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A Multivariate Craniometric Analysis of Secular Change and Variation Among Recent North American Populations

Peer Henning Moore-Jansen
University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a dissertation written by Peer Henning Moore-Jansen entitled "A Multivariate Craniometric Analysis of Secular Change and Variation Among Recent North American Populations." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Anthropology.

Richard L. Jantz, Major Professor

We have read this dissertation and recommend its acceptance:

Francis Jones, Fred H. Smith, William M. Bass

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

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

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A MULTIVARIATE CRANIOMETRIC ANALYSIS OF SECULAR CHANGE AND VARIATION AMONG RECENT NORTH AMERICAN POPULATIONS

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Peer Henning Moore-Jansen

August 1989

DEDICATION

To Cathy and Rorik

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ABSTRACT

This study presents an investigation of secular trends in craniometric variation among Afro-American and Euro-American North American populations from 1750 to the present. An additional analysis of collection specific cranial variation between two prominent anatomical collections is also undertaken. Both investigations address the question of crania variation in reference to the proper application of craniometric analysis to medico-legal identiciation of racial affiliation in forensic anthropology.

The craniometric data include individual historic specimens and cemetery populations from Canada, Philadelphia and New Orleans. Anatomical specimens are collected from the Hamann-Todd and R. J. Terry collections, and recent forensic cases are obtained from forensic laboratories across the nation.

Predicated on the idea that secular change in cranial size and shape contribute to the differentiation between temporally different crania series, it is suggested that temporally earlier cranial series are less appropriate as calibration samples for the identification of contemporary U.S. populations. Analyses were performed on eighty crania variables to document temporal differences among racial and ethnic groups, and to explore patterns of

variation related to gender within each group. Group differences were examined by multivariate analysis of variance and temporal differences were investigated using multivariate analysis of covariance and canonical correlation. Specificity of collection association was examined by canonical discriminant analysis.

The multivariate analysis of cranial variation revealed similar temporal trends in size and shape between Afro-American female and male crania, while Euro-American gender differed somewhat in their direction of change. Temporal trends and collection specificity are both statistically significant. Collections are suggested to reflect ethnic differences, particularly within the Euro-American group.

It is found that significant temporal changes among Afro-American and Euro-American cranial series and ethnic specificity of individual skeletal collections can render problematic the application of earlier cranial series to the identification of recent forensic cases.

An alternative to present calibration standards for forensic identification of crania is offered. Two additional cranial series of Hispanic-American males and

American Indian of both sexes were added to the sample to define a four group calibration sample.

Calibration standards were calculated using discriminant analysis for the separation of racial or ethnic groups. Four, three and two group discriminant function were calculated for a sample of post 1900 crania to conclude the analysis.

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I. INTRODUCTION

Statement of Purpose

The present study addresses the question the medico-legal application of craniometric standards for the identification of racial or ethnic groups. In past research craniometric data was applied for this purpose, regardless of temporal differences between the calibration data and the unidentified specimens. The present study investigates the relevance of temporal control.

In an attempt to address the question of temporal specificity among cranial series of different time period, it is necessary to understand the influence of cranial plasticity or micro-evolution temporal patterns of cranial size and shape. The present study seeks to illustrate specific temporal patterns of cranial change in size and shape in American populations of African and European descent during the past two centuries.

Three primary objectives of this analysis are: 1) investigation of temporal and geographical patterns of cranial variation in size and shape, and their direction, within major racial or ethnic groups in the United States. Potential trends are explored both in terms of secular change reflecting temporal phenotypic plasticity; 2) exploring collection specificity related to "geographical" variation; and 3) composing a revised cranial calibration sample for medico-legal application, potentially more appropriate in time and space, and providing alternative two, three, and four group models for the identification of racial or ethnic affiliation in both sexes.

Statement of the Problem

The concept of separating biological populations based on patterns of skeletal variability based on quantitative or qualitative observations has long been used in the field of physical anthropology. Morphological and metric observations frequently provide a basis for classification of individual skeletal or fossil remains based on predefined clusters of population variation. The application of multivariate statistical techniques to morphometric data provides a method for testing a priori hypotheses of association. It may also be used as an exploratory measure.

Metric observations obtained from comparative skeletal collections have been used to calculate specific parameters of variation among gender or racial or ethnic groups as represented by the particular calibration samples. It is against such parameters that unidentified skeletal remains, as encountered in medico-legal investigations, may be evaluated. However, evidence of recent temporal change in morphometric variation raises questions about the application of older population data to contemporary populations. An understanding of recent microevolutionary and/or secular changes in the metrical dimensions of the human skeleton is necessary when carrying out research in skeletal biology related to the field of medico-legal investigation.

Few collections of contemporary human skeletal material contain sufficient numbers of specimens to develop approximate population parameters suitable for forensic analysis. For this reason, most research is based on a small number of anatomical skeletal collections assembled largely during the first three decades of the twentieth century (Jantz and Moore-Jansen 1984). Recently, the nature of these collections and their application to skeletal biology research related to human identification has been questioned (Ayers et al. n.d.; Ericksen 1982). Specific concerns relate to the accuracy in age documentation (Katz and Suchey 1986), biases in the socioeconomic representation, questions of general pathological condition (Corruccini 1974), and biases in the demographic and temporal structures (Jantz and Moore-Jansen 1984; 1988a; 1988b).

In their studies of craniometric variation among recent Americans of European descent, Ayers and co-workers

(n.d.) and Jantz and Moore-Jansen (1988a) observed a greater cranial length and height and a longer cranial base among recent forensic cases than in earlier anatomical series. These differences between the earlier anatomical and later forensic series indicate that the application of the earlier anatomical cranial series to the calibration of metric standards. for the estimation of racial or ethnic affiliation of more recent populations should be re-considered. The present study addresses those concerns related to the application of currently available metric standards to determine the racial or ethnic affiliation of recent forensic specimens. More appropriate, alternative measures of craniometric assessment of racial or ethnic affiliation are offered.
To arrive at alternative measures, there is a need to understand the magnitude and direction of temporal differences within and among groups. This study to illustrates secular trends among several Afro-American and Euro-American cranial series regarding variation of both size and shape of the cranium and describes the direction of these trends.

Another problem concerns the question of cranial homogeneity between groups of two different anatomical series, the Hamann-Todd and R. J. Terry collections. The two series are approximately contemporary but geographically distinct. They are drawn largely from the populations of two major cities in the United States, Cleveland, Ohio and St. Louis, Missouri, respectively. It is assumed that they reflect ethnic variation that exists between the populations of these two cities. Therefore, an exploratory investigation has been undertaken to illustrate collection specific patterns of cranial variation and to document, if possible, any ethnic differences between the two series.

The third problem addressed is related to the application of discriminant function analysis for the racial assessment of crania in forensic anthropology. Based on the analysis of secular trends and collection association a need is indicated for a contemporary forensic skeletal data base. It is from this data base that discriminant function parameters for the metric estimation of race in recent forensic cases can be derived. Such a data base is currently being developed at the University of Tennessee with the participation of physical anthropologists, particularly the practitioners of forensic anthropology, from across the United States (Jantz and Moore-Jansen 1984; 1987; 1988a; 1988b; Moore-Jansen 1987; Moore-Jansen and Jantz 1986). Based on a study of the among group-pattern of variability in crania of the forensic data base, Jantz and Moore-Jansen offered an alternative to present multivariate standards for the metrical determination of race. Noticeably absent from their study are functions pertaining to females for other than Afro- and Euro-American groups. Also absent are functions for pooled gender (i.e. functions to be applied for race determination when gender of the individual is unknown). The present study is undertaken, in part, to further investigate the problems addressed by Jantz and Moore-Jansen (1988a; 1988b). It is meant to provide a more detailed illustration of cranial form using a data set containing an added number of groups, including Hispanic-American males an American Indians of both sexes. The data base also includes a greater number of cranial variables. This study proposes a revised cranial calibration sample suitable for human identification research and a series of discriminant functions for race identification derived therefrom. Discriminant functions for the craniometric identification of four racial or ethnic groups by gender and for pooled sexes are presented.

Multivariate statistical techniques are used to perform the analyses related to secular trends and cultural homogeneity. Temporal analyses are performed using variations of multiple regression techniques to determine the presence and direction of trends.

Discriminant analyses are employed to illustrate potential group differences and to compute statistical models for the separation of racial or ethnic groups by means of craniometric data.

The next section of this dissertation provides background on issues critical to the present study. A brief discussion of the definition and determination of racial or ethnic affiliation is followed by a review of past investigations of cranial geographical and temporal, or secular variation. Next is a comment on cranial gender and age differences and the effect that particularly age specific cranial changes may have on the determination of independent secular changes. A review of past multivariate applications to craniometric data for the skeletal identification of racial or ethnic affiliation completes the second section.

Section three includes a description of the cranial series used in the analysis and is followed, in section four, by an illustration of the demographic profile of the samples and a documentation of the recording and measurement techniques. A brief presentation of the statistical techniques used is provided in section five. Sections six, seven and eight comprise a presentation and discussion of the statistical analysis into the patterns of morphometric cranial variation in terms of secular trends, collection association and discriminant function analysis, respectively. Concluding remarks and suggestions for future research are presented in section nine.

Eleven appendices include detailed information on cranial specimens, measurement definitions, recording techniques, summary statistics and most notably, a set discriminant functions and their stepwise selection models. Together, the findings of the present investigation represent direct contributions to skeletal biology and to future applications of craniometric identification in forensic anthropology.

II. BACKGROUND

Introduction

Any study is subject to a number of questions which must be addressed prior to its implementation. Those questions considered most important in this study involve the clarification of racial or ethnic group affiliation and whether these categories are biologically meaningful or merely categories of convenience to the user. The definition of groups is an important element in that it provides the framework for the interpretation of patterns of cranial variation. This section subsequetly begins with a discussion of the question of racial affiliation and what constitutes a racial or ethnic group in the present study.

Other questions involve the reality of the secular effect as reflected by temporal change. How does one identify, illustrate and explain temporal change? Is temporal change always unidirectional? Few studies have addressed these questions in terms of craniometric variation. Therefore, a review of investigations into secular change is presented, using parallels in other areas of skeletal biology, including anthropometry, growth and development. A brief summary of investigations into temporal patterns of craniometric variability and some conclusions regarding the secular effect are also presented.

The central focus of this study is the identification of the secular effect by means of multiple regression analysis. However, it can be difficult to distinguish observed patterns of temporal variation as purely secular. Of a number of other potential contributors to overall change, three factors are considered most important in this context. These include the effects of racial or ethnic affiliation, gender and individual age (i.e., age at time of death). Each of these may contribute simultaneously to the patterns of variation. Group affiliation is considered concurrently with the time effect (i.e. date of birth) in the this investigation. However, the problem of age is more complex. The question of the age effect, i.e., the difficulty of separating it from temporal variation, is discussed.

This section is concluded with a review of past research into the use of multivariate discriminant analysis as a means for the craniometric separation of racial or ethnic groups. A comparison of the method of numeric identification with morphological classification and the specific application of the former to forensic skeletal identification is a matter of special concern here.

Racial or Ethnic Affiliation

The question of racial affiliation and what constitutes a race is an issue which has received wide attention in anthropological debates in recent history (Boyd 1950; Coon 1963; Dobzahnsky 1962; 1963; Garn 1961a; Livingstone 1962). However, the biological definition of race is an issue which is of less concern to the forensic anthropologist. Rather, the forensic anthropologist is burdened with the identification of race in terms of cultural perceptions of racial affiliation sometimes attributed without a biological basis. For example, cultural perceptions of group association based on skin color and hair form may have a biological basis for some individuals, whereas in others, skin color and hair form may be of little relevance. Cultural perception may thus replace biological phenomena in the assignment of group affiliation while applying either culturally or socially based distinctions of what constitutes membership into one group or another.

Medico-legal identification of racial or ethnic affiliation is concerned with the elucidation of patterns of biological variability among socioculturally defined groups. A main objective of this study is to define skeletal differences which facilitate the separation of individual skeletal remains in terms of general social classifications. In other words, does evidence of factual craniomorphometric patterns of variation, subject to both genetic and environmental control (Dubrul and Laskin 1961; Garn 1961b; Nakata et al. 1974; Nakata, Yu and Nance 1974; Sekla and Soukup 1969; Susanne and Sharma 1978; Scott 1958), reflect cultural perceptions of group affiliation, regardless of their biological basis?

In the context of the present study, four groups are defined. Group affiliation is based on African, European, American Indian and Mexican/Hispanic origins. While each group represents a single socioculturally defined unit of classification, they certainly share common elements in their respective gene pools as a result of continued admixture. Estimates range from slight to one quarter or more of shared genes between groups (Glass and Li 1953; Herskovits 1930; Pollitzer 1958; 1969; Saksena 1974; Workman et al. 1963). However, in spite of their increasing heterogeneity, the extent of the enforcement of sociocultural barriers among groups is expected to reflect itself in the gene pool of each group, thus providing a biological basis for the separation of social groups.

The Secular Effect

Studies of temporal variation often include the investigation of systematic changes in physiological or physical characteristics in successive generations referred to as secular trends (Price et al. 1987). Temporal trends may reflect microevolutionary changes, gradually shifting over time as a result of selection and genetic admixture, or they may reflect less permanent phenotypic changes or oscillations within a relatively plastic skeletal structure. Phenotypic plasticity may be in response to modifications of environmental conditions such as changes in diet and nutrition, health and hygiene, and possible changes in the physical environment relating to climate and occupation (Eveleth 1975; 1978; Fogel 1986; Frisancho 1978; Malina et al. 1987; Steegman 1985).

Craniometric analysis alone tells us little about secular changes and their probable cause. However, an extensive amount of research has explored the question of the secular effect in growth and development and in adult stature. Both have been observed concurrently with changes in the cranium or head (Bielicki and Welon 1964; Boas 1912, Goldstein 1936; Ito 1942; Olivier et al. 1979). This is not to say that cranial and stature changes are necessarily correlated. Indeed, the absence of such a correlation has been observed (Ounsted et al 1985, cited in Roche et al. 1986). Some find secular trends to be variable specific and independent (Charzewski and Bielicki 1978; Roche et al. 1987; Smith et al. 1986). Others find independence between some variables, but note a distinct relationship between others such as cranial base length and vault breadth (Taylor and DiBennardo 1980; Michejda 1972). Changes in the timing of growth exhibit the potential for at least some effect on adult size and shape (Tanner 1955; 1960). Changes in timing of maturation have been associated with mixture of nutritional effects related to socioeconomic stratification or cultural diversity, assortive mating and genetic effects; either retarding or accelerating growth (Ito 1942; Michelson 1944; Ramsey 1950; Takahasi 1966; Wingerd et al. 1974). Although changes in the age of maturation and increases in stature have been documented as more significant in lower socioeconomic groups (Boyne 1960), these trends are also observed in "privileged" higher socioeconomic groups (Meredith 1941a).

Secular trends in stature, occurring during the last two hundred years have been noted for populations all over the world. On the average, the increase amount to between .5 and 1 cm per decade for adult stature (Bowles 1932; Eveleth and Tanner 1976; Fogel 1986; Goldstein 1943; Malina 1985; Meredith 1941a; 1941b; 1976; Morant 1950; Tanner 1955; 1960; Trotter and Gleser 1951). However, the agents of causation of temporal variation are not well understood. In some cases, changes in stature have been linked to timing of maturation and assumed to be environmentally determined (Chinn and Rhona 1984). Alternatively, it has been argued that changes in maturation are due to environmental factors such as nutrition and hygiene, whereas adult stature is attributable to genetic effects, mirroring a breakdown of genetically isolated breeding populations or heterosis (Billy 1980; Trotter and Gleser 1951).

The presence of secular trends in stature, maturation and shape and their direction, if any, has been questioned by various researches. Recent studies have indicated a slowdown or cessation, and even a possible reversal of the generally observed positive trend (Bakwin and Laughlin 1964; Bock and Sykes 1989; Cameron 1976; Malina et al. 1983; Malina et al. 1987; Tobias and Netscher 1977). Although stature displays what in general may be described as a gradual increase, several studies have identified negative trends in adult stature (Ganguly 1979; Tobias 1985). Similar findings have been presented for maturation (Richter and Kern 1987), and head form (Roche et al. 1986). This suggests that the secular phenomenon is not unidirectional and may be a reflection of the effect of different environments on the ability of an organism to achieve the full genetic potential for the particular dimension under investigation.

A number of anthropometric investigations of secular changes in cranial form include studies of morphological variation between immigrants to the United States and their children. These studies have demonstrated noticeable temporal changes. Among U.S. born children of European descent, the most notable change was a narrower head and face (Boas 1940). Immigrant children born in Japan but reared in the United States were characterized by a narrowing of the cranial vault and face and smaller nasal aperture relative to same generation Japanese reared in Japan (Ito 1942). A similar study by Shapiro (1939) suggested that migrant populations were not random samples of their parent populations but represented evidence of physical selection, an observation supported by other investigators (Boas 1912; Eveleth and Tanner 1976; Kobliansky and Arensburg 1977; MacBeth and Boyce 1987).

It is difficult to conclude what the specific causes of the secular effect may be. However, it is not unreasonable to assume that a combination of environmental and genetic influences regulate secular changes. In addition, it has been suggested that environmental influences must precede ages eight to ten years to influence the development of adult cranial vault size. Adult dimensions are closely approximated by that age (Goldstein 1943; Hackett 1984). However, due to slower growth of the facial skeleton, it has been suggested that environmental influences may continue to operate during adolescence (Baer and Harris 1969; Tanner 1962). Environmental influence this late in youths has been rejected by others (Goldstein 1936). Alternative explanations include genetically determined differences in hormone secretion during the late foetal period. The indirect effect that hormone secretion may have on regulating adult size and shape of the cranium is due to the influences that the former may have on the rate and timing of maturation (Tanner 1972).

Craniometric Variation and Secular Trends

The study of population differences in craniometric variation has been widely explored in the context of skeletal biological research. Early studies of cranial variation, (eg. Schwarz 1862), were defined primarily by anecdotal assessment of morphological characteristics for purposes of classification. With the development of the techniques of biometry and statistical analyses such as Pearson's Coefficient of Racial Likeness (Pearson 1926; 1928), the application of cranial measurements to quantify biological distance relationships between different populations was widely practiced. Questions regarding population affinities in historic and prehistoric cranial series were addressed within local and regional frameworks (Bennington 1912 ; von Bonin 1931a; 1931b; Hooke 1926; Hooke and Morant 1926; Kitson 1931; MacDonnell 1904; 1906; Morant 1926; 1928; 1931a; 1931b; Stoessiger and Morant 1932 Reid and Morant 1928; Trevor 1949; Woo and Morant 1932; Young 1931).

A more recent shift in craniometric research addresses the more specific question of morphometric change in human populations. Periodic cranial changes have been documented in studies of prehistoric and historic cranial series from Europe (Hooke and Morant 1926; Morant 1926; 1931a; Stoessiger and Morant 1932), North America (Hrdlicka 1925; Jantz 1972; 1973; 1974; 1977; Key 1983; Shapiro 1930), Africa (De Villiers 1968; Huizinga et al. 1967; Knipp 1970; Talbot and Mulhall 1962; Tobias 1959a; 1959b; Trevor 1949), and Asia (Harrower 1928; Woo and Morant 1932). In Europe, changes in size and shape reflecting a gracilization of crania of a largely homogeneous population appear to precede a later decrease in cranial size from the Mesolithic to more recent time (Henke 1981; Henneberg 1988; Sokal et al. 1987). Others have documented temporal trends in cranial shape during the past two millennia which are characterized by shorter, broader and lower crania with shorter facial height (Bass 1964; Bielicki and Welon 1964; Jantz 1977; Jantz and

Willey 1983; Rösing and Schwidetzky 1977; 1981; Schwidetzky and Rösing 1975; 1984; Sokal and Uytterschaut 1987; Stewart 1940). However, most recent trends in populations of Africa, Europe and Asia indicate a return towards a narrowing of the vault relative to its length, although the direction of other lesser changes is not as uniformly documented (Billy 1980; Huizinga et al. 1967; Huizinga and Slob 1965; Kanda 1978; Olivier et al. 1979; Sokal and Uytterschaut 1987).

More strictly defined generational, or secular, change observed within most recent populations during the past two centuries indicate that cranial size and shape remains plastic. In a limited sample of U.S. Afro-American crania extending the period from 1675 to ca. 1970, documented secular changes include general increase in size, lower vault height and a higher narrower face (Angel 1976). In a sample of Euro-American crania from the same period, secular changes are characterized by a greater vault height, a shorter, narrower face and a broader palate (Angel 1976). In a later study of portions of these series, evidence of slight increases in height, breadth and length of the vault and height of the cranial base was noted (Angel 1982).

Recently, investigations into the differences between Afro-American crania of earlier anatomical and recent forensic specimens noted an increase in cranial height and length of the cranial base, and a narrowing of the face and interorbital breadth. Evidence of a broader palate and longer mastoids is also shown. A similar comparison of Euro-American anatomical collection specimens and recent forensic crania show an increase in cranial length, height and length of the base, along with a general narrowing of the vault and face, a broadening of the palate, an increase in facial height, nasal breadth and a decrease in interorbital breadth (Jantz and Moore-Jansen 1988a). These findings indicate that secular change has occurred in cranial size and shape during the past century and that earlier anatomical series are not representative of contemporary populations. Analogous results are found in cephalometric investigations of parent-offspring similarities using radiographs of individuals born between 1910 and 1920, based on comparisons of these to those of their children born between 1940 and 1950 (Smith et al. 1986). The investigation by Smith and co-workers examined the direction and amount of change observed in three dimensions including craniofacial depth, breadth, and height. An increase in facial depth and height was observed in contrast to a decrease in breadth of the face and vault.

The observed temporal trends of cranial form is evidence of the plasticity of the human phenotype within a complex and incompletely understood framework of genetic and environmental influences. However, recent multivariate studies of structural patterns of craniometric variation may contribute to the understanding of specific sources of variation (Brown 1973; Heathcote 1986; Howells 1973; Howells and Schwidetzky 1981; Jantz 1972; 1973. 1977; Key 1983; Pietrusewsky 1984; Ubelaker and Jantz 1986).

The environmental effects of improved health, hygiene, diet and improved social conditions, along with strong genetic influences, admixture, heterosis and selection have been proposed to explain temporal change (Angel 1976; 1982; Billy 1980; Bielicki and Welon 1964; Boas 1912; Haley and Elwood 1986; Richardson and Malhotra 1974; Susanne and Sharma 1978). Climatic adaptation, though correlated with cranial shape, is considered less likely to explain recent secular changes, at least for groups inhabiting same or similar environments (Beals 1972; 1983; Bielicki and Welon 1964; Van Vark et al. 1985).

The Effect of Age

An important effect on the general variation observed in the cranium is age related changes in size and shape. Following the expansion of the brain and the corresponding growth of the cranium, bone is added along the sutural margins to fill spaces between the individual cranial bones (Moss and Young 1960). With the joining and eventual closure of the sutures, normal growth terminates. Continued change is explained as a result of steady apposition and resorbtion of bone on the outer and inner tables of the cranium (Enlow 1968; Tallgren 1974). While the most notable change is the closure of the sutures, evidence of a symmetrical enlargement from younger to older age groups of both ectocranial and endocranial dimensions based largely on cephalometric observations has been documented (Baer 1956; Behrents 1985; Garn et al. 1967; Hrdlička 1938; Israel 1968; 1973; 1977; 1978; Macho 1986; Thompson and Kendrick 1964; Todd 1924). More recent investigations illustrate age changes in vault and face breadth and in orbital height and may provide the basis for renewed investigation into the question of the effect of age on cranial shape as well as on size (Moore-Jansen and Jantz 1989).

Specific cranial changes associated with age have been noted, particularly in the region of the nasion-bregma and bregma-lambda chords (Israel 1973), in the bizygomatic and maximum cranial dimensions and orbital height (Moore-Jansen and Jantz 1989). An initial increase followed by a decrease is observed in the facial height dimensions, while cranial height decreases with age (Macho 1987). A thickening of the cranium in the frontal region and at the position of lambda has also been demonstrated (Adeloye et al. 1975; Israel 1973; 1977; Todd 1924).

Investigations of both historic and prehistoric crania have addressed age-related changes in the cranium (Guagliardo 1982). Prehistoric materials from Indian Knoll suggest changes in additional dimensions such as cranial base length and basion-prosthion (Ruff 1980), although changes in the cranial base have been refuted elsewhere (Zuckerman 1955). It is worth pointing out that the observation of age-related changes in prehistoric material may be more difficult to distinguish from secular changes. By their nature, prehistoric skeletal series are frequently plagued by a confounding of cohorts and generations of one or more breeding populations (Cadien et al. 1974). Accordingly, morphometric change observed between age groups in prehistoric series may be complicated due to possible temporal variation, unless adjusted for age (Guagliardo 1982; Ruff 1980).

Discriminant Function Analysis of Crania in Medico-Legal Investigation

The determination of racial or ethnic affiliation is primarily assessed from morphological characteristics and measurements of the cranium (Angel 1982; Bass 1971; 1986; Brues 1958; n.d.; Comas 1960; Gill 1984; Glanville 1969; Hooton 1943; 1946; Krogman 1939; 1978; Post 1969; Saksena 1965; Schulter 1967a; 1967b; Schulter and Finnegan 1977; Stewart 1948; 1979; Todd 1929; 1930; Woo 1949). However, the use of cranial measurements and discriminant function analysis is also firmly established (Giles and Elliot 1962; Howells 1970; Jantz and Moore-Jansen 1988a).

The best known and most widely used forensic application of multivariate statistical analysis for the separation of groups by racial or ethnic affiliation was developed from Afro-American and Euro-American samples of cadaver collection specimens assembled during the early part of this century. Prehistoric materials from a single site, Indian Knoll in Kentucky, were used to represent the modern American Indian groups (Giles and Elliott 1962). The Giles and Elliot discriminant functions have been evaluated many times, and consistently high rates of misclassifications for American Indian test samples have been noted (Ayers et al. n.d.; Birkby 1966; Gill 1984; Snow et al. 1979). The failure of classification is considered a reflection of the homogenous nature of the Indian Knoll series. It is not representative of temporally more recent and geographically more varied American Indian groups. Good classification is noted for a lesser number of test cases of Afro-American and Euro-American groups (Snow et al. 1979) However, more recent studies of a much larger and regionally diverse forensic sample find less satisfactory results particularly with respect to Afro-American and American Indian samples (Ayers et al. n.d.).

In 1970, an alternative set of discriminant functions for the attribution of racial affiliation was presented in the literature. The main difference between these and other standards was in the choice of measurements and populations used (Howells 1970). The choice of measurements by Howells (1970) represented selection based on the discriminating ability of the individual measurements. However, the choice of an African rather than an Afro-American calibration sample contributed to inaccurate identifications. Recently, new alternative discriminant functions have been published for the identification of racial or ethnic affiliation (Jantz and Moore-Jansen 1988a). This study applied a contemporary forensic sample of geographically diverse nature for the calibration of discriminant functions.

The principle of multivariate analysis in human racial or ethnic affiliation is essential to skeletal identification in medico-legal investigation, whether it is by morphological assessment or by metric analysis. Both ways of assessment require skill and experience in technique and interpretation on the part of the observer. The visual observer must have a great deal of experience in assessing the infinite variability in skeletal morphology. Metric analysis requires an understanding of statistical analysis, measurement technique, and the skills of a visual observer to properly evaluate the numerical results (Bronowski and Long 1952).

Several questions must be addressed in the application of discriminant functions in skeletal identification. How robust is the technique, and what assumptions are associated with it? How are variables selected for adoption into specific models? How representative are the calibration samples of the population universe studied? How efficient are the models and is there an inherent bias in classification?

Multivariate cranial analysis by discriminant functions assesses individual measurements reflecting size and shape of the skull. It weighs each according to its contribution to the specific composition of the individual remains. The process is similar to that carried out by an experienced observer who assesses scores of traits and characteristics before reaching a final decision. But here the likeness ends. The multivariate numerical analysis of skeletal morphology provides an unbiased estimator of the biological profile of the individual (i.e., variables are weighted according to their independent contribution to discrimination) (Fatti 1986; Van Vark and Van der Sman 1982:22). This condition cannot possibly be satisfied by the morphological approach. In socalled "unbiased" discriminant function analysis, it is assumed that an individual test case belongs to one of the groups represented by the calibration sample from which a particular set of functions was derived. A discriminant function will always determine the position of an individual specimen in terms of the multivariate clusters defining each group included in the calibration data set. Even if an unknown specimen does not come from any of the groups represented in the analysis, it is still determined which one of those groups it most closely resembles in multivariate space. The potential problems of misidentification are readily apparent if specific assumptions are not met. But with skilled evaluation, the observer can adjust or refine visual impressions based on the result of a discriminant analysis.

The choice of variables is an important part of determining appropriate models for discriminant functions. It is well known that some variables are better discriminators of groups than are others. Cranial measurements, including cranial length, breadth, maximum frontal and bizygomatic breadth, nasal breadth and upper facial height are considered the most efficient variables for the separation of local populations (Howells 1970; Marcellino et al. 1978; Rightmire 1972). Cranial breadth dimension and particularly biauricular breadth of the cranial base have been found especially useful in the separation of populations (Howells 1966a; 1969; 1970). Statistical methods such as stepwise discriminant analysis may be used to customize optimal models for the separation of particular groups.

In studying fragmentary crania, morphological observation is sometimes at a disadvantage since few useful characteristics may be available for identification. Morphometric analysis, using standardized discriminant scores is likewise at a disadvantage since it may only be applied to those specimens which permit the recording of measurements required for a particular function. Alternatively, customized discriminant function may be developed to address the special needs of individual fragments (Jantz et al. 1988). It is only fair to say that the efficiency of discriminant functions may experience a decline depending on the nature and extent of the fragment. Variable selection is limited to include fewer measurements representing a smaller portion of the morphometric variation. Variables may also differ noticeably in their discriminating ability, when compared to more complete variable models.

Ultimately, the ability of discriminant functions to identify group association is reliable only to the degree that their calibration sample is representative of the population(s) studied. Choice of cranial samples large enough to calibrate useful discriminant functions appropriate for application to contemporary U.S. populations, as is necessary in forensic analysis, has always been difficult. The use of anatomical skeletal collections derived from cadavera obtained during the first part of this century and representing a population or a segment thereof born between 75 to 150 years ago, is not necessarily the best option. However, up until the present time, such collections have been essentially the only option. Other problems are incurred by using prehistoric skeletal series which antedate their modern counterparts by several millennia. Such problems include inherent temporal bias reflecting microevolutionary or secular changes which are ascribed to cultural change, genetic admixture, breakdown of social barriers, and improved nutritional conditions (Angel 1976; 1982; Birkby 1966; Jantz and Moore-Jansen 1984, 1988a; 1988b). Geographical bias incurred by the lack of broader regional representation in the available series is also evident (Birkby 1966; Gill 1984; Jantz and Moore-Jansen 1988b). Socioeconomic bias also exists in sample composition, favoring lower income groups and indigents (Cobb 1952; Trotter 1981). However, a bias in sampling toward lower socioeconomic groups is of less concern in human identification analysis since forensic cases are largely presented by individuals of this segment of the general population anyway (Jantz and Moore-Jansen 1988a; 1988b).

The question of sampling and choice of calibration series was recently addressed by members of the Physical Anthropology Section of the American Academy of Forensic Sciences. An effort to assemble a temporally and geographically representative calibration data set was initiated (Jantz and Moore-Jansen 1984; Moore-Jansen and Jantz 1986). A computerized data base containing standardized skeletal measurements and observations from documented contemporary skeletal remains was established at the University of Tennessee under the direction of Richard Jantz and me. The project was carried out with the cooperation and participation of practicing forensic anthropologists across the nation. The data base includes specimens of various racial or ethnic groups born in this century from nearly all states. The majority of specimens in the calibration sample are born since 1920. Socioeconomically, the samples used are appropriate for a representative calibration data set in forensic analysis. They are all or nearly all forensic cases themselves, and as such are not randomly selected. Accordingly, the strongly reflect what may be expected in a forensic specimen of recent origin.

III. SKELETAL SAMPLES EMPLOYED

Introduction

The primary objective of the data collection procedures was to obtain a large series of complete and undeformed adult crania. To appropriately address the specific questions raised in the present study, it was necessary to approximate a temporally and geographically varied collection of cranial data, including documented material from recent forensic cases, early anatomical specimens, and historic cemetery populations. Afro-American and Euro-American cranial data were collected for studies of temporal and spatial variation and comprise the majority of the sample. Additional data on native American Indian and Hispanic-American crania were collected for inclusion in the calibration samples used to calculate discriminant functions. The following is a brief description regarding the nature and content of the various sources and collections from which the present data set is drawn.

Hamann-Todd Collection

The crania from the Hamann-Todd collection represent the single largest comparative anatomical skeletal collection in the United States. This collection of skeletonized cadavers was initiated by Dr. Carl August Hamann during his tenure as Professor of Anatomy at Western Reserve University in Cleveland, Ohio. By the time Dr. Hamann's successor, Dr. Thomas Wingate Todd, assumed responsibility for the collection in 1912, it already included several hundred specimens (Thompson 1981). Todd maintained and expanded the collection until his death in 1938, at which time it included ca. 2600 skeletons (Cobb 1952; 1981). The accumulation of skeletons continued for some time after Todd's death, and today the collection consists of more than 3300 individuals (Lattimer, personal communication). The specimens are complemented by a detailed file, frequently including information pertaining to age, ethnic affinity, gender, date of birth and/or date of death. Place of birth, occupation and cause of death is also documented when known. Other materials include an anthropometric recording sheet, hair and skin samples and cadaver photographs.

In 1932, the contents of the collection were described as 82 percent male, with only 18 percent, or 385 females out of a total of 2139 skeletons. Approximately, two thirds of the males and only slightly more than one half of the females are Euro-American in origin. The remainder represented Afro-American, Asian-American, Mexican-American and American Indian groups (Cobb 1952).

According to published estimates, sixty percent of the Euro-American sample and one percent of the Afro-American sample are foreign born. This estimate is based on a sample of 723 Euro-Americans (52.6 percent) and 453 Afro-Americans (61 percent) for whom place of birth could be documented (Cobb 1952:795). After sorting his data into two age groups, i.e., an "older" and a "middle aged" group, Cobb suggested that the older age group represented an earlier wave of Scandinavian, British and German immigrants which peaked in 1880. A second wave of eastern central, eastern and southern European immigrants arriving up until the time of World War I is represented by the "middle aged" group (Cobb 1952:795).

Documenting place of birth for the native born Euro-Americans is difficult, although records indicate many were born in Ohio, New York and Pennsylvania. Native born Afro-Americans in the collection are largely migrants from the South who went north during World War I. The northward migration of southern Afro-Americans was partially in response to a recent labor shortage in northern urban areas. The reduction of the available work force was partly due to legislation restricting the influx of European immigrant workers (Dinnerstein and Reimers 1975;

Fogel 1986). The majority of the Afro-American sample comes from Georgia, Alabama, the Carolinas, Tennessee, Virginia, Kentucky, Mississippi and Arkansas (Cobb 1952).

All segments of the Todd collection can be said to be largely representative of a lower socioeconomic strata. This is relected in records indicating cause of death. The majority of specimens died of tuberculosis, pneumonia, alcoholism all of which causes are characteristic oflower socioeconomic groups (Cobb 1952:796).

Originally an entity of Western Reserve University (Case-Western Reserve) Department of Anatomy, the Hamann-Todd collection is currently housed at the Cleveland Museum of Natural History.

R. J. Terry Collection

The second largest anatomical skeletal collection in the United States was assembled by Dr. Robert James Terry during his tenure as department head of the Department of Anatomy at Washington University, St. Louis, Missouri. Dr. Terry began his collection in 1914 by accumulating the skeletons of dissecting room cadavers obtained from Washington University. He continued his collection until his retirement in 1941, at which point Dr. Mildred Trotter, aided by a gross anatomy technician by the name of Mr. Rhoades, assumed the primary responsibility for maintaining and adding to the collection (Cobb 1952).

By 1965, the Terry collection consisted of 1636 skeletons accompanied by records documenting gender, age, ethic affinity, cause of death, date of birth and/or death (Thompson 1981). For many specimens, additional records including cadaver photographs, anthropometric measurements and hair samples are available. Also present is a large collection of death masks made of plaster of Paris.

Due to the efforts of Dr. Trotter and her assistants, imbalances in the ethnic and gender composition of the collection were corrected by replacing and adding specimens (Trotter 1981). Socioeconomic representation is generally restricted to low income groups. Cause of death is attributed to diseases of poverty and exposure, such as pulmonary tuberculosis and alcoholism (Corruccini 1974). Little information was found pertaining to place of birth of many of the specimens. Intuitively, the collection appears to be largely native born, although several foreign born individuals were noted.

In the early to mid 1960's, the Anatomy Department at Washington University expressed an interest in disburdening itself of the collection. As a result, Drs. Trotter and T. Dale Stewart, the latter of the Smithsonian Institution, arranged a transfer of the collection to the

National Museum of Natural History at the Smithsonian Institution, where it is now on permanent loan (Trotter 1981).

Forensic Skeletal Collections and Historic Burials

Some of the data used in this study is compiled in a data base of Afro-American, Euro-American, Hispanic-American and native American Indian forensic cases and historic burials at the University of Tennessee's Anthropology Department. The data base was developed under the direction of Dr. Richard L. Jantz and is currently the responsibility of the author. All data are stored in a dBase format on an IBM PC.

The cranial data set assembled for the present study is an extension of the Forensic Data Bank in that it provides additional cranial measurements and observations than normally collected for the Forensic Data Bank project (Jantz and Moore-Jansen 1984; 1988a). The Forensic Data Bank includes a basic cranial record with additional data documenting age, gender and ethnic affinity, place and date of death, and birth. The data were obtained from various forensic laboratories including those at the Universities of Arizona, New Mexico, Tennessee, Georgia, Louisiana State University, The Smithsonian Institution, The San Diego Museum of Man, and the Oklahoma State and

New York State Medical Examiner's offices. A relatively large set of historic native American Indian cranial data was obtained from the Chicago Field Museum, The National Museum of Natural History, and The Army Medical Museum. These crania were originally assembled during the latter half of the nineteenth and early twentieth century by collectors and by army surgeons stationed in the Indian Territories during this period. First or second hand documentation regarding tribe, gender and other data pertaining to age and date of birth or death is often available. The material is primarily from the Plains and Basin areas but also includes a few Eastern and Southwest specimens.

The native American Indian material is currently under investigation by Drs. Douglas H. Ubelaker and Douglas W. Owsley, both of the Smithsonian Institution, and Dr. Richard L. Jantz of the University of Tennessee, who kindly provided additional skeletal observations to confirm any associated documentation on age, gender and tribal affiliation. Letters of documentation on the remains are currently housed at the Smithsonian Institution.

Snake Hill Cemetery at Fort Erie

The crania from this series are part of a larger skeletal sample from an early nineteenth century battlefield cemetery near Fort Erie, Ontario. The earthworks at Fort Erie represent a small military post on the Canadian side of the Niagara river across from the city of Buffalo, New York. Despite its size, Fort Erie played an important role in the latter part of the War of 1812 between the United States and Britain which ended with the signing of the Treaty of Ghent on December 24, 1814 (Coles 1965; Hitzman 1965; Mahon 1972; Smith 1985).

The skeletal material from Fort Erie consists of ca. 28 individuals and was recovered from the Snake Hill battlefield cemetery, associated with a small field hospital. All of the materials are presumed to represent casualties from the late summer campaign of 1814, and evidence of traumatic injury, gunshot wounds and amputations indicate that these were indeed battlefield victims (Karnei 1987). Historical artifacts including regimental uniform buttons and badges of rank identify several of the remains as those of militia men from upstate New York and Pennsylvania. The archaeological evidence is supported by historic documentation whic indicates that most of the military force at Fort Erie came from these two states (Hitzman 1965).

Although most of the remains were found to be of American militia men, it is possible that army regulars of unknown national origin may occur in the sample. Stray British, Polish, German and Spanish army regulars and mercenaries, or deserted Canadian militia, were all present in the Niagara Theater of the War (Thompson 1832), and might reasonably occur in the Snake Hill battlefield cemetery. Historical references to a "Colored" militia company in the Niagara Theater under the command of Captain Robert Runchey of the British army, and to Afro-American seamen and more than 900 Afro-American prisoners-of-war in Dartmoor Prison (Hitzman 1965:89) confirms the presence of Afro-American troops among the Fort Erie series. Historic documentation demonstrates the presence of seamen among the defensive forces at Fort Erie, although nothing is said regarding their ethnic affinity (Thompson 1832).

The Snake Hill battlefield cemetery was excavated during the winter of 1987/88 (Williamson 1988a; 1988b). All skeletal and dental materials were measured and recorded by the author during a brief visit to the Royal Ontario Museum in March 1988. The author was acting as part of a consulting team to the Armed Forces Institute of Pathology, Washington, D.C., led by Dr. Douglas W. Owsley of the Smithsonian Institution. The remains were returned to the United States during the summer of 1988 for reburial.

First African Baptist Church

The crania from this group represent a subset of 26 adult individuals from a partially disturbed nineteenth century cemetery population in Philadelphia, Pennsylvania. The site was re-discovered in 1980 during construction and was the subject of archaeological investigations in 1983 and 1984 (Parrington and Widener 1986). The material was analyzed and measured in part by Dr. Richard Jantz and the author prior to its return for re-interment.

The First African Baptist Church represents a religious establishment of first or second generation free Afro-Americans established in Philadelphia in 1809. Historical records point to a gradual abolition of Afro-American slaves in the Philadelphia area beginning in 1701. In 1780, the Afro-American segment of the population of Philadelphia was estimated at six thousand. The vast majority of this population were free (Parrington and Roberts 1984). The population represented here is actually one of two branches of a church which separated in 1816 and which relocated to the area of the present cemetery in 1822 or 1823 (Parrington and Widener 1986). In spite of available city health records for individuals interred in the cemetery, construction and development during the past 150 years have eliminated any trace of individual identification. From among more than 70 people documented, individuals of both African and American birth were noted. The interment of individuals continued from the early 1820's until sometime time during the early or mid 1840's. After 1841, the history of the cemetery is relatively unknown. The use of the cemetery as late as 1843 has been suggested (Rankin-Hill, personal communication). It was no longer associated with the church after 1848 (Parrington and Roberts 1984; Parrington and Widener 1986).

An investigation of the skeletal material to reconstruct the general health profile of the series was undertaken in 1986 and 1987 at the Smithsonian Museum under the direction of Dr. J. Lawrence Angel. This study yielded observations of a preponderance of males over females among the remains. Child or infant remains nearly equal the number of adult interments. Observations of pathological lesions were limited to a few cases of trauma and three incidences of tuberculosis. Malnutrition was indicated by dental hypoplasia, especially in females (Angel et al. 1987; Kelley n.d.). Stature estimates indicate that males of the Philadelphia series are taller than more recent Afro-American series, while females are shorter (Kelley n.d.). From these observations, it is suggested that infant mortality was relatively high in the Philadelphia population, thus implicating poor sanitary conditions and nutritional status. It is also possible that Philadelphia females underwent considerably greater exposure to stress and disease than did males, resulting in their smaller stature.

St. Peter and St. Louis No. 2 Cemeteries

A small number of crania were assembled from a larger sample of skeletal materials exhumed from two cemeteries figuring prominently in the history of New Orleans, Louisiana. The two cemeteries, St. Peter and St. Louis No. 2 were excavated in 1984 under the direction of Drs. Douglas W. Owsley of the Smithsonian Institution and Charles E. Orser of Louisiana State University in Baton Rouge, Louisiana. Of the 32 burials exhumed, 26 were adult and many were fragmentary (Owsley et al. 1985).

The St. Peter cemetery was probably in use during the period between 1720 and 1810. It includes interments of both Afro- and Euro-American origin, of which the former are assumed to be primarily slaves (Owsley et al. 1987). The St. Louis No. 2 cemetery was established in 1823 and continues to be in use (Owsley et al. 1985). The individuals included in the present analysis are thought to date from a period around 1805 (Owsley, personal communication).

A pattern of extensive arthritic degenerative disease was noted in the Afro-American material. This pattern indicates great physical stress. Several instances of anemic conditions and traumatic injuries and a high incidence of caries were also noted. These observations have been interpreted as reflecting conditions of hard physical labor and an inadequate and highly cariogenic diet (Owsley et al. 1987). In contrast to the small number of burials, a large amount of data on the interments was available from archival records. An interesting observation deduced from these records is a noticeably high mortality rate among young adult females (Owsley et al. 1985:164).

The sample sizes of all of the series described above are listed in Table 1. A more detailed discussion of the sample sizes and the craniometric methods is presented in the following section.

Table 1. Collections and sample by racial or ethnic affiliation.

Collection	Afro-American	Euro-American	American Indian	Hispanic-American	Total
Hamann-Todd	[illegible]	98	1	1	218
R. J. Terry	105	125	-	1	231
Forensic	28	115	10	24	177
Historic	7	4	138	-	149
Snake Hill	-	5	-	-	5
First African Bap.	26	-	-	-	26
St. Peter	4	1	-	-	5
St. Louis No. 2	1	-	-	-	1
	289	348	149	26	812

IV. THE DATA BASE

Introduction

Cranial data were collected for 872 individuals of different racial or ethnic affiliation, representing approximately two hundred years of U.S. history from ca. 1750 to 1970. To be included in the present study, crania had to be complete, undeformed, and of an adult individual of known racial or ethnic affiliation. Reasonably accurate information pertaining to the date of birth or death of the individual was also required. Exceptions to these requirements included crania from earlier historic series for which only morphological evidence was available. Accordingly, 60 crania of racial or ethnic affiliations other than Afro- or Euro-American, subadult status, or too fragmentary in nature, were excluded.

Crania were divided into four categories of racial or ethnic affiliation based on sociological definitions obtained from associated records: Afro-American, Euro-American, American Indian and Hispanic American. Each group was composed of individuals of both sexes with one exception. In the Hispanic-American group there were only enough males were available for analysis.

Individual Profile Data

Information on age, gender and racial or ethnic affiliation based on available medical, police or other records, were obtained from the Todd, Terry and forensic collections. Identification was documented for all individuals from these series based on soft tissue, by dental or skeletal x-ray, by fingerprint identification, or by associated medical records, death certificates and police records. Racial or ethnic affiliation, although sociologically based, was determined in the same manner.

Age was obtained from hospital or other records, including death certificates, driver licenses, personal identification cards, and county health records. However, in lieu of a recent renewal of the debate concerning the nature of the available age data for the Hamann-Todd collection (Katz and Suchey 1986), a selective measure for chosing individuals from this series was invoked. Only individuals for which ages were assessed by Dr. Todd himself, as either "Probably correct", "Undoubtedly correct", or "Certainly correct", were recorded (Jellema, personal communication).

Date and place of birth were recorded when available. However, more frequently than not, these data were absent. In these instances, year of death and age, both of which were always obtained, were used to calculate date of birth of an individual.

A different approach was taken in documenting the historical materials used. A total of 138 crania of American Indian, 38 Afro-American and 10 Euro-American origin were obtained from historic cemetery series or individual burials. All are associated with circumstantial information which is considered together with morphological assessments of age, gender and racial affiliation. Morphological standards for the skeletal identification of gender and racial affiliation (Bass 1971; Krogman 1939; 1978; Phenice 1969; Stewart 1979) were invoked when specific documentation was unavailable. Only specimens displaying complete dental eruption, a closed spheno-occipital synchondrosis, and fused epiphyses were used to assure that only adult individuals were included. It should be noted that the presence of a united spheno-occipital synchondrosis alone is not sufficient evidence to question recorded ages of less than seventeen years in more recent forensic specimens (Powell and Brodie 1963). Drs. Ubelaker and Owsley of the Smithsonian Institution in Washington, D.C., and Dr. Jantz at the University of Tennessee kindly provided me with cranial and postcranial assessments of age, gender and racial or ethnic affiliation for the majority of the historical materials.

Only in the case of the Fort Erie crania did I chose to adopt my personal observations of age, and even then the differences in measurements were minor and negligible. Drs. Ubelaker and Owsley, and Ms. Jennifer Kelley Olsen also provided me with historical documentation and descriptions of most of the historic crania along with their personal assessment of the identity of the individual specimens.

Since information pertaining to date of birth is unavailable for most of the historic crania, year of death was estimated from available records of death. These records include correspondence and newspaper clippings documenting events of burial, hangings, warfare and other episodes. In the case of the First African Baptist Church crania, individual dates of death could not be determined from the available information. Since the period of use is well documented, a mean date of interment was calculated and used in place of year of death. For materials used from the New Orleans cemeteries, Dr. Owsley kindly provided me with a "best estimate" for the interment of the individuals used from this series. Date of birth was then estimated by subtracting age from year of death.

The inaccuracies incurred from these estimates are considered to be of little consequence to the present study. Differences in the year of birth of the earliest segment represented by these three groups may conceivably vary between five to 10 years. However, under no circumstances will this have an effect on comparisons with later and better documented series.

Tables 2 through 9 provide a detailed demographic profile of the samples drawn from each of the cranial series discussed in the previous section. The tables show samples sizes by racial or ethnic affiliation, means, standard deviations and ranges for age, year of birth and death. A complete list of specimens and individual profile data is included in Appendix A. Information pertaining to collections association, gender, racial or ethnic affiliation, age, year of death and place of birth and death is included to the extent it could be determined from available information or observations.

Craniometric Measurements and Protocol

Sixty-five measurements were recorded for each of the 812 crania used in the present study. The measurements, angles, variable code names and instruments used are presented in Table 10. The definitions and protocol used for recording are those developed by Howells (1966a; 1973) and Key (1983). An abbreviated description of individual measurements is presented in Appendix B.

Table 2. Demographic profile of cranial sample from the Hamann-Todd collection. Sample size, means, standard deviations and ranges for age, year of birth and death, by racial or ethnic affiliation and gender, (n = 216)

	Afro-American		Euro-American	
	Females	Males	Females	Males
Sample Size:				
Number	72	46	61	37
Age:				
Mean	36.97	35.11	43.46	45.14
Standard deviation	13.02	12.15	10.51	16.65
Range	17-87	18-73	23-67	28-77
Date of Birth:				
Mean	1890.07	1886.91	1883.82	1877.11
Standard deviation	13.36	12.22	11.24	10.8
Range	1835-1920	1853-1906	1856-1911	1846-1898
Date of Death:				
Mean	1927.04	1922.02	1927.3	1922.24
Standard deviation	5.17	3.66	5.19	3.58
Range	1919-1938	1919-1936	1919-1931	1919-1936

Table 3. Demographic profile of cranial sample from the R. J. Terry collection. Sample size, means, standard deviations and ranges for age, year of birth and death, by racial or ethnic affiliation and gender, (n = 230).

	Afro-American		Euro-American	
	Females	Males	Females	Males
Sample Size:				
Number	40	65	50	75
Age:				
Mean	46.5	46.14	55.84	55.41
Standard deviation	18.79	18.83	14.45	16.65
Range	18-85	17-86	27-91	19-87
Date of Birth:				
Mean	1893.55	1886.94	1898.64	1879.67
Standard deviation	17.8	20.37	16.85	24.46
Range	1861-1934	1848-1929	1861-1933	1843-1943
Date of Death:				
Mean	1940.05	1933.08	1954.48	1935.08
Standard deviation	9.82	7.99	9.2	10.95
Range	1924-1962	1926-1963	1931-1965	1922-1966

Table 4. Demographic profile of cranial sample from most recent forensic skeletal collections. Sample size, means, standard deviations and ranges for age, year of birth and death, by racial or ethnic affiliation and gender, (n = 143).

	Afro-American		Euro-American	
	Females	Males	Females	Males
Sample Size:				
Number	16	12	38	77
Age:				
Mean	36.22	48.29	32.78	43.01
Standard deviation	18.4	19.26	16.5	16.26
Range	18-80	26-74	16-75	17-73
Date of Birth:				
Mean	1945.78	1931.54	1947.38	1937.32
Standard deviation	16.94	17.4	16.21	16.72
Range	1901-1959	1905-1960	1907-1967	1904-1963
Date of Death:				
Mean	1982.00	1979.83	1980.16	1980.32
Standard deviation	4.52	5.84	4.28	4.6
Range	1973-1987	1969-1988	1972-1988	1964-1988

Table 5. Demographic profile of cranial sample of native American Indian skeletal collections. Sample size, means, standard deviations and ranges for age, year of birth and death, by racial or ethnic affiliation and gender, (n = 149).

	Historic		Forensic	
	Females	Males	Females	Males
Sample Size:				
Number	70	68	2	9
Age:				
Mean	32.81	33.79	26.00	39.22
Standard deviation	10.35	9.46	5.66	7.89
Range	17-62	19-63	22-30	28-50
Date of Birth:				
Mean	1860.83	1850.53	1953.5	1937.00
Standard deviation	22.91	18.55	2.12	9.39
Range	1763-1916	1804-1892	1952-1955	1926-1954
Date of Death:				
Mean	1893.64	1884.32	1979.50	1976.22
Standard deviation	21.14	18.69	3.54	4.6
Range	1800-1975	1846-1937	1977-1982	1966-1982

Table 6. Demographic profile of cranial sample from Hispanic-American skeletal collections. Sample size, means, standard deviations and ranges for age, year of birth and death, by racial or ethnic affiliation and gender, (n = 26).

	Forensic	
	Females	Males
Sample Size:		
Number	2	[illegible]
Age:		
Mean	47.5	34.71
Standard deviation	41.72	[illegible]
Range	18-77	17-71
Date of Birth:		
Mean	1929.00	1935.46
Standard deviation	38.[illegible]	28.15
Range	1902-1956	1844-1966
Date of Death:		
Mean	1976.5	1969.7
Standard deviation	35.35	26.22
Range	1974-1979	1866-1986

Table 7. Demographic profile of cranial sample from various individual historic burials. Sample size, means, standard deviations and ranges for age, year of birth and death, by racial or ethnic affiliation and gender, (n = 11).

	Afro-American		Euro-American	
	Females	Males	Females	Males
Sample Size:				
Number	2	5	0	4
Age:				
Mean	51.00	33.6	-	32.25
Standard deviation	15.56	12.37	-	7.03
Range	40-62	25-52	-	26-42
Date of Birth:				
Mean	1859.00	1856.2	-	1838.00
Standard deviation	1.41	23.09	-	19.40
Range	1858-1850	1838-1892	-	1812-1855
Date of Death:				
Mean	1910.00	1889.8	-	1870.25
Standard deviation	14.14	25.33	-	[illegible]
Range	1900-1920	1863-1918	-	1855-1885

Table 8. Demographic profile of cranial sample from the First African Baptist Church, (n = 26), and Fort Erie, (n = 5) cemeteries. Sample size, means, standard deviations and ranges for age, year of birth and death, by racial or ethnic affiliation and gender.

	First African Baptist Afro-American		Ft. Erie Euro-American	
	Females	Males	Females	Males
Sample Size:				
Number	15	11	0	5
Age:				
Mean	32.93	44.55	-	22.7
Standard deviation	11.46	11.81	-	5.72
Range	19-58	19-58	-	17-32
Date of Birth:				
Mean	1799.07	1787.45	-	1791.3
Standard deviation	11.46	11.81	-	5.72
Range	1774-1813	1774-1813	-	1781-1796
Date of Death:				
Mean	1832.00	1832.00	-	1814.00
Standard deviation	-	-	-	-
Range	1821-1843	1821-1843	-	-

Table 9. Demographic profile of cranial sample from the St. Peter and St. Louis 2 cemeteries, New Orleans. Sample size, means, standard deviations and ranges for age, year of birth and death, by racial or ethnic affiliation and gender, (n = 6).

	Afro-American		Euro-American	
	Females	Males	Females	Males
Sample Size:				
Number	3	2	0	1
Age:				
Mean	32.67	48.25	-	42.00
Standard deviation	17.21	8.84	-	-
Range	19-52	42-54	-	-
Date of Birth:				
Mean	1781.67	1756.75	-	1863.00
Standard deviation	4.04	8.84	-	-
Range	1778-1786	1750-1763	-	-
Date of Death:				
Mean	1814.33	1805.00	-	1805.00
Standard deviation	16.17	-	-	-
Range	1805-1833	-	-	-

Table 10. Cranial measurements and variable code names, instruments and programs for calculating variables.

Measurement	code	Instrument/Program used to calculate	Measurement	code	Instrument/Program used to calculate
Glabella-Occipital Length	GOL	Spreading Calipers	Nasion-Bregma Fraction	FRF	Co-ordinate Calipers
Nasion-Occipital Length	NOL	Spreading Calipers	Bregma-Lambda Chord	PAC	Co-ordinate Calipers
Basion-Nasion Length	BNL	Spreading Calipers	Bregma-Lambda Subtense	PAS	Co-ordinate Calipers
Basion-Bregma Height	BBH	Spreading Calipers	Bregma-Lambda Fraction	PAF	Co-ordinate Calipers
Maximum Cranial Breadth	XCB	Spreading Calipers	Lambda-Opisthion Chord	OCC	Co-ordinate Calipers
Maximum Frontal Breadth	XFB	Spreading Calipers	Lambda Opisthion Subtense	OCS	Co-ordinate Calipers
Minimum Frontal Breadth	WFB	Sliding Calipers	Lambda-Opisthion Fraction	OCF	Co-ordinate Calipers
Bizygomatic Breadth	ZYB	Sliding Calipers	Foramen Magnum Length	FOL	Sliding or Co-ordinate
Biauricular Breadth	AUB	Sliding Calipers	Foramen Magnum Breadth	FOB	Sliding or Co-ordinate
Minimum Cranial Breadth	WCB	Sliding Calipers	Nasion Radius	NAR	Radiometer
Biasterionic Breadth	ASB	Sliding Calipers	Subspinale Radius	SSR	Radiometer
Basion-Prosthion Length	BPL	Sliding Calipers	Prosthion Radius	PRR	Radiometer
Nasion-Prosthion Height	NPH	Sliding Calipers	Dacryon Radius	DKR	Radiometer
Nasal Height	NLH	Sliding Calipers	Zygo-orbitale radius	ZOR	Radiometer
Bijugular Breadth	JUB	Sliding Calipers	Frontomalare Radius	FMR	Radiometer
Nasal Breadth	NLB	Sliding Calipers	Ectoconchion Radius	EKR	Radiometer
External Palatal Breadth	MAB	Sliding Calipers	Zygomaxillare Radius	ZMR	Radiometer
External Alveolar Length	MAL	Sliding Calipers	M1 Alveolus Radius	AVR	Radiometer
Mastoid Height	MDH	Sliding Calipers	Bregma Radius	BRR	Radiometer
Mastoid Breadth	MDB	Sliding Calipers	Vertex Radius	VRR	Radiometer
Orbital Height	OBH	Dial Calipers	Lambda Radius	LAR	Radiometer
Orbital Breadth	OBB	Dial Calipers	Opisthion Radius	OSR	Radiometer
Interorbital Breadth	DKB	Dial Calipers	Basion Radius	BAR	Radiometer
Naso-Dacryal Subtense	NDS	Dial Calipers	Nasion Angle (ba-pr)	NAA	INDIAN
Simotic Chord	WNB	Dial Calipers	Prosthion Angle (ba-na)	PRA	INDIAN
Simotic Subtense	SIS	Dial Calipers	Basion Angle (na-pr)	BAA	INDIAN
Bimaxillary Breadth	ZMB	Co-ordinate Calipers	Nasion Angle (ba-br)	NBA	INDIAN
Zygomaxillary Subtense	SSS	Co-ordinate Calipers	Basion Angle (na-br)	BBA	INDIAN
Bifrontal Breadth	FMB	Co-ordinate Calipers	Zygomaxillare Angle	SSA	INDIAN
Naso-Frontal Subtense	NAS	Co-ordinate Calipers	Naso-Frontal Angle	NFA	INDIAN
Biorbital Breadth	EKB	Co-ordinate Calipers	Dacryal Angle	DKA	INDIAN
Dacryon Subtense	DKS	Co-ordinate Calipers	Naso-Dacryal Angle	NDA	INDIAN
Inferior Malar length	IML	Co-ordinate Calipers	Simotic Angle	SIA	INDIAN
Maximum Malar Length	XML	Co-ordinate Calipers	Frontal Angle	FRA	INDIAN
Malar Subtense	MLS	Co-ordinate Calipers	Parietal Angle	PAA	INDIAN
Cheek Height	WMH	Co-ordinate Calipers	Occipital Angle	OCA	INDIAN
Supraorbital Projection	SOS	Co-ordinate Calipers	Bistephanic Angle	STA	INDIAN
Glabella Projection	GLS	Co-ordinate Calipers	Cranial Base Angle	CBA	INDIAN
Bistephanic Breadth	STB	Co-ordinate Calipers	Posterior Base Angle*	OPA	FLEX
Stephanic Subtense	STS	Co-ordinate Calipers	Anterior Base Angle*	BOA	FLEX
Nasion-Bregma Chord	FRC	Co-ordinate Calipers	Cranial Base Flexion Angle*	CFA	FLEX
Nasion-Bregma Subtense	FRS	Co-ordinate Calipers			

The instruments used include spreading, sliding, co-ordinate calipers, dial calipers with a special attachment for reading subtenses, and a radiometer. All measurements were recorded to the nearest millimeter, except simotic chord and simotic subtense which were measured to the nearest tenth of a millimeter.

Eighteen angular dimensions were calculated to the nearest degree using a Clipper program "INDIAN", written by Dr. Patrick Key of Key Co., Inc., and a Basic program "FLEX" written by me with the assistance of Dr. Jantz.

A recording form suited to the specialized needs of the present study was designed by me for the gathering of craniometric data (Appendix C). The form includes all variables observed directly on the cranium. In addition, other measurements on the cranium and mandible not used in the present study were recorded. A corresponding dBase III Plus (Ashton-Tate 1986) program for data input, written by the author, was used to computerize and manage the data set on an IBM PC. The data were transferred onto to the Vax cluster at the University of Tennessee Computing Center, using Procomm and an Evercom 2400 baud internal modem. The data were printed using the "PRINT" procedure in SAS (SAS Institute, Inc. 1985) and hand checked against the original recording forms. Summary statistics were also calculated in order to find obvious typographical errors in the data set.

Inter-Observer Error

Of the 812 crania recorded for this investigation, 250 were measured by Dr. Richard L. Jantz of the University of Tennessee. Dr. David R. Hunt and I measured 436 crania jointly, and I measured 126 crania alone. No attempt was made to test for inter-observer error, although I was able to check the measurements of Dr. Hunt and myself against those of Dr. Jantz on seven separate occasions when we measured the same specimen. With one exception, the comparison did not yield inconsistencies in the measurement techniques used. In the first part of the study, an inconsistency in the technique for measuring bijugal breadth was noted between Dr. Hunt and me. As a result, all specimens recorded prior to the discovery of the inconsistency were re-measured. I also spent time at the initial stages of the study remeasuring crania, previously measured by Dr. Jantz, so that I could adjust any differences in my technique to fit that of Dr. Jantz. As I am also the recorder of most of the crania measured by Dr. Jantz and used in this study, I have had several years of experience observing and registering his technique.

Estimation of Missing Values

Since multivariate procedures such as those used in the following analysis require that all observations be present for each individual specimen, it was necessary to select only complete crania. However, due to common occurrences of breakage in exhumed materials and bone resorption, which is typical of middle and older age groups in any of the series, certain measurements were sometimes not obtainable directly from the cranium. Rather than discarding such specimens, missing values were estimated using a FORTRAN program "ESTIMATE" written by Dr. Patrick Key and modified by me to meet the specific needs of this study. The program, as it was used here, estimates the missing data points "according to an individual data vector within the context a variance-covariance structure" (Key 1983:44) for temporally defined groups in series of ten year intervals. Thus several subsets of the overall sample are estimated separately, by gender and racial or ethnic affiliation. Less than one tenth of one percent of the entire sample was estimated for a maximum of 14 variables. Ca. 30 percent of the crania with missing values called for the estimation of a single variable. Approximately 80 percent called for the estimation of 10 or less variables. M1 Alveolar Radius (AVR) was the single most commonly estimated variable.

The next most commonly estimated variables were dimensions which include the anatomical landmark Prosthion.

V. ANALYTICAL PROCEDURES

Introduction

The purposes of the statistical analysis are: 1) determine if temporal effects on craniometric variation in size and shape (cf. secular changes) occur in two cranial series of Afro-American and Euro-Americans and to describe any specific changes in individual cranial variables, ; 2) to test the homogeneity of craniometric samples from the two largest anatomical series in the United States, the Hamann-Todd and R.J. Terry collections and to describe potential differences of individual cranial variables in the two series; and 3) to compute multivariate statistical models for the identification of racial or ethnic affiliation from crania of recent origin, using a calibration sample appropriate to the extent possible for temporal and geographic association.

This analysis is concerned with the effect of five variables on cranialcranial sizeand shape. These variables are ethnic affiliation, gender, collection association, date of birth, and age at time of death. The problem of separating the age effect in this type of analysis has been previously discussed and is not considered in this analysis. Multivariate statistical testing of the four remaining effects is carried out by multivariate analysis of variance (MANOVA) and multivariate analysis of co-variance (MANACOVA). Individual variables are described in terms of canonical correlation. Multivariate models for the identification of racial or ethnic affiliation in crania are addressed via discriminant function analysis.

Summary Statistics

Means and standard deviations and sample sizes for all craniometric variables are calculated using the PROC MEANS procedure of the Statistical Analysis System (SAS) package (SAS Institute, Inc. 1985). These statistics are computed for each of the Afro-American and Euro-American samples of the two cadaver collections and for seven "recent" calibration samples of Afro-American, Euro-American, American Indian and Hispanic-American affiliation.

Multivariate Analysis of Variance

Multivariate analysis of variance, MANOVA, is used to explore the relationship between one or more of the independent classification variables (i.e. racial or ethnic affiliation, gender and collection association), and the dependent cranial variables. MANOVA examines the simultaneous effect of the independent variable(s) on all of the dependent variables and evaluates the relationship between groups in terms the homogeneity of their respective mean vectors. The calculations are based sum of squares and cross-product matrices (SSCP). A multivariate test statistic, Wilks' Lambda, is calculated to test the significance for the main effects and interaction effect. The Wilks' Lambda is a ratio of the determinant of the SSCP error matrix of the effect being tested over the sum of the determinant of the corresponding SSCP hypothesis and the SSCP error matrices (Tatsuoka 1971). Accordingly, Wilks' Lambda is a measure of differentiation among groups, the probability of which is tested by the F test of significance. A decrease in the Wilks' Lambda is contrasted by an increase in the F value which in turn is indicative of improved statistical significance.

The main effects and their interaction are tested for significance of the craniometric homogeneity between groups. The interaction term tests the hypothesis that variance-covariance matrices are equal among groups defined by the main effects. The absence of heterogeneity of the variance-covariance matrices (cf. interaction) justifies pooling of groups and simplifies further analysis. The model is rerun without the interaction term to illustrate the effect of each of the independent variables. Degrees of freedom are improved accordingly.

A significant interaction term is equivalent to rejecting the null hypothesis of equal variance covariance matrices. In this instance, it may be concluded that groups behave differently in the magnitude and/or direction of the observed variability for the effects tested.

The PROC GLM procedure of the SAS package (SAS Institute, Inc. 1985) is employed to compute the MANOVAs. A MANOVA was computed for the main effects of racial or ethnic affiliation (RACE) and gender (SEX) and their interaction term (RACE*SEX). This was done to shed light on the importance of maintaining separation of the groups in further analysis. A second MANOVA was computed for the effects of collection association (CUR), gender (SEX) and their interaction term (CUR*SEX). This test was carried out separately on groups of Afro-American and Euro-American crania to examine the homogeneity of male and female samples from the Hamann-Todd and R. J. Terry collections.

Multivariate Analysis of Covariance

The special problem of determining the existence and direction of a secular effect in the Afro-American and Euro-American cranial series is addressed by multivariate analysis of covariance technique. MANACOVA is an extension of regression analysis and analysis of variance.

MANACOVA adjusts the quantitative dependent variables for differences in the covariate so that the relationship between the independent class variable and the adjusted values of the dependent quantitative variables may be examined (Wildt and Ahtola 1978). Thus, MANACOVA defines the amount of variability in the dependent variables which is explained by the independent variable and its covariate.

First, it is necessary to determine a presence or absence of interaction between the class variable and the covariate. Interaction implies inequality of slopes, and in this instance canonical correlation is used to examine groups separately. If, on the other hand, no interaction is indicated, the null hypothesis of homogeneity of the slopes defining the variance-covariance matrices of the classes cannot be rejected. It may be assumed that classes may be analyzed together. The multivariate test statistic Wilks' Lambda and an associated F test is used to illustrate group differences and test the significance of the relationships of the dependent variables and each term in the model.

In order to elucidate the relationship between a matching set of continuous cranial variables and a class variable, such as gender, in terms of a continuous covariate, such as year of birth, one must first test the homogeneity of slopes between groups. In order to determine if there is significant interaction between the class variable and the continuous covariate, the interaction vector is again tested for significance. If significant, it is concluded that the slopes defining the classes within the class variable are not parallel and the null hypotheses of homogeneity is rejected. The amount of the variance accounted for by the term is indicated by R^2 and is tested by F or Wilks' Lambda. If the interaction term is significant, it is concluded that direction of change in cranial size and shape through time, varies between sexes.

When interaction is noted, MANACOVA is no longer appropriate as a means to study patterns of variation between groups. Other more appropriate measures are taken to study the pattern of variation. These measures include the application of separate canonical correlation analysis using the "PROC CANCORR" procedure (SAS Institute, Inc. 1985). The canonical correlations indicate if significant temporal and sexually dimorphic patterns of variation are present and assess group relationships along these patterns. The magnitude and direction of changes is assessed according to the relative size and sign of the correlation coefficients on the canonical variable.

Discriminant Analysis

Discriminant analysis examines the relationship between several continuous variables and a single class variable, and produces linear combinations of the variables in the model which best discriminates between groups. Linear combinations are composed of variables selected for the maximum discrimination of populations. The method of selection was done using the "PROC STEPWISE" procedure (SAS Institute, Inc. 1985). Stepwise regression is an exploratory technique of multivariate regression which permits the identification of the optimum model of continuous variables for separating groups. The "MAXR" procedure is used to determine the best single variable model, two variable model, etc. to achieve the best model for discrimination. The full 80 variable data set, a reduced data set without angles, subtenses and fractions, and a smaller data set representing measurements employed in the skeletal data bank were used. Discriminant functions were calculated for all three data sets.

The "PROC DISCRIM" procedure (SAS Institute, Inc. 1985) is used to extract a linear combination of the continuous cranial variables that provides optimum discrimination between groups of racial or ethnic affiliation. The procedure allows a test of homoscedasticity and classifies each specimen in the group from which it has the lowest generalized squared distance (SAS Institute, Inc. 1985). In cases of homoscedasticity, group means are tested using the Mahalanobis generalized distance measure. Mahalanobis distances and p-values provide an illustration of the discriminating ability of the particular variable model between reference populations (Fatti 1986). The efficiency of the linear discriminant function is tested and probabilities of misclassification are estimated.

Canonical correlation using the "PROC CANDISC" procedure (SAS Institute, Inc. 1985) is used to derive linear combinations of the craniometric variables, summarizing the within group variation between major collections (Cooley and Lohnes 1966). The resulting canonical variables are tested for overall difference and significance with Wilks' Lambda and an F statistic. Statistically significant canonical variables are examined and interpreted for a more detailed understanding of the relative contribution of the individual variables on the canonical vector. Correlation coefficients or loadings are interpreted with according to their magnitude, and the direction of their relationship is defined by the positive or negative sign. Results of the relationships among groups are plotted to provide visual presentation of the results.

VI. SECULAR TRENDS

The present section presents the results of the analysis into the secular variation in Afro-American and Euro-American female and male crania which have occurred during the past 200 years. A discussion of the findings addresses the question of both temporal among-group cranial variation in racial or ethnic groups, and within-groups patterns of sexual dimorphism. A sample of 289 Afro-American and 348 female and male crania dating from ca. 1750 to the present, and obtained from various skeletal collections, provides the basis for the present analysis. The elucidation of significant secular trends during this period can provide valuable documentation of why craniometric analysis of recent forensic cases, using discriminant function analysis, may result in incorrect identifications when using older populations for calibration.

The Homogeneity of Racial or Ethnic Groups

The first question that arises concerns the effect of group on craniometric variation. If it can be shown that groups of different racial or ethnic affiliation display similar patterns of cranial variation, a case may be made for using a pooled multigroup sample in further investigation of secular trends. A multivariate analysis of covariance was carried out to test the homogeneity of the covariance matrices of the two groups of Afro-American and Euro-American cranial series.

Results of a preliminary study suggested that patterns of variation due to racial or ethnic affiliation do not concur with those associated with gender. Therefore, analyses were done separately for female and male crania. The model tests the null hypothesis of no canonical correlation for interaction between the main effect of racial or ethnic affiliation (RACE) and the covariate time (DOB). The results of the model (RACE*DOB) for multigroup female and male cranial samples are in Tables 11 and 12. An examination of the results of the female crania in Table 11 shows that the interaction term accounts for approximately 52 percent of the variation along the canonical variable (R_c = .5176). The multivariate test statistic Wilks' Lambda of .48 is highly significant (F = 2.87, p = .0001).

The analysis of the male crania in Table 12 follows the same pattern observed among the female groups. For males, the interaction term accounts for approximately 43 percent of the variation along the canonical variable (R_c = .4316). With a Wilks' Lambda of 0.56 (F = 2.43, p = .0001), male crania similarly exhibit unequal slopes among groups. From these results, it is concluded that the

Table 11. MANACOVA test of interaction, racial or ethnic affiliation (RACE), gender (SEX) and their covariate, year of birth (DOB), in Afro-American and Euro-American female crania from 1750-1970, (n = 297).

Model	Canonical Correlation	Squared Canonical Correlation	Standard Error	Eigen Value	Wilks' Criterion	F Ratio	PR > F
DOB*RACE	0.719457	0.517619	0.028133	1.0730	0.48238130	2.87	0.0001

Table 12. MANOVA test of interaction, racial or ethnic affiliation (RACE), gender and their covariate, year of birth (DOB), in Afro-American and Euro-American male crania from 1750-1970, (n = 340).

Model	Canonical Correlation	Squared Canonical Correlation	Standard Error	Eigen Value	Wilks' Criterion	F Ratio	PR > F
DOB*RACE	0.657032	0.431691	0.031004	0.7596	0.56830946	2.43	0.0001

trends between the two groups do not coincide and that the application of pooled racial or ethnic groups is unwarranted in further analysis. Therefore, crania of Afro-American and Euro-American affiliation are examined separately for more detailed information on within-group variation.

Secular Trends in Afro-American Crania

The determination of a secular trend, its relative magnitude, and its direction was done first for male and female crania of Afro-American affiliation. The question of within-group variation is addressed by a multivariate analysis of covariance, by testing the pattern of the covariation between the main effect gender (SEX) and a covariate, time (DOB). The results are presented in Table 13. A contribution by the interaction term (SEX*DOB) of 32 percent (R_c = .3247) of the variation along the canonical variable is found to be not significant by a high Wilks' Lambda of .68 (F = 1.24, p = .1168). It is concluded that the sample covariance matrices are equal for female and male groups and that their respective slopes follow the same trend or direction of temporal cranial variation. It is determined that there is no reason to separate crania by gender in further

Table 13. MANACOVA test of interaction and main effect gender (SEX), and its covariate, year of birth (DOB), in Afro-American female and male crania from 1750-1970, (n = 289).

Model	Canonical Correlation	Squared Canonical Correlation	Standard Error	Eigen Value	Wilks' Criterion	F Ratio	PR > F
DOB*SEX	0.569898	0.324783	0.039926	0.4810	0.6752167	1.24	0.1168
DOB	0.716011	0.512672	0.028766	1.0520	0.48732831	2.72	0.0001
SEX	0.876070	0.767499	0.013724	3.3011	0.23250110	8.54	0.0001

investigation of of the contribution of individual variables to this trend.

A MANACOVA was rerun on the pooled series of female and male Afro-American crania, without the interaction term, to explore the pattern of cranial variation along the independent canonical variables for gender and time. Table 13 shows a strong gender effect (SEX), marked by a significant Wilks' Lambda of .23 (F = 8.54, p = .0001). It signifies a noticeable degree of sexual dimorphism in the Afro-American crania series. Further investigation into sexual dimorphism is beyond the scope of this study. Returning to the temporal variable (DOB) in Table 13, a strong correlation contributing 51 percent of the variation along the temporal canonical variable (R_c = .5126) is observed, with a Wilks' Lambda of .49, (F = 2.72, p = .0001). From these results, it is shown that a strong contribution of the observed cranial variation in the pooled female-male series of Afro-American crania may be attributed to the temporal variable and that a temporal, or secular, trend is both present and statistically significant. It should be noted that temporal trend presented takes into account any effect due to gender.

Figure 1 is a graphic presentation of the overall direction of temporal trend for pooled female and male

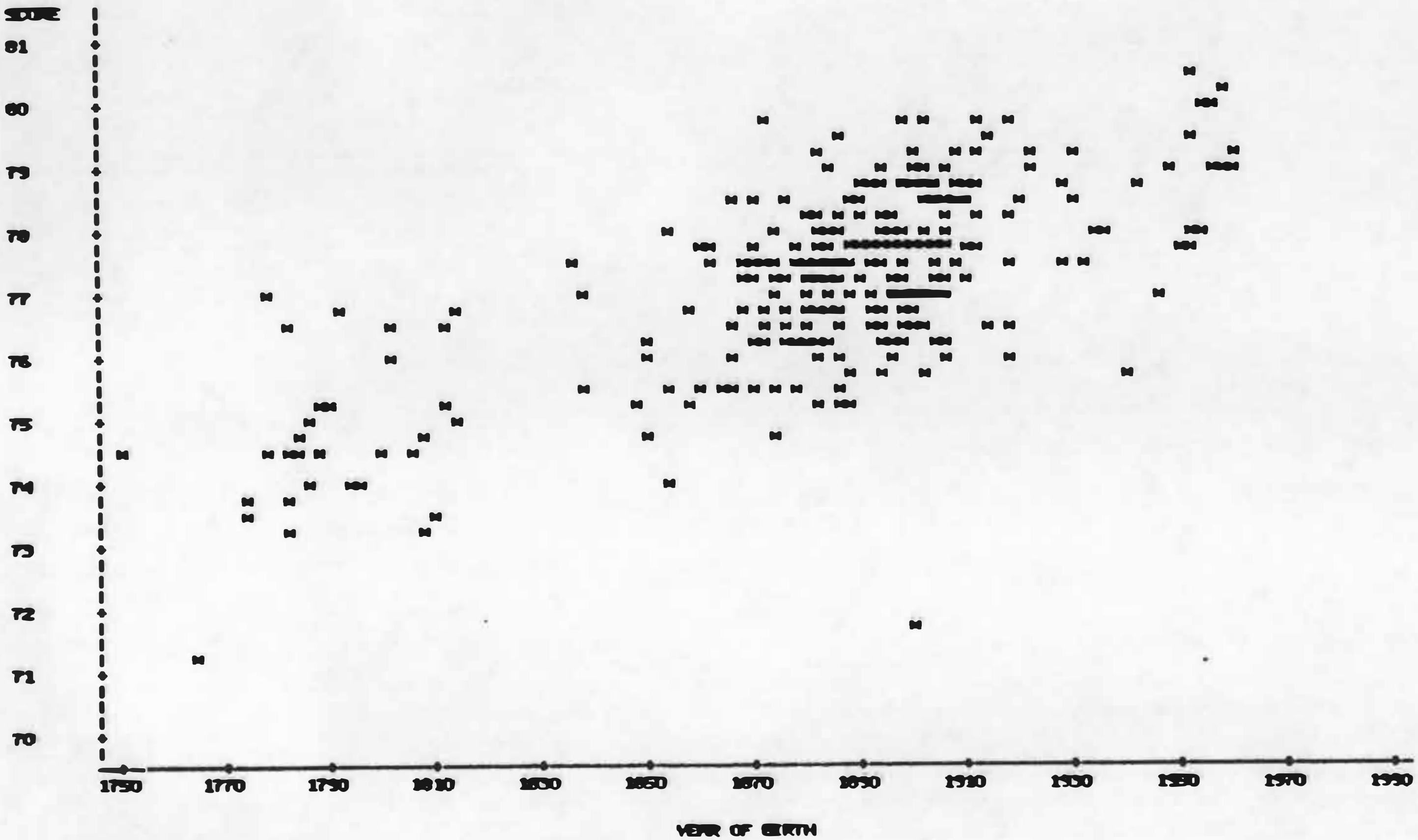

Figure 1. Plot of composite raw canonical score and year of birth denoting a secular trend in female and male Afro-American crania. SCORE = 28.9367 + 0.0256*YEAR

Afro-American cranial series with dates of birth from 1750 to 1970. The plot of the secular trend is produced by multiplying each measurement by its corresponding raw coefficient on the canonical variable. Total scores for each individual are plotted against time, illustrating the slope of the relationship between the composite score and year of birth. A predicted slope of the relationship between the composite score and year of birth is predicted by means of regression. A slope of .0256 is found to be significant (p = .0). It is important to note here that the slope of the relationship between score and date of birth represents an increase in absolute values of the scores derived from the raw canonical coefficient. In Table 14, it is shown that for Afro-American these scores are generally negative. In other words, the trend shown in Figure 1 represents an increasingly negative trend which may be translated as a general cranial reduction.

A more detailed description of temporal variation in individual cranial dimensions is possible by inspection of the independent canonical time variable. The morphological pattern of temporal variation in each individual variable and the magnitude and direction of the canonical coefficients on this axis is shown in Table 14. Loadings are largely negative, demonstrating a decrease in the individual dimensions. High negative loadings are

Table 14. Total canonical structure for year of birth for crania of Afro-American females and males from 1750-1970, (n = 149).

Code	Canonical Structure	Code	Canonical Structure
GOL	- 0.2749	FRC	- 0.1742
NOL	- 0.2540	FRS	0.0393
BNL	- 0.2074	FRF	- 0.1780
BBH	- 0.2576	PAC	- 0.1103
XCB	- 0.2763	PAS	- 0.0025
XFB	- 0.2058	PAF	- 0.2895
WFB	- 0.1813	OCC	- 0.0576
ZYB	- 0.4197	OCS	0.0206
AUB	- 0.2055	OCF	- 0.0077
WCB	- 0.1982	FOL	- 0.0954
ASB	- 0.1141	FOB	- 0.1193
BPL	- 0.2162	NAR	- 0.0697
NPH	0.1010	SSR	- 0.2922
NLH	0.1976	PRR	- 0.1350
JUB	0.3918	DKR	- 0.1020
NLB	- 0.3135	ZOR	- 0.1857
MAB	- 0.1035	FMR	- 0.1876
MAL	- 0.0601	EKR	- 0.2188
MDH	- 0.0803	ZMR	- 0.3196
MDB	- 0.1299	AVR	- 0.2499
OBH	0.0004	BRR	- 0.1598
OBB	- 0.2613	VRR	- 0.1688
DKB	- 0.1827	LAR	- 0.2014
NDS	0.0196	OSR	- 0.2062
WNB	0.0223	BAR	- 0.1355
SIS	- 0.0438	NAA	- 0.1519
ZMB	- 0.2100	PRA	- 0.0605
SSS	- 0.1549	BAA	0.2578
FMB	- 0.2736	NBA	- 0.0693
NAS	0.1409	BBA	0.0628
EKB	- 0.3371	SSA	0.0281
DKS	0.1454	NFA	- 0.2429
IML	- 0.0390	DKA	- 0.2468
XML	- 0.0153	NDA	- 0.1442
MLS	0.0516	SIA	0.0439
WMH	0.0536	FRA	- 0.1373
SOS	- 0.1359	PAA	- 0.0458
GLS	- 0.2151	OCA	- 0.0461
STB	- 0.1924	STA	0.1646
STS	- 0.1972	CBA	0.0931

noted for bizygomatic breadth (ZYB), nasal, breadth (NLB), biorbital breadth (EKB) and zygomaxillare radius (ZMR). Other moderately high negative scores include cranial length (GOL, NOL), vault breadth (XCB), height (BBH), parietal curvature (PAF), facial depth (SSR, AVR), upper breadth (FMB), and orbital breadth (OBB). Among the lesser number of positive coefficients, high and moderately high loadings are noted for midfacial breadth (JUB) and basion angle (BAA).

The slope is predicted for nine selected cranial dimensions and is plotted in graphic illustrations of the relationship between these variables and time (Figure 2 through Figure 13. Of the 12 variables shown, nine dimensions are found to exhibit a significant temporal trend. In Figure 2, cranial length (GOL) exhibits a negative rate of change amounting to -.0288 mm/year (p = .0098). Cranial height (BBH) is defined by a negative rate of change amounting to -.024 mm/year (p = .0115) (Figure 3), and cranial breadth (XCB) displays a rate of .0254 mm/year (p = .0035) (Figure 4). Other dimensions shown include facial height (NPH) with a positive slope of .0146 (p = .0408) (Figure 5), facial depth (EKR) with a slope of -.0124 (p = .0498) (Figure 6), and breadth ((ZYB), slope = -.0431 , p = .0001) (Figure 7); (EKB), slope = -.0242, p = .0006 (Figure 8); (OBB), slope = -

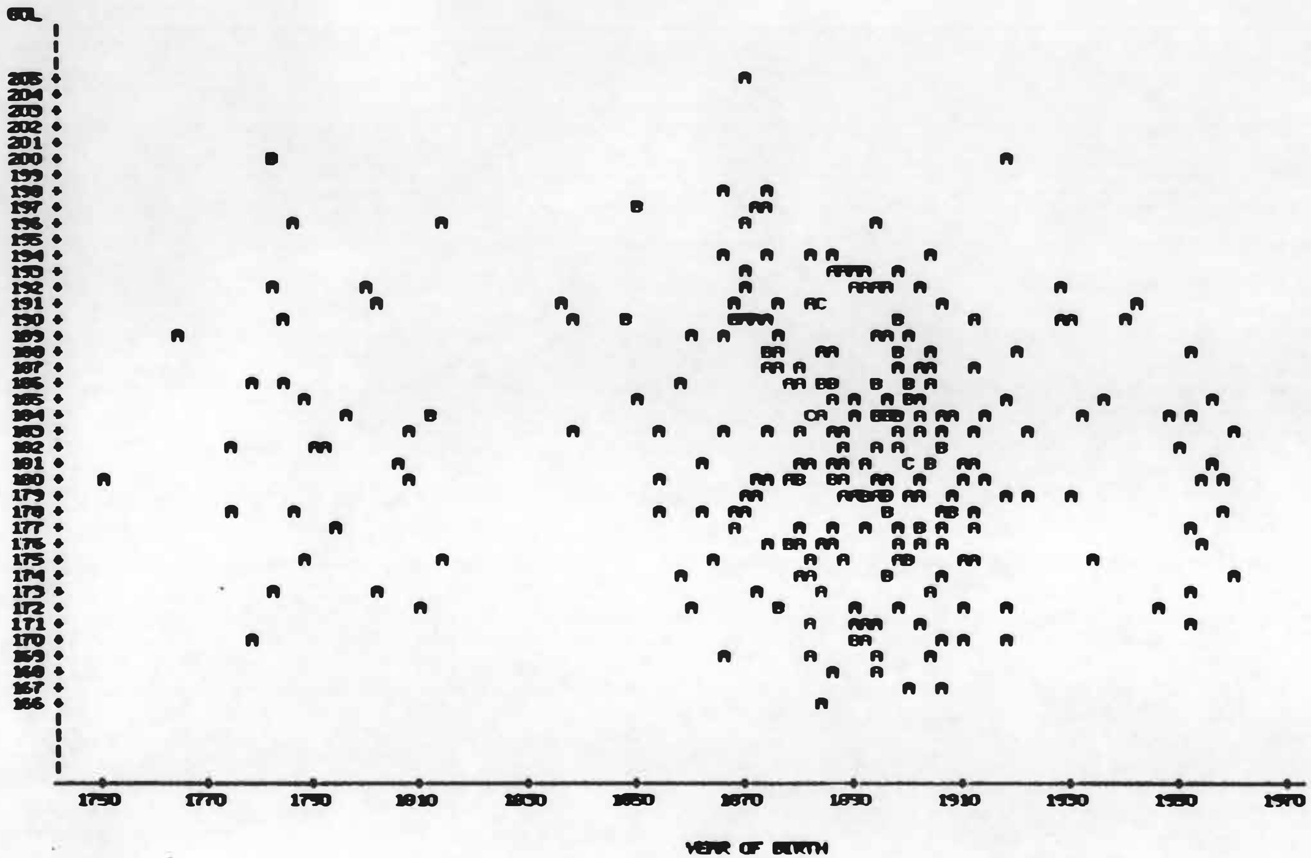

Figure 2. Plot of Glabella-Occipital Length and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. GOL = 236.5695 - 0.0288*YEAR.

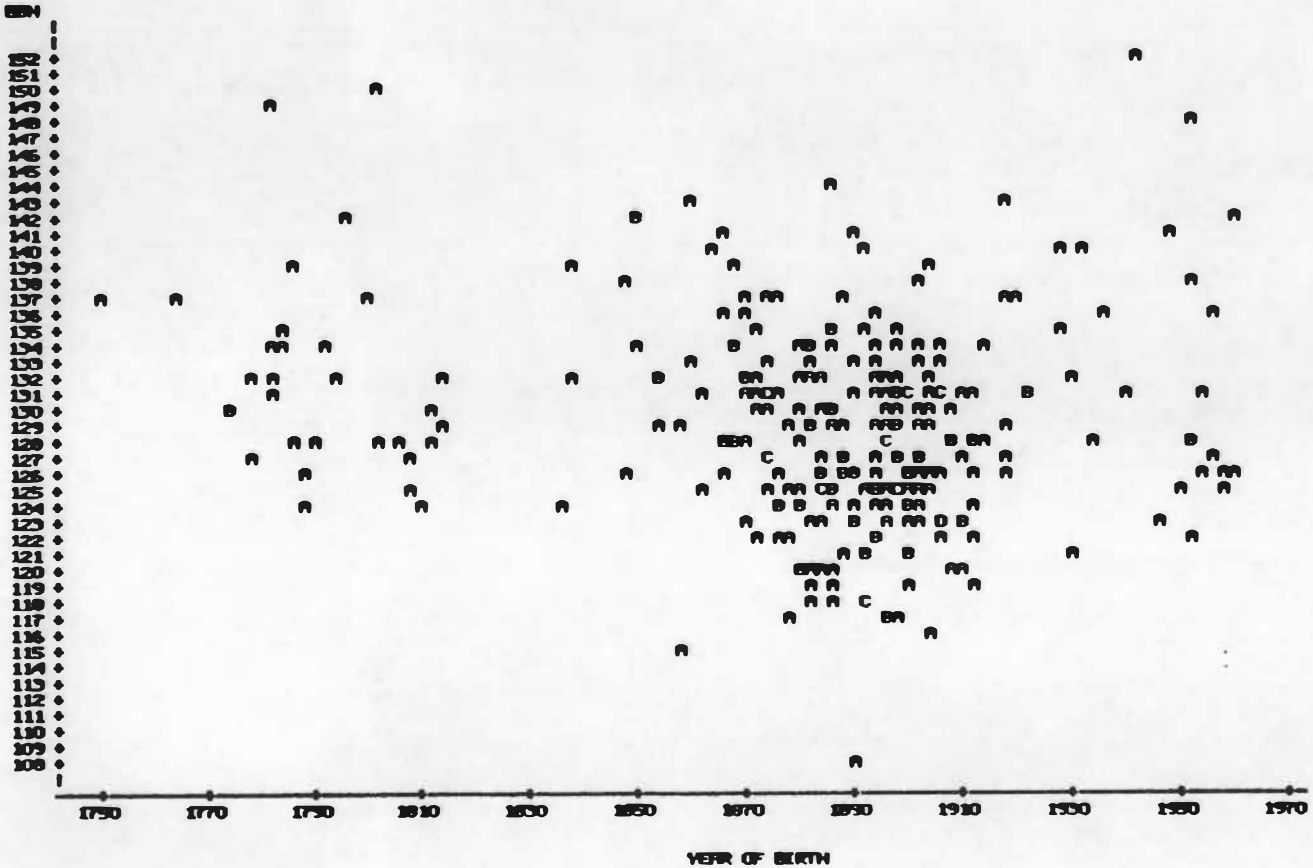

Figure 3. Plot of Basion-Bregma Height and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. BBH = 174.1294 - 0.024*YEAR.

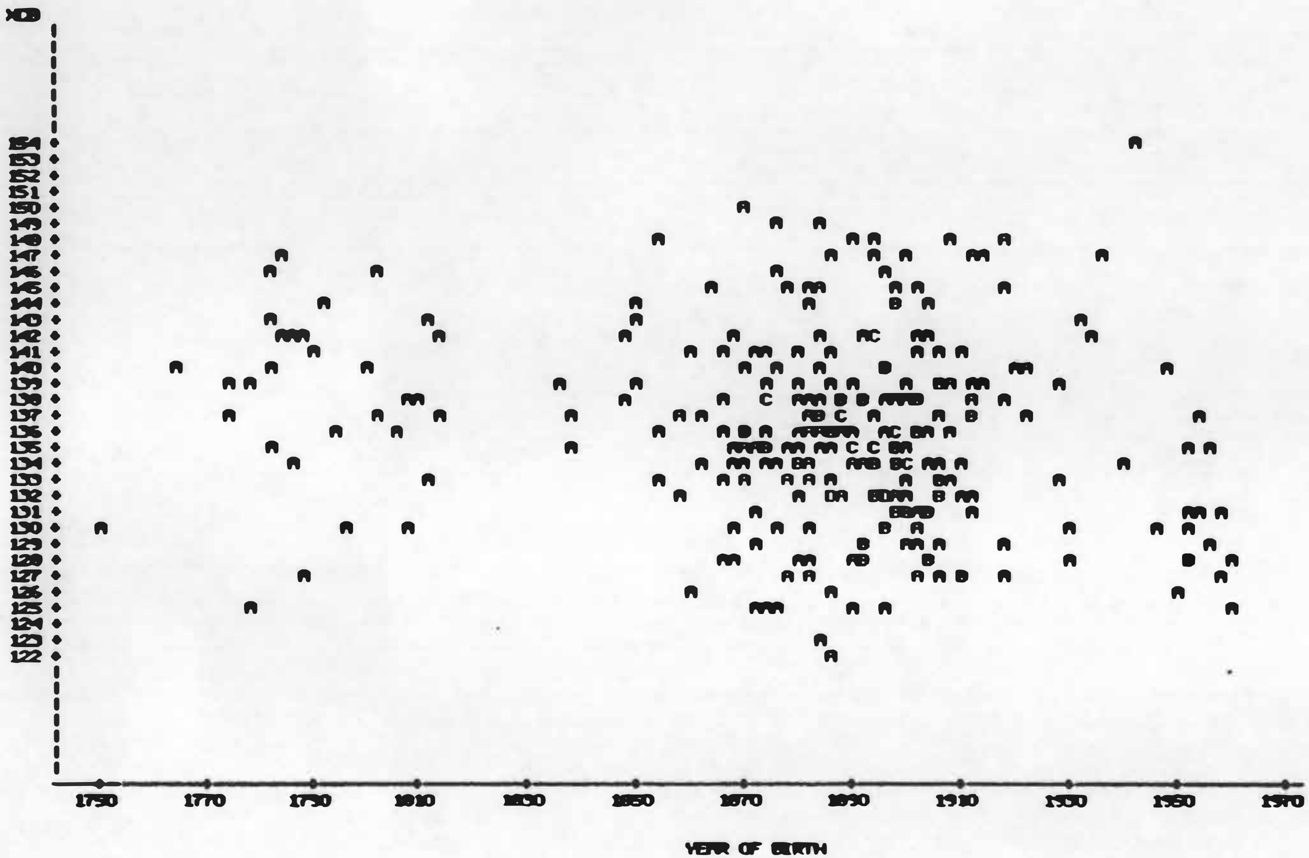

Figure 4. Plot of Maximum Cranial Breadth and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. XCB = 183.7612 - 0.0254*YEAR.

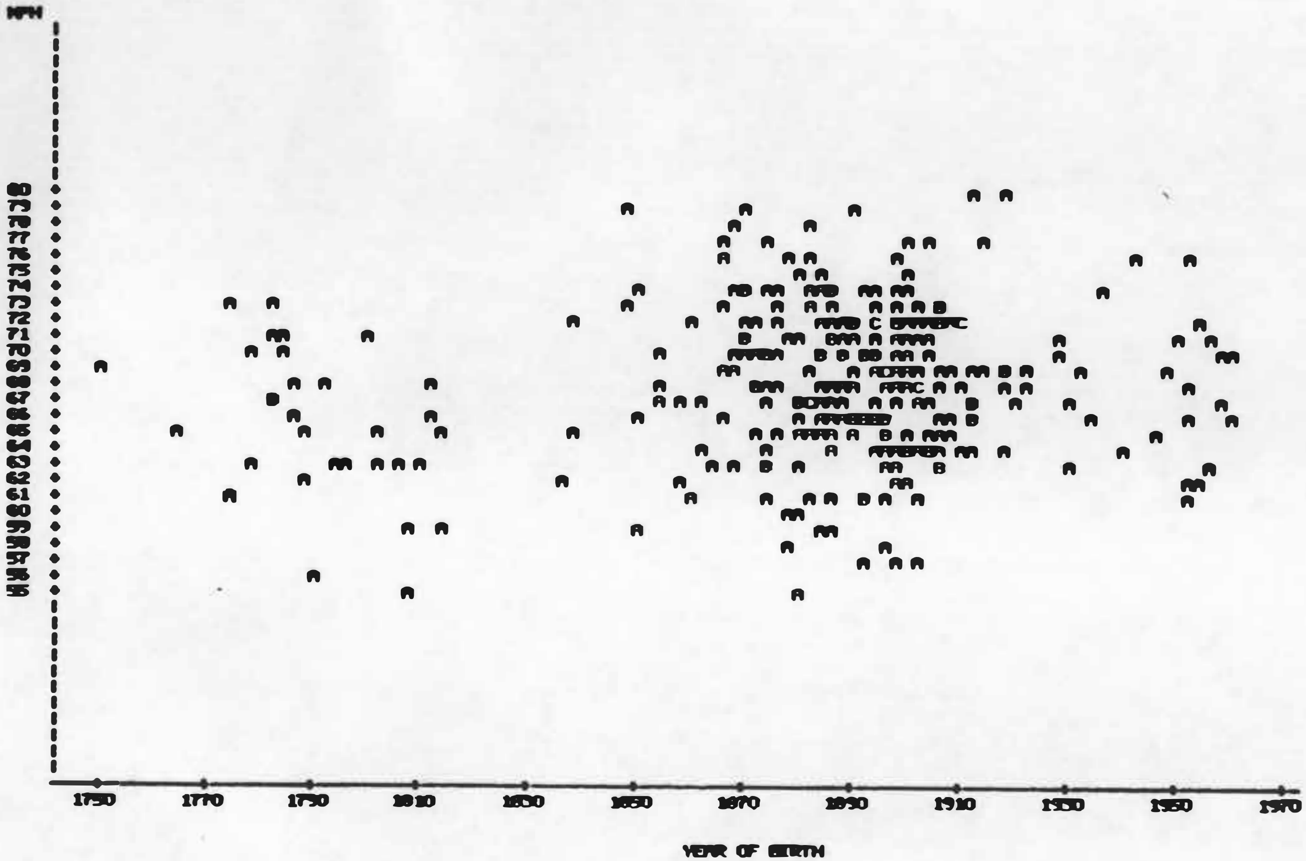

Figure 5. Plot of Nasion-Prosthion Height and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. NPH = 40.5194 - 0.0146*YEAR.

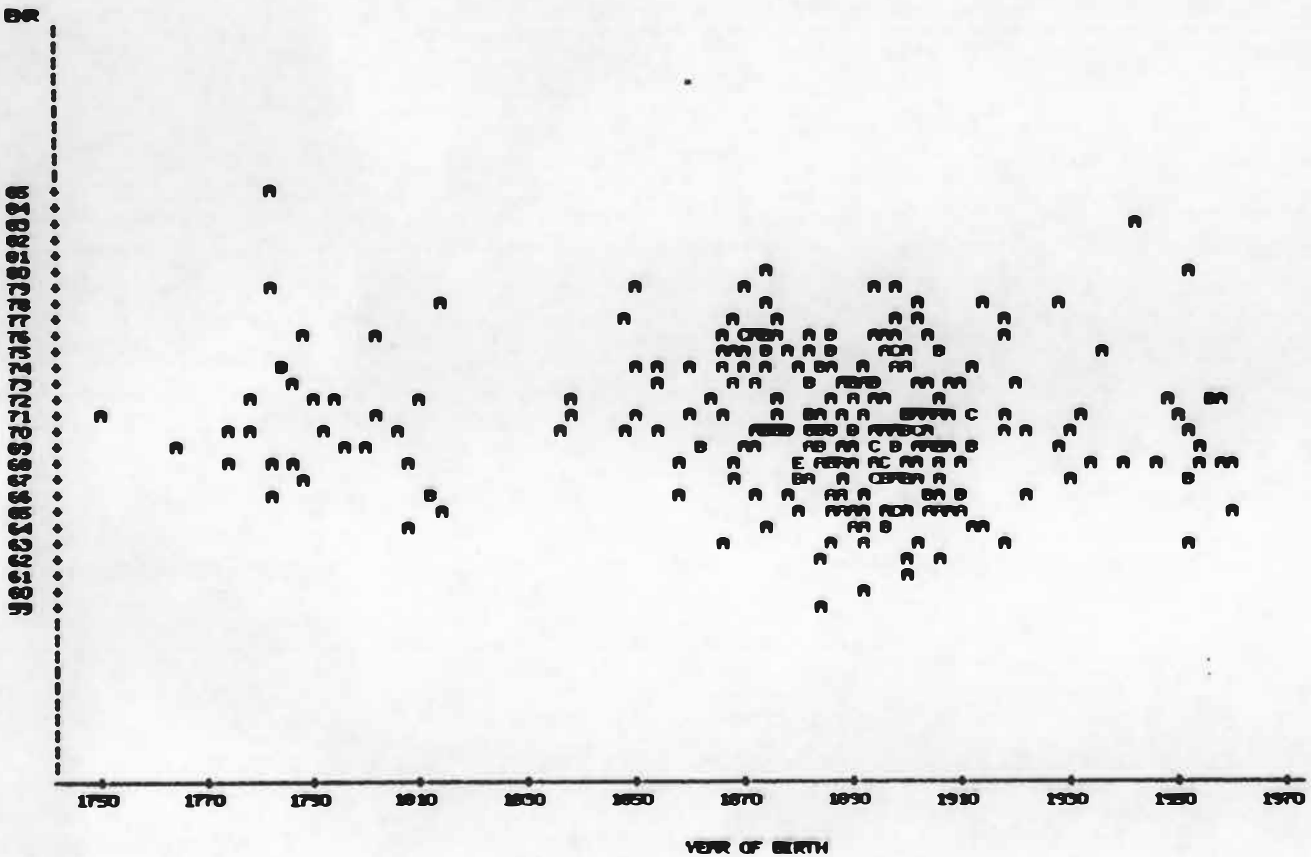

Figure 6. Plot of Ectoconchion radius and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. EKR = 93.8039 - 0.0124*YEAR.

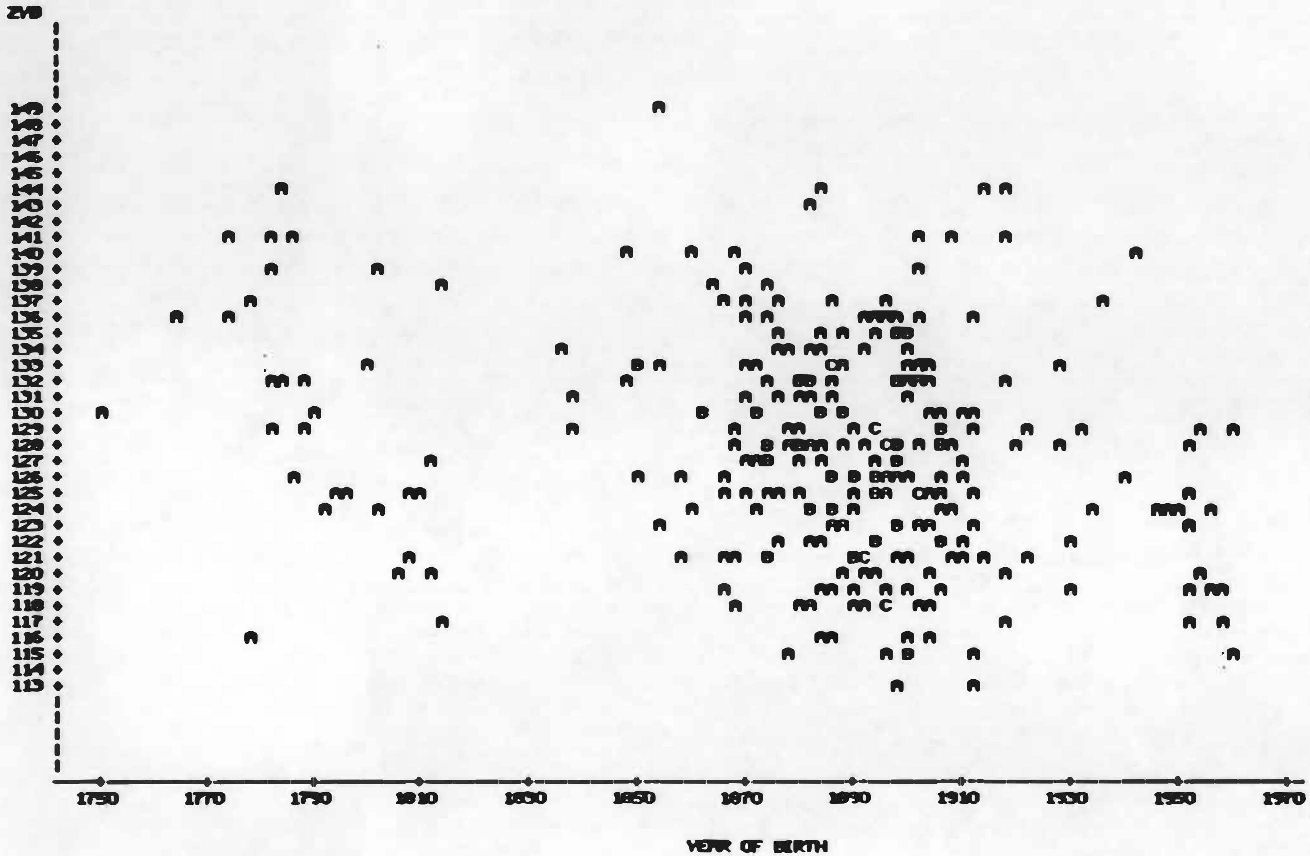

Figure 7. Plot of Bizygomatic Breadth and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. ZYB = 208.7778 - 0.0431*YEAR.

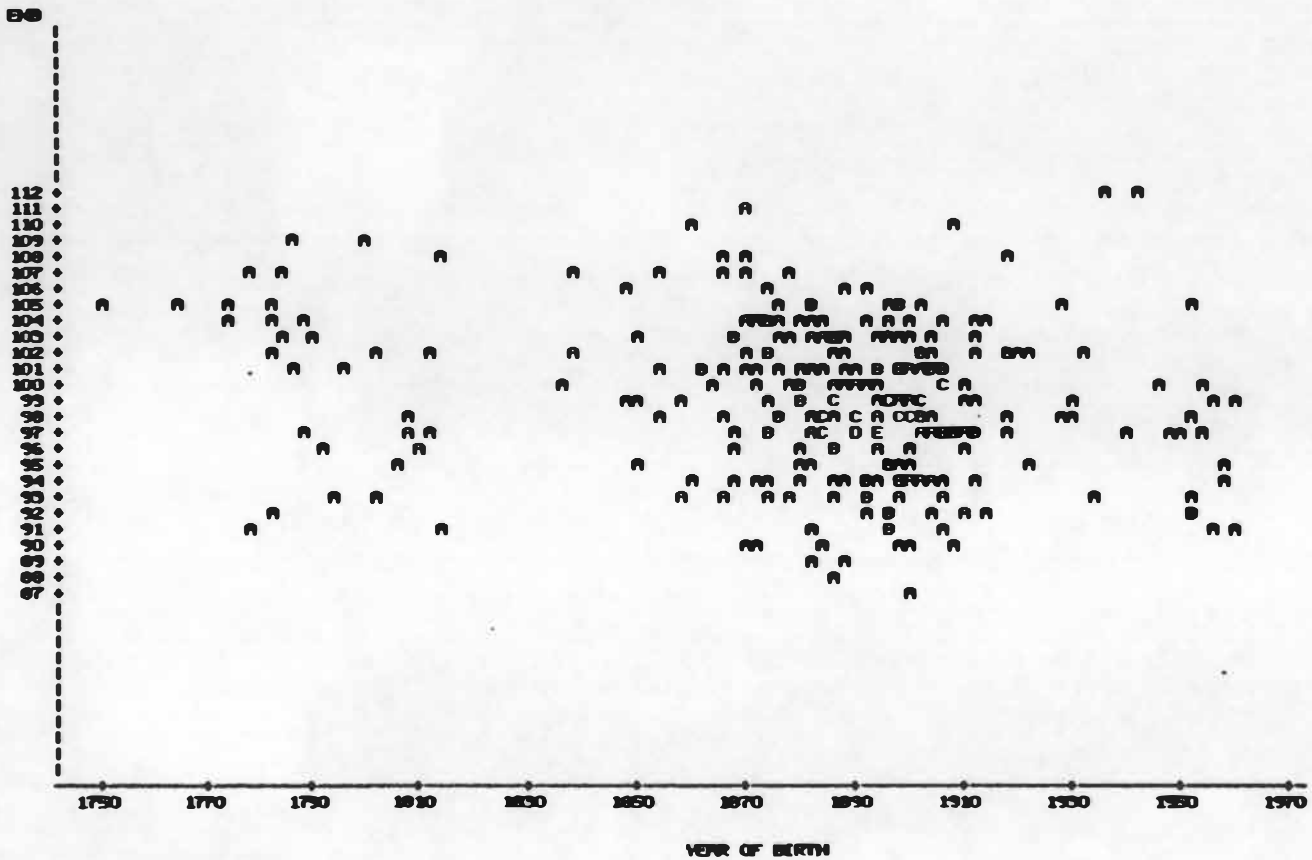

Figure 8. Plot of Biorbital Breadth and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. EKB = 144.6033 - 0.0242*YEAR.

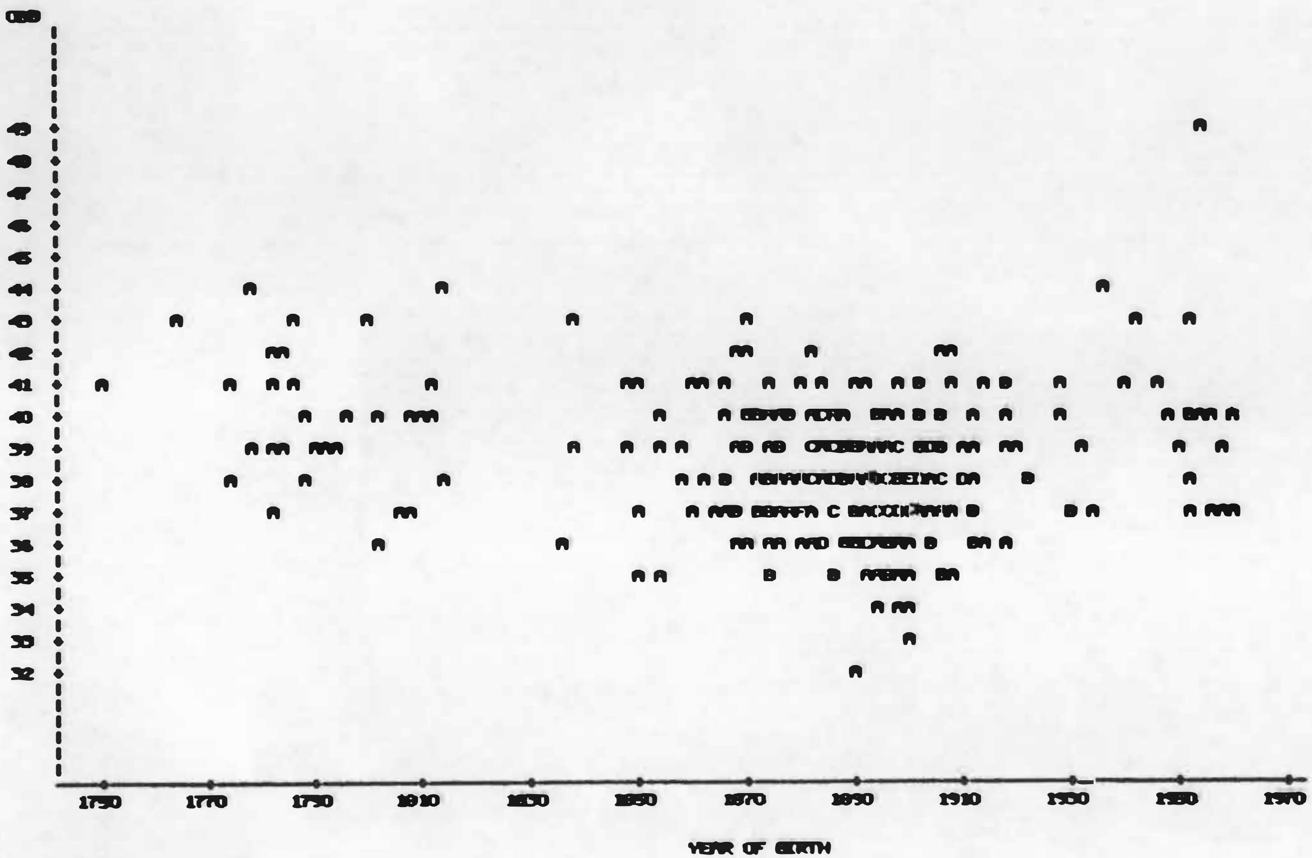

Figure 9. Plot of Orbital Breadth and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. OBB = 54.6892 - 0.0087*YEAR.

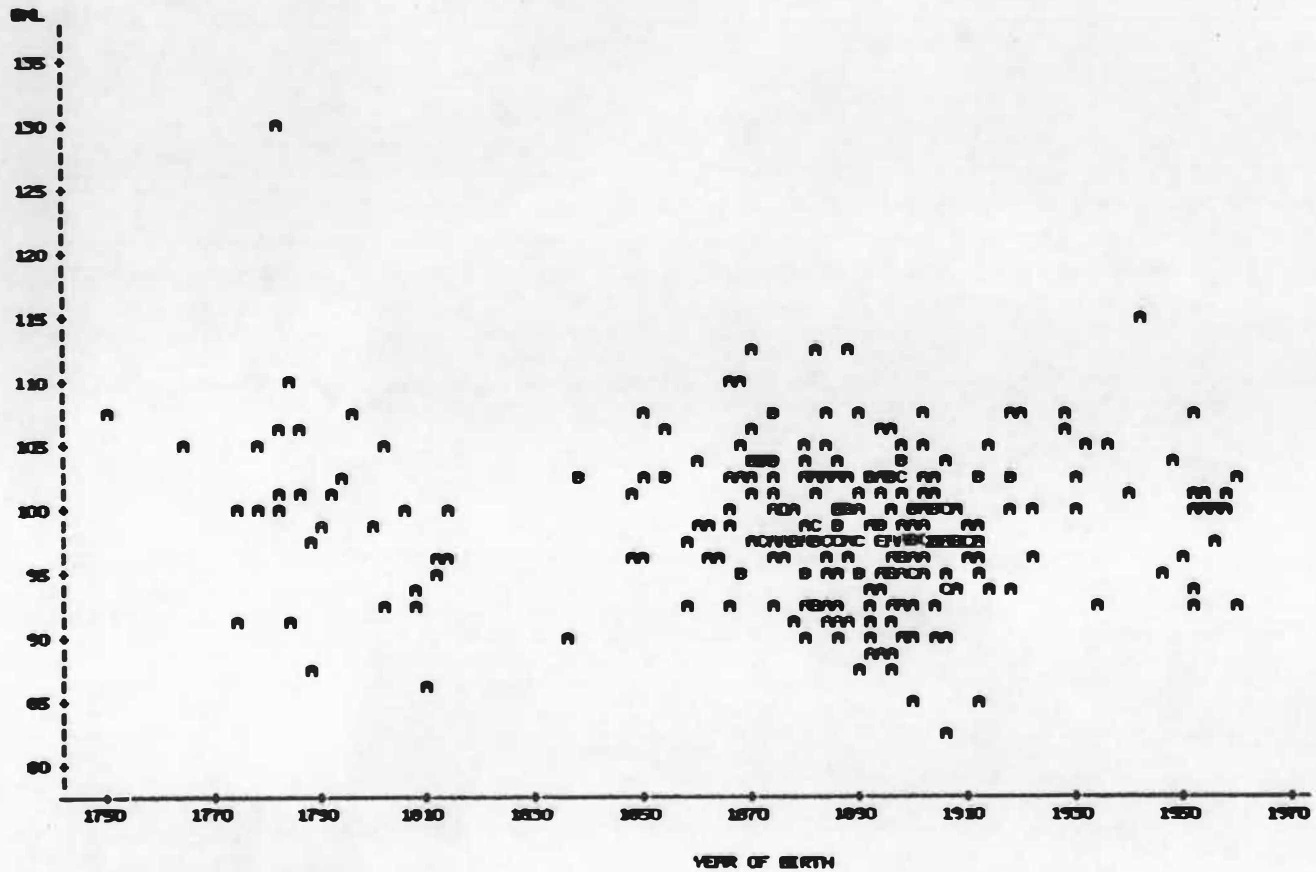

Figure 10. Plot of Basion-Nasion Length and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. BNL = 127.7541 - 0.0154*YEAR.

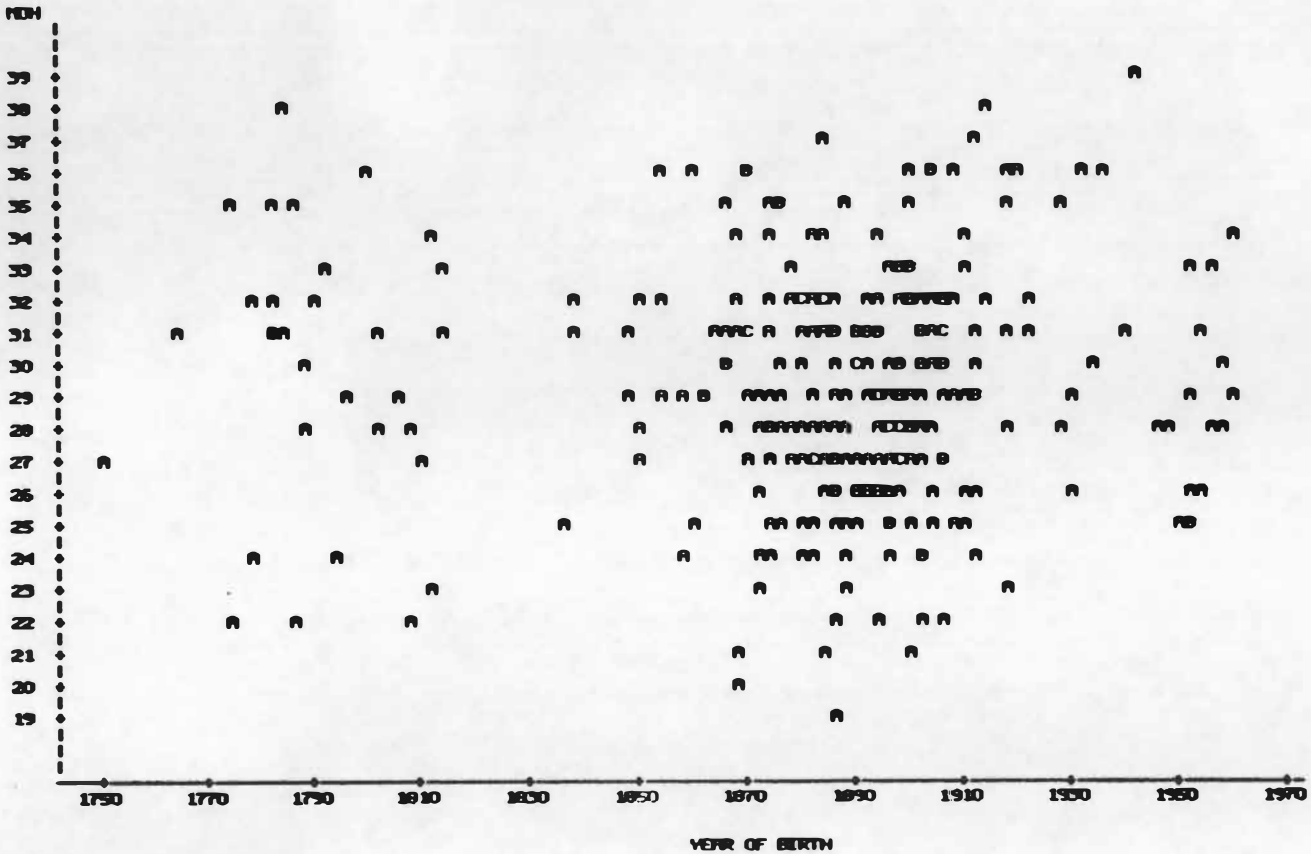

Figure 11. Plot of Mastoid Height and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. MDH = 31.7772 - 0.0013*YEAR.

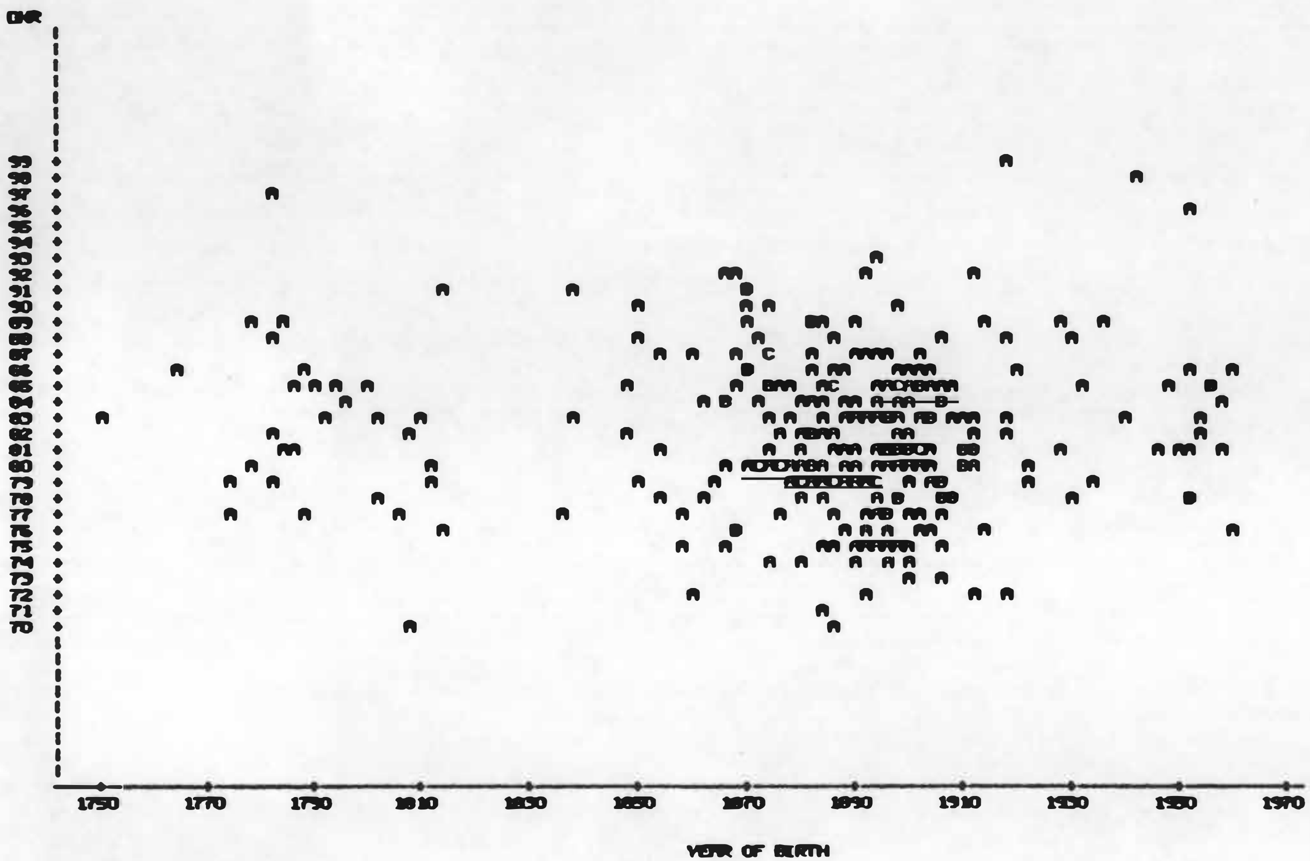

Figure 12. Plot of Dacryon radius and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. DKR = 89.6807 - 0.0041*YEAR.

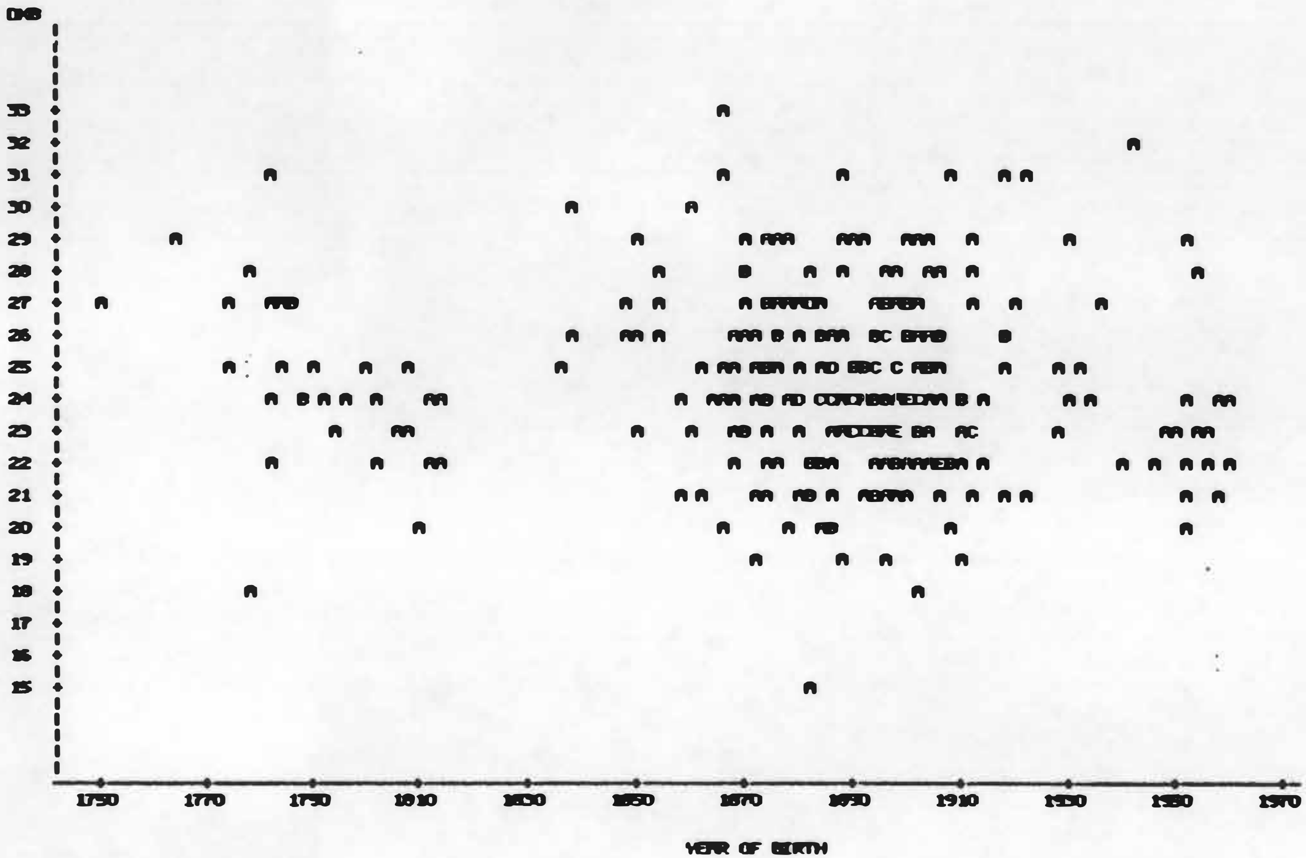

Figure 13. Plot of Interorbital Breadth and year of birth denoting a secular trend in female and male Afro-American crania. A = 1 observation; B = 2 observations; etc. DKB = 37.8033 - 0.0071*YEAR.

.0087, p = .0067 (Figure 9)). Other variables which did not meet the .05 level of significance include cranial base length (Figure 10), mastoid height (Figure 11), dacryon radius (Figure 12), and orbital breadth (Figure 13).

Overall, the crania of the Afro-American series are best described as generally decreasing in size as reflected by the uniform direction of negative values. The absence of a mixed pattern of positive and negative trends among the craniometric dimensions along the canonical variable indicate little or no changes in shape. Three important exceptions showing change in shape are the lower midfacial breadth, the bijugal dimension (JUB), and facial height (NPH, NLH). A summary discussion of the results and a comparison with those of the Euro-American series is presented at the end of this section.

Secular Trends in Euro-American Crania

A similar analysis was done of the Euro-American cranial series. An analysis of the within-group homogeneity of slopes between female and male series was carried out by a multivariate analysis of covariance, MANACOVA. The MANACOVA tests the null hypothesis of no canonical correlation of the interaction term of gender (SEX) and time (DOB). Table 15 shows a slightly greater

Table 15. MANACOVA test of interaction of gender (SEX) and year of birth (DOB), in Euro-American crania from 1750-1970 (n = 248).

Model	Canonical Correlation	Squared Canonical Correlation	Standard Error	Eigen Value	Wilks' Criterion	F Ratio	PR > F
DOB×SEX	0.580336	0.33679	0.035758	0.5078	0.66321028	1.68	0.0013

contribution of the interaction term to the variation along the canonical variable than is noted for the Afro-American series. The correlation, .5803, (R_c = .3368), is qualified by a significant Wilks' Lambda of .66 (F = 1.68, p = .00013).

From the results in Table 15, which show unequal slopes, it is concluded that Euro-American male and female samples do not exhibit parallel trends or directions of change in time. Since they do not coincide, male and female samples are maintained as separate groups in further investigation of secular patterns of change in size and shape.

Two separate canonical correlations were computed for the female and male cranial series to illustrate the temporal relationship among the individual cranial dimensions. A multivariate test of the significance of the overall relationship in each of the sexes is illustrated in the following discussion. Both females and males exhibit a strong canonical correlation in the Euro-American series. Females show the highest correlation, attributing 83 percent of the observed variation to temporal association (Table 16). The overall relationship is characterized by a small Wilks' Lambda of .17 (F = 4.27, p = .0001). A graphic illustration of the temporal

Table 16. Test of temporal relationship among individual cranial dimensions in Euro-American female crania from 1750-1970, (n = 149).

Model	Canonical Correlation	Squared Canonical Correlation	Standard Error	Eigen Value	Wilks' Criterion	F Ratio	PR > F
DOB	0.913304	0.834124	0.013635	5.0286	0.16587584	4.27	0.0001

pattern in Euro-American female crania is shown in Figure 14.

The male cranial series illustrated in Table 17 also shows a strong relationship between time and cranial variation. A correlation of 0.8561 is noted, with an R_c of .73 and a Wilks' statistic of .27 ($F = 4.01$, $p = .0001$). A slope of .0757 ($p = .0$) denotes a significant overall rate of change in the composite score of females. The male pattern of temporal cranial variation is shown in Figure 15. In males, the temporal change is defined by a slope of .041 ($p = .0$).

The morphological pattern of temporal variation for Euro-American female crania in Table 18 is generally characterized by a mixture of positive and negative loadings, suggesting temporal change in cranial size and shape. Variables with high positive loadings for female crania include cranial height (BBH, BRR, VRR) and frontal curvature (FRF, FRS), facial projections (SOS, DKR, EKR) and cranial base length (BNL). The highest negative loadings are seen in facial depth (NDS), orbital and interorbital breadth (OBB, DKB). Other variables with moderately high positive loadings include frontal chord (FRC), vault breadth (ASB, STB). Additional variables with negative loadings are facial breadth (ZYB, EKB),

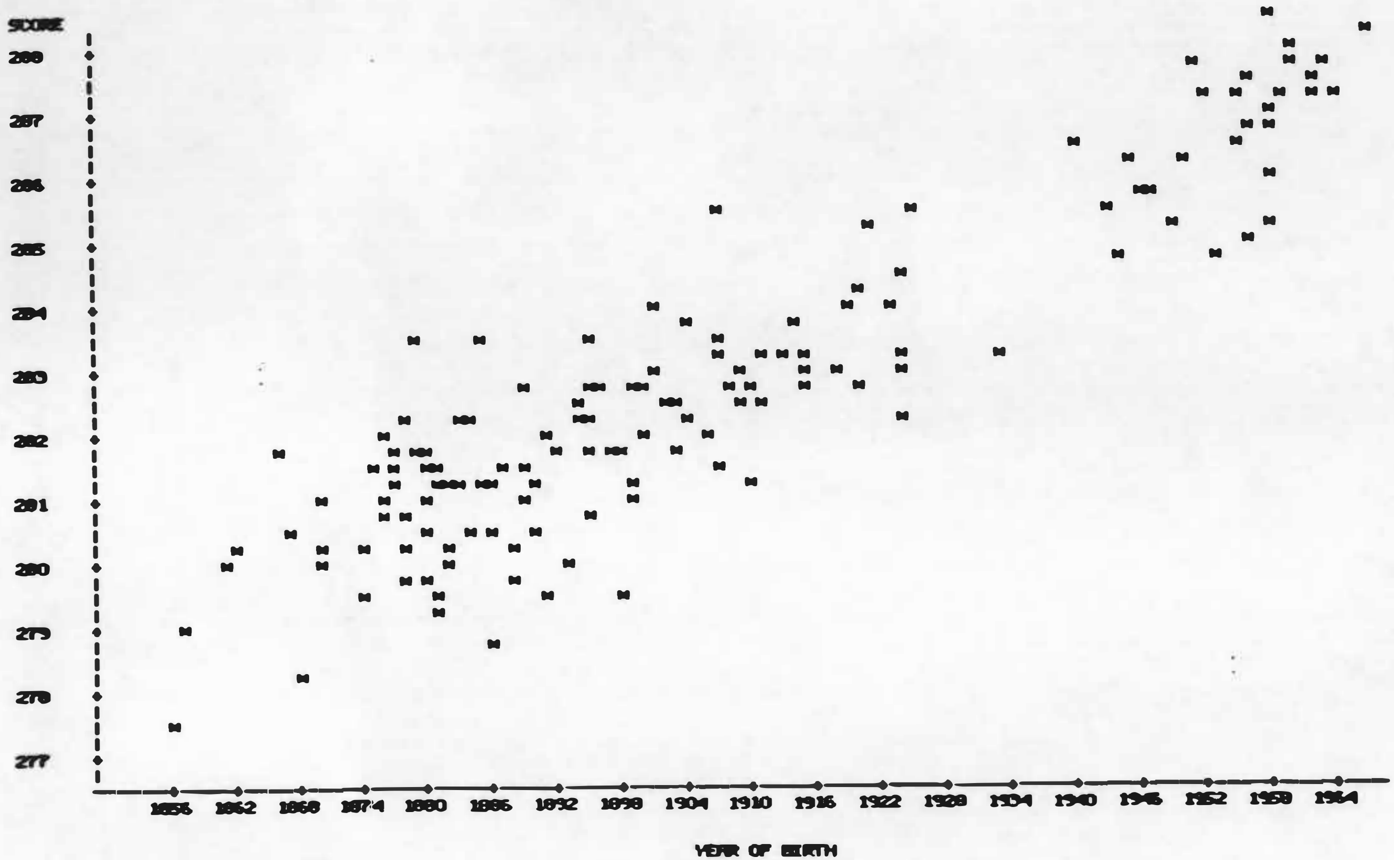

Figure 14. Plot of composite raw canonical score and year of birth denoting a secular trend in female Euro-American crania. SCORE = 138.4326 + 0.0757*YEAR.

Table 17. Test of tempral relationship among individual cranial dimensions in Euro-American male crania from 1750-1970, (n = 199).

Model	Canonical Correlation	Squared Canonical Correlation	Standard Error	Eigen Value	Wilks' Criterion	F Ratio	PR > F
DOB	0.856071	0.732858	0.019033	2.7433	0.26714182	4.01	0.0001

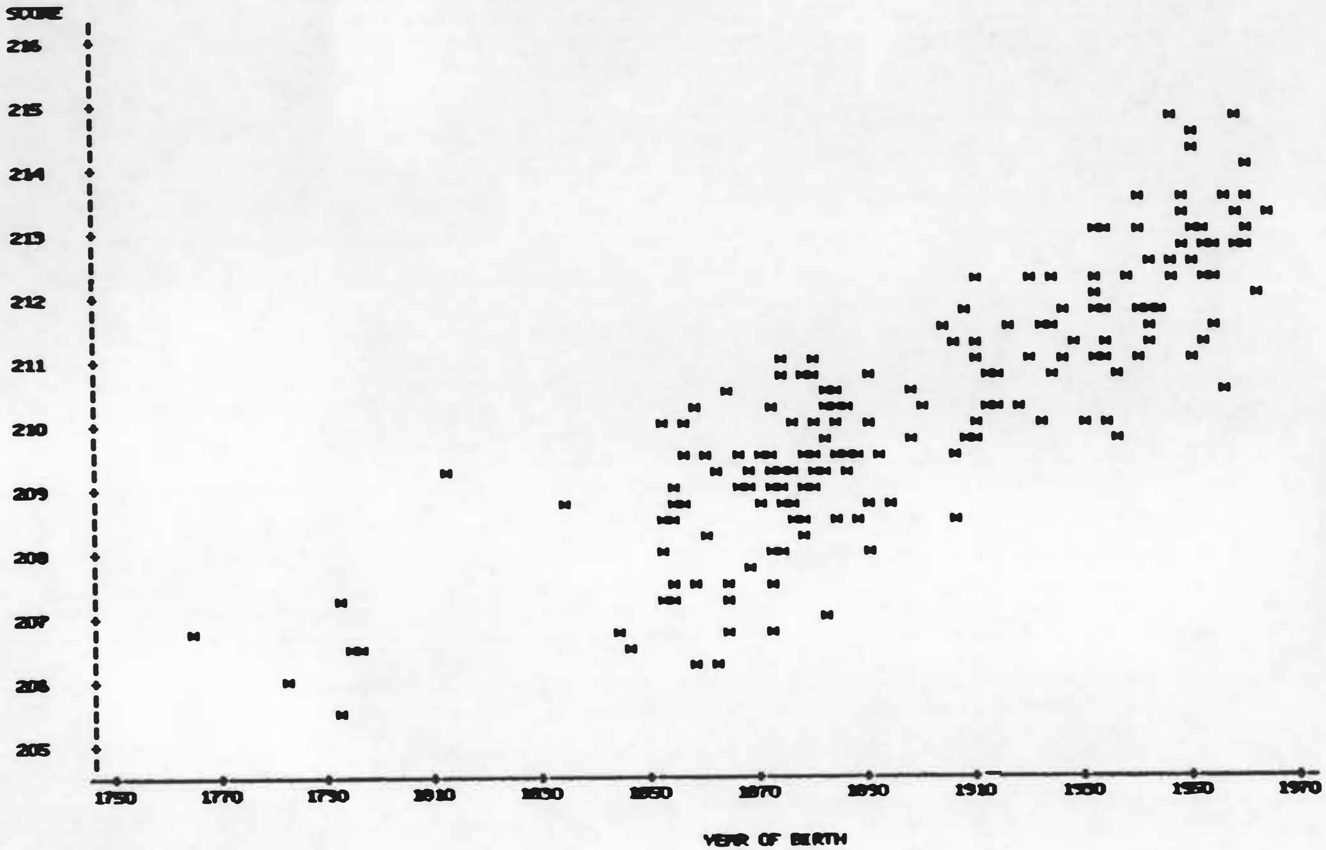

Figure 15. Plot of composite raw canonical score and year of birth denoting a secular trend in male Euro-American crania. SCORE = 132.3901 + 0.041*YEAR.

Table 18. Total canonical structure for year of birth for Euro-American female crania from 1750-1970, (n = 149).

Code	Canonical Structure	Code	Canonical Structure
GOL	0.1271	FRC	0.2630
NOL	0.1249	FRS	0.3035
BNL	0.3592	FRF	0.3166
BBH	0.4497	PAC	- 0.1222
XCB	- 0.2228	PAS	0.1184
XFB	- 0.0918	PAF	0.0778
WFB	- 0.0766	OCC	0.2059
ZYB	- 0.2553	OCS	0.1029
AUB	- 0.1803	OCF	0.1350
WCB	- 0.2696	FOL	0.1164
ASB	0.2588	FOB	0.0966
BPL	0.1895	NAR	0.2724
NPH	0.1489	SSR	0.2164
NLH	0.1159	PRR	0.1648
JUB	- 0.1267	DKR	0.4279
NLB	- 0.2218	ZOR	0.2485
MAB	0.2345	FMR	0.2218
MAL	0.0868	EKR	0.3088
MOH	0.2309	ZMR	0.2121
MOB	- 0.0877	AVR	0.0535
OBH	0.1665	BRR	0.3451
OBB	0.3818	VRR	0.3468
DKB	- 0.4383	LAR	0.1130
NOS	- 0.3474	OSR	0.1628
WNB	- 0.0575	BAR	0.2150
SIS	0.1896	NAA	- 0.1083
ZMB	- 0.2748	PRA	0.1565
SSS	0.1591	BAA	- 0.0670
FMB	- 0.1744	NBA	0.1893
NAS	0.1542	BBA	- 0.1922
EKB	- 0.2789	SSA	- 0.2664
DKS	- 0.0525	NFA	- 0.2083
IML	0.0036	OKA	0.2116
XML	- 0.0442	NDA	0.0525
MLS	- 0.0759	SIA	- 0.2489
WMH	0.1238	FRA	- 0.1975
SOS	- 0.3380	PAA	- 0.2477
GLS	- 0.0530	OCA	- 0.0016
STB	- 0.2765	STA	- 0.1446
STS	- 0.0072	CBA	- 0.2262

maxillary and minimum cranial breadth (ZMB, WCB), facial depth (NAR) and angle (SSA).

Figure 16 through Figure 27 illustrate the individual positive and negative trends and rate of change for a select number of cranial variables. Significant slopes are observed for height (BBH, slope = .0812, p = .0001) (Figure 16); breadth (XCB, slope = -.038, p = .0128) (Figure 17); cranial base length (BNL, slope = .0518, p = .0001) (Figure 18); and mastoid height (MDH, slope = .0221, p = .0098) (Figure 19). Facial dimensions include breadth (ZYB, slope = -.0354, p = .0042; EKB, slope = -.032, p = .0017) (Figure 20 and Figure 21), orbital and interorbital breadth (OBB, slope = .0225, p = .0001; DKB, slope = -.0343, p = .0001) (Figure 22 and Figure 23), and facial depth (DKR, slope = .0535, p = .0001; EKR, slope = .0323, p = .0005) (Figures 24 and Figure 25). Other variables which did not meet the .05 level of significance include cranial length and facial height (Figure 26 and Figure 27).

Table 19 shows the results obtained for the Euro-American male cranial series. Variables with high loadings for male crania include cranial height (BBH, BRR, VRR) and curvature (FRF, OCC), facial depth (NAS, NAR, DKR, ZOR, EKR, ZMR), orbital breadth (OBB), mastoid height (MDH), length of the cranial base (BNL), foramen magnum length

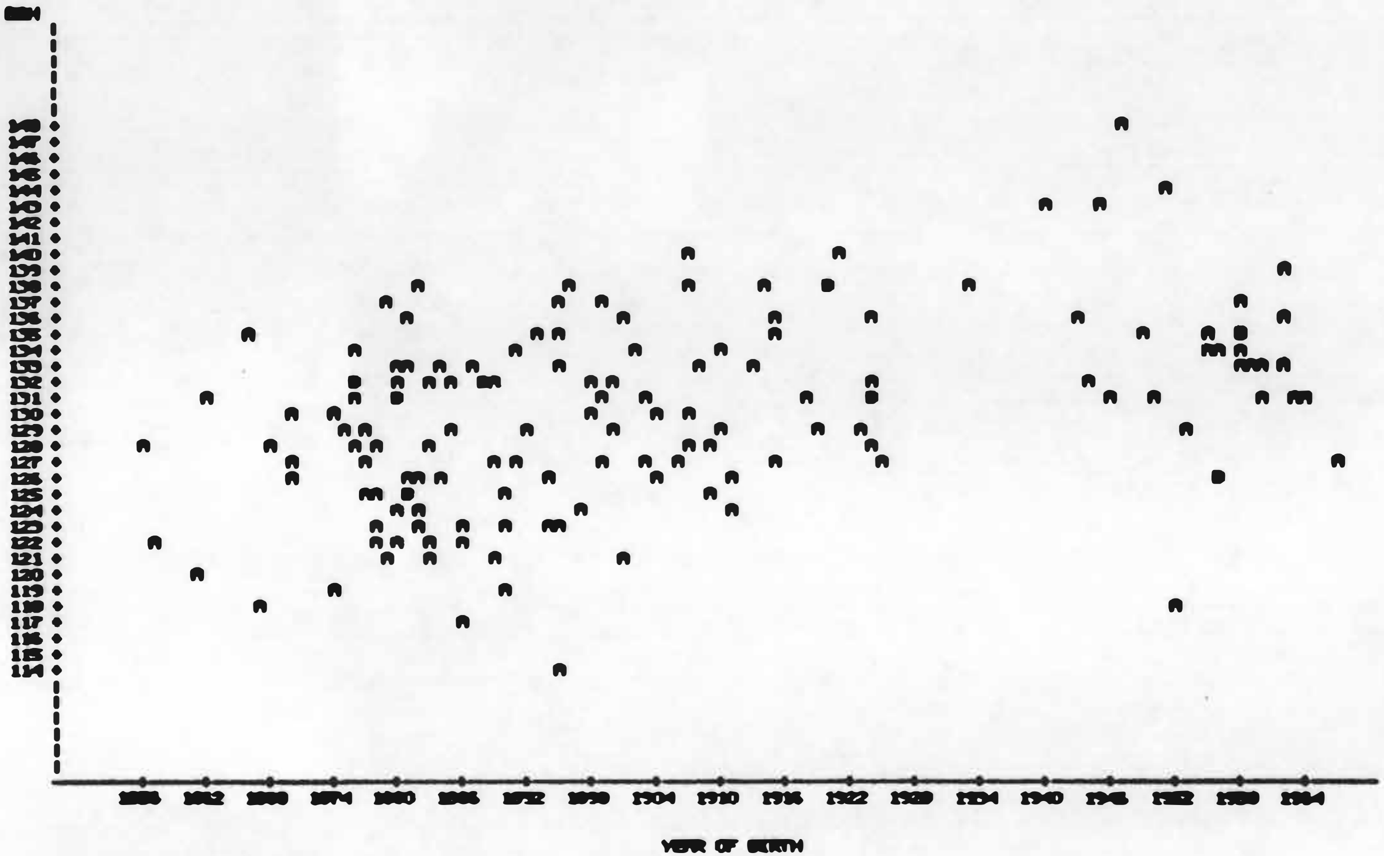

Figure 16. Plot of Basion-Bregma Height and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. BBH = -24.6685 + 0.0812*YEAR.

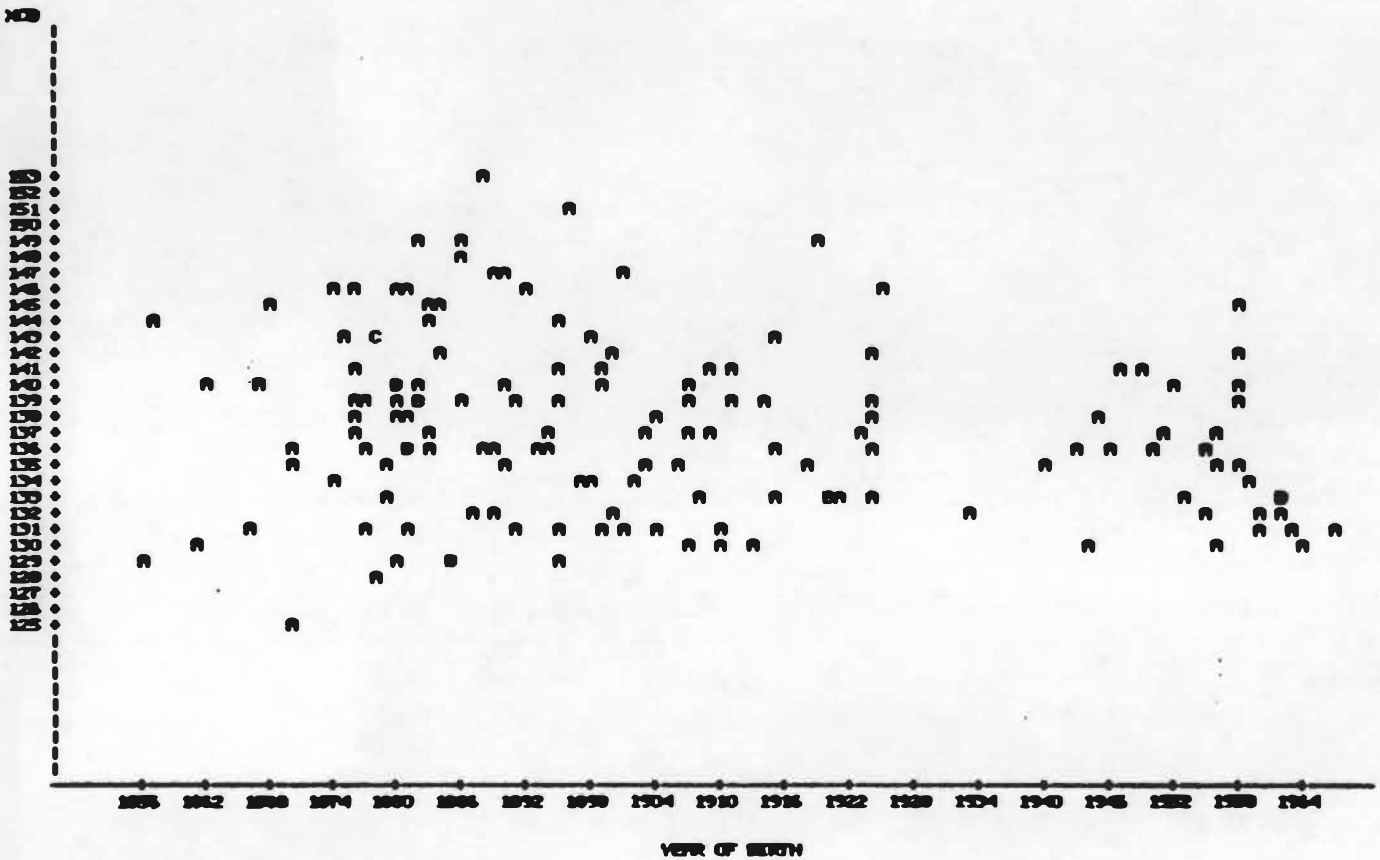

Figure 17. Plot of Maximum Cranial Breadth and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. XCB = 209.8024 - 0.038*YEAR.

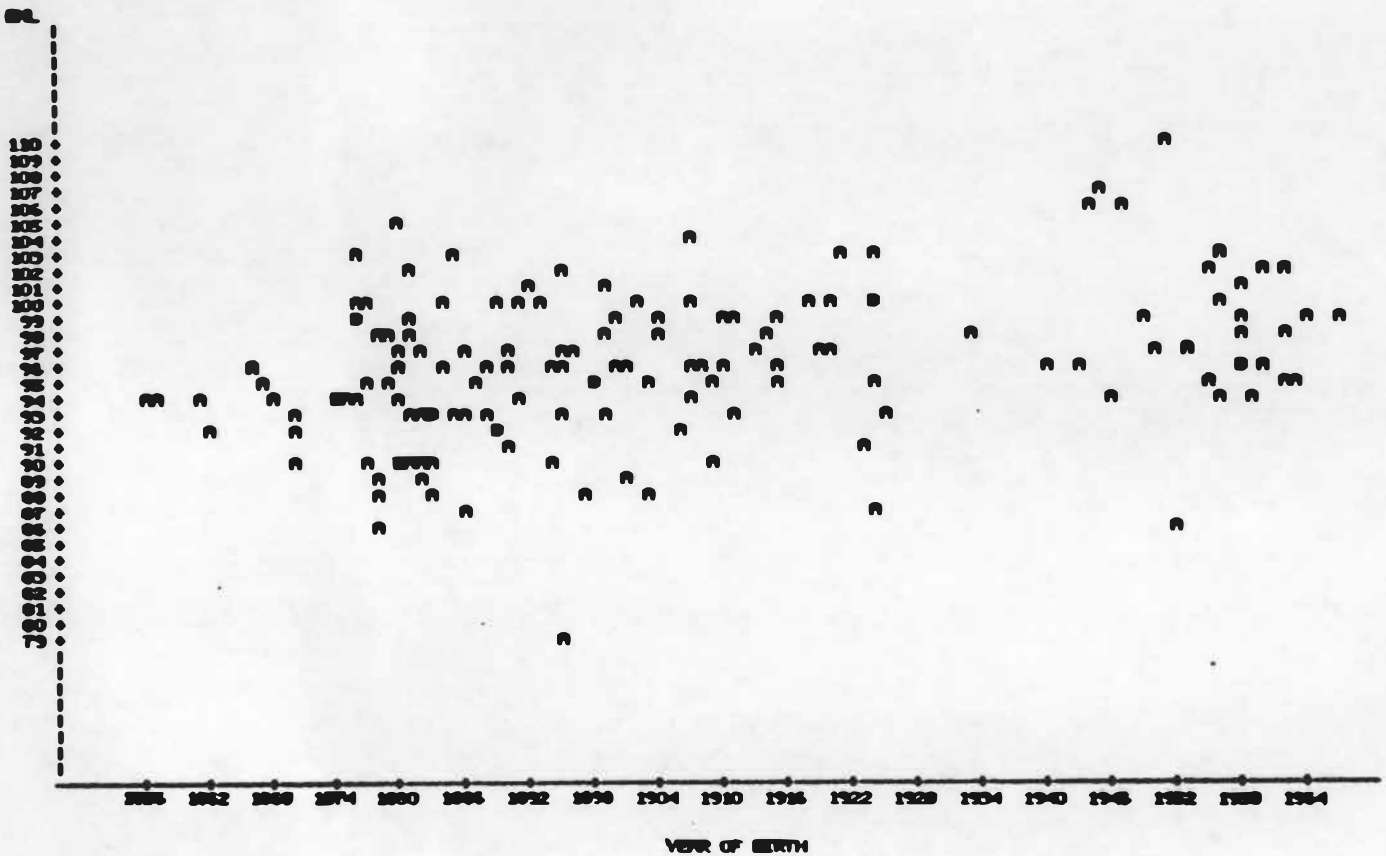

Figure 18. Plot of Basion-Nasion Length and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. BNL = -2.6941 + 0.0518*YEAR.

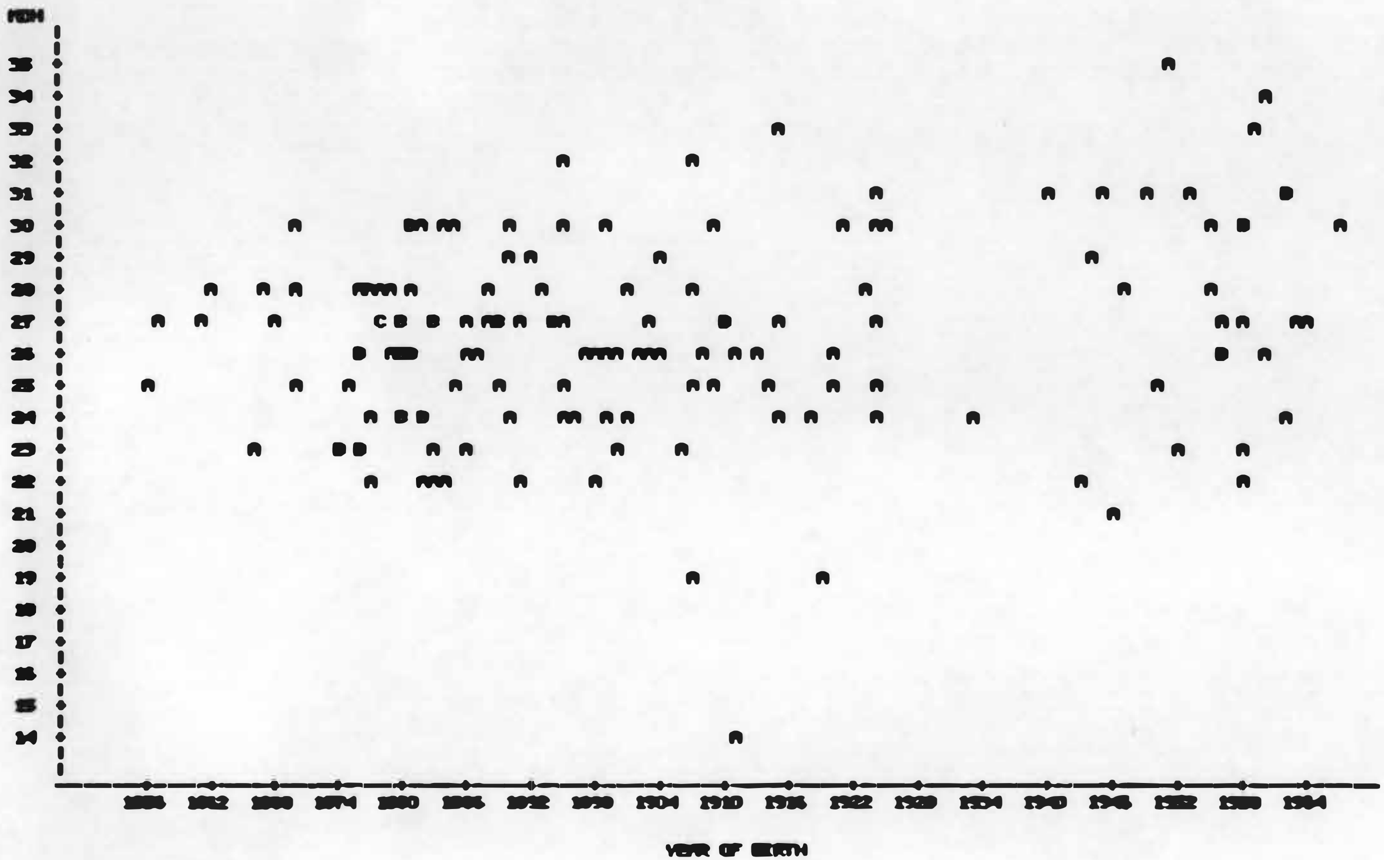

Figure 19. Plot of Mastoid Height and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. MDH = -15.5304 + 0.0221*YEAR.

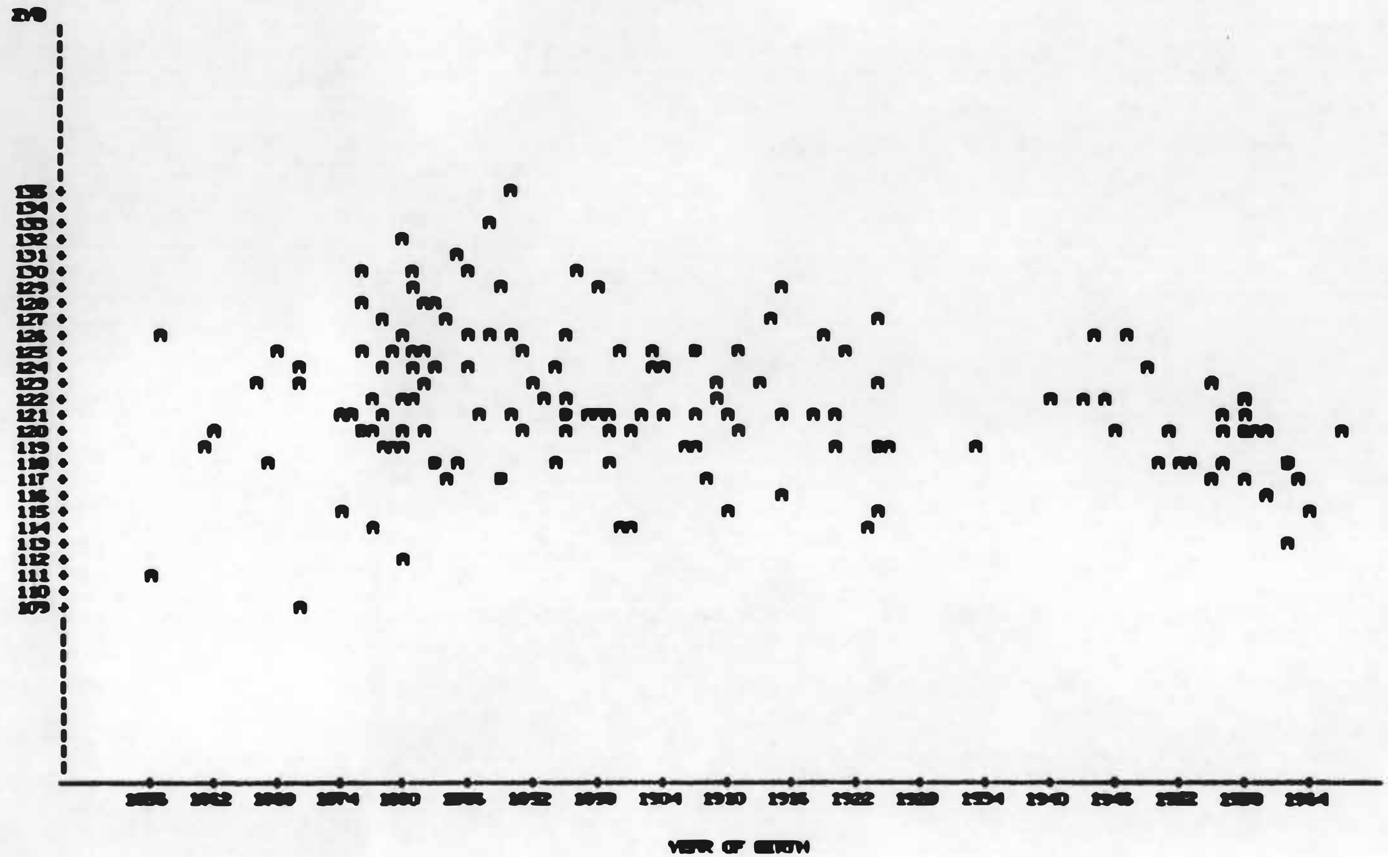

Figure 20. Plot of Bizygomatic Breadth and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. ZYB = 189.073 - 0.0354*YEAR.

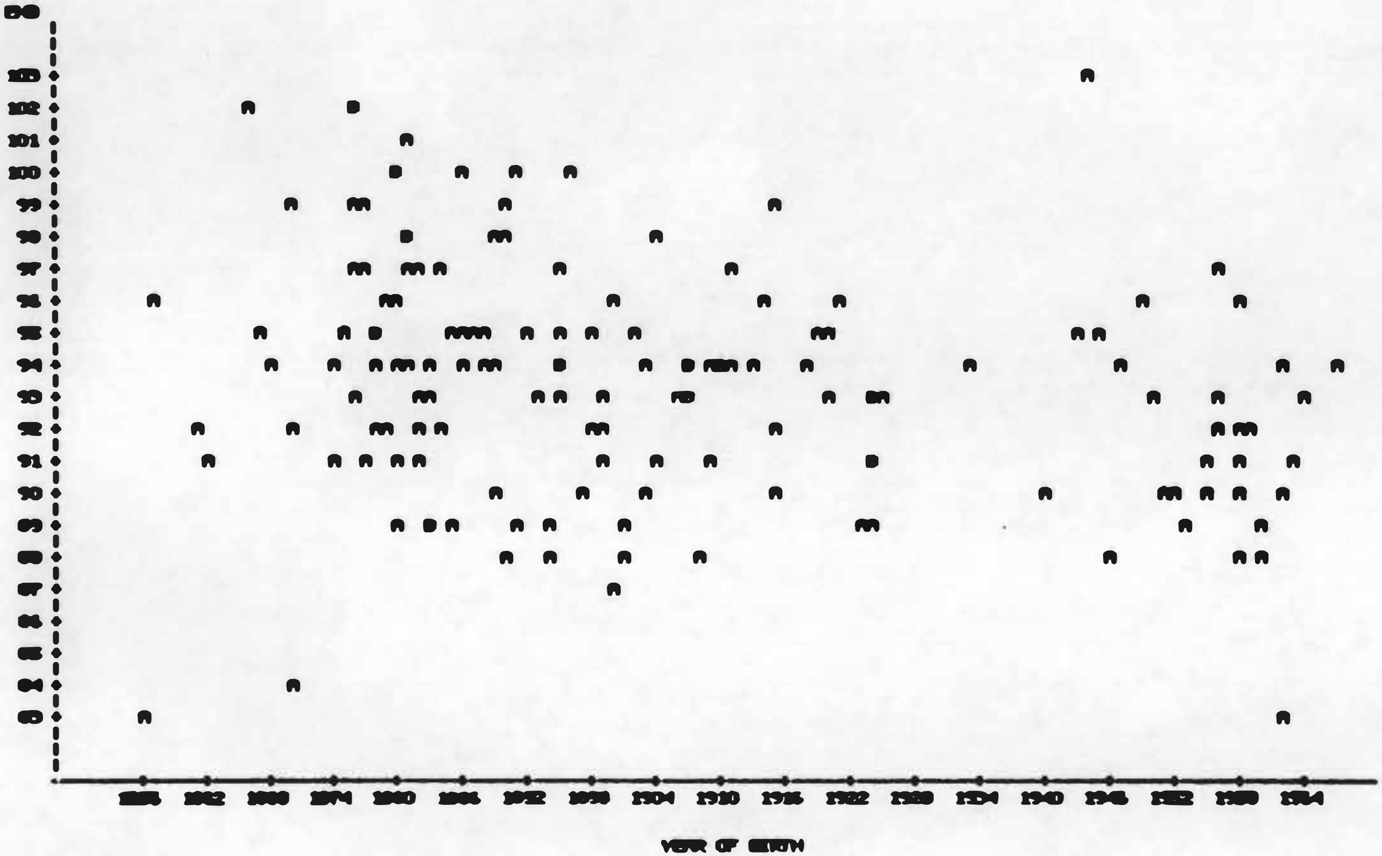

Figure 21. Plot of Biorbital Breadth and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. EKB = 154.4795 - 0.032*YEAR.

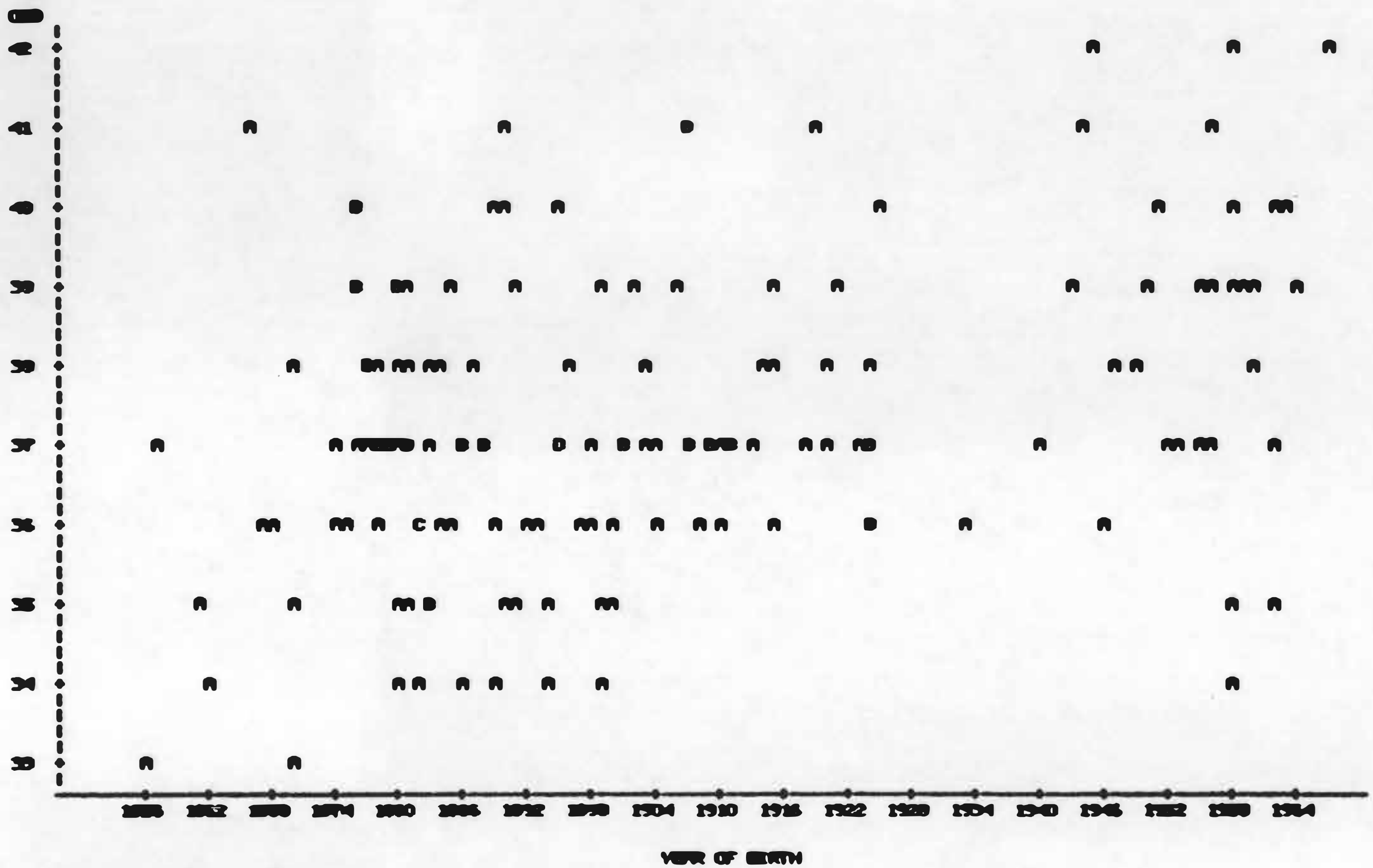

Figure 22. Plot of Orbital Breadth and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. OBB = -5.6288 + 0.0225*YEAR.

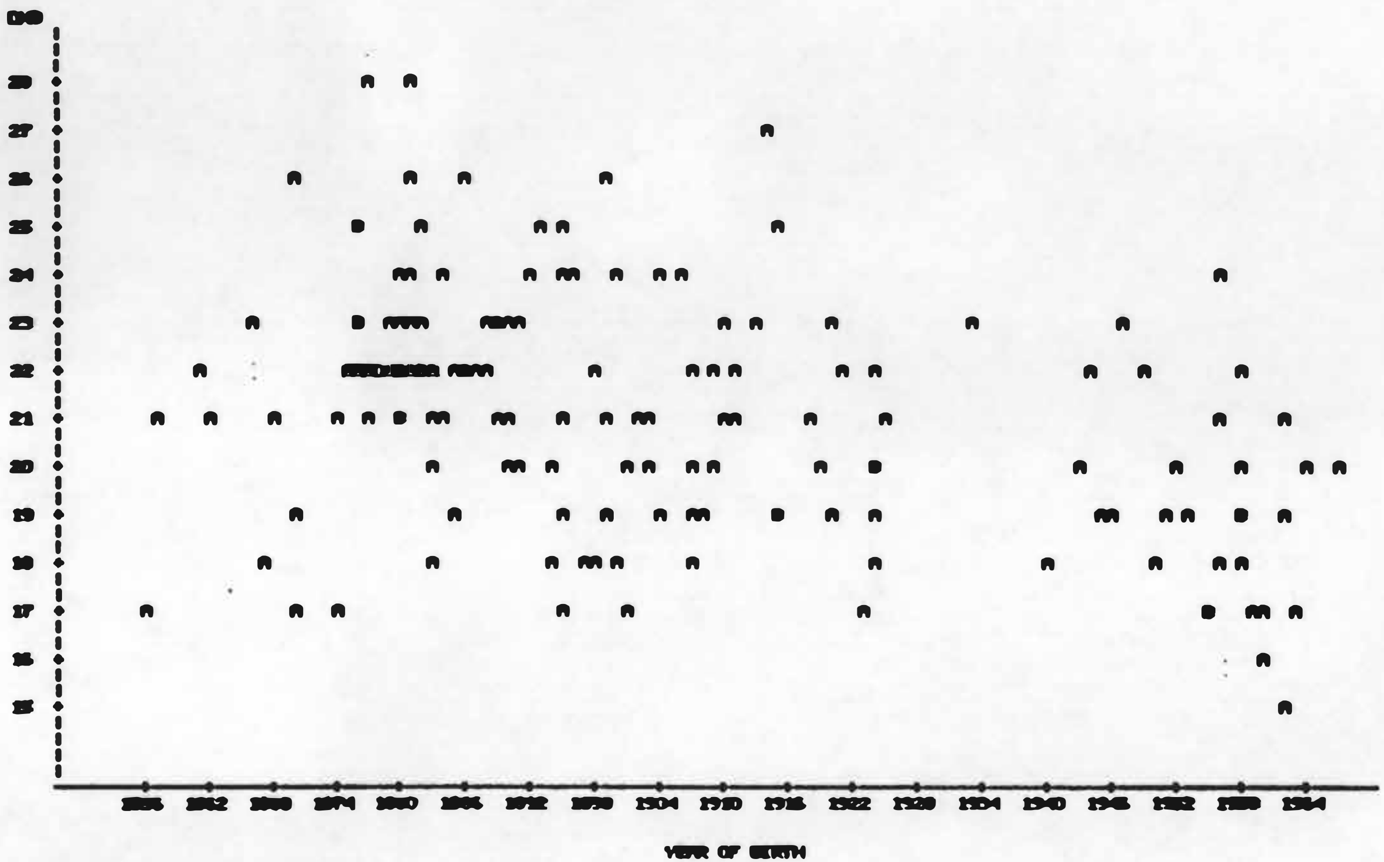

Figure 23. Plot of Interorbital Breadth and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. DKB = 86.5179 - 0.0343*YEAR.

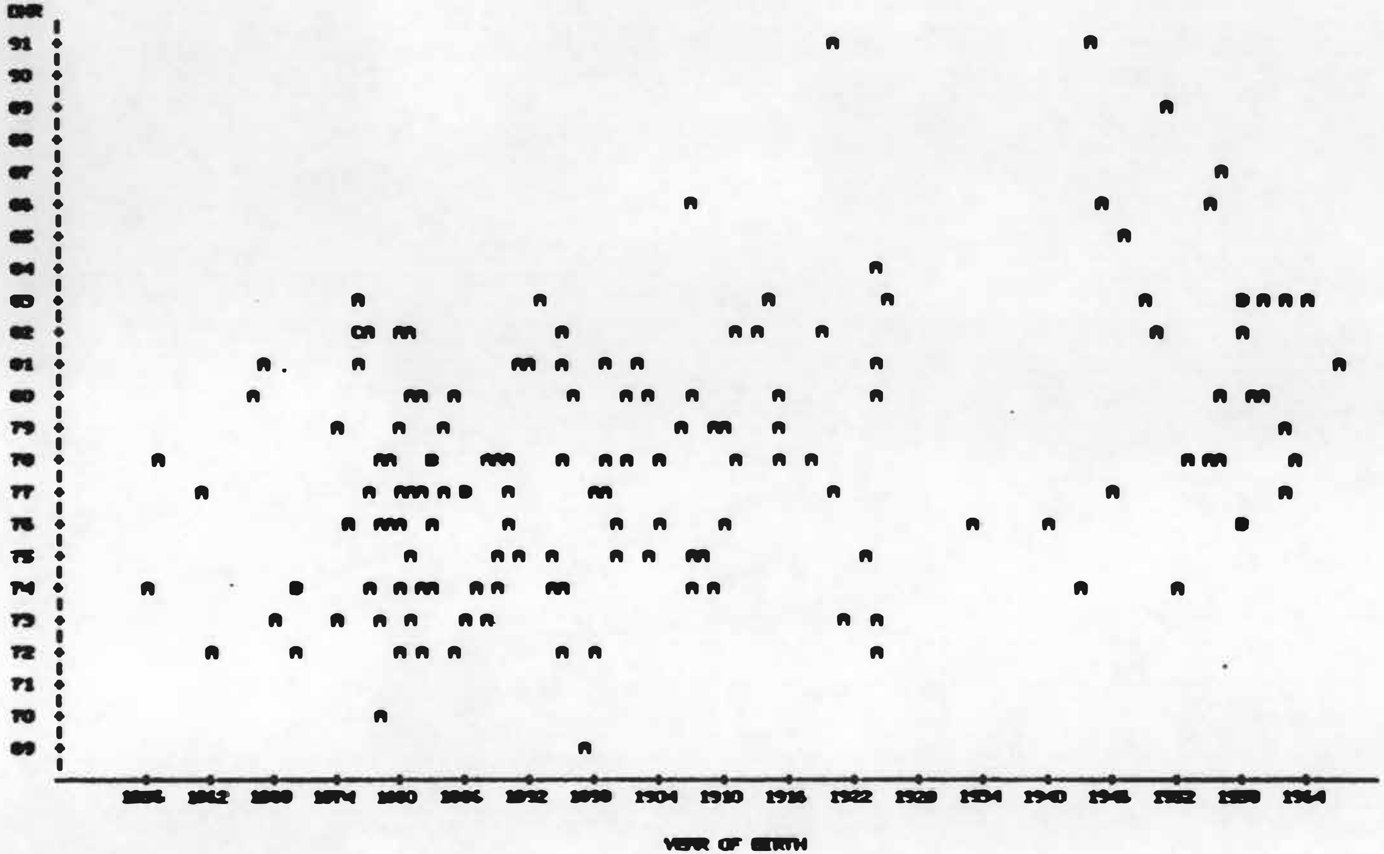

Figure 24. Plot of Dacryon Radius and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. DKR = -23.9442 + 0.0535*YEAR.

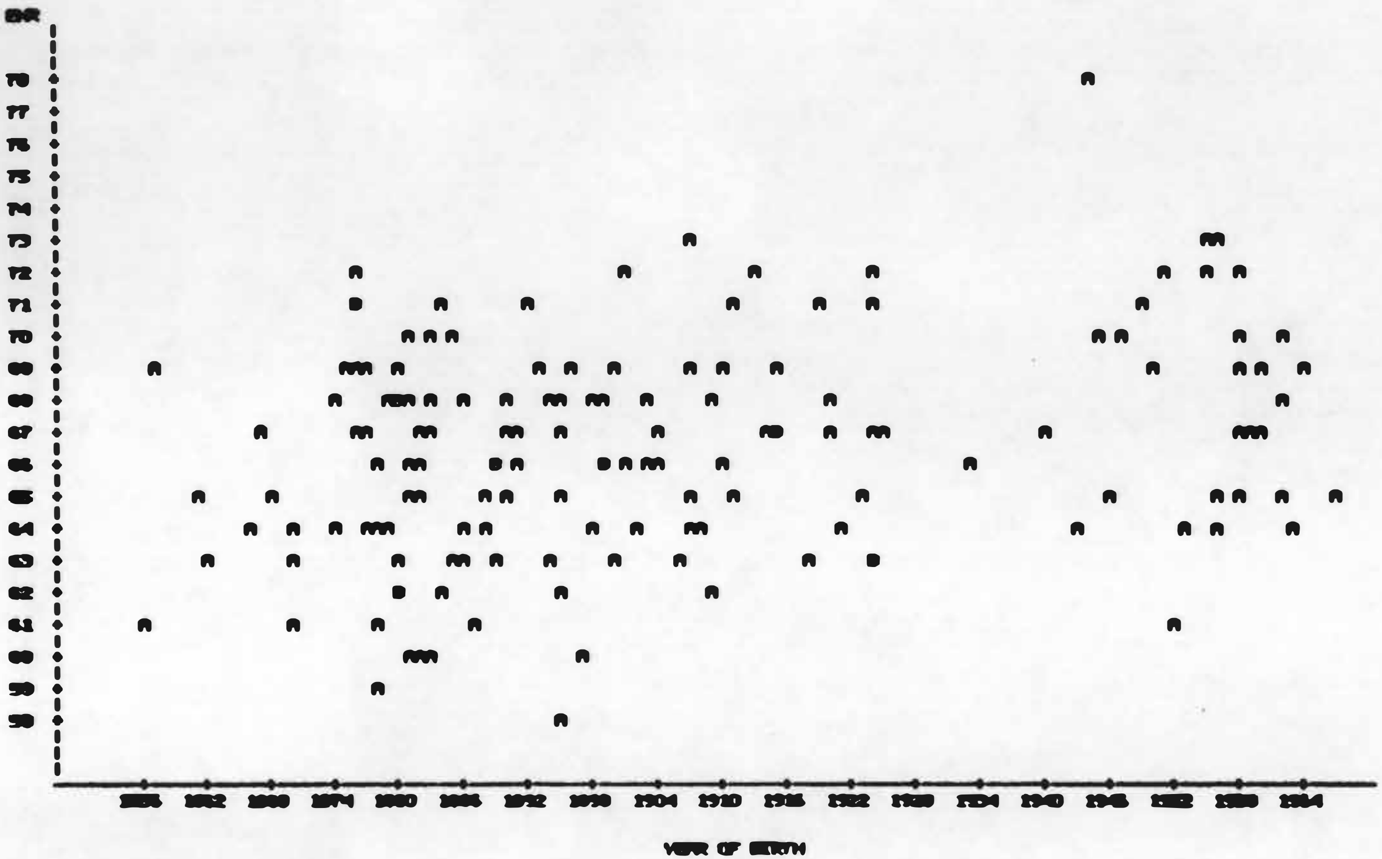

Figure 25. Plot of Ectoconchion Radius and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. EKR = 4.8788 + 0.0323*YEAR.

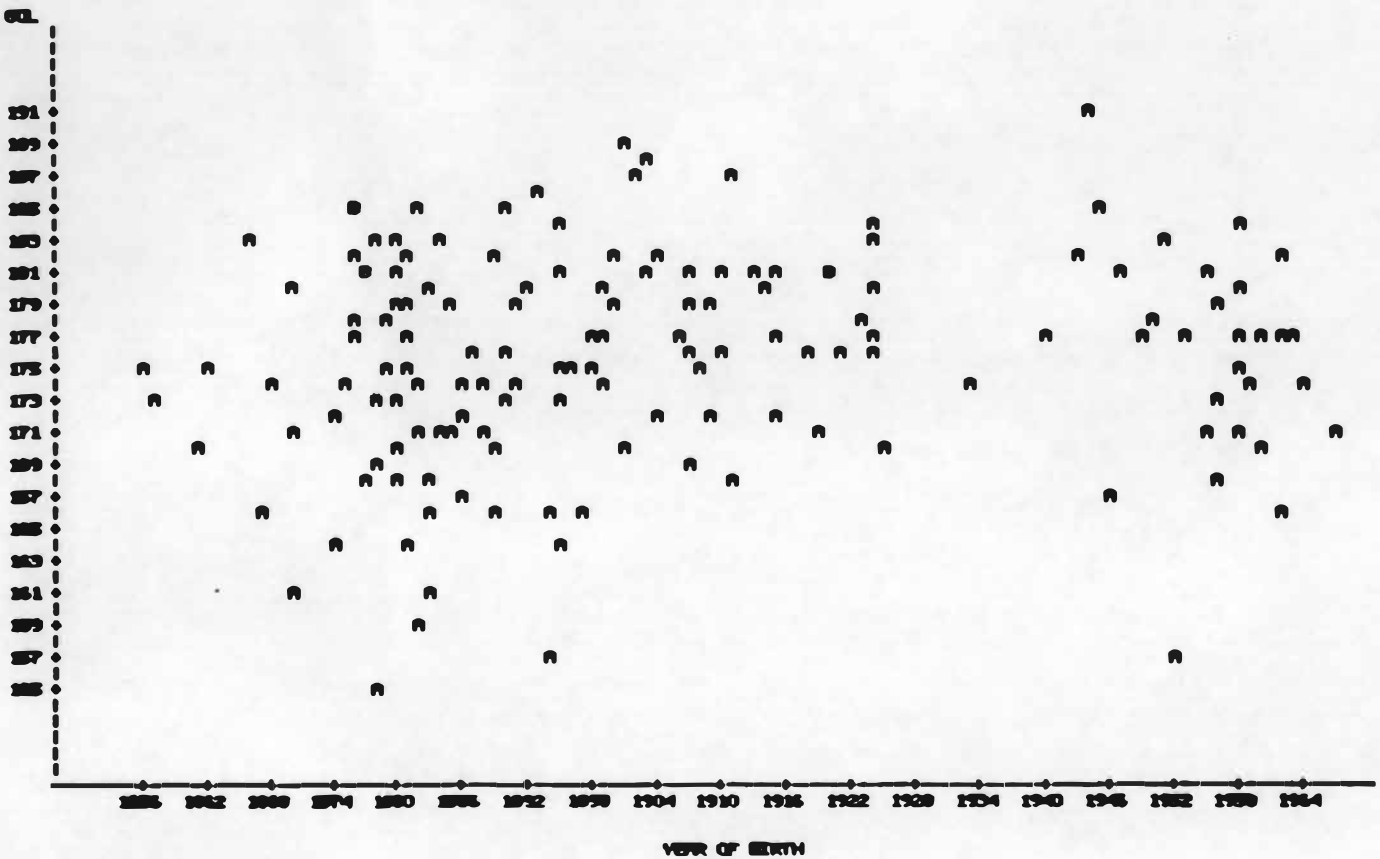

Figure 26. Plot of Glabella-Occipital Length and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. GOL = 125.2857 + 0.0264*YEAR.

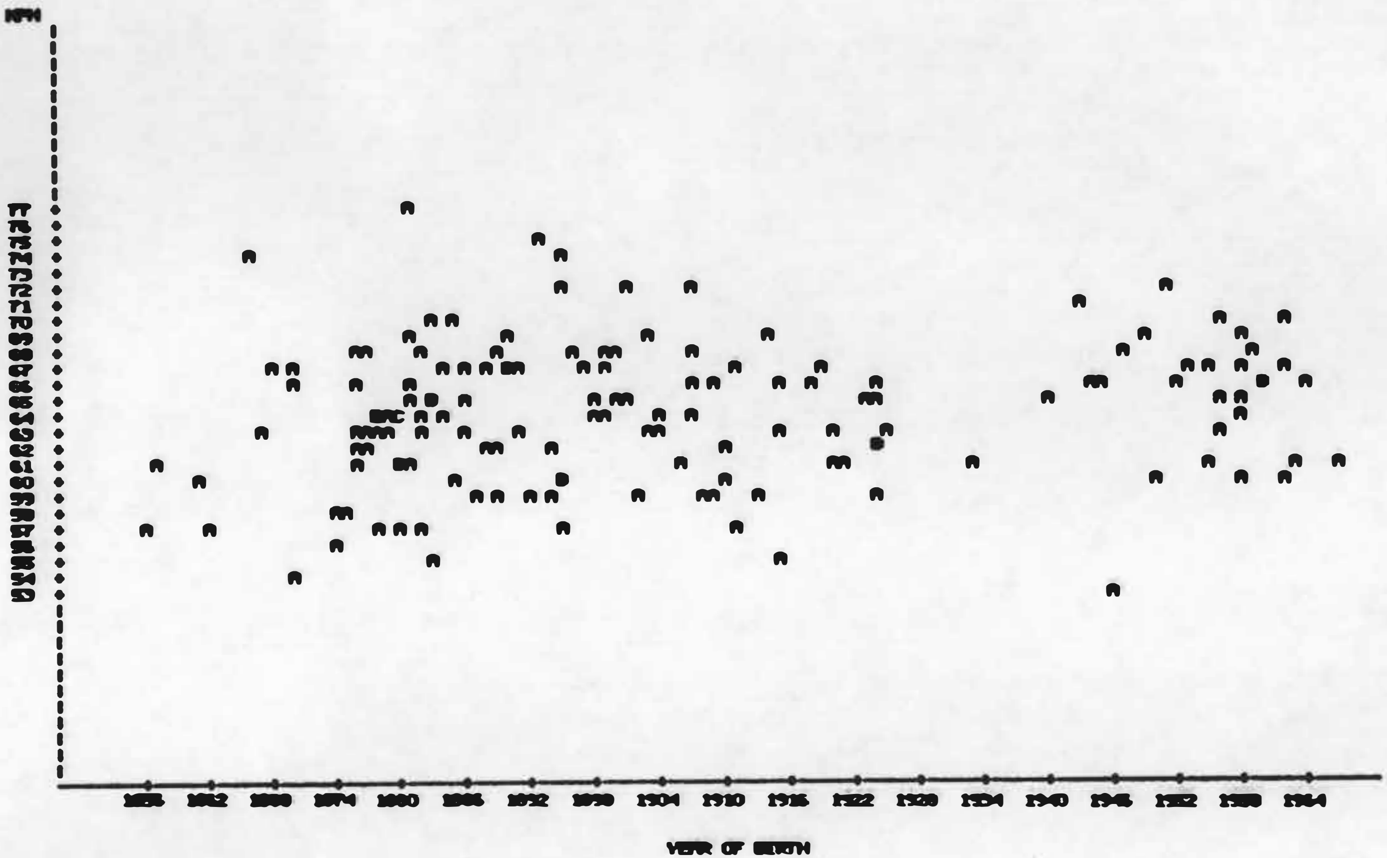

Figure 27. Plot of Nasion-Prosthion Height and year of birth denoting a secular trend in female Euro-American crania. A = 1 observation; B = 2 observations; etc. NPH = 25.7025 + 0.0202*YEAR.

Table 19. Total canonical structure for year of birth for Euro-American male crania from 1750-1970, (n = 199).

Code	Canonical Structure	Code	Canonical Structure
GOL	0.1490	FRC	0.1863
NOL	0.1495	FRS	0.0985
BNL	0.3569	FRF	0.4529
BBH	0.4457	PAC	- 0.1297
XCB	- 0.0340	PAS	0.0211
XFB	- 0.0073	PAF	0.0907
WFB	0.1290	OCC	0.3377
ZYB	- 0.0616	OCS	0.2387
AUB	0.1061	OCF	0.2948
WCB	- 0.0348	FOL	0.3290
ASB	0.1876	FOB	0.1029
BPL	0.2194	NAR	0.3642
NPH	0.2593	SSR	0.2883
NLH	0.0723	PRR	0.2651
JUB	- 0.0458	DKR	0.3560
NLB	0.1639	ZOR	0.3467
MAB	0.1326	FMR	0.2477
MAL	0.1696	EKR	0.3039
MOH	0.3968	ZMR	0.3276
MOB	- 0.0125	AVR	0.2024
OBH	0.1235	BRR	0.4825
OBB	0.3607	VRR	0.4923
OKB	- 0.2867	LAR	0.2302
NOS	- 0.1828	OSR	0.1342
WNB	0.1502	BAR	0.0025
SIS	0.1595	NAA	- 0.0548
ZMB	- 0.2749	PRA	0.0804
SSS	0.1440	BAA	0.0012
FMB	0.0544	NBA	0.2350
NAS	0.4245	BBA	- 0.2384
EKB	- 0.0142	SSA	- 0.2714
DKS	0.0402	NFA	- 0.4168
IML	0.1234	DKA	0.1001
XML	- 0.0454	NOA	0.0159
MLS	- 0.1738	SIA	- 0.1365
WMH	0.0581	FRA	0.0278
SOS	- 0.0709	PAA	- 0.1269
GLS	0.0558	OCA	- 0.0529
STB	- 0.0069	STA	- 0.3302
STS	0.2792	CBA	0.0208

(FOL) and frontal shape (NFA,STA). With the exception of the negative loading for bistephanic angle (STA), all of the above variables are characterized by positive loadings. Moderately high positive loadings are also seen in facial height (NPH) and depth (SSR, PRR) and curvature of the vault (STS, OCF), with negative loadings for interorbital breadth (DKB), maxillary breadth (ZMB), frontal and facial angles (SSA, STA).

An examination of the coefficients on the canonical variable identify a pattern of temporal variation in Euro-American crania characterized by a positive trend. The direction and temporal relationship of a few select variables are demonstrated in Figure 28 through Figure 35. The rate of change is defined in the dimensions of height (BBH, slope = .0618, p = .0001) (Figure 28), base length (BNL, slope = .0377, p = .0001) (Figure 29), and mastoid height (MDH, slope = .0278, p = .0001) (Figure 30). Estimates of rate of change in the craniofacial dimensions include height (NPH, slope = .0227, p = .0018) (Figure 31), orbital and interorbital breadth (OBB, slope = .0177, p = .0001; DKB, slope = .0135, p = .0006) (Figure 32 and Figure 33), and depth (DKR, slope = .035, p = .0001; EKR, slope = .023, p = .0002) (Figure 34 and Figure 35).

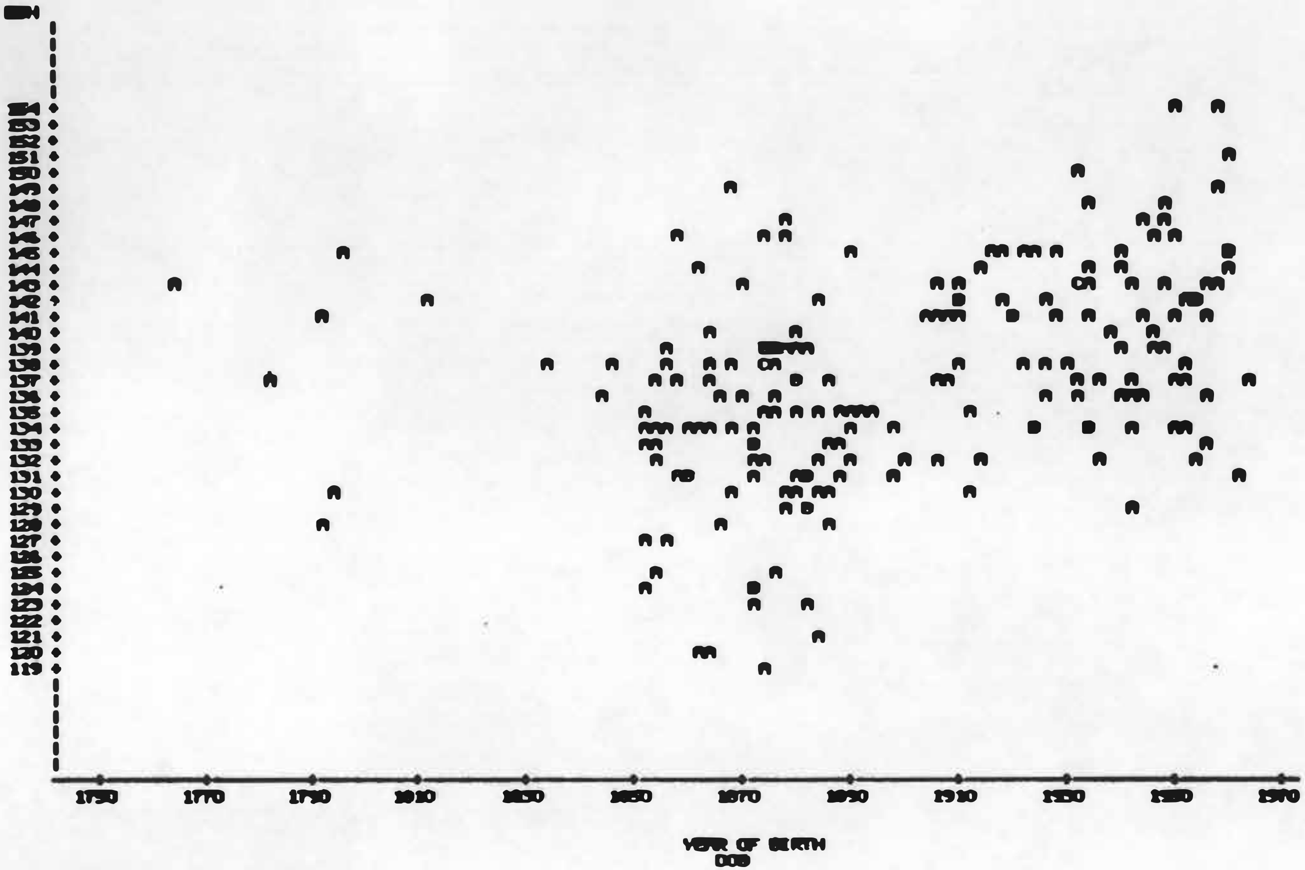

Figure 28. Plot of Basion-Bregma Height and year of birth denoting a secular trend in male Euro-American crania. A = 1 observation; B = 2 observations; etc. BBH = 19.7092 + 0.0618*YEAR.

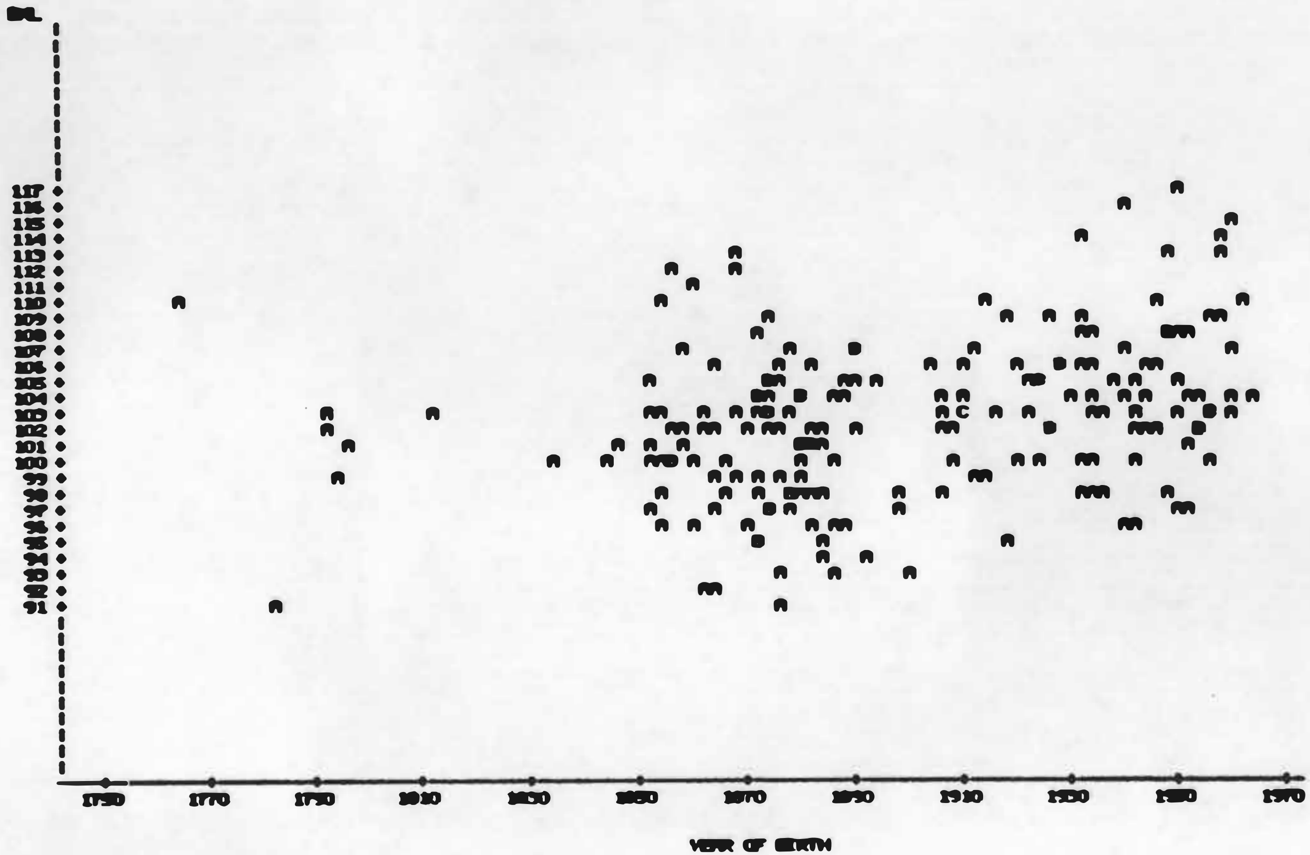

Figure 29. Plot of Basion-Nasion Length and year of birth denoting a secular trend in male Euro-American crania. A = 1 observation; B = 2 observations; etc. BNL = 31.0496 + 0.0377*YEAR.

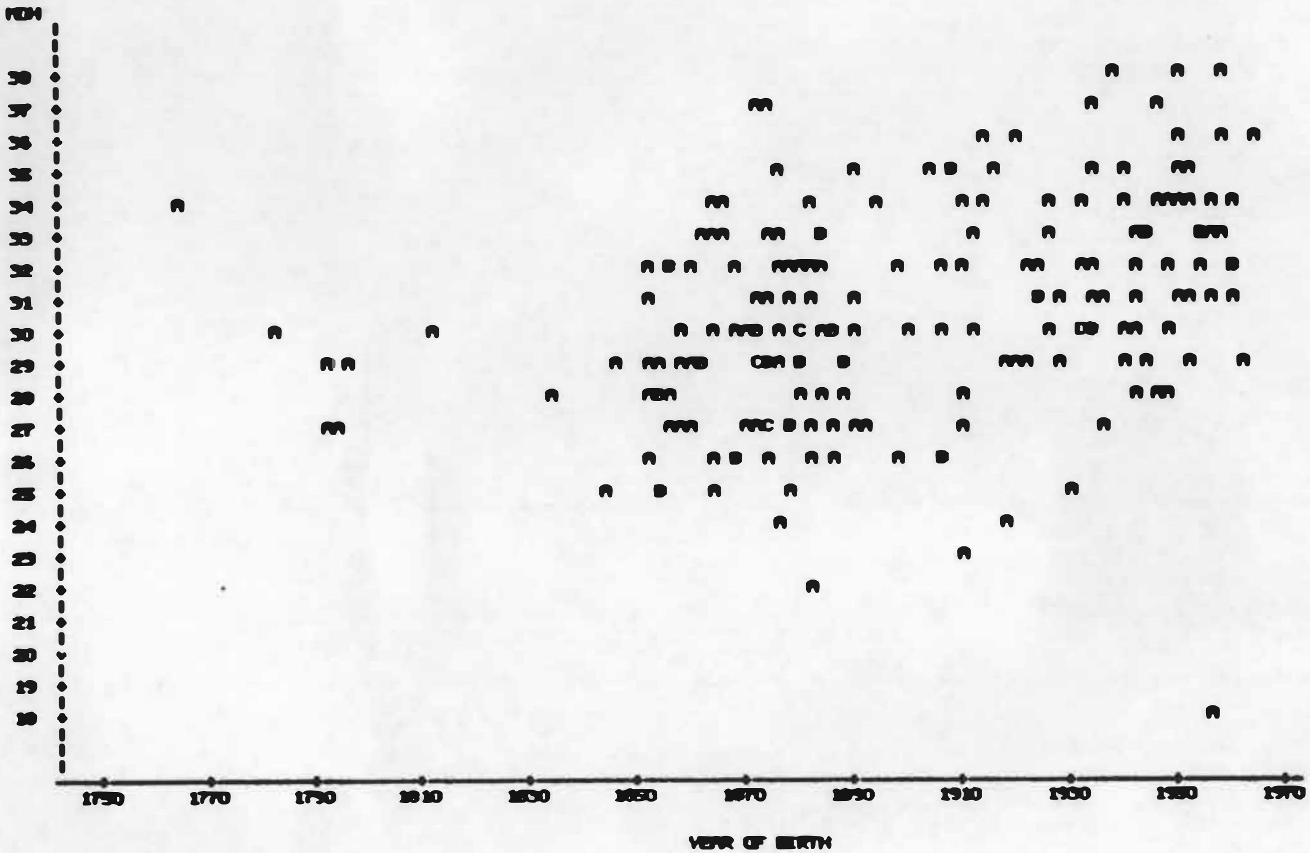

Figure 30. Plot of Mastoid Height and year of birth denoting a secular trend in male Euro-American crania. A = 1 observation; B = 2 observations; etc. MDH = -22.2242 + 0.0278*YEAR.

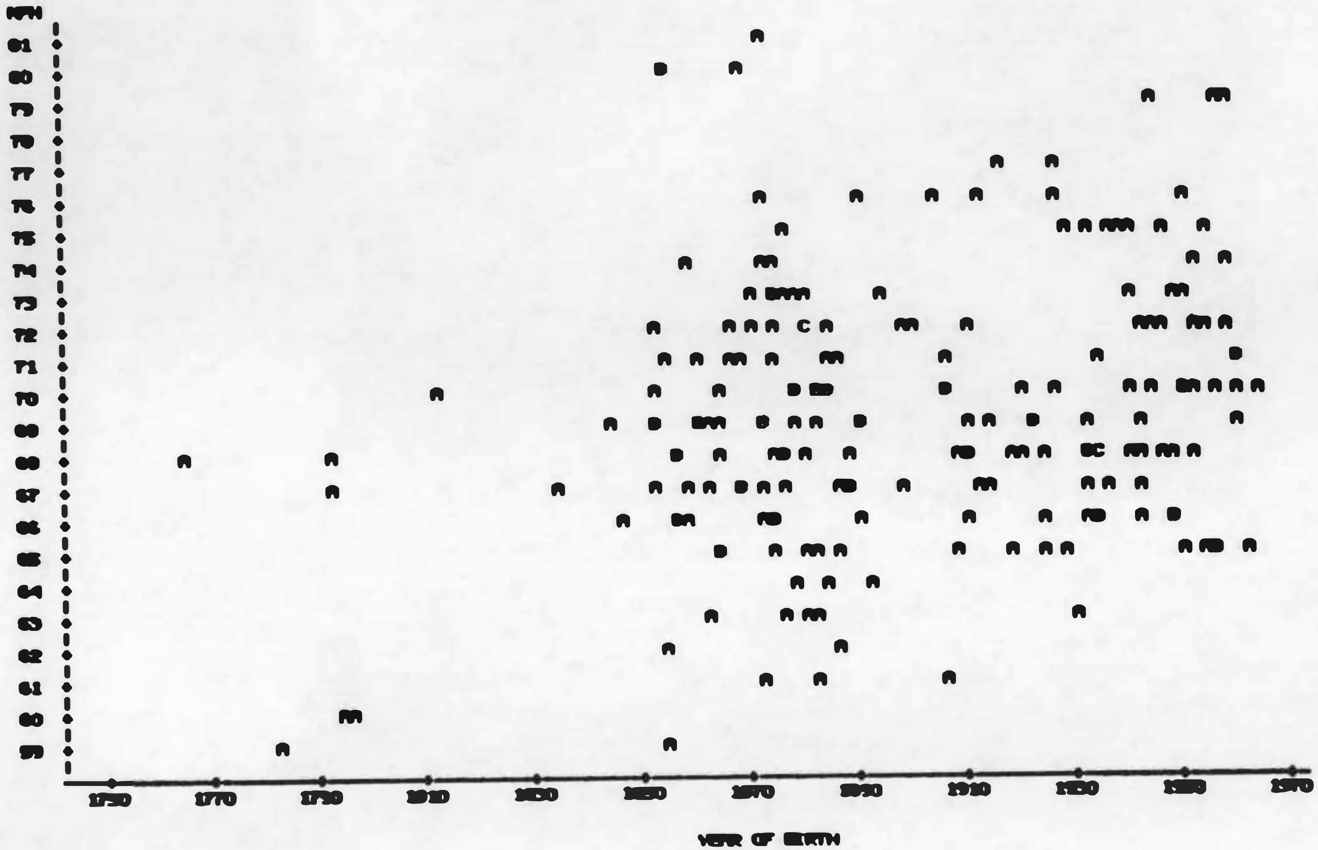

Figure 31. Plot of Nasion-Prosthion Height and year of birth denoting a secular trend in male Euro-American crania. A = 1 observation; B = 2 observations; etc. NPH = 26.2247 + 0.0227*YEAR.

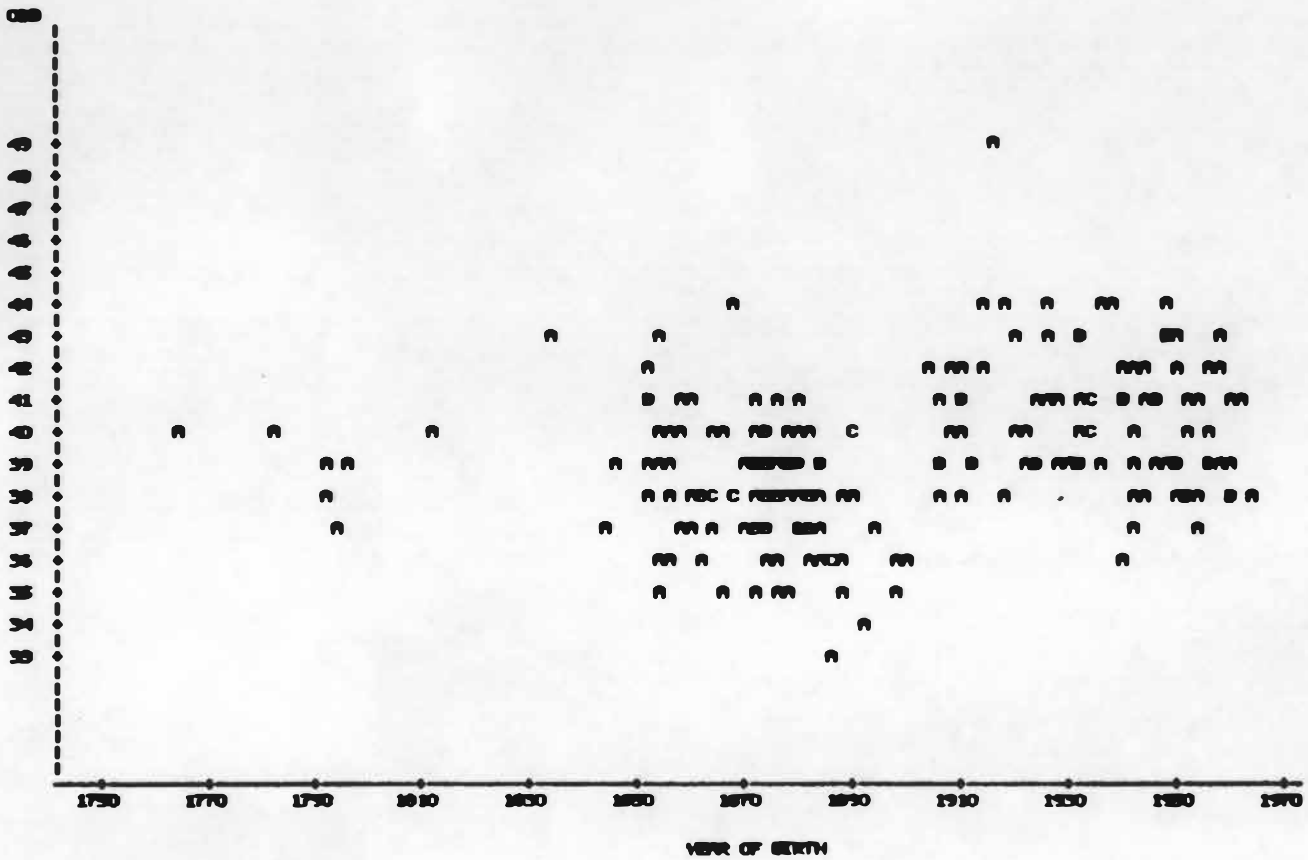

Figure 32. Plot of Orbital Breadth and year of birth denoting a secular trend in male Euro-American crania. A = 1 observation; B = 2 observations; etc. OBB = 5.6 + 0.0177*YEAR.

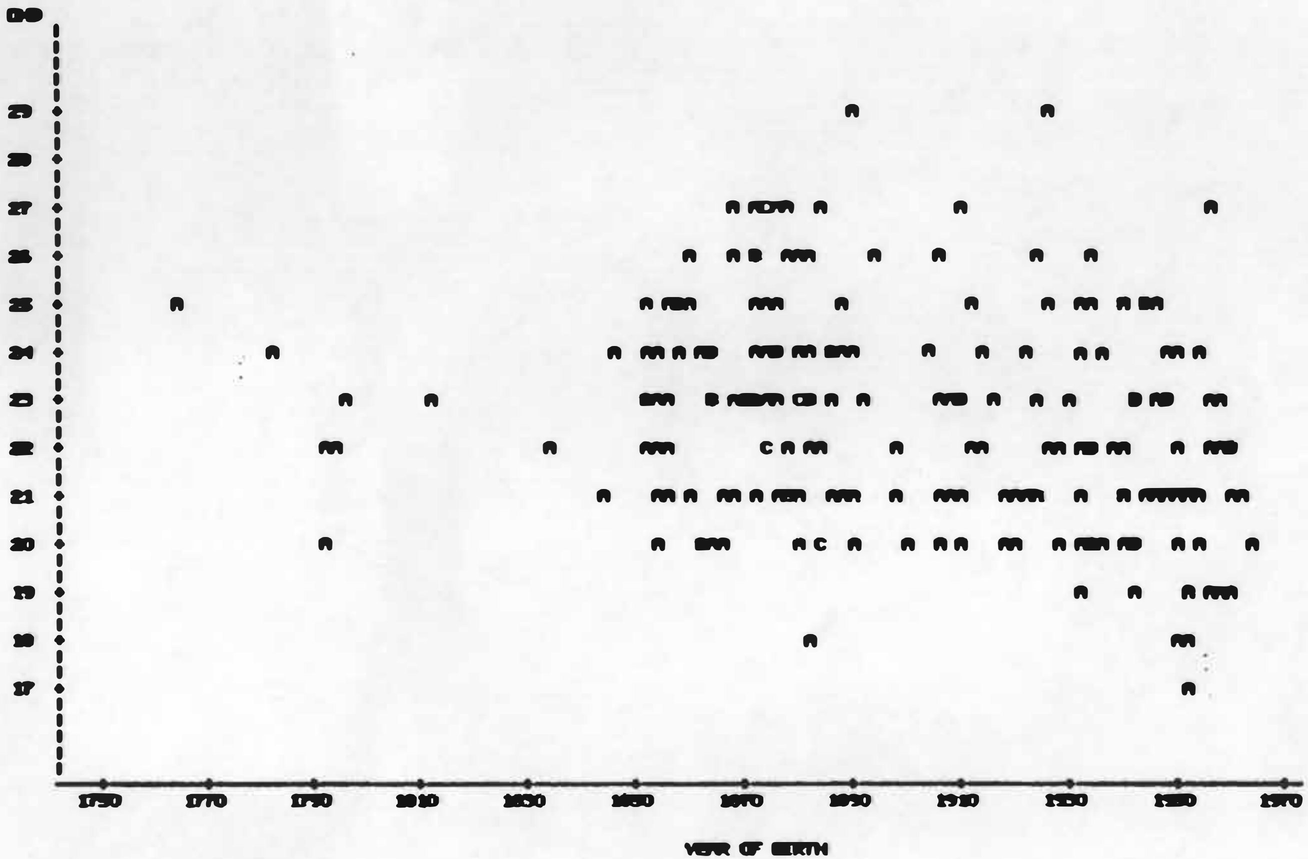

Figure 33. Plot of Interorbital Breadth and year of birth denoting a secular trend in male Euro-American crania. A = 1 observation; B = 2 observations; etc. DKB = 48.1904 - 0.0135*YEAR.

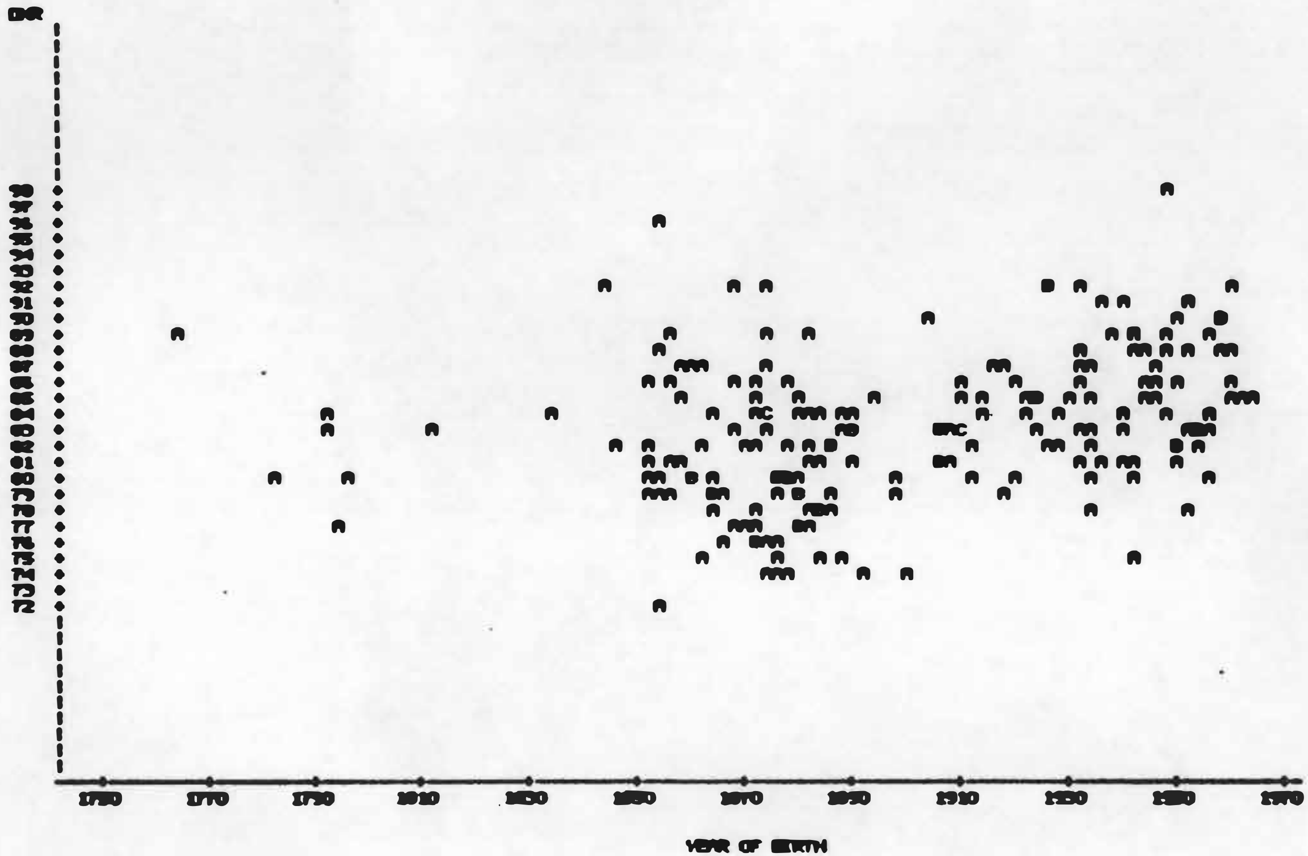

Figure 34. Plot of Dacryon Radius and year of birth denoting a secular trend in male Euro-American crania. A = 1 observation; B = 2 observations; etc. DKR = 16.6046 + 0.035*YEAR.

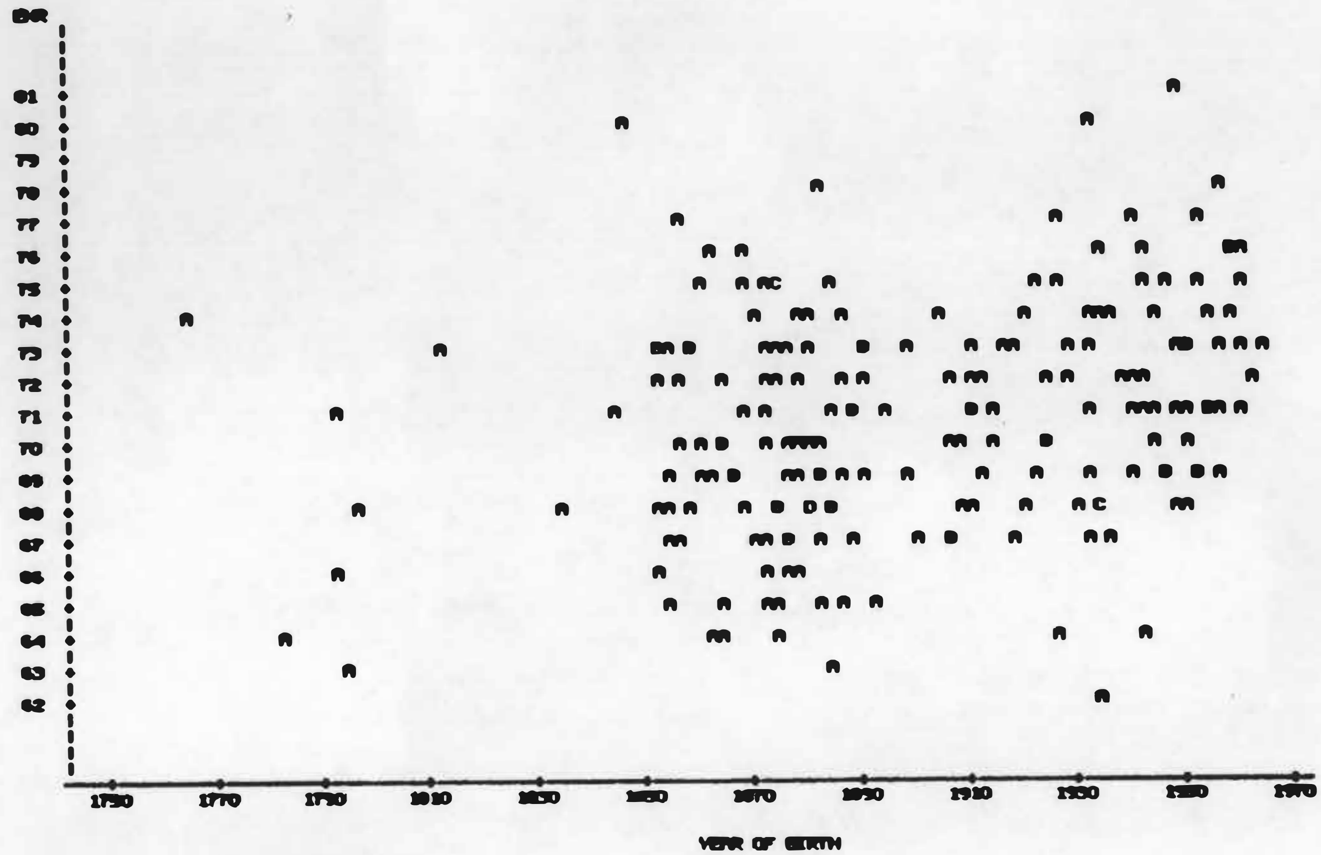

Figure 35. Plot of Ectoconchion Radius and year of birth denoting a secular trend in male Euro-American crania. A = 1 observation; B = 2 observations; etc. EKR = 27.0493 + 0.023*YEAR.

To illustrate major group differences and within-group variation a summary comparison of the demonstrated group trends is presented below.

<u>Group Comparison of Temporal Cranial Trends</u>

Patterns of temporal variation indicative of a secular trend are tabulated for those craniometric variables which show the greatest amount of change during the past two centuries. Table 20 through Table 23 summarize the pattern of the secular changes in the crania vault. The vault is examined in terms length, height, breadth and curvature.

The secular trend in the Euro-American series is exhibited by a temporal change in the vault as defined by a lesser increase in the frontal segment of the cranial length and a prominent increase in cranial height (Table 20). However, the increase in height is primarily a reflection of an increase in vault height superior to the transmeatal axis as defined by the vertex and bregma radii. Table 21 shows that the portion of the total cranial height below the transmeatal axis defined by the basion and opisthion radii exhibits contributes less to the total cranial height than is observed for the bregma and vertex radii in Table 20.

Table 20. Total canonical structure for temporal association (DOB). Recent secular change in the size and shape of the cranial vault of Afro- and Euro-American skeletal series between 1750 and 1970.

Variable	Code	Euro-American Females	Euro-American Males	Afro-American pooled gender
Length:				
Glabella-Occipital Length	GOL	+ 0.1271	+ 0.1490	- 0.2749
Nasion-Occipital Chord	NOL	+ 0.1249	+ 0.1495	- 0.2540
Nasion-Bregma Chord	FRC	+ 0.2630	+ 0.1863	- 0.1742
Height				
Basion-Bregma Height	BBH	+ 0.4497	+ 0.4457	- 0.2576
Bregma Radius	BRR	+ 0.3461	+ 0.4825	- 0.1598
Vertex Radius	VRR	+ 0.3468	+ 0.4923	- 0.1688
Curvature:				
Frontal Subtense	FRS	+ 0.3035	+ 0.0985	+ 0.0398
Frontal Fraction	FRF	+ 0.3166	+ 0.4629	- 0.1780
Stephanic Subtense	STS	- 0.0072	+ 0.2792	- 0.1972
Parietal Fraction	PAF	+ 0.0778	+ 0.0907	- 0.2895
Lambda Radius	LAR	+ 0.1130	+ 0.2302	- 0.2014
Occipital Subtense	OCS	+ 0.1029	+ 0.2387	+ 0.0206
Occipital Fraction	OOF	+ 0.1350	+ 0.2948	- 0.0077
Lambda-Opisthion Chord	OOC	+ 0.2059	+ 0.3377	- 0.0576
Breadth:				
Bistephanic Breadth	STB	- 0.2765	- 0.0069	- 0.1924
Minimum Cranial Breadth	WCB	- 0.2696	- 0.0348	- 0.1982
Maximum cranial breadth	XCB	- 0.2228	- 0.0340	- 0.2763
Biasterionic breadth	ASB	+ 0.2588	+ 0.1876	- 0.1141

Table 21. Total canonical structure for temporal association (DOB). Recen secular change in the size and shape in the cranial base of Afro- and Euro-American skeletal series between 1750 and 1970.

Variable	Code	Euro-American Females	Euro-American Males	Afro-American pooled gender
Length:				
Basion-Nasion Length	BNL	+ 0.3592	+ 0.3569	- 0.2074
Height:				
Opisthion Radius	OSR	+ 0.1628	+ 0.1342	- 0.2062
Basion Radius	BAR	+ 0.2150	+ 0.0025	- 0.1355
Breadth:				
Biauricular Breadth	AUB	- 0.1803	+ 0.1061	- 0.2055
Foramen Magnum:				
Length	FOL	+ 0.1164	+ 0.3290	- 0.0954
Breadth	FOB	+ 0.0966	+ 0.1029	- 0.1193
Mastoid Process:				
Length	MDH	+ 0.2309	+ 0.3968	- 0.0803

Table 22. Total canonical structure for temporal association (DOB). Recent secular change in the size and shape of the face of Afro- and Euro-American skeletal series between 1750 and 1970.

Variable	Code	Euro-American Females	Euro-American Males	Afro-American pooled gender
Depth/Projection:				
Supraorbital Projection	SOS	- 0.3380	- 0.0709	- 0.1359
Nasion Radius	NAR	+ 0.2724	+ 0.3642	- 0.0697
Naso-Frontal Subtense	NAS	+ 0.1542	+ 0.4245	+ 0.1409
Dacryon Subtense	NDS	- 0.3474	- 0.1828	+ 0.2972
Dacryon Radius	DKR	+ 0.4279	+ 0.3560	- 0.1020
Frontomalare Radius	FMR	+ 0.2218	+ 0.2477	- 0.1876
Ectoconchion Radius	EKR	+ 0.3088	+ 0.3039	- 0.2188
Zygoorbitale Radius	ZOR	+ 0.2485	+ 0.3467	+ 0.1857
Zygomaxillare Radius	ZMR	+ 0.2121	+ 0.3276	- 0.3196
M1 alveolar Radius	AVR	+ 0.0535	+ 0.2024	- 0.2499
Subspinale Radius	SSR	+ 0.2164	+ 0.2883	- 0.2922
Prosthion Radius	PRR	+ 0.1648	+ 0.2651	- 0.1350
Basion-Prosthion Length	BPL	+ 0.1895	+ 0.2194	- 0.2162
Height:				
Nasion-Prosthion Height	NPH	+ 0.1489	+ 0.2598	+ 0.1010
Breadth:				
Bizygomatic Breadth	ZYB	- 0.2563	- 0.0616	- 0.4197
Bijugular Breadth	JUB	- 0.1267	- 0.0468	+ 0.3918
Nasal Breadth	NLB	- 0.2218	+ 0.1639	- 0.3135
External Palatal Breadth	MAB	+ 0.2345	+ 0.1326	- 0.1085
Bimaxillary Breadth	ZMB	- 0.2748	- 0.2749	- 0.2100
Frontomalar Breadth	FMB	- 0.1744	+ 0.0544	- 0.2736
Biorbital Breadth	EKB	- 0.2789	- 0.0142	- 0.3371
Interorbital Breadth	DKB	- 0.4883	- 0.2867	- 0.3371
Orbital Breadth	OBB	+ 0.3818	+ 0.3607	- 0.2613

Table 23. Total canonical structure for temporal association (DOB). Recent secular change in the size and shape of the angular cranial dimensions of Afro- and Euro-American skeletal series between 1750 and 1970.

Variable	Code	Euro-American Females	Euro-American Males	Afro-American pooled gender
Nasion Angle (Na-Br)	NBA	+ 0.1893	- 0.2350	- 0.0590
Basion Angle (Na-Pr)	BAA	- 0.0670	- 0.0012	- 0.2678
Zygomaxillary Angle	SSA	- 0.2664	- 0.2714	- 0.0070
Naso-frontal Angle	NFA	- 0.2083	- 0.4168	- 0.2429
Dacryal Angle	DKA	+ 0.2116	+ 0.1001	- 0.2468
Simotic Angle	SIA	- 0.2489	- 0.1365	- 0.2465
Parietal Angle	PAA	- 0.2477	- 0.1269	+ 0.0981
Bistephanic Angle	STA	- 0.1446	- 0.3302	+ 0.1754
Cranial base Angle	CBA	- 0.2262	+ 0.0208	- 0.0576
Basion Angle (Na-Br)	BBA	- 0.1922	- 0.2384	+ 0.0228

Returning to Table 20, it is noted that the breadth dimension of the Euro-American cranium is characterized by a narrowing of the vault in females except at asterion where widening is observed. Little change is observed in the breadth dimensions for the male cranial series. The most notable change in the individual bones of the vault is seen in the shape of the frontal bone. Table 20 shows the increase in sagittal curvature and cranial length. In males, the bistephanic angle reflects a decrease and shape change in the transverse dimension of the frontal bone (Table 23).

The cranial base is characterized by an increase in its length in both sexes and by an elongation of the foramen magnum in in the male series. The cranial base appears most stable in the breadth and depth dimensions. An increase in mastoid length is observed for both female and male Euro-American series (Table 22).

Craniofacial temporal changes are most prominent in the Euro-American series (Table 22). Both females and males are characterized by a significant increase in the facial radii resulting in a greater projection of the face. With the exception of a decrease in supraorbital projection in females, the increase in facial projection is consistent in upper, middle and lower sections of the face (Table 22). Height of the face shows little or only moderate increase. This increase is slightly greater in male crania than in female crania. Breadth dimensions of the face follow the trend observed in the vault. The secular trend observed in the face is characterized by a narrower face in all of the external dimension except in the palate (Table 22). An increase in palatal breadth is contrasted by a prominent decrease in interorbital breadth and a corresponding increase in orbital breadth. Although minor, an interesting contrast between female and male crania is illustrated by a temporal decrease in the nasal breadth of the female crania and a slight increase in the male crania.

In the angular variables relating to cranial shape, changes in the facial configuration are characterized by a more pointed face. It is more pronounced in males than in females and is characterized by decreases in the naso-frontal and zygomaxillary angles (Table 23). A pointed frontal illustrated by the bistephanic angle is noted in the male series.

In contrast, the Afro-American series exhibits only minor changes in shape. A uniform negative temporal trend indicates a general decrease in cranium size of the Afro-American series. Where Euro-American crania may experience a slight increase in vault length, Afro-American crania are characterized by a corresponding decrease. Cranial height exhibits a similar contrast (Table 20), but in this case there appears to be little difference in the rate of its two segments defined by the vault and base heights (Table 20 and Table 21). Changes in vault breadth and curvature are slight in the Afro-American series and reflect the overall decrease in size. An exception to this pattern is a relatively greater decrease in the parietal fraction which translates into a minor change in the upper vault curvature. The significance of this decrease is not easily explained.

The cranial base of the Afro-American series exhibits change in the opposite direction of the cranial base changes noted in the Euro-American series (Table 21). The observed shortening and possible narrowing is minor, if at all significant. No change is seen in mastoid height in the Afro-American series in contrast to the lengthening of the mastoid process in the Euro-American series.

Craniofacial changes in the Afro-American series show a trend towards a shorter and narrower face in contrast to the longer, but also narrower face in the Euro-American series (Table 23). The face is uniformly shorter. The relative increase in the projection of dacryon may reflect some minor changes in the shape of the midfacial projection of the face. A reduction in the basion angle at basion and between prosthion and nasion is a reflection of the reduced height and shortening of the cranial base.

For the two series of Afro-American and Euro-American crania examined, two distinct temporal trends can be identified. On the one hand, the Afro-American series exhibits a general, temporally defined reduction in cranial size with lesser changes in shape. The Euro-American sample, on the other hand, is characterized by a noticeable projection and possible increase in height of the face, a minor increase in cranial length and a prominent increase in height, and a marked decrease in vault and facial breadth.

VII. COLLECTION ASSOCIATION

Univariate statistics are listed in Appendix D for the Hamann-Todd and R. J. Terry cranial series, including menas and standard deviations by gender and race. The definitions corresponding to each of the 65 measurements and 15 angles, referred to in section four are presented in Appendix B.

The Hamann-Todd and R. J. Terry Skeletal Series

The investigation into the variation among collections addresses the question of the geographical and demographic differences between the Hamann-Todd and the R. J. Terry anatomical collections. Collection association is assumed in part to define population differences based on historical or geographical origin. It is well documented that the anatomical series represent lower socioeconomic segments of two urban populations (Cobb 1952; Corruccini 1974; Trotter 1981). Further, it is thought that recent internal migration of Afro-Americans from the rural South is represented in the collections. European immigrants entering the United States during latter part of the nineteenth century represent two major periods of immigrations. The earlier infusion of immigrants was generally representative of northern and western Europe, including Britain, Germany, and the Scandinavian countries. On the other hand, the later group of immigrants included a greater number of central, eastern and southern Europeans, and more recently central and southern Europeans (Dinnerstein and Reimers 1975). Available census data from Cleveland, Ohio and St. Louis, Missouri, homes of the two anatomical collections, suggest a recognizable differentiation in the ethnic makeup of the two cities. St. Louis, on the one hand, is generally German/British whereas Cleveland is has an added component of eastern and southern European ethnic groups.

To test the hypothesis that geographical variation reflects ethnic differences, several MANOVAs were done for the Afro-American and Euro-American series. The null hypothesis of zero canonical correlation is tested for the interaction of each of the main effects. In Table 24, the test of interaction between gender and collection association in the Afro-American sample shows a nonsignificant correlation for the interaction term with a Wilks' Lambda of .6593 (F = .9, p = .6862). No interaction is interpreted to mean that differences due to gender do not vary between collections. In Table 25, the Euro-American series show a significant correlation with the interaction term, indicated by a Wilks' Lambda of .5333 (F = 1.53, p = .0140). It is suggested that patterns of sexual dimorphism within each collection may,

Table 24. MANOVA test for interaction, gender (SEX) and collection association (CUR) in Afro-American crania of the Hamann-Todd and R. J. Terry anatomical skeletal collections, (n = 223).

Model	Canonical Correlation	Squared Canonical Correlation	Standard Error	Eigen Value	Wilks' Criterion	F Ratio	PR > F
CUR*SEX	0.583718	0.340727	0.044448	0.5168	0.65927296	0.90	0.6862
CUR	0.787920	0.620818	0.025507	1.6373	0.37918212	2.89	0.0001
SEX	0.881204	0.776520	0.015033	3.4747	0.22348012	6.12	0.0001

Table 25. MANOVA test for interaction, gender (SEX) and collection association (CUR) in Euro-American crania from the Hamann-Todd and R. J. Terry anatomical skeletal collections, (n = 223).

Model	Canonical Correlation	Squared Canonical Correlation	Standard Error	Eigen Value	Wilks' Criterion	F Ratio	PR > F
CUR*SEX	0.683147	0.5481	0.035956	0.8751	0.53331032	1.53	0.0140

at least in part, reflect contrasting trends between collections.

Canonical Discriminant Analysis of Collection Association

A canonical discriminant analysis , CANDISC, was performed to explore and illustrate the patterns of cranial morphometric variation due to collection association suggested by the MANOVAs presented above. A CANDISC is done separately for the Afro-American and Euro-American series. Four groups defined by sex and collection are used in each of the two separate analyses. Sample sizes for the four Afro-American and four Euro-American samples from the two collections are shown in Table 26. An examination of Table 26. shows minor problems incurred in the sampling of the two collections. The problem of sampling relates specifically to the male groups in the Hamann-Todd collection and to the female Afro-American group of the R. J. Terry collection. Since canonical discriminant analysis is a robust technique, the assumption of multivariate normality of the distribution of each group is assumed reasonable for the purposes of the present study. However, caution is urged in the interpretation of the results.

Table 26. Sample size by ethnic affinity and gender of crania from the Hamann-Todd and R. J. Terry anatomical skeletal collections.

	Euro-American		Afro-American		
Collection	Sample Size	Percent	Sample Size	Percent	Total
Terry males	n = 75	33.63	n = 65	29.15	140
Terry females	n = 50	22.42	n = 40	17.94	90
Todd males	n = 37	16.59	n = 46	20.63	83
Todd females	n = 61	27.36	n = 72	32.28	133
	N = 223	100.00	N = 223	100.00	446

Among-Group Variation - Afro-American Series

The differences among the Afro-American crania of the Hamann-Todd and R. J. Terry collections is explained by two axes of variation and reflects a homogeneous pattern of sexual dimorphism. The first axis is represented by large loadings and probably reflects size variation and sexual dimorphism. The second axis defines specific shape changes in the crania of the Afro-American crania between collections. These shape changes are unrelated to trends of sexual dimorphism. The more complex picture exhibited by the Euro-American sample is characterized by a third canonical variate. While the two first axes may be interpreted much the same as in the Afro-American sample, the third variate adds a complex picture of contrasting patterns between groups where relative patterns of sexual dimorphism interact with collection association.

Canonical discriminant scores are used to explore further the pattern of variation exhibited in the Afro-American series from the two anatomical collections. Two canonical axes, significant at the .05 level, are defined and account for 91.45 % of the total variance due to sex and geographical location between the groups (Table 27). Each renders a morphological interpretation of the among-group pattern of variation. The first canonical axes (CAN1) accounts for approximately 65 % of the total

Table 27. Canonical discriminant analysis of Afro-American female and male crania of the Hamann-Todd and R. J. Terry anatomical skeletal collections, (n =- 223).

Number	Canonical Correlation	Approximate Standard Error	Squared Canonical Correlation	Eigen Value	Proportion of Variation	Likelihood Ratio	F Ratio	PR > F
1	0.890586	0.013883	0.793143	3.8343	0.6476	0.05321643	2.9097	0.0001
2	0.782590	0.026011	0.612445	1.5803	0.2669	0.25726167	1.7341	0.0001

variance and displays high loadings for bizygomatic breadth (ZYB) and bijugal breadth (JUB). Moderate loadings are exhibited for cranial length (GOL and NOL), height (BBH), base length (BNL), face and nasal height (NPH and NLH), breadth of the midface (FMB, EKB), orbital and mastoid height (OBB,MDH) and facial depths (NAR, SSR, DKR and EKR). These results indicate an apparent sexual dimorphism in these dimensions (Table 28).

The second axis (CAN2) account for 25.72 % of the total variance. Moderate positive loadings are noted for the naso-dacryal and zygomaxillary subtenses (NDS, SSS), the occipital fraction (OCF) and the zygomaxillare radius (ZMR). Moderate negative loadings are observed for the zygomaxillary, naso-dacryal and simotic angles (SSA, NDA and SIA) (Table 28). The patterns of variation observed along the second axis characterize specific differences in shape between the two collections.

The Mahalanobis generalized distances for the four Afro-American cranial series are presented in Table 29. along with their associated probabilities (i.e., probabilities of exceeding the Mahalanobis distance). The greatest distance (4.6202) is observed between males of the Hamann-Todd collection and females of the R. J. Terry series. The next greatest distance is between Hamann-Todd females and R. J. Terry males (4.5906). There are closer

Table 28. Total canonical structure for Afro-American crania, Hamann-Todd and R. J. Terry anatomical skeletal collections.

Code	CAN1	CAN2
GOL	0.5355	0.0877
NOL	0.5179	0.0877
BNL	0.5669	- 0.0178
BBH	0.5085	- 0.1084
XCB	0.3437	- 0.0165
XFB	0.4286	- 0.1764
WFB	0.3815	- 0.0568
ZYB	0.7038	0.0691
AUB	0.4968	- 0.0583
WCB	0.4396	0.1282
ASB	0.3881	- 0.0041
BPL	0.4478	0.0444
NPH	0.5365	0.0309
NLH	0.5474	0.1129
JUB	0.6561	- 0.1388
NLB	0.3393	- 0.0428
MAB	0.4043	0.0028
MAL	0.3695	0.0320
MDH	0.5332	0.1098
MDB	0.3771	- 0.0451
OBH	- 0.0339	0.0969
OBB	0.4824	- 0.1812
DKB	0.2972	- 0.0780
NDS	0.2760	0.2811
WNB	- 0.0529	- 0.0626
SIS	0.2074	0.1812
ZMB	0.4414	- 0.0966
SSS	0.2504	0.2042
FMB	0.5352	0.0286
NAS	0.2505	- 0.0808
EKB	0.5077	- 0.0353
DKS	0.2303	- 0.0552
IML	0.3515	0.1222
XML	0.4813	0.0252
MLS	0.2499	- 0.0705
WMH	0.3537	- 0.0304
SOS	0.4764	- 0.1584
GLS	0.4663	0.1201
STB	0.1608	- 0.1241
STS	- 0.0765	- 0.1167
FRC	0.4116	- 0.0563
FRS	- 0.0216	- 0.0895
FRF	0.3021	- 0.0123
PAC	0.3918	0.0009
PAS	0.1642	- 0.0308
PAF	0.3244	0.0581
OCC	0.0285	0.0671
OCS	- 0.1624	0.1115
OCF	- 0.0386	0.2358
FOL	0.2980	- 0.0360
FOB	0.2989	0.0287
NAR	0.5362	0.0205
SSR	0.5269	0.1087
PRR	0.4883	0.0858
DKR	0.5090	- 0.0393
ZOR	0.4507	0.0383
FMR	0.4774	0.0867
EKR	0.5324	0.1022
ZMR	0.4337	0.2011
AVR	0.4648	0.0362
BRR	0.4882	- 0.1660
VRR	0.4223	- 0.1257
LAR	0.2640	0.1045
OSR	0.1803	0.0210
BAR	0.1231	0.1394
NAA	- 0.1008	0.0613
PRA	- 0.0061	- 0.0868
BAA	0.1280	0.0241
NBA	- 0.0484	- 0.1008
BBA	- 0.0646	0.0181
SSA	- 0.0095	- 0.2565
NFA	- 0.0899	0.0892
DKA	- 0.0827	- 0.0075
NDA	- 0.0582	- 0.2891
SIA	- 0.2630	- 0.2219
FRA	0.2625	0.0832
PAA	0.0573	0.0458
OCA	0.1811	- 0.0864
STA	0.1781	0.0979
CBA	- 0.0325	- 0.1469

Table 29. Mahalanobis distances between groups of Afro-American crania. Samples of the Hamann-Todd and R. J. Terry anatomical skeletal collections.

Group/Crania	Terry males	Terry females	Todd males	Todd females
Terry males	-	3.9282	3.0150	4.5906
Terry females	0.0006	-	4.6202	2.9711
Todd males	0.0467	0.0001	-	4.2042
Todd females	0.0001	0.0001	0.0001	-

*Distance are listed above the diagonal, corresponding probabilities (PR > Mahalanobis distance) are listed below.

distances between males and females of the same collections with the Hamann-Todd series exhibiting a distance of 4.2042 between males and females. A distance of 3.9282 is indicated between the corresponding gender groups of the R. J. Terry collection. Closest of all paired comparisons are the respective male and female comparisons between the two collections. Generalized distances between the two male groups (3.015) and female groups (2.9711) are practically identical.

The distances exhibited in the Afro-American anatomical series (Hamann-Todd and R. J. Terry) indicate that groups of the same gender are slightly closer between collections than groups of opposite gender within each collection. Most dissimilar are groups of opposite gender between the two series. In other words, dimorphism within each series is greater than geographical differences in samples of same gender between series. The distances are highly significant between all groups, reflecting the strength of the pattern of variation between groups for the variable data set used.

The class means on the first two canonical variates for the four Afro-American series representing the Hamann-Todd and R. J. Terry anatomical collections are depicted in Table 30. Differences between collections are noted along the first canonical variate. The mere difference in

Table 30. Class means on canonical variates CAN1 and CAN2 for Afro-American crania of the Hamann--Todd and R. J. Terry anatomical human skeletal collections.

Group/Crania	CAN1	CAN2
Terry males	2.1124	- 0.8899
Terry females	- 1.3615	- 1.7377
Todd males	1.6507	1.7545
Todd females	- 2.2053	0.6569

class means suggests that Todd collection specimens of either gender are smaller than their counterparts among the Terry collection. A graphic illustration of the class means is presented in Figure 36. Females and males are restricted to the left and right hand sides of the graph, respectively. Series (or geographical location) is defined on the second axis (CAN2). Correspondingly, Hamann-Todd and R. J. Terry crania are separated into the upper and lower half of the plot.

The results of the Mahalanobis generalized distances of the Afro-American crania from the anatomical collections of Hamann-Todd and R. J, Terry indicate that sexual dimorphism within each series (anatomical collection) is greater than same gender variation between groups. Comparisons of sexual dimorphism between series is most dissimilar.

The first canonical axes of the Afro-American analysis is overwhelmingly one of positive loading, indicating that size variation and not shape is explained. According to the group means (Appendix D), males are generally larger than females. Males exhibit longer, higher vaults, longer bases, broader bizygomatic region and midface. The nasal aperture is wider, face height is larger, and face is more forward. Mastoid processes are longer. The alternating positive and negative signs for

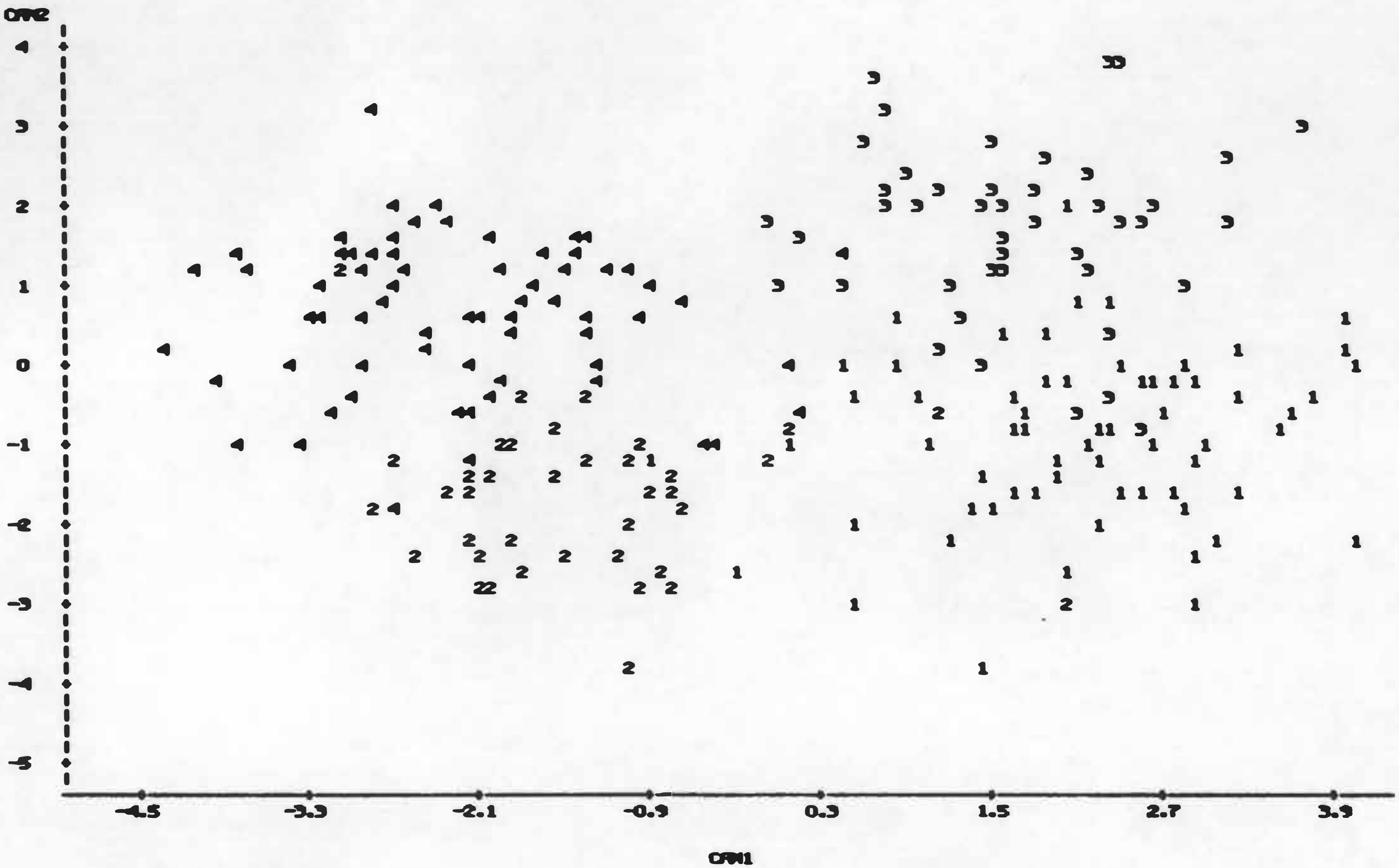

Figure 36. Plot of Hamann-Todd and R. J. Terry Afro-American crania along the first and second canonical variates (CAN2*CAN1). 1 = R. J. Terry males; 2 = R. J. Terry females; 3 = Hamann-Todd males; 4 = Hamann-Todd females.

the loadings on the second variate indicate that this axis reflects differences in cranial shape. The most distinguishable characteristics are the changes in the nasal region and are defined by a raised nasal profile and corresponding decreases in both simotic and naso-dacryal angles. A second feature is exhibited by a deeper subspinale relative to more projecting malars resulting in a lesser zygomaxilare angle. After studying the group means in Appendix D, it becomes apparent that the second variate (CAN2) represents geographical variation in shape, primarily of the nasal region and the anterior maxillary region. In this instance, the Hamann-Todd collection crania display more projecting malars and higher nasal bridges in comparison to those of the R. J. Terry series. This is reflected particularly in the two naso-dacryal and zygomaxillary angles, and represents a significant difference in shape between the two series. A note of caution about the naso-dacryal angle is appropriate. The recorded dimensions of the naso-dacryal complex are extremely variable reflected in inordinately high standard deviations. Further examination of the means in Appendix D, indicates that males are consistently larger than females in both series. In the R. J. Terry sample, females exhibit depressed occipital regions and exceed males in occipital subtense. Females also exceed males in a number of angular dimensions which indicate slight shape differences. This is probably due to the smaller size of females. Among the Hamann-Todd series, females exceed males in minimum cranial breadth, bistephanic, frontal and occipital subtense, indicating a slightly less accentuated curvature of the female skull. The Hamann-Todd females, like their Terry counterparts, exhibit a number of angular dimensions which exceed the male means. This indicates sexually dimorphic characteristics of size and shape, most noticeably in the cranial base. The R. J. Terry male crania are longer, broader and higher compared to the Hamann-Todd male crania. The cranial base is also longer, broader and lower (cranially). The bizygomatic region, the lower midface and nasal breadth is wider. A more projecting nasion is contrasted by a deeper subspinale. Vault curvature is slightly greater in R. J. Terry males with a more projecting nasion; a raised region og bregma and vertex relative to the transmeatal axis. The upper maxillary region of subspinale is receding while malars are slightly more projecting. Basion is more cranial in R. J. Terry males, while opisthion is lower.

An explanation for the differences,when comparing gender between groups and within groups, may be found in the recent common origin of the two series. Both represent urban Afro-American populations of generally lower socio-economic strata, and both have a faily recent documented origin in rural southern populations. While little direct information is available about places of birth of the individuals in the two series, some documentation does exist to support the theory of common southern origins. A number of individuals were actually recorded as having been born in southern states. Large numbers of rural southern Afro-Americans migrated north with the industrialization of the large northern cities (Dinnerstein and Reimers 1975). A large number of Afro-American migrants from the rural south settled in the Cleveland area during the first two decades of the twentieth century (Cobb 1952).

Among-Group Variation - Euro-American Series

The class means and Mahalanobis generalized distances for the four Euro-American samples from the Terry and Todd anatomical collections are displayed in Table 31 and Table 32. The patterns of relationship among groups are consistent with those observed in the Afro-American samples. Again, comparisons between collections of groups of the same gender are most similar (males: 3.8385; females: 3.3324). Comparisons of groups of opposite gender within each collection display greater distances (Hamann-

Table 31. Class means on canonical variates CAN1, CAN2 and CAN3 for Euro-American crania of the Hamann-Todd and R. J. Terry anatomical skeletal collections.

Group/crania	CAN1	CAN2	CAN3
Terry males	2.6970	- 0.7424	- 0.5621
Terry females	- 1.8453	- 1.7000	1.0815
Todd males	1.4365	2.4297	1.1938
Todd females	- 2.6748	0.8324	- 0.9195

Table 32. Mahalanobis distances between groups of Euro-American crania. Samples of the Hamann-Todd and R. J. Terry anatomical skeletal collections.

Group/Crania	Terry males	Terry females	Todd males	Todd females
Terry males	-	4.9245	3.8385	5.6093
Terry females	0.0001	-	5.2760	3.3324
Todd males	0.0303	0.0001	-	4.8908
Todd females	0.0001	0.0001	0.0001	-

*Distances are listed above the diagonal, corresponding probabilities (PR > Mahalanobis distance) are listed below.

Todd: 4.8908; R. J. Terry: 4.9245). Most distant are between collection comparisons of groups of opposite gender (Hamann-Todd males w/ R. J. Terry females: 5.276; Hamann-Todd females w/ R. J. Terry males: 5.6093). The observed relationship between cranial metrics and collection association is highly significant in all pairwise comparisons at the .03 level of significance.

To illustrate graphically the patterns of relationship between each sample, class means of two of the three canonical variates are presented in Figure 37. Figure 37 illustrates the separation of gender groups along the first canonical variate with the smaller females concentrated on the left hand side and the larger males on the right hand side of the plot. Collections are separated along the second axis with the Hamann-Todd crania assuming the upper portion and R. J. Terry crania the lower.

In the case of the Euro-American series, three canonical axes account for the total variance due to sex and collection association between groups (table 33). All three axes are significant at the .01 level. The first axis (CAN1) account for 66 % of the total variance. High loadings are displayed for bizygomatic (ZYB), bijugal breadth (JUB) and other midfacial breadth dimensions (ZMB, FMB, EKB). Higher loadings are also noted for

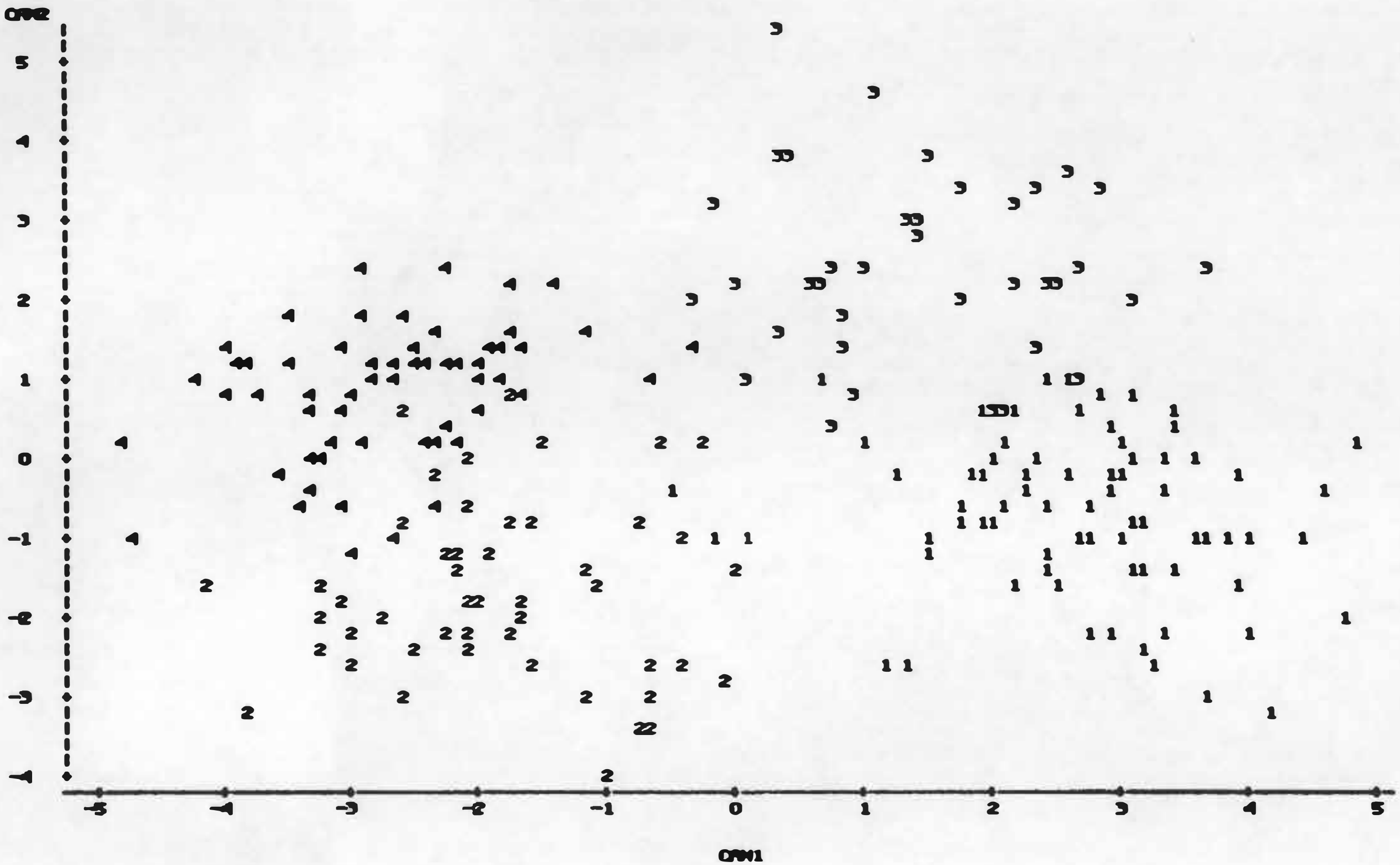

Figure 37. Plot of Hamann-Todd and R. J. Terry Euro-American crania along the first and second canonical variates (CAN2*CAN1). 1 = R. J. Terry males; 2 = R. J. Terry females; 3 = Hamann-Todd males; 4 = Hamann-Todd females.

Table 33. Canonical discriminant analysis of Euro-American female and male crania of the Hamann-Todd and R. J. Terry anatomical skeletal collections, (n = 223).

Number	Canonical Correlation	Approximate Standard Error	Squared Canonical Correlation	Eigen Value	Proportion of Variation	Likelihood Ratio	F Ratio	PR > F
1	0.921255	0.010154	0.848711	5.6099	0.6600	0.02688809	4.1018	0.0001
2	0.819105	0.022009	0.670932	2.0389	0.2399	0.17772712	2.4488	0.0001
3	0.678164	0.036249	0.544089	0.8515	0.1002	0.54009297	1.5502	0.0121

maximum length (GOL, NOL), cranial base length (BNL), biauricular breadth (AUB), cranial height (BBH) and upper facial height (NPH). Nasal height and mastoid length and breadth all exhibit high loadings. Finally, high loadings characterize most variables representing facial forwardness whether it is in the upper (NAR, DKR FMR), middle (ZOR, EKR, ZMR), or lower regions (PRR, AVR, SSR) (Table 34).

The second axis characterizing the Euro-American sample of anatomical collection specimens is defined by both high positive and negative loadings. Positive high canonical scores (loadings) are seen on vault breadth, both in terms of maximum breadth (XCB) and anterior vault (STB). The highest single loading is noted for occipital fraction (OCF). High negative scores are observed for cranial length (GOL, NOL), orbital breadth (OBB), lambda radius (LAR) and prosthion angle (PRA). The second axis account for approximately 24 % of the total variance.

The third canonical axis accounts for 10 % of the total variance due to gender and collection association. Three variables define the third axis (Table 34). The highest positive loading is observed for the naso-dacryal subtense (NDS). Two additional variables, occipital subtense (OCS) and naso-dacryal angle display moderate loadings. The former is positive, the latter is

Table 34. Total canonical structure of Euro-American crania, Hamann-Todd and R. J. Terry anatomical skeletal collections.

Code	CAN1	CAN2	CAN3	Code	CAN1	CAN2	CAN3
GOL	0.5711	-0.2167	0.1022	FRC	0.4455	-0.0123	0.0822
NOL	0.5543	-0.2270	0.1287	FRS	0.0066	0.0511	-0.0305
BNL	0.6566	-0.1000	-0.0077	FRF	0.4615	0.0604	0.1797
BBH	0.5358	-0.1188	0.0274	PAC	0.4655	-0.1814	0.0188
XCB	0.3554	0.2641	-0.0656	PAS	0.3622	-0.0522	0.0682
XFB	0.4228	0.0940	-0.0039	PAF	0.2357	-0.0257	0.0483
WFB	0.3683	0.0367	-0.0191	OCC	0.0446	-0.1397	0.1306
ZYB	0.7611	0.1457	-0.0294	OCS	-0.2842	-0.0505	0.2041
AUB	0.5914	0.0455	-0.0485	OCF	-0.2237	0.3012	0.1191
WCB	0.4544	0.0652	-0.0464	FOL	0.3786	-0.0857	0.0611
ASB	0.5069	0.0201	0.1830	FOB	0.3903	-0.1889	0.0873
BPL	0.5515	0.0604	-0.0478	NAR	0.5815	-0.0508	0.1137
NPH	0.5762	0.0255	0.0296	SSR	0.6873	0.1177	-0.0194
NLH	0.6272	-0.0522	0.1080	PRR	0.6031	0.1468	0.0135
JUB	0.7068	-0.0302	-0.0024	DKR	0.5491	-0.1504	0.0428
NLB	0.2863	-0.1166	-0.0619	ZOR	0.5790	0.0041	-0.0168
MAB	0.3975	0.0866	0.1534	FMR	0.5654	-0.0572	-0.0121
MAL	0.4800	0.1064	0.1626	EKR	0.5962	0.0411	0.0515
MDH	0.5741	0.0898	-0.0739	ZMR	0.5167	0.1827	-0.0294
MDB	0.5228	-0.0425	0.0257	AVR	0.6719	0.1047	-0.0681
OBH	0.1559	-0.1787	0.0193	BRR	0.4535	-0.0939	0.0037
OBB	0.4356	-0.2690	0.0049	VRR	0.4659	-0.1442	0.0901
DKB	0.3103	0.1717	0.0917	LAR	0.2995	-0.2295	0.0477
NDS	0.1636	0.1932	0.2816	OSR	0.3349	-0.1443	-0.0453
WNB	-0.0630	0.0090	0.1240	BAR	0.3589	-0.1038	-0.0084
SIS	0.1986	0.0001	0.0605	NAA	0.0299	-0.1917	-0.1010
ZMB	0.5321	0.1686	-0.0671	PRA	-0.0966	-0.2258	0.0349
SSS	0.3516	0.1196	0.0509	BAA	0.0793	0.0316	0.0396
FMB	0.5054	0.0616	0.0071	NBA	-0.0582	-0.0976	-0.0261
NAS	0.1553	-0.0551	0.1600	BBA	-0.1135	0.0998	0.0779
EKB	0.5022	0.1269	-0.0189	SSA	-0.1393	-0.0593	-0.0685
DKS	0.2408	-0.0608	-0.0974	NFA	0.0098	0.0813	-0.1738
IML	0.4505	0.0959	-0.0153	DKA	-0.0928	-0.0440	0.1118
XML	0.6124	0.0824	-0.0905	NDA	0.0661	-0.0727	-0.2078
MLS	0.2996	0.0700	-0.1088	SIA	-0.2500	0.0099	0.0410
WMH	0.4219	0.0782	-0.0485	FRA	0.2818	-0.0453	0.1039
SOS	0.4799	-0.0824	-0.1781	PAA	-0.1528	-0.0526	-0.0685
GLS	0.5146	-0.0069	0.1155	OCA	0.3099	0.0839	-0.1194
STB	0.2397	0.2388	-0.0028	STA	0.2740	0.0062	0.0029
STS	-0.1162	0.0849	-0.0104	CBA	-0.2332	0.1142	-0.0131

negative. Additional variables of moderate positive loadings are biasterionic breadth (ASB), frontal fraction (FRF) and external palatal length and breadth (MAB, MAL). Two variables displaying negative loadings are nasal subtense (NAS) and naso-frontal angle.

As in the case of the Afro-American analysis, the first canonical axis is generally characterized by positive loadings and appears to reflect size differences due to sexual dimorphism (Table 34). Euro-American males exhibit longer, higher crania with larger, wider and more projecting faces than females and are generally larger than their female counterparts in most dimensions. The mixture of positive and negative loading along the second axis suggest that size alone does not define this axis (Table 34). Shape variation is represented by longer and broader crania. Males exhibit more a depressed posterior vault associated with a greater occipital curvature as defined by a smaller Lambda radius and a greater occipital fraction. Shape variation of the male face is characterized by narrower orbits and a smaller prosthion angle. The smaller angle is probably due to the confounding effect of less distinct reductions in the projection of the nasion and basion radii. These two dimensions are used to calculate the prosthion angle.

When reviewing the group means in appendix D in order to investigate the variation explained along the second axis, it is observed that the second axis defines variability between collections. In association with the class means, the second axis separates the two collections. The R. J. Terry collection is characterized by longer crania with narrower vaults as illustrated by lesser bistephanic and maximum cranial breadth dimensions. A more depressed posterior vault, associated with a greater occipital curvature which is defined by a shorter Lambda radius and greater occipital fraction is accentuated in the Todd crania. The facial angle at prosthion is less in the Todd crania, possibly the result of a deeper nasion and a higher (cranial) basion. The change in the prosthion angle and the corresponding nasion and basion radii probably reflects a steeper facial slope and a more highly flexed cranial base. The third axis also appear to be of shape rather than size and is defined by three variables: naso-dacryal subtense, angle, and occipital subtense. The variation described on the third axis is particular to an increase in the nasal subtense relative to dacryon and to a corresponding decrease in the naso-dacryal angle. This implies a raised or more superiorly positioned nasal root relative to dacryon which results in a narrower naso-dacryal profile.

The third axis, in Table 34, also defines an increase in the posterior projection of the occipital region. Other shape variations are exhibited in the size and shape of the external palate, frontal flatness, and breadth of the biasterionic region of the vault.

Using the class means to interpret the variation indicated by the third axis suggests that the latter identifies patterns of variation within each gender between collections. Relative to the Hamann-Todd females, the R. J. Terry collection females are generally characterized by greater vault breadth at asterion, greater frontal and occipital curvature as defined by the subtenses of the frontal and occipital bone. Hamann-Todd females also distinguish themselves from their counterparts of the R. J. Terry collection by wider naso-dacryal profiles (a greater NDS, and a smaller NDA). The Hamann-Todd crania also exhibits a greater NFA. R. J. Terry collection females are further characterized by longer and broader palates than their Hamann-Todd collection counterparts. In males, the reverse pattern of that presented in the female crania is demonstrated. Hamann-Todd male crania display larger and broader palates, greater frontal and occipital curvatures and a narrower naso-dacryal profile.

The third axis again describes group variation between collections but is particular to differences of relationship within each gender. In other words, the third axis describes male and female patterns of variation between collections, where these patterns contrast in direction along gender groups.

VIII. DISCRIMINANT FUNCTIONS

Univariate statistics for the four male and three female cranial data sets of the calibration sample is listed in Appendix D, including means and standard deviations by sex and racial or ethnic affiliation. The corresponding measurement definitions are listed in Appendix B.

The Contemporary Calibration Sample

The final problem of this study is the definition of an appropriate calibration sample for future forensic application in the identification of racial or ethnic affiliation. The application of the preceding findings of secular trends and geographic variation to the question of a more appropriate calibration data for the identification of contemporary forensic cases, can now be addressed. An examination of the trends observed show general linear patterns, which are relatively uninterupted in positive or negative directions. It is clear from these finding that contemporary groups differ significantly from preceding generations. However, no clear break is apparent between appropriate samples and less appropriate samples for the identification of contemporary groups. It appears that an arbitrary decision based on relative contemporaneity and considerations regarding sample size may be sufficient.

The approach taken here is to define relative contemporaneity of a calibration sample to include the individuals of three adult generations. This is meant to include all individuals born since 1910 in the calibration sample. This standard was used for the determination of eligible specimens of Euro-American females and males in the calibration sample. However, due to the smaller sample size available for Afro-American crania, the cut-off date was moved back one more decade include all Afro-American individuals born since 1900. Two additional series of American Indian and male Hispanic-American crania were added to expand on the discriminant functions application. The Hispanic-American groups includes only individuals born since 1900. However, American Indian group includes specimens born no earlier than 1750 as well as a smaller number of contemporary specimens.

The inclusion of a temporal group of American Indians ranging over 200 years admittedly re-opens the debate concerning recent temporal variation in these crania. This study does not address this issue as related to American Indian crania, primarily due to the smaller sample sizes available and the less accurate method of aging and determining year of birth. The present sample represents a wide range groups and tribes from the Plains area, the Midwest, the South, Southwest and the Northeast.

All regions are not equally represented in this sample, and this series does not address all the problems of geographical representation. In spite of these shortcomings, it is suggested that the present American Indian series is a desirable alternative to other more temporally distant and geographically homogenous samples such as the Indian Knoll series which predates the present sample by approximate 5,000 years and is restricted in its geographical representation to a small area within the Southeast.

The demographic profile of the calibration used in the derivation of discriminant functions for the identification of racial or ethnic affiliation is shown in Table 35. The sample is clearly not balanced but does reflect reasonable representation of each group.

Craniometric Variation in Contemporary Groups

Craniometric variation of the calibration sample is explored to elucidate the pattern of among-group relationships. Four groups of male crania (Afro-American, Euro-American, American Indian and Hispanic-American) and three groups of female crania (Afro-American, Euro-American and American Indian) are examined by way of canonical discriminant analysis to illustrate both the relationships among groups and to illustrate the main

Table 35. Sample size, mean age, year of birth and year of death, by ethnic affinity and gender for crania used in the calibration of the discriminant functions.

	Post 1900 Afro-American		Post 1910 Euro-American		Historic-Post 1900 American Indian		Post 1900 Hisp-American
	Females	Males	Females	Males	Females	Males	Males
Sample Size:							
Number	44	37	50	79	72	77	24
Age:							
Mean	29.92	33.36	33.95	37.79	32.63	34.43	34.71
Standard deviation	13.72	15.71	13.41	13.06	10.28	9.4	14.12
Range	17-80	17-742	16-61	17-65	17-62	19-63	17-71
Date of Birth:							
Mean	1922.26	1916.31	1940.79	1939.32	1863.4	1860.63	1938.98
Standard deviation	21.58	15.97	18.56	13.96	27.3	33.09	21.83
Range	1901-1951	1901-1960	1911-1967	1911-1963	1763-1955	1804-1954	1890-1966
Date of Death:							
Mean	1952.18	1949.68	1974.74	1977.11	1936.03	1895.06	1973.69
Standard deviation	13.81	23.13	10.06	10.24	25.22	34.54	16.39
Range	1923-1987	1919-1988	1936-1988	1932-1988	1800-1982	1846-1982	1920-1986

variables contributing to the separation of groups. Mahalanobis generalized distances for the three female and four male groups are illustrated in Table 36 along with their associated probabilities. All distances are highly significant in both females and males. The greatest distances are observed in both sexes among American Indians and Afro-Americans. American Indian females are closest to Hispanic-American males. Euro-American males and females displays the least distance. However, Hispanic-Americans differ significantly from all groups. Six significant canonical axes are identified. Thes axes account for the total group variation. Only three of the canonical variates accounting for 89 % of the group variation are interpreted here for purposes of illustration (Table 37). Group means on the three variates are listed in Table 38. A graphic illustration of the relationship among groups reflected by the group means along the first and second canonical variates are shown in Figure 38.

The first canonical variate (CAN1) shows no clear separation of gender. Instead it appears to represent racial variation. The first canonical variate separates American Indian females and males from Afro-American and Euro-American groups. Hispanic-American males represent an overlapping buffer between Euro-American and American

Table 36. Mahalanobis distances betweend groups among the calibration sample.

	Euro-American Males	Euro-American Females	Afro-American Males	Afro-American Females	American Indian Males	American Indian Females	Hispanic American Males
Euro-American							
Males	-	3.9974	5.2473	5.9246	5.1961	6.4123	5.1288
Females	0.0001	-	6.2402	5.2177	5.7917	5.3688	3.6600
Afro-American							
Males	0.0001	0.0	-	3.8229	5.4349	6.5341	6.1303
Females	0.0001	0.0001	0.0001	-	6.0217	5.7490	5.1371
American Indian							
Males	0.0	0.0	0.0	0.0	-	3.6725	5.3660
Females	0.0	0.0	0.0	0.0	0.0001	-	4.7132
Hispanic-American							
Males	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	-

*Distance are listed above the diagonal, corresponding probabilities (PR > Mahalanobis distance) are listed below.

Table 37. Canonical discriminant analys of recent forensic calibration sample.

Number	Canonical Correlation	Approximate Standard Error	Squared Canonical Correlation	Eigenvalue	Proportion	Likelihood Ratio	Approximate F Ratio	PR > F
1	0.910505	0.887741	0.008783	0.829019	0.3954	0.00356448	5.7660	0.0
2	0.886028	0.860457	0.011041	0.735046	0.2978	0.02084724	4.3839	0.0
3	0.841413	0.807209	0.015000	0.707576	0.1977	0.09698469	3.0135	0.0

Table 38. Class means on canonical variates CAN1 and CAN2 and CAN3 for the forensic calibration sample.

Group/crania	CAN1	CAN2	CAN3
Euro-American			
Males	-2.3437	0.2468	-2.4553
Females	-1.9870	2.3221	0.4248
Afro-American			
Males	-1.3923	-3.7846	0.2538
Females	-1.3336	-2.0290	2.7169
American Indian			
Males	2.3283	-0.7745	-1.7266
Females	2.9798	0.8851	0.9850
Hispanic-American			
Males	-0.5209	1.5201	1.0730

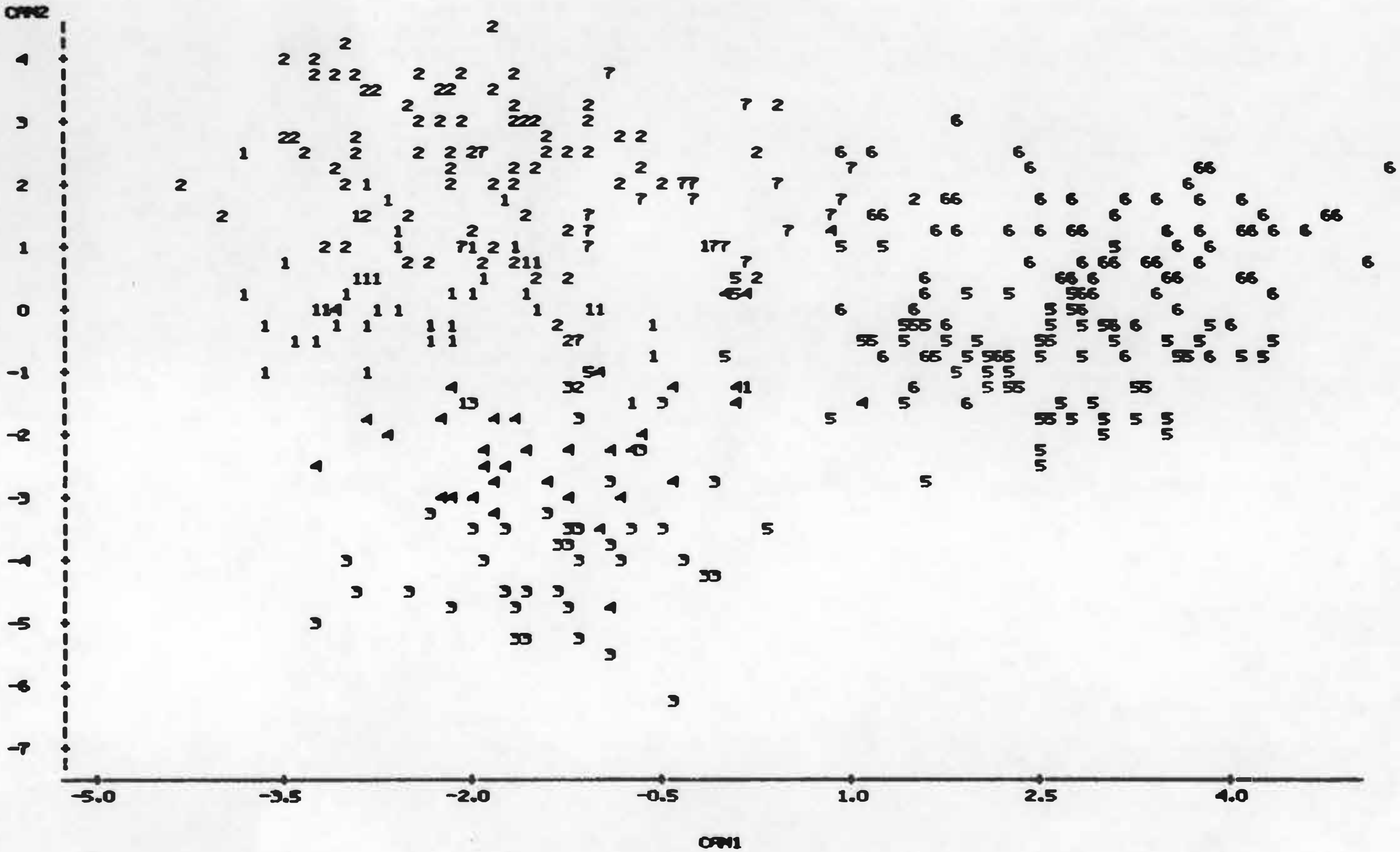

Figure 38. Plot of recent calibration sample crania along the first and second canonical variates (CAN2*CAN1). 1 = Euro-American males; 2 = Euro-American females; 3 = Afro-American males; 4 = Afro-American females; 5 = American Indian males; 6 = American Indian females; 7 = Hispanic-American males.

Indian crania. The second canonical variate (CAN2) is more complex and appears to reflect a confounding of race and sex. Most apparent is the separation of Afro-American and Euro-American crania along the second axis. However, males are separate from females within each group, with females occurring in the upper portion of each group cluster and males occurring in the lower portion. The third axis (CAN3) also appears confounded for gender and racial affiliation. This axis separates sexes even less clearly than is observed in the second axis CAN2.

The total canonical structure is presented for the first three canonical variates in Table 39 to permit a morphological interpretation of the individual variables and their contribution to group separation. The first axis is characterized by high loadings on facial and cranial base breadth dimensions (ZYB, AUB, JUB, ZMB), clearly separating American Indian crania from all other groups. The second canonical variate displays high loading for cranial height (BBH), frontal curvature (FRF) and facial angles (NAA, PAA), separating Afro-American crania and gender. The third axis is defined by facial projection (BPL, PRR), palatal shape (MAB, MAL), orbital breadth (OBB) and facial breadth (JUB, FMB). The contribution of CAN3 to the separation of groups is less distinct, but appears similar to CAN2. In spite of its

Table 39. Total canonical structure for female and male crania of the forensic calibration sample.

Code	CAN1	CAN2	CAN3
GOL	-0.1656	0.3077	0.4277
NOL	-0.1297	0.2540	0.4186
BNL	0.0597	0.4708	0.3729
BBH	-0.3189	0.6046	0.2113
XCB	0.2058	0.4380	0.2105
XFB	-0.1834	0.4751	0.2981
WFB	-0.1162	0.2263	0.3748
ZYB	0.6749	0.3549	0.4566
AUB	0.6451	0.4294	0.2866
WCB	0.4080	0.1955	0.3877
ASB	-0.1032	0.5036	0.1717
BPL	0.1702	-0.1545	0.5696
NPH	0.3347	0.2555	0.4543
NLH	0.3749	0.4257	0.3282
JUB	0.6087	0.1788	0.5189
NLB	0.4795	-0.1260	0.3937
MAB	0.3854	-0.1773	0.5705
MAL	0.0966	-0.1904	0.5499
MDH	-0.2901	0.3009	0.5913
MDB	-0.0351	0.2361	0.4333
OBH	0.3639	-0.1034	0.0939
OBB	0.1758	0.3078	0.2781
DKB	0.0743	-0.2649	0.5039
NDS	-0.0574	0.2520	0.2518
WNB	-0.0740	-0.0393	0.0655
SIS	-0.1897	0.4993	0.0199
ZMB	0.7843	-0.0553	0.3319
SSS	-0.1902	0.1093	0.2338
FMB	0.3039	0.0833	0.5337
NAS	-0.2691	0.1845	0.2285
EKB	0.4185	0.0305	0.5244
DKS	-0.3908	0.0357	0.1673
IML	0.2056	-0.1214	0.4229
XML	0.1944	0.0220	0.4595
MLS	0.1632	-0.1107	0.2749
WMH	0.3926	0.1784	0.1986
SOS	-0.1230	0.3623	0.4384
GLS	-0.0480	0.4638	0.4331
STB	-0.3622	0.3678	0.1502
STS	-0.6046	0.2779	-0.0808

Code	CAN1	CAN2	CAN3
FRC	-0.0989	0.4174	0.2298
FRS	-0.4624	0.0200	-0.0864
FRF	0.0742	0.5821	0.1901
PAC	-0.5415	0.0842	0.3397
PAS	-0.4625	0.1334	0.1589
PAF	-0.4291	0.1680	0.2593
OCC	-0.2659	0.3090	0.1373
OCS	0.1797	0.0472	-0.1302
OCF	-0.2657	0.2572	0.0571
FOL	0.0162	0.3079	0.2272
FOB	0.0773	0.4774	0.1312
NAR	0.1486	0.3723	0.3539
SSR	0.3335	0.1518	0.4459
PRR	0.2568	-0.1421	0.5490
DKR	0.1326	0.2682	0.3004
ZOR	0.2205	0.1971	0.2861
FMR	0.3018	0.3339	0.2786
EKR	0.3294	0.2625	0.3426
ZMR	0.4158	0.1567	0.2930
AVR	0.3110	-0.0590	0.4706
BRR	-0.3799	0.5226	0.2657
VRR	-0.4527	0.4795	0.2955
LAR	-0.4557	0.1461	0.4175
OPR	0.0738	0.4318	0.1022
BAR	0.0265	0.2941	-0.0152
NAA	0.0628	-0.6303	0.2816
PRA	-0.2469	0.5681	-0.3393
BAA	0.2641	0.1224	0.0830
NBA	-0.4123	0.2772	-0.0993
BBA	0.1719	-0.2411	-0.0291
SSA	0.5821	-0.1291	-0.0108
NFA	0.3915	-0.1671	-0.0503
DKA	0.4606	0.0690	-0.0909
NDA	0.1193	-0.3969	0.0566
SIA	0.1470	-0.4976	0.0021
FRA	0.4985	0.2025	0.2002
PAA	0.2842	-0.1148	-0.0058
OCA	-0.3342	0.0872	0.1857
STA	0.6010	-0.1718	0.1676
CBA	0.1271	-0.1907	0.0935

complexity, the third axis appears to separate Afro-American crania from the other groups as well as gender.

Stepwise Selection and Discriminant Functions

Identifying group affiliation of crania using discriminant functions is considered justifiable for the calibration sample based on the preceding demonstration of cranial variation among groups. Individual vectors of measurements representing models of least number of measurements displaying maximum discriminating ability among groups are selected by way of stepwise selection. To be included in the model, a variable must be significant at less than .05. Prior probabilities and covariance matrices are assumed to be equal for the purposes of the present study.

Four group functions are calculated for males only. Three group functions for Afro-American, Euro-American and American Indian are calculated for females and males and pooled sexes. Two group functions are computed for Afro-American and Euro-American crania. Two group functions are also calculated for Euro-American and American Indian series for females and males and combined sexes. A two group function is also calculated for Euro-American and Hispanic-American male crania. The stepwise models for variable selection are presented in Appendix E, and their corresponding discriminant functions are presented in Appendix F, G, H, I. J and K for a full eigthy variable data set, a reduced data set without angles, subtenses and fractions, and a Forensic Data Bank compatible data set.

The three and four group functions are applied by multiplication of individual measurements and the corresponding coefficient of the discriminant function. A constant is added to the score, and classification is determined by the magnitude of the scores. The group displaying the highest score reflects highest probability of group membership. For two group functions, individual measurements are multiplied by the corresponding coefficients and summed. A constant is added. Classification is determined by whether the score is positive of negative. Correct classification is listed for each group for all functions.

In Appendix F through K, it is interesting to note that the better variables for the separation of groups are frequently not the standard measurements used in past research. A particularly useful variable is the bimaxillary breadth (ZMB), often associated with a cranial height dimension. Note that radii defining the vault height (VRR, BRR) prevail over total height (BBH) when the former are included in the data set. A notable absence of length dimensions is recorded. However, variable selection conforms to statements made by previous investigators regarding the superiority of breadth dimension in group separation (Howells 1970; Sokal and Uytterschaut 1987). Due to the lack of sufficient independent test samples, no testing was performed on the functions presented in Appendix E, other than the calibration sample. Testing of the present functions is critical to the evaluation of their efficiency and appropriate application. This is particularly important with the American Indian sample, which is largely historic and is only a "best" alternative to the estimation of racial or ethnic affiliation of contemporary American Indians. It is hoped that future investigation will provide sufficient samples to enable further testing.

IX. SUMMARY AND CONCLUDING REMARKS

The present study was undertaken to illustrate craniometric variation in time and space among modern Afro-American and Euro-American skeletal series. A temporal study of craniometric changes within several anatomical series was performed to illustrate the effect of secular change within a period of 230 years. A comparative study of the Hamann-Todd and R. J. Terry collections was carried out to identify within-group patterns of ethnic specificity.

A main objective was to define a temporal bias in the crania of earlier skeletal collections such as Hamann-Todd and R. J. Terry. This bias serves to illustrate why more contemporary cranial series would be more desirable in future medico-legal application of craniometric research in determining racial or ethnic group affiliation.

Statistically significant temporal changes were discovered for both Afro-American and Euro-American groups. A negative secular trend is illustrated for Afro-American females and males and reflects an overall decrease in size with only minor evidence of specific changes in cranial shape. Afro-American crania display evidence of a decrease in length, breadth and height. Changes in the face include a narrowing of the face and a narrowing of the nasal aperture and orbits. A contrasting feature is an increase in bijugal breadth and minor increases in facial and nasal height. The cranial base is reduced in both breadth and length dimensions.

Changes in the Euro-American cranium are sexually dimorphic and require separate analysis of female and male cranial series. Euro-American male crania are getting larger with an increase in height, a longer base, longer mastoid processes, orbital and nasal breadth and a slight increase in upper facial height. This is contrasted by a slight decrease in vault breadth and interorbital breadth.

The Euro-American female cranium is characterized by more distinctive changes including a prominent increase in height and a noticeable decrease in vault breadth. Female changes in vault effect do not affect biasterionic breadth in the lower part of the vault. The increase in vault height is largely a reflection of changes in the superior segment of the cranial height characterized by vertex and bregma radii. In contrast, little change is observed in the basion radius. The female Euro-American crania exhibit a reduction of orbital and nasal breadth in contrast to the trend observed in males. The female face is also more pointed.

While temporal trends occur in both Afro-American and Euro-American groups, they follow different directions. The causes of these trends have not been addressed in the present study and is clearly a complex issue. While numerous theories have been proposed to explain secular or temporal cranial change, there does not appear to be a clear explanation of the phenomenon. The three major structures of the cranium for which secular changes were observed include the base, the vault and the face. Of these, the cranial base is by far the most stable single structure, followed by the vault and then the face. Ontogenetically, the stability of the cranial base over the vault and face is fully expected. The delayed maturation of the vault and face relative to the base renders the two former more susceptible to environmental stress or influence during childhood. The face is even susceptible into adolescence.

Yet, despite its demonstrated stability, the cranial base may reflect some changes as in the timing of the fusion of the three segments of the sphenoid process. Changes in timing may affect the length of the cranial base, which in turn influences the shape or curvature of the vault (Michejda 1972; Taylor and DiBennardo 1980).

Under these circumstances, what would cause changes in the growth of the cranial base? Changes in nutrition or in hormone secretion which may affect fetal development have been proposed as a possible cause (Tanner 1972). Genetic influences may also help explain temporal variation. Such genetically influenced changes would be more micro-evolutionary in nature. The cranium is considered to be under strong genetic control (DuBrul and Laskin 1961), despite its plasticity. Accordingly, it may be that temporal trends are indeed genetically determined rather than environmental. Is it possible that increasing heterogeneity among groups may explain temporal changes?

The contrasting directions of the trends between Afro- and Euro-American crania are not easily explained as due to admixture or increased heterogeneity. On the contrary, changes appear to work in opposite directions in the two groups compared, making the heterogeneous.

A possible explanation of the phenomenon observed in the Afro-American crania may be reflect either genetic and/or nutritional influences. As stated in the presentation of the Afro-American series in section three, the early nineteenth century sample may have been better off socio-economically, and therefore healthier than the later Afro-American series from the Hamann-Todd and R. J. Terry collections. Could it be that increased urbanization played a role in the decrease in size in the Afro-American skull because of poorer socioeconomic conditions? However, this is contrary to suggestions by other researchers, of poor health and hygeine suggested to be common to early nineteenth century Afro-Americans (Angel 1982).

Finally, is there any evidence of selection toward a larger physical size during the late eighteenth and early nineteenth centuries which was followed by a relaxation of the selective pressure resulting in a decrease in Afro-American skull size? This and other questions cannot be answered at the present time.

In case of the Euro-American crania it may be possible to explain, at least in part, the observed variability. As demonstrated among the Hamann-Todd and R. J. Terry collections, there does seem to be an ethnic basis for the observed differences between the two series. The majority of the Euro-American series used in the present study is probably more representative of recent immigrants to the United States than it is of the so-called "Old American" group (Hrdlicka 1925). Accordingly, the variation observed in Hamann-Todd and R. J. Terry along with the temporal trends observed may be used to suggest that there is some confounding of ethnic variation and secular trends in the findings of the present study. Accordingly, contemporary forensic cases which represent the most recent group in the temporal analysis, would be most distant from the immigrant parents and grandparents.

How does age and cranial age changes influence the determination of secular trends? It may be argued that age effects can obscure the reality of a potential secular trend (Hertzog et al 1969). Due to the confounding of the two effects with little indication of the individual contribution of either, it would be preferable to eliminate the age factor prior to further analysis of a secular trend. Unfortunately, the sample used here is composed of a cross sectional series representing several cohorts and does not lend itself to factoring out of age. However, it is estimated from the direction of the known trend of age change and from the observed pattern of the secular trend that the overall effect of the confounding of the two effects may represent little more than a minor masking of a negative trend or perhaps a slight exaggeration of a positive secular effect.

There is no clear explanation of the phenomena observed in terms of the secular or temporal trend. The differences characterized between the Hamann-Todd and R. J. Terry collections may ascribe largely to ethnic variation between the two cities and may render these two collections less appropriate for research concerning the contemporary U.S. population in forensic identification.

Having demonstrated temporal and group variation, an alternative calibration sample of crania of contemporary

U. S. females and males was composed for the calculation of discriminant functions for application in the identification of racial or ethnic affiliation in forensic anthropology. A unique contribution of two, three and four group discriminant functions were devised for the specific purpose of forensic applications. This was done to fulfill the need for additional research tools in forensic investigation and to provide an aid to the criminal justice program. It is meant to offer a better selection of available and appropriate measures for the craniometric analysis of race.

In conclusion, I have successfully demonstrated a significant secular effect in cranial variation among recent Afro- and Euro-American populations in North America. In addition, I have pointed out a particular ethnic specificity regarding the cranial variation between the Hamann-Todd and the R. J. Terry skeletal collections. I conclude that these and probably other older anatomical collections maintained across the United States do not accurately reflect the contemporary U.S. population. From this it is further concluded that application of these series are less appropriate in terms of forensic applications, such as the determination of racial or ethnic affiliation from craniometric data. Finally, I offer an alternative calibration sample and discriminant functions for racial identification. It is recognized without further say that this sample it not without its problems, but I would argue that it reflects a relatively contemporary sample of the U.S. population. It also provides an alternative set of discriminant functions which complement previously published data using segments of the present data base. It is realized that continued research in the area of metric identification is important and that many areas have been left unexplored here. It is hoped that the present study will provide a stepping stone for further research in the area of skeletal biology, craniometrics and forensic anthropology.

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APPENDICES

APPENDIX A

LIST OF CASE BY COLLECTION ASSOCIATION, IDNUMBER, GENDER, AGE, RACIAL AFFILIATION, ETHNICITY, PLACE OF BIRTH, PLACE AND DATE OF DEATH

Appendix A. List of cases by collection association, idnumber, gender, age, racial affiliation, ethnicity, place of birth, place and date of death.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
FIRST AFRIC	FABC 800	MALE	49.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 1700	MALE	31.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 2500	MALE	19.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 2600	FEMALE	25.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 3200	MALE	51.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 4400	MALE	33.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 4800	FEMALE	39.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 5000	FEMALE	27.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 5500	FEMALE	19.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 6200	FEMALE	22.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 6600	MALE	55.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 6800	MALE	50.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 7400	FEMALE	43.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 8000	MALE	48.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 8100	MALE	50.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 8500	FEMALE	30.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 9000	FEMALE	44.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 9100	FEMALE	21.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 9700	MALE	46.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 9900	FEMALE	44.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 10000	FEMALE	21.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 10400	FEMALE	25.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 11400	FEMALE	40.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 11600	MALE	58.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 12400	FEMALE	58.0	AFRO-AM			PA	1832
FIRST AFRIC	FABC 13000	FEMALE	36.0	AFRO-AM			PA	1832
FORENSIC	239-3-85	MALE	27.0	EURO-AM			IL	1985
FORENSIC	502-2-82	FEMALE	30.0	AMER IN	SIOUX		IL	1982
FORENSIC	64-03	MALE	30.0	EURO-AM			OK	1964
FORENSIC	66-01	MALE	30.0	AMER IN	CHEYENNE		OK	1966
FORENSIC	69-02	MALE	30.0	AFRO-AM			OK	1969
FORENSIC	70-01	MALE	45.0	EURO-AM			LA	1970
FORENSIC	71-11	MALE	30.0	AFRO-AM			OK	1971
FORENSIC	72-16	MALE	30.0	EURO-AM			OK	1972
FORENSIC	77-1468	MALE	30.0	HISP-AM	MEXICAN		AZ	1977
FORENSIC	78-01	FEMALE	30.0	AFRO-AM			MS	1976
FORENSIC	812769	MALE	30.0	AFRO-AM			OK	1981
FORENSIC	83-21	MALE	28.0	AMER IN	CHEYENNE		OK	1982
FORENSIC	85-10970	MALE	19.0	HISP-AM			CA	1985
FORENSIC	85-10973	MALE	30.0	HSIP-AM			CA	1985
FORENSIC	85-10978	MALE	20.5	HISP-AM			CA	1985
FORENSIC	85-10993	MALE	30.0	HISP-AM			CA	1985
FORENSIC	DR77-3336	MALE	42.0	HISP-AM	MEXICAN		AZ	1977
FORENSIC	FA75-828	FEMALE	23.0	EURO-AM			SC	1973
FORENSIC	FA77-309	FEMALE	18.0	AFRO-AM			SC	1977

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
FORENSIC	HA 1	MALE	57.0	EURO-AM			TN	1988
FORENSIC	KRBURNS 1	MALE	70.0	AFRO-AM			GA	1988
FORENSIC	KRBURNS 2	FEMALE	30.0	AFRO-AM			GA	1987
FORENSIC	LA80 1	MALE	40.0	EURO-AM			LA	1980
FORENSIC	LA81 1	MALE	45.0	AFRO-AM			LA	1980
FORENSIC	LA81 3	MALE	50.0	AFRO-AM			LA	1981
FORENSIC	LA82 3	MALE	19.5	EURO-AM			LA	1982
FORENSIC	LA82 9	FEMALE	26.0	AFRO-AM			LA	1982
FORENSIC	LA82 17	MALE	65.0	AFRO-AM			LA	1982
FORENSIC	LA83 1	FEMALE	20.0	EURO-AM			LA	1983
FORENSIC	LA83 10	FEMALE	36.0	EURO-AM			LA	1983
FORENSIC	LA84 7	FEMALE	33.0	AFRO-AM		LA	LA	1984
FORENSIC	LA84 10	MALE	33.5	EURO-AM			LA	1984
FORENSIC	LA84 12	FEMALE	35.0	EURO-AM			LA	1980
FORENSIC	LA85 16	FEMALE	45.0	EURO-AM		CA	LA	1985
FORENSIC	LA85 17	FEMALE	27.0	EURO-AM		WI	LA	1985
FORENSIC	ME 105-77	FEMALE	26.0	EURO-AM			AZ	1977
FORENSIC	ME 170-80	MALE	38.0	AMER IN	YAQUI		AZ	1980
FORENSIC	ME 311-79	MALE	65.0	EURO-AM		ID	AZ	1979
FORENSIC	ME 403-78	FEMALE	16.0	EURO-AM			AZ	1978
FORENSIC	ME 553-76	FEMALE	16.0	EURO-AM			AZ	1976
FORENSIC	ME 554-76	MALE	26.0	EURO-AM			AZ	1976
FORENSIC	ME 562-76	MALE	45.0	AMER IN	APACHE		AZ	1976
FORENSIC	ME 564-75	MALE	49.0	EURO-AM			AZ	1975
FORENSIC	ME 639-75	MALE	30.0	HISP-AM	MEXICAN		AZ	1975
FORENSIC	ME 670-75	MALE	25.0	EURO-AM			AZ	1975
FORENSIC	ME 682-78	MALE	22.0	HISP-AM	MEXICAN		AZ	1978
FORENSIC	ME 838-77	MALE	24.0	EURO-AM		NC	AZ	1977
FORENSIC	ME-A 41-76	MALE	45.0	EURO-AM			AZ	1976
FORENSIC	ME-A 60-78	MALE	30.0	HISP-AM	MEXICAN		AZ	1978
FORENSIC	ME-A 61-78	MALE	55.0	HISP-AM	MEXICAN		AZ	1978
FORENSIC	ME-A 75-78	MALE	20.0	HISP-AM			AZ	1978
FORENSIC	MEC86 1367	MALE	52.0	EURO-AM		AR	TN	1985
FORENSIC	MEC87-2077	FEMALE	32.5	AFRO-AM			TN	1985
FORENSIC	MEC87-2078	FEMALE	32.5	AFRO-AM			TN	1985
FORENSIC	ML 83-0107	MALE	38.0	HISP-AM	MEXICAN		AZ	1983
FORENSIC	MLA 81-26	MALE	61.0	EURO-AM			AZ	1981
FORENSIC	OC86 44	MALE	28.0	EURO-AM			TN	1986
FORENSIC	OL77 3	MALE	26.5	AFRO-AM			KS	1977
FORENSIC	OMI 524-74	MALE	44.0	AMER IN	NAVAJO	AZ	NM	1974
FORENSIC	OMI 1790-75	FEMALE	23.0	EURO-AM			NM	1975
FORENSIC	OMI2137-75	MALE	22.0	EURO-AM		AR	NM	1975
FORENSIC	OMI2725-75	FEMALE	29.0	EURO-AM			NM	1975
FORENSIC	OMI2894-75	MALE	48.0	AMER IN	NAVAJO	NM	NM	1975
FORENSIC	OMI3294-78	MALE	29.0	HISP-AM	MEXICAN	MX	NM	1978

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
FORENSIC	OMI3295-78	MALE	22.0	HISP-AM	MEXICAN		NM	1978
FORENSIC	OMI3429-75	MALE	17.0	HISP-AM	CAUC/HISP	NM	NM	1975
FORENSIC	OMI3917-78	MALE	26.0	EURO-AM			NM	1977
FORENSIC	OMI3918-78	FEMALE	24.0	EURO-AM			CO	1977
FORENSIC	OMI4083-79	MALE	24.0	EURO-AM			NM	1979
FORENSIC	OMI7010-77	FEMALE	21.0	EURO-AM			NM	1976
FORENSIC	OMI7044-77	FEMALE	22.0	AMER IN	NAVAJO		NM	1977
FORENSIC	OMI7049-76	MALE	50.0	AMER IN		NM	NM	1976
FORENSIC	PCSO 37670	FEMALE	19.0	EURO-AM			AZ	1975
FORENSIC	R 11965-78	MALE	40.0	HISP-AM	MEXICAN		AZ	1978
FORENSIC	RCC 870317	MALE	27.0	AFRO-AM			SC	1987
FORENSIC	STUPD11098	MALE	67.0	HISP-AM			AZ	1975
FORENSIC	NYME UHI	MALE	26.5	EURO-AM			NY	1986
FORENSIC	UNM 4	MALE	52.0	EURO-AM			NM	1976
FORENSIC	UNM 6	MALE	41.0	EURO-AM		WI	NM	1976
FORENSIC	UNM 7	MALE	71.0	HISP-AM	CAUC/HISP		NM	1976
FORENSIC	UNM 16	MALE	60.0	EURO-AM			NM	1976
FORENSIC	UNM 17	MALE	41.0	EURO-AM	GERMAN	D	NM	1974
FORENSIC	UNM 27	MALE	25.0	EURO-AM			NM	1977
FORENSIC	UNM 28	MALE	59.0	AFRO-AM	CAUC/BLCK		NM	1977
FORENSIC	UNM 31	MALE	51.0	EURO-AM	CAUC	OH	NM	1977
FORENSIC	UNM 42	MALE	37.5	EURO-AM			NM	1978
FORENSIC	UNM 43	MALE	71.0	EURO-AM			NM	1977
FORENSIC	UNM 49	FEMALE	22.0	EURO-AM			NM	1978
FORENSIC	UNM 50	MALE	30.0	EURO-AM			NM	1978
FORENSIC	UNM 52	MALE	51.0	HISP-AM			NM	1978
FORENSIC	UNM 53	MALE	59.0	EURO-AM			NM	1978
FORENSIC	UNM 55	MALE	35.0	AMER IN	NAVAJO		NM	1978
FORENSIC	UNM 56	MALE	51.0	HISP-AM	MEXICAN	MX	NM	1977
FORENSIC	UNM 66	MALE	42.0	EURO-AM	GERMAN	D	NM	1978
FORENSIC	UNM 69	MALE	36.0	HISP-AM	MEXICAN	MX	NM	1978
FORENSIC	UNM 71	FEMALE	16.0	EURO-AM		CO	NM	1978
FORENSIC	UNM 73	MALE	47.0	EURO-AM			NM	1978
FORENSIC	UNM 74	FEMALE	18.0	EURO-AM			NM	1978
FORENSIC	UNM 76	MALE	65.0	EURO-AM			NM	1979
FORENSIC	UNM 81	MALE	73.0	EURO-AM		OR	NM	1979
FORENSIC	UNM 94	MALE	74.0	AFRO-AM		GA	NM	1979
FORENSIC	UNM 96	MALE	35.0	AMER IN	LAGUNA/PUEB		NM	1979
FORENSIC	UNM 99	MALE	69.0	EURO-AM		ND	NM	1979
FORENSIC	UNM 100	MALE	40.0	EURO-AM	HUNGARIAN	H	NM	1979
FORENSIC	UNM 103	MALE	19.0	EURO-AM			NM	1979
FORENSIC	UNM 110	FEMALE	35.0	EURO-AM		NY	NM	1979
FORENSIC	UNM 112	MALE	32.0	EURO-AM			NM	1980
FORENSIC	UNM 115	MALE	71.0	EURO-AM		NY	NM	1980
FORENSIC	UNM 117	FEMALE	56.0	EURO-AM			NM	1980

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
FORENSIC	UNM 120	MALE	30.0	HISP-AM	MEXICAN		NM	1980
FORENSIC	UNM 129	FEMALE	73.0	EURO-AM			NM	1980
FORENSIC	UNM 137	MALE	63.0	EURO-AM		OK	NM	1980
FORENSIC	UNM 140	FEMALE	61.0	EURO-AM			NM	1980
FORENSIC	UNM 141	MALE	30.0	EURO-AM		MO	NM	1981
FORENSIC	UNM 142	FEMALE	56.0	EURO-AM			NM	1981
FORENSIC	UNM 143	MALE	50.0	EURO-AM			NM	1981
FORENSIC	UNM 146	MALE	71.0	EURO-AM		NM	NM	1981
FORENSIC	UNM 147	MALE	36.0	EURO-AM		IL	NM	1981
FORENSIC	UNM 151	MALE	32.0	EURO-AM			NM	1982
FORENSIC	UT TCHSGT	MALE	34.0	EURO-AM		CT	GR	1976
FORENSIC	UT1 01	MALE	73.0	EURO-AM		TN	TN	1981
FORENSIC	UT1 05	FEMALE	21.5	EURO-AM			TN	1985
FORENSIC	UT2 01	MALE	73.0	EURO-AM			TN	1980
FORENSIC	UT2 06	FEMALE	39.0	AFRO-AM			TN	1986
FORENSIC	UT3 01	MALE	72.0	EURO-AM		ME	TN	1981
FORENSIC	UT3 07	MALE	36.0	EURO-AM			TN	1987
FORENSIC	UT4 03	MALE	30.0	EURO-AM			TN	1983
FORENSIC	UT5 06	MALE	25.0	HISP-AM	MEXICAN	MX	TN	1986
FORENSIC	UT6 06	MALE	55.0	EURO-AM			TN	1986
FORENSIC	UT73 1	FEMALE	19.5	AFRO-AM			TN	1973
FORENSIC	UT74 1	MALE	32.0	EURO-AM			TN	1974
FORENSIC	UT74 6	FEMALE	31.0	EURO-AM			TN	1974
FORENSIC	UT75 3	FEMALE	18.0	AFRO-AM			TN	1975
FORENSIC	UT75 7	FEMALE	51.0	EURO-AM	FRENCH	F	TN	1975
FORENSIC	UT78 14	MALE	55.0	EURO-AM			TN	1978
FORENSIC	UT79 10	FEMALE	58.0	EURO-AM			TN	1979
FORENSIC	UT79 13	MALE	36.0	EURO-AM			TN	1979
FORENSIC	UT80 9	MALE	35	EURO-AM			TN	1980
FORENSIC	UT80 12	FEMALE	27	AFRO-AM			TN	1980
FORENSIC	UT81 9	MALE	25	EURO-AM			TN	1981
FORENSIC	UT81 11	FEMALE	25	EURO-AM			TN	1981
FORENSIC	UT81 24	FEMALE	80	AFRO-AM			TN	1981
FORENSIC	UT83 1	FEMALE	59	EURO-AM			TN	1983
FORENSIC	UT84 3	MALE	22	EURO-AM			TN	1982
FORENSIC	UT84 5	MALE	37	EURO-AM			TN	1984
FORENSIC	UT84 6	FEMALE	25	EURO-AM			TN	1984
FORENSIC	UT84 14	MALE	45	EURO-AM		TN	TN	1984
FORENSIC	UT84 16	FEMALE	32	AFRO-AM			TN	1984
FORENSIC	UT84 30	FEMALE	35	EURO-AM			TN	1984
FORENSIC	UT85 2	FEMALE	27	EURO-AM			TX	1985
FORENSIC	UT85 4	MALE	56	EURO-AM			TN	1985
FORENSIC	UT85 16	FEMALE	29	AFRO-AM			TN	1985
FORENSIC	UT85 18	MALE	41	EURO-AM			TN	1985
FORENSIC	UT85 22	FEMALE	75	EURO-AM			TN	1985

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
FORENSIC	UT85 26	MALE	48	EURO-AM			TN	1985
FORENSIC	UT85 30	FEMALE	18	EURO-AM		TN	TN	1985
FORENSIC	UT85 35	MALE	30	EURO-AM			TN	1985
FORENSIC	UT86 8	MALE	65	EURO-AM			TN	1986
FORENSIC	UT86 15	FEMALE	28	EURO-AM		UT	TN	1986
FORENSIC	UT86 18	MALE	26	EURO-AM			TN	1985
FORENSIC	UT86 27	MALE	39	EURO-AM			TN	1986
FORENSIC	UT86 30	MALE	73	AFRO-AM			TN	1986
FORENSIC	UT87 8	FEMALE	25	EURO-AM			TN	1987
FORENSIC	UT87 16	MALE	46	EURO-AM	GERMAN	D	TN	1987
FORENSIC	UT87 18	MALE	31	EURO-AM		TN	TN	1987
FORENSIC	UT87 20	MALE	37	EURO-AM			TN	1987
FORENSIC	UT88 4	MALE	23	EURO-AM			TN	1986
FORENSIC	UT88 11	MALE	54	EURO-AM		TN	TN	1987
FORENSIC	UT88 24	FEMALE	30	EURO-AM			TN	1988
FORENSIC	UT9 87	FEMALE	65	AFRO-AM	NIGERIAN	NI	TN	1987
FORENSIC	VA-DMG81-4	FEMALE	23	EURO-AM			VA	1981
HAMANN-TODD	W 311	FEMALE	51	EURO-AM			OH	1919
HAMANN-TODD	W 454	FEMALE	38	EURO-AM			OH	1921
HAMANN-TODD	W 457	FEMALE	43	EURO-AM			OH	1921
HAMANN-TODD	W 466	FEMALE	62	EURO-AM			OH	1919
HAMANN-TODD	W 631	FEMALE	36	EURO-AM			OH	1919
HAMANN-TODD	W 642	FEMALE	27	AFRO-AM	AFRICAN		OH	1919
HAMANN-TODD	W 657	FEMALE	40	AFRO-AM	AFRICAN		OH	1919
HAMANN-TODD	W 668	FEMALE	37	AFRO-AM	AFRICAN		OH	1919
HAMANN-TODD	W 685	FEMALE	45	AFRO-AM			OH	1919
HAMANN-TODD	W 690	FEMALE	35	EURO-AM			OH	1919
HAMANN-TODD	W 698	MALE	22	AFRO-AM			OH	1919
HAMANN-TODD	W 700	FEMALE	39	EURO-AM			OH	1919
HAMANN-TODD	W 703	MALE	22	AFRO-AM			OH	1919
HAMANN-TODD	W 704	FEMALE	29	AFRO-AM			OH	1919
HAMANN-TODD	W 705	MALE	33	AFRO-AM			OH	1919
HAMANN-TODD	W 707	MALE	32	EURO-AM			OH	1919
HAMANN-TODD	W 709	MALE	33	AFRO-AM			OH	1919
HAMANN-TODD	W 716	MALE	27	AFRO-AM			OH	1919
HAMANN-TODD	W 718	MALE	39	AFRO-AM			OH	1919
HAMANN-TODD	W 721	MALE	18	AFRO-AM			OH	1919
HAMANN-TODD	W 725	MALE	47	AFRO-AM			OH	1919
HAMANN-TODD	W 740	MALE	40	EURO-AM			OH	1919
HAMANN-TODD	W 744	MALE	22	AFRO-AM			OH	1919
HAMANN-TODD	W 763	MALE	35	AFRO-AM			OH	1920
HAMANN-TODD	W 779	MALE	38	AFRO-AM			OH	1920
HAMANN-TODD	W 781	FEMALE	23	EURO-AM			OH	1920
HAMANN-TODD	W 798	MALE	36	EURO-AM			OH	1920
HAMANN-TODD	W 800	MALE	35	EURO-AM			OH	1920

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
HAMANN-TODD	W 801	MALE	38	EURO-AM			OH	1920
HAMANN-TODD	W 803	MALE	41	AFRO-AM			OH	1920
HAMANN-TODD	W 807	MALE	20	AFRO-AM			OH	1920
HAMANN-TODD	W 811	MALE	40	AFRO-AM			OH	1920
HAMANN-TODD	W 812	MALE	37	AFRO-AM			OH	1920
HAMANN-TODD	W 814	MALE	35	AFRO-AM			OH	1920
HAMANN-TODD	W 826	MALE	38	EURO-AM			OH	1920
HAMANN-TODD	W 827	MALE	30	HISP-AM	MEXICAN		OH	1920
HAMANN-TODD	W 831	MALE	47	AFRO-AM			OH	1920
HAMANN-TODD	W 842	MALE	53	AFRO-AM			OH	1920
HAMANN-TODD	W 843	MALE	48	EURO-AM			OH	1920
HAMANN-TODD	W 845	MALE	21	AFRO-AM			OH	1921
HAMANN-TODD	W 846	MALE	22	AFRO-AM			OH	1921
HAMANN-TODD	W 847	MALE	50	AFRO-AM			OH	1921
HAMANN-TODD	W 850	MALE	23	AFRO-AM			OH	1921
HAMANN-TODD	W 851	MALE	48	AFRO-AM			OH	1921
HAMANN-TODD	W 860	MALE	23	AFRO-AM			OH	1921
HAMANN-TODD	W 862	MALE	23	AFRO-AM			OH	1921
HAMANN-TODD	W 868	FEMALE	60	AFRO-AM			OH	1921
HAMANN-TODD	W 870	MALE	50	EURO-AM			OH	1921
HAMANN-TODD	W 874	MALE	23	AFRO-AM			OH	1921
HAMANN-TODD	W 879	MALE	45	EURO-AM			OH	1921
HAMANN-TODD	W 881	FEMALE	38	EURO-AM			OH	1921
HAMANN-TODD	W 882	MALE	42	EURO-AM			OH	1921
HAMANN-TODD	W 883	MALE	39	EURO-AM			OH	1921
HAMANN-TODD	W 885	MALE	50	EURO-AM			OH	1921
HAMANN-TODD	W 886	FEMALE	32	EURO-AM			OH	1921
HAMANN-TODD	W 891	MALE	38	AFRO-AM			OH	1921
HAMANN-TODD	W 892	MALE	39	EURO-AM			OH	1921
HAMANN-TODD	W 893	FEMALE	51	EURO-AM			OH	1921
HAMANN-TODD	W 898	MALE	62	EURO-AM			OH	1921
HAMANN-TODD	W 900	MALE	35	EURO-AM			OH	1921
HAMANN-TODD	W 903	MALE	67	EURO-AM			OH	1921
HAMANN-TODD	W 904	MALE	50	EURO-AM			OH	1921
HAMANN-TODD	W 906	MALE	35	AFRO-AM			OH	1921
HAMANN-TODD	W 908	MALE	38	EURO-AM			OH	1921
HAMANN-TODD	W 910	MALE	47	EURO-AM			OH	1921
HAMANN-TODD	W 921	MALE	34	EURO-AM			OH	1922
HAMANN-TODD	W 924	MALE	60	EURO-AM			OH	1922
HAMANN-TODD	W 925	FEMALE	43	EURO-AM			OH	1922
HAMANN-TODD	W 928	FEMALE	69	AFRO-AM			OH	1922
HAMANN-TODD	W 929	FEMALE	31	EURO-AM			OH	1922
HAMANN-TODD	W 931	FEMALE	34	AFRO-AM			OH	1922
HAMANN-TODD	W 933	FEMALE	28	AFRO-AM			OH	1922
HAMANN-TODD	W 935	FEMALE	60	EURO-AM			OH	1922

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
HAMANN-TODD	W 938	FEMALE	52	AFRO-AM			OH	1922
HAMANN-TODD	W 939	MALE	50	EURO-AM			OH	1922
HAMANN-TODD	W 940	MALE	48	AFRO-AM			OH	1922
HAMANN-TODD	W 941	MALE	22	AFRO-AM			OH	1922
HAMANN-TODD	W 942	MALE	45	EURO-AM			OH	1922
HAMANN-TODD	W 943	MALE	48	EURO-AM			OH	1922
HAMANN-TODD	W 944	MALE	47	EURO-AM			OH	1922
HAMANN-TODD	W 945	MALE	39	EURO-AM			OH	1922
HAMANN-TODD	W 946	MALE	38	AFRO-AM			OH	1922
HAMANN-TODD	W 947	MALE	47	EURO-AM			OH	1922
HAMANN-TODD	W 949	MALE	48	EURO-AM			OH	1922
HAMANN-TODD	W 954	FEMALE	24	AFRO-AM			OH	1922
HAMANN-TODD	W 962	MALE	44	EURO-AM			OH	1922
HAMANN-TODD	W 967	FEMALE	87	AFRO-AM			OH	1922
HAMANN-TODD	W 980	MALE	34	AFRO-AM			OH	1922
HAMANN-TODD	W 1008	MALE	47	AFRO-AM			OH	1923
HAMANN-TODD	W 1012	FEMALE	18	AFRO-AM			OH	1923
HAMANN-TODD	W 1041	FEMALE	17	AFRO-AM			OH	1923
HAMANN-TODD	W 1042	FEMALE	30	AFRO-AM			OH	1920
HAMANN-TODD	W 1046	FEMALE	24	AFRO-AM			OH	1923
HAMANN-TODD	W 1049	FEMALE	40	EURO-AM			OH	1923
HAMANN-TODD	W 1052	FEMALE	67	EURO-AM			OH	1923
HAMANN-TODD	W 1055	MALE	49	AFRO-AM			OH	1923
HAMANN-TODD	W 1059	FEMALE	28	EURO-AM			OH	1923
HAMANN-TODD	W 1061	MALE	60	EURO-AM			OH	1923
HAMANN-TODD	W 1067	MALE	42	AFRO-AM			OH	1923
HAMANN-TODD	W 1068	MALE	77	EURO-AM			OH	1923
HAMANN-TODD	W 1069	MALE	49	EURO-AM			OH	1923
HAMANN-TODD	W 1071	MALE	34	AFRO-AM	WEST INDIES	WS	OH	1923
HAMANN-TODD	W 1075	MALE	35	EURO-AM			OH	1923
HAMANN-TODD	W 1076	MALE	44	EURO-AM			OH	1923
HAMANN-TODD	W 1084	MALE	24	AFRO-AM		MO	OH	1924
HAMANN-TODD	W 1087	FEMALE	65	AFRO-AM			OH	1923
HAMANN-TODD	W 1103	FEMALE	29	AFRO-AM			OH	1924
HAMANN-TODD	W 1105	FEMALE	39	AFRO-AM		TN	OH	1924
HAMANN-TODD	W 1108	MALE	28	AFRO-AM			OH	1924
HAMANN-TODD	W 1124	FEMALE	40	AFRO-AM			OH	1924
HAMANN-TODD	W 1130	FEMALE	21	AFRO-AM			OH	1924
HAMANN-TODD	W 1149	FEMALE	50	EURO-AM	IRISH	IR	OH	1924
HAMANN-TODD	W 1157	FEMALE	25	EURO-AM	AUSTRIAN	A	OH	1924
HAMANN-TODD	W 1161	FEMALE	24	AFRO-AM			OH	1924
HAMANN-TODD	W 1162	FEMALE	28	EURO-AM			OH	1924
HAMANN-TODD	W 1190	MALE	48	AFRO-AM			OH	1924
HAMANN-TODD	W 1205	MALE	21	AFRO-AM			OH	1924
HAMANN-TODD	W 1208	FEMALE	23	AFRO-AM			OH	1924

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
HAMANN-TODD	H 1214	FEMALE	32	AFRO-AM			OH	1924
HAMANN-TODD	H 1215	FEMALE	31	AFRO-AM			OH	1924
HAMANN-TODD	H 1243	FEMALE	24	AFRO-AM			OH	1925
HAMANN-TODD	H 1253	FEMALE	31	EURO-AM	RUSSIAN	SR	OH	1925
HAMANN-TODD	H 1256	FEMALE	55	EURO-AM			OH	1925
HAMANN-TODD	H 1277	FEMALE	22	AFRO-AM			OH	1925
HAMANN-TODD	H 1279	FEMALE	39	EURO-AM			OH	1925
HAMANN-TODD	H 1294	FEMALE	28	AFRO-AM		OH	OH	1925
HAMANN-TODD	H 1297	FEMALE	40	AFRO-AM			OH	1925
HAMANN-TODD	H 1300	FEMALE	39	AFRO-AM			OH	1925
HAMANN-TODD	H 1302	FEMALE	47	EURO-AM			OH	1925
HAMANN-TODD	H 1309	FEMALE	43	EURO-AM			OH	1925
HAMANN-TODD	H 1310	FEMALE	29	AFRO-AM			OH	1925
HAMANN-TODD	H 1321	FEMALE	52	AFRO-AM			OH	1926
HAMANN-TODD	H 1324	FEMALE	49	EURO-AM			OH	1926
HAMANN-TODD	H 1327	MALE	28	EURO-AM			OH	1926
HAMANN-TODD	H 1345	FEMALE	39	AFRO-AM			OH	1926
HAMANN-TODD	H 1350	FEMALE	28	EURO-AM			OH	1926
HAMANN-TODD	H 1361	MALE	25	AFRO-AM			OH	1926
HAMANN-TODD	H 1368	MALE	53	AFRO-AM			OH	1926
HAMANN-TODD	H 1369	FEMALE	25	EURO-AM		OH	OH	1926
HAMANN-TODD	H 1383	MALE	73	AFRO-AM			OH	1926
HAMANN-TODD	H 1397	FEMALE	33	AFRO-AM			OH	1926
HAMANN-TODD	H 1399	MALE	53	AFRO-AM			OH	1926
HAMANN-TODD	H 1418	FEMALE	21	AFRO-AM		MI	OH	1926
HAMANN-TODD	H 1427	FEMALE	28	AFRO-AM		AL	OH	1926
HAMANN-TODD	H 1489	FEMALE	38	AFRO-AM			OH	1926
HAMANN-TODD	H 1494	FEMALE	45	EURO-AM			OH	1926
HAMANN-TODD	H 1516	FEMALE	37	AFRO-AM			OH	1927
HAMANN-TODD	H 1536	FEMALE	29	AFRO-AM			OH	1927
HAMANN-TODD	H 1580	FEMALE	31	AFRO-AM			OH	1927
HAMANN-TODD	H 1600	FEMALE	28	AFRO-AM			OH	1927
HAMANN-TODD	H 1601	FEMALE	48	EURO-AM			OH	1927
HAMANN-TODD	H 1617	FEMALE	32	AFRO-AM			OH	1927
HAMANN-TODD	H 1622	FEMALE	27	AFRO-AM			OH	1927
HAMANN-TODD	H 1675	FEMALE	48	EURO-AM			OH	1928
HAMANN-TODD	H 1694	FEMALE	30	AFRO-AM			OH	1928
HAMANN-TODD	H 1695	FEMALE	50	AFRO-AM			OH	1928
HAMANN-TODD	H 1707	FEMALE	25	AFRO-AM			OH	1928
HAMANN-TODD	H 1735	FEMALE	50	EURO-AM			OH	1928
HAMANN-TODD	H 1739	FEMALE	33	EURO-AM			OH	1928
HAMANN-TODD	H 1744	FEMALE	49	AFRO-AM			OH	1928
HAMANN-TODD	H 1748	FEMALE	44	AFRO-AM			OH	1928
HAMANN-TODD	H 1749	FEMALE	42	AFRO-AM			OH	1928
HAMANN-TODD	H 1752	FEMALE	48	EURO-AM			OH	1928

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
HAMANN-TODD	H 1762	FEMALE	61	EURO-AM			OH	1928
HAMANN-TODD	H 1771	FEMALE	54	EURO-AM	BOHEMIAN	D	OH	1928
HAMANN-TODD	H 1781	FEMALE	48	AFRO-AM			OH	1928
HAMANN-TODD	H 1785	FEMALE	32	AFRO-AM			OH	1928
HAMANN-TODD	H 1843	FEMALE	45	EURO-AM			OH	1929
HAMANN-TODD	H 1846	FEMALE	53	EURO-AM			OH	1929
HAMANN-TODD	H 1856	FEMALE	45	AFRO-AM			OH	1929
HAMANN-TODD	H 1871	FEMALE	36	AFRO-AM			OH	1929
HAMANN-TODD	H 1921	FEMALE	48	EURO-AM			OH	1929
HAMANN-TODD	H 1924	FEMALE	38	AFRO-AM		IN	OH	1929
HAMANN-TODD	H 1949	FEMALE	19	AFRO-AM			OH	1930
HAMANN-TODD	H 1961	FEMALE	28	AFRO-AM			OH	1930
HAMANN-TODD	H 2025	FEMALE	49	EURO-AM		MA	OH	1930
HAMANN-TODD	H 2027	FEMALE	50	EURO-AM	GERMAN	D	OH	1930
HAMANN-TODD	H 2028	FEMALE	38	AFRO-AM			OH	1930
HAMANN-TODD	H 2039	FEMALE	65	AFRO-AM			OH	1930
HAMANN-TODD	H 2048	FEMALE	52	EURO-AM	GERMAN	D	OH	1930
HAMANN-TODD	H 2053	FEMALE	45	AFRO-AM			OH	1930
HAMANN-TODD	H 2065	FEMALE	19	AFRO-AM			OH	1931
HAMANN-TODD	H 2094	FEMALE	23	AFRO-AM			OH	1931
HAMANN-TODD	H 2105	FEMALE	49	EURO-AM	SWEDISH	S	OH	1931
HAMANN-TODD	H 2115	FEMALE	45	AFRO-AM			OH	1931
HAMANN-TODD	H 2125	FEMALE	36	EURO-AM			OH	1931
HAMANN-TODD	H 2138	FEMALE	50.0	EURO-AM			OH	1931
HAMANN-TODD	H 2145	MALE	35.0	HISP-AM	MEXI-INDIAN		OH	1931
HAMANN-TODD	H 2244	FEMALE	41.0	EURO-AM	HUNGARIAN	H	OH	1932
HAMANN-TODD	H 2254	FEMALE	38.0	EURO-AM			OH	1932
HAMANN-TODD	H 2337	FEMALE	57.0	EURO-AM	RUSSIAN	SR	OH	1932
HAMANN-TODD	H 2354	FEMALE	45.0	EURO-AM			OH	1933
HAMANN-TODD	H 2414	FEMALE	47.0	EURO-AM			OH	1933
HAMANN-TODD	H 2437	FEMALE	45.0	EURO-AM			OH	1933
HAMANN-TODD	H 2476	FEMALE	53.0	EURO-AM		OH	OH	1933
HAMANN-TODD	H 2478	FEMALE	35.0	EURO-AM			OH	1933
HAMANN-TODD	H 2515	FEMALE	58.0	EURO-AM			OH	1934
HAMANN-TODD	H 2645	FEMALE	52.0	EURO-AM			OH	1934
HAMANN-TODD	H 2857	FEMALE	31.0	EURO-AM			OH	1935
HAMANN-TODD	H 2860	FEMALE	46.0	EURO-AM			OH	1935
HAMANN-TODD	H 2884	FEMALE	29.0	EURO-AM			OH	1936
HAMANN-TODD	H 2923	FEMALE	37.0	EURO-AM			OH	1936
HAMANN-TODD	H 2924	FEMALE	56.0	EURO-AM			OH	1936
HAMANN-TODD	H 2939	FEMALE	25.0	EURO-AM			OH	1936
HAMANN-TODD	H 2945	MALE	31.0	AFRO-AM			OH	1936
HAMANN-TODD	H 2955	MALE	45.0	EURO-AM			OH	1936
HAMANN-TODD	H 2970	MALE	30.0	AFRO-AM			OH	1936
HAMANN-TODD	H 2995	MALE	39.0	EURO-AM			OH	1936

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
HAMANN-TODD	H 3022	FEMALE	50.0	AFRO-AM			OH	1936
HAMANN-TODD	H 3131	FEMALE	43.0	AFRO-AM			OH	1937
HAMANN-TODD	H 3161	FEMALE	44.0	AFRO-AM			OH	1937
HAMANN-TODD	H 3173	FEMALE	44.0	AFRO-AM			OH	1937
HAMANN-TODD	H 3182	FEMALE	48.0	AFRO-AM			OH	1937
HAMANN-TODD	H 3210	FEMALE	47.0	AFRO-AM			OH	1937
HAMANN-TODD	H 3269	FEMALE	43.0	AFRO-AM			OH	1938
HAMANN-TODD	H 3318	FEMALE	42.0	AFRO-AM			OH	1938
HAMANN-TODD	H 3336	FEMALE	33.0	AFRO-AM			OH	1938
HAMANN-TODD	H 3378	FEMALE	45.0	AFRO-AM			OH	1938
HIST IND	225063	MALE	37.0	AMER IN	SIOUX		SD	1864
HIST IND	225074	FEMALE	22.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	225085	MALE	27.0	AMER IN	UTE		UT	1858
HIST IND	225091	MALE	30.0	AMER IN	CHEYENNE		CO	1864
HIST IND	225094	MALE	27.0	AMER IN	MORPVAVAPAI		AZ	1868
HIST IND	225102	MALE	27.0	AMER IN	APACHE		AZ	1874
HIST IND	225224	MALE	22.0	AMER IN	ARAPAHO		OK	1872
HIST IND	225251	MALE	30.0	AMER IN	CHEYENNE		WY	1878
HIST IND	225254	MALE	32.0	AMER IN	SIOUX/DAKOT		SD	1872
HIST IND	225256	MALE	19.0	AMER IN	PAIUTE-VANT		UT	1872
HIST IND	227508	MALE	30.0	AMER IN	SIOUX/GIANT			1800-1900
HIST IND	243332	MALE	37.0	AMER IN	SIOUX/YANKT		ND	1868
HIST IND	243378	FEMALE	62.5	AMER IN	SIOUX/BRULE		SD	1869
HIST IND	243487	MALE	42.0	AMER IN	LIPAN		TX	1872
HIST IND	243489	FEMALE	27.0	AMER IN	TONKAWAY		TX	1870
HIST IND	243541	FEMALE	52.0	AMER IN	SAC		KS	1865
HIST IND	243547	MALE	30.0	AMER IN	CHEYENNE		KS	1867
HIST IND	243548	MALE	30.0	AMER IN	CHEYENNE		KS	1867
HIST IND	243549	MALE	22.0	AMER IN	CHEYENNE		KS	1869
HIST IND	243550	MALE	30.0	AMER IN	CHEYENNE		KS	1868
HIST IND	243551	MALE	30.0	AMER IN	CHEYENNE		KS	1868
HIST IND	243552	MALE	30.0	AMER IN	CHEYENNE		KS	1868
HIST IND	243553	MALE	30.0	AMER IN	CHEYENNE		KS	1867
HIST IND	243554	MALE	32.5	AMER IN	CHEYENNE		KS	1868
HIST IND	243555	MALE	30.0	AMER IN	CHEYENNE		KS	1868
HIST IND	243565	FEMALE	19.0	AMER IN	KECHI		OK	1869
HIST IND	243593	MALE	30.0	AMER IN	CHEYENNE		CO	1864
HIST IND	243595	FEMALE	30.0	AMER IN	CHEYENNE		CO	1864
HIST IND	243638	MALE	27.0	AMER IN	CHIPPEWA		ND	1858
HIST IND	243639	MALE	42.0	AMER IN	CHIPPEWA		MB	1846
HIST IND	243640	MALE	32.0	AMER IN	CHIPPEWA		ND	1858
HIST IND	243642	FEMALE	45.0	AMER IN	BLACKFEET		MT	1880-1900
HIST IND	243644	MALE	21.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243645	MALE	37.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243646	MALE	42.5	AMER IN	BLACKFEET		MT	1800-1900

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
HIST IND	243648	FEMALE	47.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243649	FEMALE	33.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243650	FEMALE	27.5	AMER IN	BLACKFEET		MT	1800 1900
HIST IND	243651	FEMALE	25.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243652	MALE	47.5	AMER IN	BLACKFEET		MT	1800 1900
HIST IND	243653	FEMALE	37.5	AMER IN	PIEGAN		MT	1835
HIST IND	243654	FEMALE	52.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243656	MALE	26.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243657	FEMALE	20.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243658	MALE	32.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243659	MALE	40.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243660	FEMALE	26.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243661	MALE	42.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243666	FEMALE	45.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243668	MALE	34.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243669	FEMALE	52.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243673	MALE	40.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243674	FEMALE	32.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243675	MALE	37.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243676	MALE	30.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243677	FEMALE	26.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243679	FEMALE	42.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243680	MALE	24.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243683	MALE	27.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243684	MALE	40.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243685	FEMALE	45.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243686	FEMALE	20.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243721	MALE	42.0	AMER IN	SIOUX/OGALA		WY	1864
HIST IND	243723	MALE	37.0	AMER IN	SIOUX		WY	1866
HIST IND	243724	MALE	52.0	AMER IN	SIOUX/OGALA		WY	1866
HIST IND	243726	MALE	30.0	AMER IN	CHEYENNE		WY	1878
HIST IND	243727	MALE	30.0	AMER IN	CHEYENNE		WY	1877
HIST IND	243728	FEMALE	30.0	AMER IN	CHEYENNE		WY	1878
HIST IND	243729	FEMALE	30.0	AMER IN	CHEYENNE		WY	1878
HIST IND	243730	FEMALE	30.0	AMER IN	CHEYENNE		WY	1878
HIST IND	243731	FEMALE	30.0	AMER IN	CHEYENNE		WY	1878
HIST IND	243733	MALE	42.0	AMER IN	CHEYENNE		WY	1878
HIST IND	243770	MALE	22.0	AMER IN	SHOSHONE/BA		UT	1863
HIST IND	243774	FEMALE	37.0	AMER IN	UTE/GOSH		UT	1874
HIST IND	243775	MALE	42.0	AMER IN	PAIUTE		UT	1877
HIST IND	243824	FEMALE	32.0	AMER IN	SHOSHONE		AZ	1850
HIST IND	243829	MALE	30.0	AMER IN	CHEYENNE		TX	1869
HIST IND	243832	MALE	42.0	AMER IN	KECHI		TX	1866
HIST IND	243837	MALE	22.0	AMER IN	BANNOCK		ID	1873
HIST IND	243852	MALE	30.0	AMER IN	POTTAWATOMI		IN	1800-1900

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
HIST IND	243884	FEMALE	22.0	AMER IN	CHOCTAW		AL	1869
HIST IND	243891	FEMALE	37.0	AMER IN	SHAWNEE		OH	1800
HIST IND	243917	FEMALE	30.0	AMER IN	CHEYENNE		OK	1867
HIST IND	243929	MALE	27.0	AMER IN	UTE/GOSH		UT	1884
HIST IND	243932	FEMALE	25.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	243998	MALE	33.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	259359	MALE	22.0	AMER IN	POTTAWATOMI		WI	1800-1900
HIST IND	310781	MALE	19.0	AMER IN	SHOSHONE		NV	1911
HIST IND	41892	FEMALE	32.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41893	FEMALE	17.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41894	FEMALE	22.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41899	MALE	45.0	AMER IN	BLACKFEET			1800-1900
HIST IND	41900	FEMALE	37.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41904	FEMALE	35.0	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	41907	FEMALE	42.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	41908	FEMALE	27.5	AMER IN	PIEGAN/SO		MT	1800-1900
HIST IND	41910	FEMALE	27.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	41911	FEMALE	27.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	41913	FEMALE	32.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41915	FEMALE	22.5	AMER IN	BLACKFEET		MT	1800-1900
HIST IND	41916	MALE	32.5	AMER IN	PIEGAN/NO		AB	1800-1900
HIST IND	41917	FEMALE	21.5	AMER IN	PIEGAN		AB	1800-1900
HIST IND	41918	FEMALE	27.5	AMER IN	PIEGAN		AB	1800-1900
HIST IND	41919	FEMALE	30.5	AMER IN	BLACKFEET		AB	1800-1900
HIST IND	41922	FEMALE	27.5	AMER IN	BLACKFEET		AB	1800-1900
HIST IND	41923	FEMALE	22.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41924	FEMALE	27.5	AMER IN	BLACKFEET		CN	1800-1900
HIST IND	41924	FEMALE	27.5	AMER IN	BLACKFEET		CN	1800-1900
HIST IND	41925	FEMALE	22.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41926	MALE	32.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41927	FEMALE	20.0	AMER IN	PIEGAN		AB	1800-1900
HIST IND	41928	FEMALE	30.0	AMER IN	BLACKFEET			1800-1900
HIST IND	41929	MALE	52.5	AMER IN	BLACKFEET		CN	1800-1900
HIST IND	41931	FEMALE	47.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41932	FEMALE	22.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41933	MALE	32.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41934	MALE	22.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41936	FEMALE	37.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41937	FEMALE	22.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41938	FEMALE	17.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41940	FEMALE	32.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41941	MALE	47.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41942	FEMALE	27.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41943	MALE	37.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41944	FEMALE	47.5	AMER IN	BLACKFEET			1800-1900

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
HIST IND	41945	MALE	62.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41946	FEMALE	37.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41947	FEMALE	32.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41948	FEMALE	42.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41949	FEMALE	42.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41951	FEMALE	32.5	AMER IN	BLACKFEET		AB	1800-1900
HIST IND	41952	MALE	22.5	AMER IN	BLACKFEET			1800-1900
HIST IND	41960	FEMALE	52.5	AMER IN	CROW		MT	1800-1900
HIST IND	41961	FEMALE	32.5	AMER IN	CROW			1800-1900
HIST IND	OMI2495-75	FEMALE	59.0	AMER IN	ACOMA/PUEBL	NM	NM	1975
HIST IND	W 1538	MALE	63.0	AMER IN			OH	1927
HIST IND	W 2895	FEMALE	34.0	AMER IN			OH	1936
HIST IND	W 3040	MALE	47.0	AMER IN			OH	1937
HISTORIC	ANATSPECIM	FEMALE	62.0	AFRO-AM			KS	1920
HISTORIC	IRONCOFFIN	MALE	42.5	EURO-AM			LA	1855
HISTORIC	JAMES ISL	FEMALE	40.0	AFRO-AM			SC	1900
HISTORIC	LA 1956	MALE	26.5	EURO-AM			NB	1860
HISTORIC	LA84 11	MALE	52.5	AFRO-AM			LA	1900
HISTORIC	SD74/JP	MALE	30.0	EURO-AM			SD	1881
HISTORIC	SD75/JB	MALE	30.0	EURO-AM			SD	1885
HISTORIC	SI 173	MALE	25.5	AFRO-AM			VA	1918
HISTORIC	UNION 8 5	MALE	25.0	AFRO-AM			SC	1863
HISTORIC	UNION 814	MALE	25.0	AFRO-AM			SC	1863
HISTORIC	UT88 7	MALE	40.0	AFRO-AM			TN	1905
NEW ORLEANS	B0003	MALE	54.5	AFRO-AM			LA	1805
NEW ORLEANS	B0005	MALE	42.0	EURO-AM			LA	1805
NEW ORLEANS	B0006	FEMALE	19.0	AFRO-AM			LA	1805
NEW ORLEANS	B0023	MALE	42.0	AFRO-AM			LA	1805
NEW ORLEANS	B0029	FEMALE	27.0	AFRO-AM			LA	1805
NEW ORLEANS	B0104	FEMALE	52.0	AFRO-AM			LA	1833
R.J. TERRY	T 9R	MALE	71.0	AFRO-AM			MO	1941
R.J. TERRY	T 11R	FEMALE	24.0	AFRO-AM			MO	1942
R.J. TERRY	T 12R	FEMALE	41.0	EURO-AM			MO	1941
R.J. TERRY	T 13R	MALE	28.0	AFRO-AM			MO	1938
R.J. TERRY	T 14R	MALE	38.0	EURO-AM			MO	1944
R.J. TERRY	T 16R	FEMALE	91.0	EURO-AM			MO	1957
R.J. TERRY	T 18R	FEMALE	37.0	AFRO-AM			MO	1944
R.J. TERRY	T 24R	FEMALE	52.0	AFRO-AM			MO	1940
R.J. TERRY	T 26R	FEMALE	50.0	AFRO-AM			MO	1942
R.J. TERRY	T 31R	MALE	38.0	AFRO-AM			MO	1940
R.J. TERRY	T 36R	MALE	70.0	AFRO-AM	AFRICAN		MO	1940
R.J. TERRY	T 37R	FEMALE	55.0	EURO-AM			MO	1940
R.J. TERRY	T 45R	MALE	32.0	HISP-AM	MEXICAN		MO	1942
R.J. TERRY	T 46R	MALE	67.0	AFRO-AM			MO	1950
R.J. TERRY	T 48R	FEMALE	60.0	AFRO-AM			MO	1942

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
R.J. TERRY	T 56R	FEMALE	57.0	AFRO-AM			MO	1939
R.J. TERRY	T 60R	FEMALE	39.0	AFRO-AM			MO	1938
R.J. TERRY	T 66RR	FEMALE	80.0	EURO-AM			MO	1950
R.J. TERRY	T 69R	FEMALE	52.0	EURO-AM			MO	1952
R.J. TERRY	T 81R	FEMALE	61.0	AFRO-AM			MO	1945
R.J. TERRY	T 86R	FEMALE	71.0	AFRO-AM			MO	1939
R.J. TERRY	T 100RR	FEMALE	85.0	AFRO-AM			MO	1950
R.J. TERRY	T 109	MALE	46.0	EURO-AM			MO	1922
R.J. TERRY	T 111R	MALE	38.0	EURO-AM			MO	1943
R.J. TERRY	T 112R	FEMALE	59.0	EURO-AM			MO	1946
R.J. TERRY	T 125R	MALE	31.0	AFRO-AM			MO	1936
R.J. TERRY	T 126R	MALE	50.0	EURO-AM			MO	1939
R.J. TERRY	T 131R	MALE	39.0	EURO-AM			MO	1939
R.J. TERRY	T 143	MALE	58.0	AFRO-AM			MO	1936
R.J. TERRY	T 149R	FEMALE	70.0	EURO-AM			MO	1946
R.J. TERRY	T 162R	FEMALE	40.0	EURO-AM			MO	1946
R.J. TERRY	T 171R	FEMALE	29.0	AFRO-AM			MO	1939
R.J. TERRY	T 174R	FEMALE	60	EURO-AM			MO	1950
R.J. TERRY	T 176R	FEMALE	74	EURO-AM			MO	1950
R.J. TERRY	T 177R	FEMALE	33	AFRO-AM			MO	1939
R.J. TERRY	T 187R	MALE	29	EURO-AM			MO	1946
R.J. TERRY	T 192	MALE	73	EURO-AM	GERMAN	D	MO	1924
R.J. TERRY	T 198R	MALE	40	EURO-AM			MO	1951
R.J. TERRY	T 199R	FEMALE	56	AFRO-AM			MO	1946
R.J. TERRY	T 219	MALE	72	EURO-AM			MO	1924
R.J. TERRY	T 224	MALE	64	EURO-AM	GERMAN	D	MO	1924
R.J. TERRY	T 225R	FEMALE	55	EURO-AM			MO	1957
R.J. TERRY	T 229	MALE	41	EURO-AM			MO	1924
R.J. TERRY	T 230	MALE	38	EURO-AM	GERMAN	D	MO	1924
R.J. TERRY	T 234	MALE	60	EURO-AM	GERMAN	D	MO	1923
R.J. TERRY	T 253RR	MALE	36	AFRO-AM			MO	1944
R.J. TERRY	T 255	FEMALE	22	AFRO-AM			MO	1924
R.J. TERRY	T 262	MALE	72	EURO-AM			MO	1925
R.J. TERRY	T 268	MALE	62	EURO-AM			MO	1925
R.J. TERRY	T 303R	MALE	30	EURO-AM			MO	1940
R.J. TERRY	T 306R	FEMALE	50	EURO-AM			MO	1953
R.J. TERRY	T 311R	MALE	27	EURO-AM			MO	1950
R.J. TERRY	T 312R	FEMALE	64	EURO-AM			MO	1953
R.J. TERRY	T 355	MALE	60	AFRO-AM			MO	1936
R.J. TERRY	T 360	MALE	46	AFRO-AM			MO	1926
R.J. TERRY	T 364	MALE	70	EURO-AM	GERMAN	D	MO	1926
R.J. TERRY	T 368	MALE	56	AFRO-AM			MO	1927
R.J. TERRY	T 371	MALE	56	AFRO-AM			MO	1927
R.J. TERRY	T 377	MALE	21	AFRO-AM			MO	1926
R.J. TERRY	T 378	MALE	72	EURO-AM	GERMAN	D	MO	1926

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
R.J. TERRY	T 379	MALE	58	EURO-AM			MO	1926
R.J. TERRY	T 381	MALE	47	AFRO-AM			MO	1926
R.J. TERRY	T 391	MALE	50	AFRO-AM			MO	1927
R.J. TERRY	T 398	MALE	32	AFRO-AM			MO	1927
R.J. TERRY	T 405R	FEMALE	34	EURO-AM			MO	1943
R.J. TERRY	T 431	MALE	42	EURO-AM	RUSSIAN	SR	MO	1928
R.J. TERRY	T 433	MALE	59	EURO-AM			MO	1928
R.J. TERRY	T 486	MALE	46	AFRO-AM		GA	MO	1928
R.J. TERRY	T 493	MALE	75	EURO-AM	SWISS	CH	MO	1928
R.J. TERRY	T 500	MALE	68	AFRO-AM			MO	1928
R.J. TERRY	T 501	MALE	77	EURO-AM	GERMAN	D	MO	1928
R.J. TERRY	T 505	MALE	57	EURO-AM			MO	1928
R.J. TERRY	T 508	MALE	60	AFRO-AM			MO	1928
R.J. TERRY	T 509	MALE	28	AFRO-AM			MO	1928
R.J. TERRY	T 511	FEMALE	34	AFRO-AM			MO	1928
R.J. TERRY	T 514RR	MALE	73	AFRO-AM			MO	1955
R.J. TERRY	T 517	MALE	46	EURO-AM			MO	1928
R.J. TERRY	T 518	MALE	41	AFRO-AM			MO	1927
R.J. TERRY	T 519	MALE	26	AFRO-AM			MO	1927
R.J. TERRY	T 520	FEMALE	27	AFRO-AM			MO	1928
R.J. TERRY	T 554R	FEMALE	55	EURO-AM			MO	1947
R.J. TERRY	T 558	MALE	69	EURO-AM	IRISH	IR	MO	1927
R.J. TERRY	T 614	MALE	50	EURO-AM			MO	1929
R.J. TERRY	T 615	FEMALE	35	AFRO-AM			MO	1929
R.J. TERRY	T 617	FEMALE	43	AFRO-AM			MO	1947
R.J. TERRY	T 618	MALE	60	AFRO-AM			MO	1929
R.J. TERRY	T 619	MALE	31	AFRO-AM			MO	1927
R.J. TERRY	T 628	MALE	60	AFRO-AM			MO	1929
R.J. TERRY	T 701	MALE	55	EURO-AM	ITALIAN		MO	1929
R.J. TERRY	T 704	MALE	40	AFRO-AM		KY	MO	1929
R.J. TERRY	T 705	MALE	46	AFRO-AM		GA	MO	1929
R.J. TERRY	T 707	MALE	26	AFRO-AM			MO	1929
R.J. TERRY	T 708	MALE	68	EURO-AM	GERMAN		MO	1929
R.J. TERRY	T 709	MALE	50	EURO-AM			MO	1929
R.J. TERRY	T 711	MALE	61	AFRO-AM			MO	1929
R.J. TERRY	T 712	MALE	47	AFRO-AM		AL	MO	1929
R.J. TERRY	T 733	MALE	60	AFRO-AM			MO	1929
R.J. TERRY	T 740R	MALE	18	AFRO-AM			MO	1938
R.J. TERRY	T 742	MALE	79	AFRO-AM			MO	1929
R.J. TERRY	T 743	MALE	53	EURO-AM			MO	1930
R.J. TERRY	T 745R	FEMALE	34	EURO-AM			MO	1943
R.J. TERRY	T 747	MALE	45	EURO-AM			MO	1929
R.J. TERRY	T 756	MALE	47	EURO-AM			MO	1929
R.J. TERRY	T 760	MALE	19	AFRO-AM			MO	1930
R.J. TERRY	T 766	FEMALE	35	AFRO-AM			MO	1930

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
R.J. TERRY	T 767	MALE	18	AFRO-AM			MO	1929
R.J. TERRY	T 770	MALE	65	AFRO-AM			MO	1930
R.J. TERRY	T 780	MALE	36	AFRO-AM			MO	1930
R.J. TERRY	T 782	MALE	30	AFRO-AM			MO	1930
R.J. TERRY	T 787	MALE	50	EURO-AM			MO	1930
R.J. TERRY	T 788	MALE	65	AFRO-AM			MO	1930
R.J. TERRY	T 790	MALE	77	AFRO-AM			MO	1930
R.J. TERRY	T 796	MALE	81	AFRO-AM		MS	MO	1930
R.J. TERRY	T 798	MALE	36	AFRO-AM		SC	MO	1930
R.J. TERRY	T 800R	FEMALE	18	AFRO-AM			MO	1948
R.J. TERRY	T 802	MALE	36	EURO-AM			MO	1930
R.J. TERRY	T 803	MALE	64	EURO-AM			MO	1930
R.J. TERRY	T 805	MALE	87	EURO-AM			MO	1930
R.J. TERRY	T 810	MALE	54	EURO-AM			MO	1930
R.J. TERRY	T 811	MALE	51	AFRO-AM			MO	1930
R.J. TERRY	T 812	MALE	56	EURO-AM			MO	1930
R.J. TERRY	T 813	MALE	60	EURO-AM			MO	1930
R.J. TERRY	T 815	FEMALE	32	AFRO-AM			MO	1930
R.J. TERRY	T 816	MALE	54	AFRO-AM			MO	1930
R.J. TERRY	T 817	MALE	55	AFRO-AM			MO	1930
R.J. TERRY	T 821	MALE	27	AFRO-AM			MO	1930
R.J. TERRY	T 825	MALE	49	AFRO-AM			MO	1930
R.J. TERRY	T 826	MALE	38	AFRO-AM		MO	MO	1931
R.J. TERRY	T 830	MALE	28	AFRO-AM			MO	1931
R.J. TERRY	T 831	FEMALE	44	AFRO-AM			MO	1931
R.J. TERRY	T 836	MALE	35	AFRO-AM			MO	1931
R.J. TERRY	T 859	MALE	23	AFRO-AM			MO	1931
R.J. TERRY	T 868	MALE	60	EURO-AM			MO	1931
R.J. TERRY	T 877	MALE	58	EURO-AM			MO	1931
R.J. TERRY	T 880	FEMALE	27	EURO-AM			MO	1931
R.J. TERRY	T 915R	FEMALE	62	EURO-AM			MO	1948
R.J. TERRY	T 929	FEMALE	20	AFRO-AM			MO	1931
R.J. TERRY	T 956	MALE	63	EURO-AM			MO	1931
R.J. TERRY	T 960	MALE	17	AFRO-AM			MO	1931
R.J. TERRY	T 963	MALE	71	EURO-AM			MO	1931
R.J. TERRY	T 970	FEMALE	21	AFRO-AM			MO	1932
R.J. TERRY	T 974	MALE	77	EURO-AM			MO	1932
R.J. TERRY	T 980	MALE	63	AFRO-AM			MO	1932
R.J. TERRY	T 985RR	FEMALE	66	EURO-AM			MO	1959
R.J. TERRY	T 1016R	FEMALE	54	EURO-AM			MO	1939
R.J. TERRY	T 1023	MALE	20	EURO-AM			MO	1932
R.J. TERRY	T 1028	MALE	67	EURO-AM			MO	1932
R.J. TERRY	T 1033	MALE	23	AFRO-AM			MO	1932
R.J. TERRY	T 1040	MALE	69	EURO-AM			MO	1932
R.J. TERRY	T 1051	MALE	74	EURO-AM			MO	1932

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
R.J. TERRY	T 1053	MALE	58	EURO-AM			MO	1932
R.J. TERRY	T 1081	MALE	40	AFRO-AM			MO	1932
R.J. TERRY	T 1089	MALE	43	EURO-AM			MO	1932
R.J. TERRY	T 1097	MALE	54	EURO-AM	SWEDISH	MN	MO	1932
R.J. TERRY	T 1100RR	FEMALE	76	EURO-AM			MO	1957
R.J. TERRY	T 1103R	FEMALE	88	EURO-AM			MO	1949
R.J. TERRY	T 1107	MALE	78	EURO-AM	CANADIAN	CN	MO	1932
R.J. TERRY	T 1111	MALE	81	EURO-AM			MO	1932
R.J. TERRY	T 1112	MALE	77	EURO-AM			MO	1933
R.J. TERRY	T 1117	MALE	85	AFRO-AM			MO	1933
R.J. TERRY	T 1120R	FEMALE	76	EURO-AM			MO	1958
R.J. TERRY	T 1130R	MALE	79	EURO-AM		IO	MO	1937
R.J. TERRY	T 1131	MALE	31	AFRO-AM			MO	1933
R.J. TERRY	T 1135	FEMALE	62	AFRO-AM			MO	1933
R.J. TERRY	T 1188	FEMALE	53	AFRO-AM			MO	1940
R.J. TERRY	T 1233R	FEMALE	63	EURO-AM			MO	1939
R.J. TERRY	T 1251	MALE	36	AFRO-AM			MO	1934
R.J. TERRY	T 1266R	MALE	77	EURO-AM			MO	1940
R.J. TERRY	T 1269R	FEMALE	69	AFRO-AM			MO	1937
R.J. TERRY	T 1271	MALE	58	EURO-AM			MO	1934
R.J. TERRY	T 1272R	MALE	57	EURO-AM	SERBIAN		MO	1937
R.J. TERRY	T 1308	MALE	66	EURO-AM			MO	1934
R.J. TERRY	T 1314	FEMALE	61	AFRO-AM			MO	1934
R.J. TERRY	T 1326R	FEMALE	67	AFRO-AM			MO	1944
R.J. TERRY	T 1327	MALE	61	EURO-AM	IRISH	IR	MO	1934
R.J. TERRY	T 1329	FEMALE	73	AFRO-AM			MO	1934
R.J. TERRY	T 1332	FEMALE	45	AFRO-AM			MO	1934
R.J. TERRY	T 1341	FEMALE	60	AFRO-AM			MO	1934
R.J. TERRY	T 1342	MALE	74	AFRO-AM			MO	1937
R.J. TERRY	T 1346	MALE	73	EURO-AM		AK	MO	1935
R.J. TERRY	T 1349	MALE	86	AFRO-AM			MO	1935
R.J. TERRY	T 1351	FEMALE	24	AFRO-AM			MO	1935
R.J. TERRY	T 1353R	FEMALE	50	EURO-AM		MA	MO	1940
R.J. TERRY	T 1354	FEMALE	25	AFRO-AM			MO	1935
R.J. TERRY	T 1390	FEMALE	55	AFRO-AM			MO	1937
R.J. TERRY	T 1443	MALE	26	AFRO-AM			MO	1936
R.J. TERRY	T 1514	MALE	70	EURO-AM			MO	1941
R.J. TERRY	T 1520	MALE	52	EURO-AM			MO	1941
R.J. TERRY	T 1522	MALE	66	EURO-AM			MO	1944
R.J. TERRY	T 1527	MALE	74	EURO-AM			MO	1941
R.J. TERRY	T 1541R	FEMALE	57	EURO-AM			MO	1952
R.J. TERRY	T 1546	MALE	52	EURO-AM			MO	1941
R.J. TERRY	T 1547RR	FEMALE	80	EURO-AM			MO	1957
R.J. TERRY	T 1557	FEMALE	64	EURO-AM			MO	1941
R.J. TERRY	T 1563	FEMALE	29	EURO-AM			MO	1962

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
R.J. TERRY	T 1564	MALE	30	EURO-AM			MO	1964
R.J. TERRY	T 1567	FEMALE	69	EURO-AM			IL	1964
R.J. TERRY	T 1569	MALE	30.0	EURO-AM			MO	1962
R.J. TERRY	T 1571	FEMALE	55.0	EURO-AM			MO	1958
R.J. TERRY	T 1572	FEMALE	45.0	EURO-AM			MO	1959
R.J. TERRY	T 1573	MALE	33.0	AFRO-AM			MO	1961
R.J. TERRY	T 1574	FEMALE	49.0	EURO-AM			MO	1964
R.J. TERRY	T 1575	FEMALE	44.0	EURO-AM			MO	1964
R.J. TERRY	T 1578	FEMALE	53.0	EURO-AM			MO	1964
R.J. TERRY	T 1579	FEMALE	49.0	EURO-AM			MO	1964
R.J. TERRY	T 1580	FEMALE	45.0	EURO-AM			MO	1963
R.J. TERRY	T 1582	FEMALE	46.0	EURO-AM			MO	1961
R.J. TERRY	T 1585	FEMALE	83.0	AFRO-AM			MO	1959
R.J. TERRY	T 1591	MALE	19.0	EURO-AM			MO	1960
R.J. TERRY	T 1593	FEMALE	50.0	EURO-AM			MO	1963
R.J. TERRY	T 1594	FEMALE	40.0	EURO-AM			MO	1964
R.J. TERRY	T 1595	FEMALE	52.0	EURO-AM			MO	1960
R.J. TERRY	T 1596	FEMALE	54.0	EURO-AM			MO	1964
R.J. TERRY	T 1598	MALE	33.0	EURO-AM			MO	1961
R.J. TERRY	T 1599	FEMALE	41.0	EURO-AM			MO	1965
R.J. TERRY	T 1600	FEMALE	26.0	AFRO-AM			MO	1960
R.J. TERRY	T 1601	FEMALE	61.0	EURO-AM			MO	1960
R.J. TERRY	T 1602	MALE	20.0	EURO-AM			MO	1963
R.J. TERRY	T 1605	FEMALE	41.0	AFRO-AM			MO	1962
R.J. TERRY	T 1606	MALE	34.0	AFRO-AM			MO	1963
R.J. TERRY	T 1607	MALE	32.0	EURO-AM			MO	1965
R.J. TERRY	T 1608	FEMALE	43.0	EURO-AM			MO	1963
R.J. TERRY	T 1609	FEMALE	54.0	AFRO-AM			MO	1960
R.J. TERRY	T 1611	FEMALE	59.0	EURO-AM			MO	1960
R.J. TERRY	T 1612	FEMALE	41.0	EURO-AM			MO	1964
R.J. TERRY	T 1615	MALE	27.0	AFRO-AM			MO	1954
R.J. TERRY	T 1618	MALE	38.0	EURO-AM			MO	1966
R.J. TERRY	T 1622	FEMALE	58.0	EURO-AM			IL	1965
R.J. TERRY	T 1623	FEMALE	74.0	EURO-AM			MO	1964
R.J. TERRY	T 1624	FEMALE	58.0	EURO-AM			MO	1965
R.J. TERRY	T 1632	FEMALE	77.0	AFRO-AM			MO	1961
SMITH INST	11-11-85	MALE	64.0	EURO-AM		RI	MD	1985
SMITH INST	12-09-75	MALE	71.0	EURO-AM			MD	1975
SMITH INST	384920	FEMALE	17.0	EURO-AM			MD	1972
SMITH INST	61118062	FEMALE	68.0	AFRO-AM	WEST INDIES	WS	DC	1985
SMITH INST	GREENE	MALE	40.0	EURO-AM			DC	1986
SMITH INST	SI 175	MALE	17.5	EURO-AM			AK	1976
SNAKE HILL	B 2	MALE	21.5	EURO-AM			ON	1814
SNAKE HILL	B 5	MALE	20.5	EURO-AM			ON	1814
SNAKE HILL	B 13	MALE	32.5	EURO-AM			ON	1814

Appendix A. Continued.

Collection Association	Id. Number	Gender	Age	Racial Group	Ethnic Group	Place of Birth	Place of Death	Date of Death
SNAKE HILL	B 27	MALE	21.5	EURO-AM			ON	1814
SNAKE HILL	B 28	MALE	17.5	EURO-AM			ON	1814

APPENDIX B

MEASUREMENT DEFINITIONS

Appendix B. Measurement Definitions (Howells 1966; 1973; Key 1983; Moore-Jansen (1987).

MEASUREMENT	CODE	DEFINITION
Glabella-Occipital Length	(GOL)	Greatest length from the glabellar region in the median-sagittal plane.
Nasion-Occipital Length	(NOL)	Greatest cranial length in the median-sagittal plane measured from Nasion.
Basion-Nasion Length	(BNL)	Direct length between Nasion and Basion. Employ Basion intermediate between Martin's "Hypo-" and "Endo-Basion" (Martin and Saller 1957), as defined by Howells (1973).
Basion-Bregma Height	(BBH)	Distance from Basion to Bregma using the intermediate Basion (see above).
Maximum Cranial Breadth	(XCB)	The maximum cranial breadth perpendicular to the median-sagittal plane.
Maximum Frontal Breadth	(XFB)	The maximum breadth at the coronal suture, perpendicular to the median-sagittal plane.
Minimum Frontal Breadth	(WFB)	Tho minimum breadth across the frontal, <u>perpendicular</u> to the median-sagittal plane.
Bizygomatic Breadth	(ZYB)	The maximum breadth across the zygomatic arches, wherever found, perpendicular to the median-sagittal plane.
Biauricular Breadth	(AUB)	The least exterior breadth across the roots of the zygomatic processes, wherever found.
Minimum Cranial Breadth	(WCB)	The breadth across the sphenoid at the base of the temporal fossa at the infratemporal.
Biasterionic Breadth	(ASB)	Direct measurement from one Asterion to another.
Basion-Prosthion Length	(BPL)	The length from Prosthion to Basion, employing Howells' intermediate Basion.

Appendix B. Continued.

MEASUREMENT	CODE	DEFINITION
Nasion-Prosthion Height	(NPH)	Upper facial height from Nasion to prosthion, using Howells' pre-alveolar point, (i.e. most anteriorly prominent point, in midline, above the septum between the central incisors (Howells 1973:169).
Nasal Height	(NLH)	The average height from Nasion to the lowest point on the border of the nasal aperture on either side.
Bijugular Breadth	(JUB)	The external breadth across the malars at the jugalia, (i.e., at the deepest points in the curvature between the frontal and temporal process of the malars.
Nasal Breadth	(NLB)	The distance between the anterior edges of the nasal aperture at its widest extent.
External Palatal Breadth	(MAB)	The greatest breadth across the alveolar borders, wherever found, perpendicular to the median-sagittal plane.
External Alveolar Length	(MAL)	The distance from Alveolon to Prosthion. Alveolon is defined as the intersection of the median-sagittal plane and a line connecting the posterior margins of the alveolar borders.
Mastoid Height	(MDH)	The length of the mastoid, below and perpendicular to, the eye-ear plane, in the vertical plane.
Mastoid Breadth	(MDB)	Width of the mastoid process at its base, through its transverse axis.
Orbital Height	(OBH)	The height between the upper and lower borders of the orbit, perpendicular to the long axis of the orbit and bisecting it.
Orbital Breadth	(OBB)	Breadth from Ectoconchion to Dacryon, approximating the longitudinal axis, bisecting orbit into equal upper and lower parts.

Appendix B. Continued.

MEASUREMENT	CODE	DEFINITION
Interorbital Breadth	(DKB)	Breadth across the nasal root, from Dacryon to Dacryon.
Naso-Dacryal Subtense	(NDS)	The subtense from the deepest point in the profile of the of the nasal bones to the interorbital breadth.
Simotic Chord	(WNB)	The minimum transverse breadth across the two nasal bones; cord between the naso-maxillary sutures at their closet approach.
Simotic Subtense	(SIS)	The subtense from the nasal bridge to the simotic chord, (i.e., from the highest point in the transverse section which is at the deepest point in the nasal profile.
Bimaxillary Breadth	(ZMB)	The breadth across the maxillae, from one Zygomaxillare anterior to the other.
Zygomaxillary Subtense	(SSS)	The projection or subtense from Subspinale to the bimaxillary breadth.
Bifrontal Breadth	(FMB)	The breadth across the frontal bone between Frontomalare anterior on each side,i.e., the most anterior point on the frontomalar suture.
Naso-Frontal Subtense	(NAS)	The subtense from Nasion to the bifrontal breadth.
Biorbital Breadth	(EKB)	The breadth across the orbits from Ectoconchion to Ectoconchion.
Dacryon Subtense	(DKS)	The subtense from Dacryon to the to the Biorbital breadth.
Inferior Malar length	(IML)	The direct distance from Zygomaxillare anterior to the lowest point on the zygotemporal suture on the external surface.

Appendix B. Continued.

MEASUREMENT	CODE	DEFINITION
Maximum Malar Length	(XML)	Total direct length of the malar in a diagonal direction from the lower end of the zygotemporal suture on the lateral face of the bone to Zygo-orbitale, at the junction of the zygomaxillary suture with the lower orbital border.
Malar Subtense	(MLS)	The maximum subtense from the convexity of the malar angle to the maximum length of the bone at the level of the zygomatico-facial foramen.
Cheek Height	(WMH)	The minimum distance in any direction from the lower border of the orbit to the lower margin of the maxilla, mesial to the masseter attachment.
Supraorbital Projection	(SOS)	The maximum projection of the supraorbital arch between the midline, in the region of Glabella or above, and the frontal bone immediately anterior to the temporal line in its forward part. Measured as a subtense to defined line.
Glabella Projection	(GLS)	The maximum projection of the midline profile between Nasion and Supra-glabellare (or the point at which the convex profile of the frontal bone changes to join the prominence of the glabellar region). Measured as a subtense.
Bistephanic Breadth	(STB)	Breadth between the intersections on either side, of the coronal suture and the inferior temporal line marking the origin of the temporal muscle.
Stephanic Subtense	(STS)	The subtense from the surface of the frontal in the median-sagittal plano to the bistephanic breadth.
Nasion-Bregma Chord	(FRC)	Tho frontal chord or direct distance from Nasion to Bregma taken in the median-sagittal plane, externally.
Nasion-Bregma Subtense	(FRS)	The maximum subtense at the highest point on the convexity of the frontal bone in the median-sagittal plane, to the frontal chord.

Appendix B. Continued.

MEASUREMENT	CODE	DEFINITION
Nasion-Bregma Fraction	(FRF)	The distance along the frontal chord recorded from Nasion to where the frontal subtense falls.
Bregma-Lambda Chord	(PAC)	The external chord, or direct distance from Bregma to Lambda, taken in the median-sagittal plane on the the external surface.
Bregma-Lambda Subtense	(PAS)	The maximum subtense at the highest point on the convexity of the parietal bones in the median-sagittal plane, to the parietal chord.
Bregma-Lambda Fraction	(PAF)	The distance along the parietal chord from Bregma to where the parietal subtense falls.
Lambda-Opisthion Chord	(OCC)	The external occipital chord, or direct distance from Lambda to Opisthion taken in the median-sagittal plane on the external surface.
Lambda Opisthion Subtense	(OCS)	The maximum subtense at the most prominent point at the basic contour of the occipital bone in the median-sagittal plane.
Lambda-Opisthion Fraction	(OCF)	The distance along the occipital chord, recorded from lambda at which the occipital subtense falls.
Foramen Magnum Length	(FOL)	The length from Basion to Opisthion, using Howells' intermediate Basion.
Foramen Magnum Breadth	(FOB)	The maximum breadth of the Foramen Magnum, measures perpendicular to the length.
Nasion Radius	(NAR)	The perpendicular to the transmeatal axis from Nasion.
Subspinale Radius	(SSR)	The perpendicular to the transmeatal axis from Subspinale.
Prosthion Radius	(PRR)	The perpendicular to the transmeatal axis from Prosthion.

Appendix B. Continued.

MEASUREMENT	CODE	DEFINITION
Dacryon Radius	(DKR)	The perpendicular to the transmeatal axis from Dacryon.
Zygo-orbitale radius	(ZOR)	The perpendicular to the transmeatal axis from Zygo-orbitale.
Frontomalare Radius	(FMR)	The perpendicular to the transmeatal axis from Frontomalare anterior.
Ectoconchion Radius	(EKR)	The Perpendicular to transmeatal axis from Ectoconchion.
Zygomaxillare Radius	(ZMR)	The perpendicular to the transmeatal axis from zygomaxillare anterior.
M1 Alveolus Radius	(AVR)	The perpendicular to the transmeatal axis from the most anterior point on the alveolus of the first molar.
Bregma Radius	(BRR)	The perpendicular to the transmeatal axis from Bregma.
Vertex Radius	(VRR)	The perpendicular to the transmeatal axis from the most distant point on the parietals, wherever found.
Lambda Radius	(LAR)	The perpendicular to the transmeatal axis from Lambda.
Opisthion Radius	(OPR)	The perpendicular to the transmeatal axis from Opisthion.
Basion Radius	(BAR)	The perpendicular to the transmeatal axis from Basion.
Nasion Angle (ba-pr)	(NAA)	The angle at Nasion, whose sides are Basion-Nasion and Nasion-Prosthion.
Prosthion Angle (ba-na)	(PRA)	The angle at Prosthion, whose sides are Basion-Prosthion and Nasion-Prosthion.
Basion Angle (na-pr)	(BAA)	The angle at Basion, whose sides are Basion-Nasion and Basio-Prosthion.

Appendix B. Continued.

MEASUREMENT	CODE	DEFINITION
Nasion Angle (ba-br)	(NBA)	The angle at Nasion whose sides are Basion-Nasion and Nasion-Bregma.
Basion Angle (na-br)	(BBA)	The angle at Basion whose sides are Basion-Nasion and Nasion-Bregma.
Zygomaxillare Angle	(SSA)	The angle at Subspinale whose sides reach from this point to Zygomaxillare anterior left and right.
Naso-Frontal Angle	(NFA)	The angle at Nasion whose two sides reach from this point to Frontomalare left and right.
Dacryal Angle	(DKA)	The angle at Dacryon formed by the orbital breadth from Ectoconchion and the subtense from Dacryon to biorbital breadth, right and left angles added.
Naso-Dacryal Angle	(NDA)	The angle formed at the midline of the nasal bones, whose sides reach from this point to Dacryon, left and right.
Simotic Angle	(SIA)	The angle at the midline of the nasal bones at their narrowest point, whose sides reach to the endpoints of the minimum breadth of the nasal bones.
Frontal Angle	(FRA)	The angle underlying the curvature of the frontal bone at its maximum height above the frontal chord.
Parietal Angle	(PAA)	The angle underlying the curvature of the parietal bones along the sagittal suture at its maximum height above the parietal chord.
Occipital Angle	(OCA)	The angle underlying the curvature of the occipital bone at its maximum height above the occipital chord.
Bistephanic Angle	(STA)	The angle formed in the midline of the frontal, whose sides reach from this point to Stephanion, left and right.

Appendix B. Continued.

MEASUREMENT	CODE	DEFINITION
Cranial Base Angle	(CBA)	The angle formed by the radius from basion to the transmeatal axis where the transmeatal axis is set equal to biauricular breadth.
Posterior Base Angle*	(OPA)	The angle at Opisthion whose sides are formed by Foramen Magnum length and by the radius from Opisthion to the transmeatal axis.
Anterior Base Angle*	(BOA)	The angle at Basion whose sides are formed by the radius from Basion to the transmeatal angle and by the Foramen Magnum length.
Cranial Base Flexion Angle*	(CFA)	The angle at Basion whose sides are formed by the radius from Basion to the transmeatal axis and Foramen Magnum length.

* Angular dimensions not used in the present study.

APPENDIX C

CRANIOMETRIC RECORDING FORM

M-J/1989 (after P/K - 1986/M-J - 1986) Record No.: M_ _ _ FDN: _ _ _ _ Ent.:___

CRANIAL MEASUREMENTS

Skull ID.:______________ Id. name :____________________ Sex :____ Positive Id. :______________

Collect. :______________ Means Id.:____________________ Sxsta:____ Place of Birth:______________

Observer :______________ Site/Loc.:____________________ Race :____ Date of Birth : / /

Recorder :______________ Ethn/Trib:____________________ Rstat:____ Place of Death:______________

Date Rec : / / 19 Period :____________________ Age :____ Date of Death : / /

Pts. damaged PR NA BR LA OP BA DK EK ZM MI ZY ____ Deform/Path:______________________________

(Spreading Calipers):

1. GOL Glab-occipital l : _ _ _
2. NOL Nasion-occipit l : _ _ _
3. BNL Basion-nasion l : _ _ _
4. BBH Basion-bregma h : _ _ _
5. XCB Max Cranial br : _ _ _
6. XFB Max Frontal br : _ _ _

(Sliding Calipers):

7. WFB Min Frontal br : _ _ _
8. ZYB Bizygomax br : _ _ _
9. AUB Biauricular br : _ _ _
10. WCB Min Cranial br : _ _ _
11. ASB Biasterion : _ _ _
12. BPL Basion-prosthion : _ _ _
13. NPH Nasion-prosthion : _ _
14. NLH Nasal height : _ _
15. JUB Bijugal breadth : _ _ _
16. NLB Nasal breadth : _ _
17. MAB Ext. palatal br : _ _
18. MAL Ext palatal l : _ _
19. MDH Mastoid height : _ _
20. MDB Mastoid breadth : _ _

(Dial Calipers):

21. OBH Orbital height : _ _
22. OBB Orbital breadth : _ _
23. DKB Interorbital br : _ _
24. NDS Nas-dacryon subt : _ _
25. WNB Simotic chord : _ _ ._
26. SIS Simotic subtense : _ _ ._

(Coordinate Calipers):

27. ZMB Bimaxillary br : _ _ _
28. SSS Zygo-max subtense: _ _
29. FMB Bifrontal breadth: _ _ _
30. NAS Nasio-frontal sub: _ _
31. EKB Biorbital breadth: _ _ _
32. DKS Dacryon subtense : _ _

33. IML Malar l, inferior : _ _
34. XML Malar l, maximum : _ _
35. MLS Malar Subtense : _ _
36. WMH Cheek ht, minimum : _ _
37. SOS Supraorb project : _ _
38. GLS Glabella projection: _ _
39. STB Bistephanic breadth: _ _ _
40. STS Stephanic subtense : _ _
41. FRC Frontal chord : _ _ _
42. FRS Frontal subtense : _ _
43. FRF Frontal fraction : _ _
44. PAC Parietal chord : _ _ _
45. PAS Parietal subtense : _ _
46. PAF Parietal fraction : _ _
47. OCC Occipit. chord : _ _ _
48. OCS Occipit. subtense : _ _
49. OCF Occipital fraction : _ _

(Sliding or Coordinate Calipers):

50. FOL Foramen Magnum l : _ _
51. FOB Foramen Magnum br : _ _

(Radiometer):

52. NAR Nasion radius : _ _ _
53. SSR Subspinale radius : _ _ _
54. PRR Prosthion radius : _ _ _
55. DKR Dacryon radius : _ _ _
56. ZOR Zygorbit radius : _ _ _
57. FMR Frontomalar radius : _ _
58. EKR Ectoconchion radius: _ _
59. ZMR Zygomaxillare rad : _ _
60. AVR M1 Alveolar radius : _ _ _
61. BRR Bregma radius : _ _ _
62. VRR Vertex radius : _ _ _
63. LAR Lambda radius : _ _ _
64. OSR Opisthion radius : _ _
65. BAR Basion radius : _ _
: _ _
66. MTT Mastoid rad. (Tip) : _ _

FORENSIC
DATA BANK MEASUREMENTS:

67. BAB Basion-bregma : _ _ _
68. BAN Basion-nasion : _ _ _
69. BAP Basion-prosth : _ _ _
70. NPR Nasion-prosth : _ _
71. FMT Upper face br : _ _ _
72. OBL Orbit breadth : _ _
73. EKE Biorbital br : _ _ _
74. MFM Interorbit br : _ _

MANDIBULAR MEASUREMENTS:

(Sliding Calipers):

75 GNI Symphysis ht : _ _
76. HML Body ht,at for: _ _
77. TML Body br,at for: _ _
78. GOG Bigonial br : _ _ _
79. CDL Bicondylar br : _ _ _
80. WRL Min Ramus br : _ _
81. MRL Max Ramus br : _ _
82. MCS Man cond. sag : _ _
83. MCT Man cond. trv : _ _

(Mandibulometer):

84. XRL Max Ramus ht : _ _
85. MLT Mandibular lt : _ _ _
86. MAN Mandib angle : _ _ _

COMMENTS:

87. BAZ Basi-Zygomax. : _ _ _

(Peer H. Moore-Jansen/Department of Anthropogy - University of Tennessee, Knoxville, TN 37996-0720.

APPENDIX D

GROUP MEANS AND STANDARD DEVIATIONS FOR AFRO-AMERICAN AND EURO-AMERICAN SERIES FROM THE TERRY AND TODD ANATOMICAL COLLECTIONS, AND CALIBRATION SAMPLES FOR DISCRIMINANT FUNCTIONS

Appendix D. Means and standard deviations for Afro-American and Euro-American series from the Terry and Todd anatomical collections, and calibration samples for discriminant functions, section 1. Means are in line one, standard deviations are in line two.

Series	n	GOL	NOL	BNL	BBH	XCB	XFB	WFB	ZYB	AUB	WCB	ASB	BPL
Afro-American	40	178.20	176.38	96.70	126.50	134.10	112.93	93.98	123.33	115.13	70.38	102.98	98.40
Females (Terry)		6.33	5.99	4.23	4.92	5.45	4.77	4.97	5.28	4.67	4.68	4.69	5.14
Afro-American	65	186.31	183.49	101.23	131.14	137.95	117.15	97.71	131.98	120.78	73.51	100.05	102.77
Males (Terry)		6.56	6.38	4.53	5.66	5.50	4.97	4.56	5.83	5.33	3.55	5.84	5.50
Euro-American	50	178.36	176.12	96.12	130.16	136.52	115.16	93.52	122.18	117.06	69.34	100.02	88.54
Females (Terry)		5.55	5.42	4.45	5.50	5.10	5.70	4.20	4.51	5.10	3.67	4.29	5.12
Euro-American	75	184.71	181.63	102.27	135.77	141.92	120.12	96.79	132.40	124.23	73.16	111.76	95.51
Males (Terry)		7.08	6.81	4.86	6.46	5.78	5.35	4.83	5.20	5.73	3.82	4.72	6.34
Afro-American	72	179.01	176.85	95.36	124.68	134.01	111.53	93.72	123.18	114.71	70.53	103.72	97.61
Females (Todd)		6.62	6.43	5.03	4.97	4.97	5.12	4.58	4.70	4.94	3.40	4.78	6.31
Afro-American	46	185.35	182.91	100.52	129.24	136.70	114.22	96.09	130.91	118.57	73.935	106.15	102.76
Males (Todd)		6.42	5.93	3.65	5.01	5.63	5.09	4.23	4.68	5.74	3.30	4.94	5.22
Euro-American	61	172.98	170.62	94.21	127.61	138.84	115.20	93.34	122.25	116.72	69.41	105.82	88.41
Females (Todd)		6.94	6.63	3.87	5.02	5.99	5.87	4.36	4.83	5.30	3.89	5.28	5.09
Euro-American	37	180.22	177.54	99.43	132.84	143.32	119.86	96.14	131.38	122.51	72.46	111.89	94.05
Males (Todd)		7.82	7.38	3.95	5.47	6.50	5.90	3.94	5.00	4.71	4.17	4.60	5.54
Afro-American	44	177.545	175.93	96.66	126.68	132.95	111.27	93.75	122.02	114.93	69.14	105.02	98.75
Females (>1900)		5.25	5.14	4.34	4.78	5.02	5.05	4.70	4.16	4.46	3.18	4.34	5.31
Afro-American	37	184.70	182.35	101.59	132.65	137.89	116.70	97.16	131.27	120.97	73.35	108.92	101.57
Males (>1900)		5.81	5.65	4.87	7.00	6.78	6.14	5.14	6.23	6.28	4.28	6.24	6.28
Euro-American	50	176.70	174.26	97.98	133.20	136.16	114.90	93.42	120.40	115.48	67.72	108.94	89.88
Females (>1910)		6.07	6.09	4.51	5.48	4.49	5.91	4.42	3.55	3.89	3.42	3.73	5.17
Euro-American	79	186.78	183.57	104.59	140.45	141.48	120.51	97.73	130.80	124.18	72.29	114.15	96.56
Males (>1910)		7.94	7.79	4.81	5.46	6.17	5.42	5.57	5.42	5.46	4.59	5.49	5.68
American Indian	72	176.14	174.54	98.58	128.04	137.71	111.72	91.50	131.31	125.04	71.62	107.24	95.01
Females (>1750)		6.48	6.27	3.90	4.75	4.95	4.91	4.43	5.48	4.61	4.27	4.81	4.58
American Indian	77	181.52	179.21	103.48	132.62	142.57	116.79	96.56	141.99	132.03	76.38	110.69	99.18
Males (>1750)		7.56	7.60	4.41	5.81	6.15	4.98	4.79	5.48	5.12	4.21	4.72	4.92
Hispanic-American	24	179.83	177.58	100.42	134.58	137.75	116.63	93.50	128.67	122.08	69.79	109.21	95.91
Males (>1900)		5.25	5.41	3.45	4.29	5.00	3.74	4.58	5.11	5.77	5.24	5.24	3.62

Appendix D. Means and standard deviations for Afro-American and Euro-American series from the Terry and Todd anatomical collections, and calibration samples for discriminant functions, section 2. Means are in line one, standard deviations are in line two.

Series	n	MPH	MLH	JUB	MLB	MAB	MAL	MDH	MDB	OBH	OBB	DKB	NDS
Afro-American	40	66.63	47.73	110.20	24.55	63.68	55.63	27.05	11.50	34.03	37.73	23.75	10.93
Females (Terry)		3.75	3.34	5.34	2.18	5.30	3.26	2.92	1.57	1.83	1.63	3.09	1.38
Afro-American	65	70.75	51.28	117.14	26.03	66.65	57.54	30.83	13.09	34.00	38.94	25.60	12.20
Males (Terry)		4.40	3.01	5.28	2.32	4.95	3.49	3.39	2.88	1.09	1.68	2.65	1.90
Euro-American	50	64.34	49.70	106.88	22.78	56.58	50.18	25.92	11.24	33.14	37.48	21.62	12.58
Females (Terry)		4.45	3.12	4.80	2.00	4.56	3.22	2.66	2.30	2.36	1.58	2.48	1.79
Euro-American	75	69.41	53.11	113.84	23.80	59.60	52.85	29.73	13.19	33.48	38.67	22.93	12.69
Males (Terry)		4.20	2.82	4.95	1.755	5.46	3.50	2.98	1.92	2.12	1.70	2.24	2.30
Afro-American	72	65.93	47.93	108.86	24.39	62.78	55.06	27.42	11.19	34.32	36.85	23.82	11.68
Females (Todd)		4.24	2.91	4.88	2.06	3.84	3.45	3.24	2.35	2.05	1.69	2.13	1.67
Afro-American	46	70.41	51.22	114.20	25.48	66.39	57.65	30.63	12.54	34.35	38.22	24.50	12.83
Males (Todd)		3.88	2.75	4.97	2.53	4.38	3.27	2.80	1.52	2.10	1.62	2.56	2.00
Euro-American	61	63.36	48.13	104.39	22.44	55.36	49.28	26.10	10.64	32.39	36.44	21.66	12.20
Females (Todd)		4.39	2.69	4.39	2.01	4.74	3.38	2.69	1.62	1.97	1.63	2.44	1.75
Euro-American	37	68.405	52.16	111.30	22.95	60.46	53.49	29.03	12.51	32.65	37.32	23.62	14.00
Males (Todd)		4.16	3.16	4.92	1.81	4.57	3.07	2.72	2.06	2.26	2.015	2.14	1.83
Afro-American	44	66.50	48.07	109.82	24.48	63.45	55.59	28.02	11.07	34.43	38.25	23.41	10.59
Females (>1900)		3.52	2.88	4.59	1.93	3.84	3.23	2.99	2.17	1.65	2.40	2.75	1.83
Afro-American	37	70.49	51.81	116.46	26.135	67.22	56.92	32.05	13.00	34.46	39.57	25.24	11.89
Males (>1900)		4.19	2.98	5.56	2.16	4.49	3.65	3.65	3.30	2.01	1.7	2.85	1.95
Euro-American	50	64.32	49.20	104.66	21.96	57.30	50.18	27.14	10.42	33.34	38.14	19.94	11.16
Females (>1910)		4.03	2.78	4.28	2.01	3.63	3.10	4.00	2.37	2.17	1.87	2.39	2.23
Euro-American	79	70.05	52.41	113.19	23.96	60.76	53.67	31.87	13.01	33.57	40.48	21.96	12.27
Males (>1910)		3.88	2.84	5.28	2.03	4.70	3.54	3.28	2.10	1.70	2.17	2.24	2.09
American Indian	72	68.82	51.51	113.84	25.42	62.37	52.61	24.97	10.68	35.08	39.09	21.60	10.32
Females (>1750)		3.66	2.51	4.84	1.98	3.62	2.81	2.96	1.88	1.87	1.88	2.03	1.96
American Indian	77	72.41	54.61	122.26	26.23	66.47	55.03	29.44	12.49	35.39	40.66	22.88	12.09
Males (>1750)		4.75	3.70	4.93	1.79	3.84	3.26	3.31	2.08	2.50	1.96	2.51	2.33
Hispanic-American	24	71.79	53.79	110.65	24.17	63.71	53.88	32.61	12.78	34.50	38.58	21.17	11.25
Males (>1900)		3.62	2.66	3.70	2.04	3.06	2.71	3.04	2.37	2.27	1.56	1.95	2.21

Appendix D. Means and standard deviations for Afro-American and Euro-American series from the Terry and Todd anatomical collections, and calibration samples for discriminant functions, section 3. Means are in line one, standard deviations are in line two.

Series	n	WMB	SIS	ZMB	SSS	FMB	NAS	EKB	DKS	IML	XML	MLS	WMH
Afro-American	40	8.90	2.76	91.13	23.55	97.45	18.30	97.08	13.63	35.10	52.88	10.93	21.08
Females (Terry)		2.26	0.79	6.34	2.50	4.39	2.45	4.13	2.20	4.63	3.97	1.56	2.47
Afro-American	65	8.96	3.19	95.29	25.15	102.29	19.05	101.29	14.35	37.34	55.57	11.52	22.35
Males (Terry)		2.25	1.15	5.17	3.00	4.51	2.27	4.34	1.96	4.18	4.18	1.62	2.58
Euro-American	50	8.84	3.99	85.08	22.82	94.56	18.42	93.76	13.44	31.76	49.50	9.62	20.12
Females (Terry)		1.97	1.25	4.12	4.18	3.51	2.67	3.50	1.77	3.35	3.24	1.40	2.86
Euro-American	75	8.37	4.34	91.25	24.95	98.71	18.55	97.81	14.48	34.80	54.83	10.81	22.59
Males (Terry)		1.80	1.31	4.99	2.64	4.24	2.40	3.55	2.02	3.45	3.93	1.63	2.72
Afro-American	72	9.04	2.94	89.72	24.31	97.31	17.51	96.57	13.28	35.01	51.60	10.60	20.50
Females (Todd)		2.18	1.04	5.21	2.56	4.19	2.91	3.91	2.12	3.23	3.60	1.60	2.50
Afro-American	46	8.51	3.48	93.48	25.83	101.41	18.72	100.00	14.04	38.11	55.87	11.24	22.13
Males (Todd)		1.93	1.12	4.53	2.85	3.77	2.79	3.73	2.07	3.59	3.98	1.66	2.08
Euro-American	61	8.57	3.81	86.03	22.77	94.18	17.51	93.97	13.39	31.66	49.74	9.90	20.26
Females (Todd)		1.81	1.08	4.59	3.06	4.30	2.44	3.93	1.81	3.47	3.56	1.80	2.37
Euro-American	37	8.75	4.32	91.03	25.32	98.14	18.62	97.65	13.76	34.70	53.68	10.54	22.22
Males (Todd)		1.66	1.20	5.34	2.93	3.52	2.28	3.53	2.40	2.67	2.98	1.64	2.80
Afro-American	44	9.18	3.04	90.34	24.48	97.05	18.80	96.52	13.55	36.20	53.05	10.95	20.86
Females (>1900)		2.05	0.98	5.54	2.71	3.80	2.56	3.67	2.10	3.41	3.58	1.41	2.56
Afro-American	37	9.08	3.44	94.54	25.24	102.00	19.95	101.22	14.22	37.89	55.51	11.11	22.30
Males (>1900)		3.11	1.25	5.24	3.02	4.58	2.94	4.37	1.81	4.55	4.44	1.61	2.77
Euro-American	50	8.69	4.44	83.78	23.86	93.56	18.68	92.50	13.14	31.70	49.30	9.54	20.38
Females (>1910)		2.06	0.99	4.75	3.77	3.43	2.61	3.32	2.18	2.92	3.60	1.51	2.96
Euro-American	79	8.96	4.77	88.42	25.44	99.29	20.82	97.99	14.44	35.56	54.03	10.30	22.38
Males (>1910)		2.01	1.30	5,47	2.91	4.44	2.72	3.93	2.30	3.45	3.53	2.31	3.39
American Indian	72	8.60	3.25	96.61	23.10	97.58	17.67	97.67	12.05	35.04	51.97	10.26	22.97
Females (>1750)		1.78	0.98	4.30	2.83	4.02	2.50	3.70	2.05	3.42	3.58	1.63	2.38
American Indian	77	8.65	4.11	102.23	24.13	102.23	18.62	102.01	12.09	37.06	55.57	11.23	24.36
Males (>1750)		1.74	1.15	4.93	2.86	3.63	2.58	3.51	2.12	3.87	4.39	1.72	2.24
Hispanic-American	24	8.96	4.39	90.58	25.70	95.61	19.00	94.48	12.65	33.08	50.25	9.96	22.46
Males (>1900)		1.74	1.08	5.48	2.88	3.86	2.43	2.94	2.29	2.83	3.23	1.04	2.45

Appendix D. Means and standard deviations for Afro-American and Euro-American series from the Terry and Todd anatomical collections, and calibration samples for discriminant functions, section 4. Means are in line one, standard deviations are in line two.

Series	n	SOS	BLS	STB	STS	FRC	FRS	FRF	PAC	PAS	PAF	OCC	OCS
Afro-American	40	5.15	2.23	109.95	33.95	107.08	25.68	44.78	116.18	24.10	56.55	91.40	26.00
Females (Terry)		1.14	1.14	6.44	5.68	5.98	2.73	3.74	6.72	2.94	5.54	4.97	3.28
Afro-American	65	6.29	3.11	112.25	33.08	110.32	25.20	46.69	122.37	25.85	60.98	92.52	25.28
Males (Terry)		1.49	1.13	6.44	5.44	5.37	2.93	4.16	6.93	2.79	5.61	5.95	3.25
Euro-American	50	5.38	2.48	113.08	36.42	107.58	25.50	46.44	116.90	25.26	57.36	94.92	26.62
Females (Terry)		1.23	0.99	6.39	4.77	4.84	2.55	3.47	6.38	2.76	5.24	5.75	3.21
Euro-American	75	6.95	3.51	117.03	35.63	111.51	25.72	48.95	122.23	26.85	59.25	94.04	24.05
Males (Terry)		1.63	1.36	6.88	6.33	5.80	3.06	3.98	7.02	2.90	5.85	6.13	2.95
Afro-American	72	4.68	2.10	109.21	33.28	105.42	25.08	44.19	116.38	24.69	57.39	92.54	26.78
Females (Todd)		1.29	0.98	6.14	5.41	4.54	2.80	3.96	7.44	3.42	6.09	6.35	3.58
Afro-American	46	5.63	3.35	109.78	31.96	109.54	24.98	46.37	120.56	24.76	60.22	92.61	26.07
Males (Todd)		1.25	1.40	8.10	5.10	5.67	3.21	3.95	7.51	2.88	5.83	5.95	3.70
Euro-American	61	5.36	2.02	115.02	37.38	105.95	25.84	45.15	113.54	24.38	56.34	92.61	25.69
Females (Todd)		1.18	0.81	6.54	4.71	4.06	2.63	3.30	7.12	2.68	5.19	4.93	2.70
Euro-American	37	6.00	3.35	119.24	36.70	110.73	25.86	49.41	118.16	26.30	58.70	93.43	25.08
Males (Todd)		1.20	1.48	7.33	5.11	6.24	3.22	3.16	6.19	3.04	4.80	5.21	4.06
Afro-American	44	4.77	1.89	107.84	32.57	106.93	26.23	44.61	113.82	24.45	55.25	92.68	26.89
Females (>1900)		1.18	1.15	7.10	4.97	5.63	4.70	4.51	6.79	5.27	7.16	6.09	4.84
Afro-American	37	5.86	3.11	111.27	32.19	109.81	25.32	48.27	119.62	25.22	61.00	95.46	25.81
Males (>1900)		1.57	0.94	7.29	5.70	5.65	2.68	4.55	7.05	2.89	5.77	6.50	2.71
Euro-American	50	4.86	2.10	111.94	37.30	108.94	27.16	47.86	113.32	25.10	57.08	95.20	27.06
Females (>1910)		1.39	0.76	7.07	5.56	4.63	2.64	4.54	5.92	2.34	5.10	4.58	4.83
Euro-American	79	6.43	3.82	117.09	38.63	113.85	26.59	52.87	118.66	26.29	60.55	98.62	27.20
Males (>1910)		1.62	1.39	6.28	6.09	5.05	3.03	4.05	7.59	2.91	5.91	5.48	2.94
American Indian	72	4.14	2.03	106.05	28.98	107.32	23.81	48.66	105.89	21.39	52.72	92.51	28.83
Females (>1750)		1.14	0.95	6.99	4.14	4.35	2.52	3.63	4.86	2.39	3.85	4.67	4.04
American Indian	77	6.01	3.32	109.26	28.74	111.23	23.49	51.29	109.17	22.62	54.00	93.87	28.00
Males (>1750)		1.41	1.28	7.04	4.89	4.58	2.47	3.65	6.72	3.69	5.60	5.20	4.30
Hispanic-American	24	5.79	3.33	111.50	33.04	110.13	24.71	53.29	111.71	24.67	58.02	96.12	27.42
Males (>1900)		1.28	1.06	4.74	3.84	3.85	2.16	3.71	6.86	4.36	4.83	6.31	4.77

Appendix D. Means and standard deviations for Afro-American and Euro-American series from the Terry and Todd anatomical collections, and calibration samples for discriminant functions, section 5. Means are in line one, standard deviations are in line two.

Series	n	OCF	FOL	FOB	NAR	SSR	PRR	DKR	ZOR	FMR	EKR	ZMR	AVR
Afro-American	40	38.85	34.58	27.25	91.95	92.78	102.13	80.53	78.00	74.08	68.38	67.63	79.93
Females (Terry)		7.84	3.37	3.04	4.56	4.77	5.47	4.31	4.18	3.87	3.61	3.88	5.15
Afro-American	65	40.29	36.18	29.02	96.09	97.60	106.40	83.75	81.32	77.32	72.12	71.00	84.26
Males (Terry)		7.04	2.49	2.36	4.66	5.30	5.29	4.34	4.86	3.80	3.85	4.78	5.83
Euro-American	50	42.80	35.36	30.02	91.18	87.50	93.22	78.32	75.30	73.02	66.34	64.22	73.02
Females (Terry)		7.12	2.39	2.02	3.56	4.53	4.49	3.58	3.59	2.93	3.29	3.53	3.69
Euro-American	75	40.16	36.69	31.20	95.40	94.68	99.47	82.16	79.72	76.93	70.39	68.53	79.61
Males (Terry)		7.81	2.19	2.36	4.61	4.45	4.97	4.55	3.71	3.91	3.49	3.86	4.24
Afro-American	72	42.47	34.36	27.50	90.72	92.46	101.43	78.99	77.36	73.78	68.13	68.11	79.33
Females (Todd)		7.06	2.55	2.61	4.52	4.69	5.01	3.90	4.06	3.53	3.53	3.44	4.65
Afro-American	46	42.39	35.59	28.59	95.96	98.07	106.94	83.28	81.26	77.57	72.39	72.15	83.96
Males (Todd)		7.04	3.07	2.31	4.57	4.57	4.68	3.89	3.82	3.91	3.85	3.71	4.62
Euro-American	61	45.16	34.54	28.72	89.08	87.38	93.21	76.21	74.64	72.03	65.51	64.80	73.20
Females (Todd)		5.43	2.40	2.44	3.65	3.78	4.09	3.13	3.35	3.13	2.92	3.47	3.56
Euro-American	37	45.89	36.05	30.16	94.27	93.86	99.41	79.92	78.46	75.35	69.78	68.70	78.49
Males (Todd)		5.17	2.04	2.01	4.45	4.07	4.43	4.15	3.64	3.28	3.66	3.09	3.82
Afro-American	44	42.36	34.89	28.07	91.93	93.36	102.75	80.68	78.09	73.66	68.34	68.14	79.91
Females (>1900)		6.96	3.10	2.87	4.14	4.44	4.79	3.90	3.78	3.03	3.03	2.99	4.20
Afro-American	37	44.54	36.57	29.27	96.24	96.73	105.51	84.24	81.27	76.73	71.84	70.95	83.27
Males (>1900)		7.22	2.40	2.50	5.39	5.35	5.78	5.54	5.35	4.22	4.56	5.77	5.82
Euro-American	50	45.72	35.28	29.74	92.14	89.34	94.42	80.30	76.74	73.94	67.80	66.00	73.86
Females (>1910)		6.12	2.51	1.85	4.24	4.59	4.75	4.41	3.84	3.43	3.40	3.48	4.63
Euro-American	79	47.89	37.75	31.38	97.96	96.27	100.92	85.11	81.77	77.82	71.78	70.86	79.74
Males (>1910)		6.53	2.33	2.02	4.18	4.61	5.30	3.99	4.10	3.32	3.49	4.24	5.25
American Indian	72	42.28	35.60	29.31	94.01	94.90	100.51	82.54	80.25	76.42	70.96	71.22	79.81
Females (>1750)		5.35	2.94	2.21	3.92	4.25	4.44	3.56	3.95	3.46	3.06	3.79	4.50
American Indian	77	42.73	36.96	31.22	97.77	98.32	104.03	84.64	81.97	79.12	73.42	73.44	82.87
Males (>1750)		6.80	2.38	2.00	3.95	4.06	4.42	3.17	3.83	3.32	2.97	4.08	4.33
Hispanic-American	24	48.42	36.17	30.04	94.08	94.38	100.58	81.92	78.33	75.79	70.54	68.79	78.54
Males (>1900)		7.48	2.46	2.22	3.15	2.68	3.63	3.11	3.12	3.04	2.90	3.32	3.97

Appendix D. Means and standard deviations for Afro-American and Euro-American series from the Terry and Todd anatomical collections, and calibration samples for discriminant functions, section 6. Means are in line one, standard deviations are in line two.

Series	n	BRR	VRR	LAR	OPR	BAR	NAA	PRA	BAA	NBA	BBA	SSA	NFA
Afro-American	40	115.60	118.95	104.40	37.58	12.33	71.45	68.75	39.93	76.70	55.38	125.30	139.00
Females (Terry)		4.79	4.72	3.69	4.21	2.99	3.69	3.75	2.31	3.88	3.55	5.16	4.14
Afro-American	65	119.51	122.72	107.80	39.63	12.75	70.86	68.48	40.60	76.49	54.92	124.34	139.22
Males (Terry)		4.32	4.11	4.77	4.14	3.46	3.77	3.11	3.14	3.64	3.02	5.52	4.28
Euro-American	50	117.12	120.50	104.20	40.10	14.04	63.20	76.16	40.60	79.24	54.36	123.90	137.48
Females (Terry)		4.70	4.67	5.22	3.48	3.05	2.98	4.37	3.66	3.62	3.50	8.05	5.26
Euro-American	75	121.16	123.89	106.24	42.40	16.25	64.32	74.80	40.96	78.81	53.65	122.65	138.80
Males (Terry)		5.39	5.17	5.86	4.05	4.15	4.09	3.81	3.10	3.58	2.79	5.15	4.75
Afro-American	72	113.54	118.01	105.71	38.17	12.42	71.83	68.24	39.94	76.47	55.38	123.10	140.51
Females (Todd)		4.51	4.09	4.88	4.11	3.23	3.87	3.54	2.80	2.56	2.94	4.73	5.55
Afro-American	46	117.28	120.59	107.46	38.96	13.85	71.41	68.07	40.59	75.80	55.20	122.17	139.48
Males (Todd)		5.53	5.38	5.05	5.36	3.67	3.48	3.19	2.88	3.04	2.84	5.99	5.85
Euro-American	61	115.56	117.87	101.25	39.08	13.08	64.87	74.75	40.47	78.95	54.56	124.28	139.28
Females (Todd)		4.04	4.41	5.48	3.64	3.00	3.86	3.66	3.38	2.89	2.28	6.53	4.73
Euro-American	37	119.05	121.89	103.27	40.43	14.84	65.14	73.51	41.19	78.19	54.65	121.84	138.41
Males (Todd)		5.43	4.64	5.53	4.09	3.66	4.80	4.09	3.04	3.49	3.22	5.25	4.41
Afro-American	44	114.68	118.00	104.61	37.89	12.77	71.84	68.41	39.75	76.82	55.25	123.07	137.77
Females (>1900)		4.55	4.39	3.87	4.25	3.08	3.44	3.27	2.40	3.00	3.30	5.87	4.93
Afro-American	37	120.08	123.11	108.89	39.84	13.59	69.73	69.62	40.68	77.57	53.97	123.86	137.32
Males (>1900)		6.61	6.10	4.73	3.60	3.77	4.14	2.93	3.03	3.25	3.07	5.99	5.42
Euro-American	50	118.88	121.64	103.22	40.22	14.66	63.32	76.96	39.80	79.98	53.60	120.84	136.60
Females (>1910)		4.36	4.53	4.79	2.67	3.46	3.44	3.65	2.63	2.95	2.56	7.52	4.96
Euro-American	79	125.03	127.61	108.53	42.76	15.94	63.56	76.01	40.53	79.97	52.97	120.03	134.53
Males (>1910)		4.18	4.35	5.00	3.91	4.04	4.00	4.00	2.74	3.07	2.70	6.08	5.27
American Indian	72	114.58	116.36	100.21	40.18	14.55	66.40	71.96	41.57	76.67	54.60	128.94	140.25
Females (>1750)		3.99	3.99	3.77	3.07	3.18	3.17	3.28	2.27	2.90	2.67	5.48	4.97
American Indian	77	118.04	120.03	102.35	42.14	15.18	65.94	72.25	41.81	76.25	54.45	129.47	140.08
Males (>1750)		4.44	4.65	5.09	3.11	3.28	3.41	3.05	3.23	3.41	2.32	5.77	4.74
Hispanic-American	24	120.08	123.54	106.67	40.83	14.63	65.21	71.92	42.79	79.46	53.46	121.65	136.65
Males (>1900)		4.04	4.25	4.57	3.16	2.12	2.45	2.69	2.08	3.30	2.62	5.46	4.31

Appendix D. Means and standard deviations for Afro-American and Euro-American series from the Terry and Todd anatomical collections, and calibration samples for discriminant functions, section 7. Means are in line one, standard deviations are in line two.

Series	n	DKA	NOA	SIA	FRA	PAA	OCA	STA	CBA
Afro-American Females (Terry)	40	138.75 6.23	94.80 10.37	116.15 14.45	127.83 3.09	134.85 3.56	119.08 4.37	117.00 6.37	155.85 5.79
Afro-American Males (Terry)	65	137.89 5.21	93.12 10.52	109.85 16.41	130.00 4.26	134.15 3.20	121.58 4.56	119.37 6.47	156.20 6.22
Euro-American Females (Terry)	50	139.08 4.75	81.70 10.77	97.00 17.40	128.52 3.74	133.14 3.49	120.62 4.67	114.72 5.29	153.00 6.08
Euro-American Males (Terry)	75	137.24 5.58	84.99 10.09	89.23 11.80	129.99 4.23	132.35 3.75	124.31 4.63	117.75 7.58	150.77 7.23
Afro-American Females (Todd)	72	138.81 6.26	91.46 8.09	114.78 15.87	128.17 4.02	133.96 4.27	119.08 4.71	117.67 6.22	155.64 6.05
Afro-American Males (Todd)	46	137.98 5.70	87.98 9.37	102.41 17.15	130.13 4.53	135.33 3.56	119.61 7.93	120.07 7.26	153.74 7.09
Euro-American Females (Todd)	61	137.95 5.56	83.49 9.45	97.56 17.15	127.21 3.93	133.41 3.52	121.61 3.86	114.20 4.81	154.74 5.80
Euro-American Males (Todd)	37	137.86 6.94	80.65 8.88	92.32 16.91	129.62 4.35	131.95 3.72	123.54 6.26	117.00 5.31	152.81 6.50
Afro-American Females (>1900)	44	139.48 6.26	96.11 11.35	113.25 13.76	126.86 6.76	133.43 9.17	119.25 6.76	118.11 6.02	155.02 5.78
Afro-American Males (>1900)	37	138.92 5.10	93.78 9.64	103.35 20.64	129.86 4.11	134.16 3.75	122.68 4.17	120.35 7.39	154.81 6.87
Euro-American Females (>1910)	50	140.72 5.71	84.42 10.74	88.86 17.05	126.32 4.24	132.00 3.29	120.60 7.70	112.92 6.72	151.62 6.57
Euro-American Males (>1910)	79	139.18 6.00	84.27 10.19	87.28 13.42	129.72 4.21	132.10 3.22	121.86 4.44	113.51 7.53	151.28 7.06
American Indian Females (>1750)	72	144.78 5.21	93.33 10.37	106.42 17.22	131.79 3.98	135.93 3.59	115.75 6.93	122.99 4.88	153.79 5.77
American Indian Males (>1750)	77	145.93 5.82	87.68 11.67	94.12 18.43	133.97 3.47	134.92 5.37	117.61 7.09	124.79 6.08	154.08 5.68
Hispanic-American Males (>1900)	24	142.61 6.06	87.38 8.83	91.46 12.41	131.58 3.45	132.50 5.76	120.83 7.26	118.96 4.86	153.04 3.88

APPENDIX E

STEPWISE MODEL SELECTION FOR RACIAL OR ETHNIC AFFILIATION

Appendix E-1. Stepwise model selection for racial or ethnic affiliation. Section 1, four groups: Afro-American, Euro-American, American Indian and Hispanic American males.

	Full 80 Variable Set				Reduced 35 Variable Set				Forensic 23 Variable Set			
Step	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2
1	ZMB	98.05	0.0001	0.313	ZMB	98.05	0.0001	0.313	PAC	55.95	0.0001	0.206
2	ZMB	70.23	0.0001		ZMB	73.47	0.0001	0.423	MAB	27.97	0.0001	0.298
	BRR	44.89	0.0001		PAC	40.63	0.0001		PAC	50.65	0.0001	
3	ZMB	64.28	0.0001	0.515	ZMB	64.28	0.0001	0.510	BBH	21.78	0.0001	0.363
	STB	22.38	0.0001		STB	22.38	0.0001		MAB	26.30	0.0001	
	PAC	29.49	0.0001		PAC	29.49	0.0001		PAC	29.90	0.0001	
4	ZMB	69.60	0.0001	0.5168	BBH	17.89	0.0001	0.5104	BBH	22.72	0.0001	0.3833
	EKB	18.09	0.0001		ZMB	77.46	0.0011		MLH	6.88	0.0093	
	PAC	35.75	0.0001		EKB	15.31	0.0002		MAB	23.54	0.0001	
	PRA	20.96	0.0001		PAC	19.40	0.0001		PAC	28.11	0.0001	
5	OBH	10.05	0.0018	0.539	BBH	13.55	0.0003	0.53	BBH	23.19	0.0001	0.405
	ZMB	75.00	0.0001		OBH	11.25	0.0009		ZYB	11.94	0.0007	
	EKB	24.71	0.0001		ZMB	86.51	0.0001		MAB	25.33	0.0001	
	PAC	26.00	0.0001		FMB	22.16	0.0001		EKB	12.94	0.0004	
	PRA	18.76	0.0001		PAC	12.30	0.0006		PAC	14.28	0.0002	
6	OBH	11.00	0.0011	0.56	BBH	7.40	0.0071	0.548	BBH	15.04	0.0001	0.429
	ZMB	61.38	0.0001		OBH	10.39	0.0015		XCB	8.88	0.0032	
	EKB	17.44	0.0001		ZMB	69.23	0.0001		ZYB	20.01	0.0001	
	STB	10.23	0.0016		EKB	15.94	0.0001		MAB	26.20	0.0001	
	PAC	20.35	0.0001		STB	8.18	0.0047		EKB	14.68	0.0002	
	PRA	13.26	0.0003		PAC	12.45	0.0005		PAC	13.96	0.0002	
7	OBH	11.48	0.0008	0.568	BBH	8.07	0.0049	0.56	BBH	12.34	0.0005	0.446
	ZMB	57.87	0.0001		MAB	5.47	0.0203		XCB	10.26	0.0006	
	EKB	19.23	0.0001		OBH	10.29	0.0015		ZYB	20.31	0.0001	
	STB	5.49	0.0200		ZMB	44.41	0.0001		MAB	27.16	0.0001	
	FRS	3.90	0.0496		EKB	18.20	0.0001		OBH	6.34	0.0125	
	PAC	16.84	0.0001		STB	7.40	0.0071		EKB	17.92	0.0001	
	PRA	13.26	0.0003		PAC	13.03	0.0004		PAC	10.84	0.0012	
8	-	-	-		-	-	-		BBH	10.54	0.0014	
	-	-	-		-	-	-		XCB	11.36	0.0009	
	-	-	-		-	-	-		ZYB	23.31	0.0001	
	-	-	-		-	-	-		MAB	23.45	0.0001	
	-	-	-		-	-	-		OBH	7.09	0.0084	
	-	-	-		-	-	-		EKB	17.74	0.0001	
	-	-	-		-	-	-		PAC	8.51	0.0039	
	-	-	-		-	-	-		FOL	4.39	0.0373	

Appendix E-2. Stepwise model selection for racial or ethnic affiliation. Section 1, three groups: Afro-American, Euro-American and American Indian males.

	Full 80 Variable Set				Reduced 35 Variable Set				Forensic 23 Variable Set*			
Step	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2
1	ZMB	271.20	0.0001	0.588	ZMB	271.20	0.0001	0.588	-	-	-	-
2	ZMB	210.40	0.0001	0.685	BBH	44.52	0.0001	0.667	-	-	-	-
	VRR	57.96	0.0001		ZMB	236.29	0.0001		-	-	-	
3	OBH	10.97	0.0011	0.702	BBH	32.44	0.0001	0.699	-	-	-	-
	ZMB	196.05	0.0001		ZMB	204.21	0.0001		-	-	-	
	VRR	52.31	0.0001		PAC	20.05	0.0001		-	-	-	
4	XFB	36.01	0.0001	0.725	BBH	16.88	0.0001	0.720	-	-	-	-
	OBH	29.51	0.0001		ZMB	201.40	0.0001		-			
	ZMB	225.53	0.0001		STB	14.48	0.0002		-			
	LAR	24.13	0.0001		PAC	17.21	0.0001		-			
5	XFB	29.46	0.0001	0.74	BBH	20.36	0.0001	0.739	-	-	-	-
	OBH	24.35	0.0001		XFB	29.63	0.0001		-	-	-	
	ZMB	208.27	0.0001		ZYB	15.52	0.0001		-	-	-	
	PAS	9.70	0.0021		OBH	14.17	0.0002		-	-	-	
	LAR	19.92	0.0001		ZMB	63.08	0.0001		-	-	-	
6	XFB	25.19	0.0001	0.749	GOL	9.25	0.0027	0.751	-	-	-	-
	MDH	6.72	0.0103		BBH	11.93	0.0007		-	-	-	
	OBH	27.37	0.0001		XFB	30.21	0.0001		-	-	-	
	ZMB	200.47	0.0001		ZYB	16.45	0.0001		-	-	-	
	PAS	9.56	0.0023		OBH	15.44	0.0001		-	-	-	
	LAR	16.24	0.0001		ZMB	64.43	0.0001		-	-	-	
7	XFB	29.17	0.0001	0.759	GOL	9.48	0.0024	0.76	-	-	-	-
	ZYB	8.98	0.0031		BBH	9.72	0.0021		-	-	-	
	OBH	16.89	0.0001		XFB	29.04	0.0001		-	-	-	
	ZMB	51.27	0.0001		ZYB	18.65	0.0001		-	-	-	
	PAS	9.40	0.0025		MDB	6.37	0.0124		-	-	-	
	LAR	16.77	0.0001		OBH	14.05	0.0002		-	-	-	
	PRA	8.30	0.0044		ZMB	67.80	0.0001		-	-	-	

* Model includes same variables as in Jantz and Moore-Jansen 1988a.

Appendix E-2. Stepwise model selection for racial or ethnic affiliation. Section 2, three groups: Afro-American, Euro-American and American Indian females.

	Full 80 Variable Set				Reduced 35 Variable Set				Forensic 23 Variable Set			
Step	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2
1	ZMB	225.90	0.0001	0.581	ZMB	214.55	0.0001	0.567	ZYB	156.8	0.0001	0.489
2	WFB	49.09	0.0001	0.678	WFB	50.98	0.0001		DBH	37.98	0.0001	0.585
	ZMB	324.75	0.0001		ZMB	313.21	0.0001		ZYB	179.20	0.0001	
3	WFB	55.4	0.0001	0.712	WFB	57.42	0.0001	0.706	DBH	29.26	0.0001	0.637
	ZYB	18.65	0.0001		ZYB	19.65	0.0001		WFB	22.97	0.0001	
	ZMB	78.17	0.0001		ZMB	73.98	0.0001		ZYB	219.85	0.0001	
4	WFB	38.87	0.0001	0.751	WFB	40.29	0.0001	0.745	DBH	22.05	0.0001	0.678
	AUB	32.07	0.0001		AUB	33.95	0.0001		WFB	31.82	0.0001	
	ASB	28.67	0.0001		ASB	27.52	0.0001		ZYB	180.29	0.0001	
	ZMB	127.18	0.0001		ZMB	120.35	0.0001		MAB	20.45	0.0001	
5	WFB	36.23	0.0001	0.768	DBH	9.20	0.0028	0.759	DBH	17.21	0.0001	0.696
	AUB	42.36	0.0001		WFB	31.67	0.0001		WFB	31.29	0.0001	
	ASB	26.76	0.0001		AUB	39.39	0.0001		ZYB	171.29	0.0001	
	ZMB	80.67	0.0001		ASB	22.02	0.0001		MAB	24.17	0.0001	
	PRA	11.93	0.0007		ZMB	98.46	0.0001		MDH	9.32	0.0027	
6	ICB	8.73	0.0036	0.78	WFB	47.88	0.0001	0.77	DBH	12.58	0.0005	0.71
	WFB	27.48	0.0001		AUB	39.54	0.0001		WFB	37.84	0.0001	
	AUB	51.52	0.0001		ASB	25.56	0.0001		ZYB	185.10	0.0001	
	ASB	19.18	0.0001		ZMB	108.62	0.0001		MAB	26.32	0.0001	
	ZMB	71.86	0.0001		IML	9.00	0.0001		MDH	9.49	0.0024	
	PRA	12.33	0.0006		FOB	8.39	0.0001		FOB	7.83	0.0058	
7	ICB	10.88	0.0012	0.792	WFB	37.04	0.0001	0.78	DBH	14.53	0.0002	0.722
	WFB	24.44	0.0001		AUB	26.92	0.0001		WFB	36.55	0.0001	
	AUB	54.99	0.0001		ASB	22.65	0.0001		ZYB	148.15	0.0001	
	ASB	14.71	0.0002		ZMB	108.96	0.0001		MPH	6.78	0.0101	
	MDH	8.36	0.0044		IML	9.01	0.0031		MAB	13.56	0.0003	
	ZMB	62.64	0.0001		PAC	6.58	0.0113		MDH	10.71	0.0013	
	PRA	16.89	0.0001		FOB	8.23	0.0047		FOB	9.71	0.0022	
8	-	-	-	-	-	-	-	-	DBH	10.72	0.0013	0.743
	-	-	-		-	-	-		ICB	15.61	0.0001	
	-	-	-		-	-	-		WFB	23.84	0.0001	
	-	-	-		-	-	-		ZYB	20.81	0.0001	
	-	-	-		-	-	-		AUB	13.50	0.0003	
	-	-	-		-	-	-		MAB	24.04	0.0001	
	-	-	-		-	-	-		MDH	10.43	0.0015	
	-	-	-		-	-	-		FOB	11.51	0.0009	

Appendix E-3. Stepwise model selection for racial or ethnic affiliation. Section 1, two groups: Euro-American and Hispanic-American males.

	Full 80 Variable Set				Reduced 35 Variable Set				Forensic 23 Variable Set			
Step	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2
1	BRR	28.03	0.0001	0.217	BBH	22.50	0.0001	0.182	BBH	22.50	0.0001	0.182
2	BRR	17.34	0.0001	0.294	BBH	27.77	0.0001	0.28	BBH	22.77	0.0001	0.28
	PRA	10.81	0.0014		MAB	13.57	0.0004		MAB	13.57	0.0004	
3	MAB	15.49	0.0002	0.382	BBH	18.92	0.0001	0.4	BBH	18.39	0.0001	0.375
	XML	15.20	0.0002		ZMB	25.01	0.0001		MAB	19.97	0.0001	
	BRR	16.68	0.0001		EKB	24.49	0.0001		EKB	15.07	0.0002	
4	MAB	17.51	0.0001	0.432	BBH	12.57	0.0006	0.436	BBH	12.3	0.0007	0.409
	XML	11.78	0.0009		OBH	6.15	0.0149		MAB	22.05	0.0001	
	BRR	16.51	0.0001		ZMB	27.75	0.0001		OBH	5.64	0.0196	
	BAA	8.53	0.0043		EKB	29.91	0.0001		EKB	19.04	0.0001	
5	MAB	13.00	0.0005	0.473	BBH	13.42	0.0004	0.471	-	-	-	-
	OBB	11.72	0.0009		MAB	6.46	0.0126		-	-	-	
	XML	10.35	0.0018		OBH	6.86	0.0102		-	-	-	
	STS	12.87	0.0005		ZMB	11.37	0.0011		-	-	-	
	BAA	9.43	0.0028		EKB	30.03	0.0001		-	-	-	
6	MAB	12.45	0.0006	0.504	BBH	13.95	0.0003	0.492	-	-	-	-
	XML	9.58	0.0026		NLH	6.22	0.0144		-	-	-	
	STS	8.31	0.0049		MAB	7.74	0.0065		-	-	-	
	FOB	8.04	0.0056		ZMB	10.08	0.0020		-	-	-	
	BRR	7.93	0.0059		EKB	13.78	0.0003		-	-	-	
	BAA	9.51	0.0027		XML	5.84	0.0175		-	-	-	

Appendix E-3. Stepwise model selection for racial or ethnic affiliation. Section 2, two groups: Afro-American and Euro-American males.

	Full 80 Variable Set				Reduced 35 Variable Set				Forensic 23 Variable Set			
Step	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2
1	PRA	74.81	0.0001	0.398	MAB	48.73	0.0001	0.301	MAB	48.73	0.0001	0.301
2	DKB	28.79	0.0001	0.521	BBH	51.76	0.0001	0.522	BBH	51.76	0.0001	0.522
	PRA	54.06	0.0001		MAB	58.92	0.0001		MAB	58.92	0.0001	
3	DKB	42.87	0.0001	0.597	BBH	60.16	0.0001	0.632	BBH	50.36	0.0001	0.565
	VRR	20.89	0.0001		MAB	36.63	0.0001		NLB	10.83	0.0013	
	PRA	34.68	0.0001		DKB	33.29	0.0001		MAB	39.29	0.0001	
4	DKB	53.43	0.0001	0.656	BBH	35.82	0.0001	0.688	BBH	34.47	0.0001	0.622
	VRR	42.74	0.0001		AUB	19.63	0.0001		AUB	21.70	0.0001	
	LAR	18.62	0.0001		MAB	47.96	0.0001		MAB	35.83	0.0001	
	PRA	25.74	0.0001		DKB	49.13	0.0001		EKB	21.38	0.0001	
5	AUB	19.93	0.0001	0.704	BBH	32.62	0.0001	0.702	BBH	30.77	0.0001	0.645
	MAB	34.27	0.0001		AUB	25.24	0.0001		AUB	13.19	0.0004	
	DKB	70.24	0.0001		MAB	19.74	0.0001		MAB	29.17	0.0001	
	VRR	43.20	0.0001		DKB	38.76	0.0001		EKB	23.26	0.0008	
	LAR	18.79	0.0001		ZMB	5.26	0.0238		FOB	7.13	0.0087	
6	AUB	14.94	0.0002	0.728	-	-	-	-	BBH	28.80	0.0001	0.66
	MAB	20.14	0.0001		-	-	-		AUB	13.81	0.0003	
	DKB	56.36	0.0001		-	-	-		NLB	4.81	0.0305	
	VRR	31.89	0.0001		-	-	-		MAB	26.99	0.0001	
	LAR	15.27	0.0002		-	-	-		EKB	13.56	0.0004	
	PRA	9.71	0.0023		-	-	-		FOB	5.62	0.0195	
7	MAB	28.45	0.0001	0.757	-	-	-	-	-	-	-	-
	DKB	31.26	0.0001		-	-	-		-	-	-	
	SIS	11.00	0.0012		-	-	-		-	-	-	
	OCS	17.65	0.0001		-	-	-		-	-	-	
	VRR	58.08	0.0001		-	-	-		-	-	-	
	LAR	51.38	0.0001		-	-	-		-	-	-	
	OPR	24.79	0.0001		-	-	-		-	-	-	

Appendix E-3. Stepwise model selection for racial or ethnic affiliation. Section 3, two groups: Afro-American and Euro-American females.

	Full 80 Variable Set				Reduced 35 Variable Set				Forensic 23 Variable Set			
Step	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2	Code	F Ratio	PR > F	R2
1	NAA	143.59	0.0001	0.609	MAL	68.52	0.0001	0.427	MAL	68.52	0.0001	0.427
2	ASB	18.88	0.0001	0.677	BBH	44.20	0.0001	0.614	BBH	44.20	0.0001	0.614
	NAA	135.83	0.0001		MAL	76.90	0.0001		MAL	76.90	0.0001	
3	ASB	25.84	0.0001	0.736	BBH	21.68	0.0001	0.667	BBH	40.18	0.0001	0.654
	IML	20.34	0.0001		ASB	14.22	0.0003		MAB	10.35	0.0018	
	NAA	78.95	0.0001		MAL	89.12	0.0001		MAL	22.70	0.0001	
4	ASB	29.33	0.0001	0.771	BBH	17.23	0.0001	0.721	BBH	30.27	0.0001	0.687
	DKB	13.63	0.0004		ASB	17.34	0.0001		NLH	9.39	0.0029	
	IML	14.69	0.0002		MAL	59.27	0.0001		MAB	11.95	0.0008	
	NAA	62.20	0.0001		DKB	17.09	0.0001		MAL	28.25	0.0001	
5	ASB	30.92	0.0001	0.793	BBH	17.55	0.0001	0.761	BBH	29.84	0.0001	0.712
	NLB	13.60	0.0004		ASB	25.25	0.0001		NLH	15.39	0.0002	
	OBH	10.75	0.0015		MAL	21.38	0.0001		NLB	12.75	0.0006	
	IML	15.26	0.0002		ZMB	16.65	0.0001		MAL	38.87	0.0001	
	NAA	59.85	0.0001		IML	16.46	0.0001		OBH	10.08	0.0021	
6	ASB	31.36	0.0001	0.805	BBH	14.04	0.0003	0.779	BBH	32.26	0.0001	0.737
	NLB	6.29	0.0140		ASB	24.31	0.0001		NPH	8.12	0.0055	
	OBH	9.56	0.0027		MAL	23.18	0.0001		NLH	24.65	0.0001	
	DKB	5.33			ZMB	13.75	0.0004		NLB	12.80	0.0006	
	IML	12.53	0.0234		IML	19.03	0.0001		MAL	19.57	0.0001	
	NAA	56.12	0.0001		FOB	7.07	0.0094		OBH	10.04	0.0021	
7	-	-	-	-	-	-	-	-	BBH	26.78	0.0001	0.752
	-	-	-		-	-	-		XCB	5.28	0.0241	
	-	-	-		-	-	-		NPH	8.90	0.0037	
	-	-	-		-	-	-		NLH	22.88	0.0037	
	-	-	-		-	-	-		NLB	15.81	0.0001	
	-	-	-		-	-	-		MAL	14.20	0.0003	
	-	-	-		-	-	-		OBH	13.67	0.0004	

APPENDIX F

DISCRIMINANT FUNCTIONS FOR THE IDENTIFICATION OF RACIAL OR ETHNIC AFFILIATION IN MALE CRANIA

Appendix F. Discriminant functions for the identification of racial or ethnic affiliation in male crania, Section 1, four group male model with full 80 variable data set.

Variable	American Indian	Afro-American	Euro-American	Hispanic American
OBH	7.063221	6.783242	6.560990	6.945653
ZMB	2.627936	2.215380	2.067534	2.306059
EKB	4.008102	4.216116	4.041827	3.614525
STB	0.443216	0.478909	0.648079	0.609190
FRS	2.700401	2.854754	2.879325	2.639213
PAC	1.917373	2.114119	2.105275	1.992601
PRA	7.107310	6.818013	7.324236	7.002940
Constant	-881.085919	-861.543984	-878.858490	-824.885084
Classification Results:				
American Indian	66 (85.71)	6 (7.79)	0 (0.00)	5 (6.49)
Afro-American	2 (5.41)	30 (81.08)	2 (5.41)	3 (8.11)
Euro-American	3 (3.75)	8 (10.00)	61 (76.25)	8 (10.00)
Hispanic-American	1 (4.35)	0 (0.00)	2 (8.70)	20 (86.96)

Appendix F. Discriminant functions for the identification of racial or ethnic affiliation in male crania. Section 2, four group male model with reduced 35 variable data set.

Variable	American Indian	Afro-American	Euro-American	Hispanic American
BBH	02.60947	2.513176	2.825523	2.693510
MAB	0.963122	1.252881	0.862501	1.097594
OBH	7.444777	7.190784	6.980542	7.350635
ZMB	1.498912	1.019388	0.947614	1.143761
EKB	3.244608	3.410340	3.220445	2.818114
STB	0.563965	0.618379	0.767100	0.702591
PAC	1.529079	1.763070	1.679790	1.592688
Constant	-693.169207	-693.313220	-685.426480	-656.026701
Classification Results:				
American Indian	63 (81.82)	6 (7.79)	1 (1.30)	7 (9.09)
Afro-American	2 (5.41)	29 (78.38)	2 (5.41)	4 (10.81)
Euro-American	2 (2.53)	4 (5.06)	61 (77.22)	12 (15.19)
Hispanic-American	1 (4.35)	0 (0.00)	2 (8.70)	20 (86.96)

Appendix F. Discriminant functions for the identification of racial or ethnic affiliation in male crania. Section 3, four group model with forensic 23 variable data set.

Variable	American Indian	Afro-American	Euro-American	Hispanic American
BBH	2.382186	2.325733	2.648018	2.504999
XCB	1.639449	1.724871	1.884634	1.764991
ZYB	0.956056	0.291978	0.392789	0.530175
MAB	1.181895	1.337967	0.871069	1.196234
DBH	6.443720	6.325037	6.127334	6.456540
EKB	2.370792	2.874793	2.512646	2.135351
PAC	1.551307	1.740538	1.666326	1.590103
FOL	3.805452	3.838328	4.066368	3.898476
Constant	-771.938656	-776.054755	-772.552595	-734.219999
Classification Results:				
American Indian	65 (84.42)	5 (6.49)	0 (0.00)	7 (9.09)
Afro-American	4 (10.81)	28 (75.68)	3 (8.11)	2 (5.41)
Euro-American	1 (1.28)	6 (7.69)	60 (76.92)	11 (14.10)
Hispanic-American	2 (8.70)	0 (0.00)	3 (13.04)	18 (78.26)

APPENDIX G

DISCRIMINANT FUNCTIONS FOR THE IDENTIFICATION OF RACIAL OR ETHNIC AFFILIATION IN MALE CRANIA

Appendix 6. Discriminant functions for the identification of racial or ethnic affiliation in male crania. Section 1, three group model with full 80 variable data set.

Variable	American Indian	Afro-American	Euro-American
XFB	1.070672	1.248686	1.414954
ZYB	2.047087	1.750074	1.805192
OBH	6.297093	5.979935	5.648113
ZMB	2.692836	2.476353	2.209708
PAS	2.682714	2.826852	2.997401
LAR	2.856768	3.158996	3.126016
PRA	6.505614	6.235705	6.720950
Constant	-868.474937	-832.525107	-859.919062
Classification Results:			
American Indian	71 (92.21)	4 (5.19)	2 (2.60)
Afro-American	2 (5.41)	32 (86.49)	3 (8.11)
Euro-American	2 (2.50)	8 (10.00)	70 (87.50)

Appendix 6. Discriminant functions for the identification of racial or ethnic affiliation in male crania. Section 2, three group model with reduced 35 variable data set.

Variable	American Indian	Afro-American	Euro-American
GOL	2.034951	2.166785	2.180496
BBH	2.373253	2.336951	2.541558
XFB	1.225925	1.428775	1.577683
ZYB	1.986607	1.591823	1.661123
MDB	-1.647774	-1.262287	-1.269451
OBH	6.080520	5.839763	5.479767
ZMB	1.824385	1.644047	1.303243
Constant	-745.248718	-713.079895	-726.776108
Classification Results:			
American Indian	69 (89.61)	8 (10.39)	0 (0.00)
Afro-American	4 (10.81)	29 (78.38)	4 (10.81)
Euro-American	2 (2.50)	7 (8.75)	71 (88.75)

Appendix G. Discriminant functions for the identification of racial or ethnic affiliation in male crania. Section 3, three group model with forensic 23 variable data set.

Variable	American Indian	Afro-American	Euro-American
GOL	2.284036	2.397466	2.379560
XCB	1.345382	1.380399	1.542093
ZYB	1.554697	1.045150	1.004399
BBH	2.723750	2.767182	2.896880
BNL	-1.809132	-2.063137	-1.660511
BPL	2.228334	2.470516	2.074553
NFB	0.055450	0.261187	0.212000
NLB	4.278562	4.596372	4.017677
OBH	7.501978	7.524933	7.070011
Constant	-802.639593	-791.777271	-790.929522
Classification Results:			
American Indian	63 (81.82)	10 (12.99)	4 (5.19)
Afro-American	3 (8.11)	30 (81.08)	4 (10.81)
Euro-American	3 (3.80)	7 (8.86)	69 (87.34)

APPENDIX H

DISCRIMINANT FUNCTIONS FOR THE IDENTIFICATION OF RACIAL OR ETHNIC AFFILIATION IN MALE CRANIA

Appendix M. Discriminant functions for the identification of racial or ethnic affiliation in male crania. Section 1, Afro-American/Euro-American model with full, reduced and forensic variable data set.

	Variable Model		
Variable	Full	Reduced	Forensic
MAB	0.440722	0.390055	0.384635
DKB	0.881722	0.875567	
SIS	-0.973450	-	
NLB	-	-	0.395847
OCS	-0.696171	-	
EKB	-	-	0.425107
FOB	-	-	0.400971
VRR	-0.757497	-	
LAR	0.816094	-	
OPR	-0.578492	-	
BBH	-	-0.323059	-0.295939
AUB	-	-0.363927	-0.293031
ZMB	-	0.203821	
Constant	3.571516	24.453489	11.617412
D2	13.3447	10.2828	8.8058
Afro-American Mean	6.696	5.163	4.408
Euro-American Mean	-6.696	-5.163	-4.407
Misclassification Results:			
Afro-American	0/37 (0.00)	2/37 (5.41)	3/37 (8.11)
Euro-American	3/79 (3.80)	5/79 (6.33)	9/79 (11.39)

Appendix H. Discriminant functions for the identification of racial or ethnic affiliation in male crania. Section 2, Euro-American/American Indian model with full, reduced and forensic variable data set.

Variable	Variable Model Full	Reduced	Forensic
ZYB	0.430406	0.437306	0.452962
DBH	0.772916	0.795690	-
ZMB	0.592642	0.559211	-
FMB	-0.563562	-0.505953	-
VRR	-0.441715	-	-
BBH	-	-0.247895	-0.262793
XFB	-	-0.213635	-
XCB	-	-	-0.181346
MAB	-	-	0.324676
MDH	-	-	-0.224946
PAC	-	-	-0.168716
Constant	-30.371428	-30.214571	5.314742
D2	15.7083	15.2786	10.8806
American Indian Mean	8.0493	7.6563	5.465
Euro-American Mean	-8.0493	-7.6563	-5.465
Misclassification Results:			
American Indian	0/77 (0.00)	3/77 (3.90)	3/77 (3.90)
Euro-American	2/80 (2.50)	1/80 (1.25)	3/80 (3.85)

Appendix H. Discriminant functions for the identification of racial or ethnic affiliation in male crania. Section 3, Euro-American/Hispanic-American model with full, reduced and forensic variable data set.

	Variable Model		
Variable	Full	Reduced	Forensic
MAB	-0.243653	-0.196655	-0.276963
XML	0.337646	0.302196	-
STS	0.179555	-	-
FOB	-0.476316	-	-
BRR	-0.207513	-	-
BAA	-0.417527	-	-
BBH	-	0.20733	0.177762
NLH	-	-0.290918	-
ZMB	-	-0.23033	-
EKB	-	0.371349	0.356683
OBH	-	-	-0.453601
Constant	-31.54069	-31.702927	-26.095231
D2	15.7083	4.7825	3.3558
Euro-American Mean	2.8039	2.5709	1.7672
Hispanic American Mean	-2.8039	-2.5709	-1.7671
Misclassification Results:			
Euro-American	10/79 (12.66)	11/79 (13.92)	15/79 (18.99)
Hispanic American	3/24 (12.50)	2/24 (8.33)	5/24 (20.80)

APPENDIX I

DISCRIMINANT FUNCTIONS FOR THE IDENTIFICATION OF RACIAL OR ETHNIC AFFILIATION IN FEMALE CRANIA

Appendix I. Discriminant functions for the identification of racial or ethnic affiliation in female crania. Section 1, three group model with full 80 variable data set.

Variable	American Indian	Afro-American	Euro-American
XCB	3.478034	3.601434	3.822037
WFB	1.163168	1.598372	1.643170
AUB	1.488750	0.804198	0.688267
ASB	3.182578	3.216056	3.551420
MDH	1.772661	2.170928	2.133573
ZMB	1.892226	1.576439	1.221614
PRA	7.562440	7.235110	7.985578
Constant	-942.042578	-878.530478	-957.554142
Classification Results:			
American Indian	67 (93.06)	3 (4.17)	2 (2.78)
Afro-American	2 (4.55)	41 (93.18)	1 (2.27)
Euro-American	0 (0.00)	2 (4.00)	48 (96.00)

Appendix I. Discriminant functions for the identification of racial or ethnic affiliation in female crania. Section 2, three group model with reduced 35 variable data set.

Variable	American Indian	Afro-American	Euro-American
WFB	2.184918	2.557856	2.761020
AUB	4.158558	3,559595	3.657045
ASB	2.698975	2.761206	3.130115
ZMB	0.523916	0.237519	-0.268644
IML	0.967257	1.262447	0.666018
PAC	2.934818	3.152074	3.116890
FOB	3.880314	3.935849	4.363868
Constant	-759.165173	-737.649259	-775.423229
Classification Results:			
American Indian	66 (91.67)	4 (5.56)	2 (2.78)
Afro-American	2 (4.55)	39 (88.64)	3 (6.82)
Euro-American	0 (0.00)	1 (2.00)	49 (98.00)

Appendix I. Discriminant functions for the identification of racial or ethnic affiliation in female crania. Section 3, three group model with forensic 23 variable data set.

Variable	American Indian	Afro-American	Euro-American
BBH	3.826544	3.729358	4.032239
XCB	3.459278	3.637627	3.839284
WFB	1.227497	1.623918	1.685071
ZYB	1.634806	1.230889	1.061033
AUB	1.206515	0.678096	0.658763
MAB	2.355578	2.482942	1.952550
MDH	-0.161357	0.248876	0.230247
FOB	3.533542	3.583185	4.054281
Constant	-845.310100	-802.179159	-829.898618
Classification Results:			
American Indian	66 (91.67)	3 (4.17)	3 (4.17)
Afro-American	2 (4.55)	37 (84.09)	5 (11.36)
Euro-American	0 (0.00)	3 (6.00)	47 (94.00)

APPENDIX J

DISCRIMINANT FUNCTIONS FOR THE IDENTIFICATION OF RACIAL OR ETHNIC AFFILIATION IN FEMALE CRANIA

Appendix J. Discriminant functions for the identification of racial or ethnic affiliation in female crania. Section 1, Afro-American/Euro-American model with full, reduced and forensic variable data set.

Variable	Variable Model Full	Reduced	Forensic
ASB	-0.631273	-0.564269	
NLB	0.659765	-	0.903916
NLH	-	-	-1.013048
OBH	0.757259	-	0.876948
DKB	0.454223	-	
IML	0.525586	0.610552	
NAA	0.862108	-	
MAL	-	0.692239	0.569335
FOB	-	-0.503446	
NPH	-	-	0.508808
XCB	-	-	-0.222298
BBH	-	-0.326569	-0.404200
ZMB	-	0.333456	
Constant	-59.396317	30.982724	17.630649
D2	16.250	13.864	11.916
Afro-American Mean	8.124	6.929	5.935
Euro-American Mean	-8.124	-6.932	-5.935
Misclassification Results:			
Afro-American	3/44 (6.82)	2/44 (4.55)	4/44 (9.09)
Euro-American	0/50 (0.00)	1/50 (2.00)	0/50 (0.00)

Appendix J. Discriminant functions for the identification of racial or ethnic affiliation in female crania. Section 2, Euro-American/American Indian model with full, reduced and forensic variable data set.

	Variable Model		
Variable	Full	Reduced	Forensic
WFB	0.491639	0.527564	0.518847
AUB	-0.444248	-0.403631	-
ASB	0.408683	0.35398	-
SIS	-1.624187	-	-
ZMB	-0.866034	-0.862137	-
PAC	0.313444	0.286935	0.277288
ZYB	-	-	-0.690870
MAB	-	-	-0.510516
FOB	-	-	0.699598
Constant	1.300843	7.811388	14.337656
D2	21.1252	18.6699	13.4859
Euro-American Mean	10.6244	9.3333	6.4791
American Indian Mean	-10.6251	-9.3333	-6.4791
Misclassification Results:			
Euro-American	1/50 (2.00)	1/50 (2.00)	1/50 (2.00)
American Indian	2/70 (2.78)	5/72 (6.94)	6/72 (8.33)

APPENDIX K

DISCRIMINANT FUNCTIONS FOR THE IDENTIFICATION OF RACIAL OR ETHNIC AFFILIATION IN CRANIA OF UNKNOWN GENDER

Appendix K. Discriminant functions for the identification of racial or ethnic affiliation in crania of unknown gender. Section 1, Three group model with full 80 variable data set.

Variable	American Indian	Afro-American	Euro-American
XFB	0.832307	1.006793	1.212230
ZYB	0.409272	0.070705	0.148263
MDH	-1.169604	-0.774079	-0.788039
OBH	8.239607	8.095839	7.702685
ZMB	2.496549	2.316490	2.022348
PAC	1.973154	2.190282	2.191807
PRA	6.604168	6.319141	6.876458
Constant	-673.286126	-641.898007	-676.142239
Classification Results:			
American Indian	135 (90.60)	9 (6.04)	5 (3.36)
Afro-American	5 (6.17)	72 (88.89)	4 (4.94)
Euro-American	5 (3.85)	13 (10.00)	112 (86.15)

Appendix K. Discriminant functions for the identification of racial or ethnic affiliation in crania of unknown gender. Section 2, Three group model with reduced 35 variable data set.

Variable	American Indian	Afro-American	Euro-American
BBH	2.467732	2.386963	2.635766
XFB	0.624526	0.801887	0.980191
ZYB	0.416538	0.073616	0.145419
MDH	-2.119315	-1.691614	-1.799605
OBH	8.560503	8.409514	8.053886
ZMB	1.697261	1.552498	1.192166
Constant	-505.640378	-490.023304	-498.940838
Classification Results:			
American Indian	136 (91.28)	8 (5.37)	5 (3.36)
Afro-American	3 (3.70)	70 (86.42)	8 (9.88)
Euro-American	3 (2.31)	11 (8.46)	116 (89.23)

Appendix K. Discriminant functions for the identification of racial or ethnic affiliation in crania of unknown gender. Section 3, Three group model with forensic 23 variable data set.

Variable	American Indian	Afro-American	Euro-American
BBH	2.060329	1.976084	2.305157
XCB	2.708959	2.695017	2.864322
WFB	0.610456	0.847008	0.804372
ZYB	0.111064	-0.362139	-0.388232
MAB	0.977815	1.163957	0.696278
MDH	-2.118768	-1.709849	-1.764484
PAC	1.254111	1.463413	1.419411
Constant	-430.683404	-425.17931	-449.082679
Classification Results:			
American Indian	134 (89.93)	10 (6.71)	5 (3.36)
Afro-American	5 (6.17)	66 (81.48)	10 (12.35)
Euro-American	8 (6.25)	14 (10.94)	106 (82.81)

Appendix K. Discriminant functions for the identification of racial or ethnic affiliation in crania of unknown gender. Section 4, Three group model with forensic 23 variable data set.

Variable	American Indian	Afro-American	Euro-American
GOL	1.590888	1.717847	1.711748
XCB	2.456383	2.438079	2.643869
ZYB	-1.325721	-1.729768	-1.775676
BBH	2.026578	2.116522	2.246701
BNL	-1.257988	-1.614912	-1.106482
BPL	1.918938	2.253185	1.744728
WFB	0.376030	0.647874	0.599881
NLB	2.235687	2.372509	1.816201
OBH	7.901154	7.948540	7.397136
Constant	-571.418127	-578.422897	-582.119828
Classification Results:			
American Indian	127 (85.23)	13 (8.72)	9 (6.04)
Afro-American	5 (6.17)	71 (87.65)	5 (6.17)
Euro-American	5 (3.88)	7 (5.43)	117 (90.70)

VITA

Peer Henning Moore-Jansen was born on Spetember 29, 1953, in Copenhagen, Denmark. After graduating from Gladsaxe Gymnasium, where he received the "Real Eksamen" in 1969 and the "Studenter Eksamen" in 1972, he continued his education at Copenhagen University. There he studied at the Institute of Prehistory from 1972 to 1975. In 1975 he moved to the United States. In 1977, he graduated from Texas Tech University with a Bachelors of Arts degree in Anthropology. He received his Masters of Arts degree in Archaeology from the University of Arkansas, Fayetteville in 1982. He continued his post-graduate studies at the University of Tennessee, Knoxville. The Ph.D. degree in Anthropology was conferred in August 1989.

Mr. Moore-Jansen has been actively engaged in archaeological and bioarchaeological field and laboratory work in Denmark, Holland, and the United States. From 1977 to 1983 he was employed as a research assistant and research archaeologist with the Arkansas Archaeological Survey in Fayetteville, Arkansas. As a graduate research and teaching assistant at the University of Tennessee he has been actively engaged in forensic case work, and skeletal biology research in the areas of dental anthropology and craniometric variation.

Mr. Moore-Jansen is the author and co-author of several reports, publications and grant proposals in skeletal biology and archaeology. He has taught introductory and upper division anthropology, and archaeological field-school on several occasions. He is co-developer and co-director of the Forensic Skeletal Data Bank project at the University of Tennessee. He has been involved in data recording, computer registration, organization and analysis as a graduate reasearch fellow with the National Institute of Justice. with the National Institute of Justice.

The Author is a member of the American Association of Physical Anthropologists, The Human Biology Council, the International Society for the Study of Human Biology, the Society for American Archaeology, Tennessee Anthropological Association, and Arkansas Archaeological Society. He is a provisional member of the American Academy of Forensic Sciences. He is also a full member of Phi Kappa Phi and Sigma Xi Scientific Research Society. He is married to Cathy Lyle Moore-Jansen, a Masters of Arts graduate in Museum Science and Anthropology from Texas Tech University, and a Masters of Library Science graduate from the University of Tennessee, Knoxville. She is currently library supervisor at the Municipal Technical

Advisory Services library in Knoxville. Their son Rorik Henning Moore-Jansen is is a recent graduate of Sequoyah Hills Elementary School Kindergarten Program.

Moore-Jansen will assume the position of Assistant Professor in Anthropology at Wichita State University, Wichita Kansas in August of 1989.