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FORENSIC DIAGNOSIS OF RACE—GENERAL RACE VS SPECIFIC POPULATIONS

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Abstract—Commonly used methods of diagnosing racial affinity from the skull may give paradoxical results. This may be due to using single populations to represent large geographical areas, and to the use of measurements unduly subject to local variation. It is suggested that a more flexible approach, using appropriate local populations and selected measurements, would be entirely practical with the use of modern small computers.

Key words—forensic diagnosis, craniometry, race, local populations

In a legalistic society we do not like to have human remains to which we cannot attach a name. Identification of skeletal remains which are not documented may be needed for any of several reasons. First, simply to close a missing persons case, which if not resolved may leave survivors in a legal limbo for a number of years. Secondly, to return remains to next of kin for legal disposal; this may be a massive undertaking in the case of domestic disasters and military operations. Third, perhaps the most newsworthy, are cases in which homicide is suspected. Correct identification leads one to associates, motives, details of disappearance, and possible solution of a case. Without knowing who is dead, the chances of identifying the perpetrator are essentially nil. The anthropologist rarely appears in court; his task is to guide an investigation which turns up other and more trial-worthy kinds of evidence. Identifications of age and sex are more or less standardized. But identification of the most probable race or population affiliation is much more complex and difficult and continues to be a challenge to the anthropologist.

To the physical anthropologist, race is simply a phenomenon to be explained, as it is to the zoologist who sees the same kind of geographical diversity within nearly all widespread species. As a phenomenon, race is the fact that geographically separated populations differ in their gene frequencies and range of phenotypic variation, which therefore may be used to estimate the probability that an individual's area of ancestry is more probably one place than another. If the characteristics associated with geographical races were produced by pleiotropic factors, in a way comparable to the determination of secondary sexual characteristics by the presence or absence of the Y chromosome, this would be a simpler task. But since the characteristics associated with race are due to multiple independent Mendelian units, part of the same system that determines individual differences, the assignment of an individual to a particular population is based on truly multidimensional variation. Organization of the mass of data on geographically distributed traits may be on a large scale; i.e. continental or subcontinental, or on a small scale, as by tribe or other genetically defined group. It is the difference in scale of various ways of organizing human variation that we are primarily concerned with in this paper.

For a starting point we may go to the 'standard' methodology for racial identification, the formulae published by Giles and Elliot [1]. These formulae have done good service for many years and are now available in computer software for the forensic user. They were designed to distinguish as far as possible between American Black, American White and American Indian. The basic data are; for Black and White, measurements taken by the authors on dissecting room material from St Louis and Cleveland; and, for American Indian, the well-documented Indian Knoll population from Kentucky, of Archaic age, about 3500 B.C. [2].

The American Whites of Giles and Elliot represent a local sample of a population already blended from a variety of different local populations in Europe. Their American Blacks have African ancestry from a limited area of West Africa, not necessarily representing Sub-Saharans in general, and incorporating an approximate 30% admixture from a variety of Europeans and some American Indians. The Kentucky skeletal population used as a stand-in for all Indian populations in the general area of the United States, comes from a period when local tribal differences were perhaps greater than among later Indians, and greater than local differences have been in much of Europe for most of the last 2000 years.

Giles and Elliot presented two discriminant functions, one for Whites vs Blacks and one for Whites vs Indians. Each of these discriminant functions were based on two choices only. The 3-way split, if necessary, is based upon whether a specimen is more

Black by the criteria by which we distinguish Black from White than it is Indian by the criteria by which we distinguish Indian from White—actually a rather complicated concept. Note that the most distinctive differences between Black and Indian need not have loomed large in either of the first two functions, if Black and Indian diverged moderately from White but in opposite directions. Although the 2-way discriminant is made to order for sex, race is a more difficult and complicated matter.

The measurements used were eight cranial measurements which were considered standard at the end of the 19th Century, and which date back basically to the Frankfurt Convention of 1884. We still would not question that the cranium is the richest source of skeletal information about human geographical variation; but we no longer have certain preconceptions of that time, which were that comprehensive measurements, such as total head length, breadth, or height, would be the most important for large taxonomic population divisions, or that the same type of measurement would be significant for intraspecific geographical variation as for evolutionary changes.

Innovation in cranial measurements has come slowly, largely because much of a measurement's utility depends on its being taken and published by a large number of workers, so that comparisons can be made between many populations. In 1934 Woo and Morant [3], realizing that the distinctive differences between East Asian and European skulls had eluded previous study, devised some measurements of the flatness of the face and nasal region, which clearly discriminated these two population groups. At the same time they demonstrated the value of 3-point measurements (subtenses) i.e. those which measure the divergence of one point from a line defined by two other points. Newman and Snow, in 1942 [4], included some of Woo and Morant's measurements of facial flatness. Unfortunately, at about this time a general neglect of craniometry was setting in, due to the distraction of other intriguing vistas in physical anthropology, and reform of craniometry has been slow in developing. At least, by 1934, it was demonstrated that features which were small in absolute dimensions, such as the root of the nose, could be very significant as an indication of genetic difference between major areas. Since then Crichton [5] and Howells [6–8] have used innovative measurements of this kind extensively, and Gill *et al.* [9] have used subtense measurements of the midfacial region to derive improved differentiation between American Indian and White crania.

It is interesting to note that the cranial index, one of the oldest objects of veneration in the craniologists' sacred bundle, was originally of particular interest to European anthropologists because of its great range of variation within Europe. This made it useful in the interpretation of European archaeology. However, this immediately makes it suspect as a delineator of major races, though it does, for instance, nicely separate Sub-Saharan Africans from East Asians. Thus, the discriminators of populations are what and where we find them. They may be large or small in actual magnitude on the specimen, and they may be local variations in one area, yet discriminators of populations of subcontinental extent elsewhere.

It is easy to test the existence of local variations within broad categories such as those used by Giles and Elliot. Birkby [10] did so, using the Giles and Elliot formulae on a variety of American Indian and Eskimo crania from populations other than Indian Knoll, and found 36% of undeformed specimens to be wrongly diagnosed as Black or White, in disappointing contrast to the mere 15% wrongly diagnosed when Indian Knoll specimens were tested by the formulae in which Indian Knoll itself was the 'standard Indian'. The present author has made spot checks of racial diagnoses, both by using the mean of a series as if it were a 'typical individual' and by using individual measurements from populations published by Howells [6, 7]. (These individual data were generously made available to me by Dr Howells, already recorded on floppy disks for my computer.) It is disconcerting to find that Howell's Arikara males, tested by the Giles–Elliot formulae, fall, on the average, very near the 3-way junction of White, Black, and Indian; and that males of a Santa Cruz Island population measured by Howells show not only 25 out of 51 to be 'Black' but 35 out of 51 to be 'White'. Obviously there are risks in taking any single local population as a representative of a continental area. At the same time, this suggests the possibility of forensic discrimination between Indian tribes if the right approach were taken.

It should be noted that considerable changes have taken place in the equipment which the forensic anthropologist has available for racial diagnosis. In 1962, the only feasible approach was to use a mathematical technique by which all the complicated calculation was done in advance using a large main-frame computer. This made it possible for the ultimate user, by doing only eight multiplications and one addition on his desk calculator, to get a diagnosis of probable race. Discriminant function programs were already available for main-frame computers, having been used for some time by psychologists, most notoriously to assign aptitude test question to one of the two main categories of Verbal Ability vs Quantitative Ability. Although Giles and Elliot used 2-way discriminants, multiple discriminant programs are available and have been used, for instance, by Howells for his 17-population global survey in *Cranial Variation in Man* [7]. One weakness of all these discriminants is the limited number of possible alternatives. Howells' 17-population study includes only three populations in the whole New World; Eskimo, Arikara and Peruvian, to represent two large continents, whereas, as we have seen, there is considerable local variation just in the United States. In the case of the older 2-way discriminants, there is no indication in the mathematical result that an individual may fit so badly into both of the alternatives that entirely other possibilities should be considered; all that we are given is that one of the two is more probable, when it might sometimes be better described as less improbable. Even a 17-way discriminant method leaves many populations to slip through the cracks.

At the present time a great deal more can be done by the ultimate user of forensic techniques, on the personal computer which long ago replaced the desk calculator. One possibility which immediately suggests itself is the calculation of new discriminants for every set of alternatives which might be suggested by the locality and circumstances in which remains were found, and whatever measurements might be available on cranial series with which we wished to compare it. A serious limiting difficulty is that the proper calculation of a discriminant function requires that there be available, not just parameters of the kind usually published, such as means and standard deviations, but a body of individual measurements on the crania in both of two collections. Even means and standard deviations may not be available in all cases where we would like them.

One possibility which I am now investigating is the use of methods which give an absolute value for the degree of concordance between an individual and a group, given only means and SDs of the group. With such techniques we can compare an individual's match with one group and his match with any other, with a qualification in some cases if the available measures are not identical in the two cases. Such techniques have been used by psychologists and vocational counselors. In the latter case various test results on an individual are compared with recorded results on a group of successful individuals in a profession or occupation, to evaluate whether the individual is well advised to pursue that career. It is basically an extension of what one might do with a single measure, that is, to determine the individual's z-score and find how central or peripherally he falls in the distribution curve of a group. Only means and standard deviations are required. The more sophisticated technique combines the individual's z-scores on several measures, with due correction for the correlations known to exist between measures. A test with a simple measure of this sort and using the same measurements used by Giles and Elliot, gives a differential diagnosis which correctly assigns 75% of Howells' medieval Norse and medieval Hungarian males to the correct one of those two populations. This does not compare too badly with Giles and Elliot's 83% for diagnosing White vs Black vs Indian.

When original raw data are unavailable (as is usually the case) estimates of inter-measurement correlations would have to be taken from other populations for which these correlations have been calculated, with an optimistic assumption that such correlations are, in general terms, a human universal.

Flexibility in the choice of populations with which an individual is compared continues to become more necessary. At present, in many parts of the U.S., Hispanics are a significant part of the population—and Cuban Hispanics, Hispanics recently arrived from Mexico and many-generation Texan or New Mexican Hispanics cannot be considered equivalent for diagnostic purposes. (So far as I know, there is no comparative data available except for Mexicans.) In Alaska, Eskimo and Aleut must be considered; in Hawaii and California, Chinese, Japanese and Polynesians (of various provenience) are possibilities. And recently in many places in the U.S. significant numbers of Vietnamese and Cambodians have recently arrived. Some cities in Canada now have substantial populations of East Indians. A forensic anthropologist in Australia would want Aboriginal and part-Aboriginal series in his data bank, and one in Sweden or Finland a Lapp series. A method by which individuals were simply compared with appropriately chosen series in each area would be highly flexible. In addition, such a method immediately tells you if an individual is a very bad fit for everything you have compared him with and that other possibilities should be tried.

If we wish to get the greatest efficiency in forensic identification, we should stop trying to do it in a way in which the very real local variation becomes mere static to confuse the results, and try to do it in a way in which local variation makes a positive contribution to correct diagnosis. If this involves some sacrifice of mathematical sophistication, so be it. We need to know who these people are. It is perfectly legitimate (and a lot of the fun of physical anthropology) to speculate about the general relations of the larger divisions of the human species, but this is not the primary need of the forensic process.

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