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RACE CONCEPT AND PALAEOANTHROPOLOGY: A RESEARCH MODEL FOR INTERPRETING ANCIENT HUMAN REMAINS

ABSTRACT:

Two major and widely used race concepts — the traditional "typologic" and the modern "population", are strictly unsatisfactory for explaining collections of ancient human skeletal remains. Because these concepts show very little concern with the facts of natural biological groupings of man at intraspecific level when concerned with the palaeoanthropological material. The chief anthropological problem that concerns us most at present is, how best can the palaeoanthropological material be defined so as to commensurate with the facts of human biology?

The present study generates a new conceptual framework that can be used as an operationally effective research model for a meaningful interpretation of the morphological data which a given ancient skeletal material contains. This has been envisaged by bringing about a synthesis of the older classical morphological anthropology with the newer population genetics. To test the validity of the model as a rational research tool the only available extensive Bronze Age human skeletal material dated c. 2500 BC and discovered at Harappa, one of the most famous city sites in the Indus basion of the Indian subcontiment, has been employed as an example.

1. INTRODUCTION

Those concerned with the palaeoanthropological studies of human osteological materials that generally result from archaeological discoveries frequently face the problem of defining and interpreting the involved materials so as to commensurate with the facts of human biology. It has been pointed out recently by S e n (1967) that any meaninful interpretation of the ancient human skeletal material must conform to the realities of natural biological groupings of man. The difficulty that confronts us in arriving at the desired goal — that is to say, a meaningful interpretation of the morphological data which such a material contains, can be ascribed largely to two fundamental factors. The first consists in the sparsity of the surviving usable specimens which almost never render a statistically adequate sample. And the second one — the most cardinal for us — lies in the use of different concepts of "race" under which one attempts to classify human variability with the purpose of defining the physical makeup of a given sample.

In taxonomic sense, "race", in man, is used to quality different levels of classification at subspecific level. As far as the palaeoanthropological materials are concerned, two well-known concepts of race for classifying individuals into groups are most relevant. These are: the "typologic" concept of race, which is *per se* morphology based and held traditional or older, and the "population" concept, being demographic-genetic and newer in approach.

2. THE TYPOLOGIC AND POPULATION CONCEPT

In classical morphological anthropology, the typological concept of race is believed to be the most appropriate for classifying the existing subgroups of man into some discrete biological units. Therefore, postulating hypothetical pure races, this traditional method attempts to explain a population in terms of varying proportions of different racial types — namely, the Nordic, Proto-Nordic, Mediterranean, Proto-Mediterranean, Alpine, Australoid, Proto- and Pseudo-Australoid, Caucasoid, and such other types or varieties (C z e k a n o w s k i, 1967). The axiom of this concept as applied to man has been derived following the morphological conception used in animal taxonomy. The classification here is based primarily upon the similarity in physical characters

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Hooton, 1946; Olivier, 1967). Such classified groups, or discrete bundles labelled as races, are regarded to be constituted by members, or individuals, who possess a general similarity or some commonness in morphological characters. It is the assumption of the typologists' school that members of racial type, or group, are biologically related, and the groups are expected to be distinguishable phenotypically (Hooton, 1946; Czekanowski, 1967).

Genetically, the modern population concept of race is just equivalent by definition to "breeding population", or "intrabreeding unit" (Laughlin, 1966; Garn, 1969). The populations possess group-specific genic constitution, or rather gene pool, and differ from others genetically. Biologically speaking, populations having different gene pools are considered as separate races at subspecific level. Thus, it is the realization of the geneticists that populations, which are simply races, differ in relative frequencies of gene alleles or chromosome structure (Sinnot, Dobzhanski, and Dunn, 1958).

Reviewing some of the major studies on the human remains from Southwestern Asia — a region we are concerned most, it became immediately clear that these were mostly analysed in accordance with the traditional typologic concept of racial analysis (Keith, 1927; Buxton and Rice, 1931; Sewell and Guha, 1931; Hrdlička, 1938; Guha and Basu, 1938; Krogman, 1937, 1940; Gupta, Dutta and Basu, 1962; Chatterjee and Kumar, 1963).

This method, as may be recalled once more, necessarily involves in integrating a skull by a simple visual appreciation of its morpho-architectural features, and placing the specimen in some pre-conceived original and pure racial types. The net result is that in most of the ancient human skeletal collections more than one pure such, so-called, racial types and/or their supposed hybrid varieties are believed to have been involved in varying proportions in the composition of a sample. This is, however, simply inconceivable because it lacks conformity to the reality of the natural biological groupings of man. Firstly, the occurrence of such multi-racial types in a human group has been denied and ruled out (Hunt, 1959; Bielicki, 1962; Garn, 1969); and, on the top of it, the existence of human races as valid biological units has been absolutely disregarded (Livingstone, 1962; see discussion in Sen, 1967). And, secondly, this *ad hoc* breakdown of a sample obtained from a single site or locale for selecting "types", disregarding the facts of inherent variability, goes counter to the processes involved in forming natural biological groups. Since, it is known, a group must possess a spectrum of variation, the typologic concept used to classify human variability, which is a naturally occurring phenomenon, simply proves aberrant.

From this brief review, among others, two major problems emerge:

1. The typologic concept is not only untenable but evidently sterile for explaining the variability of prehistoric skeletal sample. In the majority of cases, however, such a sample is seen to be usually composed of the individual remains of males, females, and children. This together with the age structure of such a sample reflects, otherwise, a sample derived from a normal community involuted with continuous spectrum of variation. Obviously, then, there is no room for speculating that such a sample, which, although, can be expected normally to show individual variation to a greater or lesser extent, is the product of selective burial and of multiple "races".

2. Again, in the absence of any knowledge about the breeding fabric, the sample must not be regarded as representing or just equivalent to a "population", or "race", which, we have seen, consists of genetically related members. It evidences, then, that an osteological collection cannot be defined also by using this vital taxonomic racial concept of the populationists.

The chief anthropological problem that is facing us immediately is, how best then can the ancient skeletal remains be defined so as to commensurate with the facts of human biology? Unless this basic problem is resolved no meaningful interpretation with regard to its character and classification is ever possible. While characterization defines the variation within the group, classification refers best to the arrangement of the group in terms of other groups — with a view to understanding relationships as well as the ancestry, too, of the involved group. It appears plausible that if a synthesis of the classical morphological anthropology with the modern population genetics can be brought about then only we may say something of significance.

The problem at issue generates immediately one specific hypothesis in the present case, which may be formulated as follows:

That an osteological material of a site or cemetery includes only individuals who are identifiable purely in terms of homogeneity in external morphological characters. And that this unit of local race represents a community equivalent to a natural biological group — a deme. It may be viewed further that such groups, or units, are expected to differ phenotypically from others. The hypothesis is a testable one, and can be confirmed or rejected by analysing the data such an osteological material contains. In the present case, the largest available material from Harappa — a site in the Indus basin of the Indian subcontinent, has been used to test the hypothesis.

3. THE MATERIAL USED

The human skeletal remains were recovered by excavations at Harappa during 1925—1946. The site is one of the most famous and largest city sites of the Indus Valley Civilization (Vats, 1940; Wheeler, 1947). This archaeological site is a well-known type site of the Harappan culture belonging to the Bronze Age and dated c. 2500—1750 BC. The skeletons were exhumed mainly from three major and varied skeletal material bearing deposits, viz., the Square (Cemetery) R 37, Area G 289, and Area

(Cemetery) H. Out of a total collection of 235 individuals of all ages and sexes, the usable adult skulls were obtained as: 34 (15 males and 19 females) from Cemetery R 37, 10 (7 males and 3 females) from Area G, and 28 (10 males and 18 females) from Cemetery H.

It should be noted that Cemetery R 37 yielded a group of skeletons comprising the remains of altogether 108 individuals whose owners have been indisputably indentified as the real authors of the true Harappan culture (Wheeler, 1947). Cemetery H offered the remains of 104 individuals whose culture had been entirely different from that of Cemetery R 37. Stratigraphically, Cemetery H clearly postdated the R 37 locality. The burials of the above cemeteries were all regular burrials, with the exception of Area G where remains numbering altogether 23 individuals may be attributable to secondary interment (Ghosh, 1962), and of Cemetery H Stratum II where we find urn burials. The pottery discovered in association with the mass of skeletons at Area G was typically Harappan. Other information, including the criteria used for sexing and ageing the specimens, are given in Gupta, Dutta and Basu (1962) and in Dutta (1972).

The statistical analysis of the material was designed on samples from *univariate populations* concerning 21 cranial traits of continuous variation and 12 of discontinuous ones. The choice of the traits was made with a view to examining effectively some principal areas of variation in the skull, following Keith (1927), Morant (1936), and Howells (1957). Martin's technique (Martin and Saller, 1956) was followed in measuring cranial dimensions. Only the cranial part has been used, since the post-cranial material is unsuitable for a proper statistical treatment.

4. RESULTS

4.1. Traits of Continuous Variation

In accordance with the assumption just made, we are naturally interested in asking the question whether the skeletal samples of the three deposits reliably represent a single homogeneous skeletal population as far as the physical characters of skull are concerned? The argument for homogeneity of the entire material is under the assumption that there exists no difference among the three involved samples representing the skeletal populations. The assumption is simply based upon the fact that the deposits which yielded the skeletons were all located within a circuit of about 4.5 km of the ancient city site of Harappa. Accordingly, all the samples were pooled to test the assumption. The pooled material, forming now a single series, can be regarded as statistically homogeneous if there is no persistent tendency for it to differ systematically from a homogeneous population. We can immediately inquire whether the male and female samples of Harappa are homogeneous. This can be resolved in the present investigation by testing whether the Harappan variance estimates are consistently in agreement with corresponding specified hypothetical variances.

For the variance of the hypothetical population of which the Harappa series is assumed to be a sample, we have substituted the variance estimates derived from a larger series of crania so well known as the Egyptian "E". This material was largely used because it is known to be more homogeneous than most of the available series. Karl Pearson, who paid much attention to it, concludes that Egyptian "E" series is reasonably homogenous, and certainly adequately homogeneous for the study of variation (Pearson and Davin, 1924).

The chi-square (χ^2) statistic, $n\acute{s}^2/\sigma^2$ with n-1 degrees of freedom (where $\acute{s}^2$ is the unbiased variance estimate[1]) derived from the sample and σ^2 the hypothesized population variance estimate), was used. The test will analyse the variance homogeneity under the assumption that variance, σ^2, is the population parameter from which the sample comes. According to Rao (1952), this is an exact test of significance in a situation where one is specifically interested to know whether an estimated variance is in agreement with specified hypothetical variance. Heterogeneity in the material would increase the internal variance resulting in high values of χ^2 indicating significance. Since the number of degrees of freedom is small in most cases, that is less than 30, the obtained values of χ^{2+} have been contrasted against the admissible range of χ^{2-} distribution determined for small samples by Neyman and Pearson (1939). If the observed χ^2 is above the lower 5% value or below the upper 5% value, no further test is needed; the hypothesis of agreement can be accepted (Rao, 1952). Where the number exceeded 30, Pearson and Hartley's table (1954) has been compared for significance. This simple but efficient statistic has been employed for the first time in the analysis of cranial material.

It may be noted here that I have already shown elsewhere that the series formed by the material of Cemetery R 37 and Area G (excluding Cemetery H material) is more homogeneous compared to series formed by Cemetery R 37 and H or by Cemetery R 37, Area G and H (Dutta, 1972, 1975).

Table 1 presents the standard deviations of the male and female samples of Harappa and that of the corresponding characters of the Egyptian "E" series for a comparison, together with the results of the test. It could be seen that out of 21 considered for each sex, only three variance estimates relating to the orbital breadth (left), palatal breadth and bigonial breath in the males and 11 concerning the cranial length, basion-bregma height, vertical porion height, vertical transversal arc, horizontal circumference, nasal height, height and breath of both the orbits and mandibular length in the females are high and statistically significant at the 5% level of probability. The value for the vertical porion height is,

[1]) *This is obtained by dividing the corrected sum of squares by the deggrees of freedom.*

Sampling distribution of this only approximates that of χ^2).

TABLE 1

Standard deviations for the pooled Harappa series compared with those of the Egyptian "E" and the χ_2-approximation for the homogeneity of variance — Harappa vs. Egyptian

Variable	Standard deviation				Value of Chi-square with D. F. in parentheses	
	Harappa		Egyptian			
	Male	Female	Male	Female	Male	Female
Maximum cranial length (1)	6.03	7.22	5.72	4.72	31.16 (27)	74.87 (31)§
Maximum cranial breadth (8)	5.40	5.73	4.76	4.52	34.80 (26)	40.20 (24)
Minimum frontal breadth (9)	4.21	4.22	4.05	3.79	27.00 (24)	38.38 (30)
Basion-bregma height (17)	4.15	5.92	5.03	4.37	17.70 (25)	47.73 (25)§
Vertical porion height (21)	2.93	4.68	4.12	3.65	10.62 (20)	42.83 (25)§
Median sagittal arc (25)	12.51	11.99	12.51	10.49	22.02 (21)	28.74 (21)
Vertical transversal arc (24b)	6.83	12.28	9.89	8.84	10.01 (20)	44.36 (22)§
Horizontal circumference (23)	12.91	17.88	13.77	11.76	21.10 (23)	60.12 (25)§
Prosthion basion line (40)	5.10	5.32	4.85	4.08	26.54 (23)	27.20 (15)
Nasion prosthion line (48)	6.71	9.71	4.15	3.76	26.70 (24)	38.58 (24)
Bizygomatic breadth (45)	5.39	4.98	4.57	4.38	18.03 (12)	20.72 (15)
Nasal height (55)	2.80	3.63	2.92	2.60	24.88 (26)	64.19 (32)§
Nasal breadth (54)	2.15	1.83	1.77	1.64	33.54 (25)	39.72 (31)
Orbital breadth (left) (51)	2.20	2.36	1.65	1.57	42.79 (23)§	68.05 (29)§
Orbital breadth (right) (51)	2.30	3.00	1.67	1.56	30.82 (24)	99.14 (32)§
Orbital height (left) (52)	2.28	2.86	1.88	1.89	36.97 (24)	66.61 (28)§
Orbital height (right) (52)	2.30	3.00	1.91	1.84	34.85 (23)	85.15 (31)§
Palatal length (62)	3.53	3.05	3.33	2.96	26.94 (23)	18.05 (16)
Palatal breadth (63)	4.04	2.70	2.63	2.53	61.43 (25)§	20.53 (17)
Bigonial breadth (66)	9.08	5.04	6.37	5.72	26.40 (12)§	4.66 (5)
Mandibular length (68)	5.72	6.41	4.91	4.27	20.39 (14)	22.57 (9)§

NOTE: Harappa series = *Sample formed by pooling the material from Cemetery R37, Area G and Cemetery H; in the parentheses of each variable is the Martin's (1928) number; while cranial parameters are obtained from Pearson and Davin (1924), those for mandible are from Morant (1936).*

§ χ^2 *values are significant at the 5% level of probality. D. F. = Degrees of freedom.*

TABLE 2

Estimated measures of standard deviation of the Harappa cranial characters and the homogeneity of variance between the sexes

Character	Standard deviation ± standard error		Variance ratio (*F*)
	Male	Female	
Maximun cranial length (1)	6.03 ± 0.81	7.22 ± 0.90	1.43
Maximum cranial breadth (8)	5.40 ± 0.73	5.73 ± 0.81	1.12
Nasion inion length (2a)	6.71 ± 0.95	5.40 ± 0.76	1.54
Minimum frontal breadth (9)	4.21 ± 0.60	4.22 ± 0.54	1.00
Basion bregma height (17)	4.15 ± 0.58	5.92 ± 0.84	2.04
Vertical porion height (21)	2.93 ± 0.54	4.68 ± 0.65	2.56§
Median sagittal arc (25)	12.51 ± 1.89	11.99 ± 1.81	1.09
Vertical transversal arc (24b)	6.83 ± 1.05	12.28 ± 1.81	3.23§
Horizontal circumference (23)	12.91 ± 1.86	17.83 ± 2.48	1.92
Prosthion basion line (40)	5.10 ± 0.74	5.32 ± 0.94	1.09
Nasion gnathion line (47)	6.71 ± 1.58	9.71 ± 2.60	2.10
Nasion prosthion line (48)	4.29 ± 0.61	4.67 ± 0.66	1.19
Bizygomatic breadth (45)	5.39 ± 1.06	4.98 ± 0.88	1.17
Nasal height (55)	2.80 ± 0.38	3.63 ± 0.45	1,67
Nasal breadth (54)	2.15 ± 0.30	1.83 ± 0.23	1.39
Interorbital breadth (50)	1.93 ± 0.27	2.22 ± 0.28	1.32
Orbital breadth (left) (51)	2.20 ± 0.32	2.36 ± 0.30	1.51
Orbital breadth (right) (51)	1.85 ± 0.26	2.70 ± 0.33	2.12§
Orbital height (left) (52)	2.28 ± 0.32	2.86 ± 0.38	1.57
Orbital height (right) (52)	2.30 ± 0.33	3.00 ± 0.38	1.70
Maxillo-alveolar length (60)	3.90 ± 0.56	3.32 ± 0.54	1.38
Maxillo-alveolar breadth (61)	4.30 ± 0.65	2.42 ± 0.37	3.17§
Palatal length (62)	3.53 ± 0.51	3.05 ± 0.52	1.70
Palatal breadth (63)	4.04 ± 0.56	2.70 ± 0.45	1.76
Bigonial breadth (66)	9.08 ± 1.78	5.04 ± 1.46	3,29
Mandibular length (68)	5.72 ± 1.04	6.41 ± 1.43	1.26

§ *Variance ratio values are significant at the 2.5 % level of probability.*

however, just on the marginal area of significance. It can be said that only three male and 11 female variables, out of 21 considered, are significantly heterogeneous compared to the corresponding sample variables of the standard homogeneous Egyptian "E" series.

As already noted, the Harappa series has been formed by pooling together three samples from three localities, namely, R 37, Area G, and Cemetery H, supposing that these belong to the same population. One way of testing it is to examine whether there is internal consistency among the males and females of the populations by comparing their variances for each variable. This has been resolved by using the variance ratio test (F) as shown in *Table 2*. It could be seen from the standard deviation values given in Table 2 that female series is more variable than the male, which cannot be easily explained. The absolute differences are, however, not all real in statistical sense, and the differences are only significant in four out of 24 variables. The differences are in the vertical porion height, vertical transversal arc, orbital breadth (right) and maxilloalveolar breadth. Since the values are of the same order of size mostly, it can be inferred that the males and females might have been drawn from the same population. To be specific, we may say that the series can be considered as reasonably homogeneous.

To make the claim valid, a further comparison of the male and female samples of Harappa has next been made by using the most common method. This is the familiar critical ratio test, which is the ratio of the difference between the two corresponding constants to the standard error of the difference and it may be regarded as singificant when its value is greater than or equal to 2. It could be seen from *Table 3* that the female sample is more variable, the differences are only statistically significant for three variables — the vertical porion height, vertical transversal arc and maxilloalveolar breadth, out of 24 comparisons. This shows that the difference is mainly on the head height and in maxilla region. We can infer from this again that the males and females might have been drawn from the same population.

In order to make our claim stronger, I have further analysed the Harappa coefficients of variation with the known homogeneous Egyptian series. *Table 4* presents the coefficients of variation for the Harappa and the Egyptian series and the obtained values of the critical ratios. The 21 comparisons for each sex show that only three coefficients — the vertical porion height, vertical transversal arc and palatal breadth, in the males and eight concerning the cranial length, horizontal circumference, nasal height, orbital breadth and height of both the orbits and mandibular length in the females are statistically significant, that is to say, the Harappa coefficients in these cases are significantly larger than those of the homogeneous Egyptian "E" series.

The result, on the whole, suggests no marked ten-

TABLE 3

Estimated measures of coefficient of variation of the Harappa cranial characters and the homogeneity between the sexes

Character	Coefficient of variation ± standard error		Critical ratio
	Male	Female	
Maximum cranial length (1)	3.24 ± 0.43	4.05 ± 0.51	1.23
Maximum cranial breadth (8)	3.96 ± 0.54	4.36 ± 0.62	0.49
Nasion inion length (2a)	3.89 ± 0.55	3.24 ± 0.46	0.91
Minimum frontal breadth (9)	4.37 ± 0.44	4.58 ± 0.58	0.25
Basion bregma height (17)	3.10 ± 0.43	4.65 ± 0.66	1.96
Vertical porion height (21)	2.54 ± 0.39	4.26 ± 0.59	2.43§
Median sagittal arc (25)	3.33 ± 0.50	3.31 ± 0.50	0.03
Vertical transversal arc (24b)	2.24 ± 0.35	4.13 ± 0.61	2.70§
Horizontal circumference (23)	2.48 ± 0.36	3.57 ± 0.50	1.79
Prosthion basion line (40)	5.15 ± 0.74	5.63 ± 0.99	0.39
Nasion gnathion line (47)	5.47 ± 1.29	8.72 ± 2.33	1.22
Nasion prosthion line (48)	6.20 ± 0.88	7.30 ± 1.03	0.82
Bizygomatic breadth (45)	4.12 ± 0.81	4.10 ± 0.72	0.02
Nasal height (55)	5.43 ± 0.74	7.73 ± 0.95	1.92
Nasal breadth (54)	8.22 ± 1.14	7.43 ± 0.93	0.54
Interorbital breadth (50)	9.69 ± 1.34	12.09 ± 1.51	1.19
Orbital breadth (left) (51)	5.30 ± 0.76	5.90 ± 0.76	0.56
Orbital breadth (right) (51)	4.43 ± 0.63	6.67 ± 0.82	0.20
Orbital height (left) (52)	6.82 ± 0.96	8.65 ± 1.14	1.23
Orbital height (right) (52)	6.93 ± 1.00	9.16 ± 1.14	1.47
Maxillo-alveolar length (60)	6.93 ± 1.00	6.00 ± 0.97	0.67
Maxillo-alveolar breadth (61)	6.66 ± 1.00	3.91 ± 0.60	2.35§
Palatal length (62)	7.46 ± 1.08	6.72 ± 1.15	0.47
Bigonial breadth (66)	10.21 ± 2.00	6.39 ± 1.85	1.40
Mandibular length (68)	6.99 ± 1.28	8.27 ± 1.85	0.57

§ *Values of critical ratio are statistically significant*

TABLE 4

Coefficient of variation for the Harappa series compared with those of the Egyptian "E", and the test of homogeneity — Harappa vs. Egyptian

Variable	Coefficient of variation				Value of critical ratio	
	Harappa		Egyptian			
	Male	Female	Male	Female	Male	Female
Maximum cranial length (1)	3.24	4.05	3.09	2.26	0.34	2.73§
Maximum cranial breadth (8)	3.96	4.36	3.43	3.34	0.98	1.64
Minimum frontal breadth (9)	4.37	4.58	4.28	4.11	0.14	0.80
Basion-bregma height (17)	3.10	4.65	3.75	3.39	1.48	1.88
Vertical porion height (21)	2.54	4.26	3.63	3.32	2.72§	1.57
Median sagittal arc (25)	3.33	3.31	3.36	2.92	0.06	0.77
Vertical transversal arc (24b)	2.24	4.13	3.22	2,98	2.77§	1.87
Horizontal circumference (23)	2.48	3.57	2.65	2.35	0.47	2.44§
Prosthion basion line (40)	5.15	5.63	5.10	4.49	0.40	1.14
Nasion prosthion line (48)	6.20	7.30	5.90	5.64	0.34	1.58
Bizygomatic breadth (45)	4.12	4.10	3.55	3.62	0.70	0.66
Nasal height (55)	5.43	7.73	5.65	5.31	0.29	2.52§
Nasal breadth (54)	8.22	7.43	7.27	6.98	0.83	0.47
Orbital breadth (left) (51)	5.30	5.90	4.06	3.97	1.61	2.51§
Orbital breadth (right) (51)	4.43	6.67	4.06	3.92	0.58	3.32§
Orbital height (left) (52)	6.82	8.65	5.56	5.62	1.30	2.63§
Orbital height (right) (52)	6.93	9.16	5.67	5.50	1.25	3.17§
Palatal length (62)	7.46	6.72	6.70	6.26	0.70	0.39
Palatal breadth (63)	9.97	7.05	6.78	6.83	2.29§	0.18
Bigonial breadth (66)	10.21	6.39	6.80	6.68	1.68	0.15
Mandibular length (68)	6.99	8.27	4.74	4.32	1.73	2.11§

§ *Values of critical ratio are sifnificant statistically*

dency for the Harappa series to deviate systematically from the compared homogenous series. It does not also indicate that the series is, in general, markedly heterogenous than normal ones representing a single cemetery population of a restricted period of time.

A comparison with the nature of variability in the cranial characters as observed in the case of the ancient Jebel Moyans appears imperative and interesting at this stage. The series, excavated from a single cemetery at Jebel Moya in the Southern Sudan and dated first millennium BC, is assumed as sufficiently homogeneous (Mukherjee, Rao and Trevor, 1955). It should be noted that the variance ratio and the critical ratio test of coefficient of variation have expressed statistically significient differences in 19% (3/16) manle and 45% (5/11) female characters of the series in comparison to the same Egyptian "E" material. The Harappa series by critical ratio test has revealed a difference of only 14% (3/21) male and 38% (8/21) female characters. The result of the two series shows that Harappa is more homogeneous than the Jebel Moya. Therefore, I suppose, it would be not just arbitrary in accepting the Harappa series as statistically homogeneous for adequately representing the Bronze Age Harappa population. Rather, it may be observed that the evidence supplied by the data represents the statistical homogeneity of the entire Harappa material.

So far, we have attempted to resolve the question of variance homogeneity in the Harappa material by way of examining the property of the *pooled* cranial population sample in comparison to a standard homogeneous cranial series. In doing so, we have never, necessarilly, concerned integrating the scatter of the variables of the individual samples of the localities as independent and distinct entities. The criteria for pooling the samples have already been discussed.

Still, in another way, the material can be studied in a direct manner by assessing the property of variances of the individual cranial samples of Cemetery R 37, Area G and Cemetery H. We may then look for the kind of evidence that would be able to relegate itself the question of homogeneity of the material. The exact test needed for such an investigation — that is, testing the equality of variances in the k distinct samples, is due to Bartlett (1937; Cf. Talbot and Mulhall, 1962). We are particularly interested here in asking the question whether the variances in the three Harappan cranial populations from which the three samples are drawn can be regarded equal. In other words, can the different sample variances of the Harappa material be regarded just independent estimates of a common population variance, σ^2, so that the hypothesis of homogeneity can be considered valid?

Table 5 presents the estimates of standard deviations for the male samples only of the three depo-

TABLE 5

19 variable and χ^2-approximation (due to Bartlett) for the homogeneity of variance among the three male Harappa samples, degrees of freedom 2

Variable	Standard deviation and chi-square			
	R 37	G	H	Value of *M*
Maximum cranial length (1)	3.93	7.01	5.79	3.30
Maximum cranial breadth (8)	3.11	4.90	6.22	4.19
Minimum frontal breadth (9)	2.89	5.78	3.17	4.47
Basion-bregma height (17)	4.81	5.07	1.57	7.51§
Median sagittal arc (25)	12.44	16.16	6.97	2.70
Horizontal circumference (23)	9.93	10.81	12.17	0.28
Prosthion basion line (40)	4.76	2.44	4.64	2.58
Nasion prosthion line (48)	4.15	2.96	4.87	1.27
Bizygomatic breadth (45)	6.46	4.09	2.89	1.81
Nasal height (55)	3.11	2.08	3.03	1.21
Nasal breadth (54)	2.45	1.60	2.25	1.24
Orbital breadth (left) (51)	1.90	2.11	2.57	0.65
Orbital breadth (right) (51)	1.65	1.87	2.14	0.53
Orbital height (left) (52)	2.43	1.77	2.27	0.72
Orbital height (right) (52)	2.73	1.11	1.80	5.16
Palatal length (62)	3.66	4.38	2.53	1.64
Palatal breadth (63)	8.36	3.82	4.49	0.40
Bigonial breadth (66)	8.00	5.29	11.80	1.47
Mandibular length (68)	5.05	6.12	4.75	0.27

No value of M is significant at the 5 % point of χ^2 - distribution.
§ Significant at the 2.5 % point

sits. The results of Barlett's χ^2 — approximation (M) have also been provided therein. Unfortunately, the corresponding female samples could not be subject to this test due to the very limited observations available pertaining to each variable of the Area G sample. The statistical significance may now be obtained by entering the critical values of M at the 5% point of the χ^2 — distribution with k—1 degrees of freedom. It may be seen that out of 19 male variables, only a solitary character relating to vault height, the basion-bregma height, differs significantly — the value of M being 7.514 exceeds the 2.5% level with 2 degrees of freedom. Since the values of M for the remaining 18 characters are smaller than the required level of probability for significance, the hypothesis of homogeneity of variance for the males is therefore acceptable. This, in fact just leads us to conclude that the entire cranial population material is statistically homogeneous for adequately representing the parent population, the Bronze Age Harappans.

However, we know that even if samples are drawn at random from a perfectly homogeneous population, their character mean values can never be just identical. This is owing to the reason that the means of the multiple samples must also reflect

TABLE 6

19 variables and the analysis of variance

Variable	Mean value			D. F.	Value of *F*
	R 37	G	H		
Maximum cranial length (1)	187.54	180.79	188.44	2,25	4.69§
Maximum cranial breadth (8)	133.32	138.00	141.33	2,24	7.68§§
Minimum frontal breadth (9)	95.17	98.50	96.08	2,22	1.45
Basion-bregma height (17)	133.79	133.50	134.86	2,23	0.20
Median sagittal arc (25)	375.27	372.67	381.80	2,19	0.75
Horizontal circumference (23)	520.00	512.29	533.00	2,21	6.08§§
Prosthion basion line (40)	102.05	94.75	98.29	2,21	5.81§§
Nasion prosthion line (48)	70.62	66.58	68.93	2,22	1.93
Bizygomatic breadth (45)	131.25	127.88	134.33	2,10	1.32
Nasal height (55)	51.96	50.71	51.75	2,24	0.44
Nasal breadth (54)	26.68	25.71	25.88	2,23	0.52
Orbital breadth (left) (51)	42.36	40.57	41.00	2,21	1.73
Orbital breadth (right) (51)	42.32	41.14	41.57	2,22	0.92
Orbital height (left) (52)	33.92	32.14	33.92	2,22	1.59
Orbital height (right) (52)	34.18	31.86	32.92	2,21	2.53
Palatal length (62)	48.18	47.00	46.14	2,21	0.72
Palatal breadth (63)	40.00	42.71	39.31	2,23	1.54
Bigonial breadth (66)	91.75	91.00	83.13	2,10	2.23
Mandibular length (68)	82.17	78.50	85.63	2,12	1.98

§§ Values are significant at the 1 % point of F-distribution
§ Value is significant at the 2.5 % point

TABLE 7a

Trait		Cemetery R 37 + Area G			Cemetery H			Both localities		
		♂	♀	♂ + ♀	♂	♀	♂ + ♀	♂	♀	♂ + ♀
(a) Shape of calvaria										
Ellipsoid	f	6	8	14	1	6	7	7	14	21
	%	29	38	33	20	38	33	27	38	33
Pentagonoid/Ovoid	f	6	7	13	4	5	9	10	12	22
	%	29	33	31	80	31	43	38	32	35
Sphenoid/Byrsoid	f	9	6	15	—	5	5	9	11	20
	%	42	29	36		31	24	35	30	32
Total	f	21	21	42	5	16	21	26	37	63
(b) Shape of forehead										
Vertical	f	5	10	15	—	10	10	5	20	25
	%	24	45	35		63	45	19	53	38
Receding	f	16	12	21	6	6	12	22	18	40
	%	76	55	65	100	37	55	81	47	62
Total	f	21	22	43	6	16	22	27	38	65
(c) Occipital protuberance										
Round	f	6	6	12	6	6	12	12	12	24
	%	30	37	33	67	35	46	41	36	39
Protruding	f	14	10	24	3	11	14	17	21	38
	%	70	63	67	33	65	54	59	64	61
Total	f	20	16	36	9	17	26	29	33	62
(d) Shape of occiput										
Wedge shape	f	2	4	6	1	1	2	3	5	8
	%	10	22	16	17	7	10	11	15	14
House shape	f	18	14	32	5	14	19	33	28	51
	%	90	78	84	83	93	90	89	85	86
Total	f	20	18	38	6	15	21	26	33	59
(e) Supraorbital ridges										
Absent	f	1	7	8	—	8	8	1	15	16
	%	8	30	22	—	57	40	5	41	29
Slight	f	5	11	16	1	5	6	6	16	22
	%	38	48	45	17	36	30	32	43	39
Marked	f	7	5	12	5	1	6	12	6	18
	%	54	22	33	83	7	20	63	16	32
Total	f	13	23	36	6	14	20	19	37	56
(f) Shape of nose										
Straight	f	4	4	8	—	4	4	4	8	12
	%	24	29	26	—	40	33	21	33	28
Concave	f	13	10	23	2	6	8	15	16	31
	%	76	71	74	100	60	67	79	67	72
Total	f	17	14	31	2	10	12	19	24	43

TABLE 7b

		Cemetery R 37 + Area G			Cemetery H			All deposits		
		♂	♀	♂ + ♀	♂	♀	♂ + ♀	♂	♀	♂ + ♀
(*g*) *Shape of nasal bone*										
Constricted	f	8	8	16	4	—	4	12	8	20
	%	44	57	50	100	—	36	55	38	47
Wing shaped	f	10	6	16	—	7	7	10	13	23
	%	56	43	50	—	100	64	45	62	53
Total	f	18	14	32	4	7	11	22	21	43
(*h*) *Margo piriformis inferior*										
Amblykraspedotic	f	6	1	7	1	2	3	7	3	10
	%	32	5	18	17	33	25	28	11	20
Oxykraspedotic	f	13	18	31	5	4	9	18	22	40
	%	68	90	79	83	67	75	72	85	78
Orygmokraspedotic	f	—	1	1	—	—	—	—	1	1
	%	—	5	2	—	—	—	—	4	2
Total	f	19	20	39	6	6	12	25	26	51
(*i*) *Nasal root depression*										
Absent	f	4	3	7	—	6	6	4	9	13
	%	20	38	25	—	38	26	15	38	25
Shallow	f	5	4	9	3	8	11	8	12	20
	%	25	50	32	43	50	48	30	50	39
Marked	f	11	1	12	4	2	6	15	3	18
	%	55	12	43	57	12	26	55	12	37
Total	f	20	8	28	7	16	23	27	24	51
(*j*) *Subnasal prognathism*										
Absent/slight	f	5	2	7	8	13	21	13	15	28
	%	29	33	30	89	93	91	50	75	61
Medium/marked	f	12	4	16	1	1	2	13	5	18
	%	71	67	70	11	7	9	50	25	39
Total	f	17	6	23	9	14	23	26	20	46
(*k*) *Shape of dental arc*										
Upsiloid	f	5	7	12	4	2	6	9	9	18
	%	25	41	42	57	40	46	33	39	36
Paraboloid	f	15	10	25	3	4	7	18	14	32
	%	75	59	68	43	60	54	67	61	64
Total	f	20	17	37	7	6	13	27	23	50
(*i*) *Arcus zygomaticus*										
Phaenozygous	f	14	8	22	6	3	9	20	11	31
	%	78	44	61	100	43	69	83	44	63
Orthozygous	f	4	4	8	—	3	3	4	7	11
	%	22	22	22	—	43	23	17	28	23
Cryptozygous	f	—	6	6	—	1	1	—	7	7
	%	—	33	17	—	14	8	—	28	14
Total	f	18	18	36	6	6	12	24	25	49

the variance in the parent population (M o r o n e y, 1962). The only thing that we should rather expect here is that the variation between sample means be commensurate with the population variance as indicated by the variation within the individual samples. Now, if the variation of the "between samples" happens to significantly exceed the variation of the "within samples", then there is ground to suspect that the samples were not drawn actually from the same population, but from populations which had had different means. In view of the above, it is therefore necessary to reduce the total variation of the material to components associated with the possible sources of variability for testing the hypothesis that the samples are only parts derived from a common population. The most elegant, powerful and exact technique of analysis of variance has been applied to the data for this purpose. The results of the analysis of variance for the males alone are set out in *Table 6*. The female sample again could not be put to test due to inadequate sample size of the Area G material.

It may be seen that for the four out of 19 variables, namely, cranial length, cranial breadth, horizontal circumference and prosthion-basion line, the "between samples" variation is significantly greater than the "within samples" variation. This indicates that there is an additional and specific between sample" effect beyond the expectation, which makes the hypothesis untenable, as far as the above four characters are concerned. Taking into account the number of degrees of freedom, the critical values of the variance ratios (F) show significant differences at the 2.5 and 1% level of F-distribution (L i n d l e y and M i l l e r, 1962). However, it may be noted that the difference in the horizontal circumference is expected for its high correlation with the length and breadth skull dimensions. For the remaining 15 male variables the two estimates connected with the possible sources of variation are not found to differ more than what is to be expected. The critical values of F for these characters are well below the required level of probability (5%) yielding nonsignificant results.

Thus, it is seen that only three, of about 15%, characters relating to male skulls exhibit differentiation, leaving out the difference in the horizontal circumference for being highly correlated. For the overwhelming majority of characters, however, there is absolutely no evidence against the hypothesis. It should be noted that the characters differing are undoubtedly most important, anthropologically, for discrimination. But, at the same time, it must be borne in mind that the possibility of sampling error as a cousative agent for such differentiations cannot be ruled out. Therefore, weighing the facts just presented, the conclusion would be that there is, in general, no convincing evidence available that differences do exist between the three male samples in regard to character means. Nothing is, of course, known about the female samples.

The above analysis clearly marks off again that the various samples discovered at Harappa are more or less consistent. This, evidently, leads us to conclude that the entire cranial population material is statistically homogeneous for adequately representing the parent population, the Bronze Age Harappans.

4.2. Traits of Discontinous Variation

Now, some of the non-metrical discontinuous characters may be examined in order to assess the internal consistency. Twelve commonly used traits have been considered. We are interested here to test whether the discrepancies between the observed and expected frequencies of traits with regard to cemetery and sex can reasonably be ascribed to sampling fluctuations. This has been tested by χ^2 statistic. If the critical values of χ^2 indicate that the situation is such, then the observed distribution can be regarded consonant with the hypothesis that the samples are internally consistent with regard to the distribution of the traits.

Due to inadequate number of observations available for Area G, the samples of Cemetery R 37 and Area G are pooled. In some instances, two categories, or forms, had to be pooled for the sake of fair sample size. The categories thus merged generally possess nearly similar features. In spite of this, no statistical treatment could be made possible for three traits — the shape of occiput, margo piriformis inferior, and arcus zygomaticus.

The distribution of the traits is summarised in *Table 7a and 7b*. It must be stressed that the material available is by no means adequate for the fruitful investigation of our problem. The analysis, therefore, has to be accepted as an inadequate indication. This is particularly true for the distribution of traits for the male and female samples investigated separately and depositewise.

For the male samples, the distribution of the occipital protuberance does not show any significant difference by cemetery *(Table 8.)* For the females, the distributions of the shape of calvarium, forehead and occipital protuberance show that there is again no differences by cemetery. The analysis has, of course, yielded that significant statistical differences in the incidences between the male and female cranial populations of all localities do not exist for 75% traits, or 6 out of 8. Sex difference could be found for only two characters: the shape of forehead and the nasal root depression, the former is again considered as a sex marker. The finding is generally in agreement with that of B e r r y and B e r r y (1967) who, with a set of epigenetical non-metric variants, also found no distinction between the sexes in regard to most characters.

Cemetery-wise distributional pattern for eight traits, out of 12, could be tested for differences between the samples constituted by the male and female groups. It evidences that for seven characters or 88% of the total, there is no difference in the distribution of the traits of samples by cemetery *(Table 8)*.

From the information supplied by the data, it generally appears that there exist differences neither between the sexes nor between the cranial population samples of the localities in regard to the inci-

TABLE 8

Four types of distribution of the discontinuous traits in Harappa skulls and χ^2 test of homogeneity (degrees of freedom shown in parenthesis)

Trait	On the basis of frequency distribution as in Table 7 a & b			
	B Cemetery (R 37 + G) and Cemetery H			By sex, all localities
	Males only	Females only	Males + Females	
Shape of calvaria		0.043 (1)	1.198 (2)	0.823 (2)
Shape of forehead		1.080 (1)	0.687 (1)	7.761*(1)
Supraorbital ridges			2.158 (2)	
Occipital protuberance	3.440 (1)	0.017 (1)	1.046 (1)	0.164 (1)
Shape of nose				0.795 (1)
Shape of nasal bones			0.612 (1)	1.169 (1)
Depression at nasal root			1.806 (2)	10.579*(1)
Subnasal prognathism			17.888*(1)	2.966 (1)
Shape of dental arc			0.762 (1)	0.181 (1)

* *Significant at 5 % level of probability*

dences for most of the traits. This has also been indicated earlier elsewhere (D u t t a, 1974). Evidently, then, there is parhaps nothing to deny the homogeneity of the non-metrical discontinuous variations, on the whole, which, in turn, presupposes the homogeneity in the composition of the entire cranial material. This is in conformity to the hypothesis of homogeneity. In short, it may be stressed that there is no adequate indication of any marked incompatibility between the information supplied by the traits of continuous variation and that supplied by discrete, or discontinuous, ones.

5. DISCUSSION AND CONCLUSION

On the basis of the foregoing analytical and emperical evidence, there can be no doubt as to the statistical consistency and homogeneity in the involved physical characters of the Harappa skulls. It should be recalled here, once more, that the remains were obtained from three major and varied skeletal material bearing localities of the ancient city site of Harappa in the Indus basin. The internal consistency is found to be more convincing if we particularly examine the evidence exposed by the traits of continuous variation. These traits are mostly exclusive and fairly cover the principal areas of variation in skull. In the absence of rather obvious differences in separate characters independently — that is to say, in the samples of univariate populations, there is adequate ground for realisation that the owners of the skeletons, rather the skulls, could have belonged to a community representing the Bronze Age Harappan race. In terms of the theory of probability, the possibility of this assumption as valid is inescapably high and cannot be ignored. At least, there is no evidence to suggest that the three samples — Cemetery R 37, Area G and Cemetery H, could have arisen from different populations. But this, however, does not absolutely rule out the possibility that the people represented by skeletons of Cemetery H and Area G could not have been different from those represented by the Cemetery R 37 skeletons. The analysis have merely shown that evidence is lacking for such differences.

Under the given situation, the evidence of internal consistency, which by its own right presupposes the homogeneity of the samples, must be regarded to be a competent arbiter for classifying all the specimens into a "race" in terms of what may be referred to as the concept of morphological taxonomy. The entire material, which can be considered a unit sample, deserves to be viewed as possessing a continuous spectrum of variation. It follows, therefore, that there is no scope to indulge in classifying the variability of the sample on *ad hoc* basis in order to select "types", or "races", in terms of the method pleaded by the typologisits. Since the sample of Cemetery R 37, taken as chronological line for representing the true Harappa people, is consistent with the other two samples, the ethnic identity of the entire cranial series may, therefore, be established as Harappan.

It must be made clear that by thus accepting the so-called Harappan race nothing more is intended to convey in the sence which, under the genetical concept of race, corresponds to the structure of a natural biological population. Biologically speaking, populations having different gene pools are considered to be separate races. And it should be stressed that parentage alone, and nothing else, is the sole determinant in attributing individuals to such a group (L a u g h l i n, 1960). The morphological homogeneity, which we have had to depend upon for classification, is clearly an inadequate indicator for parentage and stigmatizes no genetic significance in reality. But since we are dealing with chance osteological finds discovered at a prehistoric site, and our purpose is how best can we utilise them, it would appear that the material can never be interpreted meaningfully commensurate with the natural biological groupings of man unless we could assume this race of the Harappans as biologically related and referable to a group of local, or breeding, population — rather a deme, on the basis of morphological homogeneity.

It is, therefore, pragmatical to conceive a new concept of race in order to interpret a given ancient osteological material. The analysis of the cranial material from Harappa demonstrates that a "race" may be defined, in the palaeoanthropological sense, and as an operationally effective research tool, as a natural biological unit, the membership of which is dependent solely upon the morphological homogeneity of the individual skeletal specimens obtained from a single locality.

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