DENTAL MORPHOLOGY, ATTRITION, AND PATHOLOGY IN
SELECTED SKULLS FROM TOWN CREEK INDIAN
MOUND, MOUNT GILEAD, NORTH CAROLINA

by

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A Thesis submitted to the faculty of the University of North Carolina in partial fulfillment of the requirements for the degree of Master of Arts in the Department of Anthropology.

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PREFACE

The years of collection and analyses of artifacts from both prehistoric and historic aboriginal sites have resulted in the formulation of an extended sequence of material cultures for the Indians of North Carolina. Other than Neumann's early varietal classification, however, no work with regard to the skeletal remains of these peoples has been done. In an attempt to improve this situation, the research discussed in this thesis was undertaken.

From the beginning, the purpose of this work was to select an archaeological site, examine the skeletal material recovered therefrom, and collect a set of data which would in some way characterize the population; the data would later serve as partial but important input for an extensive comparative study of the physical remains of various Indian groups in North Carolina. The collection catalogs of the Research Laboratories of Anthropology were scanned and the Town Creek site deemed most suitable for use for several reasons. First, it was known that the site was a ceremonial center and therefore thought to be fairly compact. Secondly, it was felt that since the area was occupied by force and for only a relatively short period (200 years), any physical type exhibited would be apt to be relatively free of admixture. And finally, since other culturally similar sites exist -- e.g., the Irene Mound in Georgia and Fort Watson in South Carolina -- comparisons of the North Carolina materials with out-of-state materials, if available, would be valuable.

The burials from the Town Creek site were examined. From the postcranial preservation it was evident that no single skeletal part could be expected to be present throughout the burial series. It was found, however, that a sufficient amount of dentition remained to form a small but representative sample for study.

To improve a somewhat rudimentary knowledge of dental morphology a literature search was undertaken, with the startling discovery that very few comprehensive studies of aboriginal dentition existed. Another revelation was that each investigator had personal systems for measuring and description, which made comparisons between studies always difficult and usually invalid. It was decided, therefore, to use those "standard" techniques as seemed reasonable for dental measurement and to discard other, more descriptive, analysis in favor of numerical weights (applied to the presence or absence of a trait) which could be computerized for easy storage and retrieval.

Although it would have been much simpler to have exhausted one facet, it was felt that a greater understanding of dental anthropology, as well as an increased scientific contribution, might result if three broad aspects of dentition -- morphology, attrition, and pathology -- were considered. In addition to obvious hereditary traits exhibited, it was intended to examine the individual dentitions for patterns of attrition due to culturally influenced (habits of mastication) and culture specific (e.g., cane splitting, pipe smoking) activities. Further, it was recognized that the types of food available, and the methods used in their preparation, must be related to the overall attrition and pathology demonstrated by the dentition, thereby possibly affording insight into the operating influences of the environment.

Because the amount of data collected per tooth for each burial is considerable, the scope of this research was enlarged to include presentation of a method of data management previously used in aerospace work. The suggested computer tracking matrix, when fully utilized, accommodates multiple-valued variables and provides flexibility in processing experimental data. Although the data collected during this study appear in the matrix format, at present the program is limited to one-way analysis of variance, but may be readily expanded to do hypothesis testing on selected, paired variables.

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Chapter I

SITE LOCATION AND DESCRIPTION

The Town Creek Indian Mound Site is in southern Montgomery County, North Carolina, near the small town of Mount Gilead. The site proper occupies approximately fifty acres of land, part of which overlooks the Little River near the outflow of Town Creek. See Figure 1.

During the period of cultural florescence in the area, about 1400-1600 AD, multi-environmental exploitation was possible. The climax forest provided a sizeable population of both large and small animals. Specimens recovered archaeologically include deer, bear, wolf, squirrel, racoon, opossum and the grey fox; of the bird species recovered, the turkey appears to be dominant. As the area lies in the border zone between the piedmont and coastal plain sections of the state, good river drainage from one to the other provided a reliable source of water for drinking, for fishing, and, to a limited extent, for transportation. The mild climate (very similar to that of today), the abundance of natural resources, and the fact that no natural barriers existed for either animal or human movement combined to make the area desirable for habitation.

Prior to 1400 AD the Uwharrie peoples occupied the Town Creek area. They were a semi-sedentary people who practiced agriculture, but whose main occupation was still hunting. As their dependency on agriculture grew, a more stable community pattern emerged and by the early

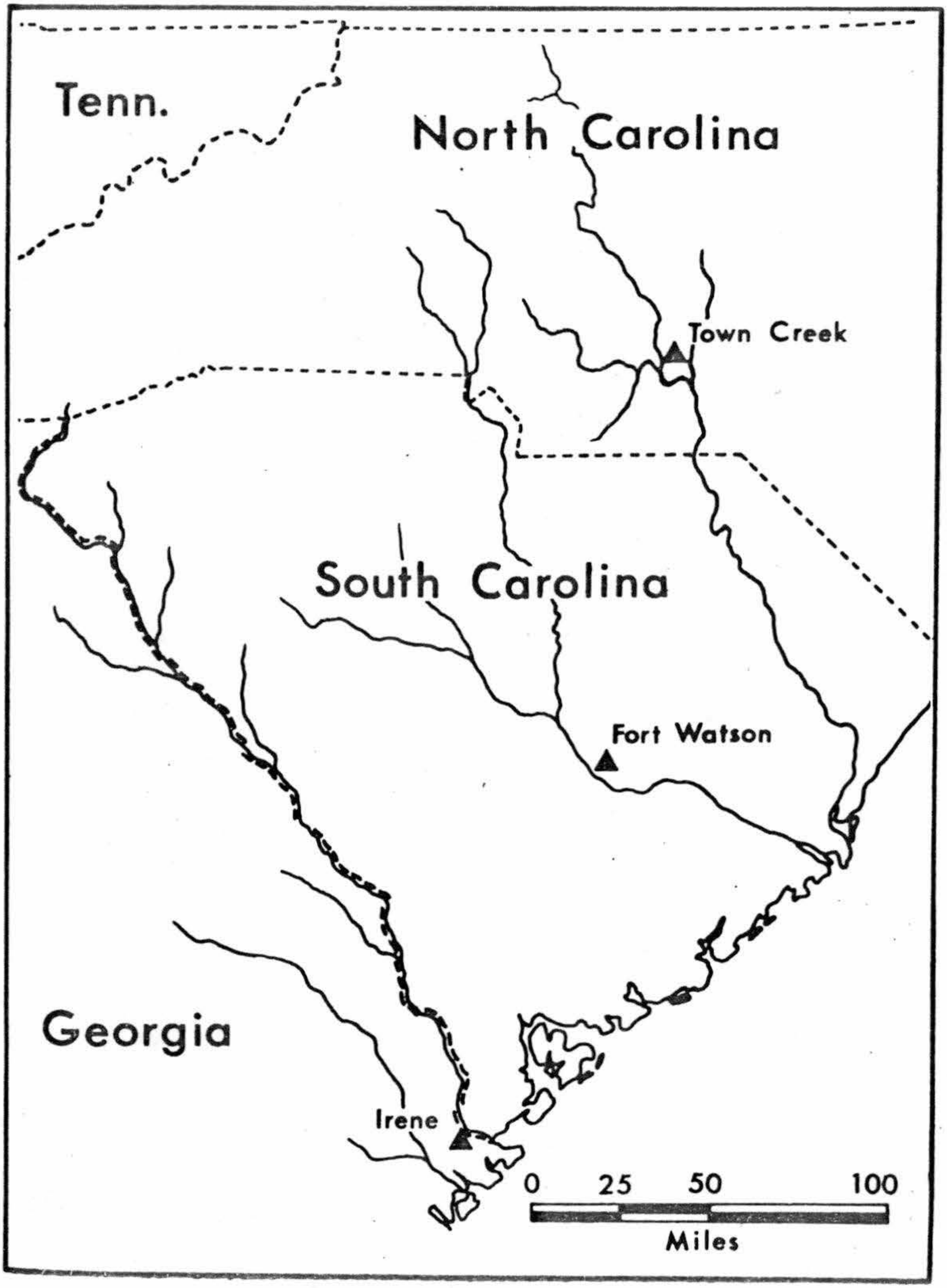


Figure 1. Geographic location of the Town Creek Indian Mound Site, with other culturally similar sites indicated.

1400's their villages had spread through west-central Carolina northward to Virginia and to the south into South Carolina (Coe, 1952).

By the middle of the fifteenth century an invasion by Indians from Georgia or South Carolina caused the withdrawal of the Uwharrie peoples from the Pee Dee River Valley of North Carolina. The new inhabitants, a Creek-derivative group, brought with them a type of late Mississippian cultural tradition, defined by Griffin as:

> the gradual shift to a substantial dependence on agriculture for food that tied the societies to specific localities, emphasized territoriality and ownership of land, provided a supply of storable food that allowed marked increase in population, permitted specialization of labor, provided markets for the exchange of goods, and led to the development of elaborate religious ceremonies centered around crop production, in which whole tribal groups took part (Griffin, 1967:189).

The new peoples built their round, bark-covered houses within stockaded villages furnished with watchtowers at the entrance. Public buildings were a part of each village, but served only as places for visitor entertainment or the conducting of local routine business. Important social, political, and especially religious activity concerning all of the towns of a tribe was carried on within a special stockaded ceremonial center. It was here also that certain of the dead were buried. In 1773 Bartram, during his travels throughout the area now designated as the South Appalachian Mississippian (Griffin, 1967), commented on the ruins of many ancient villages. In particular he cites the remains of two Creek towns. Of the first, four or five miles above Fort James on the Savannah River in Georgia, he writes:

> These wonderful labours of the ancients stand in a level plain, very near the bank of the river, now twenty or thirty yards from it. They consist of conical mounts of earth and four square terraces, &c. The great mount is in the form of a cone, about forty or fifty feet high, and the circumference of its base two or three hundred yards, ...the top or apex is flat... Some imagine these

> tumuli were constructed for look-out towers. It is reasonable to suppose, however, that they were to serve some important purpose in those days, as they were public works, and would have required the attention of a whole nation, circumstanced as they were, to have constructed one of them almost in an age (Bartram, 1940:265).

Later in his travels, Bartram remarks concerning the ruins of the ancient town of Apalachucla:

> it had been situated on a peninsula formed by a doubling of the river, and indeed appears to have been a very famous capital by the artificial mounds, or terraces... We viewed the mounds or terraces, on which formerly stood their town house or rotunda and square or areopagus, and a little behind these, on a level height or natural step, above the low grounds, is a vast artificial terrace or four-square mound, now seven or eight feet higher than the common surface of the ground; in front of one square or side of this mound adjoins a very extensive oblong square yard or artificial level plain, sunk a little below the common surface, and surrounded with a bank or narrow terrace, formed with the earth thrown out of this yard at the time of its formation... (Bartram, 1940:313-14).

And finally, of his general reaction to these early ruins Bartram writes:

> The pyramidal hills or artificial mounts, and highways, or avenues, leading from them to artificial lakes or ponds, vast tetragon terraces, chunk yards, and obelisks or pillars of wood, are the only monuments of labour, and ingenuity and magnificence that I have seen worthy of notice, or remark... The mounts and cubical yards adjoining them, seem to have been raised in part for ornament and recreation, and likewise to serve some other public purpose, since they are always so situated as to command the most extensive prospect over the town and country adjacent (Bartram, 1940:406-7).

The high river bluff location chosen by the Pee Dee people for their ceremonial center and the overall arrangement of buildings, plaza area, etc, within the center is strongly suggestive of evolution or development from Creek ceremonial structures and grounds. And, as there is resemblance between the Creek and Cherokee ceremonial houses (*ibid*, 1940; Williams, 1928), it is possible that Town Creek represents elements of both.

As a result of archaeological excavation, comparative studies, and materials analysis spanning a thirty-year period, Dr. Joffre L. Coe, Director of the Research Laboratories of Anthropology, University of North Carolina at Chapel Hill, has reconstructed the overall plan of Town Creek Indian Mound and ceremonial center (Figure 2). The main focus of the center was a large flat-topped pyramidal earthen mound. A log-paved dirt ramp led to the top of this mound where a square structure, presumably a religious temple, was built. The mound and temple represented the last phase in a series of rebuilding efforts that began with an earth-covered, ground-level ceremonial lodge. Each subsequent structural replacement started on a clean surface at a higher level, resulting over the years in a mound the size of the one reconstructed on the site today.

Across the plaza from the mound a small minor temple or priest's house was located, surrounded by a palisade. The walls of both major and minor temples were fabricated from poles interwoven with slender branches, withes, or reeds and were plastered with a layer of clay. The structures were roofed with thatch.

On the plaza between the two temples was the Square Ground. This consisted of five structures, i.e., four open-fronted sheds facing onto a square plus an additional one to the side used for storage of ceremonial paraphernalia. The sheds were equipped with three rows of bleacher-style seats, called "beds", which were occupied on special occasions according to social status; the chiefs' bed was generally to the west, the warrior's bed to the north, the henihas' (companions or lieutenants of the chiefs) to the south, and the bed for the youths to the east (Swanton, 1928). The Square Ground was considered the home of the *Talwa* or soul of the tribe, and as such was treated as holy ground.

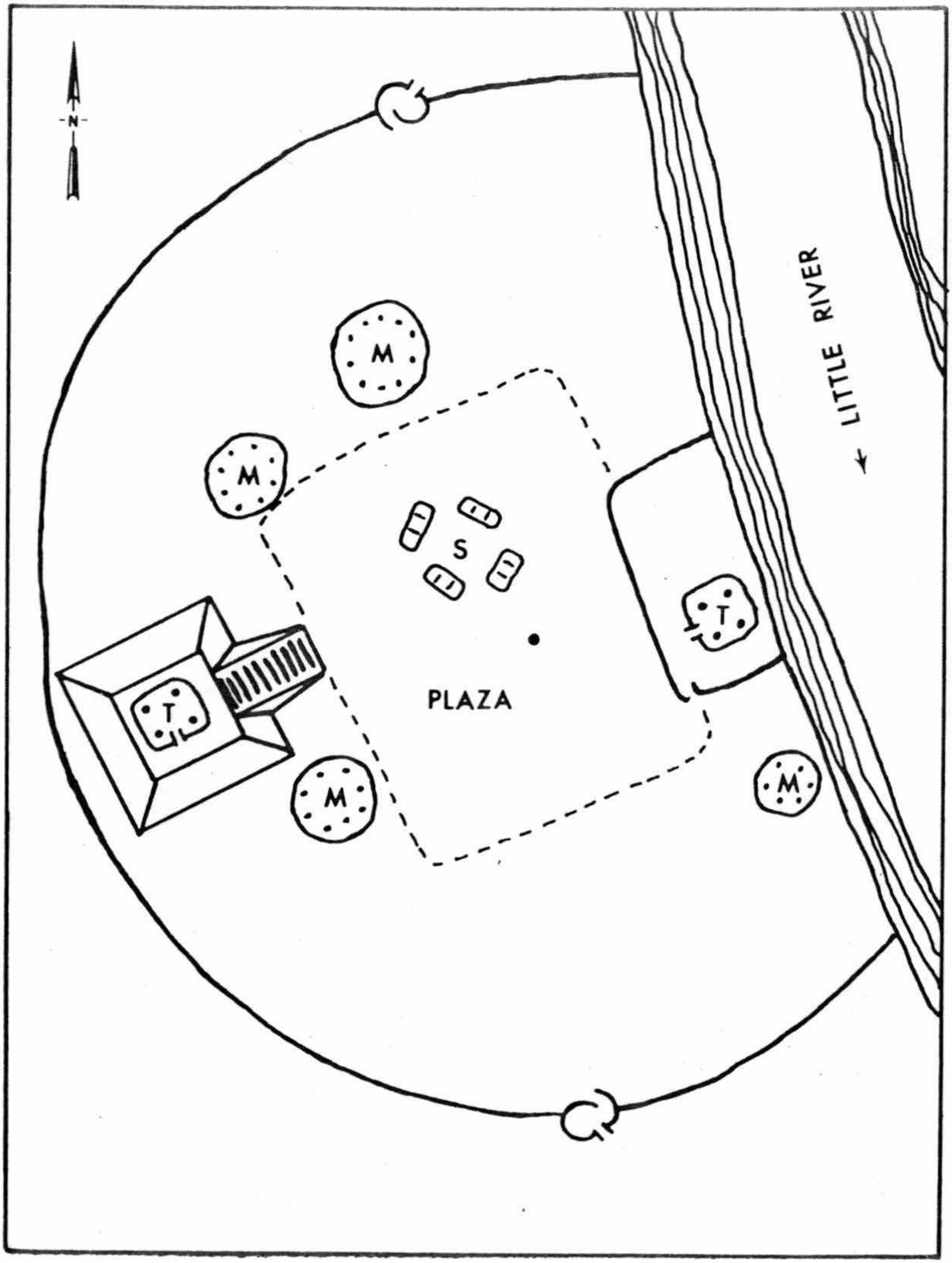


Figure 2. Layout of the Town Creek ceremonial center. (M indicates a mortuary, T a temple, and S the square ground.)

It was here also that the sacred fire of the nation burned.

As the ceremonial center was not a place of habitation for others than the priests or caretakers, the only other structures found in the area were the various mortuary complexes. These structures were made of the same materials as the temples, but were built as circular houses in various locations around the mound plaza. The adult dead were buried in bark or cane lined pits, and some infants in large ceremonially "killed" urns, in the floors of these mortuaries.

The entire ceremonial center was surrounded by a high log palisade, interwoven with branches and plastered with clay (wattle and daub construction). As with the villages, watchtowers were spaced at intervals around the palisade in much the same fashion as those incorporated in the stockades of military forts of the period.

In keeping with the Creek *Talwa* concept [Swanton (1928) notes the word is now used in a rather loose sense, generally translated as "town", but that its connotation rather covers the English concept of "tribe"] all tribe members in the Pee Dee Valley and surrounding areas owed their allegiance to and participated in all activities held at the Town Creek center. For two hundred years the Pee Dee peoples held their villages and center against attack from the former occupants of the valley. Finally, by the middle of the sixteenth century, weakened by warfare with their neighbors, the Pee Dee people deserted their homes and lands and sought refuge to the south, settling in the vicinity of Camden, South Carolina (Coe, personal communication).

As it appears today, the Town Creek site consists of a reconstructed, truncated pyramidal mound surmounted by a square temple; a smaller temple/priest's house located directly across the plaza from and facing the mound; and one reconstructed mortuary house located to the left of the mound on the plaza periphery. The two stockades, one around the minor temple and the other surrounding the entire ceremonial complex, have been rebuilt using the same post holes as well as the same methods of construction as the initial effort.

Chapter II

FOOD RESOURCES AND PREPARATION

The writings of early travelers in North Carolina indicate that the area's food resource base was considerable. By the early sixteenth century the new inhabitants of the Pee Dee River Valley were depending upon plant cultivation for over one-half of their food supply, the remainder coming from hunting, fishing, and the gathering of wild plants. Table 1 presents a condensed, though representative, listing of the various foodstuffs available in the area.

Intensive maize agriculture was an important factor in the economy of the Pee Dee people. The corn, along with beans, squash, and sometimes pumpkins, was planted, cared for, and harvested in communal fields. Because a successful harvest was essential to the welfare of all, there was a great amount of ritual associated with the preparation of fields and the planting and gathering of crops. The most important single religious activity took place at the time of the new corn harvest and was known as the Busk or Green Corn Ceremony. The event always was held at the tribal ceremonial center and usually lasted several days, during which dances, games, and ceremonies of purification took place prior to sampling the new harvest. Tribal members came from near and far to participate in these activities and to reaffirm their allegiance to the tribe before returning home.

Although large scale agriculture was practiced in the common

TABLE 1

FOOD RESOURCES IN THE PEE DEE VALLEY AREA (1550-1750 AD)
(COMPILED FROM ARCHAEOLOGICAL AND HISTORICAL SOURCES)

I. PLANT FOODS.

A. Vegetables

Stem and Leaf Varieties		Roots, Tubers, and Bulbs	
Corn (3 varieties)	Squash	Carrot	Beet
Beans (2 varieties)	Lettuce	Turnip	Leek
Red Cabbage	Fennel	Parsnip	
Savoy Cabbage	Cress	Chinabriar	
Indian Pea	Spinach	Radish	
Pumpkin	Gourd	Potato (several varieties)	
Rhubarb		Onion	

B. Fruits

Cherry (2 varieties)	Orange	Grape (3 varieties)
Apple (10 varieties)	Peach	Plum (4 varieties)
Fig (3 varieties)	Papau	Persimmon

C. Berries

Blackberry	Currant (2 varieties)	Blueberry
Gooseberry	Mulberry (2 varieties)	Dewberry
Strawberry	Huckleberry	Raspberry

D. Nuts

Hickory	Walnut	Hazelnut
Chestnut	Acorn	Chinkapin

E. Cereal Grains*

Rice	Barley	Rye	Oats

* Large quantities not usually grown.

TABLE 1 (Continued)

FOOD RESOURCES IN THE PEE DEE VALLEY AREA (1550-1750 AD)
(COMPILED FROM ARCHAEOLOGICAL AND HISTORICAL SOURCES)

II. FLESH FOODS.

A. Mammals

Deer	Rabbit	Opossum
Elk	Squirrel	Beaver
Bison	Bear	Skunk

B. Birds

Turkey	Duck	Geese	Pigeon

C. Fish

Trout	Bluegill	Sturgeon
Perch	Bass	Catfish
Carp	Pike	Shad

D. Other Aquatic Food

Mollusks	Crayfish

III. MISCELLANEOUS.

Eggs	Honey

fields, each family also maintained a separate kitchen garden. These smaller gardens were planted early and included corn, rice, beans, squash, and sometimes tobacco. Generally their yield was earlier than that of the common fields and served to support the family until the main harvest occurred. As in a large percentage of the country, the actual planting of crops in the Pee Dee region was carried out by the women (Driver, 1970). Apparently the men cleared the land and sometimes helped during the harvesting of crops, but rarely participated to any appreciable extent in planting, weeding, and other routine preharvest activities.

A sizeable amount of time was invested in gathering and processing wild plant foods. Fruits, nuts, and berries of many varieties were available in the Pee Dee region, but it is uncertain just what percentage of the total diet they represented. In the 1770's Bartram (1940) noted groves of fruit and nut trees planted in ancient abandoned towns. This would lead one to think that emphasis was gradually being shifted toward controlled food supplies and away from the erratic availability of wild plant products.

Although species of small animals, including rabbit, squirrel, and opossum were hunted most of the year, larger game such as deer and bear was generally tracked only in the fall and winter. The bow and arrow was the most common hunting weapon, but occasionally, when larger game was hurt or for some other reason incapacitated, clubs were employed in the kill (Swanton, 1946).

Fishing occurred to some extent, but the percentage of food it supplied is unknown. Fish hooks, scoop nets (Hawkins, 1848), poisoning, bows and arrows, dragging, "grabbling" (Swanton, 1946), and fish traps or weirs (Lawson, 1937) were all means of securing the catch. Fishing varied from an individual to a communal activity depending on the time of year and level of other village activity.

From the brief summary of plant and animal materials available (Table 1), it is apparent that while foodstuffs were both plentiful and varied, obtaining and processing them was a time-consuming task. The resource base was sufficiently broad so that each season yielded several different varieties of foodstuffs which either had to be prepared for immediate consumption or preserved and stored for future use. The methods employed in food processing and preservation fall into three main categories: heat treatment, mechanical alteration, and smoking and natural drying. These methods and their variations follow.

Heat Treatment

Boiling. The term 'boiling' implies a cooking process whereby the foodstuff is heated in boiling water until the tissues break down and some of the natural fluids are released into the water. In Indian cookery two types of boiling were practiced: stone boiling, or use of heated stones placed in the cooking vessel along with food and water; and direct fire boiling, accomplished by placing the pot containing the food into or near the fire. From early accounts it is assumed that the Pee Dee mainly practiced the latter. Lawson (1937) and Bartram (1940) mention boiling in connection with the following plant foods and meats: squash; corn; beans; acorns, to remove the oil; geese boiled in fat; and unborn fawns boiled in the amniotic sac. (Pottery manufacture and food boiling were probably coincidental in the Eastern United States.)

Stewing. Stewing is a means of cookery whereby food is simmered in its natural fluids, augmented with a small amount of water. Early accounts indicate that a majority of the Carolina Indians continually kept stew pots on the fire, replenishing the contents from time to time as the need arose. Peaches were reported as being stewed, but for the most part the process was applied to meats, i.e., venison, rabbit, bear, opossum, and beef tripe.

Roasting. Roasting is accomplished by covering food and subjecting it to dry heat. Early accounts make particular mention of roasting ears of green corn in hot ashes as a means of drying them prior to storage (Swanton, 1946). Meat was roasted either by skewering it on sticks placed near the fire or by wrapping it in leaves and laying it in the ashes. Acorns and nuts were sometimes roasted prior to grinding them for flour.

Barbequeing. Grilling or barbequeing food entails placing it near an open flame, a process which tends to bleed off the natural juices and to harden the exterior. Early accounts note venison, turkey, and peaches treated in this manner.

Mechanical Alteration

Before sclerodermatous seeds can in any way be utilized for food they must be subjected to some type of mechanical alteration. Threshing is usually the initial step, followed by grinding, pounding, or in some way removing the shells. In instances where further softening is needed prior to final processing, the seeds, grains, or nuts are boiled for a time in water. Unlike many of the other groups who used mortars made of stone, the Pee Dee peoples used mortars and pestles made totally of wood. Lawson, in calling attention to this fact, writes:

> There is another sort, which we call red Hickory, the Heart there of being very red, firm and durable; of which Walking sticks, Mortars, Pestils, and several other fine Turnery-wares are made; ... (Lawson, 1937:101).

Occasionally roots and vegetables also had to be altered prior to use; this meant pounding or mashing the stems in order to pre-soften them before cooking. Although such methods did to some extent break down the fibers, the hardness and toughness of the foodstuffs remained to be dealt with during mastication.

Drying and Smoking

Since the availability of fresh foods decreased during certain seasons, particularly before the large yearly corn harvest, preservation and storage of foods against shortage was necessary. Peaches, plums, persimmons, and pumpkins were a few of the plant foods that were naturally dried by placing them on mats in the sun. Lawson (1937) describes Indian corn and wild fruits being fire-dried during the summer and stored for winter use. In the Pee Dee area salting and fire drying, rather than smoking over the flames, were the most common and preferred means of meat preservation. The large food storehouses of the Creek and Santee Indians and their use to protect foodstuffs preserved by these methods from weather and predators are mentioned by early writers.

Of the methods discussed for food processing and preservation, all are able to introduce varying quantities of abrasive materials into the diet. The extent to which these materials are thought to affect the dentition will be considered in the following chapters.

Chapter III

SAMPLE DESCRIPTION

The series of skulls used in this study was selected from the Town Creek Skeletal Collection housed in the Research Laboratories of Anthropology, University of North Carolina at Chapel Hill. This collection consists of two hundred and seventy-seven burials most of which are (and have been since the time of recovery) in very fragile condition. Both sexes and all ages are represented in the collection; and, with the exception of the later "Siouan" burials, the general physical type exhibited falls within Neumann's Walcolid classification (Neumann, 1952). Figure 3 presents an overlay comparison between Neumann's Muskogid (Walcolid) variety (Robbins, 1972) and $Mg^{V}3$ Burial 37 from Town Creek; the skull from this burial is shown in Plate I.

As the baseline data from this work will be used later as part of a comparative dental survey, representative specimen selection was of special importance. The following four points, therefore, were considered in reviewing burials for possible inclusion in the study series.

1. State of Preservation

Archaeological specimens from the southeastern United States are frequently very difficult to work with because of the poor state of preservation. In many areas ground water percolation, high-acidity soils, and postmortem damage have reduced burials to little more than the major long bones and a few teeth, Plate II. Fortunately dental composition is

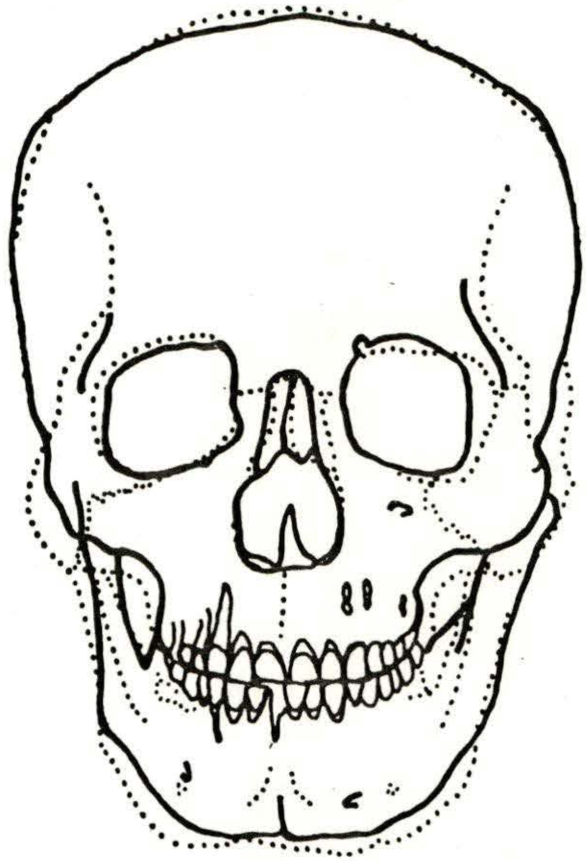


Figure 3. Skull outline comparison between Neumann's Walcolid variety (dotted lines) and Burial 37, Mg^v3, Town Creek (solid lines).

Plate I. $Mg^{v}3$ Burial 37. Muskogid variety as seen at Town Creek.

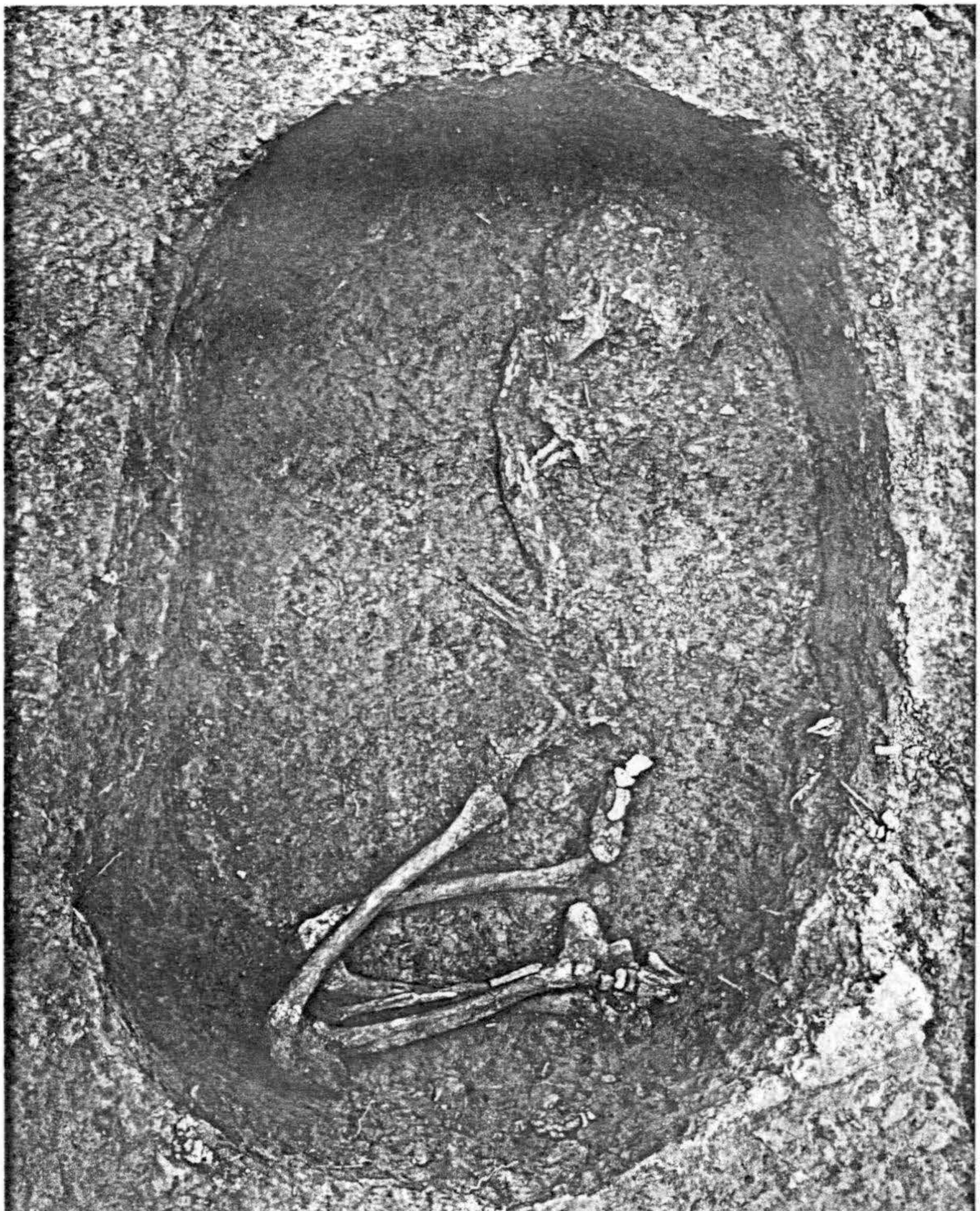


Plate II. $Mg^{v}3$ Burial 22. Preservation state typical of many Town Creek burials.

such that in most instances teeth remain intact long after the skeleton has disintegrated, allowing additional time for data on age, sex, and in some cases population size to be acquired. In using archaeological specimens, however, there are some very definite problems associated with dental preservation. The first of these is postmortem loss.

The periodontal ligament, composed of soft, fibrous connective tissue (Figure 4), is the means by which the teeth are supported and retained in their sockets. The breakdown of this ligament, in periodontal disease or following death, allows teeth that are single-rooted, or not captured in bone, to become essentially free-floating. Damp soil conditions at the time of excavation, fast drying in the field, and unstable humidity during storage prior to preservation all contribute to further separation and possible loss of such teeth from the jaws. In primary interments, a substantial percentage of postmortem loss is preventable through routine notation of missing teeth at the time of excavation, plus additional checks both during and after laboratory processing. Postmortem loss in secondary interments has usually occurred at some point prior to the reburial, making recovery of missing teeth unlikely.

Another concern in using archaeologically-recovered dental specimens is that unless preservative measures are taken soon after recovery (regardless of how sound the teeth appeared to be at the time) the teeth are apt to be dry, brittle, and have damaged enamel. Tooth enamel is composed primarily of hydroxyapatite ($Ca_5(PO_4)_3OH$) with small amounts of carbonate, magnesium, fluoride, glycoprotein, and keratin-like protein. The hydroxyapatite prism, composed of minute crystals, is surrounded by an organic zone or prism sheath (Poole and Brooks, 1961). Natural lines are formed between prisms, and it is here that fractures tend to occur

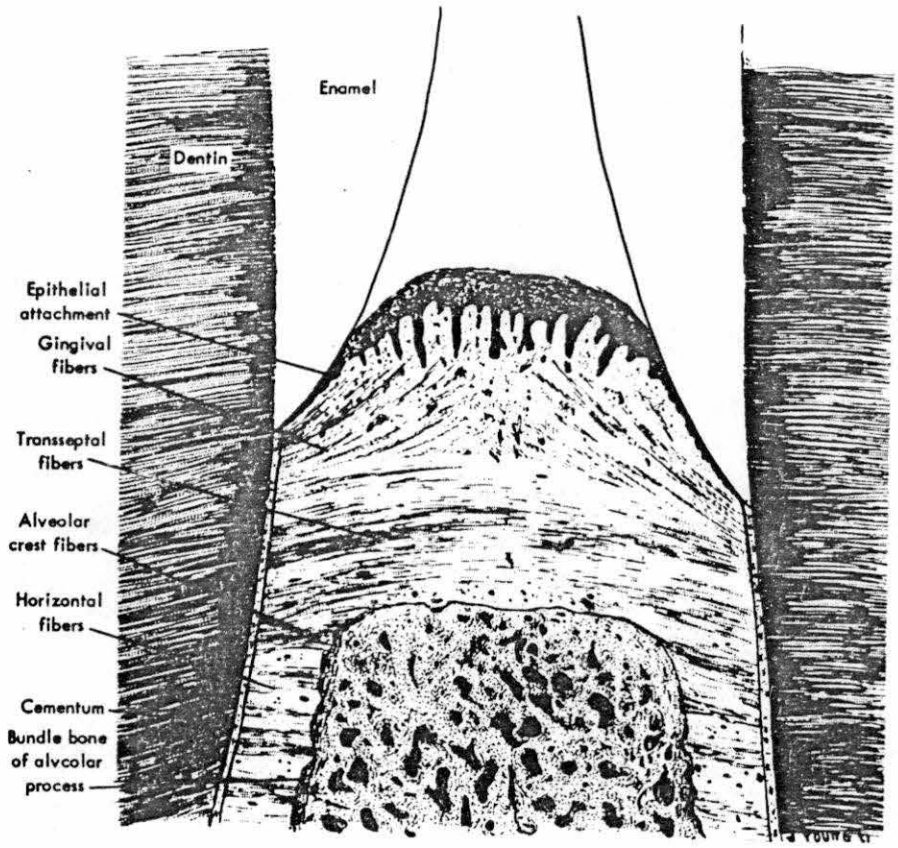


Figure 4. Fibers of the periodontal ligament. [After Young (1964), Figure 72, page 171; used by permission of the publisher.]

as the tooth dries out. As moisture leaves, multidirectional microscopic canals form throughout the dentine, resulting in separation from and loss of support to the enamel (Sognnaes, 1955). In specimens where enamel fragments have split off but are yet available, repair and a preservative coating can salvage the tooth. (The Research Laboratories of Anthropology routinely uses a preparation of vinyl acetate and resin in acetone for this.) Where enamel slivers are missing, teeth should still be preserved and may be of use provided the damage is not in an area crucial for measurement. Because restorative work takes time, all teeth should be examined and repaired prior to the start of any study program. Good preservation, whether in terms of a complete set of dentition or simply many well-preserved individual teeth, is a most important factor in the selection of specimens for study.

2. Specimen Age

In order to have a definite category with which to work, and because poor preservation would not permit closer age determination, specimens were chosen for the Town Creek series on the basis of having third molar eruption. This adult sample was thought advisable for several reasons. From a very practical standpoint, adult bone is easier to handle because it is thicker, stronger, and generally better preserved. Also, the use of adult specimens provides the maximum-possible number of permanent teeth for study. This is particularly important where postmortem loss and damage are definite considerations, as they are in this skeletal collection. Lastly, in studying progressive conditions such as attrition, it is necessary to have examples of change as it has occurred over time; older specimens are obviously more useful for this.

3. Male/Female Sample Ratio

Documentation exists regarding the slight variation between male and female dentition with respect to size (Garn *et al*, 1967a) and shape (Hrdlicka, 1923). Taking this into consideration, any study series ideally should be set up to include equal numbers of male and female specimens. Where living populations, or large well-preserved archaeological collections, are available such a ratio may be feasible. When using smaller collections, however, poor preservation and a normal predominance of male burials limits the likelihood of having equal sex representation. Often in small skeletal collections a 2:1 or 3:1 M/F ratio may be considered average; the latter is the case for the study series selected from the Town Creek burials.

4. Intra-site Specimen Comparison

When burials are recovered from a particularly large or complex site, care must be taken that specimens included in any study series be representative of the site as a whole. The importance of this is that intra-site comparison may serve to indicate differences in social class (Woolley, 1965); the appearance of a new physical type, perhaps a result of invasion or migration of peoples (Webb and Snow, 1945); or simply a change in mortuary customs due to population admixture, urbanization, or various other factors. There is no ideal way to handle intra-site specimen selection. Each site must be considered individually in terms of size, location, complexity, and burial distribution. A unit division system may work satisfactorily for sites having concentrations of features in various areas; such a system is appropriate for the Town Creek site because of the scattered mortuary complexes. The organization and use of the system is discussed in the following section.

THE TOWN CREEK STUDY SERIES

Reports from the Town Creek excavations were studied and notes made of all areas having heavy burial concentrations. Of the seven areas so located, each was given a unit designation, UNIT 1, UNIT 2,... UNIT 7. All of the burials within each unit area were examined and the best preserved selected for inclusion in the study series. UNITS 1 and 2 represent burials from the temple mound area. These include several burials from the early Pee Dee Period pre-mound mortuary house, as well as one burial from the last temple erected on the mound late in the same period. UNITS 3 through 6 include burials from four different mortuary complexes around the perimeter of the mound plaza. These also date to the Pee Dee Period, 1400-1600 AD. UNIT 7 consists of two intrusive burials which, on the basis of trade goods analysis, have been dated to the early 1700's. These two burials have been included in the series as examples of the replacement population. Without exception, the burials in the Town Creek series represent primary single interments.

Each burial differs in the size and shape of the grave, the amount and kind of grave goods, the orientation of the skeletal remains, and the general state of preservation. A brief summary follows for each site unit and its burials, as well as an indication of the location of each burial with regard to the site as a whole (Figure 5). At this point it should be noted that two different listings are used for the Town Creek material. Burials designated $Mg^{o}2$ (Montgomery County, Mound, Site 2) were excavated from the mound area proper, and those designated $Mg^{v}3$ (Montgomery County, Village, Site 3) include all other burials recovered from the site.

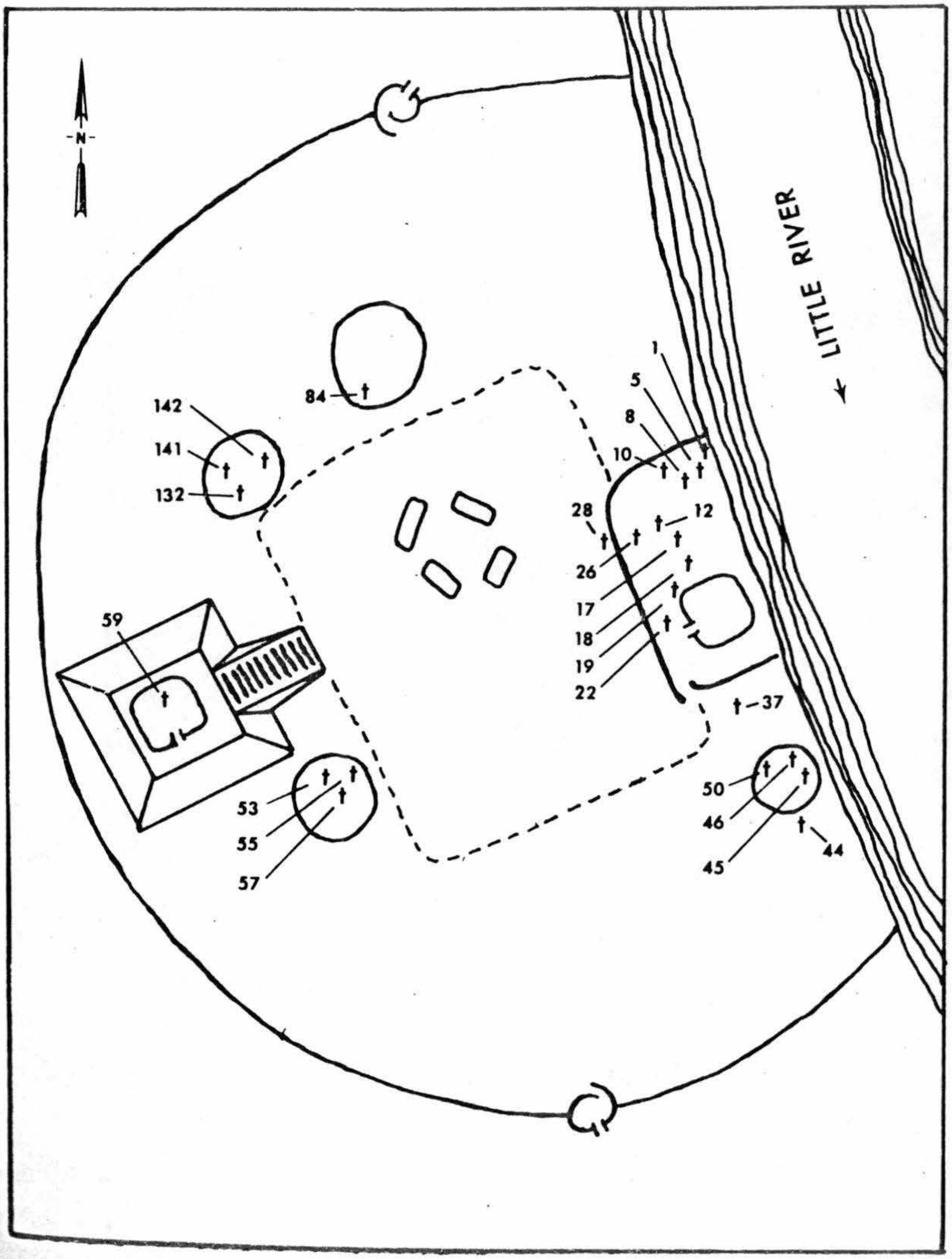


Figure 5. Locations of burials selected for the Town Creek series.

UNIT 1

UNIT 1 consists of Burials 53, 55, and 57 which were in close proximity in a structure thought to have been a pre-mound mortuary.

<u>$Mg^{O}2$ - Burial 53</u>. Originally located in 1941, Burial 53 was refilled and not excavated until August, 1950. The grave was found to be a round-cornered, rectangular pit approximately 5 ft. by 3.7 ft. in dimension. The poorly preserved skeleton, field sexed as male, was lying on its back with legs flexed to the right and with the major axis of orientation NW-SE. A rounded, unworked boulder was located at the feet of the skeleton. The pit of Burial 53 was intrusive into Burial 54. A piece of wood was located near the midsection of the burial and was thought to be part of the bark lining from Burial 54. No grave goods were recovered.

Post-cranial preservation was very poor. Although fragments were recovered, the skull has not been reassembled. The available teeth are indicated, in order from right to left, in the dental chart below. Here, as in following charts, the maxillary teeth are listed in the upper row.

$$\text{R}\ \frac{x\ 7\ 6\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ 7\ x}{8\ 7\ x\ 5\ 4\ 3\ 2\ x\ x\ x\ x\ x\ x\ x\ 7\ 8}\ \text{L}$$

<u>$Mg^{O}2$ - Burial 55</u>. Also located in 1941, Burial 55 was not excavated until 1950. The grave was a round-cornered, rectangular pit approximately 6 ft. by 3.4 ft. in dimension. The skeleton, field sexed as adult female, was lying on its back with legs and arms fully extended. The major axis of orientation was N-S with the apex of the skull to the north. The pit for Burial 55 was slightly intrusive into Burials 53 and 54; no grave goods were found in this burial.

General preservation was very poor. The skull was very fragmentary and has not been reassembled. Teeth present and suitable for study include the following:

$$R\ \frac{8\ 7\ 6\ 5\ 4\ 3\ 2\ x\ 1\ 2\ x\ x\ x\ 6\ 7\ 8}{8\ 7\ x\ 5\ x\ 3\ 2\ 1\ 1\ x\ x\ 4\ 5\ x\ x\ 8}\ L$$

Mg^{O}2 - Burial 57. Burial 57 was the third in the 1941 mortuary house, delayed-excavation series. The burial pit was ovoid in shape and about 5.6 ft. by 3.7 ft. in dimension. The skeleton, field sexed as as adult male, was lying on its back with legs flexed to the right and lying against the edge of the pit. The major axis of orientation was NW-SE, with the apex of the skull pointed NW. A single worked rock was lying over the right elbow. There were no associated grave goods.

The general condition of the bone was better than in either of the preceding burials. The skull has not been reassembled. Teeth available for study include the following:

$$R\ \frac{x\ 7\ 6\ 5\ x\ x\ x\ x\ 1\ x\ 3\ 4\ 5\ 6\ 7\ x}{8\ 7\ 6\ 5\ 4\ 3\ 2\ 1\ x\ 2\ 3\ 4\ 5\ 6\ 7\ x}\ L$$

UNIT 2

UNIT 2 consists of a single burial, Burial 59, which was found just west of the firepit in Temple 1 on top of the mound.

Mg^{O}2 - Burial 59. Burial 59 was contained in an ovo-rectangular pit approximately 4.7 ft. by 3.3 ft. in dimension. The skeleton, field sexed as a senile male, was lying flexed on its right side, facing east. The major axis of orientation was N-S. Grave goods associated with this individual include the following: 2 rattles; 2 mica buttons; 2 projectile points; 10 shell beads; and one lump of red ochre. The body is thought to have been lying on wooden planking and was possibly covered with a fur or cloth robe as evidenced by the soft humic earth immediately above the skeleton. As this burial was associated with the temple, it is possible that the individual was a tribal leader or perhaps a member of the religious hierarchy.

The state of preservation in this burial was extremely poor. The skull was fragmentary and has not been reconstructed. Teeth available for study include the following:

$$R \frac{x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x}{x\ x\ 6\ 5\ x\ x\ x\ x\ x\ x\ x\ x\ 5\ 6\ x\ x} L$$

UNIT 3

UNIT 3 consists of Burials 132, 141, and 142. These burials were recovered from a mortuary house immediately to the left of the ceremonial mound.

$Mg^{V}3$ - Burial 132. Burial 132 was located in an oval pit approximately 3.1 ft. by 2.4 ft. in dimension. The skeleton, field sexed as an adult male, was lying flexed on its left side. The major axis of orientation was E-W with the skull facing south. The burial was found at subsoil level during excavation of Burial 130. A great amount of organic matter was found above and beneath the skeleton. There were no grave goods associated with this burial.

Preservation was extremely poor for the post-cranial remains. The skull, however, was reasonably intact and has been partially restored. Teeth available for study include the following:

$$R \frac{8\ 7\ 6\ 5\ 4\ x\ x\ 1\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8}{8\ 7\ x\ 5\ 4\ 3\ 2\ 1\ 1\ 2\ 3\ 4\ 5\ x\ 7\ 8} L$$

<u>Mg^v3 - Burial 141</u>. Burial 141 was located in a round-cornered rectangular pit 5.3 ft. by 1.8 ft. in dimension. The skeleton, field sexed as an adult male, was lying fully extended on its back. The major axis of orientation was SSW-NNE. The ulna of the left arm was slightly out of place for no apparent reason. In the pit fill were what appeared to be log molds oriented lengthwise over the body. This burial was intrusive into Burial 139 and was intruded upon by Burials 140 and 142. In spite of this, the skeleton did not appear to have been particularly disturbed. No grave goods were found with this burial.

Skeletal preservation was poor. All of the bone exhibited pitting, originally assumed to have resulted from a pathological condition. However, as pitting was present only in small areas it is likely that soil acids were the contributing factor. The skull has been partially restored. Teeth available for study include the following:

$$R\ \frac{8\ 7\ 6\ 5\ 4\ 3\ 2\ x\ x\ 2\ 3\ 4\ 5\ 6\ 7\ x}{8\ x\ 6\ 5\ 4\ 3\ 2\ 1\ 1\ 2\ 3\ 4\ 5\ 6\ x\ 8}\ L$$

<u>Mg^v3 - Burial 142</u>. Burial 142 was contained in a rectangular pit 3.75 ft. by 2.4 ft. in dimension. The skeleton, field sexed as an adult male, was lying semi-flexed on its right side. The major axis of orientation was W-E, with the skull facing west. Both right and left tibiae and fibulae were posthumously broken, but none of the fragments had been removed from the burial. It was assumed that the bones had been damaged when another grave was dug but not completed. Burial 142 was intrusive into Burials 141 and 143. There were no grave goods with the burial.

Post-cranial preservation was not good. The skull was in better condition and has been partially reassembled. Teeth available for study include the following:

R 8 x 6 5 4 3 2 1 1 2 3 4 5 6 7 8 L
8 7 6 5 4 3 2 1 1 2 3 4 5 x 7 8

UNIT 4

UNIT 4 consists of one burial, Burial 84, which was recovered just outside the mortuary located to the left of the mound. This structure has been reconstructed as part of the Town Creek Indian Mound Historic Site.

Mg^V3 - Burial 84. Burial 84 was located in an oval pit 3.9 ft. by 2.6 ft. in dimension. The skeleton, field sexed as as adult male, was lying semi-flexed on its left side. The major axis of orientation was E-W, with the skull facing west. Two postholes were intrusive into the burial with one passing through the cranial area and disturbing the mandible and left scapula. The vertebrae were somewhat out of line; this was credited to root or rodent action. Grave goods associated with the burial are as follows: 2 small stones recovered from the north side of the burial; the tip of a chipped stone projectile point situated under the third rib; a small shell bead necklace; and several small sherds located near the maxilla at the edge of the posthole. The cranial and shoulder areas of this burial had been sealed over with a layer of clay. The postholes appeared to have resulted from posts being driven into the ground (as opposed to the hole being dug and the posts placed in them), since the materials were not removed but rather pushed aside.

The burial is well preserved, but the skull has not been reassembled. Teeth available for study include the following:

R 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 L
x 7 x 5 4 x x 1 1 2 3 4 5 x x x

UNIT 5

UNIT 5 consists of Burials 1, 5, 8, 10, 12, 17, 18, 19, 22, 26, and 37. These burials were recovered from a mortuary complex across the plaza from and facing the ceremonial mound.

$Mg^{V}3$ - Burial 1. Burial 1 was quite shallow and partially disturbed by plowing. The skeleton, field sexed as an adult female, was lying on its back, minus all remains inferior to the thoracic vertebrae. Orientation appeared to be E-W, with the skull facing east. There were no grave goods associated with this burial.

Preservation of the skeletal material that was present was rather poor. The skull has not been reassembled. Teeth available for study include the following:

R x x x 5 4 x 2 x x x 3 4 5 6 7 8 L
x x 6 5 4 3 x x x x 3 4 5 6 7 8

$Mg^{V}3$ - Burial 5. Burial 5 was intrusive from a habitation level through Burial 4. The grave was an oval pit approximately 6.9 ft. by 2.5 ft. in dimension. The skeleton, field sexed as an adult female, was lying partly flexed on its left side. The major axis of orientation was NE-SW with the skull facing NE. Grave goods associated with this burial were as follows: 4 perforated shell gorgets; a triangular projectile point found near the left shoulder and possibly at one time intruding into the bone; and a second triangular point found beneath the seventh thoracic vertebra.

Although preservation in general was poor, a relatively large amount of maxilla and mandible remain. Some reassembly of the skull has been attempted. Teeth available for study include the following:

R $\frac{8\ 7\ 6\ 5\ 4\ 3\ 2\ 1\ 1\ x\ 3\ 4\ 5\ 6\ 7\ 8}{8\ 7\ 6\ 5\ 4\ 3\ 2\ x\ x\ x\ x\ x\ x\ 6\ 7\ 8}$ L

Mg^{V}3 - Burial 8. Burial 8 appears to have been disturbed by plowing. The vertebrae were scattered and the lower portions of the body missing. The grave was an oval pit approximately 3.7 ft. by 2.5 ft. in dimension. The skeleton, field sexed as adult male, was lying flexed on its right side; the major axis of orientation was N-S, with the skull facing to the south. No grave goods were recovered from this burial.

Skeletal preservation is fairly good, but the skull has not been reassembled. Teeth available for study include the following:

R $\frac{x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x}{x\ x\ x\ x\ 4\ 3\ x\ x\ x\ x\ 3\ x\ x\ x\ x\ 8}$ L

Mg^{V}3 - Burial 10. Burial 10 was located in a rather shallow rectangular pit. The pit was approximately 4.6 ft. by 2.8 ft. in dimension. The skeleton, field sexed as an adult female, was lying fully flexed on its back and right side. The major axis of orientation was NW-SE, with the skull facing SE. A large irregularly shaped granite cobble was found NE of the skull on the pit floor. No grave goods were recovered from the burial.

Preservation of this burial was very poor. The skull has not been reassembled. Teeth available for study are as follows:

R $\frac{x\ x\ 6\ 5\ 4\ x\ x\ 1\ x\ x\ x\ 4\ 5\ 6\ 7\ x}{8\ 7\ 6\ x\ 4\ x\ x\ x\ x\ x\ 3\ x\ x\ x\ x\ x}$ L

Mg^{V}3 - Burial 12. Burial 12 was contained in a sub-rectangular pit 3.7 ft. by 2.8 ft. in dimension. The skeleton, field sexed as as adult male, was lying fully flexed on its back with legs to the left and arms crossed. The major axis of orientation was NE-SW, with the skull facing east. No grave goods were associated with the burial.

Preservation of the burial was very poor. The skull has been partially reassembled. Teeth available for study are as follows:

$$R\ \frac{x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ 6\ 7\ x}{x\ 7\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ 7\ x}\ L$$

<u>Mg^{v}3 - Burial 17</u>. Burial 17 was located in a bell-shaped pit appoximately 4.0 ft. by 2.4 ft. in dimension. The skeleton, field sexed as an adult male, was lying flexed on its back and left side with arms partially flexed. The major axis of orientation was NW-SE, with the skull facing north. This skeleton was badly disturbed by root activity. Two postmolds were in the grave pit, but apparently were there prior to the burial. No grave goods were recovered.

The burial is in a very poor state of preservation. The skull consists of small fragments and has not been reassembled. Teeth available for study include the following:

$$R\ \frac{x\ x\ 6\ x\ 4\ 3\ 2\ x\ x\ x\ x\ x\ x\ x\ x\ x}{8\ x\ 6\ x\ 4\ 3\ x\ x\ x\ x\ 3\ x\ x\ 6\ 7\ x}\ L$$

<u>Mg^{v}3 - Burial 18</u>. Burial 18 was contained in a rectangular pit 3.9 ft. by 2.9 ft. in dimension. The skeleton, field sexed as a young male, was lying fully flexed on its right side with the skull facing east. The burial had been disturbed by root activity, with the result that several of the ribs had been moved from their original position. No grave goods were associated with this burial.

Preservation of the burial was fair. The skull has not been reassembled. Teeth available for study are as follows:

$$R\ \frac{x\ x\ x\ 5\ 4\ 3\ x\ x\ x\ 2\ 3\ x\ x\ x\ x\ x}{x\ 7\ 6\ x\ x\ x\ x\ x\ x\ x\ 3\ 4\ x\ x\ x\ x}\ L$$

Mg^v3 - Burial 19. Burial 19 was located in a rectangular pit approximately 4.5 ft. by 3.2 ft. in dimension. The skeleton, field sexed as a mature male, was lying partially flexed on its back with legs to the left. The major axis of orientation was NE-SW, with the skull facing south. One columnar shell bead was located at each wrist of the skeleton. Additional beads were randomly scattered throughout the pit fill. Some were found as much as one foot above the burial, possibly as a result of rodent activity.

Preservation was somewhat better than usual in this burial. The skull has been partially reassembled. Teeth available for study include the following:

$$R\ \frac{x\ 7\ x\ x\ x\ x\ x\ x\ x\ 2\ 3\ 4\ 5\ 6\ x\ x}{8\ 7\ x\ 5\ x\ x\ x\ x\ x\ x\ 3\ x\ 5\ x\ 7\ x}\ L$$

Mg^V3 - Burial 22. Burial 22 was located in a nearly oval pit approximately 4.1 ft. by 3.1 ft. in dimension. The skeleton, field sexed as an adult female, was lying on its ventral and right side with arms and legs partially flexed. The major axis of orientation was E-W, with the skull facing to the south. No grave goods were associated with the burial.

Most of the post-cranial material was too fragmentary to remove from the ground. The skull has not been reassembled. Teeth available for study are as follows:

$$R\ \frac{x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ 6\ 7\ 8}{x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ 5\ x\ 7\ 8}\ L$$

Mg^V3 - Burial 26. Burial 26 was contained in a rectangular pit about 3.2 ft. by 1.8 ft. in dimension. The skeleton, field sexed as a young female, was lying on its back with its head to the left. The right arm was extended and the left arm flexed to the shoulder. The legs were missing. The major axis of orientation was NS-EW, with the skull facing north. The pelvic region was shallower than the rest of the burial, so that it was possibly disturbed by plowing. One postmold was evident, but it appeared to have predated the burial.

The condition of the burial was very poor. The skull has not been reassembled. Teeth available for study are as follows:

$$R\ \frac{8\ 7\ 6\ 5\ 4\ 3\ x\ x\ x\ 2\ 3\ 4\ 5\ 6\ 7\ 8}{8\ x\ x\ 5\ 4\ 3\ x\ x\ 1\ x\ 3\ 4\ 5\ 6\ x\ x}\ L$$

<u>Mg^V3 - Burial 37</u>. Burial 37 was located in a round-cornered pit approximately 1.5 to 2.0 ft. by 7.5 ft. in dimension. The inner pit was surrounded by a shelf about one foot wide, making the total pit dimensions 3.5 ft. by 9.0 ft. The skeleton, field sexed as an adult male, was lying fully extended with the head turned to the left. The major axis of orientation was NS-EW, with the head to the north. This burial was accompanied by a large number of grave goods, including: a chipped stone drill; 5 chipped stone projectile points; 33 pottery sherds; a copper-coated wooden ear disk placed over the right eye (Plate III); shell beads located at the wrists, ankles, and around the neck; and 4 shell ear pins lying under the left side of the mandible. The pit ledge was thought to have been used to support timbers covering the grave.

Preservation in this burial was excellent. The skull has been fully reassembled and, with the green stain caused by the copper-coated wooden disk found over the right eye, makes a most unusual specimen (Plate 1). Teeth available for study are as follows:

$$R\ \frac{8\ 7\ 6\ 5\ 4\ 3\ 2\ 1\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8}{8\ 7\ 6\ 5\ 4\ 3\ 2\ x\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8}\ L$$

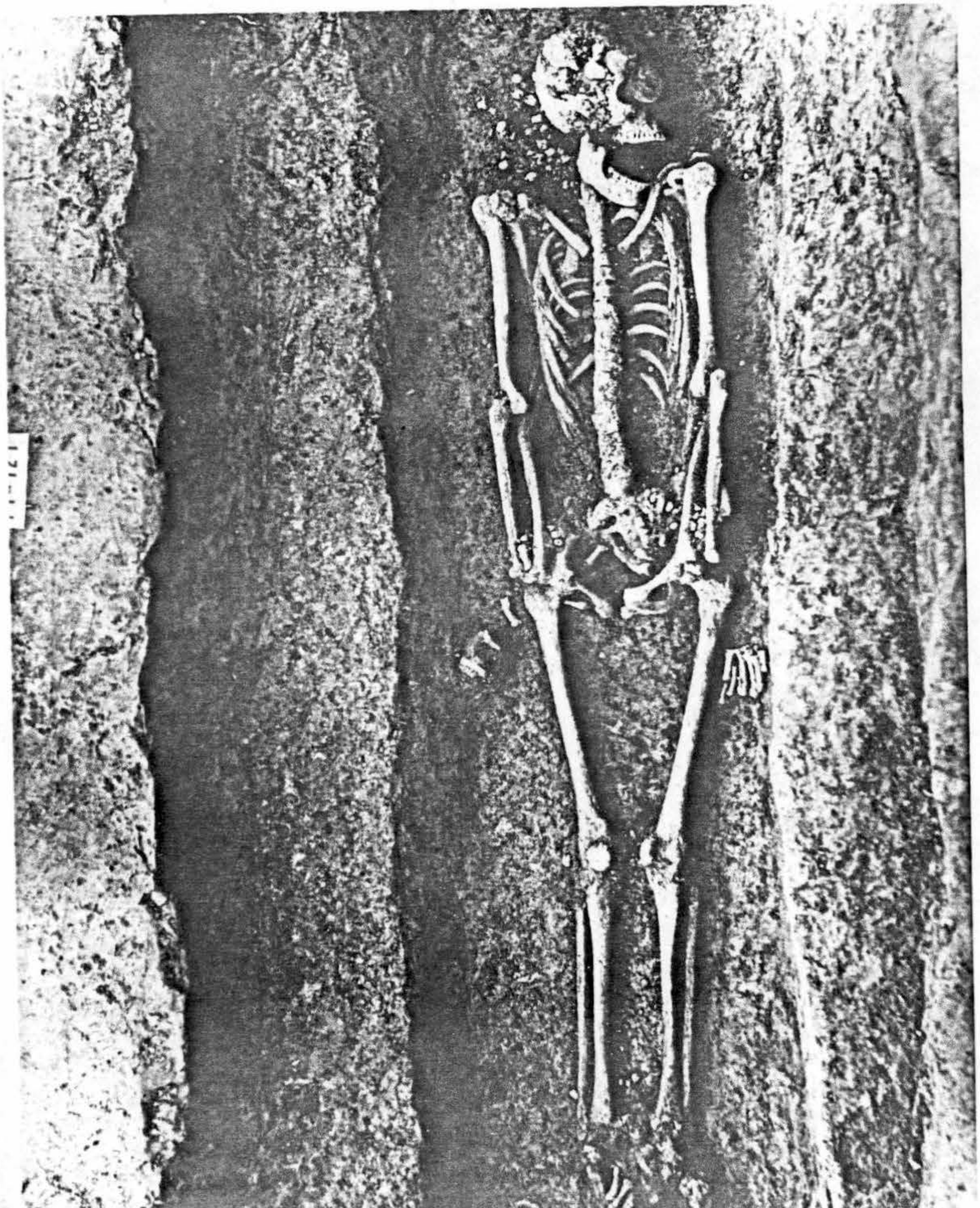


Plate III. Mg^V3 Burial 37, prior to removal of grave goods. Included were numerous shell beads and a copper-coated disk of wood, visible over the right eye.

UNIT 6

UNIT 6 consists of Burials 45, 46, and 50. These burials were in close proximity and were recovered from what was thought to be part of an early Pee Dee mortuary house. The house was located across the plaza from and slightly to the right of the ceremonial mound.

<u>Mg^v3 - Burial 45</u>. Burial 45 was located in an oval pit approximately 2.5 ft. by 2.0 ft. in dimension. The skeleton, field sexed as an adult male, was fully flexed and lying on its back with legs to the right. The major axis of orientation was NNE, with the skull facing north. Four small clay pellets were found under the chin; two had holes through their center as if to have been beads, while the other two were too badly broken to be studied.

Preservation was only fair. No attempt has been made to reassemble the skull. Teeth available for study are as follows:

$$R\ \frac{x\ 7\ 6\ 5\ 4\ 3\ 2\ 1\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ x}{8\ 7\ 6\ 5\ 4\ 3\ 2\ 1\ 1\ 2\ 3\ x\ 5\ 6\ 7\ 8}\ L$$

<u>Mg^v3 - Burial 46</u>. Burial 46 was located in an oval pit approximately 2.8 ft. by 1.8 ft. in dimension. The skeleton, field sexed as an adult male, was lying fully flexed on its right side. The major axis of orientation was SSW, with the skull facing slightly SE. No grave goods were recovered.

Preservation was good in this burial. The skull has been completely reassembled. Teeth available for study are as follows:

$$R\ \frac{x\ x\ x\ x\ x\ 3\ 2\ x\ x\ x\ x\ x\ x\ x\ 7\ 8}{8\ 7\ x\ x\ 4\ 3\ 2\ 1\ x\ x\ 3\ 4\ x\ x\ x\ 8}\ L$$

<u>Mg^v3 - Burial 50</u>. Burial 50 was contained in an oval pit approximately

5.3 ft. by 2.2 ft. in dimension. The skeleton, field sexed as as adult male, was lying on its back with the left leg slightly bent and the left arm flexed to the chin. The major axis of orientation was SE-NW. Grave goods associated with this burial include the following: a copper axe located over the left ilium; shell beads located in the neck region; a roughened round stone located slightly to the left of the left wrist; and a fresh water clam shell near the left femur.

Preservation in this burial was excellent. The skull has been fully reassembled. Teeth available for study are as follows:

$$R\ \frac{8\ 7\ x\ 5\ 4\ x\ x\ 1\ 1\ x\ x\ 4\ 5\ 6\ 7\ 8}{x\ 7\ 6\ 5\ x\ x\ 2\ 1\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8}\ L$$

UNIT 7

UNIT 7 consists of Burials 28 and 44. These two burials, representative of the Hillsboro focus, are intrusive into the earlier Pee Dee level. Plate IV (Burial 44) illustrates the shaft and chamber burial concept used by the Siouan replacement population. Trade goods analysis has dated these burials to the early 1700's.

$\underline{Mg^{V}3}$ - Burial 28. Burial 28 was located in a shaft and chamber grave. The chamber was an oval pit approximately 3.7 ft. by 2.5 ft. in dimension. The skeleton, field sexed as as adult male, was lying on its left side. The major axis of orientation was NE-SW, with the skull lying on its left side facing SW. The grave was intrusive into a Pee Dee refuse pit that had been dug but never used. This was evident from the red clay soil from the burial pit which had become mixed with fill of the refuse pit. No grave goods were recovered from this burial.

The preservation was good, and the skull has been partially

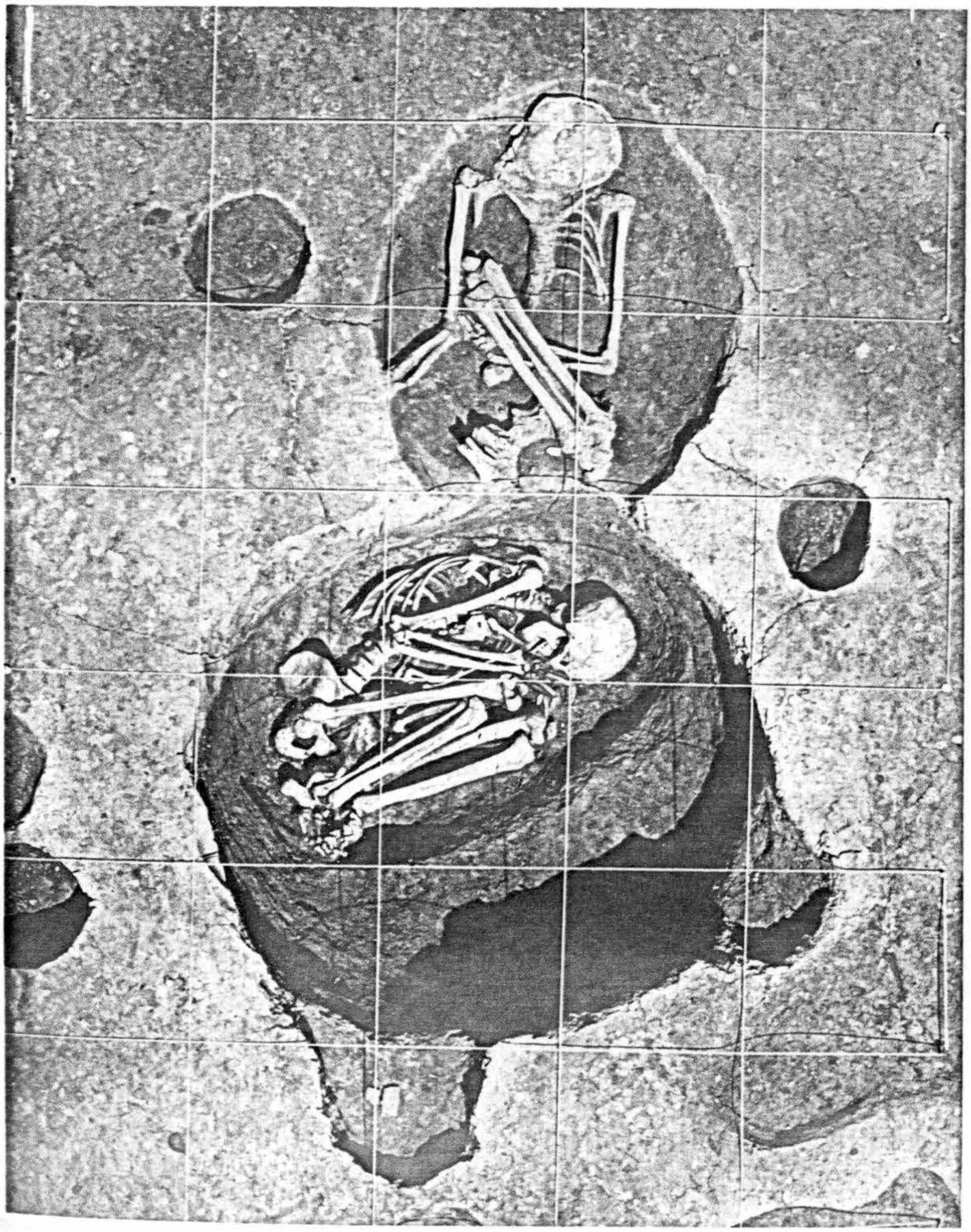


Plate IV. Mg^{V}3 Burial 44. Shaft and chamber grave concept as used by the Siouan replacement population at Town Creek.

reassembled. Teeth available for study are as follows:

R	8	7	6	5	4	x	x	x	1	2	3	4	5	6	7	8	L
	8	x	x	5	4	3	x	x	1	x	3	4	5	6	x	x	

Mg^V3 - Burial 44. Burial 44 (Plate IV) was located in a shaft and chamber grave similar to that of Burial 28. The grave was intrusive into an earlier Pee Dee burial which, as a result, had been partially destroyed. The burial chamber was an oval pit approximately 3.0 ft. by 2.5 ft. in dimension. The skeleton, field sexed as an adult male, was lying fully flexed on its left side. The major axis of orientation was NE, with the skull facing east. No grave goods were found.

Preservation was good in this burial. The skull has been fully reassembled. Teeth available for study are as follows:

R	8	7	6	5	x	x	2	1	1	2	3	4	5	6	7	8	L
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	

DISCUSSION

As can be noted from the above summaries, preservation is quite poor in most of the Town Creek burials. Due to this, teeth listed as available for study include not only complete specimens, but also teeth damaged sufficiently that only single dimensions can be determined. The first and second mandibular molars illustrated in Plate V (a and c) are examples of this condition. Data from such teeth have been included in mesial-distal or buccal-lingual metrical statistics; however, it is obviously not suitable for use in Crown Index, or other similar, studies.

Postmortem tooth loss in the 24 burials is quite high, as shown in Tables 2A and 2B. With the exceptions of the left maxillary first and second molars the frequency of loss is over 25 per cent, with the central and lateral maxillary and mandibular incisors most frequently

Plate V. Types of dental loss and damage. Postmortem loss typically occurs in the incisor and canine areas as illustrated in a and b. a and c show caries and enamel damage which inhibit proper dental measurements.

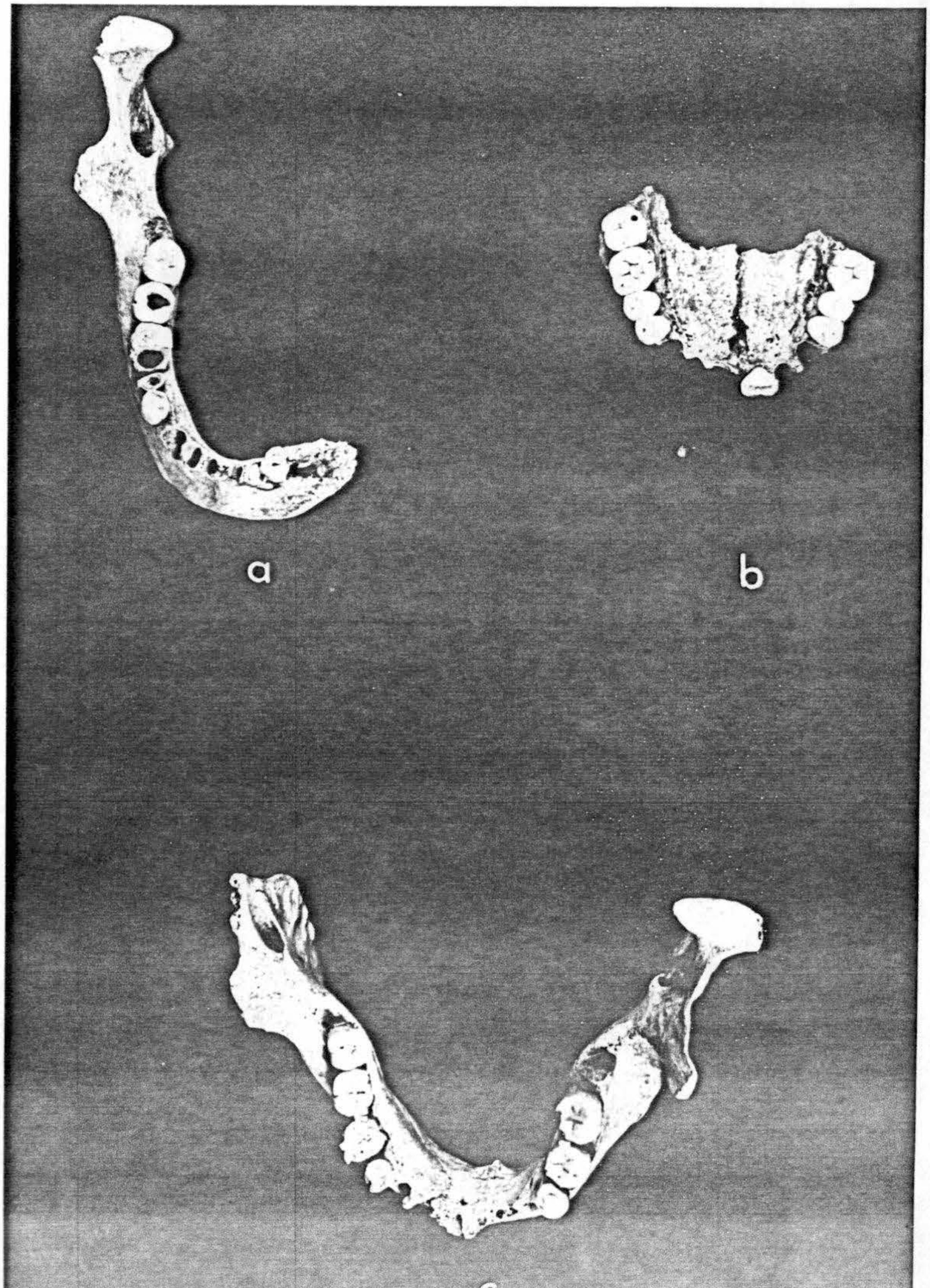


TABLE 2A

MAXILLARY POSTMORTEM TOOTH LOSS (22 SPECIMENS)

Site	Burial	Right Quadrant								Left Quadrant							
		8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
Mg^{o}2	53	x			x	x	x	x	x	x	x	x	x	x	x		x
Mg^{o}2	55								x			x	x	x			
Mg^{o}2	57	x				x	x	x	x		x						x
Mg^{o}2	59			(Maxilla missing)								(Maxilla missing)					
Mg^{v}3	132						x	x									
Mg^{v}3	141								x	x							x
Mg^{v}3	142		x														
Mg^{v}3	84																
Mg^{v}3	1	x	x	x			x		x	x	x						
Mg^{v}3	5										x						
Mg^{v}3	8			(Maxilla missing)								(Maxilla missing)					
Mg^{v}3	10	x	x				x	x		x	x	x					x
Mg^{v}3	12	x	x	x	x	x	x	x	x	x	x	x	x	x			x
Mg^{v}3	17	x	x		x				x	x	x	x	x	x	x	x	x
Mg^{v}3	18	x	x	x				x	x	x			x	x	x	x	x
Mg^{v}3	19	x		x	x	x	x	x	x	x						x	x
Mg^{v}3	22	x	x	x	x	x	x	x	x	x	x	x	x				x
Mg^{v}3	26							x	x	x							
Mg^{v}3	37																
Mg^{v}3	45	x															x
Mg^{v}3	46	x	x	x	x	x			x	x	x	x	x	x	x		
Mg^{v}3	50			x			x	x			x	x					
Mg^{v}3	28						x	x	x								
Mg^{v}3	44					x	x										
Total Absent		11	8	7	6	7	11	11	13	11	10	8	7	6	4	3	10
Percentage		50.0	36.4	31.8	27.3	31.8	50.0	50.0	59.1	50.0	45.5	36.4	31.8	27.3	18.2	13.6	45.5
Mean Loss		42.045 per cent								33.52 per cent							

TABLE 2B

MANDIBULAR POSTMORTEM TOOTH LOSS (24 SPECIMENS)

Site	Burial	Right Quadrant 8	7	6	5	4	3	2	1	Left Quadrant 1	2	3	4	5	6	7	8
$Mg^{O}2$	53			x					x	x	x	x	x	x	x		
$Mg^{O}2$	55			x		x					x	x			x	x	
$Mg^{O}2$	57									x							x
$Mg^{O}2$	59	x	x			x	x	x	x	x	x	x	x			x	x
$Mg^{V}3$	132			x											x		
$Mg^{V}3$	141		x													x	
$Mg^{V}3$	142														x		
$Mg^{V}3$	84	x		x			x	x							x	x	x
$Mg^{V}3$	1	x	x					x	x	x	x						
$Mg^{V}3$	5								x	x	x	x	x	x			
$Mg^{V}3$	8	x	x	x	x			x	x	x	x		x	x	x	x	
$Mg^{V}3$	10				x		x	x	x	x	x		x	x	x	x	x
$Mg^{V}3$	12	x		x	x	x	x	x	x	x	x	x	x	x	x		x
$Mg^{V}3$	17		x		x			x	x	x	x		x	x			x
$Mg^{V}3$	18	x			x	x	x	x	x	x	x			x	x	x	x
$Mg^{V}3$	19			x		x	x	x	x	x	x		x		x		x
$Mg^{V}3$	22	x	x	x	x	x	x	x	x	x	x	x	x		x		
$Mg^{V}3$	26		x	x				x	x		x					x	x
$Mg^{V}3$	37								x								
$Mg^{V}3$	45												x				
$Mg^{V}3$	46			x	x					x	x			x	x	x	
$Mg^{V}3$	50	x				x	x										
$Mg^{V}3$	28		x	x				x	x		x					x	x
$Mg^{V}3$	44																
Total Absent		8	8	11	7	7	8	12	14	13	15	6	10	8	12	10	10
Percentage		33.3	33.3	45.8	29.2	29.2	33.3	50.0	58.3	54.2	62.5	25.0	41.8	33.3	50.0	41.8	41.8
Mean Loss		39.06 per cent								43.78 per cent							

missing (see Plate V; a, b, and c for typical loss patterns). The data from the Town Creek series agree with previous findings that one-half to three-fourths of the incisors and one-third to one-half of the canines are typically lost postmortem from both prehistoric and aboriginal skull collections (Krogman, 1935). Tables 3 and 4 present Krogman's English and Australian postmortem loss data as compared with similar tabulations for the Town Creek series. As mentioned in earlier discussion, for the incisors and canines similar patterns of loss occur and may reasonably be attributed to the tooth root configuration. Because of the unknown factors of excavation, cleaning, and storage, any further statements as to similarities or differences in loss frequencies would be speculative.

As noted in the summaries, all burials have sex designations that were assigned in the field during recovery. All such designations were rechecked as part of this study and, with one exception, were correct insofar as could be ascertained from skull and postcranial examinations. The female assignation of the burial in question was apparently challenged at the time of laboratory processing and was changed to male. The latter designation is correct.

It should be mentioned that although a unit division system has been proposed for intra-site comparative purposes, the small number of specimens, the high incidence of postmortem tooth loss, and the normal and sometimes wide ranges of individual variation make definite conclusions with regard to specific units unwise. Differences between units will be noted, with special attention paid to possible differences between UNIT 7 (the intrusive Siouan burials) and all others. The overall results of the study, including UNIT 7 except for comparative purposes, will be presented in terms of a single population made up of all units.

TABLE 3

COMPARISON OF POSTMORTEM LOSS FREQUENCY

TOOTH	18th Century English Skulls*				Prehistoric Australian Skulls*				Town Creek Skull Series			
	Upper (39)		Lower (46)		Upper (108)		Lower (64)		Upper (22)		Lower (24)	
	#	%	#	%	#	%	#	%	#	%	#	%
1 (I_1)	66	87	71	77	126	58	64	50	24	54	27	56
2 (I_2)	48	63	66	72	94	43	48	38	21	48	27	56
3 (C)	36	47	60	65	78	36	39	30	19	43	14	29
4 (PM_1)	16	21	44	48	64	30	36	28	14	31	17	35
5 (PM_2)	10	13	36	40	58	27	52	40	12	27	15	31
6 (M_1)	4	5	-	-	12	6	8	6	11	25	23	48
7 (M_2)	6	8	6	7	25	11	8	6	11	25	18	37
8 (M_3)	10	13	8	9	50	23	12	9	21	48	18	37
Totals	196	32	291	39	507	29	267	26	133	38	159	41

* Adapted from Krogman (1935), page 45.

TABLE 4

ORDER OF POSTMORTEM LOSS IN PERMANENT DENTITIONS

18th Century English Adult Male Skulls*		Australian Adult Male Skulls*		Town Creek Skulls (Mixed Sexes)	
Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible
I^1	I_1	I^1	I_1	I^1	I_1
I^2	I_2	I^2	I_2	I^2	I_2
C	C	C	PM_2	M^3	M_1
PM^1	PM_1	PM^1	C	C	M_3
PM^2	PM_2	PM^2	PM_1	PM^1	M_2
M^3	M_3	M^3	M_3	PM^2	PM_1
M^2	M_2	M^2	M_2	M^2	PM_2
M^1	-	M^1	M_1	M^1	C

* Adapted from Krogman (1935), page 45.

Chapter IV

DENTAL MORPHOLOGY

Morphologic differentiation which was eventually to result in the hominid type of dentition began during the Permo-Carboniferous and Triassic Periods with the change from homodonty to heterodonty (Le Gro Clark, 1959). Further configurational modifications, such as the tritubercular and later quadritubercular molar forms, continuous size reduction in all of the teeth, and the gradual change to a smoother, more U-shaped dental arch occurred precursory to the Australopithecine dentition (Broom and Schepers, 1946; Broom and Robinson, 1950 and 1952). From these earliest of hominids through *Homo erectus* and *Homo sapiens* change was again characterized by a decrease in length and width of the dental arches, together with further simplification and size reduction in certain tooth groups. Brace (1962) views this "humanization" of dentition as correlating with changes in environment and ecology: specifically, those morphological changes (decrease in canine size and reduction of molar surface area) which occurred as the use of tools and fire decreased selective pressures inherent in marginal survival situations. Possibly correct, Brace's theory raises questions as to the nature and extent of morphological variation in hominid dentition that arose as a result of cultural selection.

Basically the structural formation of the dentition is histologically and embryologically the same for all vertebrates, with any subsequent differentiation reflecting phylogenetic and ontogenetic templates (Burdi, 1968). In mammals, specifically man, the dentition begins to develop with the appearance of tooth primordia in the embryonic dental ledge. After several growth stages histodifferentiation stops cell division, allowing for modelling of the various hard and soft structures of the tooth, Figure 6. The dental arches also undergo magnification during this time and by the eighth week *in utero* have assumed their characteristic catenary curve.

As the teeth form in the dental arch, their morphology is determined by the tooth districts in which they develop. It has been suggested (Butler, 1939) that "field" genes similar to those controlling regional differentiation in the vertebral column exist for the various tooth districts. Knowledge as to the specific mechanisms here involved is unavailable, for while genetics is recognized as playing a key role in all aspects of dental morphology, practical difficulties have hindered determination of gene frequencies or modes of inheritance for the various traits. One possible exception to this might be Carabelli's trait, which will be discussed in detail later in this chapter.

An analysis of the dental morphology of a population generally includes metrical data for individual tooth size as well as descriptive data (sometimes including metrical) for traits such as supernumerary cusps, supernumerary teeth, peg-shaped teeth, incisor shoveling, Carabelli's cusp, and so forth. As all of these traits are phenotypic, their description and incidence is of primary importance in establishing genotypic characteristics for the population.

The following presents a description of the dental morphology of the Town Creek series. For convenience the data are separated into two

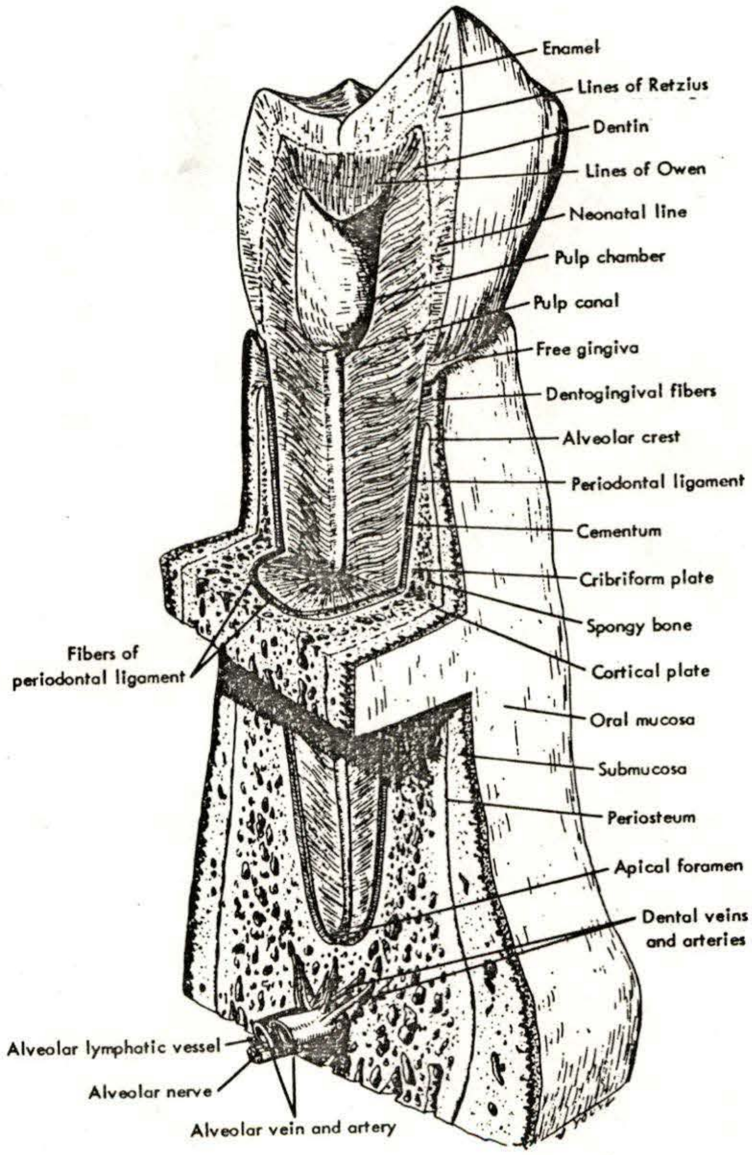


Figure 6. Longitudinal section through a typical tooth. [After Young (1964), frontispiece.]

parts: Part I, Dental Measurements; and Part II, Description of Selected Phenotypic Traits.

Part I. Dental Measurements

Odontometry has been used to estimate evolutionary trends in fossil forms, to demonstrate differences among ethnic groups, and to provide data for use in orthodontics and prosthodontics. So long as measurement techniques are clearly defined, consistently applied, and the raw data made available, one investigator theoretically should be able to make use of another's work in formulating comparative studies. This particularly should be the case where metrical data form the basis for trait description.

From the 24 Town Creek burials (18 male and 6 female) 387 teeth were complete enough to allow both mesio-distal and bucco-lingual measurements to be taken. Where possible, measurements were made on the teeth *in situ* using a sharp-jawed Boley guage with vernier, accurate to 0.1 mm; all measurements are presented in millimeters. Loose teeth were utilized in the sample only when (by matching wear facets or root and socket configurations) they could be directly associated with teeth remaining in the dental arch.

Throughout this study, in the interest of thoroughness, data were calculated separately for each tooth location within each of the four quadrants of the mouth. The data were further separated according to sex and subsequently summarized to reflect the trait over the whole population. Where appropriate, statistical data (means, standard deviations, or results of t-tests) were included.

Due to the differences in tooth shape, the actual techniques for measuring incisors and canines varied slightly from those used for premolars and molars. All measurements were taken according to methods prescribed by Wheeler (1965) and are as follows:

Mesio-Distal (MD) Crown Diameter

Anterior teeth. Measurement taken across cutting edge of tooth from crest of curvature on the mesial surface (mesial contact area) to the crest of curvature on the distal surface (distal contact area).

Posterior teeth. Measurement taken across the mesio-distal axis of the crown from the crest of curvature on the mesial surface (mesial contact area) to the crest of the curvature on the distal contact area).

Bucco-Lingual (BL) or Labial-Lingual Crown Diameter

Anterior teeth. Measurement taken at right angles to the MD measurement, from the crest of curvature on the labial surface to the crest of curvature on the lingual surface.

Posterior teeth. Measurement taken at right angles to the mesio-distal axis of the tooth, from the crest of curvature on the buccal surface to the crest of curvature on the lingual surface.

To indicate the relation of tooth length to width, the Crown Index was calculated for each tooth using the relation

$$CI = \frac{\text{MD Diameter}}{\text{BL Diameter}} \times 100 \quad .$$

Since the measurements on the two (male) Siouan specimens showed no significant differences from those for the remainder of the male population, they were included in the statistics for the total male component of the series. Tables A, B, C, and D, included in the Appendix for completeness of data, present measurement summaries for each tooth location within each of the four mouth quadrants. The sample size, parameter range, and the sample mean and standard deviation are given for MD, BL, and CI measurements. t-tests, conducted on data for antimeres, showed no significant differences in size; consequently, the data in Tables A and B (C and D) were combined to give the composite maxillary (mandibular) data which is presented in Table 5A (5B).

As is evident from the t-statistics, compiled in Table E of the Appendix, there is no significant difference in tooth size between sexes, except for two isolated instances: in the first case, the MD measurement for the mandibular M_3 antimeres was slightly larger in the males than in the females; secondly, the BL measurement for the mandibular I_2 antimeres appeared to be significantly different, but actually was not because of the small sample size (1 or 2 teeth). Therefore in future discussion reference will only be made to the statistics for the total population. Although little can be done with these measurements for the present study except compare their means with those for other populations as in Table 6, their compilation is crucial to future, detailed comparative studies.

Part II. Description of Selected Phenotypic Traits

Variation in tooth size, number, and shape has been reported for every group within the hominid line. Such differences occur in both the deciduous and permanent dentitions, and mainly in connection with the tooth in each district considered genetically most unstable, i.e.,

Maxilla I^2, PM^2, M^2, M^3; and

Mandible I_1, PM_2, M_2, M_3.

Of the teeth mentioned, the third molars are generally subject to more variation, resulting in many cases in total absence (hypodontia). As suggested by Dahlberg (1945), this may occur proportionate to the distance from the center of influence of a tooth group (a modification of Butler's field theory).

TABLE 5A

MAXILLARY MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
M^3	Male	23	5.8-10.3	8.54	0.92	6.8-11.8	9.90	1.11	87.38-139.39	116.41	10.38
	Female	6	8.1- 9.7	8.63	0.99	10.0-11.4	10.46	0.83	108.25-139.02	121.79	16.52
	All	29	5.8-10.3	8.56	0.93	6.8-11.8	10.02	1.06	87.38-139.39	117.52	11.76
M^2	Male	20	8.7-10.3	9.48	0.52	10.2-11.5	10.73	0.53	107.29-120.70	113.24	4.64
	Female	8	8.5- 9.7	9.16	0.45	9.9-11.3	10.48	0.54	108.25-120.00	114.40	4.10
	All	28	8.5-10.3	9.39	0.50	9.9-11.5	10.66	0.53	107.29-120.70	113.57	4.50
M^1	Male	17	8.6-11.3	10.18	0.63	10.1-11.5	10.71	0.35	93.75-124.42	105.57	7.25
	Female	8	8.8-10.7	10.22	0.76	10.5-11.5	11.06	0.66	103.81-119.32	108.56	6.67
	All	25	8.6-11.3	10.19	0.67	10.1-11.5	10.82	0.47	93.75-124.42	106.53	7.08
PM^2	Male	17	5.0- 7.5	6.31	0.67	7.9-10.1	9.05	0.59	125.33-166.00	143.69	13.03
	Female	7	6.2- 7.5	6.72	0.49	8.9- 9.8	9.38	0.50	130.67-148.48	140.07	6.06
	All	24	5.0- 7.5	6.43	0.61	7.9-10.1	9.15	0.57	125.33-166.00	142.63	11.55
PM^1	Male	19	5.9- 7.2	6.68	0.40	8.2-10.1	9.15	0.60	115.28-154.84	137.54	9.55
	Female	6	6.4- 7.3	6.78	0.69	9.2-10.1	9.65	0.64	132.88-157.81	142.08	12.76
	All	25	5.9- 7.3	6.70	0.48	8.2-10.1	9.27	0.61	115.28-157.81	138.63	10.33
C	Male	16	6.8- 8.4	7.66	0.53	6.6- 9.1	7.94	0.51	96.43-118.57	103.87	5.74
	Female	5	7.8- 8.3	8.12	0.17	7.8- 8.7	8.28	0.48	98.78-107.41	101.57	4.16
	All	21	6.8- 8.4	7.77	0.48	6.6- 9.1	8.02	0.50	96.43-118.57	103.32	5.45

TABLE 5A (Continued)

MAXILLARY MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
I^2	Male	10	6.4- 7.2	6.74	0.47	6.0- 7.5	6.37	0.65	87.32-104.17	94.62	9.80
	Female	4	6.9- 7.4	7.23	0.19	5.5- 6.6	6.12	0.37	74.32- 94.20	89.94	2.37
	All	14	6.4- 7.4	6.88	0.42	5.5- 7.5	6.30	0.59	74.32-104.17	91.85	8.57
I^1	Male	12	7.4- 8.5	7.92	0.49	6.2- 7.1	6.72	0.43	74.70- 95.12	84.86	5.44
	Female	4	8.5- 8.8	8.65	0.30	6.6- 6.9	6.78	0.16	75.00- 90.64	90.64	33.81
	All	16	7.4- 8.8	8.10	0.44	6.2- 7.1	6.74	0.39	74.70- 95.12	86.30	16.38

TABLE 5B

MANDIBULAR MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
M_3	Male	25	7.5-12.1	10.45	1.05	8.2-11.5	9.71	0.83	82.26-112.00	93.05	6.53
	Female	8	8.2-10.4	9.22	1.11	8.5- 9.9	9.30	0.59	91.35-120.73	101.81	12.99
	All	33	7.5-12.1	10.15	1.06	8.2-11.5	9.61	0.78	82.26-120.73	95.17	8.43
M_2	Male	18	9.5-12.0	10.48	1.19	9.0-10.8	9.66	0.75	79.17-113.68	92.70	11.69
	Female	8	9.6-10.4	10.30	0.45	9.1-10.5	9.81	0.47	90.10-101.04	95.32	3.63
	All	26	9.5-12.0	10.42	1.03	9.0-10.8	9.71	0.68	79.17-113.68	93.51	10.03
M_1	Male	14	9.6-11.6	10.66	1.00	9.6-10.9	10.26	0.41	86.04-106.19	96.51	10.28
	Female	7	9.9-11.9	10.66	0.58	9.6-10.6	10.27	0.48	89.08-100.00	96.55	4.76
	All	21	9.6-11.9	10.66	0.89	9.6-10.9	10.26	0.43	86.04-106.19	96.52	8.91
PM_2	Male	25	6.3- 8.1	6.89	0.51	7.8- 9.2	8.17	0.38	101.23-128.57	118.92	7.07
	Female	8	6.2- 7.5	6.88	0.86	7.5- 8.4	8.14	0.79	110.67-129.03	118.40	7.37
	All	33	6.2- 8.1	6.89	0.61	7.5- 9.2	8.16	0.50	101.23-129.03	118.79	7.14
PM_1	Male	21	6.0- 7.5	6.77	0.41	6.7- 9.0	7.88	0.49	100.00-130.00	116.53	6.19
	Female	8	6.0- 7.5	6.64	0.56	6.5- 7.9	7.36	0.68	86.67-130.00	109.78	14.78
	All	29	6.0- 7.5	6.73	0.45	6.5- 9.0	7.74	0.55	86.67-130.00	114.67	9.22
C	Male	21	6.1- 8.2	7.00	0.55	6.7- 8.9	7.44	0.59	90.00-118.84	107.15	7.98
	Female	6	6.3- 7.2	6.69	0.44	6.5- 7.5	7.26	0.44	101.39-120.97	108.90	8.70
	All	27	6.1- 8.2	6.93	0.53	6.5- 8.9	7.40	0.56	90.00-120.97	107.54	8.13

TABLE 5B (Continued)

MANDIBULAR MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
I_2	Male	16	5.1- 6.4	5.68	0.71	5.5- 6.4	5.89	0.29	90.16-115.38	104.21	12.88
	Female	3	5.3- 6.9	6.23	0.42	5.2- 6.9	5.90	0.14	85.15-100.00	94.42	4.58
	All	19	5.1- 6.9	5.77	0.68	5.5- 6.9	5.89	0.28	85.15-115.38	102.66	12.20
I_1	Male	15	3.8- 5.3	4.79	0.54	5.1- 6.1	5.47	0.33	100.00-144.74	115.52	15.67
	Female	2	4.7- 4.7	4.70	0.00	4.8- 4.9	4.85	0.07	103.20-103.20	103.20	0.00
	All	17	3.8- 5.3	4.78	0.52	4.8- 6.1	5.40	0.33	100.00-144.74	114.07	15.12

TABLE 6

COMPARATIVE DIMENSIONS OF FIRST AND SECOND MANDIBULAR MOLARS
(All values are average and in millimeters.)

Population	First Molar		Second Molar	
	Mesio-Dist.	Bucco-Ling.	Mesio-Dist.	Bucco-Ling.
Eskimo (Alaska, M)	11.21	11.05	11.10	10.84
Eskimo (Alaska, F)	11.43	10.82	10.73	10.53
Pueblo (M)	11.13	10.95	10.53	10.47
Pueblo (F)	10.59	10.12	9.70	9.67
Kentucky Indian (M)	10.56	11.32	11.01	11.15
Kentucky Indian (F)	10.89	10.94	10.28	10.53
Arkansas (M)	11.42	11.12	10.98	10.80
Arkansas (F)	11.00	10.80	10.51	10.34
Sioux (M)	11.71	11.38	11.60	11.21
Sioux (F)	11.28	10.92	10.98	10.61
Pecos (M, F)	11.96	10.74	11.41	10.47
Town Creek (M)	10.66	10.26	10.48	9.66
Town Creek (F)	10.66	10.27	10.30	9.81

(Adapted from Nelson (1938), page 270.)

Variation in Tooth Size

In the Town Creek dentition three instances of third molar size variation occurred, as illustrated in Plate VI. The mandibular third molars, example a, appear bulbous with increased MD and BL diameters and exceptional wrinkling of the occlusal surfaces. The right M_3 crown is sufficiently large as to be a fusion of two teeth; however, the tooth constricts to approximately normal size at the neck and only one set of roots is present; the left M_3 offers a similar appearance. A comparable tooth was noted by Leigh (1925) in his study of the Sioux. In example b, the right M_3 displays an increase in MD diameter from what appears to be an accessory mesial cusp. This tooth, though large in appearance, falls within the normal range of variation seen in the population. Example c illustrates a peg-shaped maxillary third molar, the only instance of size diminution seen in the series. A similar manifestation was seen in the Sioux dentition. All three examples of size variation occur in the Town Creek Pee Dee, as contrasted with Siouan, specimens; all three cases are from male dentition.

Supernumerary Teeth

The opposite of agenesis or hypodontia is the presence of supernumerary teeth. These have been reported for various populations (Ruffer, 1921; Goldstein, 1948; Brothwell, 1965), and again tend to occur at unstable locations within the dentition (Yardeni, 1943).

In the Town Creek series two examples of supernumerary teeth were noted, Plate VII. In the right maxilla of a Pee Dee male (a), an extra canine is present which though badly eroded is normal in size and shape. Example b illustrates a supernumerary right first premolar that, though perfectly shaped, is slightly smaller than either of the other

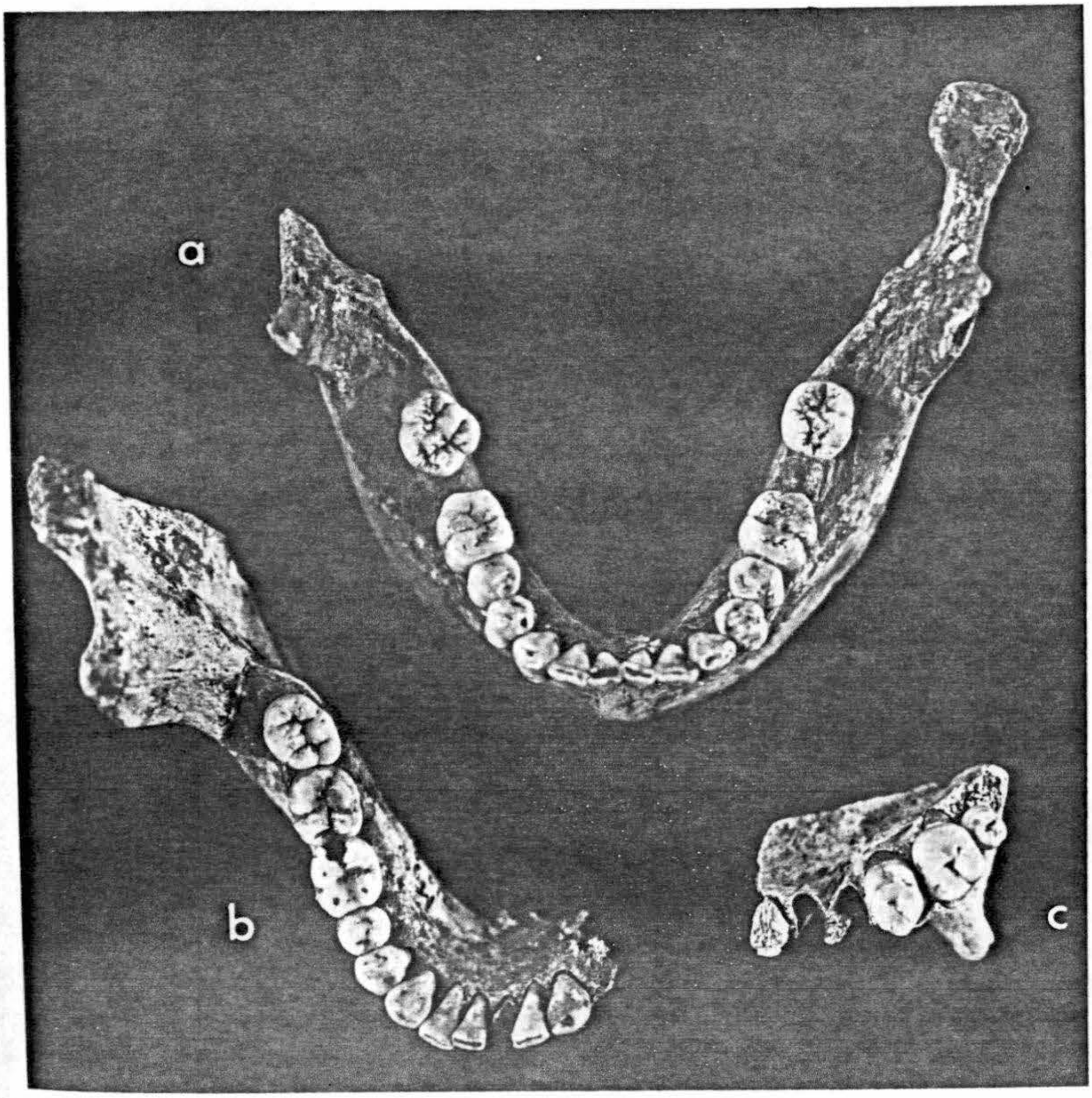


Plate VI. Variation in tooth size as seen at Town Creek.
a. $Mg^{v}3$ Burial 141. Increased MD-BL diameters in M_3 antimeres.
b. $Mg^{o}2$ Burial 57. Increased MD diameter in right M_3.
c. $Mg^{v}3$ Burial 19. Peg-shaped M^3, right maxilla.

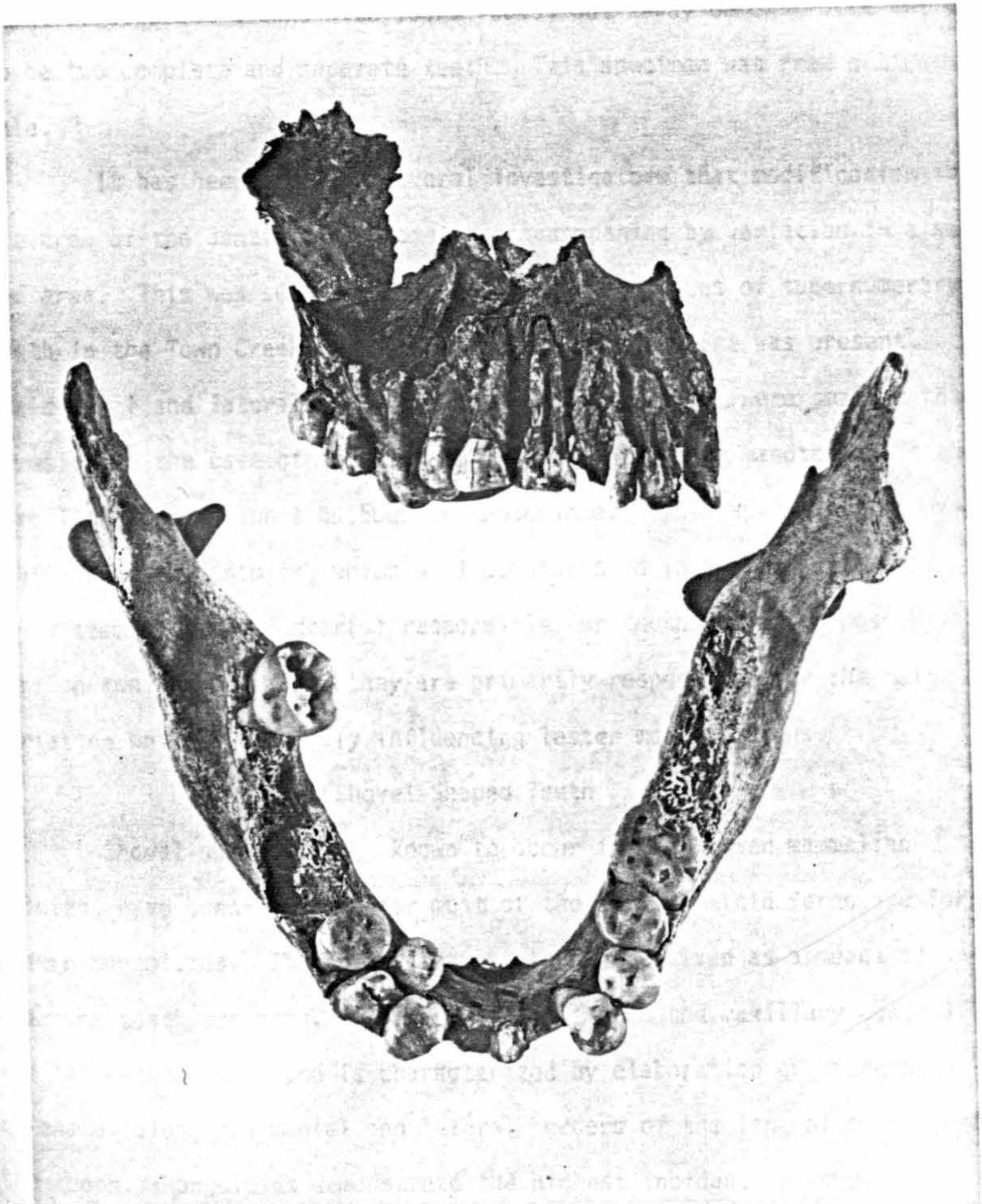


Plate VII. Examples of supernumerary teeth from two Town Creek burials. Maxillary specimen demonstrates an extra canine, while the mandible exhibits an extra premolar.

two premolars present. It was at first felt that this might be an example of separate crowns with fused roots, but X-ray demonstrated there to be two complete and separate teeth. This specimen was from a Siouan male.

It has been noted by several investigators that modification in one area of the dentition is sometimes accompanied by variation in a second area. This was seen to be true for both instances of supernumerary teeth in the Town Creek series. Where the extra canine was present, the central and lateral incisors, though badly eroded, were smaller than normal. In the case of the extra premolar, all of the mandibular teeth were large and somewhat bulbous in appearance. (This specimen also exhibited hypercementosis, which will be discussed in Chapter VI.) It would seem that the factor(s) responsible for tooth variation possibly work on two levels, i.e., they are primarily responsible for the main variation while secondarily influencing lesser modifications.

Shovel-Shaped Teeth

Shovel-shaped teeth, known to occur in many lower mammalian species, have been reported for most of the early hominid forms and for modern Mongoloids. The trait, thought to have evolved as a means of increasing tooth strength, is generally limited to the maxillary central and lateral incisors and is characterized by elaboration or overgrowth of enamel along the medial and lateral borders of the lingual surface of the tooth. Mongoloids demonstrate the highest incidence of shoveling (Hrdlicka, 1920; Carbonell, 1963), with Polynesians (Suzuki and Sakai, 1964) and whites (Dahlberg, 1945) exhibiting the trait to a lesser extent. Within the same population shoveling may appear in varying degrees; the expressivity has been defined (Hrdlicka, 1920) as follows:

Shovel-shaped. Lingual surface shows enamel rim with enclosed fossa well developed.

Semi-shovel. Enamel rim distinct, but enclosed fossa shallow.

Trace shovel. Distinct traces of enamel rim, but which cannot be classed as semi-shovel.

No shoveling. Where no trace of rim and fossa is seen, or where traces are too indistinct to give special characterization.

For work with the Town Creek series Hrdlicka's classifications were given one-digit numerical codes from 1 (shoveled) to 4 (none). Table 7 presents the data for incidence of shoveling in central and lateral incisors for both male and female dentitions. In contrast to most Indian groups, the Town Creek specimens show a low incidence of marked shoveling, as opposed to higher incidences of semi and trace shoveling. This does not reflect the true expression of this trait for two reasons. First, because of heavy postmortem loss of incisors, the sample is not representative of the population. Secondly, the majority of the specimens exhibited marked attrition which, having obliterated much of the original tooth morphology, resulted in very conservative estimates concerning the degree of shoveling. As is obvious, this further biased the results.

Table 7 shows absence of shoveling in the central incisor for two male specimens. In both cases the crown height was so reduced as to make certain determination of the shoveling degree difficult. A decision was finally made on the basis of total lack of identifiable architecture associated with either the cingular tubercle or marginal lingual ridging. Since no note of it is made in the table, mention should be made of one Pee Dee male whose central incisors demonstrated labial-lingual or

TABLE 7

INCIDENCE OF SHOVEL-SHAPED INCISORS
IN THE TOWN CREEK SERIES

Tooth		Number of Teeth	Degree (Number and per cent) Marked	Semi	Trace	None
I^2	Male	10	0 (0.00)	6 (60.00)	4 (40.00)	0 (0.00)
	Female	4	1 (25.00)	2 (50.00)	1 (25.00)	0 (0.00)
	All	14	1 (7.14)	8 (57.14)	5 (35.71)	0 (0.00)
I^1	Male	14	0 (0.00)	2 (14.28)	10 (71.43)	2 (14.28)
	Female	4	0 (0.00)	2 (50.00)	2 (50.00)	0 (0.00)
	All	18	0 (0.00)	4 (22.22)	12 (66.67)	2 (11.11)
TOTAL		32	1 (3.12)	12 (37.50)	17 (53.17)	2 (6.25)

"double" shoveling. Finally, it appears that the Town Creek males had a higher incidence of shoveled teeth than did the females. Although this is normally true for Mongoloid populations, some reservation should be held in accepting that conclusion here, because of the attrition factor and small sample size.

Carabelli's (Cusp) Trait

As one of several recognized forms of supernumerary cusp, Carabelli's trait was first described in 1842 by the Austrian dentist Georg von Carabelli. It is characterized in both fossil and modern man by the presence of an accessory cusp or tubercule on the mesio-lingual surface of the first maxillary molar. (Dahlberg, 1965, suggests that the added bulk and additional occlusal surface area aids in the transition from deciduous to permanent dentition.) The trait also appears on the second and third molars, but usually not with the same degree of expression as on M^1.

The full expression of the trait is most frequently found in white populations, with Negroids and Mongoloids showing low incidence or absence. Garn *et al* (1966) have found the trait to be sexually non-specific.

For use with the Town Creek series, a one-digit numerical code was added to Kraus' (1959) definitions of trait expression; the codes and definitions are as follow:

1 - Pronounced tubercule with prominent, palpable tip.

2 - Slight tubercule on lingual surface of tooth; tip blends with crown.

3 - One or two grooves on mesio-lingual tooth surface.

4 - One or two pits on mesio-lingual tooth surface.

Table 8 presents data for the presence of Carabell's trait in the Town Creek series. The main incidence of occurrence, as expected, is in the first molar, with fewer examples of expression in M^2 and M^3. Only two Siouan molars exhibited the Carabelli's trait and, as noted in the table, with a minor form of expression. The data in Table 9 compare the trait incidence in the Town Creek group with that for two Southwestern Indian skeletal samples. As tabulated, the incidence of the tubercular or major expression (categories 1 and 2) is higher for the Town Creek series than for the other two populations; however, the combined incidence of the expressions usual to Indian populations, grooving (category 3) and pitting (category 4), is considerably less than for the comparative groups. Examining these minor expressions individually, it is seen that grooving occurs roughly one-fourth as often in the Town Creek sample as in the other populations, while pitting is present to a much greater extent. Because, as with shoveling, a decrease in crown height (due to attrition) may have eliminated evidence of full trait expression, the data should not be considered to present an unbiased indication of the trait incidence.

In summary, data have been presented in this chapter in an attempt to demonstrate phenotypically expressed morphological traits, traits which might serve in comparative studies to characterize the Town Creek population. Metrical data for crown size show the Town Creek dentition to be for the most part only slightly smaller than that of other Indian groups. Examples of morphological variation in tooth size and number, though rare in occurrence, include two instances of mandibular third molar enlargement and one example each of peg-shaped maxillary third molar, supernumerary maxillary canine, and mandibular

TABLE 8

INCIDENCE OF CARABELLI'S TRAIT IN THE TOWN CREEK SERIES

Tooth	Number of Teeth	Trait Expression (Number and per cent) 1	2	3	4	None
M^3	29	0 (0.0)	1 (3.45)	2 (6.90)	2 (6.90)	24(82.76)
M^2	32	0 (0.0)	0 (0.00)	3 (9.38)	2 (6.25)	27(84.34)
M^1	33	0 (0.0)	6 (18.18)	4 (12.12)	10 (30.30)*	13(39.39)
TOTAL	94	0 (0.0)	7 (7.45)	9 (9.57)	14 (14.89)	64(60.16)

* Only two teeth, or 20% of this class, came from Siouan burials.

TABLE 9

INCIDENCE OF CARABELLI'S TRAIT IN SEVERAL POPULATIONS

Population	Number of M^1 Teeth	Trait Expression (per cent) 1	2	3	4	None
Prehistoric Indian (Arizona)*	98	0.00	5.10	63.30	10.20	21.40
Historic Indian (San Jose)*	43	2.30	4.60	60.50	2.30	30.30
Town Creek Series	33	0.00	18.18	12.12	30.30	39.39

* Adapted from Kraus (1959), page 119.

first premolars. (The latter appeared as a variation in one of the Siouan burials.) The incidence of shovel-shaped teeth, though thought to parallel that for other Indian groups, could not be used for comparison because of the heavy occlusal attrition. Carabelli's trait was observed to be lower in incidence in the Town Creek series than in two comparative populations, but attrition was again thought to have masked actual incidence.

The data in this chapter reflect traits which are mainly genetic in origin. The following two chapters present data for dental conditions which occurred in response to environmental challenge.

Chapter V

ATTRITION

Very early in dental research attrition was defined as gradual wearing away of the hard parts of the teeth through the physical and physiological agencies of food mastication (Leigh, 1925). While it is true that abrasives mixed in with the diet do cause attrition, as attested by Molnar's innovative mechanical chewing experiments (1968a; 1968b), many other factors contribute to the complex process. Some of these considerations are the physical characteristics of foods; stone grinding of foodstuffs prior to cooking (Greene *et al*, 1967); certain cultural practices such as the use of teeth as tools (Molnar, 1972 and Plate VIII), tooth filing (Stewart, 1941; Comas, 1960), or interproximal grooving (Ubelaker *et al*, 1969); personal habits such as bruxism (Miles, 1962) and smoking (Leigh, 1925); tooth eruption sequence, effects of aging (Lammie and Posselt, 1965), tooth substance density; and finally and more recently use of harsh cleansing agents. Taking all of these into consideration, the single certainty is that attrition begins with tooth eruption and progresses with variable differences in degree and form until loss of the tooth or death of the individual occurs.

Attrition occurs on the occlusal and interproximal surfaces and incisal edges of the teeth. Occlusal wear is first characterized by the obliteration of cusp and groove configurations, and later by varying degrees and patterns of dentine exposure. With the first break in the

Plate VIII. North Carolina Cherokee Indian using teeth as tools in the manufacture of locust-and-thistle darts.

enamel, secondary dentine formation begins as protection for the tooth pulp which, as attrition progresses, starts to recede. So long as the secondary dentine formation equals the degree of attrition the tooth remains functional. However, more advanced attrition -- characterized by "cupping" and dentine exposure -- encourages food impaction and thus contributes to caries and abscesses. Unattended, the condition will eventually result in alveolar resorption and, finally, tooth loss.

Although the basic factors causing interproximal wear are the same as those for occlusal wear, the extent and range of tooth movement involved is considerably smaller. Interproximal attrition results from adjacent teeth rubbing against each other, with formation of interstitual facets and change in tooth contact pattern from a point to a plane. Because of the decrease in mesial-distal diameter of each tooth, the net result of interproximal attrition is an overall shortening of the tooth bearing surfaces of the dental arches. Differences in opinion exist; however, Begg (1954) feels this condition makes for better tooth accomodation within the dental arches and more natural occlusion and that it is therefore both normal and desirable. Diets lacking wear-producing abrasives are cited as responsible for molar impactions and malocclusions.

Both types of attrition as well as various cultural practices leave characteristic wear patterns on the teeth. These patterns provide valuable information which may be of use in demographic studies for determining population size, in the identification of certain cultural activities, or as evidence for personal identification in forensic cases (Keiser-Nielson, 1965).

The overall occlusal surface attrition pattern in man, as well as in some non-human primates (Mills, 1963), is usually characterized by either a flat or helicoidal plane. Where flat planar occlusion exists, the occlusal surfaces of both dental arches are worn straight across, resulting in edge-to-edge bite, as in Plate I. Various authors cite cusp obliteration, freer mandibular movement, and changes in the contact relations of the teeth as reasons for this phenomenon. This type of occlusion is commonly seen in populations maintaining a hunting/gathering subsistence. The helicoidal plane of occlusion as discussed by Murphy (1959), Taylor (1963), and others exists as a rolling S-shaped curve which slopes downward and buccally in the M^1 region and upward and lingually in the M^3 region; an opposite, complementary slope occurs for corresponding areas in the mandible. This type of occlusion, in conjunction with overbite, is suggested by Brace (1962) to occur in populations having a more stable subsistence base, where presoftening of food precedes cooking and ingestion.

Materials and Methods

As in other areas of anthropological study of the dentition, the measurement of attrition has largely been descriptive and therefore subjective. The first attrition classification, proposed by Broca in 1879, was based on four very generalized categories of wear, as follows:

I. Enamel worn without cusp obliteration or dentine exposure.

II. Cusps worn down with dentine exposure.

III. Appreciable wear of the tooth crown with obliteration of the occlusal surface features.

IV. Excessive wear resulting in marked reduction in the crown portion of the tooth towards the neck region.

Most early investigators used Broca's wear classification, with the result that their attrition data is too subjective to be of significant use today in formulating comparative population studies. An improvement was made in this situation when Murphy (1959) proposed an interesting and important attrition classification based on his observations of Australian aboriginal skulls. By illustrating progressive patterns of dentine exposure, and by assigning a code to each pattern, this new system allowed specific degrees of wear to be noted for each tooth studied. Of particular importance was the fact that for the first time each of the four tooth types was represented. This is felt to be an improvement not only over the early Broca system, but also the later one due to Brothwell (1965), both of which included only molar data.

For work with the Town Creek sample a somewhat modified version of Murphy's classification was used. Two additional wear gradient patterns (Numbers 4 and 6, Figure 7) were added to the maxillary and mandibular incisor and canine series, making finer wear distinctions possible. This was felt to be necessary to obtain maximum information from the small number of specimens available. To further facilitate data management, Murphy's wear category codes were changed from alphabetical to numerical (range = 1 through 9); these are listed and defined below. The definitions are unchanged, except for the first category which formerly represented zero degree wear and which now represents wear from zero degree to slight cusp abrasion. As further clarification, the coded patterns for both maxilla and mandible are illustrated in Figure 7.

1. Tooth architecture complete, range of wear from zero degree to slight abrasion on one or more cusps.

2. Incisors or canines: horizontal hairline slit in occlusal surface enamel, slight dentine exposure.

   Premolars: small dot of dentine exposed on one cusp.

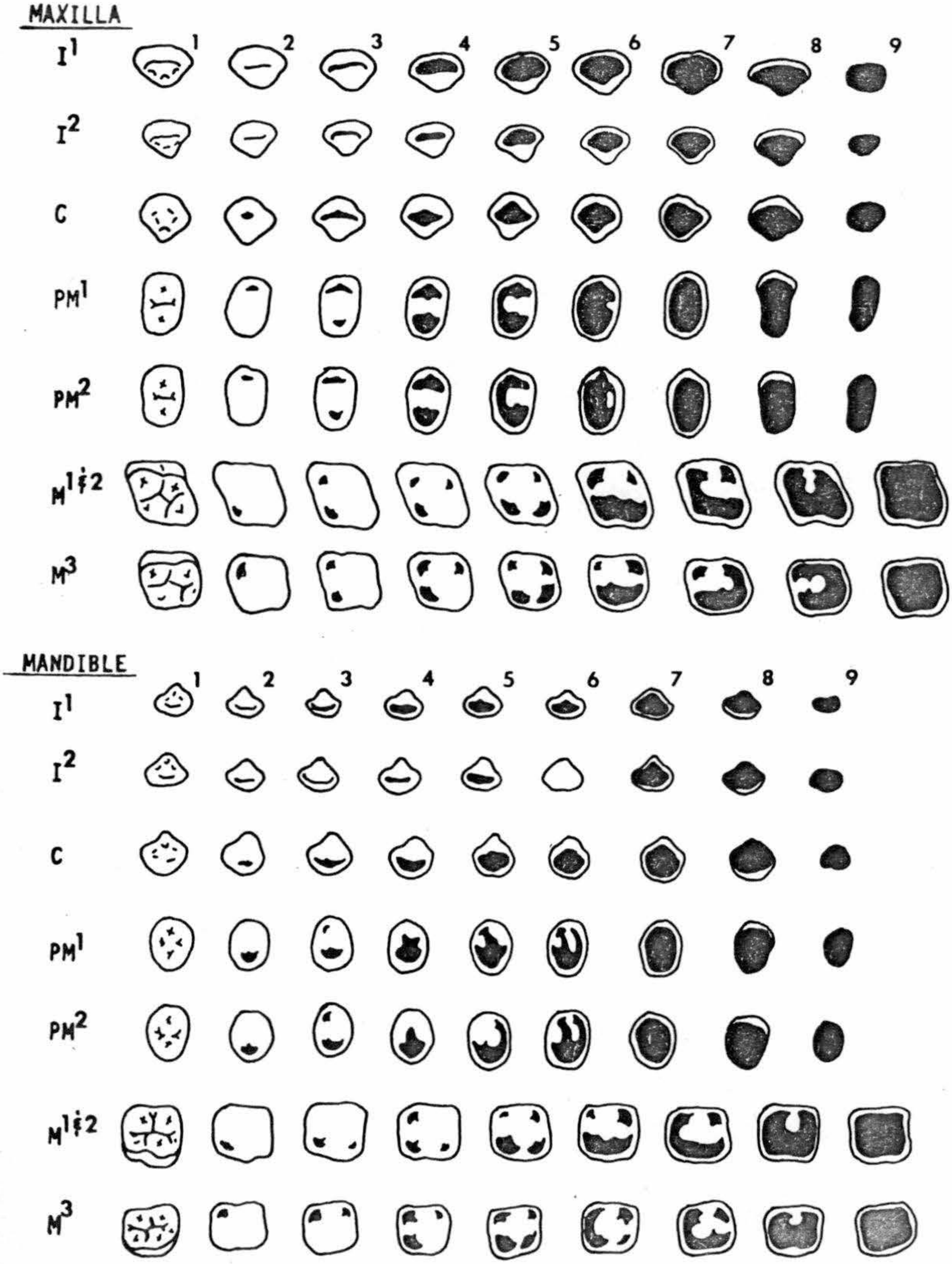


Figure 7. Numerical classification of maxillary and mandibular patterns of dentine exposure. Maxillary and mandibular lingual tooth surfaces are opposed. [Adapted from Murphy (1959).]

Molars: vector-shaped exposure of dentine on one cusp, usually the mesial-lingual.

3. Incisors or canines: widening horizontal slit in enamel between buccal and lingual tooth surfaces, increased dentine exposure.

   Premolars: dentine slightly exposed on both cusps of tooth, generally the area is largest on the buccal cusp.

   Molars: dentine exposure occurs on second cusp, usually the mesio-distal.

4. Incisors or canines: attrition is beginning to cause decrease in crown height, reducing buccal occlusal portion of tooth to enamel rim.

   Premolars: both cusps are worn through to dentine, leaving enamel bar across occlusal surface of tooth.

   Molars: attrition has caused dentine exposure on third cusp, usually the disto-buccal.

5. Incisors or canines: crown height has decreased and dentine exposure is increasing, with more wear on lingual tooth surface.

   Premolars: the two islands of exposed dentine are linked by a channel worn on the mesial or distal tooth surface.

   Molars: attrition has caused dentine exposure on fourth cusp, usually the disto-lingual.

6. Incisors or canines: tooth crown height has decreased more and attrition is continuing toward cingulum.

   Premolars: buccal and lingual areas of dentine exposure have enlarged leaving very small enamel patch, usually in the central portion of the distal rim of the tooth; in one variation, this patch of enamel may be isolated from the tooth rim.

   Molars: the two lingual areas of exposed dentine have coalesced, leaving only the enamel rim.

7. Incisors or canines: crown height is further reduced, attrition has proceeded lingually through cingular area; enamel represented only as tooth rim.

   Premolars: crown height is decreasing, enamel represented only by tooth rim.

   Molars: continuing attrition has resulted in joining of the lingual and mesio-buccal areas of exposed dentine.

8. Incisors or canines: attrition has reduced the tooth crown to within 1 to 1.5 mm of the gum line; the enamel rim, completely absent from the surface, is now a very thin shell buccally.

   Premolars: the enamel rim has been lost lingually and is very thin buccally.

   Molars: all four areas of dentine exposure are connected, leaving a small island of enamel on the occlusal surface; the island may or may not be associated with the tooth rim.

9. Incisors or canines: the tooth has been worn to the gum line with all enamel missing; the root and possibly a small amount of dentine remain.

   Premolars: the tooth has been worn to the gum line with all enamel missing; the root and possibly a small amount of dentine remain.

   Molars: the tooth has been worn to the gum line, and may have a small rim of enamel left or may be worn so that the roots and a small amount of dentine remain.

Results

Each tooth from the skull series was examined and assigned one of the above attrition codes. Tables 10A, 10B, 11A, and 11B were constructed for the four quadrants of the mouth; total sample size for each tooth location and the number of specimens in each category of dental attrition (as well as the corresponding percentage of the sample thus represented) were included. The mean attrition value for each tooth location was calculated by multiplying the number of teeth in each wear category by the corresponding weight, and the results for all wear categories were summed and divided by the total sample size for each tooth location. Formally, the calculation may be expressed as

$$W = \left(\sum_{1}^{9} C_i w_i\right)/N$$

, where W = mean attrition,
N = total location sample size,
C_i = wear category sample size,
and w_i = wear category weight.

TABLE 10A

ATTRITION FOR THE RIGHT MAXILLARY QUADRANT

Tooth	Sample Size	Specimens within Categories of Dental Attrition (number and per cent) 1	2	3	4	5	6	7	8	9	Mean Attrition
M^3	15	11(73.3)	3(20.0)	1 (6.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1.33
M^2	13	8(61.5)	4(30.8)	1 (7.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1.46
M^1	14	1 (7.1)	7(50.0)	1 (7.1)	4(28.6)	0 (0.0)	0 (0.0)	0 (0.0)	1 (7.1)	0 (0.0)	3.00
PM^2	18	7(38.9)	6(33.3)	4(22.2)	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1.94
PM^1	17	4(23.5)	3(17.6)	7(41.2)	2(11.8)	0 (0.0)	0 (0.0)	1 (5.9)	0 (0.0)	0 (0.0)	2.71
C	12	0 (0.0)	7(58.3)	0 (0.0)	2(16.7)	2(16.7)	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	3.25
I^2	10	1(10.0)	1(10.0)	2(20.0)	4(40.0)	1(10.0)	0 (0.0)	1(10.0)	0 (0.0)	0 (0.0)	3.70
I^1	11	0 (0.0)	0 (0.0)	7(63.6)	1 (9.1)	2(18.2)	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)	3.82
Totals	110	32	31	23	14	5	0	4	1	0	
Per cent		29.01	28.18	20.91	12.73	4.54	0.0	3.64	0.91	0.0	

Average attrition statistics for the right maxillary quadrant: Mean = 2.65, St.D. = 0.9764

TABLE 10B

ATTRITION FOR THE LEFT MAXILLARY QUADRANT

Tooth	Sample Size	Specimens within Categories of Dental Attrition (number and per cent) 1	2	3	4	5	6	7	8	9	Mean Attrition
M^3	14	11(78.6)	3(21.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1.21
M^2	18	8(44.4)	7(38.9)	1 (5.6)	2(11.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1.83
M^1	17	1 (5.9)	1 (5.9)	5(29.4)	6(35.3)	2(11.8)	1 (5.9)	1 (5.9)	0 (0.0)	0 (0.0)	3.82
PM^2	15	5(33.3)	4(26.7)	4(26.7)	1 (6.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.7)	2.53
PM^1	15	0 (0.0)	6(40.0)	7(46.7)	1 (6.7)	1 (6.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2.80
C	14	0 (0.0)	6(42.9)	2(14.3)	2(14.3)	3(21.4)	0 (0.0)	1 (7.1)	0 (0.0)	0 (0.0)	3.43
I^2	9	0 (0.0)	1(11.1)	3(33.3)	2(22.2)	1(11.1)	0 (0.0)	2(22.2)	0 (0.0)	0 (0.0)	4.22
I^1	11	0 (0.0)	0 (0.0)	5(45.4)	1 (9.1)	2(18.2)	0 (0.0)	3(27.3)	0 (0.0)	0 (0.0)	4.55
Totals	113	25	28	27	15	9	1	7	0	1	
Per cent		22.12	24.78	23.89	13.27	7.96	0.88	6.19	0.0	0.88	

Average attrition statistics for the left maxillary quadrant: Mean = 3.05, St.D. = 1.1651

TABLE 11A

ATTRITION FOR THE RIGHT MANDIBULAR QUADRANT

Tooth	Sample Size	Specimens within Categories of Dental Attrition (number and per cent)									Mean Attrition
		1	2	3	4	5	6	7	8	9	
M_3	17	12(70.6)	4(23.5)	1 (5.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1.35
M_2	15	7(46.5)	4(26.7)	0 (0.0)	2(13.3)	1 (6.7)	1 (6.7)	0 (0.0)	0 (0.0)	0 (0.0)	2.27
M_1	15	1 (6.7)	4(26.7)	2(13.3)	3(20.0)	2(13.3)	1 (6.7)	1 (6.7)	1 (6.7)	0 (0.0)	3.87
PM_2	19	6(31.6)	9(47.4)	1 (5.3)	1 (5.3)	1 (5.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.3)	2.37
PM_1	20	3(15.0)	10(50.0)	5(25.0)	2(10.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2.30
C	18	0 (0.0)	6(33.3)	4(22.2)	4(22.2)	3(16.7)	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	3.39
I_2	12	0 (0.0)	3(25.0)	4(33.3)	2(16.7)	0 (0.0)	1 (8.3)	2(16.7)	0 (0.0)	0 (0.0)	3.83
I_1	10	0 (0.0)	0 (0.0)	3(30.0)	4(40.0)	1(10.0)	1(10.0)	1(10.0)	0 (0.0)	0 (0.0)	4.30
Totals	126	29	40	20	18	8	5	4	1	1	
Per cent		23.02	31.75	15.87	14.29	6.35	3.97	3.17	0.79	0.79	

Average attrition statistics for the right mandibular quadrant: Mean = 2.96, St.D. = 1.0294

TABLE 11B

ATTRITION FOR THE LEFT MANDIBULAR QUADRANT

Tooth	Sample Size	Specimens within Categories of Dental Attrition (number and per cent) 1	2	3	4	5	6	7	8	9	Mean Attrition
M_3	17	13(76.5)	2(11.8)	1 (5.9)	1 (5.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1.41
M_2	17	5(29.4)	5(29.4)	2(11.8)	1 (5.9)	2(11.8)	0 (0.0)	0 (0.0)	0 (0.0)	2(11.8)	3.12
M_1	13	0 (0.0)	2(15.4)	2(15.4)	4(30.8)	2(15.4)	0 (0.0)	2(15.4)	1 (7.7)	0 (0.0)	4.46
PM_2	17	6(35.3)	7(41.2)	2(11.8)	1 (5.9)	0 (0.0)	1 (5.9)	0 (0.0)	0 (0.0)	0 (0.0)	2.12
PM_1	18	0 (0.0)	11(61.1)	5(27.8)	2(11.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2.50
C	20	0 (0.0)	7(35.0)	4(20.0)	5(25.0)	3(15.0)	1 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	3.35
I_2	10	0 (0.0)	1(10.0)	4(40.0)	4(40.0)	0 (0.0)	0 (0.0)	1(10.0)	0 (0.0)	0 (0.0)	3.70
I_1	10	0 (0.0)	0 (0.0)	3(30.0)	5(50.0)	1(10.0)	0 (0.0)	1(10.0)	0 (0.0)	0 (0.0)	4.10
Totals	122	24	35	23	23	8	2	4	1	2	
Per cent		19.67	28.69	18.85	18.85	6.56	1.68	3.28	0.82	1.68	

Average attrition statistics for the left mandibular quadrant: Mean = 3.10, St. D. = 1.0142

The total number of teeth for each attrition category was recorded and divided by the total teeth per quadrant to determine the relative percentages. Finally, the average attrition for each quadrant was calculated as one-eighth the sum of the eight location mean attrition values.

Table 12 presents a summary of the data for each of the vertical and horizontal halves of the dentition. This attrition data was derived in an analogous manner as for the preceding tables.

The percentages of total specimens within each attrition category were used to construct histograms illustrating the frequency distribution of attrition for each quadrant of the mouth. These histograms are given in Figures 8 and 9; they serve as a check on the consistency of subjective assignment of attrition weights, in that parallel trends in mean wear are evident in all histograms. An additional histogram, based on Table 12, for the combined quadrants is presented in Figure 10. Finally, Figure 11 is included to illustrate the mean attrition values for each tooth location over the entire dentition. The significance of these findings, although evident, will be developed later.

Discussion

Examination of the numerical attrition data from the Town Creek series discloses that in both the maxilla and mandible the highest degrees of attrition occurred in the central and lateral incisors and the first molars, with the lowest amounts appearing in the second and third molars. (This is perhaps better illustrated in Figure 11.) Taking individual differences into consideration, this correlates well with what is considered to be the "normal" sequence of tooth eruption, namely (M_1, I_1), I_2, (PM_1, PM_2, C), M_2, M_3. Gregory (1922) states that dental

TABLE 12

ATTRITION IN COMBINED QUADRANTS

Location	Total Teeth	Specimens within Categories of Dental Attrition (number and per cent) 1	2	3	4	5	6	7	8	9	Mean Attrition
I. Data Summary.											
Maxilla	223	57(25.6)	59(26.5)	50(22.4)	29(13.0)	14 (6.3)	1 (0.5)	11 (4.9)	1 (0.5)	1 (0.5)	2.85
Mandible	248	53(21.4)	75(30.2)	43(17.3)	41(16.5)	16 (6.5)	7 (2.8)	8 (3.2)	2 (0.8)	3 (1.2)	3.03
Rt. Face	236	61(25.8)	71(30.1)	43(18.2)	32(13.6)	13 (5.5)	5 (2.1)	8 (3.4)	2 (0.8)	1 (0.4)	2.81
Left Face	235	49(20.8)	63(26.8)	50(21.3)	38(16.2)	17 (7.2)	3 (1.3)	11 (4.7)	1 (0.4)	3 (1.3)	3.08
Totals	471	110	134	93	70	30	8	19	3	4	
Per cent		23.35	28.45	19.74	14.86	6.37	1.70	4.03	0.64	0.85	

II. Summary of average attrition statistics for combined quadrants.

	Mean Attrition	Standard Deviation
Maxilla	2.85	1.0749
Mandible	3.03	1.0218
Right Face	2.81	1.0032
Left Face	3.08	1.0922
Total Dentition	2.94	1.0487

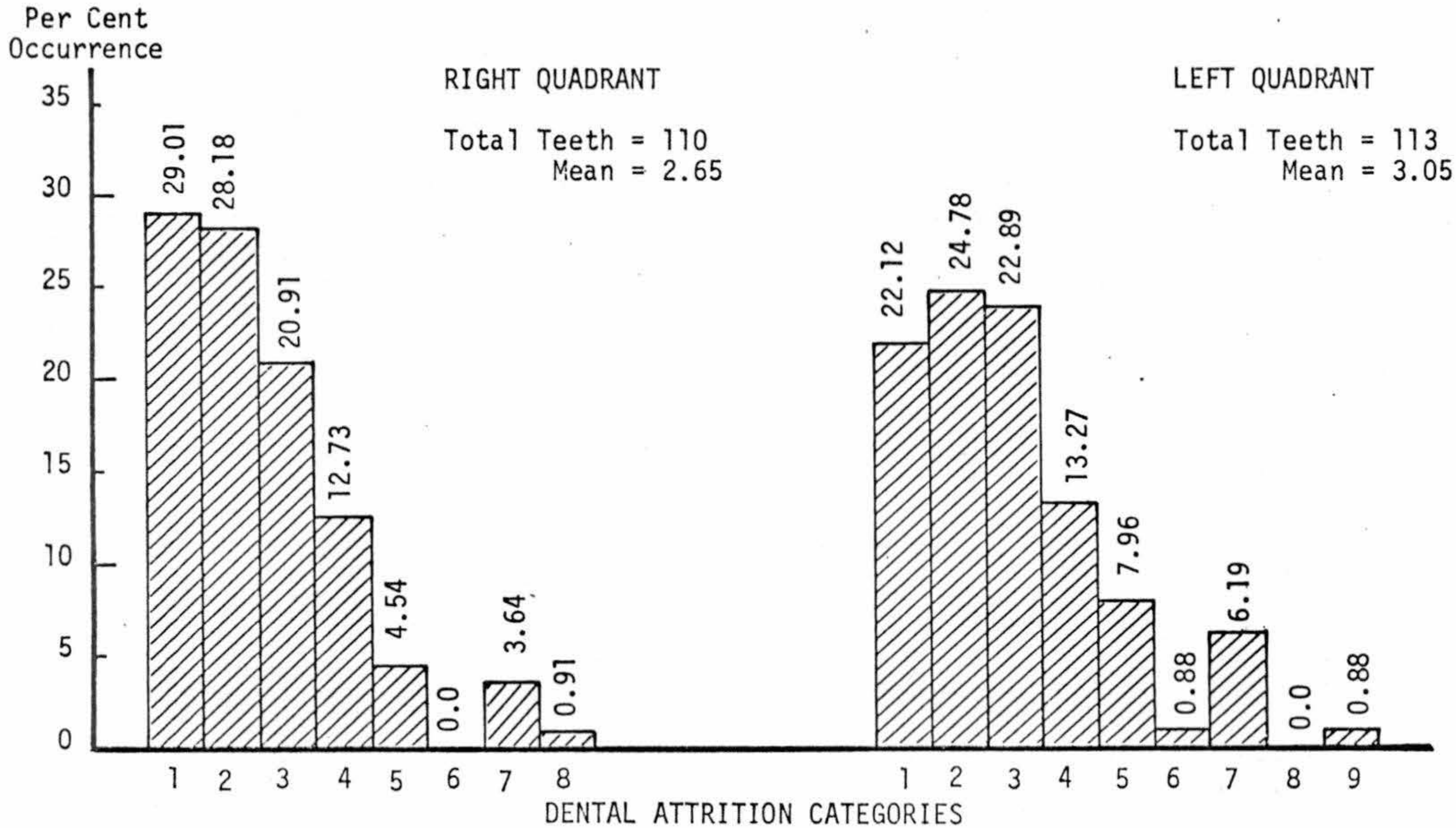


Figure 8. Dental attrition profile for maxillary quadrants.

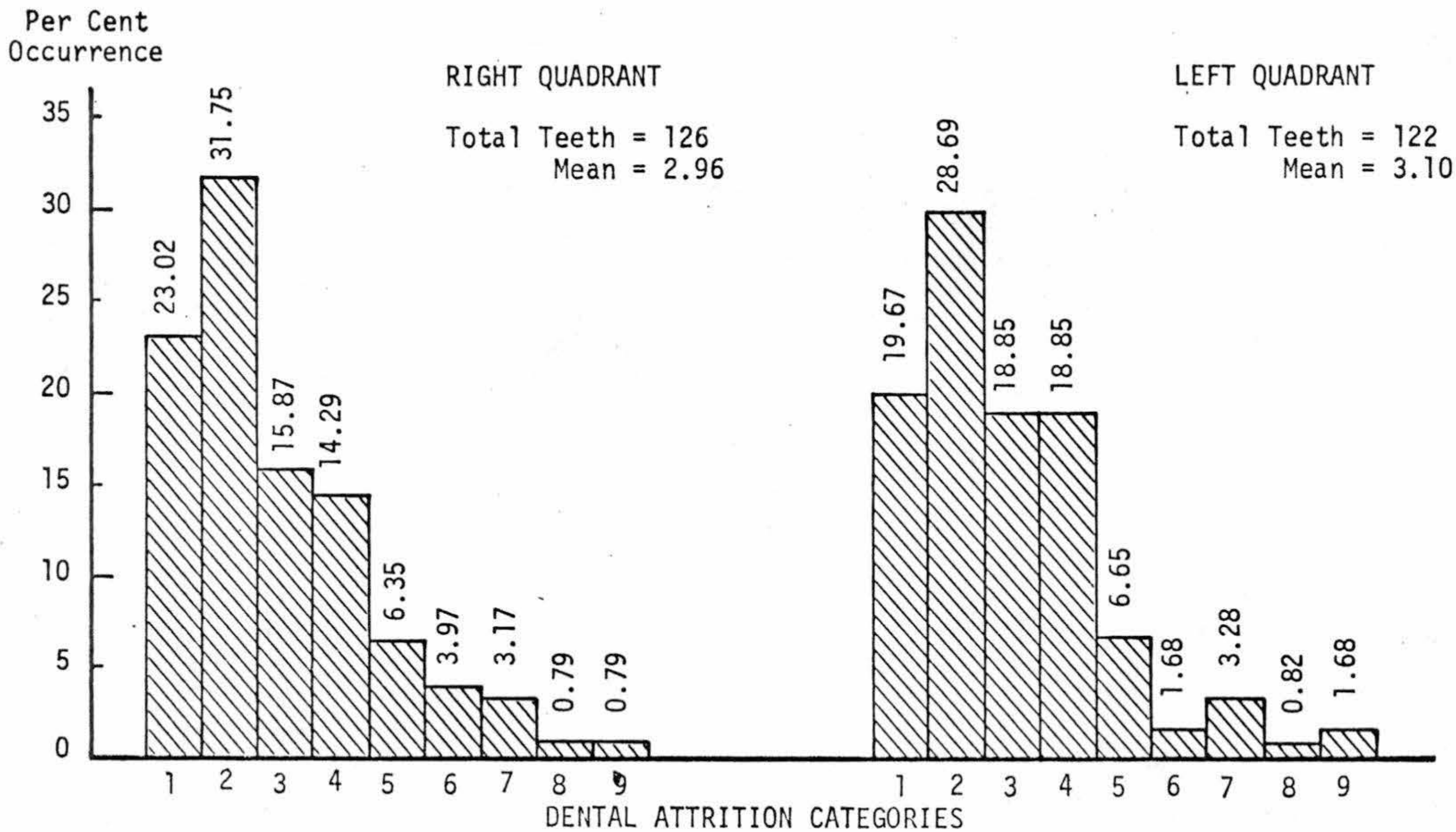


Figure 9. Dental attrition profile for mandibular quadrants.

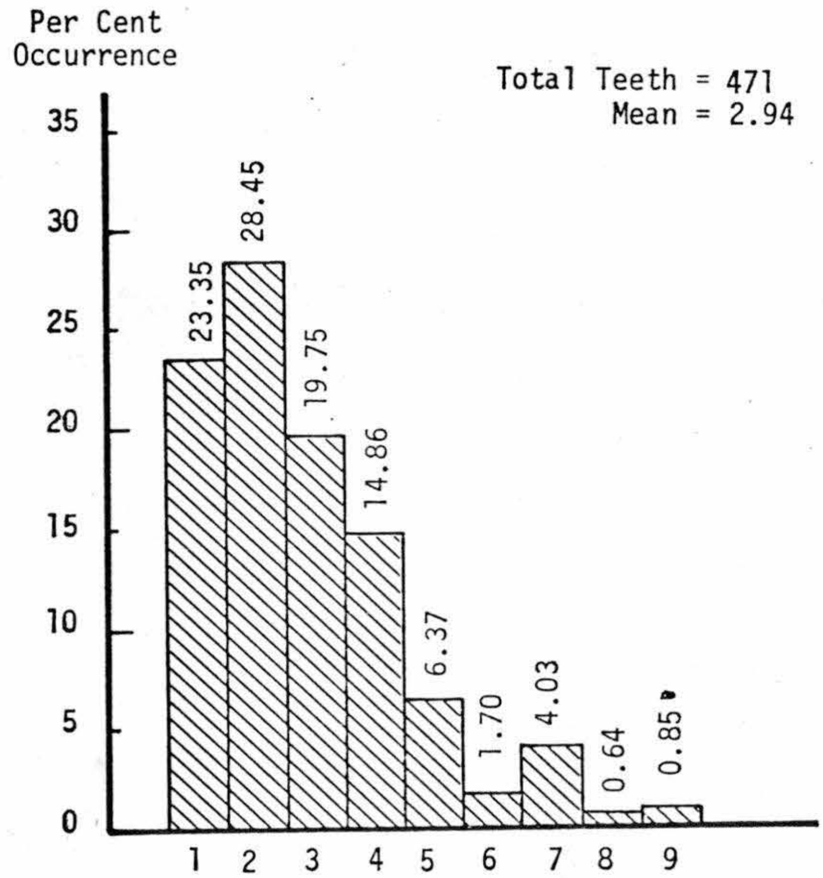


Figure 10. Dental attrition for combined quadrants.

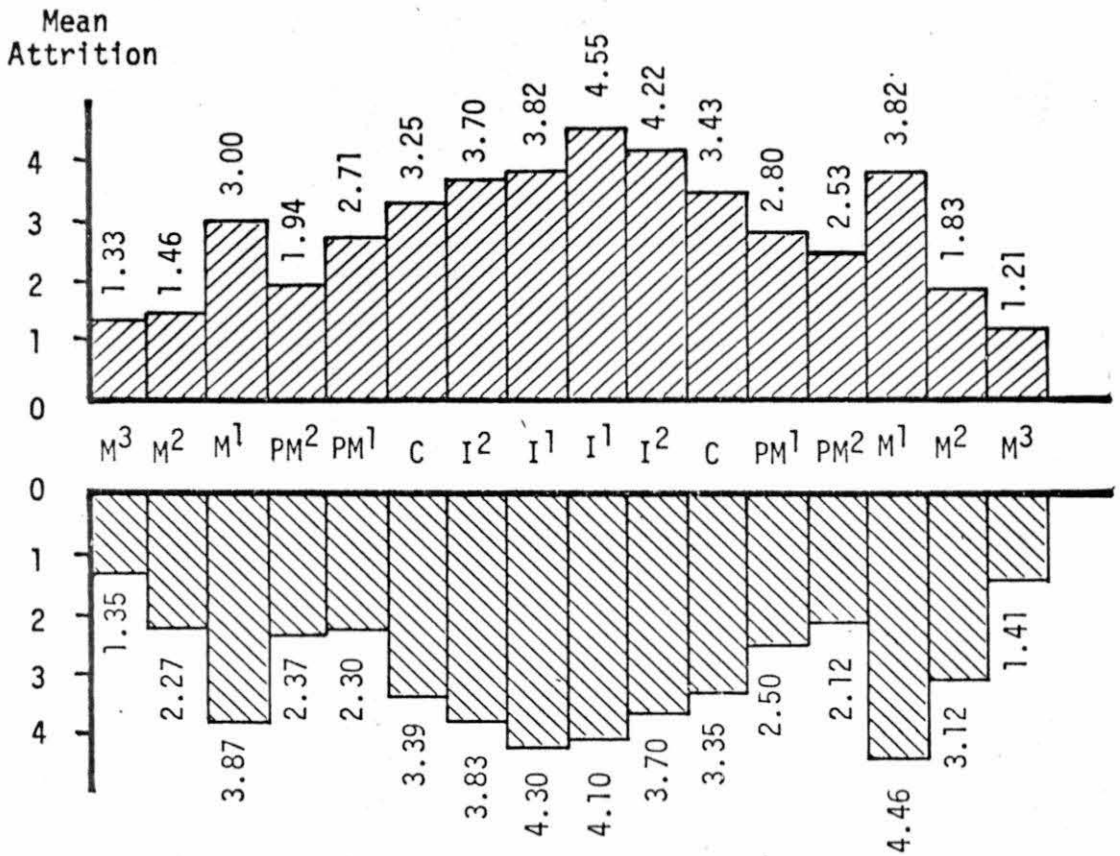


Figure 11. Mean maxillary and mandibular attrition profiles.

eruption (assumed to be alveolar eruption) tends to occur earlier in Indian populations than in white. If an earlier age of tooth eruption could be demonstrated for the Town Creek series, it might prove to be quite significant, for two reasons. First, the high degree of wear on the incisors and first molars and the low degree of wear (with one exception) on the second and third molars, if correlated with an early age of eruption, could mean that from infancy on the diet was more biased than previously thought toward foods which had to be bitten or torn in the front of the mouth, rather than ground on the rear teeth. It might follow then that drying and smoking of food was of more importance in food preservation than early historians have noted; and that such foods may have been eaten without as much presoftening as previously thought. The extent of wear on the incisors is such as to suggest that children, perhaps given dried foods for much the same purpose as a pacifier, learned very early the vigorous masticatory habits that would enable them to cope with the coarse, fibrous nature of their lifetime diet. Although erosion masks much of the surface morphology, certain of the male Town Creek skulls demonstrate moderately heavy muscle markings in the temporal area and slight gonial eversion of the mandible which may tend to indicate heavy masticatory activity.

Secondly, the low incidence of attrition on the second and third molars, if correlated with somewhat earlier tooth eruption, might suggest a shorter life expectancy for this population than is normally asserted for most aboriginal groups. As support for this point, assessment of age could best be handled by correlating newly erupted third molar dentition with the various postcranial age indicators in the same burial. Assuming that an early age at death as indicated by the low relative attrition of the second and third molars in the Town Creek series could be so verified, it probably would have had bearing on the short occupancy of the site by the Pee Dee peoples. However, this correlation would be difficult because of the poor postcranial preservation of the present sample.

As expected, the average numerical attrition for the right and left mandibular quadrants was found to be greater than for the corresponding maxillary quadrants of the mouth. The data show slightly less attrition across the right maxillary quadrant than in the other three, which might suggest that the left side of the mouth was preferred for mastication. Since the Pee Dee peoples practiced fronto-occipital cranial deformation there is a strong possibility that compensatory asymmetry of the cranial base and mandible, as discussed by Bjork and Bjork (1964) for ancient Peruvians, would have resulted in altered rates and patterns of attrition. Poor basal preservation in the Town Creek specimens, combined with lack of corroborating data from other populations, has hampered further research into this matter. At present, because the variation in the data is so small (generally well below the comparative unit increment used in defining the attrition categories), it is felt that these slight differences have no true significance but rather indicate consistent application of the category definitions.

In comparing male and female dentition for degree of attrition (Table 13), it was found that the males generally had slightly but not significantly higher levels of wear throughout the dentition, with the maxilla averaging almost half an attrition category greater. While this result may only reflect the small number of females in the series (six), it is also possible that the women, in keeping watch over the stewpot,

TABLE 13

SEX DIFFERENCES IN MEAN ATTRITION

Tooth Location	Right Maxilla		Left Maxilla		Right Mandible		Left Mandible	
	Male	Female	Male	Female	Male	Female	Male	Female
M3	1.30	1.00	1.22	1.00	1.25	1.00	1.55	1.00
M2	1.44	1.00	2.09	1.40	2.00	1.40	3.80	1.80
M1	2.14	3.50	3.55	3.75	3.40	4.50	4.00	4.50
PM2	1.83	1.50	2.89	1.25	2.50	1.00	2.17	1.00
PM1	2.75	2.25	2.80	2.00	2.25	2.00	2.46	2.67
C	3.44	2.00	3.25	2.50	3.18	3.25	3.14	3.25
I2	3.83	3.00	4.33	3.50	3.22	3.00	3.43	3.00
I1	3.86	3.00	4.57	3.00	4.14	4.00	3.71	4.00
Quadrant Means:	2.57	2.16	3.09	2.30	2.74	2.52	3.03	2.65
Quadrant St.D.:	1.057	0.944	1.099	1.053	0.925	1.361	0.890	1.309

ate somewhat softer food than the males.

One final comment should be made concerning the numerical attrition data. Taken by itself, the average attrition figure for each quadrant of the mouth is biased toward the lower wear values, for two reasons: first, each dentition normally contains three molars as opposed to two incisors, so that absolutely there are fewer incisors present initially; this difference is further increased by the relatively higher postmortem loss of the incisors as previously explained. Since in this population the incisors showed higher attrition than the molars, but are less likely to be present in the recovered sample, the mean attrition value tends to reflect unduely the relatively lower attrition of the molars. Thus, the set of mean attrition values for the individual tooth locations more clearly represent the existing wear than do the mean quadrant attrition values.

In the Town Creek dentition, attrition tended to be most pronounced on the occlusal rather than interproximal surfaces and, for the most part, appears to have progressed slowly enough so as not to exceed secondary dentine formation. As previously mentioned, attrition appeared across the dental arches as either planar or helicoidal, with individual tooth wear seen as straight (flat), or troughed. In specimens of the latter type, it seemed that the rate of wear had become accelerated to the extent that secondary dentine formation was over-run. This situation typically appeared as a concavity, surrounded by a sharp margin of enamel, in the dentine.

Although the sample is too small to make statistical inferences, visually the attrition displayed by the two Siouan burials is heavier than for the Pee Dee burials examined. It is felt that greater reliance on agriculture, accompanied by a type of mastication which probably included more trituration, would tend to, at least in part, account for this difference.

In summary, it may be said that, using a modification of Murphy's dentine exposure patterns, attrition was considered in terms of the following entities:

1. Tooth eruption sequence,
2. Tooth location within the dental arch,
3. Mean attrition for quadrant and horizontal and vertical dentition halves,
4. Whether wear was on the occlusal or interproximal surfaces,
5. Sex differences, and
6. Differences between the Pee Dee and the Siouan (insufficient sample size) components.

The results indicate that attrition does tend to correlate with the tooth eruption sequence in the Town Creek series; that wear over the dental arches probably started quite early and progressed at a fairly constant rate throughout the average individual's life; and that attrition is approximately equal in the male and female mandibles, but is slightly less in the female maxilla. From data gained through both numerical analysis and visual description, it is felt that attrition for the Town Creek series was not the result of a single factor; rather it occurred as a response to many cultural and environmental influences.

Chapter VI

DENTAL ANOMALIES AND PATHOLOGY

It appears that dental disease in one form or another has been the bane of the hominid lineage since the era of the Australopithecine apes of South Africa (Robinson, 1952). Further evidence has been cited for caries throughout the Paleolithic and Mesolithic periods, with special note of increased incidence in all the old world populations during the Neolithic (Leek, 1967). Examining this upward trend we become aware that the developing civilizations were turning more toward agriculture for their basic food supplies with the result that higher levels of carbohydrates were being introduced into the diet. While this is not suggested to be the total cause for increased dental disease, the correlation, as recognized, presents the question as to what the disease frequency might have been for populations at various stages in the transition from a hunting/gathering to an agrarian subsistence.

Along these lines one particularly interesting study, using crania from several early Texas Indian populations (Goldstein, 1948), illustrates that caries susceptibility was in fact greater in the agrarian groups, while the nomadic food-gatherers and hunters were least affected. To carry the point further, a study of prehistoric and modern Eskimo (Collins, 1932) reveals considerably higher percentages of caries in the living populations as opposed to the prehistoric one. In the living populations caries incidence tended to increase with proximity to white groups; it was concluded that the underlying cause was the availability and more frequent usage of refined, as contrasted to native, foods.

Caries occurs as a result of the dissolution of dental enamel by organic acids produced by action of bacteria (possibly *Bacillus acidophilus odontolyticus*) on starches and sugars. Genetic predilection for inferior enamel, normal wear resulting in dentine exposure, and abnormal wear as caused by certain cultural practices (particularly when combined with increasing levels of dietary carbohydrates) contribute to a favorable environment for caries formation. Populations in transition toward an agarian subsistence appear to develop more combinations of the above factors and, by so doing, show an increase in caries incidence. To develop data for testing this in the Town Creek series, which represents a transitional Southeastern U.S. Indian population, the dentition was reviewed for incidence of caries and other dental pathologies.

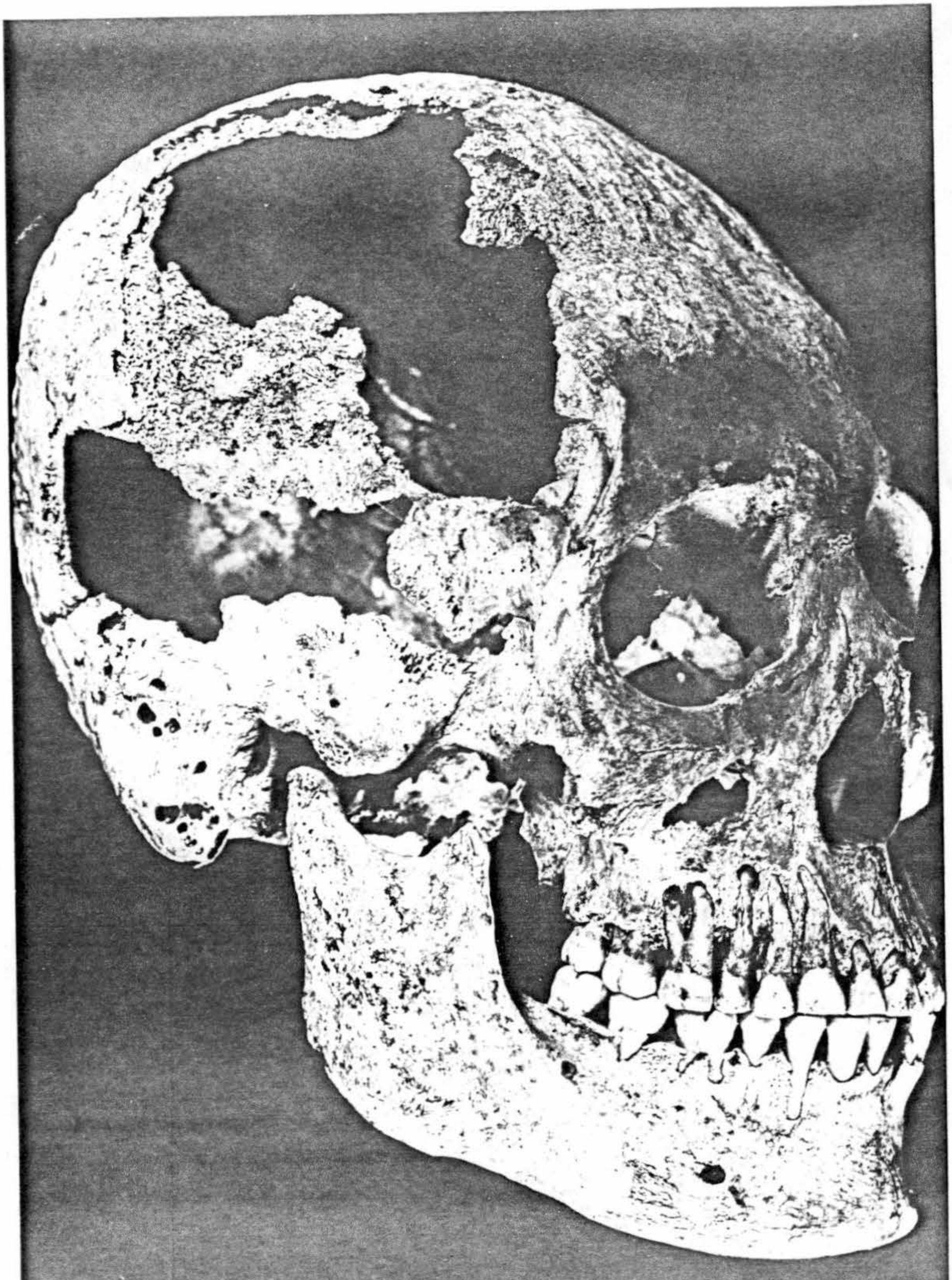
Materials and Methods

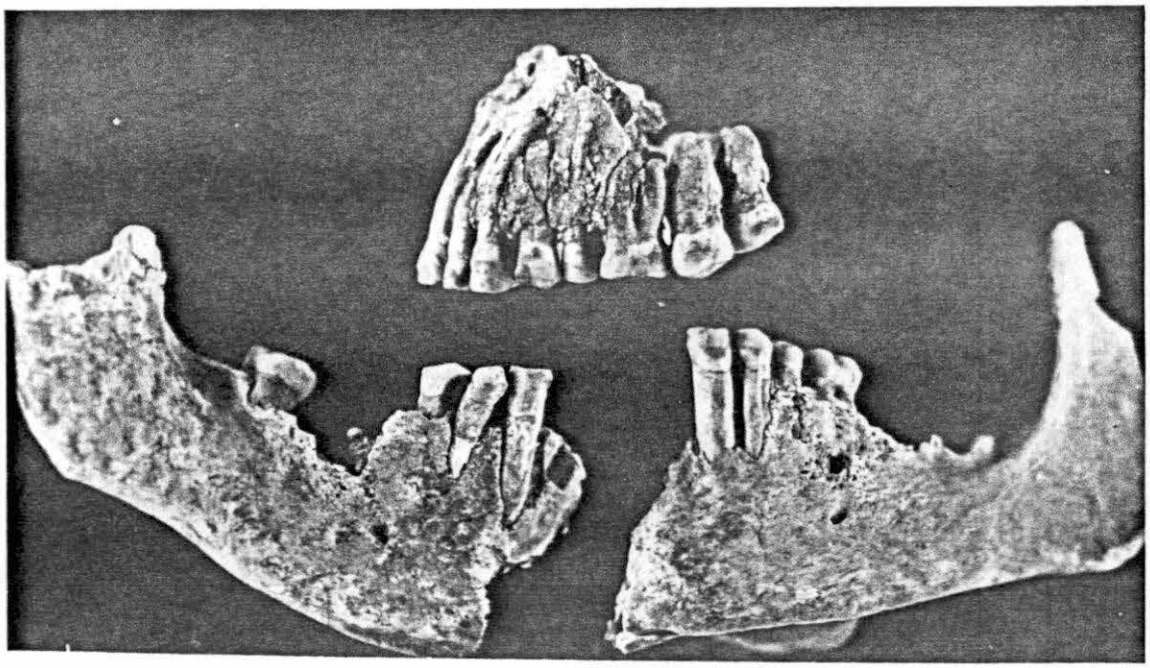
Each tooth in the dentition was examined and notation made as to the number and location of caries and/or abnormalities. For computer analysis, the caries count per tooth was recorded as a one-digit coded number, with additional card columns allocated for specific identification of up to five caries locations per tooth. Suspected caries were probed with a dental explorer to determine their extent. Where it was suspected that the defect had been caused by other than decay (Falin, 1961), or that it had developed postmortemly, it was not recorded. Although abscesses were recognized in various of the Town Creek specimens, specific notation was not kept for two reasons. First, the overall condition of many of the specimens made it very difficult to determine whether alveolar lesions resulted from premortem disease or postmortem trauma and erosion; and secondly, without the use of X-ray, apical abscesses (unless perforative, see Plate IX), could not be discerned. Both conditions acted to prevent a valid accounting of the extent of this form of periodontal disease.

Isolated pathologies such as hypercementosis and calculus were found in certain of the Town Creek dentition. Hypercementosis, an overgrowth of the cellular cementum tooth layer characterized by varying degrees of deposition in the root areas, occurred in only a single Siouan specimen, Plate X. Although the condition affected all of the teeth, as illustrated by the panoramic X-ray, there was slightly more deposition around the roots of the second and third maxillary molars. The condition was accompanied by a moderately severe generalized attrition and evidence of periodontoclasia in both the maxilla and mandible. Although not certain, it is possible that the hypercementosis occurred in response to stress on the dentition from the previously mentioned disease conditions.

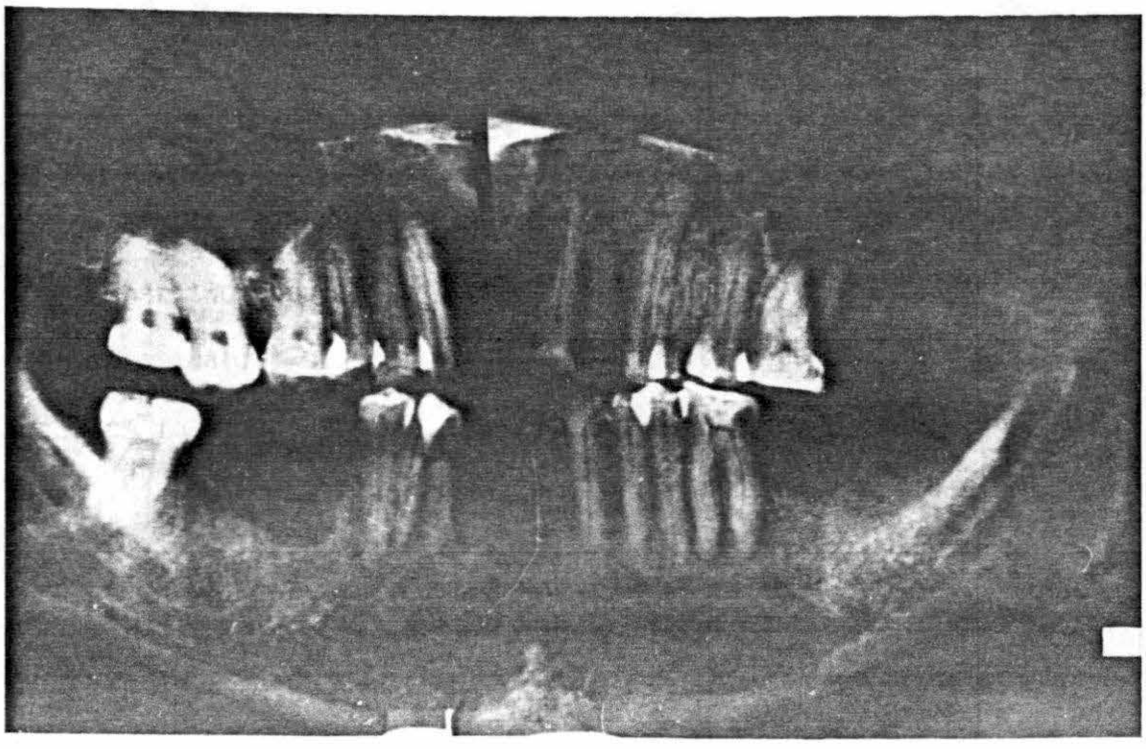
Calculus, commonly referred to as tartar, is typified by the formation of calcinous deposits ($CaPO_4$) around the cervical margins of the teeth. In some instances it is thought that small amounts of such deposits may be helpful in plugging possible caries sites. For the most part, however, the condition is considered harmful in that its progression becomes associated with alveolar resorption and periodontoclasia (Carbonell, 1966). In the Town Creek series calculus was the only pathological condition, other than caries, coded for computer analysis. A single-digit code (1, 2, or 3) was used to denote trace (0.1 mm band, as measured with the Boley gauge described in Chapter 4), moderate (0.2 mm), or heavy (0.3 mm) deposits of material.

Plate IX. Mg^{v}3 Burial 37. Perforative abscesses of maxillary PM^2 and M^1, accompanied by alveolar resorption in the M^2 area.





A



B

Plate X. $Mg^{V}3$ Burial 28 (Siouan). A. Hypercementosis accompanied by abscess and alveolar resorption in right and left mandibular M_2 areas. B. Panoramic X-ray of same specimen demonstrating total tooth root involvement.

Results

Of the 24 burials in the Town Creek series, only four were without caries: $Mg^{o}2$ Burial 59, and $Mg^{v}3$ Burials 17, 19, and 45. The distribution of caries in the remainder of the population, Table 14, was calculated separately for the males, the females, and the two Siouan burials. In all three groups, for both maxilla and mandible, molars appear to be the teeth most susceptible to caries, followed by the premolars, incisors, and canines. Similar findings, as summarized in Table 15, were noted for Predynastic Egyptian (Ruffer, 1921) and Zuni (Leigh, 1925) dentition. Although worlds removed in time and geographic location, the Egyptian dentition presented an order of caries susceptibility which nearly matched that of the Town Creek series. The Zuni, on the other hand, while more contemporaneous with the Town Creek group, showed identical order of susceptibility only in the incisors and canine teeth. From review and comparison of dietary staples it appears that the Zuni may have had as coarse, but probably not as fibrous (cleansing) a diet as the other two populations, which might in part explain differences in the molar caries susceptibility. Discounting possible bias from postmortem loss, one commonality between the Zuni and Town Creek populations which might explain the similarity in incisor and canine caries susceptibility was the cultural practice of occipital cranial deformation. While not promoted as the total explanation for this similarity, it is possible that deformation, as mentioned in Chapter V, by altering dental alignment provides a new environment in which factors such as attrition and caries susceptibility operate differently.

It is interesting that in the Town Creek sample, of the maxillary molars, M^1 has the largest number of caries and, as shown in Tables

TABLE 14

DISTRIBUTION OF CARIES IN THE TOWN CREEK SERIES

Location	Right Quadrant Male	Female	Siouan	Total	Left Quadrant Male	Female	Siouan	Total	TOTAL
I. Maxilla									
Sample	14	6	2	22	14	6	2	22	22
M^3	1	0	1	2	5	0	1	6	8
M^2	2	0	1	3	2	2	1	5	8
M^1	2	5	0	7	6	2	0	8	15
PM^2	2	0	0	2	1	1	0	2	4
PM^1	4	0	0	4	1	1	1	3	7
C	1	0	0	1	0	0	1	1	2
I^2	1	0	0	1	0	2	1	3	4
I^1	2	0	0	2	2	0	0	2	4
Totals	15	5	2	22	17	8	5	30	52
Occlusal	12	4	2	18	14	5	4	23	41
Interprox.	3	1	0	4	3	3	1	7	11
Relative Incidence	1.07	0.83	1.00	1.00	1.21	1.33	2.50	1.36	2.36
II. Mandible									
Sample	16	6	2	24	16	6	2	24	24
M_3	6	0	1	7	5	1	3	9	16
M_2	9	1	0	10	3	2	0	5	15
M_1	2	1	0	3	4	0	0	4	7
PM_2	3	0	0	3	3	0	1	4	7
PM_1	2	0	0	2	3	1	1	5	7
C	0	0	0	0	1	2	1	4	4
I_2	1	0	0	1	0	2	0	2	3
I_1	2	0	0	2	2	1	0	3	5
Totals	25	2	1	28	21	9	6	36	64
Occlusal	19	2	1	22	16	4	6	26	48
Interprox.	6	0	0	6	5	5	0	10	16
Relative Incidence	1.56	0.33	0.50	1.17	1.31	1.50	3.00	1.50	2.67
TOTALS	40	7	3	50	38	17	11	66	116
Relative Incidence	2.63	1.17	1.50	2.08	2.52	2.83	5.50	2.75	

(Note: both Siouan burials were field-sexed as male.)

TABLE 15

ORDER OF CARIES INCIDENCE IN PERMANENT DENTITIONS

Predynastic Egyptian* (Prior to 3400 BC)		Zuni** (Pre to early Columbian)		Town Creek (1400-1600 AD)	
Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible
M^1	M_2	M^3	M_3	M^1	M_2
M^3	M_3	M^2	M_1	M^3	M_3
M^2	M_1	M^1	M_2	M^2	M_1
I^1	PM_2	PM^2	PM_2	PM^1	PM_2
PM^2	PM_1	PM^1	I_1	PM^2	PM_1
PM^1	I_1	I^1	PM_1	I^1	I_1
C	I_2	I^2	I_2	I^2	I_2
I^2	C	C	C	C	C

* Adapted from Ruffer (1921), page 362.

** Adapted from Leigh (1925), page 188.

Note: both sexes are included in all three samples.

10A and 10B, the highest mean attrition. This would seem reasonable in that heavy attrition, particularly that which over-rides secondary dentine formation so that dentin and tooth pulp are exposed, provides areas for food to collect and stagnate. Conversely, of the mandibular molars, M_2 and M_3 have large numbers of caries also, but, as shown in Tables 11A and 11B, relatively low values for mean attrition. As unworn occlusal grooves could also provide locations for food sequestration and decay, such low attrition may in itself partially account for the large number of caries. Since most of the caries are located on the occlusal surfaces of the teeth, both these lines of reasoning would tend to gain support.

Of special importance in Table 14 (and perhaps more clearly presented in Table 16) is the comparison of caries distribution for the right and left halves of the dentition. Tooth-for-tooth, with few exceptions, caries incidence is higher for the left maxilla and mandible than for the right. This coincides with mean attrition summaries for each mouth quadrant, given in Table 12, and tends to support the hypothesis that the population of Town Creek preferentially masticated more on the left side of the mouth than on the right.

Although the sample size is too small for the numbers to have statistical significance, the summed data in Table 16 demonstrate that the males in the Town Creek series were slightly more caries susceptible than the females. Again, as high caries susceptibility parallels a high degree of attrition, as illustrated in Table 13, it appears that attrition is probably the major factor related to the incidence of caries in both sexes.

In the Town Creek series only five burials, two females and three males showed any evidence of calculus on the teeth (Table 17).

TABLE 16

INCIDENCE OF CARIES IN THE TOWN CREEK SERIES

	Right Quadrant			Left Quadrant			Totals		
	Male	Female	Series	Male	Female	Series	Male	Female	Series
Maxilla:									
Total Caries	17	5	22	22	8	30	39	13	52
Relative Incidence	1.06	0.83	1.00	1.38	1.33	1.36	2.44	2.16	2.36
Mandible:									
Total Caries	26	2	28	27	9	36	53	11	64
Relative Incidence	1.44	0.33	1.17	1.50	1.50	1.50	2.94	1.83	2.67
Totals:	(Right Face)			(Left Face)			(Mouth)		
Caries	43	7	50	49	17	66	92	24	166
Relative Incidence	2.39	1.17	2.08	2.72	2.83	2.75	5.11	4.00	4.83

(Note: the sample included equal numbers (6) of female maxillae and mandibles, but 16 male maxillae and 18 male mandibles.)

TABLE 17

LOCATION AND DEGREE OF CALCULUS IN FIVE AFFECTED TOWN CREEK BURIALS

	Maxilla		Mandible		
Burial	Right Quad.	Left Quad.	Right Quad.	Left Quad.	
53 (Female)	M^1 (moderate)*	M^2 (heavy)	M_3 (moderate)* M_2 (moderate)* PM_2 (trace)* PM_1 (trace) I_2 (moderate)*	M_3 (heavy) M_2 (heavy)	
59 (Male)	---	---	PM_2 (trace)*	M_1 (trace)* PM_2 (heavy)*	
45 (Female)	M^2 (trace) M^1 (trace) PM^2 (trace) PM^1 (trace) I^2 (trace) I^1 (trace)	M^2 (trace) PM^2 (trace) PM^1 (trace)* C (trace) I^1 (trace)	---	---	
46 (Male)	---	M^3 (trace) M^2 (trace)*	PM_2 (moderate)* PM_1 (moderate) C (trace)	PM_1 (trace)*	
50 (Male)	M^3 (heavy)* M^2 (trace) PM^2 (trace) PM^1 (trace)* I^1 (moderate)	M^2 (trace) M^1 (trace) PM^2 (trace) PM^1 (trace) I^1 (moderate)	M_2 (moderate) M_1 (moderate) PM_2 (moderate) I_2 (moderate)* I_1 (heavy)	M_3 (trace) M_2 (trace) M_1 (trace) PM_2 (trace) PM_1 (moderate) C (heavy)* I_2 (heavy)* I_1 (heavy)	
Degree					Total
Heavy	1	1	1	6	9
Moderate	2	1	9	1	13
Trace	9	11	4	6	30
TOTAL	12	13	14	13	52

* Opposing teeth missing.

Of the 52 teeth affected, 9 demonstrated heavy, 13 moderate, and 30 trace amounts of the deposit. For the 22 teeth with moderate or heavy calculus deposits, 10 of the opposing teeth were missing. From this it would appear that calculus deposition tends to occur more frequently and in heavier amounts on teeth where, due to attrition or loss of the opposing member, occlusion is impaired. The expanded data presented in Table 18 reveal that calculus deposition occurred mainly in the premolar and molar areas of the dentition and thus coincides with stasis of food in these regions as inferred from the overall attrition pattern. The larger calculus distribution in the maxillary M^2 and mandibular incisor and canine areas may be due to secretions from the salivary glands whose ducts open here. Generalized descriptions of distribution and degree of calculus are available for various populations, but seldom report sample sizes or sex ratio so that comparisons are not possible.

In summary, the Town Creek dentition displays relatively high caries incidence, with most caries occurring on the occlusal surfaces of the teeth. This marked susceptibility is suggested to correlate with a high degree of occlusal attrition. Other periodontal pathologies include isolated instances of calculus deposition and one instance of hypercementosis (in one of the Siouan burials). It is possible that both conditions may also be influenced by the generalized attrition demonstrated for the population.

TABLE 18

DISTRIBUTION OF CALCULUS IN THE TOWN CREEK SERIES

Location	Right Quadrant				Left Quadrant				TOTAL
	Male	Female	Siouan	Total	Male	Female	Siouan	Total	
I. Maxilla									
M^3	1	0	0	1	1	0	0	1	2
M^2	1	1	0	2	2	2	0	4	6
M^1	0	2	0	2	1	0	0	1	3
PM^2	1	1	0	2	1	1	0	2	4
PM^1	1	1	0	2	1	1	0	2	4
C	0	0	0	0	0	1	0	1	1
I^2	0	1	0	1	0	0	0	0	1
I^1	1	1	0	2	1	1	0	2	4
Totals	5	7	0	12	7	6	0	13	25
II. Mandible									
M_3	0	1	0	1	1	1	0	2	3
M_2	1	1	0	2	1	1	0	2	4
M_1	1	0	0	1	2	0	0	2	3
PM_2	3	1	0	4	2	0	0	2	6
PM_1	1	1	0	2	2	0	0	2	4
C	1	0	0	1	1	0	0	1	2
I_2	1	1	0	2	1	0	0	1	3
I_1	1	0	0	1	1	0	0	1	2
Totals	9	5	0	14	11	2	0	13	27
TOTALS	14	12	0	26	18	8	0	26	52

(Note: both Siouan burials were field-sexed as male.)

Chapter VII

DATA MANAGEMENT

In view of the several variables which were examined for each of the 32 tooth locations for each burial, and because additional similar data from other populations would be forthcoming, it was felt that a standardized method of data handling and analysis should be developed. Accordingly, an adaptation of a computer tracking matrix formerly used in aerospace work was formulated. Since direct-keyed entry was not available, the standard punched card system served as computer input.

As each tooth was examined, measurements or coded observations for the various parameters selected for study were noted in proper sequence on IBM computer coding forms. These forms served as logs for source statements which were then punched onto standard 80 column IBM cards. To form the data file the cards for each burial were first grouped according to tooth location in either the mandible or maxilla. The cards were further sorted as to mouth quadrant, with the individual tooth data arranged in the sequence (molar M_3 - incisor I_1). For ease in locating information on the printout, the burials were finally listed in numerical order, i.e., $Mg^{O}2$ Burials 53-59 and $Mg^{V}3$ Burials 1-142.

Devising and formating codes that would be specific enough to avoid misinterpretation (and therefore suitable for longterm use) was of particular importance. By only using one card per tooth it was also necessary to devise codes so as to conserve space should other data come to hand. The coding, presented in the tracking matrix format, is as follows:

Columns	Variable
1 - 4	Site Designation: four columns were used for the site designation. Two columns contain the county abbreviation, Mg; one column indicates the type of site (v = village and o = mound); and one column contained the site number as cataloged by the Research Laboratories of Anthropology. For site numbers over two digits column 5 may be used. (If an additional digit is required the county receives a one-column code, releasing the needed column.)
5	Blank.
6 - 8	Burial Number; Three columns were used. If four are needed, column 9 may be used.
9	Blank.
10	Sex: one column was used for a M or F designation.
11	Blank.
12 - 13	Age. (Not utilized in this study.)
14	Blank.
15 - 17	Tooth Location. The tooth locations were entered as a three-digit alphanumeric code in the format XYZ, where X was either L or R for the left or right dental quadrants; Y was U or L for maxilla or mandible; and Z was one of the numerals 1 - 8 for the tooth location in the arch.
18	Blank.
19	Loss Code: one column is used. Tooth loss was coded 0 - not applicable (tooth present); 1 - premortem loss, with bone resorption; 2 - postmortem loss, sharp-margined socket; 3 - tooth missing for undetermined reasons; and 4 - tooth damaged beyond use for sample.
20	Blank.
21 - 24	Mesial-distal Diameter Measurement. The mesial-distal measurements were entered in metric units, accurate to 0.1 mm; the characters NA were used to indicate non-availability of data.

25 - 26	Blank.
27 - 29	Buccal-lingual Diameter Measurement. Same as for the mesial-distal data.
30	Blank.
31	Attrition Code. The attrition code was entered as a single digit from 1 - 9. (See Chapter 5 for attrition category definitions.)
32	Blank.
33	Shoveling Code. A single character code was used to record the degree of shoveling, with 0 = absence, 1 = trace, 2 = semi-shoveled, and 3 = shoveled.
34	Blank.
35	Pathology: Caries. A single column was used to denote the number of caries per tooth.
36	Blank.
37	Location of Caries #1: one column was used to code location of caries on the tooth. (Not used.)
38	Blank.
39	Location of Caries #2. Same as for column 37.
40	Blank.
41	Location of Caries #3. Same as for column 37.
42	Blank.
43	Location of Caries #4. Same as for column 37.
44	Blank.
45	Location of Caries #5. Same as for column 37.
46	Blank.
47	Pathology: Calculus. The presence of calculus was noted and a single digit code used to denote degree; 1 - trace amount, 2 - moderate amount, and 3 - heavy amount. (Chapter 6 has definitions.)
48	Blank.

49 Variations in Morphology: one column is used to denote one of the following;
1 - Carabelli's trait,
2 - excessive wrinkling of enamel on occlusal surface,
3 - increase in size of tooth (as in fused teeth),
4 - diminution in size of teeth (pegging), and
5 - supernumerary teeth (see Plate).

With the tracking matrix, the versatile TSAR (Tele-Storage And Retrieval) computer subroutines were used. The resulting program permits any of the variables for each tooth, if entered in the standardized format, to be called directly into any of the TSAR statistical calculations. As available at Triangle University Computation Center, the TSAR package permits easy sorting on any of the above variables. For example, all upper right third molars from female burials may be grouped and compared with the similar teeth from male burials by use of the statements

Group F = 0 with Sex = F,

Group FM3 = F with Tooth Location = RU8,

Group M = 0 with Sex = M, and

Group MM3 = M with Tooth Location = RU8,

in the general TSAR grouping subroutine. The first two statements separate the female burials out and then select the data for the upper right third molar; the last two accomplish a similar division for the males. Any of the statistical techniques listed below may then be brought to bear on the selected data through use of the proper control card. Any experimental variable, or a processed variable, may be entered into calculations by similar statements.

The TSAR package includes the following subroutines:

1. Calculation of means, variances, and standard deviations of any selected numerical variable;

2. Analyses of variance, for one, two or three factors;
3. Formation and analysis of chi-square contingency tables;
4. Multiple regression analyses, with calculation of the correlation matrix;
5. Sorting on any single column variable according to its numerical values, with a frequency count of the values;
6. Paired t-tests on selected variables; and
7. Formation of new variables from the experimental ones by using arithmetic or functional operations.

Since it is intended to later compare present data with that for teeth from other sites, treatment of the site designation as a variable will permit direct intra-site comparisons through the use of the TSAR grouping feature. The combined tracking matrix and TSAR package offers a powerful and direct method of storing and retrieving large amounts of data, and of manipulating it to obtain any desired view of the underlying population(s), with only a few simple program statements. Of particular importance is the ready availability of the t-tests for examining the significance of apparent differences in sample properties.

While not fully utilized in the present research, because of the small and incomplete sample, the potential for comparative studies of several large populations makes it worthwhile to cast the Town Creek data into an acceptable format for future use.

Chapter VIII

SUMMARY AND DISCUSSION

The aim of this study was to collect, synthesize, and present a set of baseline data which would serve to characterize the dentition of one group of North Carolina Indians. Problems encountered in doing this were several. First, it was found that while the terminology of physical anthropology was being revised (Hertzberg, 1968), standardized techniques for collection and management of the anthropological data were, for the greater part, unavailable. Secondly, of the published data little could be used for comparative studies, either because the actual measuring techniques used in its collection were not defined or because the form of presentation was incomplete, e.g., percentage figures given but sample size not stated. Thirdly, early studies, often limited to one or two specific traits, while sometimes useful in study of those traits were of little value in characterizing the underlying population.

With these points in mind, a series of burials from the Town Creek skeletal collection was selected, examined, and a computer data-set developed for them. These data included both the metrical and descriptive aspects of dental morphology, attrition, and pathology. Some of the difficulties encountered during this research include poor preservation, high postmortem tooth loss, questionable sexing of the burials, small sample size, and heavy dental attrition.

Examination of the Town Creek specimens reveals the dental arches to be of medium width and sufficient length to accommodate a complete set of dentition. Mesio-distal, bucco-lingual, and Crown Index measurements show the teeth to be slightly but not significantly smaller than those of other Indian populations (Table 6). Statistical analysis of antimere data show no significant difference in size; similar testing demonstrated no significant difference in mean tooth measurements between male and female specimens. Since sexual dimorphism for tooth dimensions is recognized in most groups (Genoves, 1970), the apparent similarity in size found in the Town Creek series almost decidedly results from inaccurate field sexing of the skeletal material.

Additional isolated genetic variations were observed. Two examples of third molar enlargement, one example of third molar diminution, and two examples of supernumerary teeth were found. Information regarding the incidence of shovel-shaped incisors and Carabelli's trait in the maxillary dentition completed the (phenotypically expressed) morphological data. Because of heavy attrition, combined with the small sample size available for examination, neither shoveling nor Carabelli's trait could be classified as being present in their fullest expression.

Moderate to severe attrition displayed by both maxillary and mandibular central and lateral incisors contributed to a combination of helicoidal and edge-to-edge occlusion. A modification of Murphy's (1959a; 1959b) dentine exposure patterns was used to summarize the degree of attrition for each tooth in each mouth quadrant. Gross examination reveals slightly more wear on the left maxilla and mandible for both males and females. The metrical data for the whole mouth show the highest attrition levels in the central and lateral incisors, with the lowest attrition occurring in the second and third molars. The data further show no statistically significant difference in attrition between male and female specimens. No evidence of attrition due to ceremonial tooth mutilation or craft specialization was found.

Data available from ethnographic sources and paleobotanic specimens suggest that vigorous mastication was necessary to handle the tough fibrous foods of the Town Creek diet. This is in part supported by gonial eversion of the mandible and a roughened appearance along the linea temporalis, these both observed in some Town Creek specimens.

The dental attrition seen at Town Creek is thought to be of the same magnitude as that in the culturally similar Irene Mound population from Georgia. Although no metrical data are available, Hulse (1941) reports that the teeth were badly worn; that adolescents with semi- or non-erupted wisdom teeth already showed heavy incisor attrition; that mature specimens demonstrated wear from excessive to extreme, particularly in the incisor and canine areas; and that the very elderly exhibited total attrition of the tooth crown to the gumline for the incisors. The first three points correspond closely with the type of attrition seen at Town Creek; incomplete excavation precludes any commentary for Fort Watson.

As with the Zuni and the Town Creek population, the people from Irene practiced artificial cranial (bifronto-occipital) deformation as part of their culture. What may prove to be one of the most provocative questions raised by the Town Creek study is that of the effect of cranial deformation on intra-jaw alignment, developmental assymmetry of the dental arches, and dental attrition. Since attrition appears to result from many factors acting together, it is evident that one of these factors for the Town Creek series might be cranial deformation.

Caries is the most frequently occurring pathology in the Town Creek dentition. Metrical data show the males to have more caries than the females, with the distribution for both sexes being highest in maxillary and mandibular molars and lowest in the canines and incisors. The high postmortem loss of these last teeth has probably biased the caries distribution pattern for both sexes. Calculus was observed in five of the Town Creek burials, with heaviest deposition found on teeth whose mate on the opposing dental arch was missing. Hypercementosis was observed, as an isolated pathology, in one of the Siouan burials. (Because of the small representation of the Siouan component in the sample, no further inferences concerning this replacement people can be made.)

The extensive body of data that were gathered for the Town Creek series required that a standardized method of data management be developed. A modification of a computer tracking matrix, formerly used in aerospace, was designed. Since the Town Creek dental information is to be used in future comparative studies, practical yet flexible formating for data entries was necessary. The metric data from the study were entered directly; the descriptive data were assigned special numerical codes, based on category definitions, prior to system entry.

The TSAR computer subroutines were chosen for use with the data matrix because of their versatility. The matrix and TSAR combination, although limited in the present study by the single population entered, offers a capability for data storage, retrieval, and manipulation that is well suited for use in dental studies of anthropological populations.

For future studies, newer devices for odontometry (Garn *et al*, 1967b), the use of Xerography for study of individual wear facets, and utilization of panoramic X-ray for study of friable *in situ* teeth should be considered. The dental data ideally should be more closely correlated with paleobotanical remains and archaeologically recovered animal bone (Chaplin, 1971). And finally, comparative studies should seek to use earlier as well as later temporal samples from the same population as a means of tracing genetic variation (Brothwell, 1967); in all cases the importance of ethnographic data should be kept in mind.

In conclusion, this study has presented metrical as well as descriptive data for the dentition of one group of North Carolina Indians. Consideration of morphological traits, dental attrition, and pathological conditions has enabled certain inferences to be drawn regarding the roles of heredity, culture, and environment in shaping the adult dentition. It is felt that the data and inferences presented are sufficiently complete so as to characterize the Town Creek population in future comparative studies.

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APPENDIX

QUADRANT MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES

TABLE A

RIGHT MAXILLARY MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
M^3	Male	12	5.8- 9.3	8.35	1.10	6.8-11.8	9.80	1.17	110.00-139.39	117.86	8.92
	Female	3	8.1- 9.0	8.43	0.57	10.0-11.4	10.53	0.82	111.11-139.02	125.35	14.01
	All	15	5.8- 9.3	8.37	1.04	6.8-11.8	9.95	1.12	110.00-139.39	119.36	6.07
M^2	Male	9	8.7-10.3	9.47	0.66	10.2-12.1	10.79	0.59	107.29-120.70	113.92	5.16
	Female	3	8.9- 9.7	9.37	0.28	10.0-11.2	10.57	0.51	108.25-117.89	112.83	4.95
	All	12	8.7-10.3	9.44	0.60	10.0-12.1	10.74	0.55	107.29-120.70	113.65	5.12
M^1	Male	8	9.5-11.2	10.29	0.50	10.2-11.1	10.64	0.33	93.75-112.63	103.60	5.29
	Female	4	8.8-10.5	9.98	0.72	10.5-11.5	11.00	0.42	103.81-119.32	110.64	6.37
	All	12	8.8-11.2	10.19	0.63	10.2-11.5	10.76	0.36	93.75-119.32	105.95	5.64
PM^2	Male	9	5.0- 7.5	6.28	0.69	7.9-10.1	9.02	0.69	125.33-166.00	144.80	13:84
	Female	4	6.2- 7.5	6.78	0.47	8.9- 9.8	9.35	0.46	130.67-143.55	138.32	5.51
	All	13	5.0- 7.5	6.43	0.64	7.9-10.1	9.12	0.64	125.33-166.00	142.81	12.15
PM^1	Male	10	6.2- 7.2	6.78	0.42	8.3-10.1	9.08	0.55	115.28-148.53	134.35	10.84
	Female	3	6.5- 7.1	6.83	0.40	9.2-10.1	9.63	0.55	139.13-142.25	140.97	2.02
	All	13	6.2- 7.2	6.79	0.42	8.3-10.1	9.21	0.55	115.28-148.53	135.88	9.84
C	Male	7	6.8- 8.2	7.56	0.50	6.6- 8.4	7.64	0.62	97.06-108.70	101.18	4.28
	Female	2	8.2- 8.2	8.20	0.00	8.1- 8.6	8.35	0.35	98.78-102.88	100.83	2.90
	All	9	6.8- 8.2	7.70	0.46	6.6- 8.6	7.80	0.59	97.06-108.70	101.10	4.11

TABLE A (Continued)

RIGHT MAXILLARY MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
I^2	Male	5	6.4- 7.1	6.70	0.27	6.1- 6.7	6.26	0.25	87.32-103.08	93.61	6.28
	Female	3	6.9- 7.3	7.17	0.23	5.9- 6.6	6.33	0.45	80.82- 94.20	88.48	6.83
	All	8	6.4- 7.3	6.88	0.26	5.9- 6.7	6.29	0.33	80.82-103.08	91.69	6.47
I^1	Male	5	7.4- 8.5	8.00	0.51	6.2- 7.1	6.62	0.34	74.70- 90.54	82.96	5.92
	Female	2	8.5- 8.8	8.65	0.21	6.8- 6.9	6.85	0.07	80.00-127.54	103.77	33.62
	All	7	7.4- 8.8	8.19	0.50	6.2- 7.1	6.69	0.31	74.70-127.54	88.91	15.94

TABLE B

LEFT MAXILLARY MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
M^3	Male	11	7.5-10.3	8.74	0.68	9.0-11.6	10.02	1.03	87.38-128.00	114.83	11.78
	Female	3	8.3- 9.7	8.83	0.81	10.3-10.5	10.40	0.10	108.25-124.10	118.23	8.76
	All	14	7.5-10.3	8.76	0.70	9.0-11.6	10.10	0.94	87.38-128.00	115.56	11.33
M^2	Male	11	8.9-10.0	9.48	0.37	10.2-11.5	10.68	0.51	107.37-119.10	112.69	4.18
	Female	5	8.5- 9.6	9.04	0.52	9.9-11.3	10.42	0.55	110.42-120.00	115.34	3.60
	All	16	8.5-10.0	9.34	0.42	9.9-11.5	10.60	0.52	107.37-120.00	113.52	4.02
M^1	Male	9	8.6-11.3	10.08	0.72	10.1-11.5	10.77	0.37	94.69-124.42	107.32	8.60
	Female	4	10.1-10.7	10.45	0.26	10.8-11.5	11.12	0.51	103.85-108.49	106.47	1.97
	All	13	8.6-11.3	10.19	0.63	10.1-11.5	10.87	0.41	94.69-124.42	107.06	7.41
PM^2	Male	8	5.5- 7.1	6.35	0.65	8.3-10.1	9.08	0.46	132.39-160.00	142.45	12.04
	Female	3	6.2- 7.1	6.63	0.52	8.9- 9.8	9.43	0.56	135.21-148.48	142.41	6.81
	All	11	5.5- 7.1	6.43	0.62	8.3-10.1	9.18	0.48	132.39-160.00	142.44	10.70
PM^1	Male	9	5.9- 7.2	6.56	0.38	8.2- 9.7	9.23	0.63	132.26-154.84	141.08	7.86
	Female	3	6.4- 7.3	6.73	0.56	9.2-10.1	9.67	0.33	132.88-157.81	144.08	12.60
	All	12	5.9- 7.3	6.60	0.42	8.2-10.1	9.34	0.58	132.26-157.81	141.83	9.01
C	Male	9	7.0- 8.4	7.73	0.55	7.6- 9.1	8.18	0.40	96.43-118.57	105.97	6.62
	Female	3	7.8- 8.3	8.07	0.25	7.8- 8.7	8.23	0.53	98.80-107.41	102.07	4.66
	All	12	7.0- 8.4	7.82	0.50	7.6- 9.1	8.19	0.43	96.43-118.57	105.00	6.28

TABLE B (Continued)

LEFT MAXILLARY MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
I^2	Male	5	6.4- 7.2	6.78	0.38	6.0- 7.5	6.48	0.60	87.32-104.17	95.63	7.54
	Female	1	7.4- 7.4	7.40	0.00	5.5- 5.5	5.50	0.00	74.32- 74.32	74.32	0.00
	All	6	6.4- 7.4	6.88	0.38	5.5- 7.5	6.32	0.60	74.32-104.17	92.08	7.54
I^1	Male	7	7.4- 8.5	7.87	0.47	6.2- 7.1	6.79	0.48	81.25- 95.12	86.22	5.10
	Female	2	8.5- 8.8	8.65	0.21	6.6- 6.8	6.70	0.14	75.00- 80.00	77.50	3.54
	All	9	7.4- 8.8	8.04	0.44	6.2- 7.1	6.77	0.45	75.00- 95.12	84.28	4.91

TABLE C

RIGHT MANDIBULAR MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
M_3	Male	13	7.5-12.1	10.48	1.18	8.4-11.5	9.60	0.82	82.26-112.00	91.62	7.35
	Female	3	8.2-10.4	9.03	1.23	8.5- 9.8	9.23	0.73	90.38-119.51	103.30	14.80
	All	16	7.5-12.1	10.21	1.19	8.4-11.5	9.53	0.81	82.26-119.51	93.81	8.81
M_2	Male	9	9.7-11.6	10.46	0.74	9.0-10.2	9.54	0.57	83.33-103.03	91.62	6.35
	Female	2	10.6-10.9	10.75	0.21	9.8-10.5	10.15	0.49	92.45- 96.33	94.39	2.74
	All	11	9.7-11.6	10.51	0.70	9.0-10.5	9.65	0.56	83.33-103.03	92.12	6.06
M_1	Male	7	9.7-11.6	10.64	0.72	9.6-10.9	10.16	0.35	86.84-105.15	95.67	5.89
	Female	4	9.9-10.9	10.48	0.19	9.6-10.6	10.15	0.53	91.43-100.00	96.92	3.74
	All	11	9.7-11.6	10.58	0.36	9.6-10.9	10.16	0.51	86.84-105.15	96.12	5.27
PM_2	Male	12	6.3- 7.9	6.92	0.54	7.8- 9.2	8.20	0.39	103.80-128.57	118.71	6.78
	Female	4	6.2- 7.5	6.82	0.73	7.5- 8.9	8.25	0.62	114.67-129.03	121.17	5.96
	All	16	6.2- 7.9	6.90	0.59	7.5- 9.2	8.21	0.45	103.80-129.03	119.32	6.61
PM_1	Male	10	6.5- 7.5	6.76	0.29	6.7- 8.9	7.76	0.58	100.00-120.90	114.82	7.47
	Female	5	6.2- 7.5	6.78	0.62	6.5- 7.0	7.30	0.83	86.67-121.54	108.17	13.20
	All	15	6.2- 7.5	6.77	0.42	6.5- 8.9	7.61	0.67	86.67-121.54	112.60	9.60
C	Male	10	6.4- 8.2	7.06	0.58	6.8- 8.3	7.37	0.51	90.00-116.90	104.82	8.86
	Female	4	6.2- 7.2	6.75	0.45	7.1- 7.5	7.32	0.36	101.39-120.97	108.95	8.68
	All	14	6.2- 8.2	6.97	0.55	6.8- 8.3	7.36	0.48	90.00-120.97	106.00	8.82

TABLE C (Continued)

RIGHT MANDIBULAR MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
I_2	Male	8	5.1- 6.4	5.70	0.49	5.5- 6.5	5.89	0.24	92.19-113.73	103.82	8.61
	Female	2	5.3- 6.5	5.90	0.85	5.2- 5.6	5.40	0.28	85.15- 98.11	91.63	9.16
	All	10	5.1- 6.5	5.74	0.55	5.2- 6.5	5.79	0.24	85.15-113.73	101.38	8.68
I_1	Male	8	3.8- 5.3	4.72	0.60	5.1- 5.7	5.41	0.25	100.00-144.74	116.37	17.06
	Female	1	4.7- 4.7	4.70	0.00	4.9- 4.9	4.90	0.00	104.26-104.26	104.26	0.00
	All	9	3.8- 5.3	4.72	0.60	4.9- 5.7	5.35	0.25	100.00-144.74	115.02	17.06

TABLE D

LEFT MANDIBULAR MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
M_3	Male	12	8.5-11.9	10.42	0.89	8.2-11.5	9.83	0.85	85.71-107.37	94.60	5.49
	Female	5	8.2-10.4	9.34	1.04	8.6- 9.9	9.34	0.50	91.35-120.73	100.92	11.99
	All	17	8.2-11.9	10.10	0.93	8.2-11.5	9.69	0.77	85.71-120.73	96.46	7.77
M_2	Male	9	9.5-12.0	10.51	0.93	9.2-10.8	9.79	0.49	79.17-113.68	93.77	9.82
	Female	6	9.6-10.8	10.15	0.48	9.1-10.5	9.70	0.47	90.10-101.04	95.63	3.78
	All	15	9.5-12.0	10.37	0.79	9.1-10.8	9.75	0.48	79.17-113.68	94.51	8.05
M_1	Male	7	9.7-11.6	10.67	0.70	9.9-10.9	10.36	0.21	86.09-106.19	97.35	8.43
	Female	3	10.2-11.9	10.90	0.89	10.2-10.6	10.43	0.38	89.08-100.00	96.05	5.97
	All	10	9.7-11.9	10.74	0.75	9.9-10.9	10.38	0.26	86.09-106.19	96.96	7.89
PM_2	Male	13	6.4- 8.1	6.87	0.48	7.8- 8.9	8.15	0.37	101.23-127.69	119.12	7.32
	Female	4	6.4- 7.5	6.95	0.47	7.5- 8.3	8.02	0.49	110.67-120.59	115.63	4.33
	All	17	6.4- 8.1	6.89	0.48	7.5- 8.9	8.12	0.40	101.23-127.69	118.30	6.83
PM_1	Male	11	6.0- 7.2	6.78	0.49	7.6- 9.0	7.99	0.40	111.11-130.00	118.08	5.50
	Female	3	6.0- 6.8	6.40	0.40	7.2- 7.8	7.47	0.14	94.87-130.00	112.46	17.53
	All	14	6.0- 7.2	6.70	0.48	7.2- 9.0	7.88	0.37	94.87-130.00	116.88	8.74
C	Male	11	6.1- 8.1	6.94	0.52	6.7- 8.9	7.51	0.65	98.55-118.84	109.27	7.09
	Female	2	6.2- 7.1	6.57	0.40	6.5- 7.3	7.13	0.63	102.82-118.75	108.80	8.76
	All	13	6.1- 8.1	6.88	0.51	6.5- 8.9	7.45	0.65	98.55-118.84	109.20	7.26

TABLE D (Continued)

LEFT MANDIBULAR MESIO-DISTAL, BUCCO-LINGUAL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES
(All values are given in millimeters.)

Tooth		Sample Size	Mesio-Distal			Bucco-Lingual			Crown Index		
			Range	Mean	St.D.	Range	Mean	St.D.	Range	Mean	St.D.
I_2	Male	8	5.1- 6.3	5.66	0.51	5.7- 6.2	5.89	0.16	90.16-115.38	104.60	9.58
	Female	1	6.9- 6.9	6.90	0.00	6.9- 6.9	6.90	0.00	100.00-100.00	100.00	0.00
	All	9	5.1- 6.9	5.80	0.51	5.7- 6.9	6.00	0.16	90.16-115.38	104.09	9.58
I_1	Male	7	3.8- 5.2	4.86	0.46	5.2- 6.1	5.51	0.40	106.12-144.74	114.55	13.88
	Female	1	4.7- 4.7	4.70	0.00	4.8- 4.8	4.80	0.00	102.13-102.13	102.13	0.00
	All	8	3.8- 5.2	4.84	0.46	4.8- 6.1	5.42	0.40	102.13-144.74	113.00	13.88

TABLE E

T-VALUES ON SEX DIFFERENCES OF MD, BL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES

Tooth		Right Maxilla			Left Maxilla			Right Mandible			Left Mandible		
		MD	BL	CI	MD	BL	CI	MD	BL	CI	MD	BL	CI
M3	t	0.119	1.010	1.912	0.197	0.620	0.460	1.902	0.713	2.070	2.182	1.196	1.528
	D.F.		13			12			14			15	
	Sign.	No	No	0.10	No	No	No	0.10	No	0.10	0.05	No	No
M2	t	0.250	0.600	0.319	1.942	0.927	1.222	0.530	1.393	0.585	0.865	0.356	0.438
	D.F.		10			14			9			13	
	Sign.	No	No	No	0.10	No	No	No	No	No	No	No	No
M1	t	0.804	1.633	2.038	0.977	1.421	0.191	0.709	0.031	0.378	0.444	0.390	2.390
	D.F.		10			11			9			8	
	Sign.	No	No	0.10	No	No	No	No	No	No	No	No	0.05
PM2	t	1.300	0.858	0.887	0.667	1.077	0.005	0.294	0.192	0.645	1.215	1.063	0.785
	D.F.		11			9			14			15	
	Sign.	No	No	No	No	No	No	No	No	No	No	No	No
PM1	t	0.181	1.519	1.022	0.571	1.138	0.499	0.067	1.253	1.265	1.215	2.158	0.987
	D.F.		11			10			13			12	
	Sign.	No	No	No	No	No	No	No	No	No	No	No	No
C	t	1.735	1.501	0.106	1.020	0.174	0.932	0.953	0.176	0.791	0.944	0.760	0.084
	D.F.		7			10			12			11	
	Sign.	No	No	No	No	No	No	No	No	No	No	No	No

TABLE E (Continued)

T-VALUES ON SEX DIFFERENCES OF MD, BL, AND CROWN INDEX STATISTICS FOR THE TOWN CREEK SERIES

Tooth		Right Maxilla			Left Maxilla			Right Mandible			Left Mandible		
		MD	BL	CI	MD	BL	CI	MD	BL	CI	MD	BL	CI
I2	t	2.475	0.290	1.086	1.489	1.490	2.580	0.460	2.582	1.776	2.292	5.951	0.453
	D.F.		6			4			8			7	
	Sign.	0.10	No	No	No	No	No	No	0.05	No	0.10	0.001	No
I1	t	1.621	0.925	1.628	2.211	0.249	2.215	0.031	1.923	0.669	0.325	1.660	0.837
	D.F.		5			7			7			6	
	Sign.	No	No	No	0.10	No	0.10	No	0.10	No	No	No	No