Political economy examines several related topics, including social relations and the control of resources. Integrating these two paradigms into a biocultural approach enables researchers to investigate "...biological variation in terms of *social relations* through which individuals gain access to basic resources and labor" (Goodman and Leatherman, 1998:19). These "relations of power" determine which entities receive certain resources, such as food, as well as which groups will be exposed to various stresses, including pathogens, and are the basis of observed inequalities. Analysis of the health and nutrition of ancient groups can be more completely understood when the effects of politics and power are taken into account (Goodman and Leatherman, 1998).

The following description of the people inhabiting the three sites used in this thesis draws on information from ethnohistorical data and from archaeological data. Together, they provide a probable scenario of what life was like during the Mississippian period, including the political atmosphere. This information will later be utilized to make inferences about and to generate possible conclusions from the observed data.

Mississippian Culture

The inception of the Mississippian culture in North America was approximately A.D. 700-A.D. 900, centering upon the mid-Mississippi River area. From this origin, the Mississippian culture spread throughout many adjacent areas, including the Southeast. It lasted nearly 900 years, terminating in the 1600s with invasion and expansion of European settlers. The consequences of this cultural development included increased population and larger, more permanent towns. Two of the largest Mississippian towns are Cahokia, in present-day Illinois, and Moundville, located in what is now Alabama. However, the magnitude of these sites is more the exception rather than the rule. While there are larger sites dating from the Mississippian period than from any prior one, many of the Mississippian sites are more modest in size. Sites range in size from a single homestead or small hamlet to a large town, represented by Cahokia and Moundville (Schroedl, 1998). The social function of the sites varied as well; some of the large sites with one or more mounds are believed by archaeologists to be ceremonial centers. Ceremonial centers, however, were not necessarily population centers, as archaeological evidence shows that many small villages were often located within a few miles of a large, mounded site. Members of the society may have chosen, or been required, to live in these small, often fortified towns rather than in the village proper (Hudson, 1976).

As with any archaeological period or culture, there are features associated with the Mississippian culture, including increased population size, more permanent settlements, increased threat of warfare, dependence upon agriculture, and changes in ceramics (Chapman, 1994). The most characteristic Mississippian feature is the "…flat-topped, pyramidal earthen mound… that served as the foundation… for temples or mortuaries, chiefs' houses, and other important buildings" (Hudson, 1976:78). A mound was usually constructed at a larger site and included a ramp located at the face of the mound for access to its summit. Lewis and Kneberg in their 1955 work, The First Tennesseans, termed these mounds "…temple mounds, since their purpose was to give greater prominence to the temples which they supported" (1955:47). While the function of mound buildings may be subject to debate, archaeological research has uncovered evidence of these structures that were once situated on the summit of the mounds. The structures were usually divided into two areas: a smaller room in the back of the building and a large anterior room with a central fireplace. These buildings appear to have been destroyed periodically, the intentionality of which remains unclear. Once the structures were torn down, a layer of earth from a nearby borrow pit was placed over the entire mound, thereby increasing the size. Such enlargements occurred as many as eight or ten times at some sites. In some cases, mounds have been reported to reach 100 feet in height as the result of such additions (Hudson, 1976; Lewis and Kneberg, 1955, 1958).

Another typical feature of Mississippian sites is the large plaza located in front of the mound, which many archaeologists hypothesize served as a common area for ceremonies, games, and other activities. Along the edges of the plaza, dwellings were situated, in addition to smaller mounds and public buildings. These houses were of a more permanent nature than those found in earlier periods and included clay covered walls, sleeping benches, and hearths. Many Mississippian sites had a palisade surrounding the village as a whole. Other sites had water-filled ditches around the perimeter of the town. These defensive structures indicate that the threat of warfare and/or raiding were common throughout this time period (Chapman, 1994; Hudson, 1976; Lewis and Kneberg, 1955).

One of the major foundations of the Mississippian culture was the reliance on intensive agriculture, especially of corn, beans, and squash. As a result, many villages were established near the bottomlands of old river and stream channels, which contained the best agricultural soil. These areas of riverine soil were flooded annually, renewing the nutrients that had been leached by crops. The result was the prolonged use of the soil; it could be cultivated over more years due to the nutrient renewal. The cultivation of corn did not eliminate the need or desire for naturally occurring foodstuffs. Hunting and gathering remained important, offering meat, nuts, and berries to supplement the agricultural diet. Important energy sources for Mississippian peoples included fish, migratory waterfowl, deer, turkey, raccoon, acorns, walnuts, cherries, and plums. Natural vegetation was selectively removed in order to have access to optimum agricultural soil. Cultigens, such as pumpkins, gourds, and sunflowers, which were often grown during earlier periods, also continued to be cultivated, albeit to a lesser degree (Chapman, 1994; Hudson, 1976; Lewis and Kneberg, 1958; Smith, 1978).

Archaeologists classify the political organization of the Mississippian culture as a chiefdom, based on comparisons with historic and contemporary ethnographic information (Powell, 1988). Charles Hudson describes the political structure of

Mississippian communities based on both archaeological evidence and historic ethnographic information:

> The best evidence we have indicates that the degree of centralization of authority in the Southeastern chiefdoms stood somewhere between the tribe and the state. As the name implies, the Southeastern chiefdoms had chiefs, but in historic times these chiefs led their people more than they commanded them. These chiefdoms were not completely egalitarian, but neither were they stratified into classes of people who differed greatly in hereditary wealth. Within a chiefdom, Southeastern Indian men ranked themselves in terms of a strict hierarchy, from highest to lowest, partly with respect to age, and partly with respect to their accomplishments... (1976:202-203).

Centralization of authority included the control of information, goods, and services that were important to members of the community. Not all villages, however, had comparable amounts of centralized authority. The power of the chiefs varied from village to village, and the power of all Mississippian chiefs deteriorated with European colonization (Hudson, 1976; Powell, 1988). While Hudson may not have believed that stratification based on differences in hereditary wealth existed, stratification probably did, in fact, occur. Hereditary ranking of lineages would have most likely been the type of stratification found in these groups, with "...the chief and his lineage and related lineages...set off from the rest of the people, forming in a sense a hereditary nobility" (Chapman, 1994:77). Lineages may not have been the only source of status within a Mississippian community. An individual's status most likely fell along a continuum between high and low and was based not only on ascribed status, but on achieved status as well.

As previously stated, archaeological investigations have uncovered the remains of large, rectangular buildings on mound summits. The conclusion many archaeologists have reached regarding these structures is that they housed chiefs or other higher status individuals. The large room would have been used for chiefly or other civil affairs, while the rear room would have been the private living space for the chief and his/her family (Hudson, 1976). Although it is impossible to know the exact aspects of political organization during the pinnacle of the Mississippian culture, historic information, nevertheless, offers glimpses into what may have been occurring in the Southeast during this time period.

Chiefdoms are generally characterized by redistribution, which is "…an institutionalized relationship of reciprocity between subject and chief" (Steponaitis, 1978:419). The subjects, or commoners, were expected to turn over excess goods to the chief, who in turn was expected to offer services or other goods to the subjects. The amount and type of redistribution was quite variable among chiefdoms, depending upon the extent of centralization and the magnitude of the chief's power. Simple chiefdoms consisting of only one level in their "political hierarchy" probably had a balanced "…flow of material goods between hierarchial levels…" while complex chiefdoms with two or more levels in their hierarchy had only "[a] semblance of reciprocity between chiefs and commoners…"(Steponaitis, 1978:420). In the latter case, the chief fulfilled his/her obligation through religious services or symbolic presentations, whereas the commoners' obligation remained the same as in simple chiefdoms, or in some cases, was increased (Steponaitis, 1978). Whether Mississippian chiefdoms were simple or more complex is as yet unknown. Archaeological information may offer more clues to this question.

The knowledge of social organization for Mississippian villages is mostly based on historic ethnographic information. While archaeological evidence offers minimal information regarding kinship groups, there is little reason to believe a major shift or change occurred between the inception of the Mississippian tradition and that which was observed in the 16th century by early explorers, such as Hernando de Soto. Mississippian "[s]ocial organization was based on kinship and structured through hereditary ranked lineages" (Chapman, 1994:74). These groups had a matrilineal kinship organization, meaning lines of descent were traced through female members of a family or kin group, and "blood" relatives were restricted to the mother's side of the family. This does not, however, imply that women were in charge, although Hernando de Soto reported meeting female chiefs who held significant amounts of power. Typically matrilineal groups managed and/or owned property, including houses and agricultural lands. Some matrilineal groups also held certain ceremonial rights that could be performed only by members of that kin group. Clans were an important part of kinship organization as well and could be made up of more than one matrilineage. Members of clans, while not able to show relationships through ancestral groups, still believed themselves to be related. In historic circumstances, each clan had an animal as its symbol. Whether this type of association occurred in prehistoric Mississippian groups is uncertain. Clans, unlike matrilineal kin groups, did not own or control property, but they remained a significant aspect of Mississippian social life (Hudson, 1976).

Ethnographic information is also the predominant source of information regarding the division of labor among Mississippian peoples. This division of labor was mainly based on sex. Females were responsible for activities involving the household such as working in the family garden, preparing food for consumption, gathering and carrying firewood, pottery- and basketry-making, gathering wild plants, nuts, and berries, and curing animal skins and making clothing out of them. Males, on the other hand, were predominantly responsible for activities involving the community as a whole: politics, warfare, ceremonies, and construction of buildings. While males cleared the land for the large agricultural fields, females were the ones who cultivated them. Males also made the tools and materials used in their activities. The main way in which males contributed to their households was through hunting game animals (Hudson, 1976). While there was a separation in daily activities based on sex, both females and males appear to have had arduous and strenuous lives. It is unclear whether males and females of all ranks participated in every responsibility. Certain high-ranking members of society, such as priests, chiefs, and others, may not have been required to perform some of these activities.

Trade was also occurring during the Mississippian period. Researchers believe that trade, hunting, and warfare were the main reasons people traveled during this time. Archaeological information regarding the extent and nature of trade is somewhat lacking. There is evidence, however, to show that Mississippian peoples were, indeed, trading. One question that remains is whether trade was intentional or incidental. That is, whether people traveled with the sole purpose of exchanging goods with another group or whether trade transpired only as the result of other factors and was not a regular or systematic occurrence (Hudson, 1976). It is apparent that "...the most important circuit of exchange was between the coast and the interior. [They]...traded salt, dried fish, [and] sea shells...for red ocher, red root, flint, hard cane, feather cloaks, pottery, and animal skins"

(Hudson, 1976:316). Conch shells from the coast appear to have been highly prized in Mississippian groups and were utilized for both decorative and serviceable purposes.

Ceramics have been used as an indicator of the Mississippian culture as well, especially in Tennessee. Shell tempering of the clay used to create various vessels was typical of this time period, while groups from earlier periods used limestone-tempered clay. A change in pottery shapes has also been noted, especially with regards to the variety of items made (Chapman, 1994). Jars, bottles, bowls, pans, and plates were all created by Mississippian peoples, and the "[s]mooth and often highly polished surfaces were characteristic of this pottery whose main types of decoration were painting and modeling" (Lewis and Kneberg, 1958:87). Both utilitarian and what is believed to be ceremonial ceramics have been discovered at Mississippian sites.

The peak of the Mississippian culture occurred around A.D. 1200, during which time it influenced the majority, if not all, of the groups residing in the southeastern United States. In this time of high development, "...the territory of the Mississippian [culture] expanded, and some of the large ceremonial sites were made even larger" (Hudson, 1976:84). The Mississippian culture is more complex than researchers first assumed. At one time, it was widely believed in the archaeological community that the Mississippian tradition had evolved in Mesoamerica and diffused northward into the southeastern United States. This theory is no longer supported. While the variety of corn utilized by the Mississippian peoples was domesticated in Central America and brought to the Southeast, it is apparent that the Mesoamerican influence was not as substantial as once believed (Hudson, 1976). The Mississippian culture was, instead, created along the Mississippi River, for which it was named and was "...built out of local cultural materials" (Hudson, 1976:95). This culture was not equally developed throughout the Southeast; the areas most profoundly influenced were in the general area of its origin, including most of Tennessee. The following statement accurately summarizes the complicated and complex nature of the Mississippian culture. "It can almost be said that the more archaeologists learn about the Mississippian [culture] the less they understand" (Hudson, 1976:94).

Dallas Phase

The Mississippian culture began to diffuse into eastern Tennessee at approximately A.D. 900. Four Mississippian phases are evidenced in eastern Tennessee, including: the Martin Farm phase (A.D. 900-1000), the Hiwassee Island phase (A.D. 1000-1300), the Dallas phase (A.D. 1300-1600), and the Mouse Creek phase (A.D. 1400-1600). Each phase is characterized by a number of different features, which make the phase distinguishable in the archaeological record (Schroedl, 1998).

Within the Dallas phase, which is named for a large site on Dallas Island in Tennessee (Chapman, 1994; Lewis and Kneberg, 1958), 33 sites have been discovered in the upper Tennessee River Valley, including Toqua (40MR6), Citico (40MR7), and Tomotley (40MR5). Toqua is one of four sites that have multiple mounds, Citico is one of many sites with a single mound, and Tomotley appears to be a small village or hamlet, lacking a mound. Toqua is often used as an example of Dallas village organization due to its size (Schroedl, 1998).

One of the major features of the Dallas phase that differentiates it from the prior phases is the inclusion of burials within the village proper, that is, within the palisades or other defensive structures. In the earlier two phases, interments were kept outside of the village, while in the Dallas phase, burials have been located in the mounds, under dwellings, and in areas surrounding various structures. In some cases, archaeologists believe that a burial may have been purposely located near the structure the deceased had once inhabited (Lewis and Kneberg, 1946, 1958; Schroedl, 1998). Schroedl emphasizes the importance of such a shift, stating:

> With the movement of burials into villages the spatial dimension of social status encompassed both the living and the dead. In the Dallas phase, mortuary patterning is accompanied by the increased definition of ritual or ceremonial space associated with mounds and its separation from domestic space. The division of ritual space from domestic space magnified and reinforced social differences (1998:86).

The reasons behind such a change are quite varied and include "… differences in economic, social, political, and ritual power that developed among extended lineages…" (Schroedl, 1998:86). These lineages competed with each other over their respective statuses, with each lineage wanting to increase their status over their rivals. It was through their achievements in the economic, social, political, and ritual realms that the lineages were able to gain power. The burial rituals were simply a method by which to "…reinforce, legitimize, and add longevity to differences in status among individuals in competing lineages" (Schroedl, 1998:86). Performing these burial rituals within the village ensured that rival lineages were able to observe the status and power of the deceased individual and his/her lineage. Burial practices became another means to demonstrate social rank and status. Various burial goods accompanied the deceased; it is assumed by some archaeologists that these items were owned and utilized by the person during their lifetime. A wide range of objects has been discovered in graves, such as ornaments, weapons, tools, and pottery and were made from a variety of sources, including stone, clay, shell, and animal bone. The items, which are thought to have designated an individual's status in life, were also used to indicate that person's status in death. Interring individuals within the village walls also safeguarded the burials from violation by rivals or enemies (Lewis and Kneberg, 1946, 1958; Schroedl, 1998).

Dallas village organization and settlement patterns are distinguishing characteristics as well. One of the most unique aspects of the village organization during the Dallas phase is the pair of structures found on the summit of mounds, as observed at Toqua. The structures, as described earlier, are thought to be those belonging to high-ranking members of the community. The organization of the paired structures differed from that of the singular building. Of the pair, one structure was usually larger than the other and may have been used for ceremonial purposes. The smaller structure then served as a private dwelling. Another interpretation of these structures is that they were used for public storage. It is uncertain whether these paired structures occurred at all Dallas towns and centers (Schroedl, 1998).

One of the current theories regarding Dallas settlement patterns is that there were at least four separate polities, each made up of a multi-mound center, a single mound center, and several small villages. This theory contends that all of these polities were inhabited throughout the Dallas phase, implying that there were four chiefdoms co-occurring. A contrary theory suggests that soil exhaustion and the resulting crop failure would have led to dispersion of populations or the relocation of centers and villages. Although annual flooding could restore nutrients for a time, it was not able to prevent soil exhaustion indefinitely. The four polities, therefore, would not have been contemporaneously inhabited throughout the Dallas phase. Instead, the polities represented the movement of Dallas chiefdoms from one area to the next as the soil nutrients were depleted. The possibility of more than one chiefdom in the area remains, although this theory suggests it is unlikely that there were as many as four of them. The centers and villages would have been abandoned and reoccupied at different times throughout the Dallas phase as the chiefdoms followed soil productivity. The various incidences of mound construction in which a new layer of earth was added to the mound could be considered evidence of this movement (Schroedl, 1998).

Stress

Mississippian life was often difficult, with various sources of stress affecting the physical well being of community members. Stress can be interpreted as any type of interruption of an individual's homeostasis or normal functions (Powell, 1988). Malnutrition and disease are two of the most common types of stress, and visible indicators of their occurrence during the Mississippian period are frequently discovered on skeletal remains. Mary Lucas Powell describes the importance of nutrition for Mississippian peoples in combating these stresses, stating:

> [t]he connecting link between the two key variables of ranked social organization and physical health is nutrition, an essential element of normal growth, development, and routine tissue maintenance. Differential exposure to pathogens may provide initial opportunities for variations in disease experience, but the strength of resistance permitted by the nutritional status of stressed individuals determines in great part the ultimate outcome of encounters between hosts and invaders (1988:33).

Powell makes clear the synergistic relationship between diet and disease, emphasizing the positive effect of good nutrition on both disease resistance and recuperation from disease.

Nutritional stress is often the result of multiple dietary deficiencies and usually involves inadequate calorie and quality protein intake. High quality protein, which is found in animal products, is essential throughout an individual's life, but is especially important in times of substantial growth, such as early childhood. Although Mississippian peoples continued to hunt and consume meat, the amounts were not always sufficient, and the protein available from the mixture of corn and beans may have been diminished by the methods of preparation (Powell, 1988). Also, allocation of foodstuffs, such as meat, in a chiefdom setting may have contributed to certain sectors of the community receiving little or no high quality protein. If children were part of the group that did not consume an adequate amount of meat, they would be more adversely affected than adults of that sector. Small children have "...limited capacities for caloric intake[, which] place[s] them at a distinct disadvantage vis-à-vis older children and adults for obtaining adequate protein intake from low-quality foods..." (Powell, 1988:38). They simply cannot consume enough calories or low-quality protein to make up for the lack of high-quality foods. The result of small children's protein deficiency is weanling diarrhea syndrome, which accounts for high levels of morbidity and mortality during this period of life (Powell, 1988).

Another common nutritional deficiency is anemia, which involves inadequate iron levels. Low levels of iron can occur not only from poor iron consumption, but also from hereditary factors and from pathological conditions, such as intestinal parasites. Anemia, while the result of poor iron levels, refers to abnormally low levels of hemoglobin (red blood cells) in the blood, which is responsible for carrying oxygen to various tissues in the body. The lack of oxygen reaching the body's tissues causes red bone marrow to make more red blood cells; the red bone marrow expands, exerting pressure on the surrounding bone. The compensatory expansion causes erosion of compact bone in the form of small holes, which can be seen on the cranial vault (porotic hyperostosis) or in the eye orbits (cribra orbitalia) (Powell, 1988; Stuart-Macadam, 1985). Figure 1 depicts the active form of porotic hyperostosis, Figure 2 shows the healed form, and Figure 3 illustrates active cribra orbitalia.

During periods of stress, the body adapts and responds by stopping growth, as routine maintenance is deemed more important. Slowed growth rates, prolonged skeletal maturation, and reduced adult body size may all occur as a result of chronic stress, such as malnutrition. If the stress is removed before adulthood, catch-up growth may occur, allowing the body to reach its genetically determined size. These alterations in growth (i.e., slowed growth, etc.) are indicators of stress, as well as responses to that stress. Dental growth arrest also occurs as a response to nutritional or other stresses. Growth arrest lines, termed enamel hypoplasias, attest to the stresses once endured by an individual (Powell, 1988) (see Figure 4).

While chronic stress often results in growth arrest, other types of acute stress cause lesions, such as porotic hyperostosis and cribra orbitalia, that "...do not interfere with normal physiological functions" (Powell, 1988:40). These "stress indicators" can be utilized to gain insights into the health and well-being of people living during the Mississippian period. There are some limitations to these stress markers, such as their nonspecific nature, which means a specific disease or deficiency may not be diagnosed from the lesions. Some of the markers may be lost due to bone remodeling or tooth wear and attrition. Also, the length and intensity of an episode of stress cannot be determined

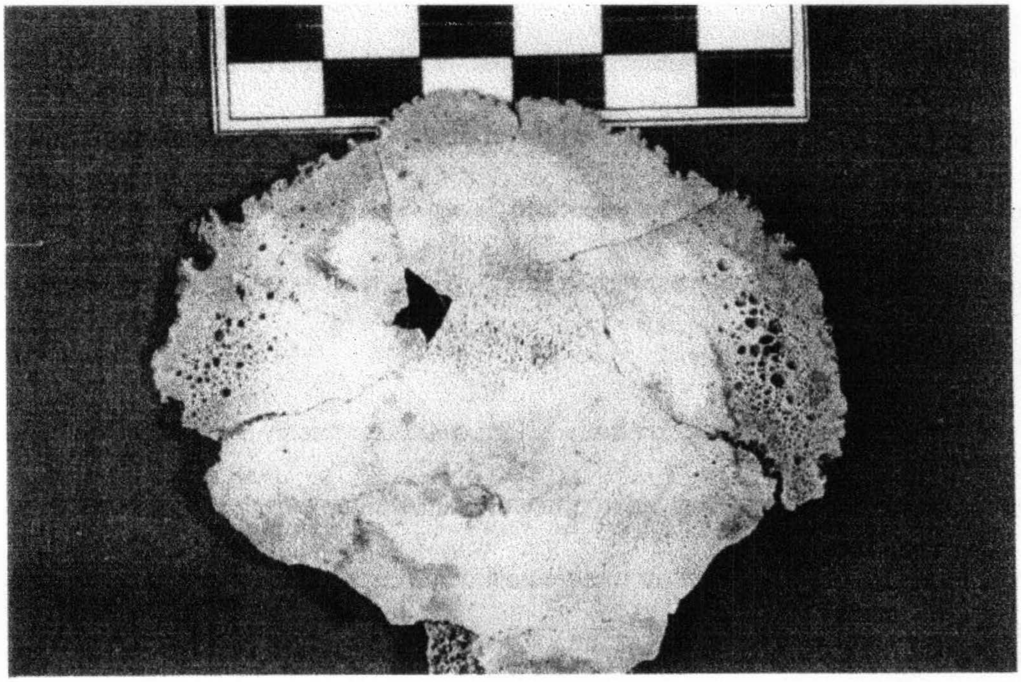

Figure 1: Active porotic hyperostosis on occipital of Toqua (40MR6) burial no. 37.

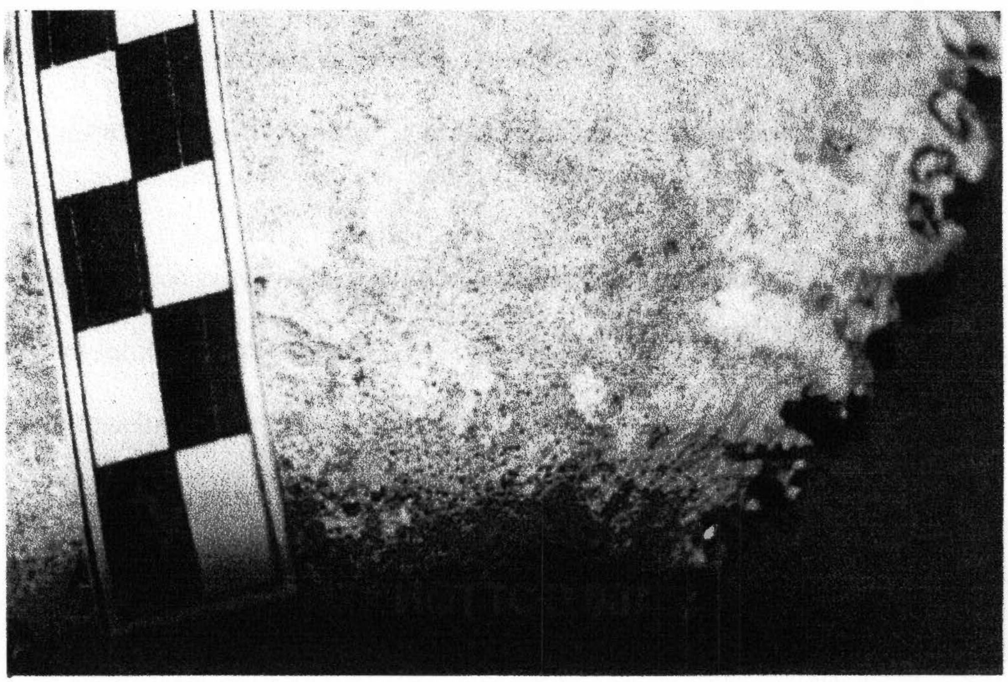

Figure 2: Healed porotic hyperostosis on parietal of Citico (40MR7) burial no. 20.

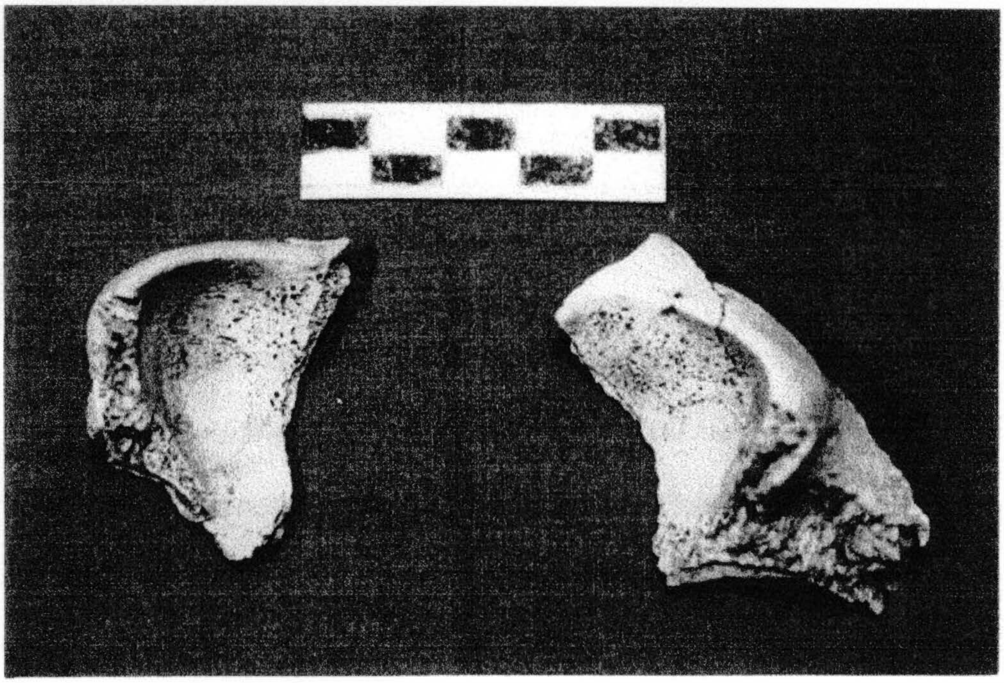

Figure 3: Active cribra orbitalia on eye orbits of Citico (40MR7) burial no. 45.

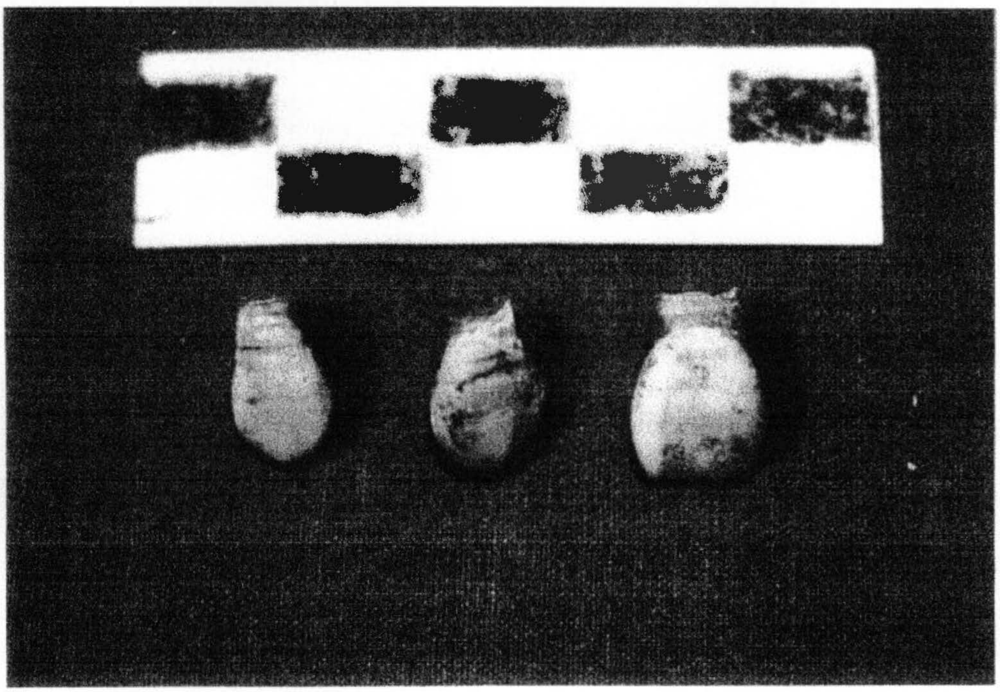

Figure 4: Enamel hypoplasias on anterior teeth of Citico (40MR7) burial no. 79.

from the stress indicators (Powell, 1988). With these limitations in mind, however, nonspecific stress indicators can be useful tools. Their very existence demonstrates that times of stress did occur during the individuals' lives. Growth arrest indicates substantial periods of malnutrition, while porotic hyperostosis and cribra orbitalia point to certain incidences of anemia.

Another type of indicator of stress, both chronic and acute, is infection or periostitis (see Figure 5). Periostitis is the inflammation of the sheath of tissue surrounding the outer surface of bone known as the periosteum. It can result from a number of different causes including trauma, bone diseases, such as osteomyelitis, generalized diseases, and soft tissue infection. Periostitis can affect almost any skeletal element, but it is commonly found on long bones. It ranges in severity from mild cases, involving simple pitting of the outer table of bone and/or tracks resulting from hypervascularity, i.e., increased blood flow to the affected area, to severe cases, involving substantial expansion of the bone shaft and/or extensive subperiosteal bone deposition, i.e., distribution of new bone beneath the periosteum. Periostitis may interfere with bone growth, depending upon its severity. Periostitis may also have a synergistic relationship with anemia, wherein the occurrence of one makes the affected individual more susceptible to the other (Aufderheide and Rodriguez-Martin, 1998).

These stress factors can be used for comparison purposes to determine whether high status individuals were immune from such nutritional deficiencies or whether dietary problems existed for all groups within a community. Gender differences can be investigated using these indicators, as well as the interaction of these stress factors with each other. These and other types of analyses can be performed to examine the

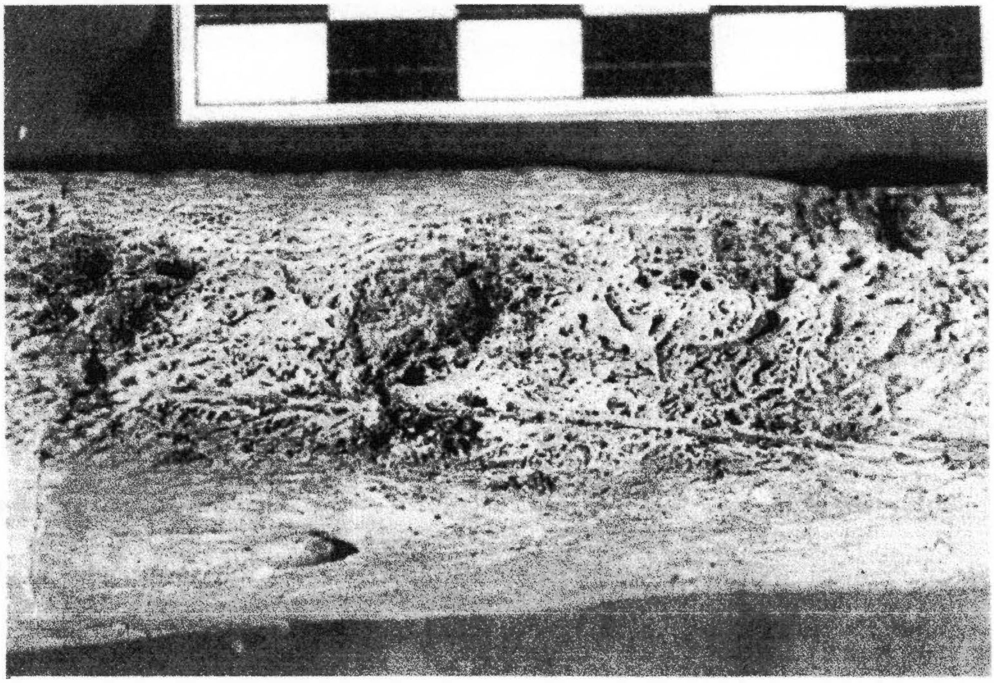

Figure 5: Periostitis on right tibia of Toqua (40MR6) burial no. 129.

interaction of health and status.

Status

While it is apparent through settlement pattern and skeletal analysis as well as ethnographic information from the sixteenth century that the Dallas phase involved some degree of social stratification, the concept of status needs some further examination. Status and status differences imply some type of inequality is at work in the society. Inequality is a phenomenon that "...exists when socially distinct entities have differential access to strategic resources...and this differentiation gives those with access the ability to control the actions of others" (Paynter, 1989:369-370). The source of this inequality, however, is unclear.

The neoevolutionary paradigm that is used to describe the transition of groups from bands to tribes to chiefdoms, asserts that due to various problems in a society, such as insufficient food resources, a more complex system is instituted to alleviate these issues. For instance, adopting a more sedentary way of life and becoming agriculturists establishes a more reliable source of food. This paradigm assumes, then, that social differentiation results (Paynter, 1989). This, however, may not be an accurate depiction of how inequality and, hence, social stratification are established. It is known that "simple" societies, those lacking in socio-organizational complexity, technological complexity, or size, have social hierarchies and inequalities based on gender, age, and interpersonal politics (Flanagan, 1989). Inequality is not unique to more complex societies, such as the chiefdoms of the Southeast. If inequalities are in place before more complex forms of social organization are established, then it is unlikely that the inequalities are a result of complexity. This idea, however, is ignored by neoevolutionists; they focus on the concept of complexity to the point that issues of inequality are virtually excluded from consideration. The complicated nature of inequality issues may be the reason for the exclusion. Also, complexity is viewed as one of the most important aspects of society; therefore, other topics are not examined.

These societies may have a separate evolution of inequality that does not necessarily coincide with an evolution of complexity. Inequality can evolve from a simple hierarchy based on sex or age to stratification based on kin-groups, and eventually to social stratification in a class or caste system, which is commonly based on race or ethnicity. The evolution of social differentiation, however, is not easy to discern. Some theorists believe that it the result of accumulation of prestige goods by a dominant group, as well as that group's increased ability to control access to essential resources that enables a society to evolve from hierarchy to stratification (Flanagan, 1989; Paynter, 1989).

It is apparent that the formation of social stratification and status is more complex than once assumed. Dallas phase people did, indeed, have social statuses, but the evolution of this differentiation is uncertain. If status is to be examined in relation to other factors, a better understanding of social differentiation and inequality are needed. These concepts remain highly contested areas in anthropology, as new information is sought and found concerning this important aspect of society.

Archaeological Investigations

Archaeology in Tennessee has a long and varied history. Beginning in 1881 with the establishment of the Division of Mound Exploration in the Bureau of American Ethnology, Cyrus Thomas investigated thousands of mounds throughout the United

States, including mounds in Tennessee. Thomas appointed J.W. Emmert to supervise the exploration of 53 mounds between 1885 and 1889, many of them in the Little Tennessee River Valley. Emmert is notable, because he was the first to record contextual information from burials, as opposed to earlier investigators whose main objective was to obtain exotic burial goods (Chapman, 1994; Hatch, 1974; Polhemus, 1987).

During the early 1900s, Clarence B. Moore oversaw investigations of approximately 34 sites along the Tennessee River, and in 1919, M.R. Harrington excavated sites on Bussell Island in the Little Tennessee River. Harrington was the first to identify the succession of prehistoric and historic cultures that had occurred in the area. While he focused on mounds, Harrington did incorporate information gained from earlier excavations. The Tennessee Valley Authority (TVA) was established in 1933 and began reservoir construction. The federal government allocated funds for archaeological fieldwork in these reservoirs, a substantial amount of which took place in Tennessee. The Works Progress Administration (WPA) was added in 1936, and large-scale archaeological fieldwork continued until the United States' involvement in World War II. Untrained workers were responsible for the bulk of the fieldwork conducted between 1934 and 1942. William S. Webb investigated 23 sites with mounds, and although he focused on excavating the mounds, he was unique in that he tested the village areas as well. The University of Tennessee Department of Anthropology's T.M.N. Lewis and Madeline Kneberg worked on data collected from the various sites along the Tennessee River and its tributaries (Chapman, 1994; Hatch, 1974; Polhemus, 1987).

The commencement of construction of the TVA's Tellico Reservoir on the Little Tennessee River in the late 1960s stimulated the re-establishment of large-scale fieldwork. Under various Congressional acts, such as the Antiquity Act of 1906, The Reservoir Salvage Act of 1960, and the National Historic Preservation Act of 1966, prehistoric and historic sites were and are protected from destruction by projects like TVA's reservoir constructions. The Tellico Archaeological Project was created to investigate the many sites that would be inundated by the creation of the Tellico Reservoir. From 1967 to 1979, the University of Tennessee's Anthropology Department conducted archaeological surveys and excavations in this area, including the sites of Tomotley, Toqua, and Citico (Chapman, 1994; Hatch, 1974; Polhemus, 1987).

The Sites

This thesis involves three sites that are part of the Dallas phase: Tomotley (40MR5), Toqua (40MR6), and Citico (40MR7). These sites are located in Monroe County, Tennessee, on the left bank of the Little Tennessee River (see Figure 6). Tomotley is the furthest downriver of the three sites, while Citico is the most upriver. All three sites were excavated as part of the Tellico Archaeological Project.

Citico

In 1967-1968, Citico was the first of these three sites to be excavated by the University of Tennessee. The site was found to contain a primary mound, several structures, and a palisade. Of the 244 burials excavated at Citico, 133 are attributed to the Dallas culture, representing approximately 185 individuals. J.W. Emmert excavated the mound during the 1890s and reported uncovering 91 burials. When the University of Tennessee began excavations, it was discovered that Emmert had not completely excavated the entire mound, and many Dallas burials were exposed (Chapman, 1979, 1994; Salo, 1969).

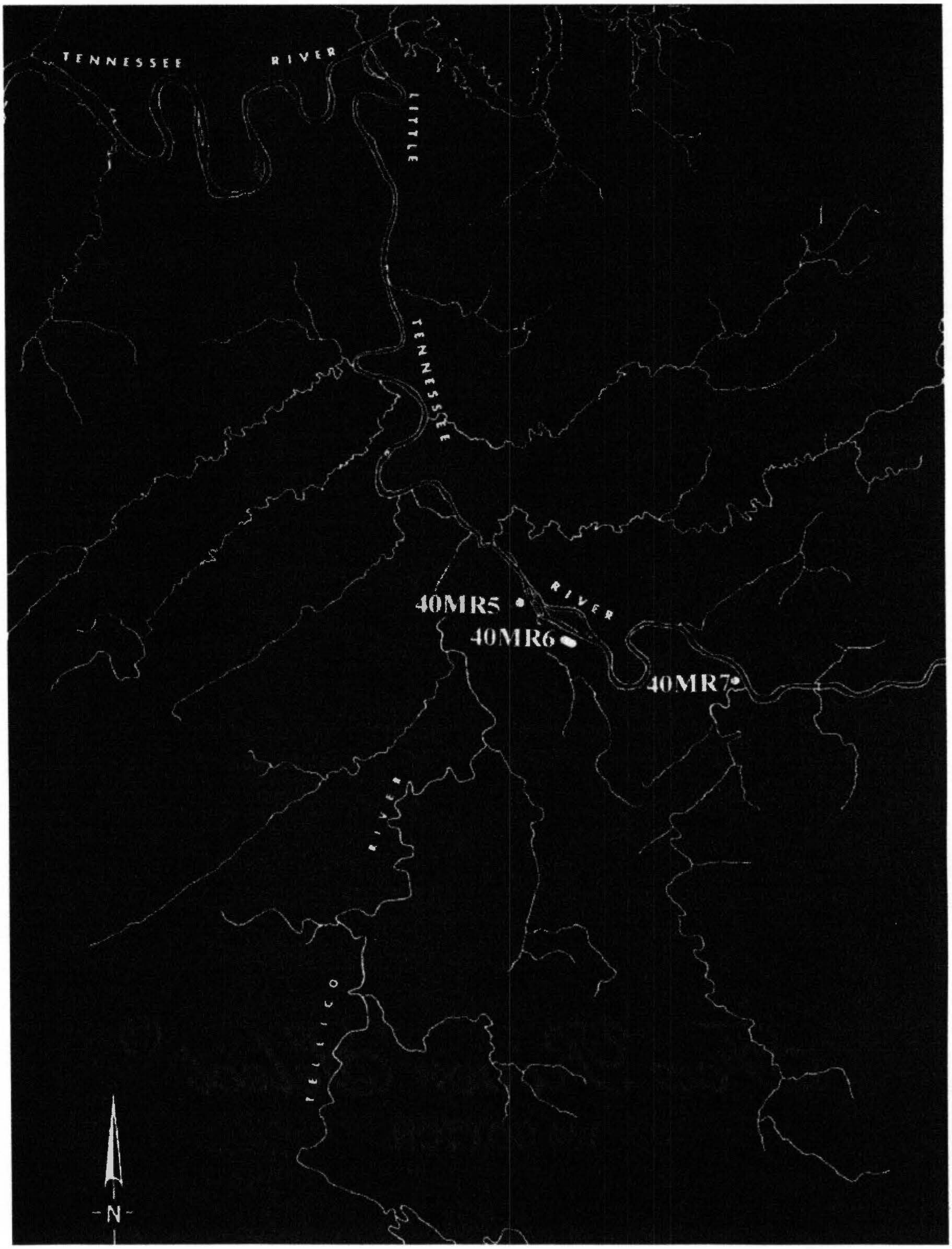

Figure 6: Location of Dallas phase sites on the Little Tennessee River (adapted from Guthe and Bistline 1978:2, figure 1).

Although the mound had been greatly disturbed by Emmert, it was shown that the mound underwent several constructions. There was no evidence of structures on the summit of the mound, but erosion or cultivation may have destroyed any indication of buildings. The summit of the mound is believed to have been substantially higher than it was during the 1960s excavations. A secondary summit was discovered on the eastern side of the mound, rising approximately four or five feet, and may have been used as a residence mound (Salo, 1969).

The burials were found throughout the Citico site, including both village and mound interments. In one area of the site, called the South Section, a high concentration of burials was discovered in the vicinity of two structures thought to be houses. As previously described, the archaeologists hypothesized that these were the remains of individuals who had resided in the nearby dwellings. Twenty-eight of the 133 Dallas burials were excavated from the mound, with most occurring near the summit. Various burial goods were found in the Dallas interments, including ceramics, shell items, pipes, stone tools, bone artifacts, and other items. Shell beads were the most prolific burial association, followed closely by ceramic vessels (Salo, 1969).

Tomotley

Tomotley was excavated in 1973 and 1974. Several cultural components were uncovered at this site, including a Dallas phase village. Fourteen structures and a palisade were discovered during excavation, but no mound was associated with this site. The village of Tomotley covered several acres, although the excavations concentrated on the northern portion. Eighty-four burials containing 93 individuals were excavated, and 55 burials were attributed to the Dallas phase. Most of the burials were found within the various structures, and a number of them contained burial associations (Guthe and Bistline, 1978).

Toqua

Toqua was the last of these three sites to be excavated (1975-1977). The site has two mounds associated with it, in addition to various structures and palisades. A total of 477 Dallas burials was recovered from Toqua, containing approximately 500 individuals. J.W. Emmert's excavations in 1884 uncovered 57 burials in Mound A, the larger of the two mounds, and 14 burials in Mound B. In the 1930s, George D. Barnes excavated the village area only and found an additional 100-150 burials. After removing the associated artifacts, the skeletal remains were simply put back into the ground. After Barnes completed his investigation, Toqua was not excavated again until the University of Tennessee began its fieldwork in 1975 (Chapman, 1994; Polhemus, 1987).

Both mounds had multiple construction phases, with Mound A showing at least 15 phases and Mound B showing three phases, although erosion and cultivation damaged much of the evidence. Construction of Mound A began in the 13th century and was estimated to have reached a height of 25 feet at its peak. Mound B was located southeast of Mound A and reached a height of six feet. Mound A shows the remains of two sets of paired structures, each of which was rebuilt a number of times, while a single large structure was built on the summit of Mound B. Evidence of three palisades was also discovered, each subsequent palisade enclosing a smaller village area. Both mounds were included within the first two palisades, but the third and final palisade excluded Mound B (Chapman, 1994; Polhemus, 1987).

Skeletal remains were excavated from both the mound and village areas. Most of the Mound A burials were found in conjunction with the final three phases of construction and were interred in the summit and flanks of the mound. Mound B also contained burials, and some archeologists propose that it was constructed for mortuary purposes. A number of village burials were associated with structures that continued to be used after interments were placed beneath the floor. Burial goods were similar to those found at Citico, including shell items, ceramics, stone tools, and bone artifacts (Chapman, 1994; Polhemus, 1987).

Previous Research

Archaeological sites dating to the Dallas phase have been the focus of several theses, dissertations, and other papers. A few researchers have utilized sites from the Dallas phase in order to investigate the skeletal manifestations of status. Hatch and Willey (1974) used stature as an indicator for status in their study of 211 burials from eight Dallas sites, including De Armond (40RE12), Hiwassee Island (40MG31), Sale Creek (40HA10), Hixon (40HA3), and Dallas (40HA1). Their attribution of social ranking to the interments was based on grave goods and burial location, while stature estimates were based on Madeline Kneberg's earlier work. Hatch and Willey discovered that there was, indeed, a difference in stature based on status for males, but that this was not applicable to females. The hypotheses formulated by Hatch and Willey to explain this phenomenon focus on either nutritional differences based on the redistribution of foodstuffs common to this group or genetic differences along kinship lines. While both ideas are plausible, neither was tested by the researchers.

Kenneth Parham's (1982) study did examine Hatch and Willey's (1974) hypothesis of nutritional differences based on status. Utilizing the large Toqua site (40MR6), Parham examined the skeletal remains for a number of health indicators, including stature, porotic hyperostosis, cribra orbitalia, periostitis, tumors, and arthritis. He also constructed life tables in order to gain statistical information regarding life expectancy, probability of death, and mortality rates. Parham determined the status of an individual burial based on whether it was a mound or village interment, assuming that high status individuals were buried in the mounds, while their lower status counterparts were interred in the village area. This assumption seems to be commonly held by many physical anthropologists working with mound sites. Parham statistically analyzed the correlation of each health indicator to status and consistently found no significant difference between the high status and the low status components. He concluded that status at Toqua was achieved throughout an individual's lifetime, rather than ascribed at birth.

As the following chapter describes, a few aspects of Parham's study will be duplicated, although there are several notable differences. For example, Parham restricted his analysis to one site; no inter-site comparisons were conducted. Another important difference is that Parham did not delineate between healed and active porotic hyperostosis and cribra orbitalia. Healed lesions indicate that the stress occurred at an earlier time in the individual's life and was no longer affecting the individual to the same degree at death, while active lesions may indicate that the individual succumbed to the stress. Finally, one of the most significant differences between Parham's study and this thesis is that Parham estimated the sex of juveniles. Juvenile aging techniques are generally believed to be inaccurate, as the skeletal characteristics commonly used to determine sex are not present until puberty. Parham's analysis of the associations between status and cribra orbitalia, as well as status and porotic hyperostosis is based on sex, which resulted in a large number of individuals being excluded from his examination due to their indeterminable sex.

Hatch, Willey, and Hunt examined Dallas (40HA1) and Hixon (40HA3) burials to determine whether "status-related stress" was present in these Dallas phase sites (1983:49). Hatch et al. used radiographs of the tibiae and femora from a number of burials to measure cortical thickness and to count and analyze Harris lines. Harris lines are growth arrest lines that can be found in the long bones of individuals affected by stress. Cortical thickness is thought to vary, especially in times of stress when the thickness is substantially less in comparison with stress-free periods. The results from this analysis were then correlated with status, which was based on burial location. They found that there was no statistically significant difference between high and low status individuals for the occurrence of Harris lines, but that there was some difference in cortical thickness based on burial location (status). Hatch et al. also noted that age- and sex-based differences existed for Harris lines and cortical thickness. They concluded that both behavioral and dietary causes accounted for the disparity observed between high and low status burials, and that status was both ascribed and achieved.

While some researchers have investigated status at Dallas phase sites using human skeletal remains, others have focused on different archaeological materials. A good example of this is Arthur Bogan's (1980) work at Toqua (40MR6). Bogan utilized the faunal remains from this site to ascertain the effects of social ranking on the distribution of food. Bogan divided the site into several zones and examined both the species of animal and the parts of the animal being consumed by residents of the different areas within Toqua. The zones that offered easy access to the mounds and the plaza were considered higher status, while the areas that were farthest from the plaza were deemed lower status. Bogan discovered that higher status individuals had access to preferred cuts of meat, while the lower status people received poorer quality cuts with less meat. He also found that certain species of animals appeared to be restricted to the higher status groups. Bogan concluded that social ranking did, indeed, affect food distribution and that the poorer quality meat given to the lower status groups resulted in protein deficiencies.

Mortuary patterning is commonly used at archaeological sites in order to determine whether status differences were present and what form of social ranking was used, i.e. ascribed or achieved (Hatch, 1974, 1976; Milner, 1982; Saxe 1970; Scott, 1983). James Hatch's (1974) thesis studied mortuary patterning at a number of Dallas phase sites, including Dallas (40HA1), Hixon (40HA3), DeArmond (3RE12), Citico (40MR7), Fain's Island (40JE1), Sale Creek (40HA10), Hiwassee Island (40MG31), and Citico (40HA5). He used a variety of factors to ascertain Dallas mortuary patterning, such as burial location, pit form, posture (e.g., flexed, extended, etc.), age, sex, stature, and burial goods. Hatch sought to create a "target structure," which would be based on findings consistent throughout the various Dallas phase sites and which could be compared against structures from other areas. His focus was on the burial goods and how they were correlated with age, sex, and burial location. Burials that lacked accompaniments were excluded from some of the analysis. Hatch reached a number of conclusions about Dallas phase burials. He found that while all ages and sexes were found in the burial mounds, adult males tended to be the most frequent. Hatch discovered that utilitarian items could be used to segregate the population based on age and sex. In other words, certain burial items were more common in a specific age and/or sex class. An example of this is that Hatch noted that shell artifacts were most often found with females, regardless of whether they were interred in the village or in the mound. Hatch also found that the widest variety and largest number of exotic artifacts accompanied a mound "sub-population." Since this subpopulation was not based on age or sex classes, Hatch concluded that Dallas social status was predominantly an ascribed one.

Hatch (1976) continued his investigation of mortuary patterning in Dallas phase groups in his dissertation. In this work, Hatch examined three generalized models of ranked societies. Type 1 was the most strictly defined in terms of three social levels, and uneven distribution of goods, foodstuffs, and other materials was the norm. Type 2 was characterized by a primary distinction between the elite and the commoners, which was also evident in burial size, location, and goods of these two groups. Type 3 also distinguished between the upper and lower classes, although the distinction was not as rigid as that found in Type 2, and the economic advantages of the higher status group were slight in comparison to the other types. Hatch determined what the archaeological record should demonstrate for each model in order for a group to be classified into one of them. He then applied these archaeological parameters to Dallas phase burials and found them to be most consistent with Type 2. He noted that in Dallas phase sites, spatial segregation of burials occurred in the form of mound versus village interments. Hatch discerned two major social classes, as well as differences in stature between the high status individuals and the low status individuals. Hatch concluded that determining the model of ranked society that best fit Dallas phase groups led to insights regarding social complexity, chiefly power, and economic structure.

Gary Scott (1983) also utilized mortuary patterning to analyze status at Toqua, examining burial size, shape, location, modifications, and goods. Using these data, Scott created and tested an energy expenditure model in order to determine relative social status among the different areas within Toqua. Scott found that the two zones, which each encompassed a mound, had the highest status due to the amount of energy required for the burials. The two zones that included village areas were found to be lower status zones, because less energy was expended in interring the dead. Scott discovered that while some factors, such as pit size, appeared to be age-dependent, others, including the energy expenditure model were not related to age. He concluded from his statistical analysis that both ascribed status and achieved status were present at Toqua.

Summary

To summarize, anthropologists are interested in examining the effects of status on health. Many studies have sought to analyze this relationship with a number of different methods. This study focuses on several sites and compares and contrasts the findings of each of them. Chapter II looks at the materials and methods employed for this study, while Chapter III describes the results obtained from the various analyses. Chapter IV discusses the results and offers possible explanations for the outcomes, and finally, Chapter V draws conclusions from the results and offers ideas for continued research.

CHAPTER II: MATERIALS AND METHODS

The three sites utilized in this thesis offer a sample size of 649 burials, 50 from Tomotley (40MR5), 418 from Toqua (40MR6), and 181 from Citico (40MR7). All skeletal remains have been previously aged and sexed; these demographic data are available through a computerized database. The metric and non-metric methods used to determine age and sex are consistent with those considered most accurate by members of the anthropological community. The demographic data for the skeletons from these three sites can be seen in Tables 1 and 2. Any skeletons that were found to be unaffiliated with the Dallas phase or whose affiliation was uncertain were excluded from the sample, as well as any burials that had commingled remains.

The skeletal remains from each site were examined to determine whether they demonstrated any of the following stress indicators: porotic hyperostosis, cribra orbitalia, enamel hypoplasias, and periostitis. These indicators were chosen, because they are general indicators of stress and are visible to the unaided eye. In cases of porotic hyperostosis and cribra orbitalia, the location and condition of the defect were recorded, i.e., whether the lesions were healed or not. If the required skeletal element (e.g., eye orbits) was not present for an individual, it was also noted. Enamel hypoplasias were documented as to which teeth were affected, and if a burial lacked teeth, a note was made.

All cases of periostitis were photographed and the area highlighted on an outline drawing of the skeletal element. After all data were gathered, a scale composed of five

Table 1: Sex Distribution of the Three Sites

Site	Male	Female	Undetermined
40MR5 Tomotley	7	5	38
40MR6 Toqua	68	58	292
40MR7 Citico	37	50	94
Total	112	113	424

Table 2: Age Distribution of the Three Sites

Site	Adult (18+)	Subadult (<18)	Undetermined
40MR5 Tomotley	26	23	1
40MR6 Toqua	191	209	18
40MR7 Citico	118	63	0
Total	335	295	19

stages was created in order to distinguish between mild and severe cases. This scale was based upon the one created and utilized by K.R. Parham (1982). Stage 1 is characterized by osteoporotic pitting and tracks resulting from hypervascularity on the outer layer of bone. Little or no subperiosteal bone deposition is found in this stage. Stage 2 consists of mild subperiosteal bone deposition accompanied by the continued presence of pitting and hypervascularity. Stage 3 demonstrates a more moderate amount of subperiosteal bone deposition in association with expansion of the bone shaft. Stage 4 is considered severe periostitis, as subperiosteal bone deposition is quite heavy and there is substantial shaft expansion. Stage 5 is, in actuality, osteomyelitis, which is an inflammation of both the bone and the bone marrow (Aufderheide and Rodriguez-Martin, 1998). It is included as the fifth stage due to its common association with periostitis. Stage 5 is characterized by the presence of cloacae, which are holes through which pus is emitted, and considerable shaft expansion. All bones demonstrating periostitis were assigned one of the five stages. These assignments were then used to characterize the individual. For individuals with multiple bone involvement, the highest stage found on the skeletal material was used as that individual's classification. Since differential diagnoses could not be attained, cases of periostitis resulting from all sources were included.

The data accumulated on porotic hyperostosis, cribra orbitalia, enamel hypoplasias, and periostitis were used to assess whether the frequency of each of these stress indicators was more common in village burials or mound burials. As previously noted, there is a consensus among many anthropologists that a mound burial indicates higher status. Following this assumption, mound versus village comparisons were used to determine if higher status individuals were less affected by these stress markers than lower status individuals. Maximum likelihood analysis of variance was used to determine whether the comparisons were significant. The stages of severity assigned to cases of periostitis were used to ascertain whether their occurrences were more severe in village or mound burials. The presence of burial goods was compared with burial location in order to discover if there was an association between these two factors.

A number of intra- and inter-site comparisons were made using these data. Within each of the sites of Toqua and Citico, a comparison was conducted between the mound and village burials. An inter-site analysis was made, in which the Toqua mound burials were compared to the Citico mound burials. A second inter-site analysis was performed, utilizing all three sites to evaluate the differences observed among village burials. Since the three sites are from the same time period and the same reservoir, the mound data from Toqua and Citico were combined and compared against the coalesced data from Tomotley, Toqua, and Citico.

All three sites were used to examine correlations of burial goods to stress indicators. An analysis of the association of a class of burial objects with the occurrence of a stress indicator, such as porotic hyperostosis, was conducted in order to determine whether status was related to a general class of items. Correlation (phi) coefficients were calculated in order to determine whether the associations were significant. This type of analysis was performed for each site individually, as well as for all three sites as a whole. Burial goods were grouped into one of eight classes, depending on their raw material. The eight burial good classes used for analysis are: shell, turtle shell, ceramics, stone, mineral, bone, ocher, and coal. The shell class includes items, such as shell beads, shell gorgets, shell spoons, pearls, and other shell items. The turtle shell class is made up of either turtle shell rattles or rattle gravels, which are the small stones placed inside the rattles. The ceramics class includes all types of pottery, partial or complete. The stone class comprises celts, discoidals, various points, and other stone tools. The mineral class includes four materials: mica, hematite, graphite, and slate. Lastly, the bone class is made up of bone beads, bone awls, bone tools, and animal teeth.

Other analyses were undertaken utilizing the stress indicator data. Since a possible synergistic relationship exists between anemia and periostitis, tests were performed to determine whether a positive correlation existed between the periostitis data and the combined data of porotic hyperostosis and cribra orbitalia. The correlations were done for the combination of Stages 1-5 of periostitis, as well as for periostitis with a single bone involved (local infection) and periostitis with multiple bones involved (systemic infection). The combined data for anemia were utilized in two ways: all cases (healed and active) of porotic hyperostosis and cribra orbitalia and all active cases of these stress markers. By analyzing both healed and active cases together and active cases separately, it is possible to examine the nature of the relationship between anemia and periostitis, if any. This analysis was done for each individual site as well as for the three sites combined.

Sex-based differences were also examined, utilizing the burials that had been assigned a sex; those burials with indeterminable sex were excluded from analyses. Burial location was used to investigate whether there were more males or females buried in the mounds or in the villages. Sex was also used to determine whether differences existed in the occurrence of each stress factor. All sex-based tests were done on a site-by-site analysis, as well as for the three sites combined.

It is important to note at this point, that sex and gender are not synonyms. Sex refers to the physical or biological aspects of an individual that are used to determine whether the person is male or female. Gender, however, is not necessarily based on sex. Gender refers to the social roles that are assigned to an individual, sometimes regardless of their biological sex. While the archaeological and historic ethnographic records do not delineate gender roles per se, insights into these social roles can be inferred. The descriptions of the activities and responsibilities of males and females can be used to discern, at least to some degree, the nature of the gender roles during the Dallas phase. Although this thesis examines differences in the occurrence of stress markers based on biological sex, there are implications for differences based on gender as well.

CHAPTER III: RESULTS

Comparisons

Comparison tests were the first type of analyses to be performed with the stress indicator data. Comparisons were conducted in a number of ways, including mound versus village, mound versus mound, and village versus village. The comparisons between mound and village burials that were conducted at Toqua (40MR6) and Citico (40MR7) yielded several significant results (see Tables 3 and 4).

At Toqua, 62.2% of the village burials are subadults (less than 18 years of age), as opposed to the 25.9% observed in mound burials. The Toqua village burials have a higher percentage of individuals with active porotic hyperostosis than the mound burials, 12.7% and 1.2%, respectively. The occurrence of periostitis (all five stages combined) is significantly different between the village and mound of Toqua; 30.1% of the village burials are affected, while only 12.7% of the mound burials are affected. The Toqua village burials also have a higher percentage of Stage 1 periostitis than the Toqua mound burials, 22.4% versus 10.0%, respectively. Both periostitis with single bone involvement and periostitis with multiple bone involvement have a higher incidence in the village compared to the mound. Single bone periostitis is found in 17.8% of the village burials and in only 9.1% of the mound burials, while 12.2% of village interments have multiple bone periostitis in comparison with 3.6% of mound interments.

At Citico, more of the mound burials have grave goods, 57.9%, in comparison to the village burials, 39.6%. Also at Citico, the mound burials have no cases individuals with combined active and healed porotic hyperostosis or healed porotic hyperostosis

Table 3: Mound versus Village Comparisons at Toqua (40MR6)

	N	% Affected in Mound	% Affected in Village	P-Value
Age (<18years)	403	25.9	62.2	**<.0001***
Sex (Female)	128	38.5	48.0	0.3834
Burial Goods	395	55.6	46.4	0.0973
Enamel Hypoplasias	359	25.5	26.8	0.7925
Porotic Hyperostosis	353	31.4	41.9	0.0829
Active Porotic Hyperostosis	353	1.2	12.7	**0.0138****
Healed Porotic Hyperostosis	353	30.2	29.6	0.9095
Cribra Orbitalia	184	21.7	31.1	0.3648
Active Cribra Orbitalia	184	17.4	29.8	0.2233
Healed Cribra Orbitalia	184	4.3	1.2	0.3024
Periostitis	396	12.7	30.1	**0.0006***
Periostitis-Stage 1	396	10.0	22.4	**0.0062***
Periostitis-Stage 2	396	2.8	3.1	0.4766
Periostitis-Stage 3	396	0	1.7	0.1628
Periostitis-Stage 4	396	0.9	1.4	0.6981
Periostitis-Stage 5	396	0	1.4	0.2125
Single Bone Periostitis	396	9.1	17.8	**0.0342****
Multiple Bone Periostitis	396	3.6	12.2	**0.0156****

*significant at 0.01 level **significant at 0.05 level
N = total number of individuals who could be evaluated for each factor

Table 4: Mound versus Village Comparisons at Citico (40MR7)

	N	% Affected in Mound	% Affected in Village	P-Value
Age (<18 years)	181	26.3	37.1	0.2192
Sex (Female)	87	37.5	60.0	0.2422
Burial Goods	177	57.9	39.6	**0.0458****
Enamel Hypoplasias	163	38.9	51.2	0.1950
Porotic Hyperostosis	158	0	29.1	**0.0023***
Active Porotic Hyperostosis	158	0	3.0	0.3913
Healed Porotic Hyperostosis	158	0	27.6	**0.0033***
Cribra Orbitalia	74	0	9.9	0.5676
Active Cribra Orbitalia	74	0	5.6	0.6725
Healed Cribra Orbitalia	74	0	7.0	0.6341
Periostitis	160	0	14.0	0.0511
Periostitis-Stage 1	160	0	4.4	0.2943
Periostitis-Stage 2	160	0	5.1	0.2557
Periostitis-Stage 3	160	0	3.7	0.3399
Periostitis-Stage 4	160	0	0	N/A
Periostitis-Stage 5	160	0	0.7	0.6735
Single Bone Periostitis	160	0	7.4	0.1701
Multiple Bone Periostitis	160	0	6.6	0.1945

*significant at 0.01 level **significant at 0.05 level
N/A=not applicable; could not be analyzed

alone, both of which are significantly less than the village burials with 29.1% and 27.6%, respectively.

Another analysis that was performed involved combining all village data from the three sites and comparing it to the combined mound data from Toqua and Citico (see Table 5). The combining of data was possible, because all three sites are from the same reservoir and the same time period. These comparisons offer several significant results. Mound burials have a significantly greater percentage of burial goods than village burials, 56.1% and 44.4%, respectively. Porotic hyperostosis (active and healed forms combined) has a greater occurrence in the village (36.7%) than in the mound (24.5%). Active porotic hyperostosis also has a higher incidence in the village than in the mound, 9.1% versus 0.9%, respectively. Village burials have a significantly higher percentage (23.7%) of periostitis (all five stages combined) than mound burials (10.4%), as well as a higher occurrence of Stage 1 periostitis, 15.9% versus 8.2%, respectively. Village burials also have a greater occurrence of periostitis with multiple bone involvement (10.2%) than mound burials (3.0%).

Only a couple of significant results were obtained from the mound comparisons of Toqua and Citico (see Table 6). The incidence of porotic hyperostosis (active and healed forms combined) is significantly different between the two mounds; Toqua mound has 31.4% of its burials affected, while Citico mound has no occurrence of this stress indicator. The healed form of porotic hyperostosis significantly differs between the mounds as well, with 30.2% of Toqua mound burials and 0% of Citico mound burials affected.

Table 5: Mound versus Village Comparisons of Combined Data

	N	% Affected in Mound	% Affected in Village	P-Value
Burial Goods	621	56.1	44.4	**0.0118****
Enamel Hypoplasias	572	29.0	34.3	0.2454
Porotic Hyperostosis	540	24.5	36.7	**0.0171****
Active Porotic Hyperostosis	540	0.9	9.1	**0.0191****
Healed Porotic Hyperostosis	540	23.6	28.4	0.3212
Cribra Orbitalia	267	19.2	24.1	0.5822
Active Cribra Orbitalia	267	15.4	22.0	0.4378
Healed Cribra Orbitalia	267	3.8	2.9	0.7897
Periostitis	586	10.4	23.7	**0.0013***
Periostitis-Stage 1	586	8.2	15.9	**0.0272****
Periostitis-Stage 2	586	1.5	3.5	0.2423
Periostitis-Stage 3	586	0	2.2	0.0824
Periostitis-Stage 4	586	0.7	0.9	0.8783
Periostitis-Stage 5	586	0	1.1	0.2214
Single Bone Periostitis	586	7.5	13.7	0.0566
Multiple Bone Periostitis	586	3.0	10.2	**0.0141****

*significant at 0.01 level **significant at 0.05 level

Table 6: Mound Comparisons of Toqua (40MR6) and Citico (40MR7)

	N	% Affected in Toqua Mound	% Affected in Citico Mound	P-Value
Burial Goods	155	55.6	57.9	0.8007
Enamel Hypoplasias	138	25.5	38.9	0.1305
Porotic Hyperostosis	110	31.4	0	**0.0016***
Active Porotic Hyperostosis	110	1.1	0	0.5956
Healed Porotic Hyperostosis	110	30.2	0	**0.0021***
Cribra Orbitalia	26	21.7	0	0.3689
Active Cribra Orbitalia	26	17.4	0	0.4323
Healed Cribra Orbitalia	26	4.3	0	0.7126
Periostitis	134	12.7	0	0.0648
Periostitis-Stage 1	134	10.0	0	0.1059
Periostitis-Stage 2	134	1.8	0	0.5057
Periostitis-Stage 3	134	0	0	N/A
Periostitis-Stage 4	134	0.9	0	0.6392
Periostitis-Stage 5	134	0	0	N/A
Single Bone Periostitis	134	9.1	0	0.1247
Multiple Bone Periostitis	134	3.6	0	0.3429

*significant at 0.01 level **significant at 0.05 level
N/A=not applicable; could not be analyzed

The village comparisons among Toqua, Citico, and Tomotley (40MR5) yielded a substantial number of significant results (see Table 7). Citico village burials have a greater occurrence (51.2%) of enamel hypoplasias than both Toqua village burials (26.8%) and Tomotley village burials (30.0%). Porotic hyperostosis (active and healed forms combined) occurs in a greater amount in the Toqua village than in the Citico village, 41.9% versus 29.1%, respectively. Active porotic hyperostosis also has a higher incidence in the Toqua village than in the Citico village, 12.7% versus 3.0%, respectively. Toqua village has a greater occurrence (31.1%) of cribra orbitalia (active and healed forms combined) than Citico village burials (9.9%), as well as a higher incidence of the active form of cribra orbitalia, 29.8% versus 5.6%, respectively. In contrast, the Citico village burials have more cases (7.0%) of healed cribra orbitalia than the Toqua village burials (1.2%). Periostitis (all five stages combined) has a greater occurrence in the Toqua village (30.1%) than in either the Citico village (14.0%) or the Tomotley village (6.7%). Toqua village burials also have a higher incidence of Stage 1 periostitis than Citico village burials, 22.4% and 4.4%, respectively. Periostitis involving only one bone has a greater occurrence in the Toqua village (17.8%) than in the Citico village (7.4%).

Comparison tests based on sex were also conducted at each of the sites and with the combined data (see Tables 8-11). The focus of this analysis is to determine whether differences in the occurrence of the stress indicators are due to sex. At Toqua, only one significant result was found; periostitis with single bone involvement occurs more frequently in males (31.3%) than in females (15.3%). Citico, Tomotley, and the combined data yielded no other significant results.

Table 7: Village Comparisons of Tomotley (40MR5), Toqua (40MR6), and Citico (40MR7)

	N	% Affected in Tomotley Village	% Affected in Toqua Village	% Affected in Citico Village	P-Value
Burial Goods	466	46.9	46.4	39.6	0.3889
Enamel Hypoplasias	434	30.0	26.8	51.2	**<.0001**[*,1] **0.0120**[**,2]
Porotic Hyperostosis	430	24.1	41.9	29.1	**0.0128**[**,1]
Active Porotic Hyperostosis	430	3.4	12.7	3.0	**0.0039**[*,1]
Healed Porotic Hyperostosis	430	20.7	29.6	27.6	0.5882
Cribra Orbitalia	241	11.1	31.1	9.9	**0.0029**[*,1]
Active Cribra Orbitalia	241	11.1	29.8	5.6	**0.0009**[*,1]
Healed Cribra Orbitalia	241	0	1.2	7.0	**0.0345**[**,1]
Periostitis	452	6.7	30.1	14.0	**0.0005**[*,1] **0.0157**[**,3]
Periostitis-Stage 1	452	6.7	22.4	4.4	**<.0001**[*,1]
Periostitis-Stage 2	452	0	3.1	5.1	0.3147[1]
Periostitis-Stage 3	452	0	1.7	3.7	0.4654[1]
Periostitis-Stage 4	452	0	1.4	0	0.1658[1]
Periostitis-Stage 5	452	0	1.4	0.7	0.5562[1]
Single Bone Periostitis	452	3.3	17.8	7.4	**0.0056**[*,1]
Multiple Bone Periostitis	452	3.3	12.2	6.6	0.1053

*significant at 0.01 level **significant at 0.05 level

[1]Toqua versus Citico [2]Tomotley versus Citico [3]Toqua versus Tomotley

Table 8: Sex-Based Comparison at Toqua (40MR6)

	N	% of Females Affected	% of Males Affected	P-Value
Enamel Hypoplasias	121	47.3	36.3	0.2260
Porotic Hyperostosis	122	70.2	73.8	0.6520
Cribra Orbitalia	92	9.1	14.6	0.4212
Periostitis	126	33.9	46.3	0.1594
Single Bone Periostitis	126	15.3	31.3	**0.0376****
Multiple Bone Periostitis	126	18.6	14.9	0.5769

**significant at 0.05 level

Table 9: Sex-Based Comparisons at Citico (40MR7)

	N	% of Females Affected	% of Males Affected	P-Value
Enamel Hypoplasias	84	60.4	63.9	0.7458
Porotic Hyperostosis	86	34.7	51.4	0.1231
Cribra Orbitalia	56	3.0	8.7	0.3751
Periostitis	85	16.7	24.3	0.3838
Single Bone Periostitis	85	10.4	8.1	0.7184
Multiple Bone Periostitis	85	6.1	18.9	0.0803

Table 10: Sex-Based Comparisons at Tomotley (40MR5)

	N	% of Females Affected	% of Males Affected	P-Value
Enamel Hypoplasias	12	40.0	28.6	0.6800
Porotic Hyperostosis	12	60.0	42.9	0.5603
Cribra Orbitalia	8	0	16.7	0.5371
Periostitis	12	20.0	0	0.2165
Single Bone Periostitis	12	20.0	0	0.2165
Multiple Bone Periostitis	12	0	0	N/A

N/A=not applicable; could not be analyzed

Table 11: Sex-Based Comparisons of Combined Data

	N	% of Females Affected	% of Males Affected	P-Value
Enamel Hypoplasias	217	52.8	45.0	0.2495
Porotic Hyperostosis	220	54.1	64.2	0.1260
Cribra Orbitalia	156	6.3	13.0	0.1667
Periostitis	223	25.9	36.0	0.1025
Single Bone Periostitis	223	13.4	21.6	0.1086
Multiple Bone Periostitis	223	12.5	14.4	0.6755

Correlations

Analyses of correlations between burial goods and the various stress factors were conducted with the data from each of the sites individually as well as with the data from the three sites combined. At Citico (40MR7), a few significant correlations are found (see Table 12). Shell, ceramics, stone, and bone are all negatively correlated with enamel hypoplasias. Stone and bone have the highest negative correlation, -0.24, while shell and ceramics have somewhat lower negative correlations, -0.18 and –0.19, respectively. These correlations indicate that when shell, ceramic, stone, or bone items are found in a burial, enamel hypoplasias are more likely to be absent. Alternatively, if any of these four burial good items are not present in a burial, the individual is more likely to have enamel hypoplasias.

Toqua (40MR6) exhibits more significant correlations than Citico (see Table 13). Shell is positively correlated (+0.17) with Stage 2 periostitis, which means that when shell items are present in a burial, Stage 2 periostitis is more likely to be present as well. Turtle shell is positively correlated (+0.12) with porotic hyperostosis; when turtle shell is found in a burial, porotic hyperostosis is also likely to be present. Conversely, if there are no turtle shell accompaniments in a burial, the individual is less likely to have porotic hyperostosis. Stone burial items are negatively correlated (-0.17) with cribra orbitalia and positively correlated (+0.16) with Stage 2 periostitis. Thus, when stone items are present, cribra orbitalia is likely to be absent, and Stage 2 periostitis has greater probability of being present. Alternatively, if stone items are absent, Stage 2 periostitis is more likely to be absent. Mineral is also positively correlated with Stage 2 periostitis (+0.19). In this case, when mineral is absent, Stage 2 periostitis is more likely to be

Table 12: Correlation (Phi) Coefficients of Citico (40MR7) Data

	Shell	Turtle Shell	Ceramic	Stone	Mineral	Bone	Ocher	Coal
EH	**-0.18****	-0.15	**-0.19****	**-0.24***	+0.04	**-0.24***	-0.08	N/A
PH	-0.11	-0.02	-0.11	+0.02	-0.02	+0.03	+0.03	N/A
CO	-0.13	+0.17	-0.15	-0.09	-0.04	-0.09	-0.04	N/A
P	-0.02	+0.04	-0.14	-0.05	-0.07	-0.10	-0.05	N/A
P1	+0.13	-0.04	-0.02	-0.07	-0.04	-0.05	-0.03	N/A
P2	-0.05	+0.14	-0.11	+0.03	-0.04	-0.06	-0.03	N/A
P3	-0.10	-0.03	-0.09	-0.06	-0.03	-0.05	-0.03	N/A
P4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P5	-0.04	-0.01	-0.04	-0.03	-0.01	-0.02	-0.01	N/A

*significant at 0.01 level **significant at 0.05 level
EH=enamel hypoplasias PH-porotic hyperostosis CO=cribra orbitalia
P=periostitis P1-P5=Stage1 periostitis-Stage5 periostitis
N/A=not applicable; could not be analyzed

Table 13: Correlation (Phi) Coefficients of Toqua (40MR6) Data

	Shell	**Turtle Shell**	**Ceramic**	**Stone**	**Mineral**	**Bone**	**Ocher**	**Coal**
EH	+0.01	+0.09	0	+0.02	-0.04	+0.07	-0.04	-0.03
PH	-0.01	**+0.12****	-0.08	+0.09	+0.02	**+0.20***	-0.06	+0.07
CO	-0.03	-0.08	-0.04	**-0.17****	-0.07	-0.14	+0.01	+0.12
P	+0.10	+0.07	-0.05	+0.03	+0.04	**+0.17***	+0.02	+0.09
P1	+0.08	+0.07	0	-0.02	-0.02	+0.10	+0.05	**+0.11****
P2	**+0.17***	+0.02	-0.05	**+0.16***	**+0.19***	**+0.14****	-0.02	-0.01
P3	-0.04	-0.03	-0.06	+0.06	-0.0	+0.11	-0.01	-0.01
P4	-0.09	+0.06	-0.06	-0.06	-0.02	+0.04	-0.01	-0.01
P5	-0.02	-0.03	+0.01	-0.05	-0.02	-0.04	-0.01	-0.01

*significant at 0.01 level   **significant at 0.05 level
EH=enamel hypoplasias   PH=porotic hyperostosis   CO=cribra orbitalia
P=periostitis   P1-P5=Stage 1 periostitis-Stage 5 periostitis

absent.

Additionally, bone burial items are positively correlated with three stress indicators: porotic hyperostosis, periostitis (all five stages combined), and Stage 2 periostitis, +0.20, +0.17, +0.14, respectively. When bone is absent, porotic hyperostosis, periostitis, and Stage 2 periostitis are likely to be absent as well. When bone is present, porotic hyperostosis is more likely to be present. Finally, coal is positively correlated to Stage 1 periostitis (+0.11). When coal is present, Stage 1 periostitis is more likely to be present, and when coal is absent, Stage 1 periostitis is more likely to be absent.

Tomotley (40MR5) does not yield any significant correlations (see Table 14). Coal could not be analyzed due to its absence within burials at the site. All periostitis cases are Stage 1; therefore, there was no analysis with Stages 2-5. While some of the correlations have phi coefficients that are comparable to those found in Citico and Toqua, none of them are significant.

When the data from the three sites are combined, a number of significant correlations result (see Table 15). Shell is positively correlated with periostitis (all five stages combined), Stage 1 periostitis, and Stage 2 periostitis, +0.10, +0.11, and +0.10, respectively. When shell is absent from a burial, periostitis, Stage 1 periostitis, and Stage 2 periostitis are more likely to be absent as well. Furthermore, turtle shell is positively correlated with porotic hyperostosis (+0.10). Therefore, when turtle shell is present in a burial, the individual is more likely to display porotic hyperostosis, yet when turtle shell is not present in a burial, porotic hyperostosis is more likely to be absent. Stone burial items are positively correlated with porotic hyperostosis (+0.09) and Stage 2 periostitis (+0.11). Thus, when stone items are not present, porotic hyperostosis and Stage 2

Table 14: Correlation (Phi) Coefficients of Tomotley (40MR5) Data

	Shell	Turtle Shell	Ceramic	Stone	Mineral	Bone	Ocher
EH	-0.03	+0.02	+0.16	+0.04	-0.09	-0.14	+0.22
PH	-0.15	+0.16	-0.04	+0.14	-0.11	+0.06	N/A
CO	N/A	-0.19	-0.12	+0.32	N/A	+0.32	N/A
P1	-0.07	-0.07	+0.24	-0.17	-0.05	+0.17	N/A

EH=enamel hypoplasias PH=porotic hyperostosis
CO=cribra orbitalia P1=Stage 1 periostitis
N/A=not applicable; could not be analyzed

Table 15: Correlation (Phi) Coefficients of Combined Data

	Shell	Turtle Shell	Cera-mic	Stone	Mineral	Bone	Ocher	Coal
EH	-0.07	+0.01	-0.04	-0.06	-0.01	-0.05	-0.03	-0.03
PH	-0.01	**+0.10****	-0.08	**+0.09****	-0.01	**+0.15***	-0.03	+0.06
CO	+0.01	-0.04	-0.04	-0.11	-0.06	-0.10	+0.01	+0.11
P	**+0.10****	+0.07	-0.05	+0.02	0	**+0.12***	0	+0.08
P1	**+0.11***	+0.06	+0.01	-0.02	-0.03	**+0.08****	+0.03	**+0.10****
P2	**+0.10****	+0.04	-0.07	**+0.11****	**+0.10****	+0.07	-0.02	-0.01
P3	-0.06	-0.03	-0.07	+0.01	-0.02	+0.04	-0.02	-0.01
P4	-0.06	+0.06	-0.05	-0.04	-0.02	+0.03	-0.01	0
P5	-0.02	-0.02	0	-0.04	-0.02	-0.03	-0.01	0

*significant at 0.01 level **significant at 0.05 level
EH=enamel hypoplasias PH=porotic hyperostosis CO=cribra orbitalia
P=periostitis P1-P5=Stage 1 periostitis-Stage 5 periostitis

periostitis are less likely to be present as well.

Mineral is also positively correlated with Stage 2 periostitis (+0.10). If mineral is absent from a burial, Stage 2 periostitis is more likely to be absent. In addition, bone is positively correlated with three stress factors: porotic hyperostosis (+0.15), periostitis (all five stages combined) (+0.12), and Stage 1 periostitis (+0.08). When bone is absent, porotic hyperostosis, periostitis, and Stage 1 periostitis are more likely to be absent. When bone is present, porotic hyperostosis is more likely to be present. Finally, coal has a positive correlation with Stage 1 periostitis (+0.10). When coal is present in a burial, Stage 1 periostitis is more likely to be present. Conversely, when coal is absent, Stage 1 periostitis is more likely to be absent.

The analysis of the relationship between periostitis and anemia produced a large number of significant results (see Table 16). At Citico, periostitis has a significant positive correlation, +0.29, with anemia (active and healed forms combined), which means that when periostitis is present, anemia is more likely to be present. Multiple bone periostitis is also positively correlated (+0.30) with anemia.

At Toqua, there are considerably more significant correlations. Periostitis, single bone periostitis, and multiple bone periostitis are all positively correlated with anemia, +0.32, +0.16, and +0.26, respectively. Periostitis and multiple bone periostitis are positively correlated to active anemia, +0.23 and +0.22, respectively. When periostitis or multiple bone periostitis is present, active anemia is more likely to be present.

Tomotley does not have any significant correlations, while the combined site data have significant results for all correlations. Periostitis, single bone periostitis, and multiple bone periostitis are all positively correlated with anemia, +0.33, +0.18, and

Table 16: Correlation (Phi) Coefficients of Anemia and Periostitis

	Citico (40MR7)	**Toqua (40MR6)**	**Tomotley (40MR5)**	**Combined Sites**
Periostitis & Anemia	**+0.29***	**+0.32***	+0.44	**+0.33***
Periostitis & Active Anemia	+0.09	**+0.23***	+0.46	**+0.24***
Single Bone Periostitis & Anemia	+0.13	**+0.16***	+0.31	**+0.18***
Single Bone Periostitis & Active Anemia	+0.06	+0.09	+0.05	**+0.11****
Multiple Bone Periostitis & Anemia	**+0.30***	**+0.26***	+0.31	**+0.27***
Multiple Bone Periostitis & Active Anemia	+0.06	**+0.22***	+0.69	**+0.22***

*significant at 0.01 level **significant at 0.05 level

+0.27, respectively. The three categories of periostitis are also positively correlated with active anemia, +0. 24, +0.11, and +0.22, respectively.

A total of 382 statistical tests was performed on the data from Tomotley, Toqua, and Citico. Of these tests, 64 of them, or 16.8%, yielded significant results. This exceeds the 5% significant results that would be expected due to random chance. In examining the two major types of analyses separately, it was found that each type of test surpassed the random chance expectation as well. Comparisons offered 27 significant results out of 107 tests, or 25.2%, while correlations produced 37 significant results, or 13.5%, from the 275 tests.

CHAPTER IV: DISCUSSION

The results of the analysis of the data discussed in the previous chapter offer a number of insights into the people who inhabited Toqua, Citico, and Tomotley. Both the comparison tests and the correlation tests impart information about how various entities interacted within and among these three sites, as well as information regarding the effects of a ranked society. While no definitive conclusions can be made, these results may help to clarify some of the uncertainties about life during the Dallas phase.

Comparisons

The comparison test results provide an understanding of the mound-village dichotomy and how status affected members of society. The mound versus village comparisons of the data from Toqua and Citico and of the combined data from the three sites reveal that, at least to some extent, individuals who were interred in the mounds exhibit less stress indicators than those buried in the villages. This agrees with the notion that higher status individuals were buried in the mounds, while their lower status counterparts were relegated to village interments. It also supports the idea that higher ranked people received better nutrition than lower ranked people, resulting in fewer cases of nutritional stress.

At Citico, porotic hyperostosis and healed porotic hyperostosis occur at a significantly higher rate in the village as opposed to the mound, which has no burials with these stress factors. The incidence of enamel hypoplasias, active porotic hyperostosis, cribra orbitalia (combined, active, and healed), and periostitis (combined and Stages 1-5), however, do not significantly differ between the Citico mound and village. Since the incidence of porotic hyperostosis is unequal between the mound and village, this may indicate that iron-deficiency anemia affected the lower status (village burials) to a greater extent than the upper status (mound burials). This trend toward anemia in the lower status group may have been the result of a poorer diet; higher status individuals may have received more or better meat, which provided them with a better source of iron. The lack of significant difference between the mound and the village of the active form of this stress indicator does not detract from this interpretation, due to the small number of cases. There are only four burials with active porotic hyperostosis in the entire Citico site, and all four are located in the village section. Likewise, cribra orbitalia, which also results from anemia, has only seven cases in the entire site, all of which are village burials. Also, cribra orbitalia, in general, affects children. Of the seven cases observed at Citico, four of them are children under the age of seven, all of whom have the active form of this stress factor. The remaining three include two adults and one teenager; however, they all have the healed form, indicating they were no longer suffering from anemia at the time of their deaths.

Burial goods, which are believed to convey status in death, are significantly higher in Citico mound burials as well. This result supports the interpretation that individuals buried in the mound are from a higher status than those buried in the village. Also, if it can be assumed that burial goods do, indeed, reflect social status, a greater percentage of high status individuals should have burial accompaniments as opposed to low status individuals; this is what is observed at Citico.

Toqua significantly differs between the mound and village in the occurrence of periostitis (all stages combined), Stage 1 periostitis, periostitis involving a single bone, and periostitis involving multiple bones. However, burial goods, enamel hypoplasias, porotic hyperostosis (combined and healed), cribra orbitalia (combined, active, and healed), and periostitis (Stages 2-5) do not differ significantly. The village burials have substantially more cases of periostitis than the mound burials, and the majority of these cases are Stage 1 periostitis, which is the mildest form of this stress marker. Since periostitis can be used as a general indicator of stress, these results indicate that the lower rank (village burials) was experiencing more stress than the upper rank (mound burials). However, since a differential diagnosis as to the cause of the periostitis cannot be made, the results observed might be the outcome of subsistence activities, trauma, poor hygiene, and/or parasitic infection, which possibly could have been restricted to lower status individuals. Although it is uncertain, members of the high status group may not have had to participate in subsistence activities and due to better living conditions and better nutrition, may have been able to avoid parasitic infections, trauma, and poor hygiene. Since both single bone periostitis and multiple bone periostitis have a significantly higher rate in the village than in the mound, it suggests that both localized infection and systemic infection were affecting the individuals buried in the village more than the individuals buried in the mound. Stages 2-5 of periostitis may not differ significantly between the mound and village, because of their small number of cases. Stage 2 has 11 afflicted individuals, Stages 3 and 4 have five cases each, and Stage 5 has only four affected burials. Most of these occur in the village area; only two Stage 2 cases and one Stage 4 case are located in the mound.

Active porotic hyperostosis also significantly differs between the Toqua mound and the Toqua village; however, the combined and healed forms do not. The lack of difference in the occurrence of healed porotic hyperostosis may suggest that members of both high and low status groups were able to survive bouts of anemia. It was the lower status individuals, however, who more frequently died while being afflicted with anemia (active cases), possibly indicating that higher status individuals may have had additional resources to help them survive anemia and other diseases. Cribra orbitalia may not differ between the mound and village of Toqua, because this stress indicator typically afflicts young children. A perusal of the cribra orbitalia data shows that the vast majority of those exhibiting the active form of this stress indicator are subadults, typically under the age of six. Early childhood is especially subject to stresses due to weaning and growth; therefore, children as a group may have been nutritionally stressed regardless of their social status.

The mound to village comparison that utilized the combined data from the three sites resulted in a number of significant differences, although enamel hypoplasias, healed porotic hyperostosis, cribra orbitalia (combined, active, and healed), and periostitis (Stages 2-5) do not differ. Like Citico, the combined mound burials have significantly more burial goods than the combined village burials. As previously stated, this fits the assumption that the mound burials are higher status individuals and the village burials are lower status individuals.

Porotic hyperostosis and active porotic hyperostosis occur in the village at a significantly higher rate than in the mound. This may once again indicate the higher status (mound) burials, in general, are less affected by anemia than the lower status (village) burials due to better nutrition or, more specifically, better sources of iron. Although there is no significant difference in the occurrence of healed porotic hyperostosis, it is possible, as discussed above, that individuals were able to survive anemia, regardless of social status. However, lower status individuals more often died while still suffering from this disease. Also previously discussed, cribra orbitalia may not differ between the mound and village of the combined sites due to its prevalence in young children as they may have been stressed as a whole, irrespective of status.

The combined mound versus combined village comparison also yielded significant differences in periostitis, Stage 1 periostitis, and multiple bone periostitis. As with Toqua, this can be interpreted as the lower rank being more stressed, in general, than the upper rank. While the cause of the periostitis is not determinable, it is clear that the higher status group was better able to avoid periostitis. The higher rate of periostitis involving multiple bones in the village rather than in the mound suggests that systemic infection was less of a problem for higher status individuals. Once again, the number of individuals with Stages 2-5 of periostitis is rather small, which may account for their lack of significant difference between the mound and the village.

The overall results of the comparisons of mound and village show that there are, indeed, differences between the two burial locations. Enamel hypoplasias, however, consistently show no significant difference in their occurrence in the mound and in the village. Hypoplasias of permanent dentition are created during tooth formation, which occurs between the ages of 3.5 and 7.0 years. Since enamel does not remodel as bone does, the hypoplastic defects observed on adult dentition is simply a record of stress that took place during childhood (Goodman and Armelagos, 1988). As in the prior discussion of cribra orbitalia, the lack of difference between mound and village burials may be the result of children being stressed as a whole, regardless of social status. Although higher status children may have received a greater quantity and/or quality of food, their nutrition may still not have been sufficient to meet the increased metabolic needs of childhood. As a result, individuals of all ages buried in either location demonstrate these childhood defects.

Porotic hyperostosis does differ significantly between the mound and the village. At Citico, the healed and combined forms both occur at a significantly higher rate in the village as opposed to the mound, and at Toqua, the active form occurs more frequently in the village than in the mound. The combined site data show both the active and combined forms of porotic hyperostosis have a higher incidence in the village rather than in the mound. Together, these support the hypothesis that due to their social status, higher status individuals (mound interments) were less affected by iron-deficiency anemia than lower status individuals. The explanation for this, in all probability, is a dietary difference based on status; the higher status group received a greater quantity and/or a better quality of food, especially of meat. The lower status group, which may, indeed, have consumed meat, probably received a smaller amount or poorer cuts. This discrepancy in food allotment could lead to vitamin and mineral deficiencies, such as iron, which would result in anemia. While the individuals buried in the mound were far from immune to anemia, they did not experience it as often as those who were interred in the village, and probably had alternative resources during times of nutritional stress.

Cribra orbitalia does not significantly differ for either the sites or the combined data. As already discussed, the fact that this anemia indicator most often affects children could simply mean that children were stressed without regard to their social status. As with enamel hypoplasias, the diet of higher status children may have been better than that of lower status children, but it was still insufficient to meet the requirements of early childhood. As a result, cribra orbitalia is found on individuals buried in both the village and the mound.

Periostitis, like porotic hyperostosis, is found to be significantly different between village burials and mound burials. Although Citico does not exhibit this significant difference, it is important to note that all cases of periostitis (all stages included) were found in the village. However, there are only nineteen individuals with this stress indicator in the entire Citico site, which results in an insignificant difference between mound and village incidences. Periostitis, of which the majority of cases are Stage 1, occurs more frequently in the village than in the mound, lending support to the notion that the higher status group buried in the mound was less affected by generalized infection than the lower status group buried in the village. Whether this was the result of parasitic infection, poor hygiene, trauma, and/or daily activities is uncertain. It may be possible, though, that the higher status individuals were able to avoid some of the situations that could lead to infection, while lower status individuals could not. Differences in the occurrence of single bone periostitis are only found at Toqua; however, multiple bone periostitis is significantly different in the Toqua data and in the combined data. Village burials tend to have a higher incidence, including the Citico village burials. Higher rates of multiple bone periostitis indicates that more systemic infection affected the lower status people, and the greater occurrence of single bone periostitis suggests that this lower status group was having more localized infection, perhaps as the result of trauma.

Burial goods data help to support the assumption that high status people were buried in mounds, and low status people were buried in village areas. The Citico data and the combined data demonstrate that more mound individuals have burial accompaniments than village individuals. While Toqua's mound does not have a significantly greater percentage of burial goods, it does, in fact, have a larger percentage than the village.

In all, the mound versus village comparisons have revealed discrepancies in the occurrence of stress factors based on status. While some childhood stress markers could not be avoided, stresses suffered during adulthood varied due to social status differences. Based on the assumption that those interred in the mounds are of a higher status than those buried in the villages, the hypothesis that higher status individuals are less stressed than lower status individuals appears to be supported by these data.

Another type of comparison conducted was one in which the Toqua mound and the Citico mound were evaluated in relation to each other. All of the significant results obtained from this analysis involve porotic hyperostosis. The results of this comparison reveal that those individuals interred in the Toqua mound were somewhat more affected by anemia than those buried in the Citico mound. The mound at Toqua has significantly more porotic hyperostosis (active and healed forms combined) and healed porotic hyperostosis than the mound at Citico. Enamel hypoplasias, active porotic hyperostosis, cribra orbitalia (active, healed, and combined), and all periostitis, however, do not differ significantly between these two mounds. Citico mound has no cases of porotic hyperostosis, and all but one of the 27 cases in the Toqua mound are healed. The higher status individuals at Toqua appear to have survived bouts of anemia, and were no longer affected at the time of their deaths. This difference between the two mounds may simply be the product of population size. Toqua appears to have had a larger number of inhabitants, including a greater number of high status people than Citico. This may have resulted in increased competition for food during periods of environmental stress, when fewer animal resources were available. Meat may have been distributed among all of the higher status individuals, but it may have been insufficient to ward off anemia for everyone. Also, since there probably was a continuum of rank within the high status group, it is expected that not all high status individuals would be equally stressed.

A village comparison was performed among the three sites in order to determine whether there is any difference in the occurrence of the various stress indicators. These results potentially offer information about how the three site types affected the amount of stress lower status individuals (village burials) endured. In examining the significant results from this comparison, a general pattern can be detected. Toqua, in most cases, has the highest occurrence of the stress markers, while Tomotley tends to not be significantly different from either site. Citico typically is significantly lower than Toqua, with a few notable exceptions.

The three different site types illustrated by Toqua, Citico, and Tomotley may be an important factor as to the observed stresses. Toqua is the largest site and has two mounds. This site had a large population size and probably was the political center for the larger region. Toqua had at least two social statuses, as evidenced by the mound and village burial data, although individual status probably fell along a continuum. Citico appears to have been a lesser mound center; it is smaller than Toqua, but contains a burial mound. Although this site may not have been as dominant as Toqua, a large number of people resided at this location. Tomotley is a farming village or hamlet, with a small population size. The lack of mound may indicate that few if any individuals of the highest status resided at this site.

Toqua village has a significantly greater occurrence of anemia indicators than Citico village. Porotic hyperostosis (active and healed forms combined), active porotic hyperostosis, cribra orbitalia (active and healed forms combined), and active cribra orbitalia all have a higher incidence, suggesting that anemia was a greater problem for people at Toqua than for those at Citico. Tomotley is not significantly different from either site, and it generally falls between Toqua and Citico. A possible explanation as to why Toqua was more affected could be its political structure. A large, important political center, such as Toqua, may have had a more strict distinction between higher and lower statuses, in which the lower status was more adversely affected than the lower status at a somewhat smaller site like Citico. At these two sites, the higher status individuals, chiefs in particular, most likely had greater access to certain foodstuffs, such as meat, and may, in fact, have expected to receive a certain portion of harvests and animal resources. The paramount chief of the region probably resided at Toqua, which may have led to an even greater disparity in the distribution of food at that site. The lower status people of Toqua may have had to give the paramount chief and the other chiefs a greater portion of their harvest and/or meat than the lower status people at Citico, resulting in more stress in the Toqua village. Alternatively, the paramount chief may have not been able to exercise the same degree of political control or power at the sites where he did not live. If he resided at Toqua, the paramount chief would have had direct control and been able to ensure that residents gave their required food portions to the chiefly elite. Citico, however, would have lacked this direct control, and lower status residents may have been able to keep larger amounts of food for themselves.

One of the exceptions at Citico is that this site's village has significantly higher occurrence of healed cribra orbitalia than the Toqua village. Once again, Tomotley does not differ significantly from either site. Although Citico has a greater rate of healed cribra orbitalia, all three sites have a rather low occurrence, and the total number of burials exhibiting this stress marker is only seven. Consequently, this result has no bearing on the discussion of the occurrence of anemia.

The other exception at Citico is the incidence of enamel hypoplasias, which is significantly higher at the Citico village in comparison to either the Toqua village or the Tomotley village. Toqua and Tomotley do not differ significantly from each other, although Toqua does have the lowest incidence. Enamel hypoplasias, along with porotic hyperostosis and cribra orbitalia, are nonspecific stress indicators, which means that a specific source of the stress cannot be determined. For example, it is known that porotic hyperostosis and cribra orbitalia are a result of iron-deficiency anemia; however, it is difficult to know what caused the anemia. Anemia can result from a variety of sources, such as parasitic infection and poor nutrition. While a nutritional cause is most likely to blame for the occurrence of porotic hyperostosis and cribra orbitalia at the three sites, the source of stress resulting in enamel hypoplasias is less clear. Enamel hypoplasias have been thought to be the product of poor nutrition, but some researchers argue that it is a combination of stresses. Others believe that they result from "…an acute, episodic insult," such as disease (Aufderheide and Rodriguez-Martin, 1998:407). Since the Toqua village may have been more nutritionally stressed than the Citico village, it appears that some other stress caused the significantly greater occurrence of enamel hypoplasias at Citico, possibly infectious disease. Enamel hypoplasias are the result of childhood stress, and subadults are especially susceptible to infectious disease. The higher incidence of hypoplasias at Citico may have been from a high rate of disease among these children. Tomotley may have been less vulnerable to infectious disease due to its small size and small population. Also, the lack of direct political control of the paramount chief may have allowed Tomotley residents to have somewhat better nutrition and, hence, an increased resistance to disease.

Periostitis (Stages 1-5 combined) was found to have a significantly greater occurrence at the Toqua village than at either the Citico village or the Tomotley village. Toqua also has a significantly higher rate of Stage 1 periostitis and single bone periostitis than Citico. Periostitis, like enamel hypoplasias, can have a number of causes as well. Poor hygiene, parasitic infection, trauma, and infectious disease can all lead to periostitis. A possible explanation as to why Toqua has a higher incidence of periostitis than Citico and Tomotley may be a combination of poor public hygiene and parasitic infection. At large sedentary sites, such as Toqua, a certain amount of garbage and human waste is expected to accumulate. This accumulation often leads to an increase in parasitic infection, which results in periostitis. Citico may have had a lower incidence due to a smaller population size, and, therefore, less accumulation of garbage and waste. Tomotley, with the lowest rate of periostitis, is the smallest of the three sites, has the least people inhabiting it, and has the least garbage accumulation.

Overall, the mound comparison and the village comparison yielded results that demonstrate the differences in the three sites. Toqua, the political center with the largest population, tends to have stress markers that are probably the result of nutritional deficiencies due to food distribution, as well as stress indicators that are caused by population size, i.e., waste accumulation. Citico, a lesser mound center with a smaller population, has a lower incidence of these stress indicators, but has the highest rate of enamel hypoplasias, which may have been caused by disease. Tomotley, a farming hamlet, appears to fall between the two larger sites in terms of incidence of stress markers and rarely is significantly different from Toqua and Citico. Although Tomotley may not have had a strict division according to social status, the people may still have been required to give portions of their food to higher status individuals at either their site or at one of the larger centers, such as Toqua or Citico. However, as mentioned earlier, the lack of political control that was exercised at Toqua by the paramount chief, may have enabled Tomotley to be somewhat healthier than the political center. Other factors, such as seasonal droughts or floods, may have been responsible for the observed stress markers. In effect, this site may have been insulated from some stresses, and vulnerable to others. The characteristics of these three sites can be utilized in the interpretation of the observed variation in stress marker incidences. While exact causes cannot be determined, reasonable explanations may be attained. It is important to note that there are most likely multiple causes to the observed differences in stress. For example, lack of food is the probable cause of several stress indicators. The reasons for the disparity in food allocation may be more complex and involved than just simple differences in status. Political control by the paramount chief, environmental stresses, and pathogens could all affect the incidences of stress markers.

The final comparison test that was conducted on these data contrasted males and females at each individual site and with the three sites combined. Of the 24 analyses performed, only one (4%) yielded a positive result, which may be the result of random chance since it falls below the expected 5%. The lack of difference between males and females in the occurrence of enamel hypoplasias, porotic hyperostosis, cribra orbitalia, and periostitis suggests that stress affected both sexes comparably. Although gender roles may have differed, as illustrated by the division of labor, the stress amount from these pursuits were somewhat equivalent. The lack of disparity in enamel hypoplasias, which are markers of childhood stress, indicates that children were affected by stress equally, regardless of sex. Porotic hyperostosis and cribra orbitalia may not differ between females and males, because food distribution was based predominantly on status rather than on sex or gender. The fact that periostitis affected the sexes in an equivalent manner reinforces the idea that the accumulation of waste and garbage was responsible for parasitic infections and other diseases, which led to periostitis. The results of this portion of the analysis offer evidence that social status was the main cause of differences in stress, rather than sex or gender.

Correlations

Analyses were conducted in order to determine whether classes of burial goods based on raw material are correlated in any manner with the various stress markers. Positive and negative correlations can then be used to further ascertain the status of an individual. For example, if the presence of shell burial items was consistently found only with individuals who bore no stress markers, and therefore were of a higher status, then it could be concluded that shell burial goods are high status items. These tests were performed for each site individually, as well as for the three sites combined. The analyses concentrated on the burial goods as the independent variable and the stress indicators as the dependent variable. That is, the presence or absence of a stress marker was examined in terms of the presence or absence of a type of burial good. While several significant results were obtained, no clear pattern was found. The significant correlations for each site are described in the previous chapter. The following discussion will focus on the few consistencies found in the results.

At Citico, there are four significant correlations. Shell, ceramic, stone, and bone burial items are all negatively correlated with enamel hypoplasias. In other words, the presence of any of these items in a burial is often accompanied by the lack of hypoplasias. No other significant correlations with this stress indicator are found at the other sites. With the exception of the ceramics, these burial goods do have significant correlations with stress markers at Toqua.

Most of the stress indicators have significant correlations at Toqua. Bone burial goods have the most significant correlations; this class of burial items is positively correlated with porotic hyperostosis, periostitis, and Stage 2 periostitis. Stone burial items are positively correlated with Stage 2 periostitis and negatively correlated with cribra orbitalia. Shell, turtle shell, mineral, and coal classes of burial goods each are positively correlated with one stress marker.

Unlike Citico and Toqua, Tomotley yielded no significant correlations. The combined data, however, produced the largest number of significant correlations, all of which are positive. Shell items are positively correlated with periostitis, Stage 1 periostitis, and Stage 2 periostitis, and bone items are positively correlated with porotic hyperostosis, periostitis, and Stage 1 periostitis.

Although the correlation tests yielded significant results, no true pattern emerges from the data. All classes of burial goods have at least one significant correlation, except ocher. The only stress markers that are not significantly correlated are Stages 3-5 of periostitis, which may be the result of their low incidence. Bone burial goods do positively correlate with porotic hyperostosis and periostitis at Toqua and with the combined data, but the lack of this correlation at the other sites creates difficulty in forming conclusions. The overall impression from the correlation tests is that the presence or absence of stress indicators on an individual is not dependent upon the class of burial objects that accompanies the burial. Furthermore, it can be concluded that the class of burial goods is not related to status.

Correlation tests were also used to examine the relationship between periostitis and anemia, which is thought to be a synergistic one. Active anemia and combined anemia were correlated with combined periostitis, single bone periostitis (local infection), and multiple bone periostitis (systemic infection). The analyses were done for each site individually and for the combined data.

At Citico, periostitis and systemic infection are positively correlated with anemia. Periostitis, local infection, and systemic infection are positively correlated with anemia at Toqua. Periostitis and systemic infection are also positively correlated with active anemia at this site. Tomotley yielded no significant correlations between periostitis and anemia, which may simply be a result of the small sample size at this site. The combined data produced significant positive correlations for all forms of periostitis and anemia.

The results of these correlation tests indicate that there is, in fact, a synergistic relationship between anemia and periostitis. The data for all significant correlations show that if periostitis is present, then anemia is more likely to be present as well. An individual suffering from periostitis may become more susceptible to anemia as the pathogens causing the infection utilize the host's iron stores. The individual's increased metabolic need in order to fight the infection may also lead to iron loss. Anemia, however, does not necessarily predict the presence of periostitis. This conclusion supports the hypothesis of some researchers, which suggests that an anemic condition will reduce the risk of bacterial or fungal infection. The pathogens rely on the host for their iron needs; therefore, the lack of iron due to anemia may result in less periostitis (Larsen and Sering, 2000).

Almost all cases of systemic infection (multiple bone periostitis) resulted in a significant correlation, excluding the Tomotley results. It is correlated with both active and combined forms of anemia, except at Citico where it fails to have a significant result with active anemia. Localized infection, though, does not have as many significant correlations. It does not produce any significant results at Citico, and at Toqua, it correlates with the combined anemia only, not the active form. These correlations illustrate that when an individual is afflicted with periostitis, especially systemic infection, that person becomes more susceptible to anemia.

The various correlation tests conducted for this thesis can be used to demonstrate the presence or absence of a relationship between two factors. In the case of burial goods and stress indicators, it appears that the presence or absence of stress markers is independent of the type of material used to make a burial item, and, therefore, there is no relationship between the burial good classes and status. Anemia and periostitis, however, do have a strong relationship. The two stresses are positively correlated, with the presence of periostitis determining the likelihood of the presence of anemia.

CHAPTER V: SUMMARY & CONCLUSIONS

The overall purpose of this study was to examine the interaction of health and status within and among three Dallas phase sites: Citico, Toqua, and Tomotley. In order to do this, burials from different locations within each site were examined for the presence or absence of various stress indicators. The stress markers chosen for this study are, for the most part, general indicators of stress that are visible to the unaided eye. Analyses were then conducted on both inter-site and intra-site bases in order to determine whether high status individuals express fewer indicators of stress than low status individuals. The determination of stress for this initial part of the analysis was based on burial location, which assumes upper rank people were interred in the mounds and lower rank people were interred in the villages. However, further analysis tested whether social status could be ascertained by another method. To accomplish this, general burial good classes were created based on the raw material of the burial items and then correlated with the stress markers. Two additional analyses were also conducted; one focused on sex differences in the occurrence of stress indicators, and the other examined the relationship of anemia and periostitis.

The results of the mound versus village comparisons conducted at Toqua, Citico, and with data combined from the three sites revealed that there are significant differences in the occurrence of some stress markers along lines of status. Porotic hyperostosis and periostitis are consistently found to have a higher rate of incidence in the village rather than in the mound, signifying that higher status individuals were less stressed than their lower status counterparts. The differences in the incidence of these stress markers appear to be the result of differential access to resources, especially food, as well as variation in exposure to pathogens, trauma, and other stresses, all of which are based on status and are the result of the political structure of these people.

Analyses conducted between the mounds of Citico and Toqua and among the villages of the three sites were used to gain insight into the similarities and differences of these sites. Porotic hyperostosis is the only stress marker that significantly differs between the mounds, and Toqua has the higher rate of occurrence. The increased rate of this anemia indicator is possibly due to the larger population size of Toqua, which may have lead to nutritional stress during periods of environmental problems.

The inter-site village comparisons yielded several significant differences. Toqua village had the highest rate of incidence of porotic hyperostosis, cribra orbitalia, and periostitis, which may be the result of its political structure, in which the lower status individuals were required to give a considerable portion of their foodstuffs to the paramount chief and other higher status people. Also, the political control of the paramount chief probably varied among the sites, contributing to the differences. Conversely, Citico had the highest rate of enamel hypoplasias. While hypoplasias are indicators of stress, the type of stress cannot necessarily be determined. It is likely that the cause of stress at Citico was not the same as that suffered at Toqua, because enamel hypoplasias do not fit the overall pattern of Toqua as the most highly stressed of the sites. It is possible that acute stress, such as disease, is responsible for the higher incidence of this stress marker at Citico rather than nutrition, which is the probable source of stress at Toqua. Tomotley typically did not significantly differ from Toqua and Citico, and usually fell between the two in the occurrence of stress indicators, probably as a result of their insulation from some stresses and their vulnerability to others.

The correlation tests between burial good classes and stress markers were found to have a number of significant results; however, no overall pattern was discovered. While small consistencies were found within some sites, no general inferences could be drawn. It is apparent that the class to which a burial object belongs does not influence whether stress indicators will be present or absent. Moreover, burial good class is not related to status.

The analysis of the effect of sex on the occurrence of stress indicators resulted in only one significant difference between females and males. This significant result may be more the outcome of random chance rather than actual differences in sex or gender. The overall conclusion is that males and females were comparably stressed during the Dallas phase. The gender roles, which encompass the daily tasks and responsibilities of females and males, may have differed, but the resulting stress did not.

Lastly, the analysis of the correlation of anemia and periostitis yielded significant results. The two stresses are positively related; the presence of periostitis generally indicates that anemia is more likely to be present as well. This synergistic relationship is one in which an individual suffering from periostitis, especially systemic infection, becomes more susceptible to other problems, anemia in particular. These results are as expected; a significant positive correlation exists between anemia and periostitis.

This study has helped to gain insight into the lives of Dallas phase people. Status seemingly had great influence on the health of the various social entities, while sex did not affect the incidence of stress markers. The differences based on status are most likely the result of multiple causes, rather than a single factor. Also, the occurrence of some stresses predisposed individuals to other stresses. Toqua, the largest site and the regional center, was the most stressed of the three sites, although Citico appears to have suffered a different type of stress than Toqua. Overall, the social stratification and political centralization of these people appears to have had a negative impact on lower status social entities, while their higher status counterparts were advantaged in terms of nutrition and health.

The three sites examined in this thesis are part of a larger regional system occurring in the Southeast. Trade of various materials into and out of the Little Tennessee River area incorporated these Dallas peoples into a network that involved a much greater portion of North America. Toqua, Citico, and Tomotley are examples of the political and social situations that were found during the Dallas phase in eastern Tennessee, in particular, and the late Mississippian period in the Southeast, in general.

Social stratification was an integral part of life for Dallas phase people; it affected the living conditions of an individual as well as characteristics of his/her burial. This stratification system was likely based on a range from low to high status and probably allowed considerable mobility along this continuum. Status incorporated both ascribed and achieved factors, illustrated by the variation found in mound and village burials. With the advent of European contact, a new system of social stratification was established in the Southeast. Rank was determined by racial categories, which were assigned at birth, and achieved status had limited impact on an individual's ranking. Stratification did not involve a range between high and low; people were simply assigned to one of two categories: European or Native. The socio-political system that had once been a vital aspect of life during the Dallas phase at Toqua, Citico, and Tomotley was substantially altered as the European invasion forced many of these societies to change in order to survive.

This analysis in no way is all-inclusive and definitive; some facets of this study require additional testing and interpretation. One aspect that can be improved upon is the number of stress indicators examined in the burials. Other factors, such as disease, Harris lines, and growth can be added for an even broader sense of the relationship between health and status. Another area that can use additional work is the correlations of status and burial goods. While this study focused on the raw material classes of burial objects, the items can be divided into other classes based on function, workmanship, etc. The total number of burial objects might also be used to correlate with stress indicators. Finally, sex and gender can, of course, be examined by a number of different methods, including its relationship with burial goods and other markers of stress. Recent research has been conducted concerning how gender can be elicited from the archaeological record (Claassen, 1992; Gero & Conkey, 1991; Nelson & Rosen-Ayalon, 2002; Wright, 1996). These types of analyses can be employed to further investigate differences based on gender and can be used in comparisons with differences based on sex.

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