SECULAR CHANGE IN THE SKULL BETWEEN AMERICAN BLACKS AND WHITES

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of
requirements for the degree of
Master of Arts

in

The Department of Geography and Anthropology

by
Nicole Danielle Truesdell
B.A., Beloit College, 2003
May, 2005

ACKNOWLEDGMENTS

I first would like to thank Dr. David Hunt for his assistance in helping me create this project over two years ago. Without his guidance and patience, I would have been lost in the initial research process. Through working at the National Museum of Natural History, Smithsonian Institute, I learned how to conduct original research.

I would also like to thank everyone on my committee, Dr. Paul Farnsworth, Dr. Robert Tague and my advisor, Ms. Mary Manhein. Their guidance helped me write my thesis and complete my studies.

I also want to thank Dr. Miles Richardson for his assistance in revising my thesis and being a person to discuss social issues. The help of Ginesse Listi with statistic analysis was greatly valued. The illustrations done by Felicia Madimenos was also of great help. The assistance of Suzanne Ill and Zoe Morris was also greatly appreciated. I would also like to thank Dr. Stanley Rhine for his permission to use his illustrations in my thesis. This was a great help.

This research was funded in part by a Robert C. West Field Research Grant from the Department of Geography and Anthropology at Louisiana State University. This grant allowed me to travel to the various skeletal collections to collect data. Finally, I would like to thank the Beloit College Robert E. McNair program for all of their support and help in my graduate studies. With this program I would not be where I am today, and for that I am eternally grateful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Biologically, discernable differences exist between and within populations based on environmental and genetic factors. Understanding these differences is necessary in forensic anthropology as biological ancestry is asked of forensic anthropologists when assessing an individual's biological profile. In order to make this assessment, secular changes in population dynamics need to be tracked.

The purpose of this research is to examine nonmetric racial characteristics in the skull between American blacks and whites. This study used twelve nonmetric traits as criteria on two different temporal groups from collections at the Smithsonian Institution (N=408) and the University of Tennessee, Knoxville (N=218). Frequencies were calculated, along with chi-squares ($p<.05$), as a means to assess accuracy of these nonmetric traits and trace secular change over time between American blacks and whites. The results of this study showed a high accuracy with the traits used, with secular change occurring in the same direction. The lower face became narrower over time in all populations, implying same directional change. The implications of this study for race identification of skeletal materials are explored.

CHAPTER 1

INTRODUCTION

Biologically, discernable differences exist between and within populations based on environmental and genetic factors. These differences have been identified by nonmetric criteria in the skull, as the skull has been shown to be the best indicator of ancestry (Bass 1995; Brues 1990). The inferences from such observations are primarily utilized in a forensic setting, but these evaluations may also be useful when dealing with historic remains in which the affiliation of the population is unknown.

The term “race” generates various levels of connotation and invokes strong controversy. Given the ambiguity of the term “race,” a distinction must be made between social “race” and biological ancestry (Gordon and Bell 1993). For the purpose of this study, social “race” is a term used to distinguish people based on physical characteristics Hirshman et al. 2000; Prewitt 2000; Skerry 2000). In contrast, biological ancestry is defined as a population’s response to environmental and genetic factors (see American Association of Physical Anthropology 1996 *Statement on Race* for complete definition). Due to social and transportational changes, populations from around the world can mate, making successive generations more admixed. This leads to “racial” features becoming more homogeneous. For forensic anthropologists and geneticists, this phenomenon can make ancestral identification difficult (Rhine 1990b).

The goal of forensic anthropology is identification of an individual based on skeletal analysis. The forensic anthropologist submits a biological profile which reports age, sex, stature, and race along with any other anomalies that will make personal identification easier (Bass 1995). Since race is reported, those in the field of forensic anthropology need to understand the diverse nature of human variability, especially within the United States. Examination of the effects of secular change between various ancestral groups within the United States is key research that should be conducted. As previous studies have shown (Jantz 2001; Truesdell 2003), modern blacks will look different morphologically from early nineteenth and twentieth-century blacks who will look different from eighteenth-century blacks. The same holds true for whites. Environmental and genetic factors influence this change over time, and this phenomenon can be reflected in modern populations (Jantz 2001).

Three questions will be addressed in this project:

1) Can nonmetric analysis be used to distinguish between American blacks and whites?
2) Of the nonmetric traits used, which ones are distinct to each of the ancestral groups?
3) Has secular change over time occurred in black and white populations?

To make identification easier, secular changes in population dynamics need to be tracked. By using nonmetric analysis, the evolution and frequency of changes in these traits can be documented as they are expressed in the skull.

Significance of Project

In the past, few articles have been published on secular change in the skull by nonmetric analysis. When dealing with a large sample size, nonmetric analysis is a preferable procedure over metrics because it is less time consuming, does not require tools, and can be completed on fragmentary remains (Rhine 1990b). Of the articles published on the use of secular change, none has compared American black and white populations through nonmetric analysis. This research is necessary in the field of forensic and biological anthropology because as modern populations increase in number, morphological change is occurring (Jantz 2001). By understanding secular change in the modern world, identification of human remains can be made easier. Ancestral classification is based on extreme European and African "types" (Blakey 1994). The changes observed will hopefully show that ancestral categories used today in forensic anthropology may be outdated and need re-evaluation for future use.

To address the questions asked above, Chapter 2 presents a literature review on the history of race in anthropology, use of nonmetrics, and the concept of secular change in the skull. Chapter 3 discusses a previous project I conducted that traced secular change over time in three temporally different groups. This research led to the project presented here. Chapter 4 lays out the materials and methods used for this project, and Chapter 5 presents the results. Chapter 6 gives a discussion on the results and presents concluding remarks, with future research possibilities.

CHAPTER 2

LITERATURE REVIEW

A review of the literature related to secular change through nonmetric analysis yielded a limited number of sources. Few articles have been published that examine American black and white groups through nonmetric analysis, especially any which attempts to trace secular change over time. However, there are a number of articles that address nonmetric analysis, secular change, and ancestral determination separately.

First, an understanding of the black and white Diaspora is needed in order to explain secular change occurring in specific traits. But, to understand these dichotomous Diasporas, the social history of the concept of race in America is examined and explained in order to tie together secular change in the skeleton with cultural self-identification.

History of Race in Physical Anthropology

Scientific racism has deeply embedded roots in European expansion and colonization (Harrison 1995). The idea of race was not only a classificatory tool to describe human variability, but also a means to justify the exploitation and extermination of native populations by their European colonial rulers (Littlefield et al. 1982).

Anthropology has played a significant role in the "construction and de-construction of race as both an intellectual device and social reality" (Harrison 1995:47-48). Since the nineteenth century, anthropologists have debated the concept of race. Darwin's idea of natural selection was transformed into popular rhetoric by Social Darwinists (Jones 1980). "Survival of the fittest," with whites being intellectually and physically superior to other races, was coined by this group. This catch phrase became immensely popular and was ingrained in the social fabric of American society.

The turn of the century saw the rise of anthropometry and racial typology in physical anthropology, led by prominent anthropologists Ales Hrdlicka and Earnest Hooton. Yet, the work of Franz Boas in the 1940s would be the turning point in American anthropology (Goodman 1997; Harrison 1995). Boas opposed racism and racist thought. He separated biological and morphological characteristics of race from its economic and social implications (Boas 1940; Harrison 1995). Boas used head measurements to demonstrate that there was more variation within populations than between them, as he uncovered drastic changes in cephalic indices in one generation of immigrants. He attributed these changes to environmental factors (Boas 1940).

By the end of World War II, Montagu proposed the idea that "race is a dangerous fallacy" since it is "largely a social construction, and not constitutive of significant biological differences between people" (1942:10-11). Montagu argued that race is a classificatory word that starts with a definition instead of arriving at one after scientific enquiry has been done (Montagu 1942). The facts obtained are molded to fit the definition instead of the other way around. Races are assumed to exist before they are proven to be true entities. This no-race policy eventually found its way into anthropological theory, and in 1964 Montagu published *The Concept of Race*. This book was a collection of essays written by various anthropologists and biologists on the concept of race. It was a definitive compilation that reflected the changing attitude of many physical anthropologists in the field regarding the construction and deconstruction of race.

Frank B. Livingstone proposed the authoritative idea that "there are no races, only clines" (1964:45). This solidified the concept that race had no biological basis.

Human variation was due to environmental and genetic factors only, leaving the concept of race as a social construction. C. Loring Brace agreed with Livingstone. Brace (1964) advocated against using race and instead opted for population variability due to genetic and environmental factors.

By 1996 the American Association of Physical Anthropologists produced an eleven-point statement on the biological aspects of race. This statement was intended for both the scientific and public arenas as a means to share the field's "current understanding of the structure of human variation from a biological perspective" (American Association of Physical Anthropologists 1996:174). Each point is related to biological or environmental factors that influence population variation (American Association of Physical Anthropologists 1996). The organization contests that socio-cultural factors are not considered when dealing with biological race.

The use of the word "race" as a term to describe an individual's ancestry has been in question since the 1940s in the anthropological community (Benedict 1959; Boas 1940; Brace 1995; Comas 1961; Harrison 1998; Kennedy 1995; Littlefield et al. 1982; Montagu 1942; Shaklin 1998; Smedley, 1998). While many in the field choose not to use the word race when explaining human variability, those in forensic anthropology are asked to assess an individual's race for identification purposes. When determining the race of an individual, the forensic anthropologist is aware of the distinction between biological ancestry and social "race." But, when reporting this biological profile to the police, the forensic anthropologist relays this information in social terms.

Norman Sauer addressed this issue in his 1992 article "Forensic Anthropology and the Concept of Race: If Races Don't Exist, Why are Forensic Anthropologists so

Good at Identifying them?" In this article Sauer explains that the forensic anthropologist "must reflect the everyday usage of society with which they interact" (1992:109). The anthropologist translates the biological information into the cultural construction that was mostly likely applied to the missing person. Yet, in the end Sauer warns the forensic anthropologist not to believe race as a biologically discrete category, even though anthropologists often use these categories.

Nonmetric Analysis

The use of nonmetric analysis in physical anthropology has its origins with Hooton in the 1930s (Brues 1990). Nonmetric analysis is used in population studies (Buikstra et al. 1990) and in the determination of sex (Phenice 1969), age (Lovejoy et al. 1985; Meindl et al. 1985), and ancestral identity (Brues 1990; Gill and Rhine 1990; Hinkes 1993; Rhine 1990b). Nonmetric traits are those discrete or quasi-continuous skeletal traits that cannot be measured (Buikstra and Ubelaker 1994). As such, these traits tend to be scored or ranked. The most common mode of scoring is presence/absence of the trait. However, in physical anthropology graded scoring is becoming more popular as traits can be observed to have degrees of variance in their manifestations (Buikstra and Ubelaker 1994).

Prior studies (Berry and Berry 1967; Deol 1957; Gruneberg 1955) showed particular nonmetric traits can indirectly reflect genotypes of a particular population, thus showing biological relatedness of population groups through trait analysis to be accurate and legitimate. Early nonmetric analysis conducted on human population groups showed that traits were reliable when used on groups believed to be linguistically related, or related on some grounds (El-Najjar and McWilliams 1978). However, they seemed less reliable when comparing widely dispersed groups (Carpenter 1976; El-Najjar and McWilliams 1978). But, when used in conjunction with metric analysis, or a large combination of traits, nonmetric investigation can be shown to be fairly accurate (Rhine 1990b).

The rise of forensic anthropology brought a need for quick evaluation of an individual's biological profile. The medico-legal world operates on a faster time table then traditional skeletal biology analysis. As such, the need for quick, but accurate, evaluation led to frequent use of nonmetric analysis (Buikstra and Ubelaker 1994). Buikstra and Ubelaker's 1994 *Standards For Data Collection from Human Skeletal Remains* outlines in detail various nonmetric traits. These traits tend to be population specific, but those traits that "include differences in the manifestations of bony structures" (Yavornitzky 2002), such as the nasal bones, are widely used today in physical and forensic anthropology. These traits can be used to compare populations for identification purposes.

The subjective nature of nonmetric use cannot be ignored. Distinguishing a trait as being narrow, intermediate, and wide can be difficult if a researcher is not experienced. Detailed explanations are needed of each trait when conducting nonmetric evaluation. Any analysis will contain a hint of subjectivity, whether it is metric or nonmetric (Rhine 1990b). Experience is vital and practice will help with familiarizing one with various traits (Brues 1990). For a starting bibliography to nonmetric analysis, consult the *Journal of Human Evolution* vol. 8, pgs 705-708 (Anonymous 1979).

Use of Nonmetrics in Ancestral Determination

Determining ancestry is one component asked of forensic anthropologists in their analysis of skeletal material. As noted earlier, the use of nonmetrics in this determination is useful as it is less time consuming than metric analysis, does not require tools, and can be completed on fragmentary remains (Rhine 1990b). Key articles were selected that used nonmetric evaluation in ancestral determination.

Gill (1986) argued that to effectively determine an individual's ancestry, the forensic anthropologist has to be fully aware of the zoological and social meaning of race. Human variation is a physical response to the success a species had in reproduction and radiation out from one environmental niche to various environmental niches. But, as long as the public perceives race as discrete and phenotypic in nature, the forensic anthropologist must be willing to relate biological ancestry in those terms.

Gill (1986) then explored the use of nonmetric analysis by looking at common traits found in five different groups: Mongoloid, American Indian, Caucasoid, Polynesian, and Negroid. Gill used a metric technique he developed on the nasal region based on Brues' (1990) nonmetric examination of nasal bone contour. This method successfully sorted Caucasoids from other population groups with 90% accuracy. Other nonmetric traits were examined as well: zygomaxillary suture shape, palate shape, mastoid form, and shape and form of the nose. Overall, the midface region was the best indicator of geographical ancestry.

In 1990, George W. Gill and Stanley Rhine published *Skeletal Attribution of Race.* This was a compilation of articles written by various forensic anthropologists from the American Southwest. This region of the country has a diverse racial make-up, with a high incidence of mixed populations. With this type of demography, ancestral identification can be difficult (Gill 1990). Forensic anthropologists in the region came together in 1981 and formed the Mountain, Desert, and Coastal Forensic Anthropologists as a way to share cases and techniques that are unique to the area (Rhine 1990a).

This group meets once a year to discuss cases and address problems from the area. During the 1982 meeting, various new techniques for ancestral identification developed from this region were discussed. Those in attendance believed these techniques needed to be addressed on a national level. In 1984, a special session was held at the 36th Annual Meeting of the American Academy of Forensic Sciences in Anaheim, California (Gill 1990) that presented these new racial identification techniques. The papers presented there, along with other papers solicited, were then complied and *Skeletal Attribution of Race* was published in 1990 (Rhine 1990a). This publication is divided into three sections. Section one includes five reports on the use of nonmetric analysis in race determination from the skull. From this section articles from Brues (1990), Rhine (1990b), and Angel & Kelley (1990) are discussed below.

Brues' (1990) article on "The Once and Future Diagnosis of Race" addresses the history of ancestral identification from cranial analysis. The recognition of characteristics unique to different ancestral populations was thought to be important in the reconstruction of prehistory (Brues 1990). Cultural change and distribution of languages were thought to be inferable from the distribution of these racial traits. Initial cranial measurements were focused on comparisons of the living and dead. In the 1930s Earnest Hooton created his "Harvard List." This was a landmark in descriptive physical anthropology as Hooton developed a 10-page recording form of measurements and observations for the cranium and post cranium (Brues 1990). This checklist is the foundation of nonmetric analysis as it lists 38 nonmetric traits with adjacent scores for the skull. The detail of this recording was most impressive, and many in the field refer to this checklist when utilizing nonmetrics.

Brues was a student of Hooton and, therefore, was influenced by his descriptive nature of human populations. Brues noticed that common errors were being made in the assessment of skull origins based on broad generalizations from standard measurements and indices (Brues 1990). This led to her research on the nasal contour. Brues was able to classify the nasal root contour into three categories: "quonset hut – low and rounded, typical of "Negroids"; tented – low to moderate in height with straight sides and angled at the midline, typical of "Mongoloids"; and steepled – high and somewhat pinched with a break in the contour near the naso-maxillary suture, typical of 'Caucasoids'" (1990:5). The accuracy of racial assignment was higher than that of Giles and Elliot (Brues 1990). This region has proven most helpful in ancestral classification and has been used by many in the field.

Rhine's 1990 study on "Nonmetric Racing of the Skull" was pivotal as it used only nonmetrics as a means to determine race from the skull. Rhine worked mainly in the Southwest and dealt mostly with Hispanic and Native American populations. Eighty-seven skulls were used from the Maxwell Museum collection. Fifty-three were of white descent, 15 of Hispanic descent, three modern American Indians, five blacks, and two black casts. All were contemporary except for nine prehistoric skulls. Forty–five traits were used, 18 on the braincase, 13 on the face, seven dental, and seven mandibular (1990b:13).

Rhine (1990b) ran a one-way frequency distribution with cross-tabulations to calculate frequencies of the traits. Only 30 to 50 percent of each sample produced expected ancestral traits (Rhine 1990b). Rhine contended this was a strong indicator of mixed ancestry as "typical" population traits were becoming less "typical" over time. Whites tended to have an inion hook, long base chord, sloping orbits, narrow-to-medium triangular nasal aperature, steepled nasals, well marked sills, canine fossa, and prominent chin (Rhine 1990b). Hispanics had a long base chord, sloping orbits, medium nasal width with tented nasals, and dull sills (Rhine, 1990b). Malar tubercale and canine fossa were present along with slight prognathism. Overall, Hispanics were a highly variable group that showed a mixture between Native American and Anglo populations (Rhine 1990b).

The small black sample used showed atypical features as there was variable sill formation, no quonset hut nasals, and no post-bregmatic depression. Additionally, this sample showed simple sutures, a wide nasal aperature, elliptical palate arcade, no incisal shoveling, no enamel extensions, buccal pits, or Carabelli's cusps (Rhine 1990b). Rhine saw this as a strong indicator of admixture and noted that it would be harder in the future to fully differentiate between blacks and whites.

The purpose of Rhine's (1990b) preliminary study was to assess the validity of nonmetric traits in distinguishing between populations that are mixed with Anglo in various degrees. In general, Rhine (1990b) contended that the midface region has proven itself to be the best indicator of population differences. The combination of shape of the nasal region, the nasal bones, nasal sills, nasal spines, and the depression of the nasals best distinguished various ancestral groups.

Rhine (1990b) stated that race cannot be deciphered from one trait, but must be determined by the combination of several traits. Admixture is always a possibility, especially in modern populations, and the forensic anthropologist must be prepared to find a great deal of variability in a group of skeletons. When one finds a number of traits associated with different populations, then one can hypothesize admixture.

Angel & Kelley (1990) examined ramus inversion of the mandible between blacks and whites in the Terry Collection and forensic cases. According to the authors, the bone midway up the posterior edge of the ramus is turned inwards for those individuals of African descent (Figure 1). This study observed the amount of turning at this area and the degree of gonial flare (Angel & Kelley, 1990).

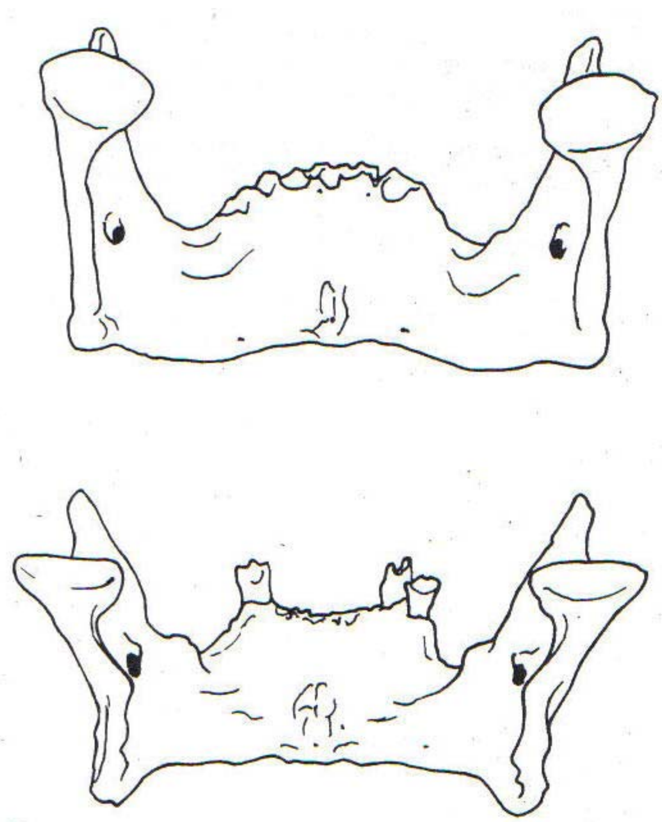

Figure 1. Ramus Inversion

Top: White male. Ramus inversion is absent

Bottom: Black male. Ramus inversion is present.

(Illustration from Angel and Kelly 1990 with permission from Stanley Rhine, Ph.D.)

The Terry Collection (N=557) and forensic cases (N=224) were divided into five generations, or 25 year periods, by year of birth (Angel & Kelley 1990:33). This was done to observe admixture, microevolution, medical care, possible nutrition, and environment (Angel & Kelley 1990). For Terry whites, inversion was lacking in both sexes 70% of the time, while only lacking in 5% of blacks. This was a 65% ancestral difference and matched closely with the forensic sample. Gonial angle flare showed little ancestral difference, but a large sex difference.

With respect to ramus inversion, males showed higher degrees of difference than females. One explanation for this was remodeling of the mandible after dental surgery, or removal of teeth. Terry white females tended to be edentulous, and this can alter morphology. Overall, this trait was shown to be successful in distinguishing Africans and African-Americans from U.S. whites. However, the authors pointed out that pterygoid development may cause an inversion near the gonial angle which may be confused with ramus inversion (Angel and Kelly 1990).

Yavornitzky's (2002) thesis, *A Test of Non-metric Ancestry Determination in Forensic Anthropology: Should the Current Categorization of Individuals of European Descent be Reconsidered?,* examined 122 male skulls from the Hyrtl Skull Collection in an attempt to re-evaluate the "European" category used in ancestral identification. The Hyrtl Collection is primarily from Central and Eastern Europe and is located at the Mutter Museum in Philadelphia.

Yavornitzky (2002) compared frequencies of nineteen nonmetric traits from the Hyrtl Collection to Rhine's 1990 Maxwell Museum sample. Identity cards give place of birth, age, name, occupation, religion, and cause of death for each individual of the collection. The collection is divided into four geographical groups based on the

Federation of East European History Societies Map Index and seven ethnolinguistic groups based on *The Historical Atlas of East Central Europe*.

Yavornitzky (2002) tested four hypotheses. Null Hypothesis 1 – European Definition Hypothesis stated that there should be no significant difference in the distribution of nonmetric traits between the Hyrtl Collection and Rhine's (1990b) Anglo population. Null Hypothesis 2- European Distinction Hypothesis stated there should be no significant difference in the distribution of nonmetric traits between the Hyrtl Collection and any of Rhine's (1990b) three non-European groups. Null Hypothesis 3 – European Trait Consistency Hypothesis stated that "none of the traits in the dataset will be statistically different between the created subgroups" (Yavornitzky 2002: 43). Null Hypothesis 4 – European Regions Hypothesis stated the means of the data will not be different among the different regions/ethnolingusitic groups represented in the Hyrtl Collection, meaning there is no significant variation in the distribution of metric and nonmetric traits among those of European ancestry.

Chi-square analysis was conducted on the entire Hyrtl dataset. For the geographic/ethnolinguistic subgroups descriptive statistics, bivariate statistics, and a multivariate statistic were performed. Five traits were discarded as they produced error results, leaving fourteen variables tested (Yavornitzky 2002).

Null 1 was rejected based on six traits. There was a difference in distribution of traits between those in the Hyrtl Collection and Rhine's (1990b) Anglo sample. Null 2 was accepted based on four traits. This indicated that the frequency of occurrence was statistically different between the Hyrtl Collection and Rhine's (1990b) Anglo sample, but statistically similar to the three other ancestral groups in Rhine's (1990b) study. Therefore, nasion depression, Carbelli's Cusp, zygomaticomaxillary suture, and venous markings do not distinguish European populations from other groups as Rhine (1990b) contended.

Null 3 was tested twice, once for the ethnolinguistic subgroups and once for the geographical subgroups. Each test used 18 valid traits and the null was rejected for both types of subgroups. Metopism, nasion depression, Carbelli's Cusp, venous markings, nasal sill, and nasal opening appeared to be better traits for distinguishing European groups along ethnolinguistic lines. Nasal sill, nasion depression, undulating mandible, ascending ramus profile, oval window, and Wormian bones proved to be better traits in distinguishing European groups based on geography. Overall this showed that "Europe can be divided along geographic and ethnolinguistic lines with equal validity" (Yavormitky 2002:46).

Null 4 (Yavormitky 2002) used Mean's Measure of Divergence test to show a statistical difference among total mean trait frequencies among the subgroups in order to see if the "European" category could be further narrowed. Due to the small sample sizes of the four geographic subgroups and six ethnolinguistic subgroups, the test was not balanced and Null 4 could not be rejected. More data are needed for the narrowing of this "European" category.

Yavormitzky (2002) shows more research has to be done on nonmetric analysis of ancestral groups. Broad racial categories used in forensic anthropology need to be re-evaluated as "cranial traits vary from population to population and cannot describe an entire group of populations deriving from a general region such as Europe or Asia" (2002:50).

Secular Change

Secular change is essentially change over time due to environmental/genetic factors. Secular trends are frequently viewed as being a biological response to a changing environment (Gordon and Greiner 1993). The traditional realm of secular change sees an association among improved socioeconomics, better health care, and nutrition. This implies a "greater attachment of genetic potential for growth" (Gordon and Greiner 1993:22).

Jantz has traced secular change in both the cranium (Jantz and Jantz 2000; Jantz 2001) and postcranium (Jantz 1999). With regard to the skull, Jantz (2001) traced secular change over time in Americans from 1850-1975. The Terry Collection and Todd Collection were used as the nineteenth century population sample, and the forensic data bank from the University of Tennessee, Knoxville (UTK) for the twentieth-century population. Canonical correlation was used to produce a linear function of skeletal variables that corresponded to year of birth. Fifteen standard cranial measurements were taken.

The results indicated that basion-bregma height and occipital chord reflected an increase in cranial vault height that was shown in blacks and whites of both sexes (Jantz 2001). Both groups exhibited an increase in the basion-nasion region, which was reflective of facial projection. Whites had overall cranial length increase that blacks did not exhibit, but both groups showed a narrowing of the face. Blacks exhibited little to no change in the mid-nineteenth century to the turn of the twentieth century. By the early twentieth century a sharp and substantial rise occurred in the black conical score. This change was most likely due to social change occurring in the United States (Jantz 2001). Whites exhibited a gradual increase from the mid-to late-nineteenth century at which "there is a steeper increase, followed by a more gradual increase" (Jantz 2001:786).

Jantz (2001) attributed changes in the skull to environmental factors. Over the years, nutrition increased, disease and age-specific mortality rates decreased, and a decrease in activity levels led to more resources devoted to growth and development. Jantz contended that "if changes are environmental plasticity then the skull can be used as a reflection of social circumstance" (2001:786). W.W. Howells' African and European samples were used as a rough approximation of an ancestral population for American blacks and whites respectively. Using a bivariate plot, Jantz showed that nineteenth century American whites were similar morphologically to European samples, but when the twentieth century approached, there was a strong differentiation. The same was seen in American blacks, except there was an intermediate degree between Africans and Europeans, primarily because of admixture and environmental change. Late twentieth century blacks varied tremendously from their nineteenth century counterparts. Late twentieth century blacks and whites were more similar to each other then they were to their earlier ancestors.

CHAPTER 3

PREVIOUS STUDY ON SECULAR CHANGE

The Project

While interning in the Physical Anthropology Department at the Smithsonian National Museum of Natural History during the summer of 2003, I conducted an initial research project on secular change over time in the skull. This study evaluated late nineteenth and early twentieth-century anatomical European and African-American samples, early eighteenth century Colonial blacks and whites, and various West and Central African groups in an attempt to trace the presence of admixture in blacks. By examining the differences between African and African-American groups in relation to European Americans, I attempted to understand population differences. I hypothesized that frequencies would show that over time black populations would display less "typical" Negroid features, and would exhibit more intermediate traits in their classification.

Three different temporal samples were evaluated, totaling 282 crania (Table 1). Morphological criteria were assessed from Hooton's "Harvard List" (Brues 1990) and Gill's 1986 "Craniofacial Criteria in Forensic Race Identification". Seven traits were selected; six assessed facial features and one described braincase form. The traits used were alveolar prognathism, orbital shape, nasal bridge, cranial form, nasal spine, nasal sill, and total nasal form. The facial region was emphasized because previous research has shown this region to be the most accurate for race attribution (Brues 1990; Gill 1986; Rhine 1990b).

Table 1. Populations used in Truesdell's (2003) Study

Population	Male	Female	Unknown	Total
Terry Collection				
Blacks	50	50	0	100
Whites	57	52	0	109
West and Central African and Caribbean				
Blacks	5	9	14	28
Whites	0	0	1	1
American Colonial Sites				
Governors Landing				
Blacks	0	0	0	0
Whites	0	0	9	9
Colonial Cemetery Site MA				
Blacks	0	0	1	1
Whites	0	0	3	3
Cliffs Plantation				
Blacks	7	2	0	9
Whites	4	1	2	7
Catoctin Furnace				
Blacks	0	0	15	15
Whites	0	0	0	0
Totals	123	114	45	282

The Terry Collection was used initially (100 Blacks and 109 Whites) to test the nonmetric criteria for accuracy and repeatability. The Terry Collection was collected from anatomy class cadavers at Washington University Medical School, St. Louis, in the early- and mid-twentieth century (Hunt 2000). These individuals then represent individuals born in the late-nineteenth and early-twentieth centuries. Racial identifications of the individuals are derived from what was written in morgue records.

Four American Colonial sites were then evaluated: The Armor and Drummond Harris Sites, Governor's Landing, Virginia (nine whites); Cliffs Plantation, Westmoreland County, Virginia (nine blacks, five whites); Catoctin Furnace, Thurmont, Maryland (nine blacks), and a Colonial Cemetery from Deep River, Maryland (one black, three whites). For each of these sites, race was interpreted from archeological materials and historical records complied by J. Lawrence Angel and Jennifer Olsen Kelley (Angel 1980; Angel 1981; Angel and Kelley 1983). These samples are comprised mainly of American blacks. This part of the investigation was designed to assess the use of non-metric criteria on an unknown sample, and to have a population that pre-dated the Terry Collection in order to assess secular change.

The last population examined was West and Central African and Caribbean blacks. The majority of blacks in the Americas are descendents from the slave trade (DeCorse 2002; Ferguson 1992), with the predominance of these individuals originating from Western and Central Africa (Donnan 1931; Eltis et al. 1999). These slaves were typically sent to North America and distributed throughout the region (Donnan 1931; Eltis et al. 1999). This population was used in order to obtain a base group from which to compare the later American black groups as a means to assess admixture.

Results from the research showed that Terry blacks exhibited typical Negroid characteristics in orbital shape (oblong), nasal bridge (wide 50% of the sample), cranial form (long, 65% of the sample), nasal spine (small, 46% of the sample), and nasal sill (dull to no sill for 84% of the population). Alveolar prognathism was not a strong characteristic in the black population with only 32.5% having pronounced and 38.6% having slight prognathism. Total nasal form was also not as expected, with only 44% having a broad nasal form (Table 2).

Table 2. Frequencies of Traits of the Terry Collection (Males and Females)

Traits	Black *n*	Black %	White *n*	White %
1. Aveolar Prognathism		n=83		n=62
Absent	11	13.3	43	69.4
Slight	32	38.6	12	19.4
Medium	13	15.7	2	3.2
Pronounced	27	32.5	5	8.1
2. Orbital Shape		n=100		n=109
Round	0	0	1	0.9
Oblong	63	63	20	18.3
Rhomboid	37	37	88	80.7
Square	0	0	0	0
3. Nasal Bridge		n=99		n=110
Narrow	20	20	84	76.4
Intermediate	26	26	21	19.1
Wide	53	53	5	4.5
4. Cranial Form		n=100		n=108
Long	65	65	15	13.9
Intermediate	19	19	20	18.5
High	16	16	73	67.6
5. Nasal Spine		n=100		n=107
Absent	22	22	9	8.4
Small	46	46	30	28.0
Medium	8	8	6	5.6
Large	24	24	62	57.9
6. Nasal Sill		n=100		n=110
Absent	41	41	5	4.5
Dull	43	43	15	13.6
Medium	3	3	4	3.6
Sharp	13	13	86	78.2
7. Total Nasal Form		n=100		n=110
Broad	44	44	25	22.7
Medium	30	30	21	19.1
Narrow	26	26	64	58.2

Whites in the Terry Collection exhibited strong "typical" Caucasoid characteristics for each of the traits. There was no alveolar prognathism; the orbits were rhomboid with a narrow nasal bridge, large nasal spine, and sharp nasal sill. Total nasal form was narrow and cranial form was high. Terry whites also tended to exhibit a much more prominent chin than blacks, as well as greater brow ridging in the medial orbital region than blacks. This may be due to the pinched nasal bridge morphology (Table 2).

The American Colonial blacks displayed higher frequencies for alveolar prognathism, wide nasal bridge, long cranial form, lack of a nasal spine, lack of a nasal sill, and a wide total nasal form. As such, this group presents more strongly "typical" Negroid features than the Terry blacks. Orbital shape showed half of the population having an oblong shape and the other half having a rhomboid shape, indicating that this trait is not useful as a racial criterion for this group. The white Colonial population was decidedly more difficult to identify. Colonial whites tend to have elongated crania, which makes their faces appear more rectangular. This gives the suggestion of African origins. Subsequently, accuracy for the Colonial whites was only 50%, while for the Colonial Blacks it was 100% (Table 3).

The African and Caribbean skeletal material overall gave the strongest typical Negroid results, as was expected. Alveolar prognathism was clearly present, along with a wide nasal bridge, long cranial form, small to absent nasal spine, absent to dull nasal sill, and a broad nasal form. As was found before, orbital shape was not a distinctive feature (Table 4).

Table 3. Frequencies of Traits of the Colonial Population (Males and Females)

Traits	Black *n*	Black %	White *n*	White %
1. Aveolar Prognathism	n=29		n=9	
Absent	8	27.6	5	55.6
Slight	0	0	1	11.1
Medium	21	72.4	1	11.1
Pronounced	0	0	2	22.2
2. Orbital Shape	n=30		n=10	
Round	0	0	0	0
Oblong	15	50	1	10
Rhomboid	15	50	9	90
Square	0	0	0	0
3. Nasal Bridge	n=29		n=8	
Narrow	4	13.8	7	87.5
Intermediate	5	17.2	1	12.5
Wide	19	65.5	0	0
4. Cranial Form	n=32		n=10	
Long	23	71.9	2	20
Intermediate	8	25	3	30
High	1	3.1	5	50
5. Nasal Spine	n=28		n=9	
Absent	24	85.7	4	44.4
Small	4	14.3	4	44.4
Medium	0	0	0	0
Large	0	0	1	11.1
6. Nasal Sill	n=30		n=10	
Absent	14	46.7	0	0
Dull	13	43.3	4	40
Medium	0	0	0	0
Sharp	3	10	6	60
7. Total Nasal Form	n=30		n=10	
Broad	19	63.3	1	10
Medium	5	16.7	0	0
Narrow	6	20	9	90

Table 4. Frequencies of Traits of the West and Central African and Caribbean Material (Males and Females)

	Black		White	
Traits	*n*	%	*n*	%
1. Aveolar Prognathism	n=21		n=1	
Absent	2	9.5	0	0
Slight	10	47.6	1	100
Medium	1	4.8	0	0
Pronounced	9	42.9	0	0
2. Orbital Shape	n=27		n=1	
Round	1	3.7	0	0
Oblong	13	48.1	0	0
Rhomboid	12	44.4	1	100
Square	1	3.7	0	0
3. Nasal Bridge	n=28		n=1	
Narrow	1	3.6	1	100
Intermediate	2	7.1	0	0
Wide	25	89.3	0	0
4. Cranial Form	n=28		n=1	
Long	23	82.1	1	100
Intermediate	1	3.6	0	0
High	4	14.3	0	0
5. Nasal Spine	n=26		n=1	
Absent	9	34.6	0	0
Small	13	50	0	0
Medium	4	15.4	0	0
Large	0	0	1	100
6. Nasal Sill	n=28		n=1	
Absent	13	46.4	0	0
Dull	12	42.9	0	0
Medium	3	10.7	0	0
Sharp	0	0	1	100
7. Total Nasal Form	n=28		n=1	
Broad	27	96.4	0	0
Medium	2	7.1	0	0
Narrow	0	0	1	100

Race attribution in the Terry Collection overall correctly identified 90% of the blacks, while 94.4% of whites were correctly classified. When divided by sex, black females yielded 90% correct, white females yielded 88% accuracy, and white males had 100% accuracy, while black males were lower at 90% correct (Table 5).

Reliability testing of the traits was conducted using two sets of 25 crania blindly selected from the Terry Collection and evaluated by myself and a second test independently evaluated by another intern. Each test obtained 84% accuracy in correctly attributing race from the cranium. These results indicated the reliability of using these traits when examining ancestry (Table 5).

Frequency comparisons of the three samples clearly show differences in facial form among these groups, illustrating secular trends are present. This can be attributed to significant admixture in the American black sample, especially after the American Civil War. Terry blacks display morphological form that is much more intermediate than the frequencies in the Colonial blacks, and certainly divergent from the frequencies of the African blacks. Conversely, the American Terry whites were not as distinctly different from their temporally earlier counterparts, other than in facial height, as discussed above.

Table 5. Overall Accuracy in the Terry Collection and Colonial Material

Terry Collection
- Males and Females
  - Blacks – 90% accurate (n=90/100)
  - Whites – 94.4% accurate (n=101/107)
- Females Only
  - Blacks – 90% accurate (n=45/50)
  - Whites – 88% accurate (n=44/50)
- Males Only
  - Blacks – 90%accurate (n=45/50)
  - Whites – 100% accurate (n=50/50)

(Table 5 continued)

Colonial Material
- Governor's Landing
  - Males and Females
    - Whites – 55.6% accurate (n=5/9)
- Cliffs Plantation
  - Males and Females
    - Blacks – 100% accurate (n=9/9)
    - Whites – 40% accurate (n=2/5)
- Governor's Landing and Cliffs Plantation
  - Males and Females
    - Blacks - 100% accurate (n=9/9)
    - Whites – 50% accurate with 50% error (n=7/14)

Reliability of Traits Test
- Investigator
  - Males and Females
    - Blacks – 91% accurate (n=11)
    - Whites – 85.7% accurate (n=14)
- Intern
  - Males and Females
    - Blacks – 87.5% accurate (n=16)
    - Whites – 88.9% accurate (n=9)

Impact on Thesis Research

The use of nonmetrics yielded favorable results when used on these three population groups. However, the gradual change seen among the three population groups led me to question the validity of race determination in modern populations. How accurate can traits used on populations from the 1700s be for modern groups? Are the same trends seen in American blacks also seen in American whites? What impact do societal norms and law have on morphological change? These were just some of the questions that plagued me and led to the research presented in this thesis.

CHAPTER 4

MATERIALS AND METHODS

Two populations were used for this study. Four hundred eight (408) skulls were sampled from the Terry Collection housed at the Smithsonian National Museum of Natural History. Two hundred eighteen (218) skulls were then sampled from the Bass Donated Collection and the Forensic Collection housed at the University of Tennessee, Knoxville (Table 6).

Table 6. Populations used in Secular Change Study

Population	Males	Females	Total
20th Century Anatomical Collection (Terry Collection)			
Blacks	112	97	219
Whites	100	89	189
Modern Collection (University of Tennessee)			
Blacks	36	9	45
Whites	115	58	173

The Terry Collection

The Terry Collection is a late-nineteenth to early-twentieth-century population collected by Robert J. Terry (1876-1966) from 1899 until 1941 (Hunt 2000). Terry was a professor of anatomy at Washington University Medical School in St. Louis, Missouri. Interested in human anatomy, Terry began to collect human skeletons used in the Medical School's anatomy class for research purposes. A majority of these bodies were from the local St. Louis morgues and hospitals. Initially, the cadavers were individuals whose bodies had not been claimed and were properties of the state. However, in 1955-56 the Willed Body Law of Missouri was passed. It required a signed document from the individual, or the immediate family, releasing the body for scientific purposes (Hunt 2000). This change caused a shift in demographics of the cadavers as the earlier collection consisted of lower income people while the latter came from middle to upper incomes (Hunt 2000).

Overall, 1,728 individuals are represented in the collection with known age, sex, ethnic identity, and cause of death (Hunt 2000). Ages range from 16 years to 102 years with birth dates from 1882-1943 (Hunt 2000). Demographically, there are 546 black males, 461 white males, 392 black females, 323 white females, five Asian males, and one of unknown origin. However, these racial classifications may be skewed as those individuals with a mixture of “white” and “black” genes are biologically “hybrids”, but mostly likely would be socially classified as black (Carpenter 1976).

The William M. Bass Donated Collection

The William M. Bass Collection is a modern population, from the twentieth century, started by William M. Bass in 1981 at the University of Tennessee, Knoxville (UTK). Currently, this collection holds over 450 individuals from Tennessee and the surrounding states (Bassett et al. 2002). All bodies were donated to the collection. In most cases, bodies were received immediately after death, and are used to study rates of human decomposition at the Anthropological Research Facility at UTK (Bassett et al. 2002). A majority of the individuals from this collection were born in the 1930s, with the overall span of birth dates starting in the 1890s and continuing into the 2000s. Where the Terry Collection ends, the Bass Collection picks up and continues on, making this collection a good source to use as a modern skeletal population.

Demographically, more males than females are represented in the collection, with a majority of males being of European descent (Bassett et al. 2002). Overall there are 372 individuals of European descent, 51 of African descent, nine Hispanics, and one Native American. Sex and ancestry are reported by either the family who donated the body or through morgue records.

Methods

Twelve nonmetric traits were used to test accuracy and viability in the two sampled populations. These traits were taken from Ernest Hooton's Harvard List (Brues, 1990) and Stanley Rhine's (1990b) nonmetric trait list. This method of recording is useful because nonmetric categories can be used without instruments, and observations can be made quickly (Rhine 1990b). These specific traits were used since they are visually prominent and thus easily recordable. Focus was placed on the mid and lower face with the selection of these traits as it has been shown in previous studies to be the best indicators of ancestral affinity (Gill 1986; Rhine 1990b; Stewart 1979; Truesdell 2003). Overall, there are three traits from the braincase, six from the midface, two mandibular, and one dental. Although used in my previous study, orbital shape and cranial form were not used for this thesis project due to high subjectivity in the evaluation of the two traits. The traits used on the midface were retained, and seven more were added that were presented in Rhine's 1990 study.

The following is a list of the twelve traits used with a description and rankings (see Figures 2-4):

1. Alveolar Prognathism (AP) - forward projection of the mandible and maxilla regions (Bass 1995:88-92; Brues 1990:3). Scored as missing (0), absent (1), medium (2), or pronunced (3).

2. Maxillary Overbite (MO) – forward projection of the maxilla over the mandible (American Board of Orthodontics 2003). Scored as missing (0), slight (1), medium (2), pronounced (3).

3. Metopic Trace (MT) – the incomplete presence of the metopic suture above the nasion classified as either absent (1) or present (2) (Rhine 1990b:20).

4. Nasal Bridge (NB) – horizontal contour around nasal root (Brues 1990:5). Specifically, the area between the eye orbits that forms the bridge of the nasal region. Scored as missing (0), narrow (1), intermediate (2), or wide (3).

5. Molar Crenulations (MC) – complex wrinkling of the molar crown (Rhine 1990b:20). Scored as either missing (0), absent (1), or present (2).

6. Post Bregmatic Depression (PBD) – a small depression that lies behind bregma on the cross section of the sagittal and coronal sutures (Rhine, 1990b:19). Scored as either absent (1) or present (2).

7. Posterior Ramus Inversion (PRI) – a slight inward turning at the posterior end of the mandibular ramus (Angel and Kelley 1990:33). Scored as missing (0), absent (1), or present (2).

8. Venous Markings (VM) – slight depressions seen above the temporal line on the frontal bone, usually before the coronal suture (Rhine 1990b:20). Scored as absent (1) or present (2).

9. Chin Profile (CP) – with the skull in Frankfurt plan the profile of the chinis scored as either missing (0), vertical (1), or prominent (2) (Rhine 1990b:20).

10. Nasal Spine (Nsp) - projection at the inferior aspect of nasal (Gill 1986:149). Scored as either absent (1), small (2), or large (3).

11. Nasal Sill (Nsill) – depressions on the sides of the nasal spine (Gill, 1986:149). Scored as missing (0), guttered (1), dull (2), or sharp (3).

12. **Total Nasal Form (TNF)** – the nasal breath or opening (Rhine 1990b:20). Scored as either narrow (1), medium (2), or large (3).

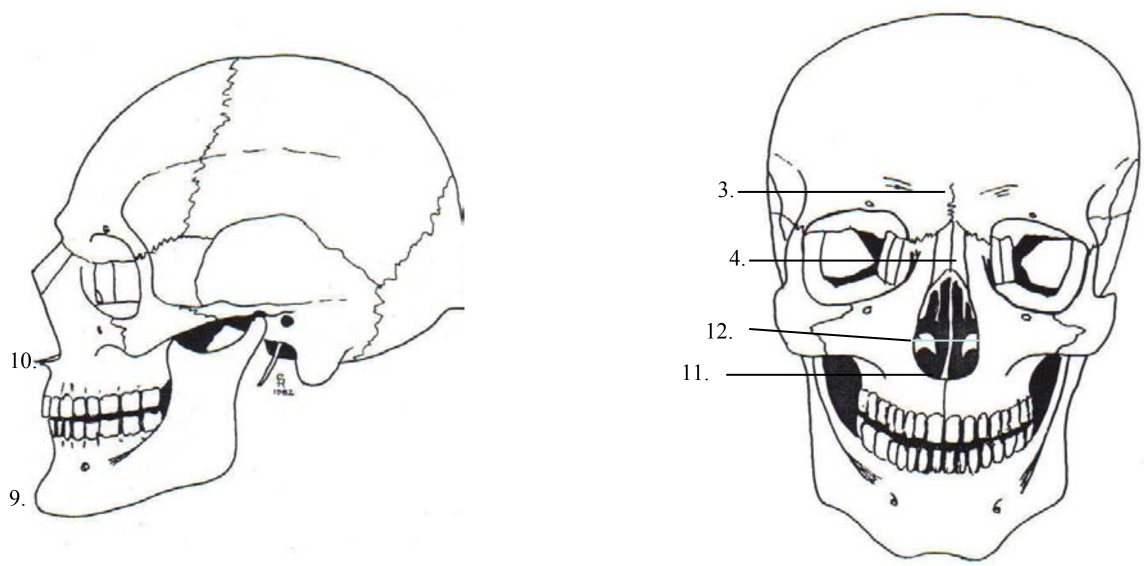

Figure 2. "Typical" white male with corresponding traits (Illustration from Rhine 1990b:10 with permission from Stanley Rhine, Ph.D.)

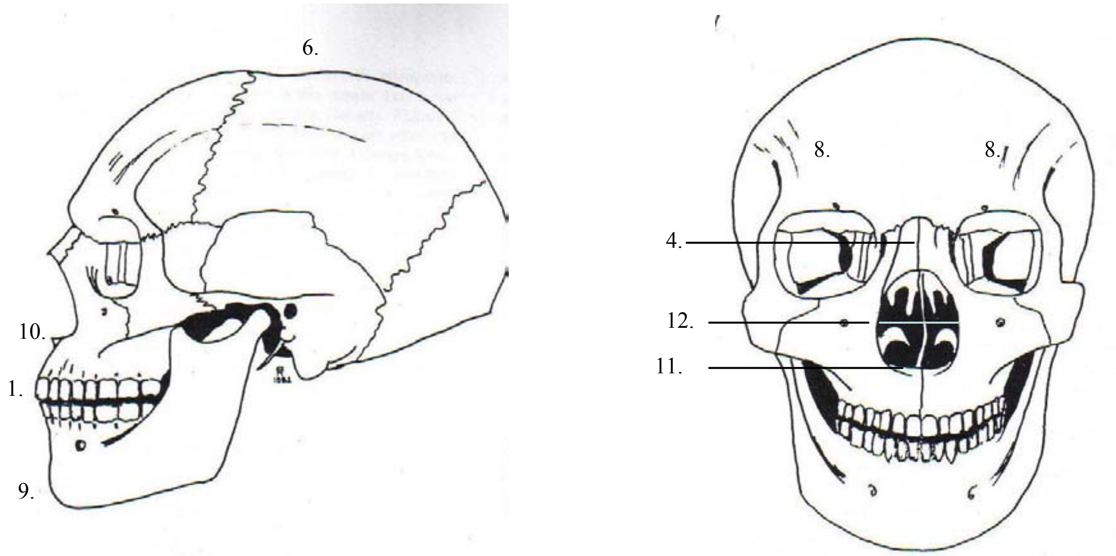

Figure 3. "Typical" black male with corresponding traits (Illustration from Rhine 1990b:12 with permission from Stanley Rhine, Ph.D.)

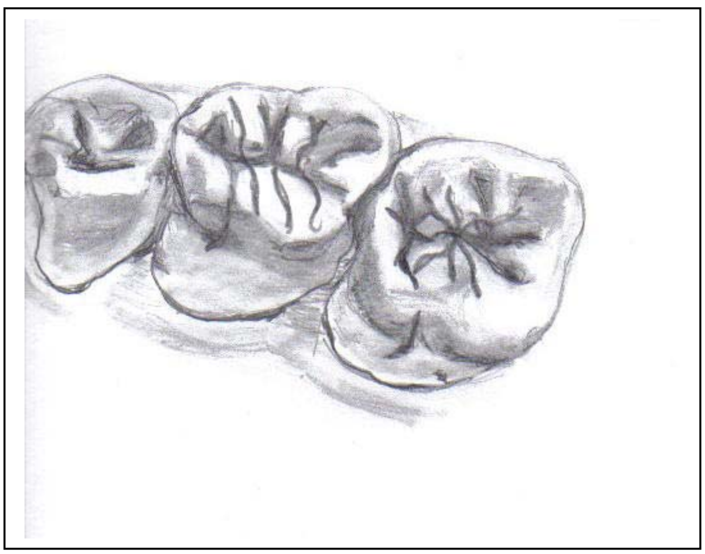

Figure 4. Molar crenulations (Illustration by Felicia Madimenos, Dept. of Geography and Anthropology, Louisiana State University).

The Robert J. Terry Collection was sampled first then the Bass Donated and Forensic Collections. The individuals are curated in separate boxes with catalog number, sex, age, and race placed on a label outside the box. To eliminate observer bias, ten to fifteen skulls were taken out at a time and placed on a table, lined up in no particular order. For the Terry Collection, the skulls were placed on a cart and wheeled into a private room where the evaluation was done. For the Bass Collection, the skulls were placed on a table already in the room. This table was faced away from the boxes so the evaluation was conducted with the author's back to the collection.

Reported race was not known before the evaluation began. Approximately 80 to 100 skulls were evaluated each day. Each skull was scored individually, using all twelve traits. A score of zero (0) indicated that the trait was missing on the individual so that particular trait could not be evaluated. When frequencies were calculated, those with a score of 0 were not used.

After each skull was scored, a predicted race was assigned to each individual. Predicted race was determined when six or more traits pointed to one ancestral group. If there was a situation in which the traits were split six and six, then black was assigned. Socially, when one is of mixed descent, the minority race is usually assigned to that person (Howells 1970). Predicted race was then entered into the spreadsheet. When the skulls were placed back into their respective boxes, reported race was taken from the outside label and entered into the spreadsheet.

Statistical Tests

After both collections were evaluated, frequencies were calculated to determine accuracy in assigning race and evaluate which traits were distinct to each ancestral group. Chi-square analysis ($p<0.05$) was used to evaluate the significance of secular change over time, if any, from the Terry to Bass Collection for black males, white males, and white females. Black females were not included in this part of the study as only nine modern black females were available. When a trait was significant, this was indicative of a directional change occurring over time. Those traits showed to be not significant were compared to the frequency tables in order to see if there were any trends occurring with those traits.

Expected Results

These twelve traits are expected to be yield a high accuracy in predicting race. Those traits that are population specific should yield a high frequency number in those respective ancestral populations. Of the twelve traits, post bregmatic depression, venous markings, or metopic trace should be least distinctive in either ancestral group. Based on Rhine's 1990b study, these traits appeared more often in black groups. However, only three casts were used, making the likelihood of occurrence questionable.

Significance from the chi-square analysis should show a change occurring over time in the two ancestral groups. Based on my previous study, there is an expectation that the face should start to elongate over time, with a majority of the change appearing in the mid to lower part of the face.

CHAPTER 5

RESULTS

Question 1

The twelve nonmetric traits used in this study have been utilized by other researchers in anthropology. The samples used here focused solely on American blacks and whites. Each question is addressed separately with corresponding results.

QUESTION 1: Can nonmetric analysis be used to distinguish between American blacks and whites?

This question is one of accuracy, and overall accuracy was high in distinguishing between black and white populations through nonmetric analysis (Table 7). Since race was known for individuals in both the Terry and Bass Collections, accuracy comparisons to the predicated race could be calculated. In the Terry Collection, blacks yielded 94% accuracy while whites had 92% accuracy. When comparing sex, males tended to have a higher accuracy, with 98% of black males being correctly identified and 99% of white males. Black females had an 89.6% accuracy rate and white females were the lowest at 85%.

For the Bass Collection, 98% of whites were correctly identified while 93% of blacks were correctly identified. When comparing the sexes, black males were correctly identified 94% while white males were 100%. Black females were correctly identified 89%, while white females were 97%.

Table 7. Overall Accuracy in the Terry and Bass Donated/Forensic Collections

Terry Collection		
	Males and Females	
		Blacks – 94% accurate (n=207/219)
		Whites – 92% accurate (n=175/189)
	Males Only	
		Blacks – 98% accurate (n=110/112)
		Whites – 99% accurate (n=99/100)
	Females Only	
		Blacks – 89.6% accurate (n=87/97)
		Whites – 85% accurate (n=76/79)
Bass Donated and Forensic Collections		
	Males and Females	
		Blacks – 93% accurate (n=43/45)
		Whites – 98% accurate (n=171/173)
	Males Only	
		Blacks – 94% accurate (n=34/36)
		Whites – 100% accurate (n=115/115)
	Females Only	
		Blacks – 89% accurate (n=8/9)
		Whites – 97 % accurate (56/58)

Question 2

QUESTION 2: Of the non-metric traits used, which ones are distinct to each of the ancestral groups?

Tables 8-10 present frequencies for each of the non-metric traits by race and sex for each population. To summarize traits, blacks exhibited certain "typical" Negroid characteristics in guttered nasal sills, small nasal spine, wide total nasal form, presence of molar crenulations, posterior ramus inversion, pronounced alveolar prognathism, venous markings, and a vertical chin profile. Whites tended to have a narrow nasal bridge, no posterior ramus inversion, a prominent chin, sharp nasal sills, large nasal spine, and a narrow nasal form. These traits tended to be specific to each racial group and can be used to distinguish between American whites and blacks.

Table 8. Frequencies of Traits for Black Males

	Terry Collection			Bass Collection		
Traits with Score	*n*		%	*n*		%
1. Alveolar Prognathism						
Missing (0)	27			18		
Absent (1)	13	n=85	15	3	n=18	17
Medium (2)	48		57	9		50
Pronounced (3)	24		28	6		33
2. Maxillary Overbite						
Missing (0)	40			20		
Slight (1)	18	n=72	25	6	n=16	37
Medium (2)	35		49	2		13
Pronounced (3)	19		26	8		50
3. Metopic Trace						
Absent (1)	111		99	36		100
Present (2)	1		1	0		0
4. Nasal Bridge						
Missing (0)	3			0		
Narrow (1)	21	n=109	19	6	n=36	17
Intermediate (2)	53		49	17		47
Wide (3)	35		32	13		36
5. Molar Crenulations						
Missing (0)	41			14		
Absent (1)	14	n=71	20	5	n=22	23
Present (2)	57		80	17		77
6. Post Bregmatic Depression						
Absent (1)	95		85	33		90
Present (2)	17		15	3		8
7. Posterior Ramus Inversion						
Missing (0)	2			5		
Absent (1)	12	n=110	11	9	n=31	26
Present (2)	98		89	22		63
8. Venous Markings						
Absent (1)	96		86	26		70
Present (2)	16		14	10		28
9. Chin Profile						
Missing (0)	2			6		
Vertical (1)	92	n=110	84	19	n=30	63
Prominent (2)	18		16	11		37
10. Nasal Sill						
Missing (0)	0		0	0		
Guttered (1)	73	n=112	65	18	n=36	50
Dull (2)	29		26	11		31

(Table 8 continued)

Sharp (3)	10		9	7		19
11. Nasal Spine						
Absent (1)	55	n=112	49	17	n=36	47
Small (2)	39		35	9		25
Large (3)	18		16	10		28
12. Total Nasal Form						
Narrow (1)	10	n=112	9	3	n=36	8
Medium (2)	30		27	14		39
Wide (3)	72		64	19		53

Table 9. Frequencies of Traits for White Males

	Terry Collection			Bass Collections		
Traits with Score	*n*		%	*n*		%
1. Alveolar Prognathism						
Missing (0)	49			83		
Absent (1)	45	n=50	90	32	n=35	91
Medium (2)	6		10	3		9
Pronounced (3)	0		0	0		0
2. Maxillary Overbite						
Missing (0)	57			93		
Slight (1)	15	n=43	33	10	n=25	40
Medium (2)	12		29	8		32
Pronounced (3)	16		38	7		28
3. Metopic Trace						
Absent (1)	92		93	112		95
Present (2)	7		7	6		5
4. Nasal Bridge						
Missing (0)	3			0		
Narrow (1)	68	n =97	70	79	n=118	67
Intermediate (2)	28		29	38		32
Wide (3)	1		1	1		1
5. Molar Crenulations						
Missing (0)	66			79		
Absent (1)	30	n=33	88	37	n=39	95
Present (2)	4		12	2		5
6. Post Bregmatic Depression						
Absent (1)	83		84	111	n-118	94
Present (2)	16		16	7		6
7. Posterior Ramus Inversion						
Missing (0)	1			9		
Absent (1)	77	n=99	78	97	n=109	89
Present (2)	22		22	12		11

(Table 9 continued)

8. Venous Markings						
Absent (1)	91	n=99	92	111	n=118	94
Present (2)	8		8	7		6
9. Chin Profile						
Missing (0)	1			8		
Vertical (1)	38	n=99	38	13	n=109	12
Prominent (2)	61		62	96		83
10. Nasal Sill						
Missing (0)	1			0		
Guttered (1)	4	n=99	4	4	n=118	3
Dull (2)	24		24	15		13
Sharp (3)	71		72	99		84
11. Nasal Spine						
Absent (1)	14	n=109	14	31	n=118	26
Small (2)	42		42	16		14
Large (3)	43		44	71		60
12. Total Nasal Form						
Narrow (1)	90	n=99	91	94	n=118	80
Medium (2)	4		4	18		15
Wide (3)	5		5	6		5

Table 10. Frequencies of Traits for White Females

	Terry Collection			Bass Collection		
Traits with Score	*n*		%	*n*		%
1. Alveolar Prognathism						
Missing (0)	66			47		
Absent (1)	18	n=24	75	9	n=11	82
Medium (2)	3		17	2		18
Pronounced (3)	2		8	0		0
2. Maxillary Overbite						
Missing (0)	68			3		
Slight (1)	9	n=22	41	2	n=11	18
Medium (2)	5		23	5		46
Pronounced (3)	8		36	4		36
3. Metopic Trace						
Absent (1)	84	n=90	93	56	n=85	97
Present (2)	6		7	2		3
4. Nasal Bridge						
Missing (0)	2			2		
Narrow (1)	50	n=87	58	39	n=56	70
Intermediate (2)	31		35	14		25
Wide (3)	6		7	3		5
5. Molar Crenulations						

(Table 10 continued)

Missing (0)	72			31		
Absent (1)	15	n=18	83	25	n=27	93
Present (2)	3		17	2		7
6. Post Bregmatic Depression						
Absent (1)	79	n=89	89	52	n=58	81
Present (2)	10		11	6		10
7. Posterior Ramus Inversion						
Missing (0)	0			5		
Absent (1)	52	n=89	58	46	n=53	87
Present (2)	37		42	7		13
8. Venous Markings						
Absent (1)	78	n=89	88	51	n=58	88
Present (2)	11		12	7		12
9. Chin Profile						
Missing (0)	0			5		
Vertical (1)	21	n=89	24	5	n=53	9
Prominent (2)	68		76	48		91
10. Nasal Sill						
Missing (0)	0			0		
Guttered (1)	0		0	3	n=58	5
Dull (2)	9	n=90	10	10		17
Sharp (3)	81		90	45		78
11. Nasal Spine						
Absent (1)	28	n=90	31	23	n=58	40
Small (2)	37		40	7		12
Large (3)	25		28	28		48
12. Total Nasal Form						
Narrow (1)	72	n=90	80	48	n=58	83
Medium (2)	10		11	7		12
Wide (3)	8		9	3		5

According to Rhine (1990b), blacks tend to have a post bregmatic depression and venous markings while whites tend to show a metopic trace. However, metopic trace and post bregmatic depression had no distinction between blacks and whites. In fact, for both groups, each of these traits tended to be absent. Overall, the midface region and posterior ramus inversion produced the best racial identification nonmetrically. Maxillary overbite was difficult to interpret because many of the individuals represented in the collections had massive tooth loss. Without dentition, interpreting the extent of maxillary overbite is difficult at best.

Question 3

QUESTION 3: Has there been a significant change over time in American black and white populations?

Observing secular change over time is the main issue addressed in this study. The chi-square statistic shows if the two samples (Terry and Bass Collections) are significantly different. Tables 11 - 13 give results of the chi-square analysis of black males, white males, and white females.

Table 11. Comparison of Black Males from the Terry and Bass Collections using 12 Nonmetric traits; Chi-square Analysis

Trait	Value	df	Sig. (2-sided)
AP	0.262	2	0.877
MO	7.189	2	0.027
MT	0.324	1	0.569
NB	0.240	2	0.887
MC	3.424	2	0.181
PBD	0.990	1	0.320
PRI	6.267	1	0.012
VM	3.738	1	0.053
CP	5.916	1	0.015
Nsill	3.863	2	0.145
Nsp	2.804	2	0.246
TNF	1.940	2	0.379

Table 12. Comparison of White Males from the Terry and Bass Collections using 12 Nonmetric traits; Chi-square Analysis

Trait	Value	df	Sig. (2-sided)
AP	0.049	1	0.824
MO	0.721	2	0.697
MT	0.358	1	0.550
NB	0.242	2	0.886
MC	1.144	1	0.285
PBD	5.734	1	0.017
PRI	4.920	1	0.027
VM	0.391	1	0.532
CP	9.824	2	0.007
Nsill	5.246	2	0.073
Nsp	22.606	2	0.000
TNF	7.215	2	0.027

Table 13. Comparison of White Females from the Terry and Bass Collections using 12 Nonmetric traits; Chi-square Analysis

Trait	Value	df	Sig. (2-sided)
AP	0.972	2	0.615
MO	2.386	2	0.303
MT	0.714	1	0.398
NB	2.010	2	0.366
MC	0.938	1	0.333
PBD	0.010	1	0.922
PRI	12.192	1	0.000
VM	0.003	1	0.958
CP	5.200	2	0.074
Nsill	6.734	2	0.034
Nsp	14.892	3	0.001
TNF	0.743	2	0.690

For black males MO, PRI, and CP were significant while AP, MT, NB, MC, PBD, VM, Nsill, Nsp, and TNF were not. White males showed significant difference in PBD, PRI, CP, Nsp, and TNF while AP, MO, NB, MC, VM, and Nsill showed no significant difference. White females demonstrated significant difference in PRI, Nsill, and Nsp while AP, MO, MT, NB, PRB, VM, CP, Nsp, and TNF showed no difference.

CHAPTER 6

DISCUSSION AND CONCLUSIONS

Race determination is complicated. Social race versus biological ancestry is a distinction made in anthropology. However, that distinction becomes blurred in forensic anthropology as forensic anthropologists are asked to convey biological ancestry in social terms. Black and white are not biological terms, but they are used in forensic anthropology when creating a biological profile of an individual. The social understanding of race is an important aspect to explore when examining secular change. As a consequence, self-identified race may differ from, or conflict with, biological ancestry (Gordon and Bell 1993). White in the early twentieth century differs from what is considered white today (Prewitt 2000; Skerry 2000). As such, the change shown in white males and females and black males may be a reflection of social change of classification along with environmental change. All these factors must be considered when exploring populations and change over time. Although beyond the scope of this research, this aspect of race determination needs to be addressed more in the forensic literature.

Accuracy was high in correctly identifying race with these twelve nonmetric traits. However, reported race came largely from morgue records for the Terry Collection and a combination of morgue records and family reporting for the Bass Collection. This can be seen as a source of error as the reported race may not correspond to biological ancestry. Given that racial categories have changed over time in American society (Hirshman et al. 2000; Littlefield et al. 1982), this may impact accuracy in assessing race when dealing with historic versus modern populations. Since this project dealt with both types of populations, the possibility of error on reported race, or inconsistency of reported race over time, is an issue that can affect correct identification of an individual's race.

Correspondingly, as social race changed over time, so have humans changed morphologically. The issue of secular change emerges with change occurring over time. Black females could not be evaluated due to the small number of available modern black females. Therefore, only black males, white males, and white females were evaluated to see if secular change had occurred over time. For black males, there was a significant change in maxillary overbite, degree of mandibular ramus inversion, and chin profile. It appears as if the chin is becoming more prominent over time with the ramus emerging straighter. This may indicate that the lower half of the face is receding inward, increasing the degree of maxillary overbite. Yet, the nasal spine and nasal bridge, nasal sill, total nasal form, along with the presence of molar crenulations, seem to remain constant over time. This is supporting evidence that the mid-face is still a good indicator of ancestry and is still usable for modern populations.

Venous markings also showed a level of approaching significant. Over time the occurrence of venous markings increased, attesting to their viability as an ancestral trait of blacks. However, regional difference may be a factor as those in the Terry Collection did not exhibit this trait in a higher number. This population was mainly from St. Louis while those in the Bass Collection are mainly from Tennessee and the surrounding area. Rhine (1990b), although a small sample size, also did not see venous markings in his population.

For white males, the lower half of the face also changes over time by receding inward. This chin becomes more prominent with a straighter mandibular ramus. The nasal spine appears longer over time and the total nasal form narrow. This may be an indicator that the lower nasal region is narrowing over time. However, nasal bridge and nasal sill remained constant, along with alveolar prognathism and maxillary overbite. The changes occurring to the mandible, along with chin profile and ramus inversion, correspond with those seen in black males.

In white females the ramus also becomes straighter over time. The nasal sill and nasal spine appear to be sharper and longer as time passed. As seen with white males, the nasal bridge, total nasal form, alveolar prognathism, and maxillary overbite remained constant.

Overall, all three groups show a change occurring over time in the face. Each has change occurring in the mandible, with the ramus becoming straighter over time. The males show a more prominent chin while whites show change occurring in the lower end of the nasal region. The nasal bridge, alveolar prognathism, and molar crenulations remained constant over time for all three groups. From this, it appears that the lower face is changing at a faster rate than the upper face.

These results correspond with Jantz's (2001) metric analysis. His findings saw a cranial vault increase with a narrowing of the face. Since both groups showed a change in the same direction, this could suggest that the same environmental and genetic factors are affecting blacks and whites. With these findings, a necessity emerges to reevaluate the racial traits used for so long to classify individuals into racial categories. The concept of race, therefore, becomes a difficult one to study as races of humans are blurred.

Although the time span from the Terry Collection to the Bass Donated Collection is small, the amount of environmental and social change that has occurred has been tremendous. Boas (1940) showed that the human skull is highly plastic and can undergo change in a short amount of time if environmental factors, such as nutrition, are altered. Over the years nutrition has increased, disease and mortality have decreased, and activity levels have decreased. These have allowed for an increase in growth and development (Jantz 2001). Socially, laws against civil rights violations and increases in travel have allowed for a greater exchange of genetic information among different populations. These are just a few factors that can lead to the secular change appearing over this short period of time.

In today's society, race is as much a part of someone's identity as his or her sex and age (Gill 1986). As such, being able to identify ancestry of an individual from skeletal remains is essential to both forensic anthropologists and osteologists. Nonmetric analysis of ancestry from the skeleton, then, is useful in this regard since certain traits have been identified that show strong correlations with ancestry. The face is the best indicator of ancestry, and, if parts or the complete skull are available, then ancestral determination should be possible.

Nonmetric analysis does contain a degree of subjectivity, but mainly it requires experience and practice. This is the same for metric analysis as well. Similar levels of observer error due to misinterpretation of the criterion or methodology can happen in both metric and nonmetric analysis. For both observational techniques, training and experience are needed in order to control for error and to gain reliability (Gill 1986; Rhine 1990b). Sample size and the use of an adequate number of traits will decrease errors in assessment of ancestry. Twelve traits were used in this study, but the results were positive and accuracy acceptable because of the large sample size used. Yet, for future nonmetric studies, more traits should be incorporated for a more complete evaluation of non-metric racial determination from the human cranium.

Overall, nonmetric analysis is an acceptable form of evaluation when determining the race of an individual. In a forensic setting, the use of nonmetrics is preferable over metrics since it requires no instruments and can be done in a fast and efficient manner. However, the current trait lists of different races should to be re-evaluated as modern populations are slowly changing morphologically. Anthropological traits are based on extreme West African and extreme Western European populations (Blakey 1994). American populations have been removed from their ancestors and appear to be developing more intermediate characteristics. More research conducted on modern forensic cases could help in understanding the changing morphology of the American public. Future studies also need to incorporate social trends into their analysis. Again, social race has an impact on the classification of biological race, especially within forensic anthropology.

Black females could not be evaluated due to a small modern sample. When trying to locate a larger sample, I found it difficult as black females were scattered throughout the country in different museums, universities, and morgues. Time and cost were an issue, and it was not possible to travel throughout the United States evaluating a few skulls here and there. Further research should be conducted on this population since no study has tackled this group.

The concept of race in anthropology has progressed throughout its two hundred year history. Racial theory is vastly different from its original definition and application in the discipline. As the concept of race has transformed over the years in anthropology, so has it evolved in popular culture. This is important for forensic anthropologists to remember when creating a biological profile.

The investigation of secular change between American blacks and whites is an issue that requires additional research. With population intermixing occurring at high rates in the United States, an effect on skeletal morphology will occur. For forensic anthropology, tracing this admixture through nonmetric analysis is necessary as anthropologists encounter these phenomena. Being able to identify this admixture is vital for understanding biological distance in modern populations. The current study can play an important role in tracing secular change in various populations in the United States.

REFERENCES CITED

American Board of Orthodontics
2003 Discrepancy Index for the Phase III Clinical Examination. Electronic Document. http://www.americanboardortho.com/professionals/road_to_cert/phase_iii/discrepancies.aspx, accessed July 12.

American Association of Physical Anthropologists
1996. AAPA Statement on Biological Aspects of Race. American Journal of Physical Anthropology 101: 569-570.

Angel, Lawrence J.
1980 Appendix III. Family Skeletons from Cliffs Plantation. *In* Fraser D. Neiman Field Archaeology of Cliffs Plantation Site Westmoreland, Virginia. For the Robert E. Lee Memorial Association.

Angel, Lawrence J.
1981 The Armor and Drummond-Harris Sites. Governor's Landing, Virginia. Unpublished Manuscript in the Archives of the Smithsonian Natural History Museum.

Angel, Lawrence J. & Jennifer Olsen Kelley
1983 The Workers of Catoctin Furnace. Maryland Archaeology Journal of the Archaeological Society of Maryland Inc 19: 1-17.

Angel, Lawrence J. & Jennifer Olsen Kelley
1990 Inversion of the Posterior Edge of the Jaw Ramus: New Race Trait. *In* Skeletal Attribution of Race. George W. Gill and Stanley Rhine, eds. Pp.1-9. Albuquerque: University of New Mexico Press.

Anonymous
1979 Nonmetric traits. Journal of Human Evolution 8:705-708.

Bass, William M.
1995 Human Osteology. A Laboratory and Field Manual (4th ed.). Columbia: Missouri Archaeological Society.

Bassett, H.E. with M.K. Spradley and L. Meadows Jantz.
2002 The William M. Bass Donated Collection at the University of Tennessee in Knoxville. Poster presented at the Annual Meeting of the American Academy of Forensic Sciences, Chicago, February 20.

Benedict Ruth
1959 Race: Science and Politics. New York: Viking Press.

Berry, A.C. and R.J. Berry
1967 Epigenetic variation in the human cranium. Journal of Anatomy 101:361-379.

Blakey, Micheal L.
1994 Bioarchaeology of the African diaspora in the Americas: its origin and scope. Annual Review of Anthropology 7:387-422.

Boas, Franz
1940 Race Language and Culture. Chicago: University of Chicago Press.

Brace, C.L.
1964 A Nonracial Approach Towards the Understanding of Human Diversity. *In* The Concept of Race. Ashley Montagu, ed. Pp.103-152. New York: Free Press.
1995 Region doe not mean "Race" – Reality versus convention in forensic anthropology. Journal of Forensic Science 40:171-175.

Brues, Alice
1990 The Once and Future Diagnosis of Race. *In* Skeletal Attribution of Race. George W. Gill and Stanley Rhine, eds. Pp.1-8. Albuquerque: University of New Mexico Press.

Buikstra, Jane E., with Susan R. Frankenberg and Lyle W. Konigsberg
1990 Skeletal Biological Distance Studies in American Physical Anthropology: Recent Trends. American Journal of Physical Anthropology 82:1-7.

Buikstra, Jane E. and Douglas H. Ubelaker, eds.
1994 Standards For Data Collection From Human Skeletal Remains. Arkansas Archaeological Survey Research Series, 44. Arkansas.

Carpenter, James Culiver
1976 A Comparative Study of Metric and Non-metric Traits in a Series. American Journal of Physical Anthropology 45:337-344.

Comas, Juan.
1961 "Scientific" Racism Again? Current Anthropology 2:303-340.

DeCorse, Christopher R.
2002 West Africa During the Atlantic slave Trade: Archaeological Perspectives (New Approaches to Anthropological Archaeology). New York: Continuum.

Deol, M.S.
1957 Genetic differentiation involving morphological characters in an inbred strain of Mice. Journal of Morphology 100:345-375.

Donnan, Elizabeth
1931 Documents Illustrative of the History of the Slave Trade to America. Publication no. 409. District of Columbia: Carnegie Institution of Washington.

El-Najjar, M.Y. and K.R. McWilliams
1978 Skeletal Nonmetric Traits. In Forensic Anthropology**:** The Structure, Morphology and Variation of Human Bone and Dentition. M.Y. El-Najjar and K.R. McWilliams, eds. Pp. 116-149. Springfield: Charles C. Thomas.

Eltis, David, with Stephan Behrendt, David Richardson, and Herbert S. Klein.
1999 The Transatlantic Slave Trade. Cambridge: Cambridge University Press.

Ferguson, Leland.
1992 Uncommon Ground. Archaeology and Early African America 1650-1800. District of Columbia: Smithsonian Institute Press.

Gill, George G.
1986 Craniofacial Criteria in Forensic Race Identification. *In* Forensic Osteology. Advances in the Identification of Human Remains. Kathleen Reichs, ed. Pp. 145-159. Springfield: Charles C. Thomas.

Gill, George G.
1990 Introduction. *In* Skeletal Attribution of Race. George W. Gill and Stanley Rhine, eds. Pp.vii-xii. Albuquerque: University of New Mexico Press.

Gill, George G. and Stanley Rhine
1990 Skeletal Attribution of Race. Albuquerque: University of New Mexico Press.

Gordon, Claire C. and Nancy A. Bell
1993 Problems of Racial and Ethnic Self-Identification and Classificaiton. National Association for the Practice of Anthropology Bulletin 13:34-47.

Gordon, Claire C. and Thomas M. Greiner
1993 Biocultural Influences in the Analysis of Secular Trends. National Association for the Practice of Anthropology Bulletin 13:22-32.

Goodman, Alan.
1997 Bred in the Bone? Sciences. 37:20-26.

Gruenberg, H.
1955 Genetical Studies on the Skeleton of a Mouse. Journal of Genetics 53:515-533.

Harrison, Faye V.
1995 The Persistent Power of "Race" in the Cultural and Political Economy of Racism. Annual Review of Anthropology 24:47-74.
1998 Introduction: Expanding the Discourse on "Race." American Anthropologist 100:609-631.

Hinkes, Madeline J.
1993 Race, Ethnicity, and Forensic Anthropology. National Association for the

Practice of Anthropology Bulletin 13:48-53.

Hirshman, Charles, with Richard Alba and Reynolds Farley
2000 The Meaning and Measurement of Race in the U.S. Census: Glimpses into the Future. Demography 37:381-393.

Howells, W.W.
1970 Multivariate analysis for the identification of race from the crania. *In* Personal Identification in Mass Disasters. T.D. Stewart. Pp. 11-121. District of Columbia: National Museum of Natural History.

Hunt, David
2000. The Robert J. Terry Anatomical Skeletal Collections. Electronic document http://www.nmnh.si.edu/anthro/coll/terry.htm, accessed February 20.

Jantz, Richard L.
1999 Secular Change in Long Bone Length and Proportion in the United States, 1800-1970. Journal of Forensic Science 110:57-67.
2001 Cranial Change in Americans: 1850-1975. Journal of Forensic Science. 46:784-787.

Jantz, R.L. & Lee Meadows Jantz
2000 Secular Changes in craniofacial morphology. American Journal of Human Biology 12:327-338

Jones, Greta
1980 Social Darwinism and English Thought. The Interaction between Biological and Social Theory. New Jersey: Humanities Press.

Kennedy, Kenneth A.R.
1995 But Professor, Why Teach Race Identification if Races Don't Exist? Journal of Forensic Science 40:797-800.

Littlefield, Alice with Leonard Lieberman and Larry T. Reynolds
1982 Refining Race: The Potential Demise of a Concept in Physical Anthropology. Current Anthropology 23:641-655.

Livingstone, Frank B.
1964. On the Nonexistence of Human Races. *In* The Concept of Race. Ashley Montague, ed. Pp 46-60. New York: Free Press.

Lovejoy, C. Owen, with Richard S. Meindl, Thomas R. Pryzbeck, and Robert P. Mensforth
1985 Chronological Metamorphosis of the Auricular Surface of the Illium: A New Method for the Determination of Adult Skeletal Age at Death. American Journal of Physical Anthropology 65:15-28.

Meindl, Richard, with C. Owen Lovejoy, Robert P. Mensforth, and Robert A. Walker
1985 A Revised Method of Age Determination Using the Os Pubis, With a Review and Tests of Accuracy of Other Current Methods of Pubic Symphyseal Aging. American Journal of Physical Anthropology 68:29-45.

Montagu, Ashley
1942 Man's Most Dangerous Myth: The Fallacy of Race. New York: Columbia University Press.
1964 The Concept of Race. New York: Free Press.

Phenice, T.W.
1969 A Newly Developed Visual Method of Sexing the Os Pubis. American Journal of Physical Anthropology 30:297-302.

Prewitt, Kenneth
2000 The US Decennial Census: Political Questions, Scientific Answers. Population and Development Review 26:1-16.

Rhine, Stanley.
1990a Foreword. *In* Skeletal Attribution of Race. George W. Gill and Stanley Rhine, eds. Pp.xiii-xix. Albuquerque: University of New Mexico Press.
1990b Non Metric Skull Racing. *In* Skeletal Attribution of Race. George W. Gill and Stanley Rhine, eds. Pp.9-20. Albuquerque: University of New Mexico Press.

Sauer, Norman J.
1992 Forensic Anthropology and the Concept of Race: If Races Don't Exist, Why Are Forensic Anthropologist So Good at Identifying Them? Social Science and Medicine 34:107-111.

Shaklin, Eugenia
1998 Profession of the Color Blind: Sociocultural Anthropology and Racism in the 21st Century. American Anthropologist 100:669-679.

Skerry, Peter
2000 *Counting on the Census?: race, group identity, and evasion of politics.* District of Columbia: Brookens Press.

Smedley, Audrey
1998 Race and the Construction of Human Identity. American Anthropologist 100:690-702.

Stewart, Thomas Dale.
1979 Essentials of Forensic Anthropology, Especially as Developed in the United States. Springfield: Charles C. Thomas.

Truesdell, Nicole
2003 Nonmetric Characteristics of the Skull for Determining Race in Blacks and Whites. Poster presented at the Annual Meeting of the American Academy of Forensic Sciences, Dallas, February 18.

Yavornitzky, Valerie Nicole
2002 Test of Non-metric Ancestry Determination in Forensic Anthropology: Should the Current Categorization of Individuals of European Descent be reconsidered. Masters Thesis, Department of Anthropology, Michigan State University.

.

.

VITA

Nicole Truesdell was born in Hazel Crest, Illinois. She was graduated from Beloit College, with a Bachelor of Arts degree in anthropology. Nicole plans to continue her studies in anthropology at Michigan State University.