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Challenge on the Frontier: Discerning American Indians from Whites Osteologically

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ABSTRACT: Throughout much of the western region of the United States the traditional metric method for discerning Amerindian skeletal remains from those of Whites or Blacks, that is, the Giles-Elliot discriminant function approach [2], has simply been shown to be ineffective [3,4]. It also seems to fail at correctly identifying the crania of Black males [19]. The region of the West that produces the lowest percentages of correct placement of American Indian skeletons appears to be the Northwestern Plains (Wyoming, Montana). For this reason, in that area of the West a number of new methods have emerged (both metric and non-metric) in recent years. The effectiveness of each of these approaches in the process of skeletal identification varies, but most of them appear to be quite useful in forensic contexts. It is also suggested that some additional new approaches which seem to hold much promise for the future, be tested objectively as well, in order to ascertain their effectiveness in forensic casework.

KEYWORDS: physical anthropology, racial identification, American Indians, Giles-Elliot method, Gill method, simometer

Influences from Bill Bass

The first Human Osteology course taught by William M. Bass at University of Kansas was in 1960. It was a small laboratory class of six undergraduate students. Half of the members of that class: Richard Jantz, Paul Lin, and myself went on to eventually complete graduate studies in physical anthropology with specialties in human osteology. So did our graduate teaching assistant for that small class, Walter H. Birkby. By the end of that course I was clearly "hooked" on physical anthropology. I was not, however, so impractical at the time as to entertain the idea of a career in such an esoteric discipline, but was nevertheless fascinated by it.

Later as part of an undergraduate minor in physical anthropology I took Bass's upper division course Human Races. It was basically a survey of world populations, which looked at the adaptive value of human traits, and examined humanity group by group and trait by trait. I was absolutely enthralled by the content of that class. It was following that particular course, and after having read Dunn and Dobzhanky's *Heredity, Race and Society* [1], that I broke the word to my parents that a career in zoology or medicine was fine, for some people, but that the *real adventure* was clearly anthropology.

So, it has certainly been no accident that my own career and the careers of other Kansas students of the 1960s have been in the field of human osteology, with research foci on the skeletal characteristics that characterize the diversity of modern populations. Bill Bass clearly sparked those interests in his students.

Some Forensic Challenges

While at University of Kansas as a graduate student (working once again with Bill Bass in human osteology and by this time also in forensic anthropology) a number of cases were encountered where Plains Indian remains needed to be identified. The techniques of racial identification at the time included: dentition (especially the assessment of shovel-shaped incisors), aspects of cranial form and outline, nasal bone form, projection and form of the malars, and the Giles-Elliot discriminant function approach [2] based upon cranial metrics.

We were aware that the Giles-Elliot approach could provide poor results with some North American Indian populations. This knowledge was based upon the work at that time by Birkby [3] in which Giles-Elliot applications on certain Southwest Indian samples were tested. These failed to correctly classify Southwest Indians over 33% of the time (66.1% correct placement, n = 39). At Kansas in those days, however, we were not certain of what to make of Birkby's contribution since for the cases there the Giles and Elliot formulae actually worked rather well. These cases were of course, in virtually all instances representative of some Central Plains Indian population.

New Findings in the West

By the early 1970s, as I relocated further west on the Plains, at University of Wyoming, the Plains Indian populations were quite a different matter. Malars, teeth and nasal bones (and even cranial proportions), remained basically the same. And, of course, these criteria are always very useful when they are present on intact specimens. Very often, however, specimens are fragmentary and also missing their teeth. It was obvious, also, after a year or two of analyzing Plains Indian skeletons from Wyoming and Montana that the Giles-Elliot approach was not working. By the mid-1980s it was seen to be even less effective in the Northwestern Plains than in the Southwest. Eventually we demonstrated [4] a failure rate of over two-thirds (only 30.2% correct placement of Northwestern Plains Indians using Giles-Elliot).

As the failure of the Giles-Elliot method [2] in the Northwestern Plains area became obvious, efforts were begun to search out new and better approaches to distinguishing Plains Indians from other groups, especially the commonly encountered early historic Whites.

New Approaches

Before delineating some of the recent approaches to skeletal race attribution, which relate specifically to differentiating American

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Indian remains from those of Whites, it would seem appropriate to review some of the still quite useful traditional approaches.

Traditional Non-metric Approaches

A number of excellent references in human osteology exist which treat the subject of racial identification from the skeleton, and focus on traditionally utilized anthroposcopic traits [*5–10*]. An earlier reference [*11*] also reviews some of these traditional methods but focuses somewhat more on recently developed or little used, "forgotten," approaches. These will be dealt with in detail below. Also, another study [*12*] reports on anthroposcopic features of the nasal skeleton of value in attributing skulls to the major geographical races.

Drawing from all of the above sources, a brief outline of some of the most important diagnostic traits can be listed. Before beginning this exercise, however, a cautionary note is deemed advisable regarding the broader subject of racial taxonomy, and actually the entire concept of race. Just like gender, stature or chronological age, race is a very useful biological category for law enforcement agencies in their attempts to define recognizable aspects of personal identity for medicolegal purposes. Many physical anthropologists who deal with modern human population origins and relationships also find race taxonomy to be a very useful tool. The utility of the race concept, however, may not necessarily relate so close to its validity. Some anthropologists today, in fact, believe that a more valid way of looking at human biological variation is through a totally clinal approach (that is, as a series of subtle gradients of traits) rather than attempting to define distinguishable major populations (which within any living species, no matter how polytypic, are never totally discrete biological entities).

The truth of the matter seems to be that some morphological traits (especially those subject to climatic forces of selection) pattern rather well geographically, while others do not. So, depending in part upon what traits are being studied, and also the research objectives and orientation of those conducting the studies, there probably will always be these two ways of looking at human variation. There will be one approach that tends to divide groups and categorize individuals, and the other that tends to ignore taxonomic groupings and focus on the more subtle clinal variations. Either approach can be well defended in particular contexts.

The main point to remember is that if one choses to embrace the race concept and racial taxonomy as a valid and useful way of dealing with human variation, as 75% of forensic physical anthropologists do [*13*], a few important realities must be kept in mind. First, populations and races are not static or fixed, but are responsive to forces of selection and are therefore constantly changing and fluid. Races are also never "pure" or even all that homogeneous. Nature maintains a high degree of genetic variation in all large populations and thus they remain responsive to external environmental changes. Furthermore, gene flow always occurs between adjacent populations (even when social prohibitions attempt to prohibit it). These two factors ensure, in other words, that the boundaries between races remain quite blurred. Also, society's concept of what constitutes a race (social race) does not always coincide so well with scientific assessment (biological race). In the United States, for instance, a person who is of 75% European decent but has a Black African grandparent is considered Black and not White. Biologically the person is much more White than Black, but socially the individual is Black. Such cases sometimes lead to problems of "fit" between the results of scientific analysis and the records available for personal identification.

Races, then, are statistical abstractions of trait complexes, and not pure entities or rigidly definable "types." The populational concept of race has over the years replaced an older typological view which has failed to encompass many of the important realities of population composition appreciated today. So even though physical anthropologists today are debating how "real" human races are, no one disputes the fact that pure racial types never existed. In fact for most traits the variation within races is greater than the slight average difference between defined races. With these points in mind the reader should be able to appreciate the trait lists presented below, as statistical abstractions of reality (generalizations), and know that there is nothing "absolute" about any of the traits mentioned on these lists.

Even though the main thrust of this article is to report on recently developed approaches for distinguishing Whites from American Indians, Blacks will also be treated in this section which relates more broadly to the traditional approaches used throughout the United States. The format for these lists is drawn largely from Rhine [*8*], a source found to be handy and effective by many students of osteology. Some useful non-metric cranial traits commonly used are:

1) *American Indians:*

Shovel-shaped incisors
Robust, flaring malars
Moderate prognathism
*Elliptic palate
Complex cranial sutures
Medium, "tilted" nasal spine
Blunt, median chin
Wide ascending ramus of mandible
Vertical ascending ramus
*Straight palatine suture
Malar tubercle
Incisor rotation
Concavo-convex nasal profile
Low, sloping sagittal arch
Wormian bones
*Low, "tented" nasals
Medium nasal aperture
*Angled zygomaticomaxillary suture

2) *Whites:*

Blade-form incisors
Small, retreating malars
*Highly arched, "steeple-like" nasal bones
Very reduced prognathism
Small, crowded dentition
Very sharp nasal sill
Square, bilateral chin
*Parabolic palate
*Curved zygomaticomaxillary suture
Projecting chin
Straight nasal profile
Nasion depression
High cranial vault
Simple cranial sutures
Mandibular "cupping" below incisors
Inion hook
*Jagged palatine suture
Long, large nasal spine

3) *Blacks:*

Blade-form incisors
Marked alveolar prognathism
Wide nasal aperture
Reduced nasal spine
Very dull nasal sill (or absent)
*Low, flat "quonset hut" nasals
Low vaulted cranium
Post-bregmatic depression
*Hyperbolic palate
Retreating chin
Blunt, median chin
Narrow ascending ramus of mandible
Oblique ascending ramus
Extreme facial prognathism
Large molars
Simple cranial sutures
*Arched palatine suture
*Curved zygomaticomaxillary suture

*These traits are described in detail in the following paragraphs.

Some diagnostic postcranial traits are likewise known, and have proven useful in racial identification. Regarding anterior femoral curvature, according to Stewart [14] Blacks have the straightest femora, Whites a moderate degree of anterior femoral curvature and various Mongoloid populations show a high degree of curvature. In the Americas, anterior femoral curvature appears to follow a cline from North to South with Eskimos revealing high curvature, North American Indians moderate curvature, and at least some South American Indian populations show a low degree of curvature [15]. Since North American Indians and Whites seem to show about the same degree of curvature, this approach throughout most of the country is useful primarily in distinguishing only Blacks from the members of other populations.

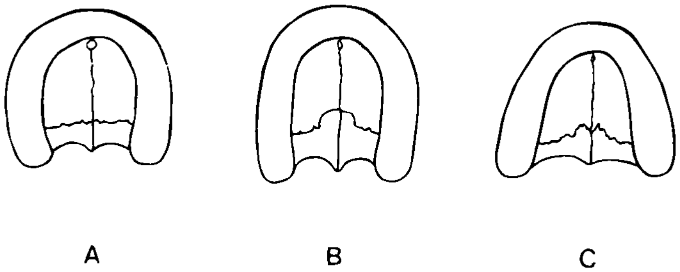

FIG. 1—(A) *Elliptic palate with a straight suture common among American Indians,* (B) *hyperbolic palate with an arched suture common among Blacks, and* (C) *parabolic palate with a jagged suture common among Whites. After Gill* [11].

Metric Approaches Old and New

The Giles and Elliot discriminant function methods [2,16] for establishing sex and race and the later Giles approach to sex identification [17] have been tested over the years by a number of investigators. The results for all of these methods of sexing seem to be quite good. In their own test of 1022 Indian Knoll skeletons, Giles and Elliot obtained 82.9% correct classification. Birkby's results [3] were better with 86.4% correct sex identification on 59 Southwest Indians, and Fisher and Gill [4] attained 85.7% on 42 Northwestern Plains Indians. Another study which utilized skeletons from a forensic context [18], but with a very small sample of test cases ($n = 7$) produced 100% correct classification by sex.

As suggested earlier the problem with the Giles-Elliot approach is not with its sexing capability, which is obviously quite good, but rather with its very poor capacity to correctly predict race. The results obtained by Birkby and also by Fisher and Gill are so bad for American Indian samples from western regions of the United States that some researchers in those areas do not use the race identification formulae at all, at least if Amerindian ancestry is suspected. Furthermore, an important recent study [19] suggests that the Giles-Elliot approach to racial attribution of Black male crania is just as bad as it is for western region Amerindians. In a sample of 23 Black males from recent forensic contexts only 47.8% placed correctly. Interestingly, however, 90.4% of Black female crania ($n = 21$) were correctly placed. And, as seems to be the case everywhere, they obtained adequate results in their racial identification of Whites. In their very adequate sample of 136 Whites from recent forensic cases, 82.7% of females and 84.0% of males were correctly classified.

If the Giles and Elliot discriminant function method for racial identification [2] has any utility whatsoever, it would seem to be in confirming Caucasoid ancestry in cases where such ancestry is already suspected based upon other evidence. Perhaps as samples grow in the future, it will also be found that the racial identity of Black females can also be supported through use of the method. Whether the method is still of some value in correctly attributing race to a significant percentage of American Indians from the Midwest and eastern areas of the United States remains to be seen.

A more recently developed metric approach to race identification from the midfacial skeleton [20–22] appears to be working much better than Giles and Elliot. The method does require the use of a modified coordinate caliper, the *simometer,* which is not a common instrument. This is a distinct disadvantage, but due to the success of the method in all parts of the United States simometers are now in use in many osteology laboratories.

In the original study in which 173 American Indian specimens from various regions were compared to 125 Whites on the degree of midfacial projection, 88.8% of Whites and 87.9% of American Indians were correctly classified. More recent applications [23,24] of this method to additional samples provide results even better than in the original study. In Curran's study of 50 Whites and 100 Amerindians from the Southwest [23] 88% of the Whites and 95% of the Indians were accurately classified.

Since this simometer approach (sometimes referred to as the Gill Method) is described in several basic references [5,7,9,21] only a couple of points need to be made at this time. First of all, the original sectioning points between Whites and Indians for the three indices (maxillofrontal, zygoorbital and alpha) listed in some references as 40-40-60 [5,7,9,20] are actually *40-38-60* as mentioned in the more recent studies [21,22]. Furthermore, as pointed out by Gill and Gilbert [22] these *same sectioning values* of 40-38-60 are the best ones for separating American Blacks from Whites utilizing the same method. The same high degree of accuracy is also attained in sorting out the Whites from Blacks. The method is of no value, however, in distinguishing the crania of Blacks from those of American Indians—about the only dimension in which the older Giles-Elliot method still holds an advantage.

New Non-Metric Techniques

Even though some attention has been paid in the past to the racial differences in palate and palatine suture forms [11,25] not much quantification of these forms by population has been attempted until recently. The common forms as presented by Gill [11] are shown in Fig. 1. Chapman and Gill have undertaken a fairly thorough study of these traits using University of Wyoming data files on North American, Mesoamerican and South American Indian populations and Polynesians, as well as some information on Whites and Blacks [26]. According to their findings, Whites show a very high frequency of parabolic palates. About half of American Indians, on the other hand show elliptic palates. Often the elliptic palate is associated with a very straight palatine suture which greatly facilitates identification of American Indian crania in those cases. The hyperbolic palate is found in considerable numbers only in samples of Blacks (46%). Whites only show 6% and American Indians 1–2% depending upon the sample.

Figure 2 shows another trait difference between American Indians and Whites that is useful to the osteologist. First published by Gill [11] following the unpublished work of Martindale [27], the form of the zygomaticomaxillary suture has proven fairly reliable in distinguishing crania from these two populations. Martindale found that approximately 85% of Plains Indians reveal the widely flaring "angled" suture form while nearly the same percentage of

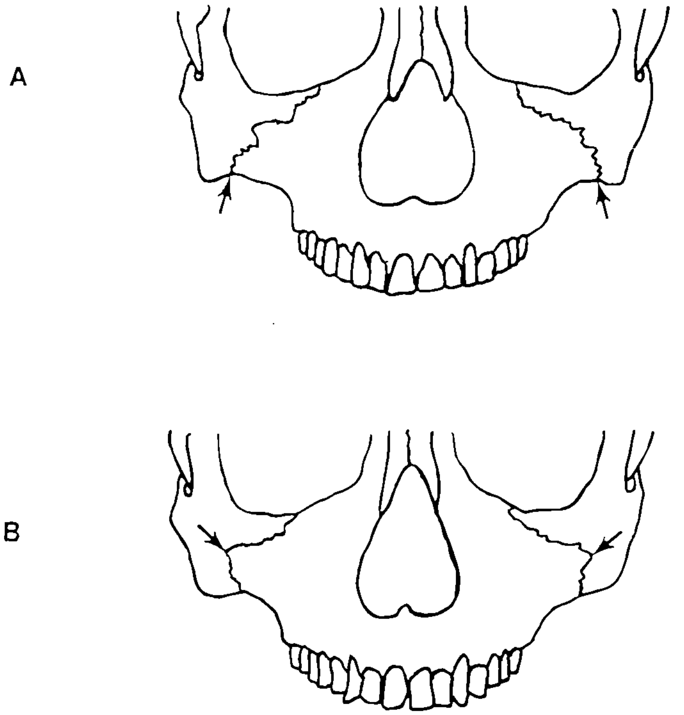

FIG. 2—(A) *The "angled" zygomaticomaxillary suture common to American Indians and* (B) *the "curved" suture common to Whites and some other populations. After Gill* [11].

Whites show the "curved" form. Other *Homo sapiens* populations show the two forms in more or less equal percentages.

Brues [*12*] describes and illustrates nasal bone morphology differences that are clearly useful in distinguishing Whites from American Indians and also Blacks. Whites have the most prominent nasal bridges which rise so abruptly from the midface that they form a "steeple-like" shape. They are high, somewhat pinched, and with a break in contour at or near the naso-maxillary suture. American Indians and others of the basic Mongoloid stock show nasal bridges that are low to moderate in height, and with relatively straight sides. They also tend to be angled in the midline, which she calls "tended." Blacks usually reveal low rounded nasal roots which Brues describes as more like a "quonset hut" in shape.

Napoli and Birkby [*28*] describe racial differences between Whites and American Indians with regard to the visibility of the oval window in the middle ear. Visualization of the oval (vestibular) window within the middle ear, as viewed through the external auditory meatus, differs greatly between these two populations. A sample of 72 American Indians examined in their study shows over half (53%) with a total lack of visibility of the oval window (masked by the posterior wall of the auditory meatus). Among 33 Whites, on the other hand, and 34 individuals of admixed White/Indian ancestry all reveal a totally visible or at least partially visible oval window. Among the American Indians 34% showed partial visibility and only 13% showed complete visibility (as opposed to 94% of the Whites). Clearly this approach to distinguishing the crania of Whites and American Indians shows great promise and should be tested on more samples from a wider geographic distribution.

Gilbert and Gill describe a useful means of quickly distinguishing between the femora of Whites and American Indians [*29*]. At the proximal end of the femur below the lesser trochanter American Indians reveal a platymeric form with both medial and lateral ridging. Whites on the other hand show much greater A-P diameters and no ridging. This condition can be evaluated either visually, metrically or both. Figure 3 shows a scatter plot [*30*] of femur measurements of Whites and Indians from the Northern Plains and Southwest. The two measurements necessary to place the plot point for each femur are simply subtrochanteric femoral A-P diameter and mediolateral diameter as described in Bass [*5*]. In the sample of 60 Whites and 60 American Indians shown in Fig. 3, 85% of Whites are correctly classified and 78.3% of the Plains and Southwest Indians. These samples consist of prehistoric and protohistoric Amerindians and Whites from both modern forensic and early historic contexts.

Since femoral diaphyses respond to biomechanical stresses which can significantly affect midshaft proportions, it is reasonable to question whether the subtrochanteric shape variation described here represents actual racial features or merely environmental stress differences that happen to correlate with race. Such cases are of course known in osteology such as the marked differences between Whites and American Indians with regard to dental occlusion and patterns of attrition. From most evidences these dental differences appear to be much more the result of cultural/environmental factors than they are of racial/genetic ones. Two lines of evidence from studies at the University of Wyoming suggest that in the case of subtrochanteric femur shape the opposite is true; that is, genetic factors are much more influential than the environmental ones. This was first suspected in 1979 when a forensic case was encountered that provided a small sample of contemporary Plains Indian femora [*31*]. Subtrochanteric measurements of the femora from those three young adult males placed them well into the American Indian sector of Fig. 3. Though their environment was essentially that of modern White Americans the femora continued to display the morphological pattern of their ancient Indian ancestors. The lingering problem here, of course, has been sample size. Within recent months, however, a much more comprehensive study has been completed which addresses this same question [*32*].

In her thorough examination of all available femora of Northwestern Plains Indians and Whites Miller has focused entirely on the subtrochanteric region. To facilitate statistical treatment of

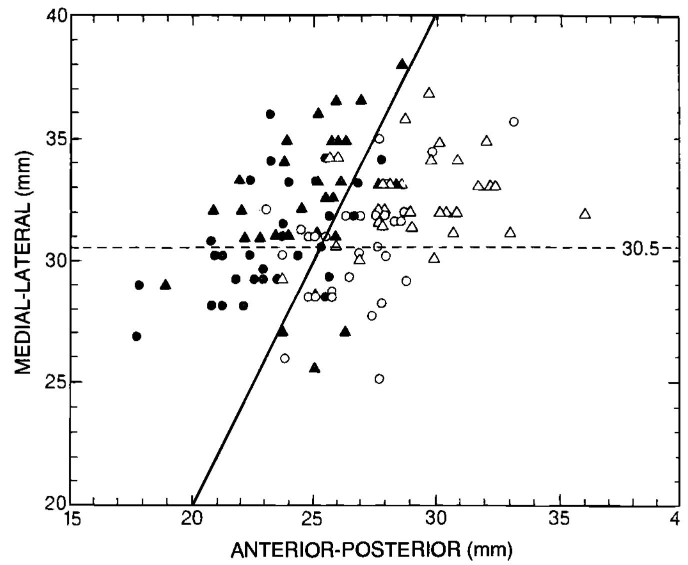

FIG. 3—*Scatter plot of subtrocharteric anterior-posterior and mediolateral femoral measurements. The Δ indicates male White, and • female Indian. After Gill and Rhine* [30].

her samples she first calculated platymeric index from the two measurements described above (providing a single variable for each individual specimen). She then statistically compared samples of Plains Indians ($n = 52$) from the Archaic, Late Prehistoric and Protohistoric time periods (and from the Red Desert to the Northern Plains grasslands). She also was able to include 19 historic Whites and 5 early historic Chinese laborers in her study. In order to search for possible environmental influences she examined differences in platymeria not only by time period and geographical region among the Amerindians, but also by age grade from childhood to old age. Even though a slight increase in platymeria can be discerned by age-grade suggesting a possible environmental influence these are not statistically significant. Neither are the very slight differences between Plains Indian samples through time and geographic space. Furthermore, the femora of the five historic Chinese males, living under exceedingly different environmental conditions (but sharing a common heritage within the Mongoloid stock), did not differ statistically from the femora of the Plains Indians. The only statistically significant differences found in Miller's study have been between the femora of Whites and those of all of the Amerindian samples (and Chinese also), and in one additional instance. In this case statistically significant differences were also found between one small sample of early historic Plains Indians from near the Bordeaux Trading Post (who possibly had some White ancestry) and the other samples of Amerindians known to have had no admixture with Whites. So, according to Miller, based upon her rather extensive statistical testing through time, space and developmental phases, the genetic/racial factor seems to be the only one that produces significant effects upon the morphology of the proximal (subtrochanteric) femoral diaphysis.

Certainly a single study with limited sample sizes has not settled the question of the relative proportions of genetic as opposed to environmental factors involved in femoral platymeria. It does, however, when coupled with earlier suggestions pointing the same direction, provide human osteology researchers with a good working hypothesis. It looks, therefore, as though genetic factors which pattern differently by race are the fundamental ones influencing femoral platymeria, and that consequently this trait will continue to prove valuable to forensic physical anthropologists involved in the assessment of ancestry from skeletal remains.

Another area of the postcranial skeleton which appears to be very different between American Indians and Whites, especially in males, is the sciatic notch area of the pelvis. I have observed in recent years that about half of Caucasoid males fail to show the narrow sciatic notch that is supposedly characteristic of *Homo sapiens* males. Rather wide, somewhat feminine notches occur on these male pelves in conjunction with a characteristically masculine pattern in the pubic area. According to this hypothesis, then, when an otherwise male-looking pelvis reveals a wide sciatic notch it is the pelvis of a male White. Clearly this new and untested approach needs to be adequately quantified. No systematic study to my knowledge has explored this condition which seems to be peculiar to only White male pelves (and appears to be characteristic of a high percentage of them).

Summary

Since the mid-1980s the number of osteological approaches to racial identification has increased dramatically. Many of the new methods focus on the challenge of distinguishing American Indian remains from those of Whites. Most of these published methods also include serious efforts at quantification, both of the approaches themselves and of the resultant effectiveness of the techniques (percentages of correct placement). Such trends clearly need to be projected into the future if human osteology is to continue to better serve the needs of archaeologists and of forensic scientists.

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