THE PHYSICAL CHARACTERS OF THE SANDAWE

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Introduction

The Sandawe are a tribe, some 21,000 strong, inhabiting part of the Kondoa Irangi District between the Bubu and the Mpondwe Rivers in the Central Province of Tanganyika. Their approximate geographical position is 5° 30′ S. and 35° 30′ E., and the area they occupy is included in what German authors have called the *abflussloses Gebiet Deutsch-Ostafrikas* (cf. Obst., 1915). They early came to the notice of Colonial explorers (Baumann, 1894; Werther, 1898), and, by reason of the presence of clicks in their language, which has connexions with Nama Hottentot, they have since received a certain amount of attention from students of linguistics (Nigmann, 1909; Trombetti, 1910; Dempwolff, 1916) as well as from administrators and missionaries (Bagshawe, 1924; Kimmenade, 1936).* No detailed ethnographical study of them has yet been undertaken, although the writings of von Luschan (1898), Reche (1914), Dempwolff and van de Kimmenade are important in this respect. Linguistic evidence apart, many who are personally acquainted with the tribe have commented on the comparatively light skin colour of its members, and, noting the occurrence of rock-paintings in their country (Kohl-Larsen, 1938, 1943), the veneration in which they hold the mantis, etc., have suggested a relationship between them and the remotely situated Bushmen and Hottentots.

In July 1944, I was able to spend a short period of leave from my military duties in East Africa among the Sandawe, and I devoted it to what was of necessity a cursory investigation of their physical characters.† My original intention was to collect skeletal remains, since only fourteen Sandawe skulls had ever been taken to Europe (Virchow, 1895; Ried, 1915) and these were clearly inadequate for the establishment of any far-reaching conclusions as to racial affinities. After some days of fruitless excavation, however, it became evident that such an object could not be achieved in the short time at my disposal and that what remained of this could most profitably be applied to somatoscopy and somatometry. Thanks to the loan of instruments and other equipment from Dr. L. S. B. Leakey in Nairobi, and to the facilities accorded me by the administrative and tribal authorities, particularly Mr. G. D. Poppelwell, then District Commissioner, Kondoa Irangi, and Mwanangwa Alphonse Inde, I succeeded in measuring a hundred adult male Sandawe, fifty adult male Nyaturu (a neighbouring tribe of Bantu-speakers), and twenty-five adult male F_1 crosses between the two.‡ I further obtained the statures of twenty-five Sandawe women, other observations on them being made by my wife, who also did all the weighing and acted as recorder. The work was carried out at Kwa Mtoro, the tribal headquarters, in the last week of July, and its accomplishment is largely due to the hospitality and assistance rendered to us in

* Père van de Kimmenade, C.S.Sp., now resident in Kenya, has compiled a Sandawe dictionary, but another authority, Père Lemblé, also of the Holy Ghost Fathers and still (as far as is known) working in Tanganyika, seems never to have made available his intimate knowledge of the language.

† I wish to record my gratitude for grants of £40 and £10, made at the instance of Professor J. H. Hutton, from the Anthony Wilkin Fund and the University Museum of Archaeology and Ethnology, Cambridge, respectively. These sums were expended on motor transport in Tanganyika, which was essential for the speedy completion of the field work, and on the collection of specimens illustrating the material culture of the Sandawe, now preserved in the Museum.

‡ The Sandawe-Nyaturu sample will be discussed elsewhere. Six male and seven female Nyaturu were measured during Obst's expedition in 1911 (Ried, 1915), but never previous to 1944, I believe, any living Sandawe of either sex.

various ways by Mrs. M. L. Reiner, by the fathers and sisters of the Passionist Mission at Kurio and by Sandawe chiefs and elders.

Despite the hazards of such an undertaking among a people heedless of birthdays, an attempt was made to estimate the age of each person examined, both by visual appreciation and with reference to the few fixed points in recent local chronology, *e.g.*, the arrival at and departure from Kwa Mtoro of " Bwana Ringe " (a German non-commissioned officer named Linke) and the outbreak and end of the 1914–1918 war. In 1944 many of the younger men, Sandawe and Nyaturu living in Usandawe, were either in the armed forces or had temporarily left the area to seek employment elsewhere as a result of the famine of the preceding two years. The means of the estimated ages of the adult males, Sandawe 46·65 and Nyaturu 47·90, are rather high when compared with that of the Sandawe women, 28·00; but no decrepit, or for that matter immature, individual was included in any of the series.

I owe the remarks on the traditional origin of the Sandawe that follow to Alphonse Inde. They are a résumé of an account he gave to me in Swahili and were corroborated by Mahomadi Mketi and Clemens Ndelima, who, like him, hold positions of responsibility in Usandawe.

The Sandawe entered the country which they now inhabit about a century ago, most of it being then unoccupied. They came from a region called Mambaka in south-western Usandawe near Ugogo, where a few still live. The original Sandawe were lighter in skin colour than are those of today.* They were at one time hunters, without stock or agriculture, but they collected and ate wild honey as well as edible roots.

Some five hundred years ago they met Nyaturu and Tatoga† with cattle (*humbu*, a corruption of the Nyaturu *ng'ombe*). These the Sandawe at first took to be wild beasts and wished to hunt but did not do so when it was seen that they were tended by humans. The Sandawe were taught stock-keeping by the Nyaturu and the Tatoga, from whom they acquired cattle,sheep and goats in exchange for their women. The bridewealth was four cattle (five in the case of a virgin) and eight sheep or goats. A sheep or a goat was eaten at the marriage feast. The Nyaturu also instructed the Sandawe in husbandry, as the Tatoga were then purely pastoral.

About four hundred and fifty years ago, after the Sandawe had almost abandoned hunting, there was a severe famine, caused by failure of the rains. Perhaps half the tribe, which was smaller than it is now, left Usandawe, never to be heard of again. Those remaining had their stock stolen by the Nyaturu and the Tatoga, and they began once more to hunt and to collect honey. The famine lasted seven years, in the course of which some Sandawe became serfs to the Nyaturu. Others, at the end of it, returned to agriculture. There have been three subsequent famines, the first, due to locusts, fifty years ago, the second at the end of the 1914–1918 war, and the third in 1942–43.

Over fifty Sandawe clans (*boyo*) exist, some of which take their names from nearby hills. In the early days there were not chiefs but only clan councils. The Alagwa clan of Tatoga origin were rainmakers. The Elewa were half Gogo. The Bisa are a Sandawe clan speaking a language allied to Ngomvia. It is not certain who made the rock-paintings in Usandawe but " people say the Portuguese."‡

In addition to the male Nyaturu, the four series described below are used for comparative purposes in the present study :—

Southern Bushmen (Dart, 1937*b*). Twenty adult male and twenty-one adult female /ˀauni-≠khomani. Measurements and a number of other observations were made on these and on thirty-six immature individuals by Professor Raymond A. Dart and three assistants. In a previous paper, Dart (1937*a*) states that the /ˀauni- and ≠khomani-speakers " represent the relics of the Southern Bushmen once spread from the Kalahari to the Cape, those generally acknowledged to be the purest of the Bushman type," and he adds that, as far as can be determined, his total of seventy-seven " are the purest group of Bushmen now extant in the Union of South Africa."

Northern Bushmen (Seiner, 1912 ; Lebzelter, 1931). A composite series of adult male !khũ (Kung). Records of the weight, stature, sitting height, span and skin colour of between thirty-three and seventy-four males (as well as of eighteen females, whose stature and skin colour alone will now be considered) were obtained by Seiner, and those of the stature and head measurements of fifty-eight males of the same tribe by Lebzelter.

Hottentots (Schultze, 1928). Seventy-four adult males, all of whom, apart from two Griquas, belong to the Nama or Namaqua division of the Hottentots, measured by Professor Leonhard Schultze (Schultze Jena). Schultze also gives the mean and frequency distribution for stature of twenty-eight female Naman, twelve measured by himself and sixteen by other observers.

Dahomeans (Herskovits, 1937). Ninety-three adult male subjects from Dahomey measured by Professor Melville J. Herskovits, who furnishes means and

* Shown a photograph of a Bushman with "peppercorn" hair, the informant declared that this was the ancestral type. At present it is unpopular and when it occurs is often shaved off !

† The Tatoga, Taturu or Mangati, who speak a Nandi dialect, are among the southernmost Nilo-Hamites. The Sandawe still refer to them as Taturu, but Tatoga is the more correct name, Mangati or " enemies " being an opprobrious term applied by the Masai.

‡ In East Africa, many local *miracula* are attributed to the Portuguese, the first Europeans generally known there.

standard deviations for metrical characters and for percentages of skin pigmentation taken with the colour-top.

To represent the " true " or Guinean Negro as opposed to the " Khoisaniform " Bushmen and Hottentots and the ostensibly Negroid " Zingian " Nyaturu,* I have chosen the Dahomean from several available West African series, on account both of its size and of my own experience of Herskovits's skill as an anthropometrician. A complaint which will recur explicitly or otherwise throughout this study concerns the all-too-familiar difficulty of trying to decide how measurements of different observers were taken (Mahalanobis, 1928 ; Tildesley, 1928, 1933).

Non-Metrical Features†

The Sandawe were reluctant to part with their scalp hair, and only twenty-five specimens of this (still to be examined microscopically) were secured. Several instances of tufted hair approaching the " peppercorn " condition were noted, but the fineness of the gradations between it and the more common " fleecy " type did not encourage an attempt to separate them. Of the males, eighteen Sandawe and six Nyaturu had grey or greying scalp hair, but none of the Sandawe women was in any way grizzled. In regard to body hair, except for that in the axillary and pubic regions where, even allowing for depilation, it is also scant, the Sandawe men were extremely glabrous. Only five of the hundred had a " slight " development of this, as against eleven with a " slight " and one with a " moderate " amount among the fifty Nyaturu. The body hair of the remaining ninety-five male Sandawe and thirty-eight Nyaturu was so sparse that it could be regarded as virtually absent. Application of the χ^2 test to these figures gives $\chi^2 = 12$ for one degree of freedom ($P < \cdot 001$). Thus the Nyaturu, though far from hirsute, are significantly more so than the Sandawe.

Unfortunately the familiar pigmentation scales could not be procured in East Africa during the war, and a makeshift all-purpose one of ten grades, produced in the field with the aid of a box of ordinary water-colour paints, was used in their stead. Table I shows the values for hair colour of the combined male and female Sandawe and the male Nyaturu samples, arrived at by standardizing the field scale with the Fischer-Saller *Haarfarbentafel* after the exclusion of grey and shaven individuals. There is no significant difference between the two distributions of hair colour thus classified. While nearly all the subjects fall within the categories W (black-brown) and X (black), it is of interest to note that the single Nyaturu with the so-called " deepest blue-black " (Martin, 1929, p. 34) value of Y was also unique in having wavy rather than spiralled hair.

Table I. *Hair Colours of Sandawe and Nyaturu*

Fischer-Saller Category	Sandawe ♂ + ♀	Nyaturu ♂
W	7 (6·5%)	2 (5·4%)
X	99 (92·5%)	34 (91·9%)
Y	1 (0·9%)	1 (2·7%)
Totals	107 (99·9%)	37 (100·0%)

Standardization of the field scale with Felix von Luschan's *Hautfarbentafel* did not prove altogether successful, but it may be taken that in the male and female Sandawe, separate and combined, and the male Nyaturu, the mode for skin colour, matched on the unexposed surface of the left upper arm, was about von Luschan 25. For a comparison of my results

* To explain the classification and nomenclature employed here, it should be said that I agree with Gates (1944) in dividing contemporary mankind into five major groups—for which Australiform, Caucasiform, Khoisaniform, Mongoliform and Negriform may be suggested as suitable designations —but differ from him in attributing subspecific or varietal rather than specific rank to them. To quote Mayr (1949), " the essence of the species concept is the non-interbreeding of a population with other populations, a phenomenon which can be tested only when such populations are in contact," this point of view being implicit in a previous study of human crosses (Trevor, 1938). I am also in sympathy with some recent mammalogists, ornithologists and ichthyologists in regarding " race " as a lesser category than subspecies or variety, a practice which Hubbs (1943) feels will come to be widely adopted in vertebrate zoology. My " Negriform " embraces the African Negroes and Negrillos, the Asiastic Negritos and the Oceanic pygmies, Papuans, Melanesians and Tasmanians. " Negroid " I use as a convenient adjective for the various branches of the (African) Negro race, provisionally termed Congolians, Guineans, Nilotes, Sudanians and Zingians. To avoid the equivocal " Bantu," " Zingian," proposed by Wood (1868–70, I, p. 1) among others, corresponds to the *sous-race sud-africaine* of Vallois (1944) and the " South African Negro " of the Witwatersrand School. The restriction of the suffix "—oid " to the *grand' races* or varieties as advocated by Montandon (1933) is unlikely to be adhered to consistently in practice, *e.g.*, " Melanesioid." At present there is perhaps but one Khoisaniform race, which, following Schultze (1928), may be called " K(h)oisan," although this word is currently applied to Bushmen and Hottentots in a linguistic and cultural as well as a physical sense.

† I should like to acknowledge to the full the generous advice and assistance given to me by this *Journal's* Associate Editor for Physical Anthropology, Miss Miriam L. Tildesley, M.B.E., particularly in suggesting the treatment of part of the data discussed in the present section and in checking and revising the calculations in the next one.

with those of investigators on the Bushmen, viz., Dart and Seiner, it seemed that the only practical expedient was to consider three broad classes of skin colour, (i) yellowish- and reddish- to light-brown, (ii) medium brown, and (iii) chocolate and darker brown, the first comprising von Luschan 6 and 15–20, the second von Luschan 21–25 and the third von Luschan 26–32. This has been done in Table II. If the χ^2 test is applied to the Sandawe and Nyaturu distributions in the table, $\chi^2 = 3\cdot99$ for $P > \cdot10$, showing no significant difference between them. It is obvious, however, that both distributions differ significantly from those of the two Bushman series, as do these from each other. While the Northern Bushmen are almost all medium brown, the Southern Bushmen have both more of the dark and many more of the lighter skins than they. The Sandawe and the Nyaturu are less homogeneous than the Northern Bushmen in that they include more dark-skinned, and more homogeneous than the Southern Bushmen in not also having a large proportion of lighter-skinned, subjects.

Table II. *Skin Colours of Bushmen, Sandawe and Nyaturu*

Von Luschan Categories	Southern Bushmen ♂ + ♀	Northern Bushmen ♂ + ♀	Sandawe ♂ + ♀	Nyaturu ♂
6, 15–20	41 (53·2%)	5 (5·7%)	11 (8·8%)	2 (4·0%)
21–25	20 (26·0%)	82 (93·2%)	92 (73·6%)	33 (66·0%)
26–32	16 (20·8%)	1 (1·1%)	22 (17·6%)	15 (30·0%)
Totals	77 (100·0%)	88 (100·0%)	125 (100·0%)	50 (100·0%)

The field scale, unsuitable as it seems at first blush for the recording of eye colour, can nevertheless be used to obtain a fair approximation of the lightness or darkness of the iris among the Sandawe and the Nyaturu, since, with a single exception, this was always brown. The exception was a male Sandawe whose eyes were greenish and unlike any grade in the field scale. The eyes of the other individuals examined fell into five divisions, the first of which may be equated with Category 2 (deep dark brown), the second and third with Category 3 (dark brown), and the fourth and fifth with Category 4 (brown) of the *Augenfarbentafel* of Rudolf Martin. There were none in Martin's Category 1 (black-brown). In order to compare the combined male and female Sandawe and the male Nyaturu with the combined male and female Southern Bushmen, the eye colours of the few subjects in Dart's total series having the intermediate values of Martin 1–2, 2–3, and 3–4 have been assigned, half to the "whole number" categories immediately above and half to those immediately below them in Table III. The Sandawe and the Nyaturu distributions in this table not only differ to a marked degree from that of the Southern Bushmen but also from each other ($P > \cdot 01$). In so far as the distributions can be relied upon, they indicate that the Sandawe have the lightest and the Southern Bushmen the darkest eyes, the Nyaturu eye colour, too, being appreciably lighter than the Southern Bushman. It must be added, however, that tests have shown the lack of consistency with which classification by the Martin and other eye-colour scales is repeated, even by the same observer and still more by different observers (Grieve and Morant, 1946, and unpublished data from Tildesley). One must therefore accept the above conclusions with reserve. As for hair and skin colour, though these presumably offer less scope for observational variability and bias, estimates of the latter have yet to be obtained.

Table III. *Eye Colours of Southern Bushmen, Sandawe and Nyaturu*

Martin Category	Southern Bushmen ♂ + ♀	Sandawe ♂ + ♀	Nyaturu ♂
1	15 (19·7%)	0 (0·0%)	0 (0·0%)
2	26 (33·6%)	15 (12·1%)	16 (32·0%)
3	31 (41·4%)	99 (79·8%)	32 (64·0%)
4	4 (5·3%)	10 (8·1%)	2 (4·0%)
Totals ...	76 (100·0%)	124 (100·0%)	50 (100·0%)

Since the "lobelessness" of Bushman and Hottentot ears has often been commented on, the frequency of this condition was noted for ninety-nine male Sandawe and fifty Nyaturu, the ears of the hundredth Sandawe man being so mutilated as to make exact observation impossible. Nine Sandawe and eleven Nyaturu had ears which lacked any definite lobe. In twenty-one of the Sandawe and twelve of the Nyaturu, the ear-lobes were "sessile" or attached directly to the base, and in sixty-nine of the Sandawe and twenty-seven of the Nyaturu they hung free. These distributions give $\chi^2 = 5 \cdot 51$ for two degrees of freedom ($P > \cdot 05$). They cannot therefore be considered significantly different.

To sum up the evidence derived from comparisons of non-metrical characters between the Sandawe and the Nysturu samples, they exhibit no significant differences in hair colour, skin colour and form of the ear-lobe, but they differ significantly in the amount of body hair and in eye colour as recorded by the far from perfect scale improvised in the field.

An attempt to determine the incidence of certain other traits generally associated with the Khoisan (Schapera, 1930, pp. 58–9, 62) was made in the case of the male and female Sandawe but not in that of the Nyaturu. " Slight " steatopygia occurred in thirteen of the hundred men and in twelve of the twenty-five women. Seven of the women were " moderately " and three " pronouncedly " steatopygous. The detumescent penis could be classified as " diagonal " in six of the hundred male Sandawe and as " pendulous " in the rest. There was no suggestion of any horizontally-directed organs such as those of the four Northern Bushmen figured by Seiner (1912, p. 279). Hypertrophy of the *labia minora* was not observed in the twenty-five Sandawe women examined.

Metrical Features

In addition to the height of the Sandawe women, the following characters were measured on the male subjects :

KG (*Körpergewicht*), weight with the minimum of clothing, usually the loincloth alone.

KH (*Körperhöhe*), stature to the vertex with the head in the standard horizontal (tragion-orbitale) plane.

SH (*Sitzhöhe*), sitting height to the vertex, the subject being seated on a box 51 cm. high with the knees flexed, the thighs perpendicular to the trunk and the head in the standard horizontal plane.

SW (*Spannweite*), span with the anthropometer held in front of the subject.

L (*Kopflänge*), maximum head length from the glabella in the median sagittal plane.

B (*Kopfbreite*), maximum head breadth above the level of the ears perpendicular to *L*.

B′ (*kleinste Stirnbreite*), minimum frontal breadth between the temporal crests.

J (*Jochbogenbreite*), maximum bizygomatic breadth

GH′ (*Gesichtshöhe*), facial height from the nasion (the fronto-nasal suture in so far as it can be palpated) to the gnathion.

NH′ (*Nasenhöhe*), nasal height from the nasion to the subnasale.

NB (*Nasenbreite*), nasal breadth between the most lateral points on the alae.

OL′ (*Ohrlänge*), aural length from the superaurale to the subaurale.*

OB′ (*Ohrbreite*), aural breadth from the praeaurale to the postaurale.

All linear measurements were made by " contact," *i.e.*, without pressure. Shortly after the start of the investigation it was found necessary to abandon a few other characters, including *W* (*Unterkieferwinkelbreite*) or bigonial breadth and *OH* (*Ohrhöhe*) or projective head height from the left tragion to the apex, taken in the absence of B. K. Schultz' parallelometer with a Martin anthropometer, because of the amount of repetition that would have been required to determine them with any prospect of accuracy in the limited time available. Apart from von Pirquet's Pelidisi index ($100\ \sqrt[3]{10\ KG/SH}$), which is used to assess nutritional status, the indices calculated are the " cormic " or relative sitting height ($100\,SH/KH$), relative span ($100\,SW/KH$), cephalic ($100\ B/L$), facial ($100\,GH'/J$), nasal ($100\ NB/NH'$) and aural ($100\,OB'/OL'$).

For most metrical characters, the various series considered in this study seem to be comparable, but the mean facial and nasal heights of the Southern Bushmen and the Hottentots are so much less than those of the Northern Bushmen, Sandawe, Nyaturu and Dahomeans that it may be supposed that Dart and Schultze measured them in a different way from Lebzelter, Herskovits and myself. Professor Dart did not describe his technique in the paper he published in 1937 but possibly employed what Bunak (1941) has termed the " sellion," or the most depressed part at the root of the nose, as his upper terminal. This is the " nasion " of Topinard (1891) and the British Association Committee (1908) and still has several advocates (*e.g.*, Speiser, 1928 ; Buxton, Trevor and Blackwood, 1939). Professor

* The terminals of *OL′* and *OB′* are as defined in Martin's text (1928, I, p. 190) and not as shown in the illustrations accompanying it. I now prefer to take aural length as a maximum without reference to the standard horizontal plane and designate this *OL*. Aural breadth, *OB*, is the greatest chord, perpendicular to *OL*, from a point on the line joining the two otobasia, to the posterior margin of the ear. On the vexed question of technique in ear measurements see Tildesley (1949).

Schultze claimed that his facial and nasal heights had been taken from the *Stirn-Nasennaht*, a statement which he was kind enough to confirm in a conversation at Marburg in 1946. Nevertheless his values for these characters would appear to agree more closely with facial and nasal heights from the sellion (*GH* and *NH*) than from the nasion (*GH'* and *NH'*). While, owing to the uncertainty involved, it has been reluctantly decided to omit them and the indices of which they are components from the comparison of means in so far as the Southern Bushmen and the Hottentots are concerned, there is no equally substantial reason why they should not be included in that of variabilities. For these four characters the means in question and those at either end of the ranges in Table V are:

Facial Height. Southern Bushmen 102·15 ± 1·46 (20), Hottentots 105·91 ± 0·76 (74), Northern Bushmen 117·00 ± 0·86 (58), Nyaturu 120·68 ± 0·93 (50).*

Nasal Height. Southern Bushmen 38·90 ± 0·80 (20), Hottentots 41·91 ± 0·42 (74), Dahomeans 50·63 ± 0·37 (93), Northern Bushmen 54·14 ± 0·47 (58).†

Facial Index. Southern Bushmen 76·61 ± 1·10 (20), Hottentots 80·55 ± 0·57 (74), Dahomeans 84·15 ± 0·51 (93), Northern Bushmen 91·09 ± 0·64 (58).

Nasal Index. Southern Bushmen 109·27 ± 1·88 (20), Hottentots 100·15 ± 0·98 (74), Northern Bushmen 73·00 ± 1·10 (58), Dahomeans 86·81 ± 0·87 (93).

The estimated standard deviations (*S.D.*s)‡ of the male Sandawe and the Nyaturu are included with others in Table IV,§ and it is evident from inspection that they are of the same order as those usually found in somatometric series. The populations from which the Tanganyika samples have been drawn may therefore be considered to be quite homogeneous in the accepted sense of that term.

The estimated variability of a particular character in any one population may be compared with that in any other by first squaring the estimated *S.D.* of the character in each to obtain its variance (V). If the larger V is then divided by the smaller, the quotient is Professor R. A. Fisher's variance ratio (F), the significance of which at various levels may be tested by consulting Table V in Fisher and Yates (1948). The smaller the samples, the greater is the value of F required to establish significance. F has been used anthropologically in comparing the variabilities of three African Negro cranial series, viz., Ashanti and revised measurements of Benington's Gabunese and Tetela (Trevor, 1949), and it may also be applied to the present material.

Of the 147 comparisons made, twenty-seven are significantly different at the 5 per cent. level, but it is unlikely that all of them represent a difference in true variability, for two reasons. Firstly, there are several variance estimates for each character in the case of the populations considered. If the parametric or true variances of a character were equal for all the populations, and the greatest and the least of the variance estimates were compared by the F-test, one might expect that they would appear to be significantly different. The more variance

* The figures after a ± sign throughout this study denote standard and not probable errors, the latter being less convenient in practice and nowadays little used; unless otherwise stated, the figures in parentheses are the sample sizes.

† Kitson (1931) gives the mean nasal heights to the base of the spine for two pooled cranial series of male Bushmen and Hottentots as 44·2 (45) and 46·0 (26) respectively. Analogous measurements on living Khoisan, when the anatomical nasion is used as a landmark, would be anticipated to be greater than these. Unpublished male means for the nasal height to the left *nariale* or lowest point on the inferior margin of the pyriform aperture taken on crania in the University of Cape Town by my colleague Mr. G. I. Jones show corresponding differences from the mean nasal heights recorded by Dart and by Schultze, viz., Cape Coast (Southern) Bushmen 47·5 (29) and Hottentots 48·6 (14).

‡ The estimated *S.D.* may be defined as $\sqrt{\{\Sigma(x - \bar{x})^2/(n-1)\}}$ where $\bar{x}$ is the arithmetic mean of a sample and $x - \bar{x}$ the deviations of n observations from it. This *statistic* gives the best estimate of the population *S.D.* (σ), as does $\bar{x}$, viz., $\Sigma x/n$, of the population mean (μ), since the *parameters* or quantities characterizing the population from which the sample is drawn are usually unknown. While the arithmetic mean is obtained by dividing the sum of observations by n, in the case of the *S.D.* the divisor $(n - 1)$ represents the number of "degrees of freedom"—here written ϕ, following Davies (1949)—or independent values in a sum of squares from which a statistic can be calculated. If the number of observations in a sample is large, of the order of fifty or more, say, but certainly not less than thirty, the use of n rather than $(n - 1)$ makes little if any difference to the value of the estimated *S.D.*, although division by $(n - 1)$ is the more correct procedure and it is desirable to employ it consistently.

§ The standard deviations of the two Bushman and the Hottentot series are given for the first time in this table. I am indebted to Dr. C. Radhakrishna Rao of Calcutta, formerly my research assistant, and to Mr. Gordon H. Luce of Rangoon for calculating some of those of the Southern Bushmen and of the Sandawe and the Nyaturu respectively, as well as for other computational help; and to Mr. F. J. Anscombe of the Statistical Laboratory, Cambridge, who has generously answered many tedious queries regarding the analysis of variance and general procedure in statistics. Lebzelter does not furnish variabilities in his paper on the Northern Bushmen, and the values shown under that heading in Table IV have been determined for Seiner's material only.

estimates available, the more likely is this to occur. Secondly, even in a succession of completely unrelated judgments, the practice of regarding a difference between samples as indicative of a population difference if it has no more than a 5 per cent. probability of occurring by chance, will lead to an incorrect conclusion once in twenty times.

The above reasons, however, will not make as many as twenty-seven judgments wrong out of 147, and an examination of them as a group will show where significance can most reliably be inferred. In the following analysis the values of the variance ratios are given in parentheses:

(i) The Southern Bushmen are significantly more variable than the Sandawe, the Nyaturu and the Dahomeans in aural breadth (2·45, 2·22 and 2·32); than the Sandawe and the Nyaturu in nasal index (2·72 and 2·01); and than the Hottentots, the Sandawe and the Nyaturu in aural index (2·01, 2·61 and 3·04). In no character for which the Southern Bushmen can be compared with any other of the six series is its variability significantly the smaller.

(ii) The variability of the Northern Bushmen can be compared with that of the Southern Bushmen and that of the Hottentots for but a single character, stature, and with that of the Dahomeans for stature and sitting height alone. None of these four ratios is significant at the 5 per cent. level. There remain for comparison the Sandawe and the Nyaturu. The Northern Bushmen are significantly more variable than the Nyaturu in sitting height (1·61); than the Sandawe and the Nyaturu in cormic index (1·97 and 2·39); and than the Sandawe and the Nyaturu in relative span (1·80 and 1·76). For no character are they less variable than the latter.

(iii) Comparison of the Hottentot, the Sandawe and the Nyaturu variances yields seven significant ratios, and here honours are more evenly distributed. The Hottentots are significantly more variable than the Sandawe in nasal index (2·27) and than the Nyaturu in facial height and nasal index (1·68 and 1·68); and they are significantly less variable than the Nyaturu in head breadth and nasal breadth (2·03 and 1·71). The Sandawe are significantly less variable than the Nyaturu in head breadth (1·65) and significantly more variable in facial height (1·57).

TABLE IV. *Estimated Standard Deviations of Male Khoisan and Other Populations**

Character	Southern Bushmen	Northern Bushmen	Hottentots	Sandawe	Nyaturu	Dahomeans	Mean Weighted *S.D.*
KG	—	4·78 (32)	—	5·09 (100)	5·46 (50)	—	5·14 [179]
KH	5·41 (20)	6·32 (72)	6·51 (73)	6·01 (100)	5·85 (50)	6·39 (93)	6·20 [402]
SH	—	3·92 (72)	—	3·31 (100)	3·08 (50)	3·49 (93)	3·48 [311]
SW	—	6·64 (69)	—	6·25 (94)	6·97 (47)	—	6·54 [207]
L	6·17 (20)	—	5·45 (74)	5·01 (100)	5·60 (50)	7·03 (93)	5·87 [332]
B	5·48 (20)	—	3·92 (74)	4·34 (100)	5·58 (50)	4·80 (93)	4·66 [332]
B′	5·03 (20)	—	—	4·38 (100)	4·50 (50)	—	4·49 [167]
J	5·32 (20)	—	4·17 (74)	4·23 (100)	4·27 (50)	4·83 (93)	4·47 [332]
GH′	*5·08* (20)	—	*7·09* (74)	6·85 (100)	5·47 (50)	6·57 (93)	6·55 [332]
NH′	*3·81* (20)	—	*3·76* (74)	3·42 (100)	3·40 (50)	3·72 (93)	3·60 [332]
NB	2·59 (20)	—	2·36 (74)	2·85 (100)	3·08 (50)	3·28 (93)	2·90 [332]
OL′	4·42 (20)	—	3·77 (73)	3·84 (56)	3·59 (35)	4·49 (93)	4·07 [272]
OB′	3·58 (20)	—	2·61 (73)	2·29 (56)	2·40 (35)	2·35 (93)	2·52 [272]
$100\sqrt[3]{10}$ *KG/SH*	—	3·91 (32)	—	3·63 (100)	3·16 (50)	—	3·56 [179]
100 *SH/KH*	—	1·74 (72)	—	1·24 (100)	1·13 (50)	—	1·40 [219]
100 *SW/KH*	—	3·03 (69)	—	2·26 (94)	2·28 (47)	—	2·54 [207]
100 *B/L*	2·60 (20)	—	2·64 (74)	2·66 (100)	2·82 (50)	3·31 (93)	2·87 [332]
100 *GH′/J*	*3·94* (20)	—	*5·11* (74)	4·99 (100)	4·71 (50)	—	4·90 [240]
100 *NB/NH′*	*10·97* (20)	—	*10·03* (74)	6·65 (100)	7·75 (50)	—	8·40 [240]
100 *OB′/OL′*	6·96 (20)	—	4·91 (73)	4·31 (56)	4·00 (35)	—	4·84 [180]

* The units are kilogrammes for *KG*, centimetres for *KH*, *SH* and *SW*, and millimetres for the remaining absolute measurements. The number of observations, n, on which each estimated *S.D.* is based is shown in parentheses ( ). The number of degrees of freedom, ϕ, in the case of each mean weighted *S.D.* is shown in brackets [ ]. The characters of which the absolute and indicial values are given in *italics* were probably measured in a different way from the rest. All measurements of Seiner's subjects Nos. 17 and 73, who were deformed or diseased, and the measurements for *SW* of his Nos. 33, 37 and 57, who had sustained injury to an arm or a middle finger likely to affect this character, have been omitted in calculating the estimated *S.D.*s of the Northern Bushmen and their means in Table V. The *S.D.*s of the Dahomean *sample* given by Herskovits have been multiplied by $\sqrt{\{n/(n-1)\}}$, *i.e.*, $\sqrt{(93/92)}$, to obtain estimates of the corresponding *population* values. The estimated *S.D.*s for *KH* of the various female series are Southern Bushmen 5·76 (21), Northern Bushmen 5·80 (18), Hottentots 6·30 (28) and Sandawe 5·00 (25), the mean weighted *S.D.* being 5·73 [88].

(iv) The Dahomeans are significantly more variable than the Hottentots, the Sandawe and the Nyaturu in head length (1·66, 1·97 and 1·57); than the Hottentots in nasal breadth (1·94); than the Nyaturu in aural length (1·56); and than the Hottentots and the Sandawe in cephalic index (1·57 and 1·55). Only for aural breadth does another series exceed them in variability, this being the Southern Bushmen.

Clearly the data for the Southern Bushman, the Northern Bushman and the Dahomean samples represent populations of measurements the true variances of which, taken as a whole, are greater than those of the corresponding populations represented by the Hottentot, the Sandawe and the Nyaturu samples. Whatever the truth behind this individual significant difference or that, their combined significance cannot be in doubt.

It is not difficult to suggest some explanations of such a result, apart from the actual variability existing in the physical characters of the Southern and the Northern Bushmen, the Dahomeans, etc. The average degree of relationship between the individuals composing a sample has some influence on the variability of a character, and presumably Herskovits's series of ninety-three Dahomeans did not all belong to the same kind of restricted inbreeding group as did (with two exceptions) Schultze's seventy-four Hottentots, and my hundred Sandawe and fifty Nyaturu. Again, the variability of metrical characters depends both on the nature of the character itself and on the precision with which it is measured. Observational "errors" and bias are subjects about which we are still much in the dark, but the little work that has so far been done on them shows how widely some observers differ from others in consistency of measurement—a factor that, for any given degree of inconsistency, affects the variation of a smaller character, such as aural breadth, far more than that of a larger. Aural breadth is the only character for which the limited number of available comparisons of Southern Bushman, Northern Bushman and Dahomean variabilities indicate a significant difference between two of them. This character is defined both inadequately and very variously in different text-books (Tildesley, 1949), and indeed with text and illustrations contradicting each other in Martin (1914 and 1928) and Hooton (1946). Whether the aural breadths of the Dahomeans and the Southern Bushmen were measured according to the same definition is uncertain; and in the case of the Southern Bushmen, apparently measured by four observers, differences in observational bias may easily have contributed to the greater variability of the data. If it is legitimate, statistically, to use the mean weighted value of the various standard deviations of each character to find the standard errors of the respective means, these irrelevant differences will be ironed out.*

* [A further reason may be adduced for using, if possible, standard errors based on the mean weighted *S.D.*s. Among the Northern Bushman means in Table V are included Lebzelter's for eleven characters, ten of them not measured by Seiner whose material furnished the available *S.D.*s for this group. Though Lebzelter gave no *S.D.*s in the brief paper from which his means were taken, he did give values for "$\pm$ E (M)." This is the symbol used in the first edition of Martin's *Lehrbuch* (1914) for the probable error of the mean, which has, of course, only to be divided by ·67449 to give the corresponding standard error. An examination of the values given under the headings "$\pm$ E (M)" and "*E*" in Schebesta and Lebzelter (1933), where the symbols are undefined but can be identified by analyzing afresh Schebesta's individual measurements, showed, however, that it was not the probable error that Lebzelter had in fact calculated. He had followed the recommendation given in the second edition of the *Lehrbuch* (1928), calculating the mean deviation instead of the standard deviation and reckoning $\pm$ (mean deviation $\times$ 1·25)/$\sqrt{n}$ as the standard error of the mean. At the same time he had altered the terminology, changing its ε for the mean deviation into *E*, and its $\pm$ m into $\pm$ E (M), that is, into the symbols used in the first edition of the *Lehrbuch* not for the standard, but for the probable, error.

Identification being thus established, the question is whether $\pm$ (*M.D.* $\times$ 1·25)/$\sqrt{n}$ can be regarded as a satisfactory substitute for $\pm$ *S.D.*/$\sqrt{n}$. It is true that, taken to one place of decimals, the average value of the mean deviation of a sample in terms of its standard deviation is ·8, whatever the size: for $n = 31$, for example, it is ·806; for $n = 110$, ·800; for $n = 401$, ·798 (Geary, 1936, Table III). But its variability is greater and its distribution more skew. (*M.D.* $\times$ 1·25) is therefore a poorer estimate of the σ of the population (on which statistical theory bases the standard error) than is the sample *S.D.*, and still poorer of course than the latter multiplied by $\sqrt{\{n/(n-1)\}}$. Again, no test has as yet been worked out for judging whether two sample *M.D.*s differ significantly, to correspond with the *F*-test for comparing *S.D.*s. It is well therefore if, for the purpose of comparing Lebzelter's Northern Bushman means with those of the other racial groups in Table V, standard errors based on the mean weighted *S.D.*s can be substituted for those he himself calculated.

In the process of identifying the symbols used by Lebzelter, three sets of measurements recorded by Schebesta on Central African Pygmiesawere analyzed afresh. The following are the estimated standard errors of their means, together with Lebzelter's corresponding values for $\pm$ E (M):—

Values Obtained for Standard Errors of Means

	♂ Efé ($n = 98$)		♂ Basúa ($n = 44$)
	Stature	Cephalic index	Chest girth
Tildesley ...	$\pm$ ·525	$\pm$ ·276	$\pm$ ·747
Lebzelter ...	$\pm$ ·51	$\pm$ ·261	$\pm$ ·70

These may now be put on record. M. L. T., Assoc. Ed.]

TABLE V. *Means of Male Khoisan and Other Series**

Character	Southern Bushmen	Northern Bushmen	Hottentots	Sandawe	Nyaturu	Dahomeans
KG	—	40·41 ±0·91 (32)	—	49·40 ±0·51 (100)	52·22 ±0·73 (50)	—
KH	155·82 ±1·38 (20)	157·15 ±0·54 (130)	162·42 ±0·73 (73)	164·63 ±0·62 (100)	165·44 ±0·88 (50)	168·87 ±0·64 (93)
SH	—	80·06 ±0·41 (72)	—	82·75 ±0·35 (100)	83·44 ±0·49 (50)	83·72 ±0·36 (93)
SW	—	158·06 ±0·79 (69)	—	173·07 ±0·67 (94)	174·19 ±0·95 (47)	—
L	190·20 ±1·31 (20)	188·02 ±0·77 (58)	192·12 ±0·68 (74)	188·70 ±0·59 (100)	190·40 ±0·83 (50)	193·47 ±0·61 (93)
B	144·85 ±1·04 (20)	138·88 ±0·61 (58)	140·00 ±0·54 (74)	141·77 ±0·47 (100)	144·24 ±0·66 (50)	146·55 ±0·48 (93)
B′	105·10 ±1·00 (20)	111·00 ±0·59 (58)	—	104·34 ±0·45 (100)	105·80 ±0·63 (50)	—
J	133·45 ±1·00 (20)	128·96 ±0·59 (58)	132·47 ±0·52 (74)	133·87 ±0·45 (100)	135·52 ±0·63 (50)	141·18 ±0·46 (93)
GH′	—	117·00 ±0·86 (58)	—	119·97 ±0·65 (100)	120·68 ±0·93 (50)	118·81 ±0·68 (93)
NH′	—	54·14 ±0·47 (58)	—	51·16 ±0·36 (100)	51·04 ±0·51 (50)	50·63 ±0·37 (93)
NB	42·17 ±0·65 (20)	38·72 ±0·38 (58)	41·66 ±0·34 (74)	40·90 ±0·29 (100)	42·14 ±0·41 (50)	43·95 ±0·30 (93)
OL′	57·05 ±0·91 (20)	—	55·77 ±0·48 (73)	58·45 ±0·54 (56)	58·86 ±0·69 (35)	58·51 ±0·42 (93)
OB′	31·67 ±0·56 (20)	—	32·86 ±0·29 (73)	33·32 ±0·34 (56)	33·69 ±0·43 (35)	33·82 ±0·26 (93)
100 $\sqrt[3]{10\,KG}/SH$	—	93·59 ±0·63 (32)	—	95·51 ±0·36 (100)	96·46 ±0·50 (50)	—
100 *SH/KH*	—	50·99 ±0·16 (72)	—	50·27 ±0·14 (100)	50·43 ±0·20 (50)	{49·58 ±0·15 (93)}
100 *SW/KH*	—	100·81 ±0·31 (69)	—	105·11 ±0·26 (94)	105·38 ±0·37 (47)	—
100 *B/L*	76·17 ±0·64 (20)	74·97 ±0·38 (58)	72·92 ±0·33 (74)	75·17 ±0·29 (100)	75·78 ±0·41 (50)	75·85 ±0·30 (93)
100 *GH′/J*	—	91·09 ±0·64 (58)	—	89·67 ±0·49 (100)	89·12 ±0·69 (50)	{84·15 ±0·51 (93)}
100 *NB/NH′*	—	73·00 ±1·10 (58)	—	80·23 ±0·84 (100)	82·92 ±1·19 (50)	{86·81 ±0·87 (93)}
100 *OB′/OL′*	55·79 ±1·08 (20)	—	59·08 ±0·57 (73)	57·16 ±0·65 (56)	57·34 ±0·82 (35)	{57·80 ±0·50 (93)}

* The units are kilogrammes for *KG*, centimetres for *KH*, *SH* and *SW* and millimetres for the remaining absolute measurements. The number of observations on which each mean is based is shown in parentheses ( ). The standard errors have been found in all cases from the mean weighted *S.D.*s in Table IV. Lebzelter's mean for *KH* of his fifty-eight Northern Bushmen (!khũ), viz., 157·7, has been pooled with that of Seiner's seventy-two members of the same tribe, 156·6, to obtain the value given above. The indices in braces { } of Herskovits's Dahomeans were determined from the component means and not from individual measurements. The means for *KH* of the various female series are Southern Bushmen 145·97 ± 1·25 (21), Northern Bushmen 148·23 ± 1·35 (18), Hottentots 149·70 ± 1·08 (28) and Sandawe 157·16 ± 1·15 (25). Their standard errors have been found from the mean weighted *S.D.* given in the footnote to Table IV.

TABLE VI. *Significant Differences between Means of Male Khoisan and Other Series**

Character	Southern—Northern Bushmen	Southern Bushmen—Hottentots	Southern Bushmen—Sandawe	Southern Bushmen—Nyaturu	Southern Bushmen—Dahomeans	Northern Bushmen—Hottentots	Northern Bushmen—Sandawe	Northern Bushmen—Nyaturu	Northern Bushmen—Dahomeans	Hottentots—Sandawe	Hottentots—Nyaturu	Hottentots—Dahomeans	Sandawe—Nyaturu	Sandawe—Dahomeans	Nyaturu—Dahomeans
KG	—	—	—	—	—	—	− 9·01 ± 1·04	−11·81 ± 1·17	—	—	—	—	− 2·82 ± 0·89	—	—
KH	NS	− 6·60 ± 1·56	− 8·81 ± 1·51	− 9·62 ± 1·64	−13·05 ± 1·52	− 5·27 ± 0·91	− 7·48 ± 0·82	− 8·29 ± 1·03	−11·72 ± 0·84	*− 2·21 ± 0·96*	− 3·02 ± 1·14	− 6·45 ± 0·97	NS	− 4·24 ± 0·89	− 3·43 ± 1·09
SH	—	—	—	—	—	—	− 2·69 ± 0·54	− 3·38 ± 0·64	− 3·66 ± 0·55	—	—	—	NS	NS	NS
SW	—	—	—	—	—	—	−15·01 ± 1·04	−16·13 ± 1·24	—	—	—	—	NS	—	—
L	NS	NS	NS	NS	*− 3·27 ± 1·44*	− 4·10 ± 1·03	NS	*− 2·38 ± 1·13*	− 5·45 ± 0·98	+ 3·42 ± 0·90	NS	NS	NS	− 4·77 ± 0·85	− 3·07 ± 1·03
B	+ 5·97 ± 1·21	+ 4·85 ± 1·17	+ 3·08 ± 1·14	NS	NS	NS	− 2·89 ± 0·77	− 5·36 ± 0·90	− 7·67 ± 0·78	*− 1·77 ± 0·72*	− 4·24 ± 0·85	− 6·55 ± 0·72	− 2·47 ± 0·81	− 4·78 ± 0·67	− 2·31 ± 0·82
B′	− 5·90 ± 1·16	—	NS	NS	—	—	+ 6·66 ± 0·74	+ 5·20 ± 0·86	—	—	—	—	NS	—	—
J	+ 4·49 ± 1·16	NS	NS	NS	− 7·73 ± 1·10	− 3·51 ± 0·79	− 4·91 ± 0·74	− 6·56 ± 0·86	−12·22 ± 0·75	*− 1·40 ± 0·69*	− 3·05 ± 0·82	− 8·71 ± 0·69	*− 1·65 ± 0·77*	− 7·31 ± 0·64	− 5·66 ± 0·78
GH′	—	—	—	—	—	—	− 2·97 ± 1·08	− 3·68 ± 1·27	NS	—	—	—	NS	NS	NS
NH′	—	—	—	—	—	—	+ 2·98 ± 0·59	+ 3·10 ± 0·69	+ 3·51 ± 0·60	—	—	—	NS	NS	NS
NB	+ 3·45 ± 0·75	NS	NS	NS	*− 1·78 ± 0·72*	− 2·94 ± 0·51	− 2·18 ± 0·48	− 3·42 ± 0·56	− 5·23 ± 0·48	NS	NS	− 2·29 ± 0·45	*− 1·24 ± 0·50*	− 3·05 ± 0·42	− 1·81 ± 0·51
OL′	—	NS	NS	NS	NS	—	—	—	—	− 2·68 ± 0·72	− 3·09 ± 0·84	− 2·74 ± 0·63	NS	NS	NS
OB′	—	NS	*− 1·65 ± 0·66*	− 2·02 ± 0·71	− 2·15 ± 0·65	—	—	—	—	NS	NS	*− 0·96 ± 0·39*	NS	NS	NS
$100\sqrt[3]{10}$ *KG/SH*	—	—	—	—	—	—	− 1·92 ± 0·73	− 2·87 ± 0·80	—	—	—	—	NS	—	—
100 *SH/KH*	—	—	—	—	—	—	+ 0·72 ± 0·21	*+ 0·56 ± 0·26*	+ 1·41 ± 0·22	—	—	—	NS	+ 0·69 ± 0·21	+ 0·85 ± 0·25
100 *SW/KH*	—	—	—	—	—	—	− 4·30 ± 0·40	− 4·57 ± 0·48	—	—	—	—	NS	—	—
100 *B/L*	NS	+ 3·25 ± 0·72	NS	NS	NS	+ 2·05 ± 0·50	NS	NS	NS	− 2·25 ± 0·44	− 2·86 ± 0·53	− 2·93 ± 0·45	NS	NS	NS
100 *GH′/J*	—	—	—	—	—	—	NS	*+ 1·97 ± 0·94*	+ 6·94 ± 0·82	—	—	—	NS	+ 5·52 ± 0·79	+ 4·97 ± 0·86
100 *NB/NH′*	—	—	—	—	—	—	− 7·23 ± 1·38	− 9·92 ± 1·62	−13·81 ± 1·40	—	—	—	NS	− 6·58 ± 1·21	− 3·89 ± 1·47
100 *OB′/OL′*	—	− 3·29 ± 1·22	NS	NS	NS	—	—	—	—	*+ 1·92 ± 0·86*	NS	NS	NS	NS	NS

* The units are kilogrammes for *KG*, centimetres for *KH*, *SH* and *SW* and millimetres for the remaining absolute measurements. The letters NS denote that a difference is non-significant, *i.e.*, less than twice its estimated standard error. Differences shown in *italics* are not greater than two-and-a-half times their respective estimated standard errors.

An " overall " test, due to Professor M. S. Bartlett (1937), can be employed to see whether there is in fact evidence that the standard deviations of single characters are heterogeneous among themselves.* The results of its application show that this is not so for fourteen out of the twenty characters tested, and that, as far as the exceptions are concerned (head length, head breadth, cormic index, relative span, nasal index and aural index), the degree of heterogeneity appears to be quite low and most unlikely to affect the validity of the comparisons of mean measurements which will follow and which are based on standard errors estimated from the mean weighted *S.D.*s given in the last column of Table IV.

Table V provides the means, together with their estimated standard errors, of the metrical characters of the male Sandawe and the Nyaturu and of the series used for comparison with them, the female means for *KH* being given in the footnote to it. Where individual measurements of the comparative material are furnished, the means have been recalculated from these to two places of decimals for the sake of uniformity, although one place would be quite adequate. In terms of the divisions conventionally employed in the anthropometry of the living, the Sandawe and the Nyaturu are of medium height (160·0—169·9 cm.), brachycormic (x — 50·9),† dolichocephalic (x — 76·9), leptoprosopic (88·0 — x) and mesorrhine (70·0 — 84·9). They differ from the Southern and Northern Bushmen, who are both short (150·0—159·9), and from the Dahomeans, who are just platyrrhine (85·0 — x).

A statistically simple but effective method of comparing individual characters in the various groups is to divide the difference between any two means by its estimated standard error.‡ If d is the difference between any pair of means the respective standard errors of which are s_1 and s_2, then it may be taken as significant when $d/\sqrt{(s_1^2 + s_2^2)} = 2 \cdot 0$ or more, *i.e.*, at this level such a difference would arise by chance, in either direction, about once in twenty times.§ Table VI gives the values of the differences of or above the level of significance between all pairs of means that can be compared, together with their standard errors. In examining the way in which the several series differ among themselves, it is convenient to begin with those that are most conspicuously distinguished from the others in the matter of size.

Dahomeans. The Dahomeans are largest in the majority of their recorded characters, the fewest and least significant differences occurring between them and the Nyaturu, who have tentatively been classed as Negroids. The nasal height (NH') of the Dahomeans is exceeded, however, by that of the Northern Bushmen. They also differ from this and the other series in having not only absolutely, but also proportionately, broader noses (NB and 100 NB/NH') and faces (J and 100 GH'/J). With their taller stature (KH) goes a reduced cormic index (100 SH/KH), indicating greater relative length of leg.

Northern Bushmen. At the other end of the scale are the Northern Bushmen, shorter in stature than any but the Southern Bushmen from whom they do not differ significantly, and with a higher cormic index than any other series for which this is available. They also have the smallest means for the rest of the linear characters, apart from minimum frontal breadth (B') and nasal height (NH'), in both of which they are the greatest of any.

Southern and Northern Bushmen. When comparing the Southern Bushmen with other series, the fact must be borne in mind that its twenty individuals are too few to indicate the smaller population differences that larger samples could make apparent. Their sampling differences are judged in the light of a larger standard error, and must therefore be larger to be regarded as significant. In spite of this, the Southern Bushmen are found to differ very significantly, and in this case therefore very considerably, from the Northern Bushmen in four of the six linear characters recorded for both, viz., they have greater head breadths (B), bizygomatic breadths (J) and nasal breadths (NB), and narrower foreheads (B'). This would still be true if the mean weighted *S.D.*s on which the standard errors were based had been as large as the largest estimated for a single series. Nor are the characters in question those especially subject to

* The details of Bartlett's test for homogeneity would be out of place here, but it is clearly described in *Statistical Methods in Research and Production: with Special Reference to the Chemical Industry* (Davies, 1949). Anthropologists whose mathematical equipment is as limited as my own will, I believe, find this lucid and up-to-date manual of considerable value to them, despite the seeming remoteness of its title from their subject.

† For the values of the cormic index see Vallois (1934, p. 119).

‡ The formula for the standard error of a mean is $S.D./\sqrt{n}$, where $S.D.$ is the estimated standard deviation and n the number of observations on which the mean is based.

§ It is assumed here that the *total* number of observations used in working out such " standardized differences " is not too low; say, at least, thirty. If the number of observations for both means combined is less than thirty, the figure of 2·0 given above needs to be slightly increased in accordance with Table III of Fisher and Yates (1948) for the distribution of t.

difficulties of measurement or differences of technique, with the exception of B' which has sometimes produced appreciable divergences in observational bias.

In studying Table VI for light on the respective resemblance of Southern and of Northern Bushmen to the Hottentots, the Sandawe and the Nyaturu, one must again remind oneself that the Southern Bushman sample would be less capable of indicating population differences than the much larger Northern Bushman sample. It is only where the Southern Bushmen offer positive evidence of differing from one of the other populations that inferences may be drawn.

In regard to the Hottentots, both Southern and Northern Bushmen differ significantly from these in one of the major head diameters, the Southern Bushman head being broader (B) than the Hottentot and the Northern Bushman head shorter (L), with the result that both Southern and Northern Bushmen have a higher cephalic index. The Southern Bushmen and the Hottentots alike differ from the Northern Bushmen, however, in having broader faces (J) and noses (NB).

The Southern Bushmen, the Sandawe and the Nyaturu have three characters in which they all differ from the Northern Bushmen—broader faces (J) and noses (NB) and also narrower foreheads (B'). The Sandawe head breadth (B) is intermediate between the Southern and the Northern Bushman, being significantly less than the former and larger than the latter.

On the whole, for the characters compared, the Southern Bushmen differ less than the Northern Bushmen from the remaining series. Dart has been quoted above as saying that the Southern Bushmen are " generally acknowledged to be the purest of the Bushman type," but such positive evidence as is yielded by his sample of twenty suggests that it is the Northern Bushmen that are the more differentiated from the other populations under consideration. At the same time, attention must be drawn to the fact that Lebzelter's Northern Bushmen display some peculiar mean values, notably for B' (*per se* and in relation to B), J and NB, which may cast doubt on the comparability of his technique with that of other observers. In such a case, Dart's series, small as it is, would represent the head measurements of Bushmen better than the larger one of Lebzelter. The stature, sitting height and span of the Northern Bushmen are not, of course, in question.

Hottentots, Sandawe and Nyaturu. Compared with the Sandawe and the Nyaturu, the Hottentots are significantly shorter (KH), have narrower heads (B), a lower cephalic index (100 B/L), narrower faces (J) and shorter ears (OL'), though in all these respects they differ more from the Nyaturu than from the Sandawe. In head length (L), on the other hand, they are significantly greater than the Sandawe and do not differ significantly from the Nyaturu. As has been already noted, the Nyaturu series is nearer than any other to the Dahomean, which is the largest in the majority of its recorded dimensions.

Comparison of the Sandawe with the Nyaturu means shows that in only four of the thirteen absolute measurements—weight (KG), head breadth (B), bizygomatic breadth (J) and nasal breadth (NB)—are there significant differences between them, and for each of these four the Sandawe means are rather smaller. There is no significant difference between any of the seven indices calculated. These results are hardly surprising when it is realized that the two Tanganyika tribes have lived in adjacent areas, and to a certain extent intermarried, for several generations.* Such is the picture that emerges from a

* In a suggestive paper on Indonesian influences, physical and cultural, in East Africa, A. T. and G. M. Culwick (1936, p. 61) state that, while living in the Singida District of Central Tanganyika, inhabited mainly by Nyaturu, they were struck by " the occurrence of olive or very light brown skins among the Wanyaturu, the Waniramba and the Wanisanzu, together with cases of cheek-bones and slanting eyes reminiscent of Asia, and a peculiar depressed sort of nose." In the course of some three years' interrupted residence in the Northern and Central Provinces of the Territory between 1919 and 1929, I noticed that several members of the Nyiramba and other Bantu-speaking tribes possessed similar traits, which I should attribute to admixture with a Khoisaniform element rather than to an Asiatic source. As will be seen, the Nyaturu data appear to bear out such a supposition. This, however, is no new news. Haddon (1905, p. 514) and Schapera (1930, p. 28) have drawn attention to it and both remark that the Bushmen may once have extended " even to the confines of Abyssinia." As regards possible cultural indications of the former presence of Khoisan peoples in that country, a number of Bushman-like rock-paintings were discovered by Mr. Bernard Fagg near Diredawa in the course of the war, and on 29 March 1943 I came across between forty and fifty similar representations of animals and about half-a-dozen of human beings at a spot named Nolle Shakasharifa, which is 2,040 metres above sea-level and lies some 10 kilometres north-east of Harar. These were photographed by Captain K. R. W. Ker, The Buffs (now of H.B.M. Embassy, Rio de Janeiro), who accompanied me on the trip together with Captain George Hartman, Intelligence Corps, Ato Wolde Emmanuel (a government official from Harar), Ahmed Ali Shamar (an old Harari with some knowledge of geology, our guide) and Basha Ahmed Shami (his son, also of Harar). A local Galla declared that the paintings went back beyond living memory and were attributed to the time of Harla, a legendary king. Unfortunately, Captain Ker's camera, still loaded with the film he had exposed, was stolen a few days later, and no details of the subjects of the paintings are therefore available. I understand that Mr. Fagg intends to describe his Diredawa finds, and the facts relating to those at Nolle are placed on record in the hope that future investigators in the Harar region may be able to examine them more thoroughly than I had the good fortune or leisure to do.

comparison of the available single characters of the six populations under review.

Application of Mahalanobis's Generalized Distance Statistic

While the means of single characters may be usefully compared by the above method, anthropologists have often felt the need for a measure of group resemblance or divergence based on several characters. A number of attempts to devise such a statistic have been made, and one of the most extensively used in craniometric investigations is the Pearsonian Coefficient of Racial Likeness (C.R.L.), which has also been applied to studies of the living by Hasluck and Morant (1929), von Bonin (1930), Mahalanobis (1930), Guha (1935) and Morant (1936). As Karl Pearson (1926) himself pointed out, however, a defect in the C.R.L. is that it takes no account of the intercorrelations of the characters, so that in squaring the differences between corresponding means (expressed in terms of the *S.D.* of the character) and adding these together as independent values, error is introduced. The results have therefore to be treated as approximate and interpreted with caution. But, used in the light of experience and judged by the criterion of reasonableness, C.R.L. values have proved themselves useful, if not perfect, for the assessment of relationships, especially if these are close.

The Generalized Distance Statistic (D^2), since devised by Professor P. C. Mahalanobis (1936), provides a more precise instrument for the purpose. It has recently been employed in a comparison of twenty-two Indian castes and tribes (Mahalanobis, Majumdar and Rao, 1949), and is now applied to the data of the present study. I am grateful to Dr. Rao for undertaking the computations it entails and for initiating me into its use, as I am for personal advice regarding D^2 from Professor Mahalanobis.

D^2 differs from the C.R.L. in that (i) the characters are the same for all series compared, (ii) their intercorrelations are taken into account, (iii) it is independent of the sizes of the samples, and (iv) indices may be omitted since the ratios between any pair of characters are inherent in the correlation coefficients. It further assumes that the populations represented in the samples it compares have "common dispersion matrices" (Rao, 1948, p. 180), that is, that the standard deviations of the characters used are the same in each of the populations; that the coefficients of correlation between the characters are also sensibly equivalent; and that the characters are normally distributed. While these are the theoretical assumptions, in practice it is enough if they are approximately correct, as they often may be. If so, what is needed is to get as close estimates as possible of the standard deviations and correlations common to the populations compared. These may be obtained either from a very long series, or from pooled estimates of a number of shorter series. In the case of the Indian castes and tribes referred to, they are the pooled estimates derived from twenty-two samples which comprised, in all, 4,000 individuals.

In the present instance correlation coefficients were unobtainable for all the series compared, as the individual measurements were not given for the Dahomeans nor for the Northern Bushmen measured by Lebzelter. Those used were therefore found from the largest sample, the Sandawe. Seven of its characters have been correlated *inter se*, and the resultant values of the coefficient (r) are shown in Table VII. (As it was later decided, for reasons already stated, that both GH' and NH' in two of the series were probably taken by a technique which rendered them non-comparable with the others, these characters were omitted from the calculation of D^2.)

The number of observations for each character being 100 and the number of degrees of freedom for r therefore ninety-eight, values of either sign less than ·23 are non-significant (Davies, 1949, Table E)—twelve out of twenty-one in Table VII—and higher values will be correct only within a corresponding margin of error. Table VIII gives, for comparison, coefficients for the same or analogous characters of Schultze's male Hottentots, which my friend and

Table VII. *Correlations of Characters Measured on Male Sandawe**

Character	*KH*	*L*	*B*	*J*	*GH'*	*NH'*	*NB*
KH	—	·2580	·0409	·1844	·3155	·1091	−·2025
L	·2580	—	·2612	·3965	·2357	·2716	·1437
B	·0409	·2612	—	·5327	·0976	−·0033	−·0610
J	·1844	·3965	·5327	—	·2705	·1751	·0292
GH'	·3155	·2357	·0976	·2705	—	·5781	·1731
NH'	·1091	·2716	−·0033	·1751	·5781	—	·1773
NB	−·2025	·1437	−·0610	·0292	·1731	·1773	—

* The number of observations is 100 for all pairs.

TABLE VIII. *Correlations of Characters Measured on Male Hottentots**

Character	*KH*	*L*	*B*	*J*	*GH*	*NH*	*NB*
KH	—	·3096	·0269	·1933	·2172	·2411	·0045
L	·3096	—	·1631	·4501	·1944	·1850	·2583
B	·0269	·1631	—	·2266	·5413	·0167	·0371
J	·1933	·4501	·2266	—	·2615	·3666	·2316
GH	·2172	·1944	·5413	·2615	—	·6204	·0057
NH	·2411	·1850	·0167	·3666	·6204	—	·1621
NB	·0045	·2583	·0371	·2316	·0057	·1621	—

* The number of observations is 73 for all pairs involving *KH* and 74 for the rest.

former pupil Dr. R. K. Mukherjee has been good enough to work out. Since, in this case, the numbers of degrees of freedom are seventy-one and seventy-two, the limit beyond which the coefficients are significant is ·27, and only five out of the twenty-one coefficients exceed it.

The two sets were submitted to Mr. D. V. Lindley, University Demonstrator in Statistics, Cambridge, who kindly informs me that the differences between them, as well as those between their sample standard deviations, are not significant of population differences. It is obvious, however, that the two sets of sample estimates themselves differ very considerably, as is indeed only to be expected when values of up to 23 and ·27, respectively, could easily be obtained by chance from samples of the given sizes drawn from a population in which $r = 0$.

The standard deviations used in calculating D^2 have also been derived from the Sandawe data and are those of the sample itself, viz., *KH* 5·98, *L* 4·99, *B* 4·32, *J* 4·20 and *NB* 2·83.† They are slightly—between ·02 and ·04—less than the estimates of the Sandawe parameters given in Table IV, but the difference is negligible. More important is the fact that a standard deviation estimated from a sample of 100 has a standard error of 7 per cent.

It is evident that both the *r*'s and the *S.D.*s employed here, especially the former, fall short of being reliable estimates of the correlation coefficients and standard deviations which the six populations sampled are presumed to have in common. The values of D^2 to which they contribute can therefore pretend to no high degree of accuracy either. To some extent it will be possible to check them by the more limited conclusions drawn from the comparison of the means of individuals characters as well as by linguistic and other evidence, and the overall picture they present may be suggestive of the pattern of relationships which links the six populations. The application of D^2 to this material will also serve to illustrate the use of the most promising analytical instrument yet designed for the measurement of the "distances" between populations where adequate data are available.

Since means are available from all the series compared for five characters alone, it is on the combined evidence of stature (*KH*), head length (*L*), head breadth (*B*), bizygomatic breadth (*J*) and nasal breadth (*NB*) that D^2 must rest. A worse selection of characters could have been made, though some part at any rate of the considerable differences in mean stature may be due to Nurture rather than Nature. Each character in addition to these, in so far as it exhibited differentiation and was not highly correlated with any other used, would have contributed to the assessment of distance; but each increment would have multiplied the amount of arithmetic until, with ten, a limit would have been reached beyond which it was clearly impracticable to go. On this question Rao (1948, p. 201) offers the following comment:

> "The number of characters . . . depends on the nature of the groups compared. For anthropological classification about ten well chosen characters may be sufficient if the groups belong to a compact geographical region. If a number of groups living under different environmental conditions are considered, the procedure would be to obtain first a broad classification based on a small number of characters and then use possibly different panels of characters to distinguish the groups classed alike by the above method. If, for instance, the ethnic composition of a country like India is to be studied, one might use the four characters, stature, sitting height, head length and head breadth to obtain a broad classification into clusters and then use a panel of about 10 characters for studying the relative positions within a cluster."

The first step in calculating the values of D^2 is to express the means in terms of standard deviation units, and the characters when thus treated may be

† The values of the Sandawe *sample* standard deviations for two characters not so used but appearing in Table VII are *GH′* 6·81 and *NH′* 3·40. Those for corresponding or analogous characters of the Hottentot *sample* given in Table VIII, with which all seven Sandawe *S.D.*s were compared, are *KH* 6·47, *L* 5·41, *B* 3·89, *J* 4·14, *GH* 7·04, *NH* 3·74 and *NB* 2·34.

TABLE IX. *Mean Values in Standard Deviation Units of Male Khoisan and Other Series*

Series	*kh*	*l*	*b*	*j*	*nb*
Southern Bushmen	26·0568	38·1162	33·5300	31·7738	14·9011
Northern Bushmen	26·2792	37·6793	32·1481	30·7047	13·6820
Hottentots	27·1605	38·5010	32·4073	31·5404	14·7209
Sandawe	27·5301	37·8156	32·8171	31·8738	14·4523
Nyaturu	27·6655	38·1563	33·3888	32·2666	14·8905
Dahomeans	28·2391	38·7715	33·9235	33·6142	15·5300

denoted by writing their symbols in lower-case type, as has been done in Table IX.

If the characters selected were uncorrelated, then the D^2 between any two series would be the sum of the squares of the differences of their means in standard deviation units. Since, however, they have manifest associations with one another, an aggregate distance has to be determined by ascertaining that part of the difference in mean values, expressed as before, which is played by each character independently of the differences in the others.

Thus the square of the distance between two series in regard to stature (KH) is

$$(kh_1 - kh_2)^2,$$

where kh_1 and kh_2 are the means in terms of standard deviation units for the first and the second series respectively; but if head length (L) is now added, the difference between l_1 and l_2 *independent* of that between kh_1 and kh_2 requires evaluation.

Given the kh of a series for which the correlation coefficients in Table VII are valid, the magnitude of its l independent of kh is

$$Y_2{}^* = l - \cdot 2580\, kh$$

·2580 being the coefficient of correlationbetween KH and L. Y_2 has $l - \cdot 2580 = \cdot 933436$ as its variance and ·966145 as its standard deviation.

If δ denotes the difference between the values of Y_2 for the two series, then the additional contribution made by head length to their distance apart is

$$\delta^2 / \cdot 933436,$$

and the distance represented by both KH and L is

$$(kh_1 - kh_2)^2 + (\delta^2 / \cdot 933436).$$

Similarly, with the addition of each successive character, only that portion of the difference which is independent of the characters already considered needs to be evaluated for D^2. The order in which the characters are taken is immaterial.

Given the values of r in Table VII, the functions for KH, L, B, J, NB, NH' and GH' taken in this order are:

$$Y_1 = kh$$

$$Y_2 = l - \cdot 2580\, kh$$

(standard deviation of $Y_2 = \cdot 966145$)

$$Y_3 = b - \cdot 268522\, Y_2 - \cdot 0409\, Y_1$$

(standard deviation of $Y_3 = \cdot 964895$)

$$Y_4 = j - \cdot 463430\, Y_3 - \cdot 373807\, Y_2 - \cdot 1844\, Y_1$$

(standard deviation of $Y_4 = \cdot 797253$)

$$Y_5 = nb - \cdot 066251\, Y_4 + \cdot 113137\, Y_3 - \cdot 209918\, Y_2 + \cdot 2025\, Y_1$$

(standard deviation of $Y_5 = \cdot 950344$)

$$Y_6 = nh' - \cdot 147879\, Y_5 - \cdot 153285\, Y_4 + \cdot 078552\, Y_3 - \cdot 260813\, Y_2 - \cdot 1091\, Y_1$$

(standard deviation of $Y_6 = \cdot 940304$)

$$Y_7 = gh' - \cdot 516349\, Y_6 - \cdot 222084\, Y_5 - \cdot 211754\, Y_4 - \cdot 046468\, Y_3 - \cdot 159708\, Y_2 - \cdot 3155\, Y_1$$

(standard deviation of $Y_7 = \cdot 751787$).

The additional functions Y_6 and Y_7, involving nasal height and facial height, although unnecessary for the present purpose, are given for possible future use with the Sandawe correlation matrix. The means of kh, l, b, j, nb, nh' and gh' having been determined for any series for which this matrix is appropriate, the values of $Y_1 \ldots Y_7$ can be obtained by substituting them in the above formulae.

The values of $Y_1 \ldots Y_5$ for the six series under consideration, expressed in their standard deviation units, are represented by $y_1 \ldots y_5$ in Table X.

The D^2 between two of them is the sum of the squares of the differences in the values of $y_1, y_2, \ldots$, and all possible Generalized Distances so found are shown in Table XI. Each of these is statistically significant.†

* The symbols Y_1 ($= kh$), Y_2, Y_3, etc., stand for "transformed characters," which are linear functions of the observed characters and are mutually uncorrelated. The method of calculating transformed characters is shown in Mahalanobis, Majumdar and Rao (1949, Appendix 5).

† The significance may be tested by entering the value of D^2 multiplied by the product of the sample sizes and divided by their sum in a χ^2 table for five degrees of freedom.

TABLE X. *Transformed Characters in Standard Deviation Units of Male Khoisan and Other Series*

Series	y_1	y_2	y_3	y_4	y_5
Southern Bushmen	26·0568	32·4936	24·9088	5·1370	16·8733
Northern Bushmen	26·2792	31·9820	23·6048	4·7078	15·6211
Hottentots	27·1605	32·5971	23·6706	5·2372	16·7489
Sandawe	27·5301	31·7890	23·2534	5·5881	16·7691
Nyaturu	27·6655	32·1055	24·7986	5·6207	17·2482
Dahomeans	28·2391	32·5891	25·1985	6·7350	17·9240

TABLE XI. *Values of* D² *between Male Khoisan and Other Series*

Series	Southern Bushmen	Northern Bushmen	Hottentots	Sandawe	Nyaturu	Dahomeans
Southern Bushmen	—	3·76	2·79	3·12	3·12	8·51
Northern Bushmen	3·76	—	2·71	3·82	6·84	16·16
Hottentots	2·79	2·71	—	1·09	2·09	7·12
Sandawe	3·12	3·82	1·09	—	2·78	7·57
Nyaturu	3·12	6·84	2·09	2·78	—	2·42
Dahomeans	8·51	16·16	7·12	7·57	2·42	—

The least distance occurs between the Sandawe and the Nama Hottentots; further, the respective D^2 values between each of these and the other four groups are of the same order. The linguistic evidence, which suggests, but can never prove, kinship, thus receives support from the physical evidence. After the Hottentots, it is the Nyaturu who come nearest to the Sandawe, a fact hardly surprising in view of the intermarriage presumed to have taken place between the two contiguous tribes. The Hottentots occupy a central position among the five South and East African series, being closer to the Southern and the Northern Bushmen, the Sandawe and the Nyaturu than any one of them is to any other. If allowance is made for the aberrant mean values of some of the head measurements of the Northern Bushmen already mentioned, there seems to be a strong Khoisaniform element in the Nyaturu; yet the last have the lowest D^2 of all with the Dahomeans, who are otherwise sensibly removed from the remaining populations—a conclusion perhaps to be expected on *a priori* grounds.

The evidence synthesized by D^2 is clearly to the effect that the Hottentots and the Sandawe are of the same stock and do not merely possess affinities in language; that the traditions of the Sandawe concerning their contacts with the neighbouring Nyaturu are confirmed by the degree of the physical resemblance between them; and that the Bantu-speaking Nyaturu and the distant Dahomeans received their racial make-up partly from the same source. In all, D^2 does not contradict but confirms and extends the inferences made from a consideration of the differences between single characters, and for those characters on which it is based it synthesizes the evidence as individual comparisons could not do, while the latter give the nature of the differences which D^2 synthesizes. Together they make it possible to place, with some confidence, among the Khoisan, or at least the Khoisaniforms, the Sandawe whose physical characters are the prime object of this study.

References

BAGSHAWE, F. J. ... ... 1924 "The Peoples of the Happy Valley (East Africa). Part III. The Sandawi." *J. Afr. Soc., Lond.*, 24.

BARTLETT, M. S. ... ... 1937 "Properties of Sufficiency and Statistical Tests." *Proc. Roy. Soc* Ser. A., 160.

BAUMANN, O. ... ... 1894 *Durch Massailand zur Nilquelle*. Berlin.

BONIN, GERHARDT VON ... ... 1930 "Der Koeffizient der Rassenähnlichkeit und seine Anwendung am Lebenden." *Anthrop. Anz.*, 7.

BRITISH ASSOCIATION COMMITTEE ... 1908 "Anthropometric Investigation in the British Isles." *Rep. Brit. Ass* (Dublin). (Reprinted with additional illustrations by the Royal Anthropological Institute, London, 1909.)

BUNAK, V. V. ... ... 1941 *Antropometria* (in Russian). Moscow.

BUXTON, L. H. DUDLEY, TREVOR, J. C., and BLACKWOOD, BEATRICE. 1939 "Measurements of Oxfordshire Villagers." *J. R. anthrop. Inst.*, 59.

CULWICK, A. T. and G. M. ... ... 1936 "Indonesian Echoes in Central Tanganyika." *Tanganyika Notes*, No. 2.

DART, RAYMOND A. ... ... 1937*a* "The Hut Distribution Genealogy and Homogeneity of the */ʔauni-≠khomani* Bushmen." *Bantu Studies*, 11.

——— ... ... 1937*b* "The Physical Characters of the */ʔauni-≠khomani* Bushmen." *Bantu Studies*, 11.

DAVIES, OWEN L. (ed.) ... ... 1949 *Statistical Methods in Research and Production: with Special Reference to the Chemical Industry* (2nd ed.). Edinburgh.

DEMPWOLFF, OTTO ... ... 1916 "Die Sandawe: Linguistisches und ethnographisches Material aus Deutsch-Ostafrika." *Abh. hamburg. KolonInst.*, 34 (Reihe B, Bd. 19).

FISHER, R. A. ... ... 1946 *Statistical Methods for Research Workers* (10th ed.). Edinburgh.

———, and YATES, F. ... ... 1948 *Statistical Tables for Biological, Agricultural and Medical Research* (3rd ed.). Edinburgh.

GATES, R. RUGGLES ... ... 1944 "Phylogeny and Classification of Hominids and Anthropoids." *Amer. J. phys. Anthrop.*, N.S. 2.

GEARY, R. C. ... ... 1936 "Moments of the Ratio of the Mean Deviation to the Standard Deviation." *Biometrika*, 28.

GRIEVE, J., AND MORANT, G. M. ... ... 1946 "Records of Eye-Colours for British Populations and a Description of a New Eye-Colour Scale." *Ann. Eugen.*, 13.

GUHA, B. S. ... ... 1935 "The Racial Affinities of the Peoples of India." *Census of India, 1931*, I, Part IIIA.

HADDON, A. C. ... ... 1905 "Address to the Anthropological Section." *Rep. Brit. Ass.* (South Africa).

HASLUCK, MARGARET M., and MORANT, G.M. 1929 "Measurements of Macedonian Men." *Biometrika*, 21.

HERSKOVITS,, MELVILLE J. ... ... 1937 "Physical Types of West African Negroes." *Hum. Biol.*, 9.

HOOTON, EARNEST ALBERT ... ... 1946 *Up from the Ape* (rev. ed.). New York.

HUBBS, CARL L. ... ... 1943 "Criteria for Subspecies, Species and Genera, as Determined by Researches on Fishes." *Ann. N.Y. Acad. Sci.*, 44.

KIMMENADE, MARTIN VAN DE ... ... 1936 "Les Sandawe (Territoire du Tanganyika, Afrique)." *Anthropos*, 31.

KITSON, ELISABETH ... ... 1931 "A Study of the Negro Skull with Special Reference to the Crania from Kenya Colony." *Biometrika*, 23.

KOHL-LARSEN, LUDWIG ... ... 1943 *Auf den Spuren des Vormenschen* (2 vols). Stuttgart.

———, and MARGIT ... ... 1938 *Felsmalereien in Innerafrika*. Stuttgart.

LEBZELTER, VIKTOR ... ... 1931 "Zur Anthropologie der Kung Buschleute." *Anz. Akad. Wiss. Wien*, M.-N. Kl., 68.

LUSCHAN, F. VON ... ... 1898 "Beiträge zur Ethnographie des abflusslosen Gebiets in Deutsch-Ost-Afrika. I. Die Wassandaui." (Part V of Werther *infra.*)

MAHALANOBIS, P. C. ... ... 1928 "On the Need for Standardisation in Measurements on the Living." *Biometrika*, 20A.

——— ... ... 1930 "A Statistical Study of Certain Anthropometric Measurements from Sweden." *Biometrika*, 22.

——— ... ... 1936 "On the Generalized Distance in Statistics." *Proc. nat. Inst. Sci. India*, 12.

———, MAJUMDAR, D. N., and RAO, C. R. 1949 "Anthropometric Survey of the United Provinces, 1941: A Statistical Study." *Sankhyā*, 9.

MARTIN, RUDOLF ... ... 1914 *Lehrbuch der Anthropologie in systematischer Darstellung*. Jena.

——— ... ... 1928 *Lehrbuch der Anthropologie in systematischer Darstellung* (2nd ed., 3 vols.). Jena.

——— ... ... 1929 *Anthropometrie* (2nd ed.). Berlin.

MAYR, ERNST ... ... 1949 "The Species Concept: Semantics versus Semantics." *Evolution*, 3.

MONTANDON, GEORGE ... ... 1933 *La Race, les Races*. Paris.

MORANT, G. M. ... ... 1936 "A Contribution to the Physical Anthropology of the Swat and Hunza Valleys Based on Records Collected by Sir Aurel Stein." *J. R. anthrop. Inst.*, 66.

NIGMANN, E. ... ... 1909 "Versuch eines Wörterbuchs für Kissandaui." *Mitt. Seminar. orient. Sprach.*, 12.

OBST, ERICH ... ... 1915 "Das abflusslose Rumpfschollenland im nordöstlichen Deutsch-Ostafrika." *Mitt. geog. Ges. Hamburg*, 29.

PEARSON, KARL ... ... 1926 "On the Coefficient of Racial Likeness." *Biometrika*, 18.

RAO, C. RADHAKRISHNA ... ... 1948 "The Utilization of Multiple Measurements in Problems of Biological Classification." *J. R. statist. Soc.*, Ser. B, 10.

RECHE, OTTO ... ... 1914 "Zur Ethnographie des abflusslosen Gebietes Deutsch-Ostafrikas." *Abh. hamburg. KolonInst.*, 17 (Reihe B, Bd. 11).

RIED, H. A. ... ... 1915 "Zur Anthropologie des abflusslosen Rumpfschollenlandes nordöstlichen Deutsch-Ostafrika." *Abh. hamburg. KolonInst.*, 31 (Reihe B, Bd. 17).

SCHAPERA, I. ... ... 1930 *The Khoisan Peoples of South Africa*. London.

SCHEBESTA, PAUL, and LEBZELTER, VIKTOR 1933 *Anthropology of the Central African Pygmies in the Belgian Congo*. Prague.

SCHULTZE, LEONHARD ... ... 1928 "Zur Kenntnis des Körpers der Hottentotten und Buschmänner." *Denkschr. med.-naturw. Ges. Jena*, 17.

SEINER, FRANZ ... ... 1912 "Beobachtungen und Messungen an Buschleuten." *Z. Ethn.*, 44.

SPEISER, FELIX ... ... 1928 "Anthropologische Messungen aus Espiritu Santo (Neue Hebriden)." *Verh. naturf. Ges. Basel*, 39.

TILDESLEY, MIRIAM L. ... ... 1928 "Racial Anthropometry: A Plan to Obtain International Standardization of Method." *J. R. anthrop. Inst.*, 58.

——— ... ... 1933 "The Albanians of the North and South. *Biometrika*, 25.

——— ... ... 1949 "Techniques of Ear Length and Breadth Measurement Reviewed and Tested." *Arch. Julius Klaus-Stiftung*, 24.

TOPINARD, PAUL ... ... 1891 "Documents sur l'indice nasal du vivant, recueillis par le Dr. Beddoe et M. Lecarguet." *Anthropologie, Paris*, 2.

TREVOR, J. C. ... ... 1938 "Some Anthropological Characteristics of Hybrid Populations." *Eugen. Rev.*, 30.

——— ... ... 1949 "The Metrical Features of Ashanti and Other African Negro Crania." *Homenaje a Don Luis de Hoyos Sainz, I.* Madrid.

TROMBETTI, ALFREDO ... ... 1910 "La lingua degli Ottentoti e la lingua dei Wa-sandawi." *R. C. Accad. Bologna*, Cl. Sci. Mor., Ser. 1, 3.

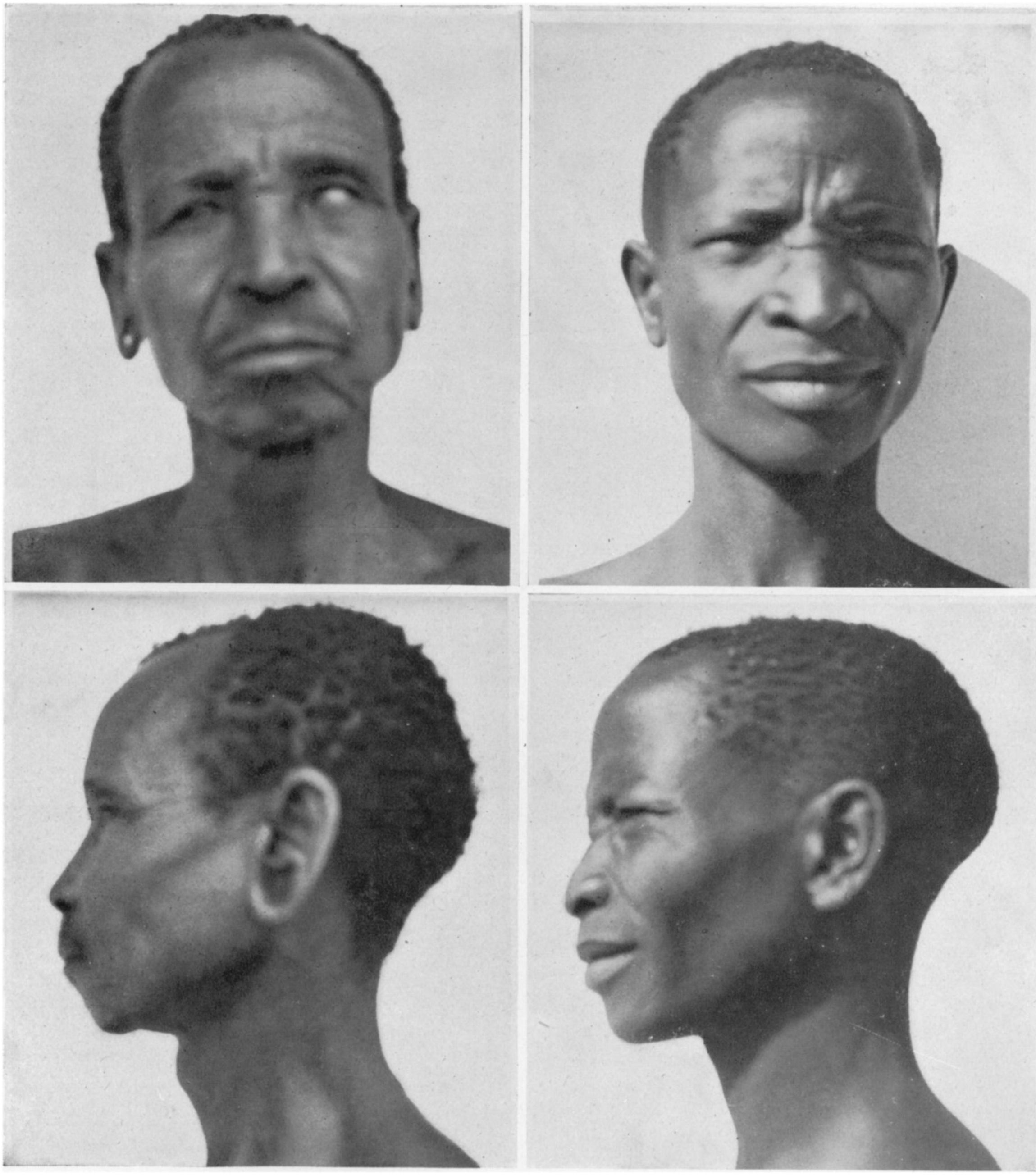
VALLOIS, HENRI-V. ... ... 1934 "La valeur raciale des mensurations et indices du tronc et des membres: essai de classification." *Congr. int. Sci. anthrop. ethn.* (London).

——— ... ... 1944 *Les Races Humaines*, Paris.

VIRCHOW, R. ... ... 1895 "Neue anthropologische Beobachtungen aus Ost-, Süd- und Südwest-Africa." *Z. Ethn.*, 27.

WERTHER, C. WALDEMAR (ed.) ... ... 1898 *Die mittleren Hochländer des nördlichen Deutsch-Ost-Afrika*. Berlin.

WOOD, J. G. ... ... 1868–70 *The Natural History of Man* (2 vols.). London.



TWO SANDAWE

THE OLDER MAN IS A BETTER REPRESENTATIVE OF THE TYPE THAN THE YOUNGER ONE.