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**ANTHROPOLOGICAL OBSERVATIONS ON THE
ANGLO-INDIANS OF CALCUTTA.**

**PART II
ANALYSIS OF ANGLO-INDIAN HEADLENGTH**

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ANTHROPOLOGICAL OBSERVATIONS ON THE ANGLO-INDIANS OF CALCUTTA.

PART II. ANALYSIS OF ANGLO-INDIAN HEAD LENGTH.

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FOREWORD.

The first part of the present study was published in 1922¹. Dr. N. Annandale who had placed the material at my disposal explained its special character in an Introductory Note. The subjects were with very few exceptions men between the ages of 18 and 40, and with a few exceptions belonged to the middle-class of the so-called Anglo-Indians, mostly employed as clerks, mechanical engineers, overseers and so forth, or else fresh from school and about to take up employment of the kind. Dr. Annandale had attempted to eliminate "from the measurements analysed those of persons known to have recent Negro or Mongoloid blood, persons one of whose parents or grand-parents was a Negro or belonged to Mongoloid stock." Dr. Annandale was confident that he had been fairly successful in excluding recent Negro blood, but felt doubtful regarding Mongoloid influences, and was of opinion that probably some Mongoloid admixture was present in many individuals.

"The measurements were taken in the Zoological laboratory of the Indian Museum in the years 1916-1919. They were made.....on one system and with the same instruments. The system was that recommended in the British Association hand-book on anthropology and the instruments were the "Anthropometer" (112) and Instrumententascher (203) supplied by Harman of Zurich."

I must offer an explanation and an apology for the great delay in publishing the second part. The material for this part had been reduced in 1923, but certain unforeseen difficulties prevented its publication.

Dr. Annandale had stated that the chief aim of the investigations was "to throw some light on the question of the origin of human races by fusion." I had planned to study this problem from the statistical point of view in two ways.

- (A) To test the homogeneity (or the heterogeneity) of the Anglo-Indian data.
- (B) To compare quantitatively the Anglo-Indian measurements with those for Indian castes and tribes as well as for races of European origin.

My original intention was to adopt the following routine procedure for testing the homogeneity of the measurements for each character separately :—

- (i) The type of the frequency distribution ;

¹ *Records of the Indian Museum*, Vol. XXIII, April, 1922.

- (ii) Whether a statistical dissection into real components was practicable or not :
- (iii) An empirical comparison of the standard deviation (and the coefficient of variation) with the corresponding values for other races.

As work proceeded it became clear that with a sample of size 200 there was practically no chance of the first two tests being applied with success. In other words, in a sample of 200, the observed frequency distribution could almost invariably be graduated by a normal curve within the limits of errors of sampling. Consequently no significance could be attached to elaborate statistical dissections. I must confess that owing to my inexperience I had adopted a more ambitious programme in this direction than was justified by the size of the sample. After analysing a few characters I, however, definitely abandoned attempts at statistical dissection. Results for the few characters already analysed are being published, not because I attach much anthropological significance to them, but as numerical examples of a method of investigation which might prove more fruitful with larger samples.

The only test of homogeneity left was a comparison of the magnitude of the standard deviation and the coefficient of variation with the corresponding values for other races. I had used Risley's data for Indian castes and tribes for this purpose in my work on stature. I encountered a new difficulty as soon as I came to the indices : I shall discuss this point in detail a little later.

In 1923-24 I approached the question of a systematic comparison of the Anglo-Indian measurements with those of other races. A little before this Prof. Karl Pearson had formulated his well-known Coefficient of Racial Likeness for judging the degree of resemblance between two races. I decided to select a suitable group of Indian castes and tribes from Risley's book and calculate the Pearsonian Coefficient of Racial Likeness (C^2) for each pair of races included in my list. A study of these coefficients would show the inter-connexion between the selected castes. I could then easily calculate the coefficients for the Anglo-Indian measurements, and thus study the relation of the Anglo-Indians to the Indian castes and tribes. I explained my plans to Dr. Annandale at Bangalore in 1924. He immediately became greatly interested in the question, and suggested that I should choose this problem for discussion in my presidential address to the Anthropological Section of the Science Congress in 1925.

As soon as I started work on this problem several difficulties however cropped up. I had a brief opportunity of discussing some of them with Dr. Annandale before his sudden death in April 1924. It was only after his passing away that I fully realised how great a stimulus had been his never-failing interest in my anthropological work, and how handicapped I was without his guidance and advice.

I shall now briefly consider the nature of the difficulties alluded to above :—

(a) *The Need for a Suitable Statistical Formula.*—I selected about 30 castes and tribes from Risley's data and proceeded to calculate the values of the Pearsonian Coefficient of Racial Likeness of 7 Bengal castes

and the Anglo-Indian sample with respect to these 30 selected castes and tribes. The results have been fully discussed in a paper on "Analysis of Race-mixture in Bengal" which was given as the presidential address to the Anthropology Section of the Indian Science Congress in 1925, and was published in the Journal of the Asiatic Society of Bengal (Vol. XXIII, pp. 301-333). A careful study of the values of C^2 obtained by me made me feel extremely doubtful regarding the use of the Pearsonian C^2 in such cases. Although C^2 is an adequate *test* of the existence of divergence between different samples, I could not accept it as a satisfactory *measure* of the amount of such divergence. Values of C^2 were too profoundly affected by the size factor ($\frac{n-n_1}{n+n_1}$) to make it a reliable tool for comparison. I decided to drop the size factor altogether, tentatively developed a new coefficient $D\ddot{s}$ and used it for my analysis in this paper. In 1926-27 I obtained an expression for the probable error of this new coefficient $D\ddot{s}$. In 1928 I used the new formula for an analysis of certain Chinese data¹. In certain papers communicated to the Indian Science Congress, 1929, I further developed the statistical theory of several coefficients of divergence², and finally in a second paper communicated to the Indian Science Congress, 1930, I made a detailed empirical study of the new coefficients on an exceptionally large series of anthropological measurements from Sweden³. The results reached in the above papers show, I think, that a particular coefficient which I have called D^2 , is a suitable measure of divergence. It has all the advantages of the Pearsonian C^2 but does not suffer from any of its drawbacks. In 1927 I had discussed the question of the size-factor with Prof. Pearson in London; at that time he was unable to accept my views. I am glad to note, however, that he has recently revised his views⁴ and has decided to make allowances for the size-factor in C^2 . The values of his new standardised coefficients (C^2 reduced to a standard population⁴) would give practically the same results as my coefficient of divergence (D^2). But the coefficient of divergence (D^2) possesses one great advantage; the theoretical distribution of D^2 has been determined so that in actual practice the probable error of D^2 can be calculated and used for comparison. It should therefore prove distinctly more useful than the standardized coefficient of Pearson.

(b) *Want of Standardisation in the Measurements on the Living.*--A second difficulty was the want of standardisation in the measurements on the living. I obtained incredible results with several series of data of non-Indian origin. I utilised a short period of leave in London in 1927 to study this question carefully. I came to the astounding conclusion that more than 70% or 80% of the data collected by leading anthropologists were probably useless for comparative purposes for want of

¹ *J. A. S. B.*, Vol. XXIII, 1927, Appendix III, pp. 328-329.

² *Journ. As. Soc. Bengal*, Vol. XXIII, 1927, No. 3. Issued 18th September 1928. Appendix III, pp. 329-330.

³ *Man in India*, Vol. VIII, Nos. 2 and 3, April and September, 1928, p. 113. etc.

⁴ This paper on "Tests and Measures of Group Divergence" is in the press and will be shortly published.

⁵ The anthropological results are being published in the *Biometrika*, Vol. XXII, 1930.

⁶ *Biometrika*, Vol. XXB, 1928, pp. 376-378. (Karl Pearson, "Note on Standardization of Method of using the Coefficient of Racial Likeness".)

adequate standardisation in the technique (*Biometrika*, Vol. XXA, 1928, July, Parts I and II). I have decided therefore to abandon for the present the programme of extensive comparison of mean values.¹

(c) *Difficulties in using Risley's data.*—As soon as I started working on the indices given in Risley's book I became aware that Risley's figures were full of discrepancies. Karl Pearson had noticed this in 1903² and had come to the conclusion that such discrepancies rendered Risley's data practically useless. A careful scrutiny showed, however, that the discrepancies were in many cases of such a nature that they could be easily reconciled.

There were obvious printing mistakes such as Mahomedan Vertico-Cephalic Index No. 15 (Vol. I, p. 118) printed 47·9, actual 49·7; Malpahari Vertico-Cephalic Index No. 70 (Vol. I, p. 135) printed 75·0 for actual 70·5, etc. Almost equally obvious were mistakes due to wrong entries, *i.e.*, using an adjoining figure for the correct one in calculating the index, or taking an adjoining (wrong) value from the index-table. These also could be corrected with certainty. In many cases the same individual measurement enters in two or more indices; in such cases mistakes could be eliminated by double or triple checking.

I felt convinced that if the clerical and printing mistakes could be eliminated from Risley's data, they would furnish splendid material for comparative purposes, for the whole series of measurements had been taken by only 3 observers and on one definite system. In 1924 I did not have sufficient leisure to undertake the heavy work of recalculation and checking of over 47,000 individual indices given by Risley. But during the last 2 years the work of recalculation and checking of about 59,000 individual measurements and 47,000 indices given by Risley (together with 792 and 636 mean values) has been steadily pursued and is now nearly complete. I believe that with this revision of Risley's data the greater bulk of them may be used with safety for purposes of comparison.

It will be seen that all these years I have steadily kept before me the programme of a critical analysis of Dr. Annandale's measurements on the Anglo-Indians. There were grave difficulties in the way. All the work I have done in anthropology during the last few years was directed towards removing these difficulties. Some of the difficulties have been surmounted, and the work of analysis can now proceed more smoothly than before. This is my excuse for the long delay.

It will be realised that certain changes in the programme have become inevitable. I propose to publish as quickly as possible the descriptive statistics of Dr. Annandale's measurements. At the same time I shall continue to reduce the revised version of Risley's data, and as soon as the work of reduction is completed I hope to be able to start the actual work of comparison and analysis, following generally the method described in the preliminary paper on "Race-mixture in Bengal."§

¹ I may note, however, that I have devised a photographic apparatus with which I believe it will be possible to take photographs of *profiles* of living persons quickly and under standardised conditions.

² *Biometrika*, II (1902-03), p. 348.

§ *J. A. S. B.*, Vol. XXIII, 1927, Appendix III, pp. 328-329.

Table of Individual Measurements.

Table 1 (*see pp. 139—143*) gives the individual measurements. The card number given in column 2 refers to the serial number in the original records of Dr. Annandale.

Section I.—Frequency Type.

The frequency constants¹ for Head Length were calculated with a grouping unit of 1 mm. and are given in Table 2.

Table 2.—Frequency Constants: Anglo-Indian Head Length.

N = Total number of individuals = 200. Grouping Unit = 1 mm.

Mean (M) = 182.45 50 ± 0.41 15 mm.

Standard Deviation (σ) = 8.62 93 ± 0.29 10 mm.

Coefficient of Variation (V) = 4.72 95 ± 0.15 97

$\beta_1 =$ 0.01 04 44 ± 0.00 82 95.

$\beta_2 =$ 3.71 82 06 ± 0.72 90 84.

$\mu_2 =$ 74.46 42 ± 5.85 49.

$\mu_3 =$ — 65.66 72 ± 115.10 97.

$\mu_4 =$ 20617.38 83 ± 6168.40 85.

It will be seen that neither β_1 nor β_2 differs significantly from the Gaussian values of 0 and 3 respectively. We anticipate therefore that a normal curve should give a good fit. I give in Table 3 a comparison of the observed and expected values of the frequency distribution as graduated by a normal curve.

I adopted a grouping unit of 3 mm. I also distributed the borderline frequencies in observed values, that is, divided them equally between adjoining cells. The actual comparison² is shown in Table 3.

Table 3.—Goodness of fit: Normal Curve.

| Range. | Expected Values (m) | Observed Values (m ¹) | (m—m ¹) ² | $\frac{(m-m^1)^2}{m}$ |
|------------|---------------------|-----------------------------------|----------------------------------|-----------------------|
| Beyond 160 | 0.96 | 1.50 | 0.29 16 | 0.30 37 |
| 160—163 | 1.52 | 3.50 | 3.92 04 | 2.57 92 |
| —166 | 3.57 | 3.50 | 0.01 69 | 0.00 50 |
| —169 | 6.48 | 1.50 | 24.80 04 | 3.82 72 |
| —172 | 11.05 | 14.00 | 8.70 25 | 0.78 75 |
| —175 | 16.13 | 15.00 | 1.27 69 | 0.07 91 |
| —178 | 22.17 | 13.00 | 84.08 89 | 3.79 29 |
| —181 | 26.37 | 30.00 | 13.17 69 | 0.49 96 |
| —184 | 27.00 | 32.50 | 30.25 00 | 1.12 04 |
| —187 | 25.32 | 30.00 | 21.90 24 | 0.86 50 |
| —190 | 21.72 | 21.00 | 0.51 84 | 0.02 39 |
| —193 | 16.01 | 19.50 | 12.18 01 | 0.76 01 |
| —196 | 10.46 | 5.00 | 29.81 16 | 2.85 01 |
| —199 | 5.92 | 4.50 | 2.01 64 | 0.34 06 |
| —202 | 3.16 | 2.00 | 1.34 56 | 0.42 58 |
| —205 | 1.44 | 2.00 | 0.31 36 | 0.21 78 |
| Beyond 205 | 0.92 | 1.50 | 0.33 64 | 0.36 56 |
| | | | | $\chi^2 = 18.84$ 55 |

¹ For explanation of symbols *see* Mahalanobis, 1922, pp. 15-19.

² *See* Mahalanobis, 1922, pp. 35-44.

Summing up column 5, I get $\chi^2 = 18.85$ approximately. The number of cells is 17, therefore n^1 (the number of degrees of freedom) is 16. I find from Biometric Tables XII (p. 27) that corresponding to $n^1 = 16$, $\chi^2 = 18.85$, $P = 0.24$ approximately. That is, the fit would be as bad or worse about once in four trials. The normal curve may therefore be considered to give a satisfactory fit.

Although the normal curve gives a good fit, the observed values of β_1 and β_2 show a tendency towards a distribution of Pearsonian Type IV. I give below the calculated constants for a Type IV curve.¹

Table 4.—Constants for a Type IV curve.

If X = deviation from the origin, and
 Y = corresponding frequency, then

$$Y = Y_0 \left(1 + \frac{x^2}{a^2} \right)^{-m} - v \tan^{-1} \left(\frac{x}{a} \right) \dots \dots \dots (1)$$

where the constants are defined by the following formulæ:—

$$r = \frac{6(\beta_2 - \beta_1 - 1)}{2\beta_2 - 3\beta_1 - 6} = 11.65 \ 52 \ 43$$

$$m = \frac{1}{2} (r + 2) = 6.82 \ 76 \ 21$$

$$v = \frac{r(r-2)\sqrt{\beta_1}}{\sqrt{\{16(r-1) - \beta_1(r-2)^2\}}} = + 0.72 \ 33$$

$$a = \frac{\sigma}{4} \sqrt{\{16(r-1) - \beta_1(r-2)^2\}} = 28.14 \ 53 \ 70$$

The origin is at a distance (va/r) from the Mean, i.e., in this case at 184.1317 mm, and

$$Y_0 = \frac{N}{a \cdot F(r, v)} = 9.6817,$$

where $F(r, v)$ is found from Biometric Table LIV, pp. 126-142.

It is convenient to use the following form for drawing the curve:—

$$x = a \tan \theta \tag{2.1}$$

$$r + 2 - v \theta$$

$$Y = Y_0 \cdot (\cos \theta) \cdot e \tag{2.2}$$

¹ Elderton, pp. 64-73.

Table 5.—Calculations for Type IV curve.

| θ | $28.14537 \times (\tan \theta)$ | $0.3141287 \times -0872620$ $= v \log_{10} e \times \theta$ | Col. (3)—(1) | $13.665243 \times L \cos. \theta$ $(\tau+2) \log \cos. \theta$ | $\log Y_0 = 0.9859508$ Col. (4)+Col. (5) | $\log Y_0 = 0.9859508$ Col. (5)—Col. (4) | $\log Y (+)$ $\log Y_0 + \text{Col. (6)}$ | $\log Y (-)$ $\log Y_0 + \text{Col. (7)}$ |
|----------|---------------------------------|--|--------------|---|---|---|--|--|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 5° | 2.4624 | -0274129 | 1̄.9725871 | 1̄.9773897 | 1̄.9499768 | 1̄.0048026 | 0.9359276 | 0.9907534 |
| 10° | 4.9628 | -0548258 | 1̄.9451742 | 1̄.9092131 | 1̄.8543873 | 1̄.9640389 | 0.8403381 | 0.9499897 |
| 15° | 7.5415 | -0822387 | 1̄.9177613 | 1̄.7944040 | 1̄.7121653 | 1̄.8766427 | 0.6981161 | 0.8625935 |
| 20° | 10.2441 | -1096516 | 1̄.8903484 | 1̄.6311146 | 1̄.5214630 | 1̄.7407862 | 0.5074138 | 0.7267170 |
| 25° | 13.1244 | -1370645 | 1̄.8629355 | 1̄.4165894 | 1̄.2795249 | 1̄.5536539 | 0.2654757 | 0.5396047 |
| 30° | 16.2497 | -1644775 | 1̄.8355225 | 1̄.1471019 | 2̄.9826244 | 1̄.3115794 | 1̄.9685752 | 0.2975302 |
| 35° | 19.7076 | -1918904 | 1̄.8081096 | 2̄.8169715 | 2.6250811 | 2̄.0088619 | 1̄.6110319 | 1̄.9949127 |
| 40° | 23.6167 | -2193033 | 1̄.7806967 | 2̄.4194606 | 2.2001573 | 2̄.6387639 | 1̄.1861081 | 1̄.6247147 |
| 45° | 28.1454 | -2467162 | 1̄.7532838 | 3̄.9446816 | 3.0979654 | 3̄.1913978 | 2̄.6839162 | 1̄.1773480 |
| 60° | 33.5423 | -2741291 | 1̄.7258709 | 3̄.3791150 | 3.1049865 | 3̄.6532447 | 2̄.0909373 | 2̄.6391955 |

Table 6.—Ordinates for Type IV curve.

(Anglo-Indian Head Length.)

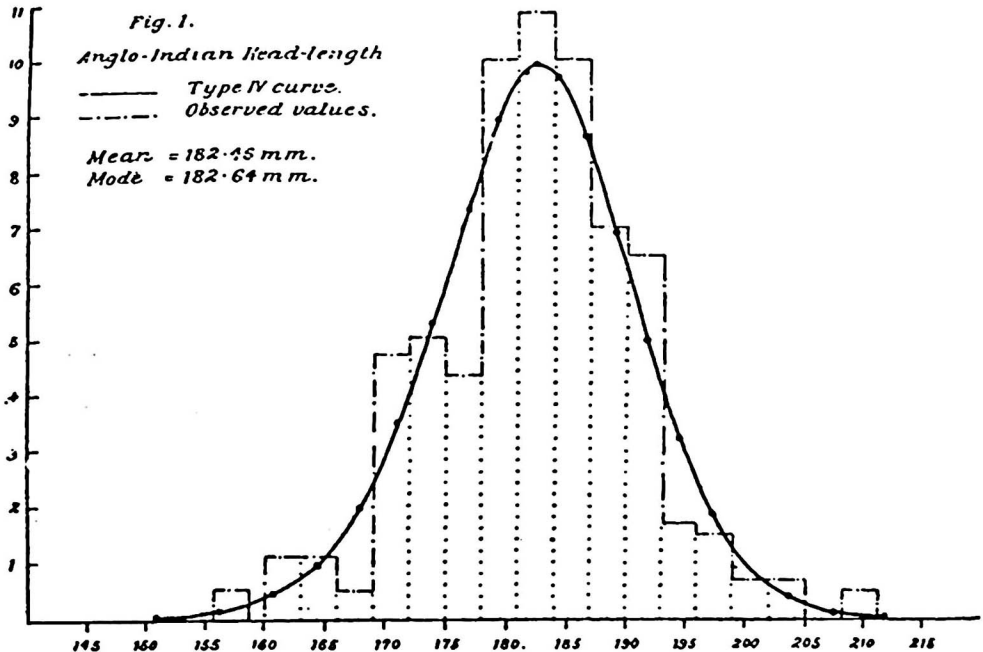
| | 0° | X (in mm.) | Y | | 0° | X (in mm.) | Y |
|---|-----|------------|--------|------|-----|------------|--------|
| — | 50° | 150.5894 | 0.0436 | + | 5° | 186.5941 | 8.6283 |
| — | 45° | 155.9863 | 0.1404 | | 10° | 189.0945 | 6.9237 |
| — | 40° | 160.5150 | 0.4214 | | 15° | 191.6732 | 4.9902 |
| — | 35° | 164.4241 | 0.9881 | | 20° | 194.3758 | 3.2167 |
| — | 30° | 167.8810 | 1.9839 | | 25° | 197.3561 | 1.8428 |
| — | 25° | 170.9073 | 3.4642 | | 30° | 200.3814 | 0.9302 |
| — | 20° | 173.8876 | 5.3299 | | 35° | 203.8393 | 0.4084 |
| — | 15° | 176.5902 | 7.2877 | | 40° | 207.7484 | 0.1535 |
| — | 10° | 179.1689 | 8.9123 | | 45° | 212.2771 | 0.0483 |
| — | 5° | 181.8693 | 9.7893 | + | 50° | 217.6740 | 0.0123 |
| | 0 | 184.1317 | 9.6817 | | | | |
| | | | | Mean | .. | 182.6408 | 9.8682 |

As Type IV is the most difficult curve of the Pearsonian family, I am giving below full details of the calculation in Table 5. I have used intervals of $\theta = 5^\circ$.

Column 1 gives values of θ in intervals of 5° which was sufficiently close for our purposes. Column 2 gives $x = a \tan \theta$, and is formed by putting $a = 28.14537$ on the calculating machine and multiplying directly by successive values of $(\tan \theta)$ obtained from Chamber's (or some other mathematical) tables. Column 3 gives $v \cdot \log_{10}(e)$ multiplied by θ (in radians). Since in this case $v = 0.723308$, and $\log e = 0.4342945$, we have $v \cdot \log_{10}(e) = 0.3141287$. Multiplying this by the value of $\theta = 5^\circ$ (in radians), i.e., by 0.0872620 , we get $.0274129$: we obtain the other figures in column 3 by successive addition. Subtracting unity from column 3, we get column 4 in the usual logarithmic form. Column 5 gives $(r+2) \log \cos \theta$, and is obtained directly by putting $(r+2) = 13.655243$ on the machine, and multiplying through by $(L \cos \theta)$

taken from Chamber's tables. Column 6 is obtained simply by adding together columns 4 and 5, and column 7 by subtracting column 4 from column 5. Adding $\log Y_0 = 0.9859508$ to column 6 and column 7 we get finally the values of "log Y" in column 8 and column 9 for positive and negative values of "x" respectively.

It should be remembered that the origin of the curve is at 184.13 mm. Adding or subtracting the values of x given in Table 5, column 2, we get the values of Head Length in mms. shown in Table 6, column 2. Corresponding to each value of "x" we have the value of "log Y" in columns 8 and 9 of Table 5. Values of "Y" given by the antilogarithms are shown in column 3 of Table 6. For convenience of reference I have given successive values of θ in column 1 of Table 6. The mode ($Y = 9.8682$) occurs at 182.6408 mms. Fig. 1 shows the observed values and the graduation by the Type IV curve.¹



I plotted the Pearsonian Type IV curve on a graph paper on a very large scale (50 cm. \times 42 cm.). The graduated values were then measured graphically from the curve with the exception of the two end-groups ("beyond 160 mm." and "beyond 204 mm."); the values for these two end-groups were obtained by dividing the total remainder proportionately. The observed and graduated values, and the calculations for the goodness of fit are shown in Table 7.

¹The type IV ordinates are given in Table 6, and the curve is shown by a continuous line in Fig. 1. The observed values are shown in the form of rectangles drawn in a broken line. The ordinates for the observed values are given by $\frac{1}{3}$ of the figures given in column (3) of Table 7. (As we are using a grouping unit of 3 mm., the frequencies are divided by 3.)

Table 7.—Anglo-Indian Head Length : Type IV curve.

| Range. | Expected. (m). | Observed. (m ¹). | (m—m ¹) ² | $\frac{(m-m^1)^2}{m}$ |
|------------|-------------------|---------------------------------|----------------------------------|-----------------------|
| 1 | 2 | 3 | 4 | 5 |
| Beyond 160 | 3.00 | 1.5 | 2.25 00 | 0.75 00 |
| —163 | 1.81 | 3.5 | 2.85 61 | 1.57 79 |
| —166 | 3.34 | 3.5 | .02 56 | .00 77 |
| —169 | 6.12 | 1.5 | 21.34 41 | 3.48 76 |
| —172 | 10.29 | 14.0 | 13.76 41 | 1.33 76 |
| —175 | 15.81 | 15.0 | .65 61 | .04 15 |
| —178 | 22.69 | 13.0 | 93.89 61 | 4.13 81 |
| —181 | 27.81 | 30.0 | 4.79 61 | .17 25 |
| —184 | 29.34 | 32.5 | 9.98 56 | .34 03 |
| —187 | 26.42 | 30.0 | 12.81 64 | .48 51 |
| —190 | 20.70 | 21.0 | .09 00 | .00 43 |
| —193 | 14.15 | 19.5 | 28.62 25 | 2.02 28 |
| —196 | 8.21 | 5.0 | 10.30 41 | 1.25 52 |
| —199 | 4.73 | 4.5 | .05 29 | .01 12 |
| —202 | 2.37 | 2.0 | .13 69 | .05 78 |
| —205 | 1.16 | 2.0 | .70 56 | .60 83 |
| Beyond 205 | 2.05 | 1.5 | .30 25 | .14 77 |
| | | | | $\chi^2 = 16.44 56$ |

For 17 cells, $n^1 = 16$, we have $\chi^2 = 16.4$, leading to $P = .357$. The fit is now excellent, for once in three trials the fit would be worse.

We conclude therefore that although the normal curve gives a good fit (with 3 mm. grouping) a more satisfactory fit is given by a Type IV curve.

This result is in agreement with those found by other observers. Goring¹ noted for English criminal data that "a slightly skew curve of Type IV describes our statistics of Head Length rather better than does a normal curve, although the deviation from the normal type is very slight." Tocher² also found that the Head Length of the Scottish insane could be graduated better by a Type IV curve than by a normal curve.

¹ Goring, p. 154.

² Tocher, *Biom.*, V (1906-7), pp. 304-305.

Section II.—Attempts at Statistical Dissection.

I give below the results of mathematical dissections of the frequency-curve. Owing to the smallness of the size of the sample (200) I do not attach much importance to the numerical values; I am quoting them, however, as illustrations of a method of analysis which might prove more fruitful with larger samples.

(a) *Use of "tail" functions*¹.—Fitting a "tail" function to the shorter end I find the following distributions:—

$$m_1 = 181.45, \quad \sigma_1 = 7.55$$

From the longer end I get in the same way,

$$m_2 = 184.96, \quad \sigma_2 = 7.84$$

It will be noticed that these distributions do not differ significantly from the total distribution given by

$$m_0 = 182.46, \quad \sigma_0 = 8.63$$

(b) *Asymmetrical dissection*.—Using Pearson's nonic method² I merely get a trivial solution with

$$\left. \begin{array}{l} m_1 = 183.1 \text{ mm} \\ n_1 = 202.1 \end{array} \right\} \quad \left. \begin{array}{l} m_2 = 251 \text{ mm} \\ n_2 = -2.1 \end{array} \right\}$$

This solution evidently attempts to eliminate the "giant" observation at 212.

(c) *Symmetrical dissection*.—More promising results are given with a symmetrical dissection³. Using the moment-coefficients actually calculated with a grouping unit of 1 mm, but reducing them to a grouping unit of 8 mm for arithmetic convenience, we have:—

$$\begin{array}{l} \mu_3 = 1.17 \ 18 \ 40 \\ \beta_2 = 3.70 \ 49 \ 53 \\ \beta_4 = 23.33 \ 85 \ 99 \end{array}$$

Putting $X = w/\mu_2$, the equation for x is given by

$$(\beta_2 - 3) \cdot X^2 + \frac{5 \beta_2 - \beta_4}{5} \cdot X - \frac{5 \beta_2^2 - 3\beta_4}{15} = 0$$

Substituting numerical values we obtain

$$0.7011 X^2 - 0.9627 X + 0.0914 = 0$$

which leads to $X = +1.2705$, and $+0.1026$

This gives

$$\left. \begin{array}{l} \sigma_1 = 9.76 \text{ mm} \\ n_1 = 153.68 \end{array} \right\} \quad \left. \begin{array}{l} \sigma_2 = 2.77 \text{ mm} \\ n_2 = 46.32 \end{array} \right\}$$

The distribution for Head Length can therefore be broken up into two normal curves with the same Means but widely different Standard Deviations. It will be remembered that we had succeeded in breaking up the Stature distribution in a similar way⁴, and had obtained two components of size 150.11, and 49.89, and Standard Deviations 74.12 mm and 44.89 mm. respectively. The agreement of the analysis in these

¹ Mahalanobis, 1922, pp. 47-49.

² Mahalanobis, 1922, pp. 49-55.

³ Mahalanobis, 1922, pp. 55-57.

⁴ Mahalanobis, 1922, p. 57.

two cases is indeed striking. For both Stature and Head Length about a fourth of the sample appears to represent a stringently selected population.

Section III.—Change of Head-Length with Age.

I have used Pearson's method of Non-linear Regression¹ for investigating the question of growth. The relevant formulæ and constants are given below :—

Let T_p be any age-group, T_0 the mean age for the whole sample, σ_1 the standard deviation for age. Let Y_p be the expected mean Head Length for the p th age-group (*i.e.*, corresponding to T_p), Y_0 the observed mean value of the whole sample, and σ_2 the S. D. for Head Length. Then we write :—

$$t_p = (T_p - T_0) / \sigma_1, \quad y_p = (Y_p - Y_0) / \sigma_2 \dots\dots\dots(1)$$

We can now express y_p as a function of t_p in the following form :—

$$y_p = b_0 + b_1 \cdot t_p + b_2 \cdot t_p^2 + b_3 \cdot t_p^3 \dots\dots\dots(2)$$

Where $b_0, b_1, b_2,$ and b_3 are certain constants which can be calculated from a knowledge of the moment-coefficients.

If N is the total number of observations, we define the mixed moment-coefficient p'_{qq} , by the following formula :—

$$N p'_{qq} = S (T - T_0)^q \cdot (Y - Y_0)^q \dots\dots\dots(3)$$

Where T and Y are the actual age and observed Head Length for any individual, and S denotes a summation for all N individuals.

Here also we can use provisional base numbers T', Y' for convenience of arithmetical calculations, and then transfer to the true mean values T_0 and Y_0 . The required formulæ for such reduction are given below :—

Let $p'_{11}, p'_{21}, p'_{31}, p'_{41},$ etc., be moment-coefficients referred to arbitrary axes T', Y' . Let the distances of T', Y' from T_0, Y_0 be p_{10}' and p_{01}' , respectively.

The moment-coefficients p_{11}, p_{21}, p_{31} and p_{41} referred to true means T_0, Y_0 are :—

$$\begin{aligned} Np_{11} &= Np'_{11} - Np'_{10} \cdot p'_{01} \\ Np_{21} &= Np'_{21} - 2 p'_{10} \cdot Np'_{11} + (p'_{10})^2 \cdot Np'_{01} - p'_{01} \cdot Np_{20} \\ Np_{31} &= Np'_{31} - 3 p'_{10} \cdot Np'_{21} + 3 (p'_{10})^2 \cdot Np'_{11} - (p'_{10})^3 \cdot Np'_{01} \\ &\quad - p'_{01} \cdot Np_{30} \\ Np_{41} &= Np'_{41} - 4 p'_{10} \cdot Np'_{31} + 6 (p'_{10})^2 \cdot Np'_{21} + 4 (p'_{10})^3 \cdot Np'_{11} + \\ &\quad (p'_{10})^4 \cdot Np'_{01} - p'_{01} \cdot Np_{40} \end{aligned}$$

We also define the following quantities (remembering that $\sqrt{\beta_1}$ must be given the same sign as μ_3 or p_{30}) :—

$$\begin{aligned} \beta_1 &= \frac{p_{30}^2}{p_{20}^3}, \quad \beta_2 = \frac{p_{40}}{p_{20}^2}, \quad \beta_3 = \frac{p_{30} \cdot p_{50}}{p_{20}^4}, \quad \beta_4 = \frac{p_{60}}{p_{20}^3} \\ r &= \frac{p_{11}}{\sigma_1 \cdot \sigma_2}, \quad \bar{\epsilon} = \frac{p_{21} p_{20} - p_{11} p_{30}}{\sigma_1^4 \cdot \sigma_2}, \quad \bar{\xi} = \frac{p_{31} p_{20} - p_{11} p_{40}}{\sigma_1^5 \cdot \sigma_2}, \quad \bar{\theta} = \frac{p_{41} p_{20} - p_{11} p_{50}}{\sigma_1^6 \cdot \sigma_2} \\ \varphi_2 &= \beta_2 - \beta_1 - 1, \quad \varphi_3 = (\beta_3 - \beta_1 \beta_2 - \beta_1) / \sqrt{\beta_1}, \quad \varphi_4 = \beta_4 - \beta_2^2 - \beta_1 \end{aligned}$$

¹ K. Pearson : Skew Correlation and Non-linear Regression, 1905.

We then find ²

$$b_2 = (\bar{\epsilon} \cdot \varphi_4 - \bar{\xi} \cdot \varphi_3) / (\varphi_2 \cdot \varphi_4 - \varphi_3^2)$$

$$b_3 = (\bar{\xi} \cdot \varphi_3 - \bar{\epsilon} \cdot \varphi_2) / (\varphi_2 \cdot \varphi_4 - \varphi_3^2)$$

$$b_0 = -(b_2 + b_3 \sqrt{\beta_1})$$

$$b_1 = +(r - b_2 \sqrt{\beta_1} - b_3 \cdot \beta^1)$$

As records for age were not available for 9 subjects, all the constants had to be calculated afresh. Numerical values are given below.

For the age distribution (N = 191) we have

| | | | |
|-------------------|----------------|-----------------------------|------------------|
| Mean age = | 24.27 23 years | σ_1 (S. D. of age) = | 6.332 |
| P ₂₀ = | 40.09 34 48, | P ₅₀ = | 12 84 60.94 88 |
| P ₃₀ = | 3 32.05 01 90, | P ₆₀ = | 2 60 83 02.10 05 |
| P ₄₀ = | 74 93.97 31, | | |

Leading to—

| | | | |
|-------------|----------|--------------------|---------|
| $\beta_1 =$ | 1.71 07, | $\sqrt{\beta_1} =$ | +1.308 |
| $\beta_2 =$ | 4.66 19 | | |
| $\beta_3 =$ | 16.50 76 | $\beta_4 =$ | 40.4706 |

For Head Length we have :—

$$\text{Mean} = 182.1675 \text{ mm, } \sigma_2 = 8.598 \text{ mm.}$$

The mixed moment=coefficients are

| | | | | |
|-------------------|--------------|--------------------|--------------------------|----------|
| P ₁₁ = | +5.21 62, | P ₃₁ = | — 1.76 87 | |
| P ₂₁ = | —3.36 53, | P ₄₁ = | —6066.20 37 | |
| r = | +0.09 58 11, | $\bar{\epsilon} =$ | — 0.13 50 81 | |
| $\bar{\xi} =$ | —0.44 74 75, | $\bar{\theta} =$ | — 1.64 81 10 | |
| $\varphi_1 =$ | +1.95 12, | $\varphi_2 =$ | + 5.21 54, $\varphi_3 =$ | +17.0266 |

We get finally

| | | | |
|---------|--------------|---------|-------------|
| $b_3 =$ | —0.02 79 72, | $b_2 =$ | + .00 55 90 |
| $b_1 =$ | +0.21 89 02, | $b_0 =$ | + .03 10 07 |

The Regression of Head Length on Age may therefore be written :—

$$Y_p = +.031007 + 0.218902 t_p + .005590 t_p^2 - .027972 t_p^3.$$

Calculated and observed values for the different age-groups are shown in Table 8. Fig. 2 exhibits the same results graphically. It will be noticed that the agreement between graduated and observed values is

² Equations (iv) and (liii) of Pearson (1905) p. 25. I have used Pearson's formula (xliz), p. 24.

not very satisfactory. There is a small increase up to the age of 35 years, and then a more rapid decrease.

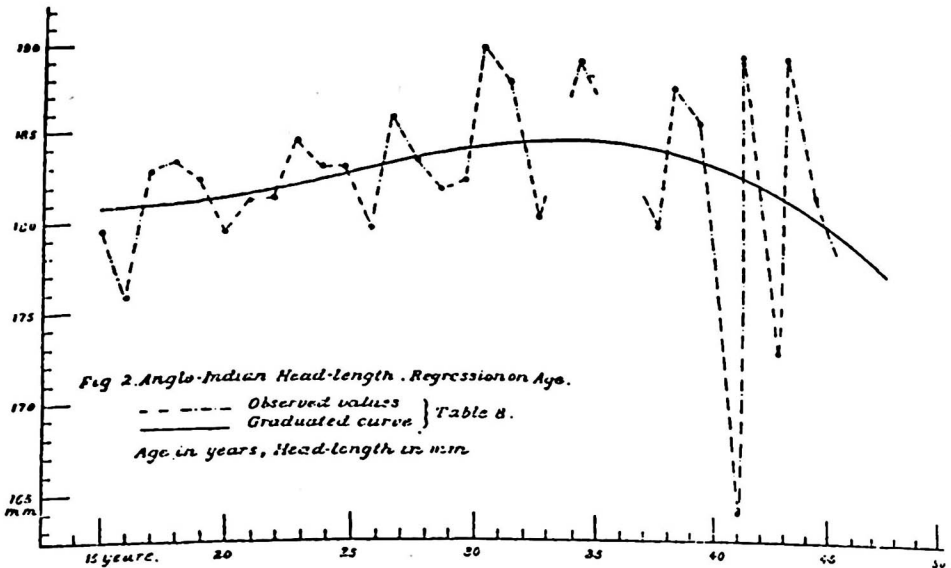


Table 8.—Regression of Head Length on Age.

| Age. | n_p | Observed Values. | Graduated Values. | Age. | n_p | Observed Values. | Graduated Values. |
|------|-------|------------------|-------------------|------|-------|------------------|-------------------|
| 15 | 1 | 179.50 | 180.54 | 32 | 6 | 188.00 | 184.37 |
| 16 | 4 | 175.75 | 180.60 | 33 | 3 | 180.33 | 184.49 |
| 17 | 8 | 182.63 | 180.70 | 34 | — | — | 184.57 |
| 18 | 9 | 183.22 | 180.85 | 35 | 3 | 183.33 | 184.66 |
| 19 | 24 | 182.29 | 181.04 | 36 | — | — | 184.57 |
| 20 | 19 | 179.27 | 181.26 | 37 | — | — | — |
| 21 | 16 | 181.12 | 181.51 | 38 | 1 | 180.00 | 184.29 |
| 22 | 19 | 181.32 | 181.78 | 39 | 2 | 188.00 | 184.05 |
| 23 | 8 | 184.50 | 182.06 | 40 | 1 | 186.00 | 183.72 |
| 24 | 11 | 183.00 | 182.35 | 41 | 1 | 164.00 | 183.31 |
| 25 | 6 | 183.00 | 182.65 | 42 | 2 | 190.00 | 182.81 |
| 26 | 8 | 179.50 | 182.95 | 43 | 1 | 173.00 | 182.20 |
| 27 | 9 | 186.44 | 183.23 | 44 | 1 | 190.00 | 181.49 |
| 28 | 5 | 183.40 | 183.51 | 45 | 1 | 182.00 | 180.68 |
| 29 | 8 | 181.88 | 183.77 | 46 | — | — | — |
| 30 | 12 | 182.33 | 184.00 | 47 | — | — | — |
| 31 | 1 | 190.00 | 184.20 | 48 | 1 | 170.00 | 177.51 |

We can test the significance of the change of Head Length with age by Fisher's method of analysis of variance.¹ In view of the importance of the method I give below full details of the calculations.

Let us consider any particular age-group, say 18. Choose a convenient base number, say 180 mm. From each individual measurement (belonging to the 18th age-group) subtract 180 mm. We then have the following series of 9 deviations for the 9 individuals:—

$$-8, +16, +2, +4, +12, -6, +3, 0, +6.$$

Adding together these 9 deviations we get the total excess $e_{18} = +29$. In the same we can form the total excess (e_p) for each age-group.

Actual calculations are shown in Table 9. Column 1 gives the age-group (p); column 2 gives (n_p) the total number of individuals in the age group. Columns 3 and 4 give the total excess ($+e_p$ or $\times e_p$); column 5 is formed by squaring the total excess and dividing by the number of individuals (e_p^2 / n_p).

Table 9.—*Regression of Anglo-Indian Head Length on Age.*

| 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
|---------------|-------------------------------|-------------------------------|---------------|------------------------------------|-------------------------------|-------------------------------|---------------|
| Age-group (p) | Number in Age-group (n_p) | Excess over 180 mm. $+ e_p$ — | e_p^2 / n_p | Age-group (p) | Number in Age-group (n_p) | Excess over 180 mm. $+ e_p$ — | e_p^2 / n_p |
| 15 | 1 | .. 2 | 4.00 | 31 | 1 | 10 .. | 100.00 |
| 16 | 4 | .. 17 | 72.25 | 32 | 6 | 48 .. | 384.00 |
| 17 | 8 | 21 .. | 55.12 | 33 | 3 | 1 .. | 0.33 |
| 18 | 9 | 29 .. | 93.44 | 35 | 3 | 28 .. | 261.33 |
| 19 | 24 | 55 .. | 126.04 | 38 | 1 | 0 .. | 0 |
| 20 | 19 | .. 14 | 10.32 | 39 | 2 | 16 .. | 128.00 |
| 21 | 16 | 18 .. | 20.25 | 40 | 1 | 6 .. | 36.00 |
| 22 | 19 | 25 .. | 32.90 | 41 | 1 | .. 16 | 256.00 |
| 23 | 8 | 36 .. | 162.00 | 42 | 2 | 20 .. | 200.00 |
| 24 | 11 | 33 .. | 99.00 | 43 | 1 | .. 7 | 49.00 |
| 25 | 6 | 18 .. | 54.00 | 44 | 1 | 10 .. | 100.00 |
| 26 | 8 | .. 4 | 2.00 | 45 | 1 | 2 .. | 4.00 |
| 27 | 9 | 58 .. | 373.78 | 48 | 1 | .. 10 | 100.00 |
| 28 | 5 | 17 .. | 57.80 | TOTAL | 191 | +494 —70 | 2875.01 |
| 29 | 8 | 15 .. | 28.12 | Total excess = | +424 .. | | —941.24 |
| 30 | 12 | 28 .. | 65.33 | Total Variance between Age-groups. | | | =1933.77 |

Adding together columns 3 and 4 we get the total excess for the whole sample + 424.

Summing up column 6 we get 2875.01 which is the variance between the age-groups referred to 180. Subtracting $941.24 = (424)^2/191$, we finally get 1933.77 as the total variance between 29 age groups referred to the true mean.

By direct calculation we find that the total variance referred to the adopted base number 180 mm is 14826. Transferring to the mean value by subtracting $(424)^2/191 = 941.24$, we get finally the total variance (referred to the true mean) = 13884.76. The total variance 13884.76 represents $190 = (191 - 1)$ degrees of freedom. The variance between age-group 1933.77 represents $28 = (29 - 1)$ degrees of freedom. Subtracting 1933.77 from 13884.76 we get 11950.99 as the total variance within the age-group with $190 - 28 = 162$ degrees of freedom. We thus get the following table for the analysis of variance.

| Type of variation. | Degrees of freedom. | Variance. | Mean Sq. | S. D. |
|-------------------------|---------------------|-----------|----------|-------|
| Between age-groups . . | 28 | 1933.77 | 69.06 | 8.31 |
| Within age-groups. . . | 162 | 11950.99 | 73.77 | 8.59 |
| TOTAL VARIANCE . | 190 | 13884.76 | 73.78 | 8.59 |

It would be seen from the above Table that the variation between the age-groups is of the same order as the variation within age-groups. The change of Head Length with age cannot therefore be considered significant¹.

It will be noticed further that the variance within age-groups is 73.77, while the total variance is 73.78. The numerical value of the Standard Deviation will not therefore be reduced by applying a correction for age.

We may investigate the question of significance of the change in Head Length with age in a different way. The Pearsonian "correlation ratio" may be defined as the ratio of the variability between age-groups to the total variability².

$$\eta^2 = \frac{S \{ n_p (\bar{Y}_p - \bar{Y})^2 \}}{S (Y - \bar{Y})^2}$$

The correlation ratio η "provides an upper limit, such that no regression function can be found, the correlation of which with Y (the dependent variable) is higher than η ."³

¹ The observed value of the coefficient of correlation is $r = +.0958 \pm .0484$. In view of the magnitude of the probable error, the correlation cannot be considered significant.

² Pearson (1905), p. 10.

³ Fisher, p. 224.

In this case,

$$\eta^2 = \frac{1933.77}{13084.76} = 0.129273$$

or $\eta = 0.3732$

It is known, however, that even when the material is really uncorrelated a value of

$$(\eta)_0 = \sqrt{(K-1)/N} \pm .6745/\sqrt{N}$$

(where K is the number of arrays, and N the size of the sample) can easily arise through chances of random sampling.¹ In this case we have 29 arrays or 28 degrees of freedom, and N = 191, and hence the random value of $(\eta)_0$ will be $.3829 \pm .488$. The observed value of $\eta = .3732$ is actually less than $(\eta)_0 = .3829$. We must conclude therefore that the observed value of η cannot be considered as indicating a significant correlation between age and Head Length.

A glance at figure 2 would show that there is a more consistent increase in Head Length up to the age of 35 years ; the irregularity comes in beyond that age.

I have therefore thought it worth while to calculate the correlation separately for all individuals up to 35 years of age. By straightforward calculation I find :—

| | | | |
|-------------------------|---------------|-----------------------------|----------------|
| Mean age | = | \bar{x} | = 23.19 years. |
| Variance in age | = S | $(x-\bar{x})^2$ | = 3938.19 |
| Mean Head Length | = . \bar{y} | | = 182.2389 mm. |
| Variance in Head Length | = S | $(y-\bar{y})^2$ | = 11584.73 |
| | | $S (y-\bar{y}) (x-\bar{x})$ | = +1064.64 |

We therefore have the coefficient of correlation

$$r = \frac{+1064.64}{(3938.19)(11584.73)} = +0.1576 \pm .0490, \text{ which may be considered to be just significant.}$$

We can now write down the linear regression equation :—

$$y = \bar{y} + b (x-\bar{x})$$

where $b = S (x-\bar{x}) (y-\bar{y}) / S(x-\bar{x})^2 = +0.2703$

We have then :—

$$y = 182.2389 + 0.2703 (x-23.1944 \text{ years}).$$

The analysis of variance is shown in the following Table :—

| Type of Variation. | Degrees of freedom. | Variance. | Mean Sq. | S. D. |
|------------------------|---------------------|-----------------|----------------|--------------|
| Between Age-groups . . | 19 | 1098.09 | 57.7942 | 7.602 |
| Within Age-groups . . | 160 | 10486.64 | 64.2915 | 8.018 |
| TOTAL . | 179 | 11584.73 | 64.9426 | 8.059 |

¹ Elderton, p. 197.

We again notice that variance between age-groups does not differ appreciably from the variance within age-groups.

The variance between the age-groups ($n' = 19$) consists of a portion which can be represented by a linear regression, and a portion which represents deviations from a straight line.¹ The part represented by linear regression is given by

$$\{S(x-\bar{x})(y-\bar{y})\}^2 / S(x-\bar{x})^2 = \frac{(1064.64)^2}{3938.19} = 385.27$$

We thus have :—

| Variance between Age-groups due to | Degrees of freedom. | Sum of Squares. | Mean Sq. | S. D. |
|------------------------------------|---------------------|-----------------|----------|-------|
| Linear Regression . . . | 1 | 387.25 | 387.25 | 19.68 |
| Deviation from Regression . . . | 18 | 710.84 | 39.49 | 6.28 |
| TOTAL . . . | 19 | 1098.09 | 57.79 | 7.60 |

We can compare the S. D. of 19.68 with the S. D. for variation within age-groups = 8.02 (based on 160 degrees of freedom).

| Type of Variation. | S. D. | Degrees of Freedom. | log. σ |
|-------------------------|-------|---------------------|---------------|
| Linear Regression . . . | 19.68 | 1 | 2.9795 |
| Within Age-groups . . . | 8.02 | 160 | 2.0819 |
| | | | $z = 0.8976$ |

From Fisher's table VI, pp. 212-214. I find that for $n_1=1$ and $n_2=160$, the 5 per cent. value of z is 0.6806, and the 1 per cent. point is .9583. We conclude therefore that the variance due to linear regression is significantly greater than the variance within age-groups. A glance at the above table also shows that deviations from a linear regression are not significant.

The negative result for Non-linear Regression is confirmed by the value of the correlation ratio, $\eta = 0.3079$. In this case we have 20 arrays or 19 degrees of freedom, and $N=180$. $(\eta)_0$ is therefore = .3249 ± .0503. The observed value of $\eta = .3079$ cannot therefore be considered to be significantly different from zero, *i.e.*, it does not indicate any definite non-linear relationship between age and Head Length. The Linear Regression up to the age of 35 years is, however, probably just significant.

Finally, it is worth noting that even for the selected group of individuals up to the age of 35 years, the Standard Deviation within age-groups (*i.e.*, corrected for change with age) is about 8.02 mm. This is lower than the general value of 8.63 mm, but is still excessively high.

¹ Fisher, pp. 221-222.

Table 10.—*Summary Table of Statistics of Head Length.*

N.B.—Col. (2) refers to the Sub-Tables in Table 11. Col. (4)—the number (g) of sub-groups whose variances are combined together. Col. (5)—the total number (n) of individuals in the whole group; the number of degrees of freedom is given by $n'=(n-g)$. Col. (7)—gives the logarithm of the S. D. to the base "e." Cols. (8) and (9)—For combined data the simple arithmetic averages of (V) and (M) are given within brackets. Col. (10)—number refers to the bibliographical list.

| Serial Number | Sub-Table Reference (Table 11). | Name of Group. | Number of Sub-groups (g). | Total Number of Individuals (n). | Standard Deviation (in mm.) σ | $\log_e \sigma$. | Coeff. of Variation $\frac{V}{M}$. | Mean Head Length (in mm.) \bar{M} . | Reference and Remarks. |
|---------------|---------------------------------|-----------------------------|---------------------------|----------------------------------|--------------------------------------|-------------------|-------------------------------------|---------------------------------------|--|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | .. | Kharga Oasis | 1 | 150 | 5.05 ± .20 | 1.6194 | 2.67 ± .10 | 189.00 ± .28 | Hrdlička (16), 1912. |
| 2 | S-1 . . | American Tribes | 13 | 291 | 5.32 ± .15 | 1.6715 | (2.79 ± .08) | (188.35 ± .21) | Boas and Livingston (4) 1898. |
| 3 | S-2 . . | Borneo and Java | 3 | 87 | 5.65 ± .29 | 1.7317 | (3.33 ± .17) | (178.56 ± .41) | Garrett (14), 1912. |
| 4 | .. | Samoa | 1 | 68 | 5.69 ± .33 | 1.7387 | 2.98 ± .17 | 190.6 ± .46 | Sullivan (41), 1921. |
| 5 | .. | Lycian Gypsies | 1 | 53 | 5.73 ± .33 | 1.7457 | 3.25 ± .21 | 176.33 ± .53 | Dudley Dunton (8), 1920 (6) |
| 6 | .. | Aino | 1 | 95 | 5.88 ± .20 | 1.7716 | 3.03 ± .15 | 193.78 ± .41 | Koganei (20), 1893. |
| 7 | S-3 | East African Tribes | 30 | 1509 | 6.03 ± .07 | 1.7969 | (3.05 ± .04) | (189.53 ± .10) | Lays and Joyce (23), 1913. |
| 8 | .. | Egyp (West Africa) | 1 | 100 | 6.28 ± .20 | 1.8374 | 3.27 ± .18 | 191.48 ± .42 | Malcolm (28), 1925. |
| 9 | .. | African Tribes (combined) | 31 | 1600 | 6.05 ± .07 | 1.8001 | (3.06 ± .04) | (189.60 ± .10) | (7) and (8) combined. |
| 10 | S-4 . . | Modern Egyptians | 17 | 9436 | 5.98 ± .02 | 1.7884 | (3.12 ± .02) | (190.96 ± .04) | Craig (7) and Orenstein (33), 1915-1917. |
| 11 | .. | Egyptian Mo-lems | 1 | 369 | 6.09 ± .15 | 1.8066 | 3.13 ± .08 | 194.50 ± .21 | Brit. Assoc. Rep. (5), 1905. |

Table 10.—Summary Table of Statistics of Head Length—contd.

| Serial Number | Sub-Table Reference (Table II). | Name of Group | Number of Sub-groups (g). | Total Number of Individuals (n). | Standard Deviation (in mm.) σ | log σ . | Coeff. of Variation V. | Mean Head Length (in mm.) \bar{M} . | Reference and Remarks. |
|---------------|---------------------------------|-------------------------------|---------------------------|----------------------------------|--------------------------------------|----------------|------------------------|---------------------------------------|--|
| 1 | 2 | S | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 12 | .. | Egyptians Total | 18 | 9805 | 5.99±.02 | 1.7901 | (3.12±.02) | (191.16±.04) | (10) and (11) combined. |
| 13 | .. | Egyptians and African Tribes. | 49 | 11414 | 6.00±.02 | 1.7918 | (3.10±.01) | (191.71±.03) | (9) and (12) combined. |
| 14 | .. | English, General Sample . | 1 | 4721 | 6.26±.04 | 1.8342 | 3.20±.02 | 195.56±.06 | Harmon (16), 1926. |
| 15 | .. | Oxford Students . | 1 | 959 | 6.23±.09 | 1.8294 | 3.17±.05 | 196.05±.13 | Schuster (40), 1911-12. |
| 16 | .. | Cambridge Students . | 1 | 1000 | 6.16±.09 | 1.8181 | 3.18±.05 | 193.51±.13 | Macdonell (27), 1901-2. |
| 17 | S-5 . | Cambridge Students . | 1 | 1011 | 6.12±.09 | 1.8116 | 3.15±.05 | 194.32±.13 | Pearson (35), 1906. |
| 18 | .. | English, Non-Criminal . | 4 | 7690 | 6.23±.03 | 1.8294 | (3.17±.02) | (194.86±.05) | (14), (15), (16) and (17) combined. |
| 19 | .. | " Non-habitual Offenders . | 1 | 3000 | 6.05±.05 | 1.8001 | 3.15±.03 | 191.66±.08 | Macdonell (27), 1901-2. |
| 20 | .. | " Habitual Criminal | 1 | 2348 | 6.39±.06 | 1.8547 | 3.34±.03 | 192.45±.09 | Goring (15), 1918. |
| 21 | .. | " Criminals (combined). | 2 | 5348 | 6.20±.04 | 1.8245 | (3.25±.02) | (192.05±.06) | (19) and (20) combined. |
| 22 | .. | " Total | 1 | 13038 | 6.22±.03 | 1.8278 | (3.20±.01) | (193.92±.04) | (18) and (21) combined. |
| 23 | S-6 . | Swedish, Total | 17 | 46983 | 6.19±.02 | 1.8229 | 3.20±.01 | 193.84±.02 | Lundborg and Lindars (26), 1926. |
| 24 | S-7 . | Greeks (combined) | 2 | 198 | 6.21±.21 | 1.8262 | 3.39±.11 | 185.34±.30 | Brit. Assoc. Rep., 6, 1913. Schilt (39), 1914. |
| 25 | .. | Ukrainians | 1 | 249 | 6.02±.18 | 1.7951 | 3.27±.10 | 184.10±.26 | Pech (38), 1925. |

| | | | | | | | | | |
|----|------|------------------------|----|-------|------------|--------|--------------|----------------|--|
| 26 | .. | Austrians | 1 | 192 | 6.03 ± .21 | 1.7967 | 3.17 ± .11 | 1.0.16 ± .29 | (4) Brasina and Wastl (4), 1929. |
| 27 | .. | Europe (combined) | 27 | 60660 | 6.20 ± .01 | 1.8245 | (3.23 ± .01) | (192.14 ± .02) | (22), (23), (24), (25) and (26) combined. |
| 28 | S-8 | Chinese Turkestan | 25 | 600 | 6.33 ± .12 | 1.8458 | (3.34 ± .06) | (184.74 ± .17) | Joyce (19), 1912 |
| 29 | .. | Armenians | 1 | 75 | 6.30 ± .35 | 1.8406 | 3.38 ± .19 | 186.5 ± .49 | Boas (2), 1924. |
| 30 | S-9 | Scottish Insane | 2 | 4756 | 6.54 ± .05 | 1.8779 | .. | .. | Tocher (46), 1906-7. |
| 31 | S-10 | Polynesians (combined) | 4 | 449 | 6.85 ± .15 | 1.9242 | (2.56 ± .08) | (189.81 ± .22) | Sullivan (41), (44), 1921 1922, 1923, 1923. |
| 32 | .. | Malta | 1 | 561 | 6.63 ± .13 | 1.8916 | 3.51 ± .07 | 188.70 ± .19 | Dudley-Buxton (10), 1922. |
| 33 | .. | Gozo | 1 | 82 | 6.55 ± .34 | 1.8795 | 3.57 ± .19 | 185.88 ± .49 | Dudley-Buxton (10), 1922. |
| 34 | .. | Cyprus | 1 | 556 | 7.00 ± .14 | 1.9459 | 3.87 ± .08 | 180.81 ± .20 | Dudley-Buxton (9), 1920 (b). |
| 35 | .. | Crete | 1 | 320 | 7.24 ± .19 | 1.9796 | 3.76 ± .10 | 191.76 ± .52 | v. Luschan (21), 1913. |
| 36 | S-11 | Eastern Mediterranean | 4 | 1549 | 6.91 ± .08 | 1.9315 | (3.03 ± .04) | (86.66 ± .12 | (82), (33), (34) and (35) combined. |
| 37 | .. | Koreans | 2 | 552 | 7.10 ± .14 | 1.9601 | 3.91 ± .08 | 181.37 ± .20 | Kubo (21), 1913. |
| 38 | .. | Serblans | 1 | 196 | 7.33 ± .25 | 1.9918 | 4.03 ± .14 | 181.91 ± .85 | Lebretter (22), 1923. |
| 39 | .. | Inner Mongolia | 1 | 52 | 7.57 ± .50 | 2.0242 | 4.00 ± .26 | 188.27 ± .71 | Dudley-Buxton (11), 1923. |
| 40 | .. | American Negroes | 1 | 961 | 6.51 ± .10 | 1.8733 | 3.31 ± .05 | 196.50 ± .14 | Herskovits (17), 1927. |
| 41 | S-12 | Poynesian Mixed | 1 | 122 | 7.47 ± .32 | 2.0109 | 3.98 ± .17 | 187.70 ± .46 | Sullivan and Winkler (44), 1929. |
| 42 | .. | Anglo-Indians | 1 | 200 | 8.03 ± .29 | 2.1552 | 4.73 ± .16 | 182.45 ± .41 | |

Section IV.—Material for the comparison of Variability in Head Length.

For reasons already explained in the foreword I do not propose to compare at this stage the mean value of the Anglo-Indian Head Length with the mean values for other groups. My main object in the present section is to gain some idea regarding the homogeneity (or otherwise) of the Anglo-Indian Head Length by a comparative study of the Standard Deviation and the Coefficient of Variation. I have collected data relating to different parts of the world which were easily available in Calcutta, but have not attempted to compile an exhaustive list.

The data are given in Tables 10 and 11. I shall start in the middle of Table 10, and begin with the English groups.¹

(14). *English, General Sample*.—The sample consists of measurements of males in Francis Galton's second Anthropometric Laboratory series of age-groups 4-7 to 70-80 years. The standard deviations were however corrected for age and reduced to a standard age of 45.5 years.² The value of S. D., 6.26, may therefore be considered to be a fairly reliable estimate of the general variability in English Head Length.

(15). *Oxford Students*.—The subjects were of ages between 18 to 23 and over, and were measured in the Anthropological laboratory of Oxford. Schuster was of opinion that the numbers available were not sufficient to make any definite statement regarding the changes of head measurements with age, but there was some indication that the Head Length increased during the period dealt with.³ Owing however to the small magnitude of the change (if any), I have not thought it necessary to correct the variances for age changes, and have taken the total variance of the whole group.

(15), (16). *Cambridge Students*.—We have two different series. W. R. Macdonell⁴ gave the results for a series of 1,000 male students of Cambridge. Pearson⁵ gave the figures for 1,011 male Cambridge students divided into four sub-groups, 1st Class, IInd Class and IIIrd Class Honours and Poll-men. The detailed figures are given in Table 11, S. 4, Nos. 71-74.

We can test the significance of the differences in Standard Deviation of the students in different classes by Fisher's method.⁶

Let σ_1 and σ_2 be the two S. D.'s based on n_1' and n_2' degrees of freedom. Let

$$Z = \log_e \sigma_1 - \log_e \sigma_2 \quad . \quad . \quad . \quad . \quad (1)$$

where natural logarithms to base "c," (and not to the base 10) are taken. Fisher states that when (n_1') and (n_2') are both large, or are moderately large but equal or nearly equal, then the distribution of Z is sufficiently normal to enable us to use the S. D. of Z which can be written:—

$$\Sigma_z = \sqrt{\frac{1}{2} \left(\frac{1}{n_1'} + \frac{1}{n_2'} \right)} \quad . \quad . \quad . \quad . \quad (2)$$

¹ The number within brackets before each group refers to the serial number in Table 10.

² Harmon, *Biom.* XVIII (1926), pp. 207-220.

³ Schuster, p. 48.

⁴ *Biom.* I (1901-2), p. 177.

⁵ *Biom.* V (1906-7), p. 124.

⁶ *Statistical Methods*, Chap. VII, p. 194.

Here n_1' and n_2' represent the numbers of degrees of freedom of the two samples respectively. The number of degrees of freedom of any S. D. can be obtained from the consideration that if n =total number of individuals, and g =number of sub-groups whose variances are pooled together, then the number of degrees of freedom is $n'=(n-g)$; usually when the S. D. refers to a single group, $g=1$, and $n'=(n-1)$.

Applying this test to the 1st Class and IInd Class Cambridge Students we obtain :—

| Name of Group. | Degrees of Freedom. | σ | $\log_e \sigma$ | $\frac{1}{2n'}$ |
|----------------------|---------------------|----------|-----------------|-----------------|
| 1st Class | 152 | 5.89±.23 | 1.7733 | .003289 |
| IInd Class | 181 | 6.03±.21 | 1.7967 | .002762 |
| | | | Z=.0234 | .006051 |

Thus $Z=.0234$, while the variance of $Z=.006050$, or $\sum_z=.0828$. We conclude therefore that Z is not significantly different from zero, *i.e.*, the difference in the two Standard Deviations is not significant. In this particular case this fact is apparent from the magnitude of the probable errors, and n' being fairly large for both samples, we could have made direct use of the probable errors. But as n' will be small in many cases, we shall be often obliged to use Fisher's method.

In the same way we find that the differences in S. D. between the other groups are practically insignificant. I have therefore used the figures for the whole groups of 1,011 students given in Table 10, No. 17.

Comparing the two Cambridge series given by Macdonell and Pearson, respectively, I find $Z=0.0065$, with $\sum_z=0.033$, or the difference to be quite inappreciable. I have combined the two variances to give a value of $\sigma=6.14$, with $n'=2011-2=2009$. If we compare this combined Cambridge series with the Oxford students we find $Z=.0146$, $\sum_z=.0278$. The difference in S. D. is therefore negligible.

Comparing the General Sample with the Cambridge Students we have :—

| | n' | σ | $\log_a \sigma$ | $\frac{1}{n'}$ |
|------------------------------|------|----------|-----------------|----------------|
| General Sample | 4720 | 6.26 | 1.8342 | .000212 |
| Cambridge Students | 2009 | 6.14 | 1.8148 | .000498 |
| | | | Z=.0194 | .000710 |

$Z=.0194$, The S. D. of $Z=\sqrt{.000355}=.0188$. The difference is again negligible.

We may therefore combine the variances for the General, the 2 Cambridge, and the 1 Oxford samples, by adding the different values

of variances and dividing by the total number of degrees of freedom. We obtain in this way :—

| | g | n | σ | n' |
|------------------------|-----|------|----------|---------------|
| Combined English . . . | 4 | 7690 | 6.23 | $7690-4=7686$ |

The combined variance is based on 4 sub-groups and 7,690 individuals. The number of degrees of freedom is therefore given by $7,690-4=7,686$. We may use $\sigma=6.23$ as a reliable estimate of the variability in Head Length of a general English population.

Certain other non-criminal English data are available. For example, F. von. Luschan's ¹ measurements of 84 members of the British Association. The actual value of $\sigma=6.16$, which is in excellent agreement with the other values. The size of the sample is however, very small. Pearson ² has given the statistics for a long series of School Boys, $n=2298$, $\sigma=6.51$. I have not, however, used this material as it refers to young children, and would not be strictly comparable with our adult data.³ I have also omitted Gladstone's hospital data, for Blakeman in analysing the data came to the conclusion that the hospital sample differed "in some essential features from the general population."⁴

(19), (20). *English Criminals*.—We may now consider the criminal data from England.

We have two long series. Macdonell ⁵ obtained the measurements of 3,000 convicts from the Central Metric Office, New Scotland Yard. The majority of the prisoners were English and Welsh, many were Irish, and only a few Scotch; no foreigners or youths under 21 were included. The cards were drawn at random from the mass on the office shelf, and we have therefore a random sample. These subjects were prisoners whose crimes and sentences were comparatively slight and who may therefore be called "non-habitual criminals."⁶

In Goring's data ⁷ observations were taken consecutively on all those sentenced to Penal Servitude after the 1st June, 1902, until 3,000 individuals had been measured. Goring has divided the data into six sub-groups according to the nature of the crime. The difference in the S. D. for Head Length, were however, found to be usually negligible.

| Name of Group. | n | σ | $\log \frac{\sigma}{e}$ | $\frac{1}{2n'}$ |
|------------------------------|-------|----------|-------------------------|-----------------|
| Non-habitual Criminals . . . | 3,000 | 6.05 | 1.8001 | -00016622 |
| Criminals (Goring) . . . | 2,348 | 6.39 | 1.8547 | -00021304 |
| | | $z=$ | -0546 | -00037926 |

¹ v. Luschan, *Zeit. f. Ethn.* 1914, pp. 58-80 (Table 11, No. 76).

² Pearson, *Biom.* III (1904), pp. 131-194.

³ The lowest age among the Anglo-Indians is 15, while the average age is greater than 24 years.

⁴ Blakeman, *Biom.* IV (1905), p. 125.

⁵ Macdonell, *Biom.* I (1901-2), p. 177.

⁶ Goring, p. 140.

⁷ Goring, Preface, p. 6.

Applying Fisher's test, we find that $Z=0.546$, with the S. D. of $Z=0.195$, which indicates a just significant difference in variability between the two samples. It is necessary to remember, however, that Goring's data covers a much wider range of ages, and the greater variability can certainly be partly assigned to this cause. Goring¹ himself has shown that if a correction for age is applied (with the help of the co-efficient of correlation between age and Head Length) the S. D. becomes reduced to 6.32.

The weighted average of the combined criminal data is given below :—

| | σ | n | σ | v |
|-------------------------|----------|-------|----------|------|
| English Criminals . . . | 2 | 5,348 | 6.20 | 3.25 |

Comparing this with the combined general English value (S. D.=6.23 $n'=7,686$), we find $Z=0.048$ with $\Sigma_z=0.126$. We conclude, therefore, that there is practically no difference in the variability of Head Length between English Criminal and Non-criminal data.

(23). *Swedish Groups.*—Detailed statistics for certain Swedish groups are given in Table 11, S-6.

The Swedish material is taken from "The Racial Characteristics of the Swedish Nation."² It consists of measurements of 46,983 conscripts and regular soldiers belonging to the Swedish army and navy. The subjects were all born in Sweden and were over 20 and under 22 years of age. The birth place of the persons examined was chosen as the basis of a regional grouping of the material into 5 territories :—four rural districts and the biggest cities. The material from the 4 rural territories was further classified into 4 groups on an occupational basis. In this way 17 sections were obtained altogether. There is very little difference in variability between the different territories, and a careful analysis of the original data shows that the material can be considered to be thoroughly hybridised.*

(24). *Greeks.*—Table 11, S-7 gives data for two short series of Greeks. The 99 Greek reformatory youths were measured by W. L. H. Duckworth.³ The author was of opinion that the material presented the character of a mixed stock of humanity.⁴ The 99 adult males from Mani (Southern Pelponnese) were measured by Schiff.⁵ There is no significant difference in the variability between the two Greek samples and the variances have been combined to give a value of $\sigma=6.21$ ($n=198$).

(25). *Ukrainians.*—Most of the subjects were peasants and nearly 75% were illiterate.⁶ The place of origin of the subjects could be deter-

¹ Goring, p. 142.

² Edited by H. L undberg and F. J. Linders, Swedish Institute of Race-Biology. Uppsala, 1926.

³ Duckworth, *Brit. Assoc. Rep.* 1912, pp. 224-268.

⁴ Duckworth, *ibid.*, p. 260.

⁵ Schiff, *Zeit. f. Ethn.* 1914, pp. 14-40.

⁶ P och, *Mitt. d. Anthrop. Ges. Wien*, LV (1925), pp. 289-333.

* See P. C. Mahalanobis: "A Statistical Study of certain Anthropometric Measurements from Sweden." *Biometrika*, Vol. XXII, 1930, pp. 106-107.

mined with certainty in most cases, both the parents usually belonging to the same or neighbouring villages. Although 517 male individuals of all ages from 1 year to 90 years were measured, the figures given here refer to adult men only.

(26). *Austrians*.—The subjects were 192 Tramway employees of Vienna, 25 to 50 years old. Nearly two-thirds of the parents were born in German-speaking countries while the remainder belonged to the Slav-speaking districts.¹

The differences in variability between Ukrainians, Austrians and Greeks (combined) are negligible. In spite of the large values of n_1' and n_2' , the All-English and the Swedish values also do not differ appreciably. Although both Ukrainians (6.02) and Austrians (6.03) have considerably lower values than the All-English (6.22), the Swedish total (6.19) or the Greeks (6.21), the differences are not significant in any case.

If we combine the variances of the above European groups, we obtain $\sigma=6.20$ approximately.

I think this figure, $\sigma=6.20$, may be considered to be a reliable estimate of the typical variability in Head Length for such thoroughly mixed but stable European groups as the English, the Swedish, the Greeks, the Ukrainians or the Austrians.

I shall now consider values of σ less than 6.20.

(7). *East African Tribes*.—We have a fairly long series of 1,509 individuals belonging to 30 different tribes.² Actual values are given in Table 11, S-3.

Leys and Joyce stated that "the measurements were procured mainly at the town surgery, Mombassa, from sick who came for advice; great care was taken in classifying the subjects according to tribe; no account was taken of a man's place of birth or residence but careful enquiries were made as regards their ancestry. It may be objected that statistics derived from measurement of the sick do not fairly represent racial types. To this it may be answered, firstly that the majority of cases were trivial; secondly that no individual was included who was suffering from a complaint which might affect head-form or stature; thirdly, about one-third were really not sick at all. Of the last mentioned about 100 were villagers seen at a mission station, another 100 or so were prisoners, chiefly political, in Mombassa gaol, and about 300 were police or applicants for admission to the police force All measurements were taken on adult males. Taken as a whole therefore the data may be regarded as fairly representative."³

Considerable inter-mixture has taken place among the agricultural tribes. "The pastoral tribes (most of the Nilotes), however, have been less affected, since, being more mobile, they have avoided disaster by periodical migrations, according to seasons, within a more or less well-defined district. Thus there has been a greater tendency to preserve homogeneity of type within the tribe, a tendency which has some time been enforced as among the Masai, by a social system which refuses to

¹ Lebzelter, *Mitt. d. Anthropol. Ges. Wien*, LIII (1923), pp. 1-40.

² Leys and Joyce, *Jour. Roy. Anthropol. Inst.* XLIII (1913), pp. 195-267.

³ Leys and Joyce, *ibid.* p. 195.

incorporate a stranger."¹ The Somali is comparatively pure but the Nilotic Kovirondo, and the Kachamega are believed to be of mixed origin.

In most cases the differences in variability are not significant. The Baganda (7.18) and the Rabai (7.25) have, however, significantly greater variabilities than the Nandi (4.06), Suk (4.24) and Lamu (4.68). Otherwise differences, although here and there suggestive of real effects, cannot be considered definitely significant. The combined weighted average S. D. of the 30 tribes is 6.03 ($n'=1479$).

(8). *West Africa.*—One short series of 100 adult males of Egap tribe is available.²

Egap is a small tribe belonging to the Tikar group of tribes in the grass land area of the Western Cameroon. The 100 males chosen were selected between the ages of 20 and 50 years, and no element other than age appeared in making the selection.

The S. D. of 6.28 suggests a greater variability than the East African tribes (6.03).

The author states that by reason of certain external influences such as the importation of women from other areas, and slavery, the homogeneous character of the tribes has been altered considerably even within the past few years.³

As the Egap variability is not however significantly different from the variability of the East African tribes, I have combined their variances to give a general African tribal variability of 6.05 ($n=1609$, $g=31$, $n'=1578$).

(10). *Modern Egyptians.*—We have splendid material for the modern Egyptians (shown in Table 11, S-4).

Craig's data⁴ consist of a series of 10,000 measurements of modern Egyptian Criminals taken from the whole collection absolutely at random. Rejecting records of women and boys or youths, a total of 9,436 individuals were obtained. The subjects were classified according to their birth place.

We also have a long series of 802 male Cairo-born Egyptians (in which youths under 20 were rejected) taken from the same criminal group, and analysed by Orensteen.⁵

The variability differs very little from place to place, and only one particular district Daquahlia (6.65) appears to have a significantly higher variability than two other districts Benisuef (5.65), and Minia (5.71). Combining the variances for the 17 districts we obtain an average variability of $\sigma=5.98$.

(11). We have a further series of *Egyptian Moslems*.⁶ The subjects consist of "the Moslem Egyptians whose parents had been born in like regions of Egypt or the Sudan. All the subjects belonged to the native Egyptian army."⁷

¹ Leys and Joyce, p. 198.

² Malcolm, *M.d. Anth. Ges. Wien*, 1925, pp. 5-45.

³ Malcolm, *ibid.* p. 43.

⁴ Craig, *Biom.* VIII (1911-12), pp. 66-78.

⁵ Orensteen, *Biom.* XI (1915-17), pp. 67-81.

⁶ *Brit. Assoc. Rep.* 1905, pp. 207-208.

⁷ *Brit. Assoc. Rep.* 1905, p. 207.

There is no significant difference in variability between the Moslem Egyptian soldiers (6.09, $n'=368$) and the other Egyptians (5.98, $n'=9,419$) for $Z=.038$, with the S. D. of $Z=.038$.

Combining the variances we obtain an average variability of 5.99 for 18 groups of Modern Egyptians, ($n=9,805$, $n'=9,787$).

I give below the results of comparison of the Modern Egyptians with several other groups.

| Name of Group. | g | n | σ | Z | Σ |
|---------------------------------|-----|--------|----------|-------|----------|
| Egyptians (combined) . . . | 18 | 9,805 | 5.99 | .. | .. |
| English (Non-criminals) . . . | 3 | 6,680 | 6.24 | -0409 | -0140 |
| „ (Criminals) . . . | 2 | 5,348 | 6.20 | -0344 | -0124 |
| All-English (combined) . . . | 6 | 13,038 | 6.22 | -0377 | -0095 |
| Swedish (combined) . . . | 17 | 46,983 | 6.19 | -0328 | ·0079 |
| African Tribes (combined) . . . | 31 | 1,609 | 6.05 | -0100 | ·0192 |

It is clear that the Modern Egyptian variability is definitely lower than the variability of such stable (although highly mixed) European groups as the English or the Swedish.

On the other hand there is no significant differentiation in variability between the Egyptians and the African tribes. Combining the variances of the African tribes and the Modern Egyptians we obtain a Total African variability of $\sigma=6.00$ ($g=49$, $n=11,414$, $n'=11,365$).

I shall now consider a few primitive groups with observed S. D.'s less than 6.00. The actual values are given in Table 10.

(6). *Aino*.—A short series of 95 individuals was fully described by Koganei.¹ The Ainos are supposed to form a very homogeneous group, and it is interesting to note that the S. D. (5.88) is comparatively low. Owing to the smallness of the size of the sample we are, however, unable to assert that the variability is definitely lower than the European combined (6.20) or the African combined (6.00) values.

(5). *Gypsies*.—We have a short series of Lycian Gypsies described by Dudley Buxton² who says "Lycian Gypsies form a small indigenous religious community which claims to keep itself free from inter-mixture with Christian Greeks or Moslems. The purity of the Lycian Gypsies will be seen to be specially striking because they live amongst an unusually mixed population". The value of the S. D., 5.73, cannot be asserted to be significantly different from 6.00 owing to the very small size of the sample, but is probably really lower.

(3). *Borneo and Java*.—We have three short series of Banjarese (33), Sundanese (37) and Javanese (17) given by Garrett.³ The num-

¹ Koganei, 1893.

² Dudley Buxton, *Biom.* XIII (1920-21), p. 96.

³ Garrett, *Journ. Roy. Anthropol. Inst.* XLII (1912), pp. 60-66. Details given in Table 11, S-2.

bers are of course much too small to yield many significant differences. Owing to the isolated nature of the groups, and their possible connexions with India I have, however, thought it worth while to include them. Differences between the three groups are, of course, insignificant on account of the very small size of the samples. Combining the variances we obtain a S. D. = 5.65, with $n' = 87 - 3 = 84$.

The difference with the European combined (6.20) although suggestive of a real effect ($Z = .0928$ against a S. D. of $Z = .0772$) cannot be called significant.

(4). *Samoan*.—Sullivan¹ has given a short series of 68 adult male natives of the Islands of Savaii and Upolu of the Samoan group. All persons with known intermixture with European or with other races were excluded. The author notes: "our series is noteworthy for its homogeneity. Taken character for character the variability is very small. As compared with a series of pure Sioux Indians and another series of Sioux-White half-bloods, the co-efficient of variation for nearly every character is apparently smaller than that of either of these groups."² Although owing to the smallness of the size of the sample significant differences cannot be asserted in many cases, it is probable that the Samoans are more homogeneous than the Modern Egyptians or African tribes.

(2). *American Tribes*.—We have an interesting series of 13 Red Indian Tribes with a total number of 291 individuals from British Columbia.³ The actual values of the S. D. were calculated by me from the original records. There are no significant differences in the variability between the different tribes, and the combined S. D. 5.32, ($n' = 278$) has been given in Table 10.

The variability is now definitely and significantly lower than the combined European value (6.20), Z being 0.1530 with a S. D. of $Z = .0425$, and also from the combined African value (6.00) with $Z = .1203$ and $\Sigma_z = .0429$. The difference with Aino ($Z = .1001$, S. D. of $Z = .0845$) is suggestive without being definitely significant.

(1). *Kharga Oasis*.—The inhabitants of Kharga Oasis in Egypt form one of the most isolated communities in the whole world. Hrdlicka⁴ is of opinion that "the bulk of the population maintained or renewed itself principally through natural augmentation"⁵ and that "the majority of the people are as yet but little mixed with the Negro."⁶ In fact he goes so far as to assert that "the type of the Kharga natives is substantially the same as that of the population of the Oasis during the first part of the Christian Era."⁷ It is therefore not at all surprising that the S. D. (5.05) comes out to be extremely small.

The differences from combined European ($Z = .2051$, $\Sigma_z = .0567$) and combined African ($Z = .1724$, $\Sigma_z = .0583$) are definitely significant

¹ Sullivan, *Mem. Bern. P. Bish. Mus.* VIII (1921-23), pp. 81-98.

² Sullivan, *ibid.* p. 82.

³ Boas and Livingston, *Brit. Assoc. Rep.* 1898, pp. 628-644. Details quoted in Table 11, S-1.

⁴ Hrdlicka, *Smith. Miscell. Coll.*, Vol. 59 (1912).

⁵ Hrdlicka, p. 7.

⁶ Hrdlicka, p. 102.

⁷ Hrdlicka, p. 103.

and from the Aino group ($Z=0.1522$, $\Sigma_z=.0931$) a little more than suggestive.

We find therefore that Aino, Lycian Gypsies and the Java and Borneo combined groups probably have a variability less than 6.00. The Red Indian tribes have a still lower variability (5.32), and the inhabitants of Samoa and Kharga Oasis come at the bottom with the extremely low values of 5.25 and 5.05 respectively.

We have now got a rough scale or levels towards the lower end. Highly mixed but stable European groups apparently have a variability of the order of 6.20, still more homogeneous groups like modern Egyptians and African tribes of the order of 6.00; then come such groups as Aino or the samples from Java and Borneo with a S. D. of the order of say 5.75. The Red Indian tribes, Samoans or the inhabitants of Kharga Oasis very likely have a variability lower than 5.50.

We can now consider variabilities greater than 6.20 mm.

(28). *Chinese Turkestan*.—Joyce¹ has discussed a fairly long series of 609 male adults belonging to 25 different tribes and localities.

The material was collected by Sir Aurel Stein and represents the inhabitants of most of the towns and villages round the deserts at Khotan, Pamir, etc. and also certain tribes of the mountaneous countries to the West and South-West.²

The relevant statistics are given in Table 11, S-8. The numbers in the sub-groups are in many cases extremely small, and it is no longer possible to use the general formula for the S. D. of Z given by equation (2), p. 118. We must now use one of the Tables given by Fisher.³ For example, let us take the case of Charklik ($\sigma=9.11$, $n=12$) and Nissa ($\sigma=4.62$, $n=9$). In the usual way we find $Z=0.6790$. Looking up Fisher's table on p. 212 (for $P=.05$), I find that for $n_1'=8$ and $n_2'=11$, $Z=0.5406$: but the observed value (0.6790) is considerably greater. We conclude that the probability is less than .05 that Z is not different from zero. That is, chances are greater than 20 to 1 against the difference between the two variabilities being negligible. As a matter of fact using the Table on p. 214 ($P=.01$), we find that chances are of the order of 60 to 1 in favour of their being different.

In the same way we find that the Charklik and Karanghu-taggh have significantly higher variabilities than the Nissa, Hami, Sarikoli and Turfan; otherwise differences are not significant. The combined variability for 25 tribes is 6.33 ($g=25$, $n=609$).

The combined variability of the inhabitants of Chinese Turkestan (6.33) is just significantly greater than 6.00, but is not significantly different from the stable European variability of 6.20. The balance of evidence is therefore in favour of the view that the tribes of Chinese Turkestan are definitely more heterogenous in their composition than the modern Egyptians, and possibly more so than stable European groups.

¹ Joyce, *Jour. Roy. Anthropol. Inst.* XLII (1912), pp. 450-484.

² Joyce, p. 450.

³ *Statistical Methods for Research Workers*, pp. 212-215.

(29). *Armenians.*—Boas¹ has given a short series of 75 Armenians who were born in Asia but had immigrated to the U. S. A., and were measured in New York. The S. D. (6.3) is of the same order as the general European variability (6.20), but is possibly slightly greater.

(30). *Scottish Samples.*—One long series of insane, one short series of insane convicts, and one short series of students are available (details given in Table 11, S-9.)

Tocher² analysed the insane data, and was of opinion that the 4381 males represented substantially what may be termed the ordinary, normal asylum, or general insane population, *i.e.*, those mentally affected but not suffering from other specific diseases. The subjects were all adults and came from different asylums in Scotland. The differences in the variability of Head Length between the different asylums are usually negligible, but the differences in mean values are in many cases significant. In fact Tocher commenting on the variation of the mean value from asylum to asylum came to the conclusion that "individual asylum groups as a whole cannot be said to form part of a general insane population of a homogeneous character".³ The same author gives the figures for 375 habitual criminals in Scottish asylums. The composition of the Non-criminal Insane and Criminal Insane were not identical; the latter contained about 35 per cent. of subjects of Irish extraction, while the former had a much smaller proportion. The data for the Aberdeen University students are also quoted from Tocher's⁴ paper. The Scottish figures are given in sub-table 9 of Table 11.

There is no significant difference in the variability of the Non-criminal and the Criminal Insane data. The Aberdeen students however have a significantly lower variability than either of the other two samples (for Criminal Insane $Z=0.1168$, with $\Sigma_z=.0485$, and for Non-criminal Insane, $Z=0.1338$, with $\Sigma_z=.0336$). This lower variability may be partly due to the lower range of age or some kind of selection in the student data, without access to the original material it is difficult to say anything further. The greater variability of the other two samples may on the other hand be a real characteristic of all insane data, or may be due to the existence of a real heterogeneity among the inhabitants of Scotland.

Let us compare the Scottish Insane (combined Criminals and Non-criminals) with the All-English :—

| | n' | $\log \sigma$ | $\frac{1}{2} \cdot \frac{1}{n'}$ |
|--------------------------------------|--------|---------------|----------------------------------|
| Scottish Insane (combined) | 4,756 | 1.8779 | -00010517 |
| English, Total | 13,038 | 1.8278 | -00003831 |
| | $Z=$ | 0.0501 | -00014348 |

¹ Boas, *Zeit. f. Ethn.* 1924, pp. 74-82.

² Tocher, *Biom.* V (1906-07), pp. 298-350

³ Author's italics, p. 327.

⁴ I have not had access to the original paper referred to by Tocher: *Anthropological Proceedings of the Aberdeen University.*

We have $Z=0.0501$, with $\Sigma_z=0.012$. There cannot be any doubt regarding the significance of the difference.

In this case we can definitely assert that owing either to racial heterogeneity of the Scottish people or to some peculiarity of the insane data the Scottish group is significantly more variable than stable European groups.

(31). *Polynesians*.—The researches of Sullivan¹ have made available a good deal of valuable data relating to Samoa, Tonga, Marquesas, and Hawaii. (Table 11, S-10.)

Tongan.—Sullivan² states "the material consists of complete description and measurements of 225 persons, 121 men and 104 women. Of these 10 were of mixed descent and were discarded. Of the remaining 215, 184 were adults more than twenty years of age and 31 adolescents. The averages.....of all measurements except stature are based on persons of eighteen years old and upwards. The material was not consciously selected and represents persons of all social classes and occupations. It may be regarded as a fair qualitative sample of the Tongan people."

The Tongan sample is considerably more variable than the Samoan. Owing to the small size of the Samoan sample the Z -test is not definitely significant ($Z=0.1914$, $\Sigma_z=1085$), although strongly suggestive of a positive effect. Sullivan ascribes the greater variability to Melanesian intermixture of comparatively recent origin.³

Marquesan.—Sullivan⁴ gives the following description of the material: "when the admitted mixed-bloods, senile and adolescent individuals were eliminated there remained two series consisting of 84 adult men and 74 adult women. Three persons with a small amount of Hawaiian blood were included in the analysis..... The material was not selected and represents persons of all social classes and occupations. It may be regarded as a fair qualitative sample of the Marquesan people of to-day. Incidentally the 201 persons represent about 11 per cent. of the total population." The Marquesan and Tongan samples do not show any appreciable difference in S. D., both being nearly equally heterogeneous. Sullivan⁵ is of opinion that both are mixed peoples, and he believed that he could recognise two distinct types, and possibly a third type also.

Hawaiian.—The material was collected by Sullivan and analysed by Wissler after Sullivan's death with the help of Sullivan's notes. The first group of 206 Hawaiian adult males consist of persons "whose parentage gave every assurance of true Hawaiian descent". In the smaller group of 47 were included "those concerning whom Sullivan entertained doubts. From his notes it seems that he considers the chances as favouring the pure descent of this group in contrast to the segregated mixed group."⁶ All the subjects considered here were 20

¹ Sullivan, *Mem. Ber. P. Bish. Mus.*, Vols. VIII and IX (1921, 1922, 1923 and 1927).

² Sullivan, *ibid.*, VIII (1922), p. 233.

³ Sullivan, *ibid.*, VIII (1922), p. 257.

⁴ Sullivan, *ibid.*, IX (1923), p. 141.

⁵ Sullivan, 1923, p. 233.

⁶ Sullivan and Wissler, 1927, p. 271.

to 59 years old. A sample of older men was available, but I have not taken it into consideration.

It will be noticed that the smaller group actually shows a lower variability (6.37) than the larger one (6.78). I think this may be interpreted as definitely confirming Sullivan's belief that the former also consists of persons of pure descent. Pooling the variances we get a Hawaiian variability of 6.72 ($n=253$).

The Hawaiian sample (6.72) is not significantly differentiated from the Tongan (6.89) or the Marquesan (7.00) in S. D. The difference between Hawaiian (6.72) and Samoan (5.69) is however strongly suggestive of a real effect ($Z=.1664$, $\Sigma_z=.0972$). Omitting Samoans, we may combine the Tongan, Marquesan, and Hawaiian groups together and obtain a S. D. of 6.85 ($n=449$, $g=4$).

This combined Polynesian S. D. (6.85) shows a just significant difference from Samoan (5.96), Z being 0.1855 with $\Sigma_z=.0927$. The difference with the Scottish Insane falls a little short of significance, but the excess over the stable European groups (6.26) is definitely significant ($Z=.0997$, $\Sigma_z=.0337$).

(36). *Eastern Mediterranean.*—We have several rather heterogeneous groups from the Eastern Mediterranean countries.

(32), (33). *Malta and Gozo.*—Dudley Buxton has collected and fully described the material.¹ The individuals measured included among the men representatives of all social classes (professional men, gunners, militia, government messengers, men doing short sentences, paupers, and by far the largest number, men in the street). All those who were either born of Maltese parents abroad or although born in Malta were not of pure Maltese parentage were rejected.² The author gives a brief review of the history of the islands, and notes that the population of the urban districts (including as it does a very large proportion of the total inhabitants of the island) is completely new to its present surroundings.³ The author gives separate figures for Malta Urban ($\sigma=6.60$, $n=237$), Malta Rural (6.68, $n=157$), Siggewe (6.33, $n=80$) and Zurrico (6.51, $n=87$). As there are no significant differences in variability between these geographical sub-groups I have used the variability of the total sample of 561 Maltese as a whole.

(34). *Cyprus.*—These measurements were also taken by Dudley Buxton.⁴ The population is highly mixed. The author says: "today one man in every 5 is a Turk. . . . some of the villagers are pure Turkish, some mixed, some pure Greek"⁵ and also that "it would appear probable that there has been a considerable influx of Negro blood at least since 1591 and possibly before."⁶

(35). *Crete.*—The material was collected by F. von Luschan.⁷ The 320 adult males belonged to 19 different Eparchies (geographical

¹ Dudley Buxton, *Jour. Roy. Anthropol. Inst.*, LII (1922), pp. 164-211.

² Dudley Buxton, p. 195.

³ Dudley Buxton, p. 101.

⁴ Dudley Buxton, *Jour. Roy. Anthropol. Inst.*, L (1920), pp. 183-235.

⁵ Dudley Buxton, p. 192.

⁶ Dudley Buxton, p. 200.

⁷ Luschan, *Zeit. f. Ethn.*, 1913, pp. 307-393.

division in Crete) and were of all classes: gendarmes, soldiers, tailors, workmen, shop-keepers, lawyers, and men in the street.

There are no significant differences in variability between Malta, Gozo, Crete and Cyprus. Although there is no question of these samples belonging to the same race, I have combined the variances of the 4 groups in order to obtain a typical figure for the variability of Head Length in the Eastern Mediterranean. I may note that this combined variability (6.91) is significantly greater than the variability of a neighbouring group, the Greeks (6.21).

The Eastern Mediterranean groups (6.91) are definitely more heterogeneous than either the Scottish Insane ($\sigma=6.54$, $Z=.0836$, $\Sigma_x=.0207$), or the Chinese Turkestan tribes ($\sigma=6.33$, $Z=.0862$, $\Sigma_x=.0329$).

Going beyond $\sigma=7.00$, we have the following groups.

(37). *Koreans*.—A long series of measurements on both the Cavalry and Infantry sections of the Korean army has been described by Kubo.¹ The great variability (7.10) of the data may be partly ascribed to the fact that a considerable amount of inter-mixture has probably taken place between the Koreans and the Chinese in recent years owing to the rapid penetration of the latter into the Northern territories. I have shown elsewhere from a study of an ensemblage of 16 head characters that "the Koreans show very great resemblance with the Chinese of Manchuria, and moderate but quite appreciable association with the Northern and Eastern Chinese."² I also found that the variation within the Chinese provinces was higher in Head Length than in many other characters.³ This would also partly explain the greater variability of the Koreans, in case, as we have very little doubt, intermixture with the Chinese of different provinces has actually occurred.

(38). *Serbiens*.—Lebzelter⁴ gives the measurements of 196 Serbians mostly belonging to North-West Serbia, who were taken war prisoners and were measured in Cracow in 1916.

(39). *Inner Mongolia*.—Dudley Buxton⁵ has given a short series of measurements on 52 adult males. "Most of the people measured came from the neighbourhood of Halong Osso (a small part of the country lying on the trade route to Urga immediate North of the wall at Kalgán) and were measured in the mission (in May 1922). All those who were not of full Mongolian blood have been excluded from the final count." Buxton explained that by Mongol he meant simply the inhabitants of Mongolia.

White and Coloured Inter-mixtures.—I have been able to collect two series representing White and Coloured inter-mixtures.

(40). *American Negroes*.—Herskovits⁶ has recently published an important paper on the American Negro. The author says, "the word Negro is, biologically, a misnomer, for the African Negroes, brought

¹ Kubo, 1913.

² Mahalanobis, 1928, pp. 117—118.

³ Mahalanobis, 1928, p. 122.

⁴ Lebzelter, *Mit. d. Anth. Ges. Wien.*, CLIII (1923), pp. 1—49.

⁵ Dudley Buxton, *Jour. Roy. Anthropol. Inst.*, LVI (1926), pp. 143—161.

⁶ Herskovits, *Anthrop. Anzeig.*, IV (1927), pp. 293—316.

to the United States as slaves, have crossed in breeding with the dominant white population, as well as with the aboriginal American Indian types with whom they came into contact, so that there is today, a small percentage of the American Negroes who may be considered to be Negro in the ordinary sense of the term." ¹ He states that "through the use of genealogies which were checked by Anthropometrical measurements", ² it has been found that only about 20 per cent.—25 per cent. of the American Negroes are of unmixed African stock. The remainder have varying amounts of mixture with White, American Indian, or both types. According to the genealogies, about one-quarter to one-third of the American Negroes claim partial American Indian ancestry, and most of the individuals who make this claim are also mixed with White. However, it is the White mixture which is more important from our point of view, for whatever Indian mixture occurred, as far as this series is concerned, took place so long ago, and was of such small quantity when compared with the amount of White crossing which took place, that it is biologically of small moment.

The present group represents, therefore, a people in which intermixture has been going on for several generations. It is, therefore, not surprising to find that the variability in Head Length is comparatively low, 6.51, which is of the same order as (in fact slightly less than) the variability of the Eastern Mediterranean or Polynesian groups. It may also be partly due to a similarity in the size of the Head Length between the White and the Negro populations of America.

(41). *Polynesian-White Inter-mixture.*—Sullivan and Wissler³ have given a small number of cases of Hawaiian and Asiatic, Hawaiian and South European, and Hawaiian and North-American crosses. Wissler remarks that the term Asiatic was used by Dr. Sullivan, apparently because one or two Japanese crosses were included, most of the individuals tested being Chinese. In reality the group should be designated Hawaiian-Chinese. The South European Group, males only, contain 10 Portuguese, 5 Spaniards, 1 Italian, and 3 Portuguese-Negroid ancestry. The North European group represent crosses between Hawaiians, White American English, a few Germans, and one or two Frenchmen, in which the English (Irish, Scotch, and English) predominate. To facilitate comparison the various sub-groups have also been combined in different ways in Table 11, S-12.

The values for the various Hawaiian mixtures are given in Table 11, S-12. The numbers are too small to give any significant differences in variability between the sub-groups. The Hawaiian All-mixture variability (7.47) is, however, quite high. It is significantly greater than the variabilities of American Negroes, Tribes of Chinese Turkestan, Scotch Insane, and stable European groups. Owing to the smallness of the size of the sample we are unable to assert significant difference from Serbians, Inner Mongolia, Armenians, or the Eastern Mediterranean groups.

¹ Herskovits, p. 293.

² Herskovits, p. 294.

³ Sullivan and Wissler, *Mem. Ber. P. Bishop Mus.*, IX (1927).

Scale of Variability.

I think we may now attempt to construct a scale of variability for Head Length, or rather, in view of the paucity of materials, a rough division into different levels or orders of variability.

Below $\sigma=5.50$ we have such exceptionally homogeneous groups as the inhabitants of Kharga Oasis (5.05) or American Indian tribes (5.32). Between 5.50 and 6.00 occur isolated groups like the inhabitants of Borneo and Java (5.65), Samoan (5.69), Lycian Gypsies (5.65), or Aino (5.88). The modern Egyptians and African tribes are represented by a fairly reliable level of $\sigma=6.00$. A little higher up we have another reliable level at $\sigma=6.20$ which represents the variability of stable European groups like the English or the Swedish. Between 6.25 and 6.50 we have such groups as the tribes of Chinese Turkestan (6.33), Armenians (6.3) and the Scottish Insane (6.54), the latter owing its comparatively greater variability either to the existence of a real heterogeneity (in Head Length) among the Scottish peoples or to some kind of peculiarity of an Insane population. Between 6.50 and 7.00, but nearer the upper end, we have the Polynesian (6.85) or Eastern Mediterranean groups (6.91). In these cases it is practically certain that the groups are affected by recent inter-mixture or are communities of comparative recent settlement and growth. The Koreans (7.10), Serbians (7.33) or the inhabitant of Inner Mongolia (7.57) all show S. D.'s greater than 7.00. It is probable that each of these groups is really heterogeneous to some extent or have been subjected to considerable inter-mixture in recent years. As far as may be judged from the present material, the upper limit of the variability of samples which would be ordinarily considered to form distinct groups probably exists somewhere near $\sigma=7.50$.

The Co-efficient of Variation.—In the main Tables 10 and 11 the Co-efficient of Variation ($V=100 \sigma/M$) is given in Col. (8) and Col. (9) respectively. In the case of combined data I have merely given the simple arithmetic average of the different values of V , and have not thought it worth while to calculate the weighted average.

The serial order for σ and V , although not exactly identical, are generally in agreement. For the most homogeneous groups such as Kharga Oasis, American Tribes, Samoan, etc., V is usually slightly greater than 3.00, the combined African value being 3.10 (1.01). For stable European groups V is of the order of 3.20, the average value for Europe being 3.23. For the more mixed groups like the tribes of Chinese Turkestan or Scottish Insane, V lies between 3.30 and 3.50. For the Polynesian groups or the races of the Eastern Mediterranean, individual values of V usually vary between 3.50 and 3.75, average values for Polynesian and Eastern Mediterranean groups being 3.56 and 3.68 respectively. In the case of the Koreans, the Serbians, and the inhabitants of Inner Mongolia, the Co-efficient is of the order of 4. The American Negroes show a value of $V=3.31$, which is slightly greater than the value for stable European groups. The Polynesian mixture on the other hand has a value $V=3.98$. We may therefore consider $V=4$ to constitute a kind of upper limit for groups with definite claims to homogeneity.

Inter-racial Variation.

The material in Table II represents data from different parts of the world and covers a wide field. We may use it for gaining some idea regarding the nature of the inter-racial variation. For this purpose I used 92 groups for which N was 25 or more. The frequency distributions for Standard Deviation (σ), the Co-efficient of variation (V), and the Mean Head Length (M), are shown below.

| Standard Deviation. (σ) | | Co-efficient of Variation. (V) | | Mean Head Length. (M) | |
|-------------------------------------|-------------|-----------------------------------|-------------|--------------------------|------------|
| Range. | Frequency. | Range. | Frequency. | Range. | Frequency. |
| Less than 4.50 | 1 | 2.375—2.500 | 3 | 176—177 | 2 |
| —4.75 | 4 | —2.625 | 2 | 178—179 | 1 |
| —5.00 | 1 | —2.750 | 3 | 180—181 | 6 |
| —5.25 | 3 | —2.875 | 3 | 182—183 | 4 |
| —5.50 | 3 | —3.000 | 6 | 184—185 | 5 |
| —5.75 | 9 | —3.125 | 11 | 186—187 | 7 |
| —6.00 | 11 | —3.250 | 32 | 188—189 | 10 |
| —6.25 | 29 | —3.375 | 10 | 189—191 | 27 |
| —6.50 | 13 | —3.500 | 8 | 192—193 | 17 |
| —6.75 | 6 | —3.625 | 5 | 194—195 | 11 |
| —7.00 | 6 | —3.750 | 1 | 196—197 | 2 |
| —7.25 | 3 | —3.875 | 3 | | |
| —7.50 | 3 | —4.000 | 4 | | |
| | | | | Total | =92 |
| Total | = 92 | —4.125 | 1 | | |
| | | Total | = 92 | | |

The frequency constants for the different statistics are given below.

| Inter-racial Constants. | Standard Deviation. (σ) | Co-efficient of Variation. (V) | Mean Head Length. (M) |
|-------------------------------------|-------------------------------------|-----------------------------------|--------------------------|
| Mean value | 6.08 \pm .035 | 3.21 \pm .16 | 189.35 \pm .32 |
| Standard Deviation | 0.59 \pm .029 | 0.33 \pm .016 | 4.55 \pm .23 |
| Co-efficient of Variation | 9.70 | 10.28 | 2.40 |

The mean value of σ , i.e., the intra-racial variability, is 6.08 mm. This represents the average degree of variation within a homogeneous group. The value of Σ , the inter-racial variability, is 4.55 mm. This represents the variation of the Mean values of the different groups. It will be noticed therefore that the variation in Mean Head Length from group to group is actually less than the average variation of individual Head Lengths within a single group.

I must note, however, that owing to the preponderance of the stable European and the relatively more homogeneous African and Egyptian samples, the observed value of the inter-racial variability (4.55 mm.) is likely to be an under-estimate. As far as we can judge from the present material, we may conclude therefore that the inter-racial variability in Head Length is of the same order as, or a little less than, the intra-racial variability. I think this result is more in keeping with the monogenetic, rather than with the polygenetic, view of the origin of the human species.

Further, allowing a deviation of roughly twice the standard deviation on either side of the mean, we find that for the intra-racial variability the normal range of fluctuation is approximately from 5.00 to 7.25, and for the Co-efficient of variation from 2.50 to 4.00 for ordinary homogeneous samples.

Section V.—Anglo-Indian Variability.

Standard Deviation.—Compared to the values of the S. D. discussed above there is no doubt that the Anglo-Indian variability ($\sigma=8.63$) is excessive. In actual magnitude it is greater than any variability we have come across in the present material based on a sample of 25 or more. The differences between the Anglo-Indian variability and the variabilities given in the main Tables 10 and 11 are in every case statistically significant with only two exceptions: Hawaiian All-mixture (7.47) and the Inner Mongolian sample (7.57). In both these cases the size of the sample is small, and the statistical insignificance may very well be due to the large errors of sampling.

We must conclude, therefore, that the Anglo-Indian sample shows an abnormally high variability in Head Length and definitely indicates recent inter-mixture. It may also be partly due to Head Length being one of the characters in which its racial constituents are more dissimilar and heterogeneous.

Co-efficient of Variation.—The Anglo-Indian value, $V=4.73 \pm .16$ is definitely and significantly higher than 4, thus confirming the results obtained by a comparison of the absolute variability.

The excessive variability of the Anglo-Indian Head Length may be due to great dissimilarity in the Head Length of the European and the Indian parent groups. It may also be partly due to a greater variability in Head Length among the parents on the Indian side. I shall discuss this point in greater detail when I shall have occasion to consider the Indian Caste data.

In spite of the excessive variability it is, however, remarkable that the frequency distribution of Anglo-Indian Head Length can be graduated satisfactorily by a continuous normal curve or by a curve of Type IV. We failed to find the slightest evidence of a Bi—or Multi—

Modal distribution. We conclude, therefore, that so far as Head Length is concerned, variation is continuous even in such a recently hybridised group as the Anglo-Indians. Either there is no Mendelian segregation in Head Length, or, if there is, the factors involved must be sufficiently complex and numerous to produce a practically continuous variation.

Section VI.—Summary of Conclusions.

(A) *Descriptive.*

(1) The sample of 200 Anglo-Indian Head Lengths can be graduated fairly well by a normal curve.

(2) The graduation is, however, improved appreciably by the use of a Pearsonian Type IV curve. This is in accordance with the results found by other observers.

(3) The normal frequency curve can be split up into two component normal curves with the same Mean value but widely different Standard Deviations. This is in agreement with the analysis of Stature obtained before. For both Stature and Head Length about a fourth of the sample appears to represent a stringently selected population.

(4) Apparently there is a small increase in Head Length between the ages of 15 and 35 which is probably significant. This is followed by a sharp decrease after 35 years. The change of Head Length with age can be represented by a cubic equation. Analysis of the variance shows, however, that owing to the smallness of the number of individuals in the different age-groups no definite significance can be attached to the Non-Linear Regression.

(B) *Comparative.*

(5) A study of material collected from different parts of the world suggests the possibility of constructing the following provisional standards for the comparison of homogeneity.

A Provisional Scale for Variability in Head Length.

| Grade of Variability. | Value of S. D. (σ) | Value of Co-efficient of Variation. (V) | Typical Groups. |
|-------------------------------|-----------------------------|---|--|
| I. Exceptionally Pure . . . | Less than 5.50 | Less than 2.75 | Kharga Oasis, American Indian Tribes. |
| II. Very Homogeneous . . . | 5.50—6.00 | 2.75—3.00 | Aino, Modern Egyptians, African Tribes. |
| III. Homogeneous | 6.00—6.25 | 3.00—3.25 | English, Swedish groups. |
| IV. Slightly Mixed | 6.25—6.50 | 3.25—3.50 | Chinese Turkestan, Scottish Insane. |
| V. Moderately Mixed | 6.50—7.00 | 3.50—3.75 | Polynesian groups, Cyprus, Malta, Crete. |
| VI. Highly Mixed | 7.00—7.50 | 3.75—4.00 | Koreans, Serbians, Inner Mongolia. |

(6) The observed variabilities for the different groups discussed in section IV fit in fairly satisfactory in the above scale and have values of the order of magnitude one would expect them to have in view of the antecedents of the respective groups.

(7) There are only a few exceptions. The greater variability of the Scottish Insane is either due to the existence of a real heterogeneity among the inhabitants of Scotland, or is due to some peculiarity of the Insane population. The American Negroes show quite normal variability $\sigma=6.51$, $V=3$, only slightly greater than that of stable European groups like the English or Swedish. This indicates that the American Negroes are already approximating to a homogeneous group so far as Head Length is concerned. The excessive variability of the Koreans may be ascribed to recent inter-mixture with the Chinese.

(8) For the present material the mean value of intra-racial variability (within the group) is $\sigma=6.08$ mm, while the inter-racial variability from group to group) is $\Sigma=4.55$ mm. That is, the individuals within a single homogeneous group show greater variation than the mean values for different groups. This result is in accordance with a monogenetic view of the origin of the human species.

(C) *Anglo-Indian Variation.*

(9) Anglo-Indian variability in Head Length as judged by the actual value of the Standard Deviation ($8.63 \pm .29$) or by the Co-efficient of Variation ($4.73 \pm .16$) is definitely and significantly greater than the variability of the other groups. This indicates recent intermixture between parent groups with widely dissimilar values of Mean Head Length.

(10) In spite of the excessive variability, the Anglo-Indian sample shows a continuous variation in Head Length. This indicates either the absence of Mendelian segregation in Head Length, or in case Mendelian segregation does occur, the existence of complex and numerous factors which serve to produce practically a continuous variation in Head Length.

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LIST OF ABBREVIATIONS.

1. *Anthrop. Anz.* Anthropologische Anzeiger (*Leipzig*).
2. *Biom.* Biometrika (*London*).
3. *J. A. S. B.* Journal of the Asiatic Society of Bengal (*Calcutta*).
4. *J. R. A. I.* Journal of the Royal Anthropological Institute (*London*).
5. *M. d. Anthrop. G. Wien.* Mitteilungen der Anthropologische Gesellschaft in Wien (*Vienna*).
6. *M. d. K. Univ. Tokio.* Mitteilungen der medizinische Fakultät der Kaiserliche Universität, Tokio. (*Tokio*).
7. *Mem. B. P. B. Mus.* Memoirs of the Bernice Puahi Bishop Museum (*Honolulu*).
8. *Rec. Ind. Mus.* Records of the Indian Museum (*Calcutta*).
9. *Z. f. Ethn.* Zeitschrift für Ethnologie (*Berlin*).

TABLE I.—INDIVIDUAL MEASUREMENTS FOR ANGLO-INDIANS.

| (1) Serial No. | (2) Card No. | (3), Age. | (4) Stature. | (5) Head Length. | (6) Head Breadth. | (7) Ceph. Index. | (8) Nasal Length. | (9) Nasal Breadth | (10) Nasal Index. | (11) Zygo. Breadth. | (12) Upper Face Length. |
|-------------------|-----------------|--------------|-----------------|---------------------|----------------------|---------------------|----------------------|----------------------|----------------------|------------------------|----------------------------|
| 1 | 87 | 15 | 1446 | 178 | 144 | 80.9 | 44 | 38 | 86.4 | 124 | 66 |
| 2 | 166 | 16 | 1624 | 162 | 142 | 87.6 | 47 | 27 | 57.4 | 102 | 57 |
| 3 | 180 | 16 | 1588 | 179 | 150 | 83.8 | 49 | 39 | 79.6 | 110 | 69 |
| 4 | 147 | 16 | 1666 | 174 | 142 | 81.6 | 50 | 36 | 72.0 | 118 | 63 |
| 5 | 144 | 16 | 1726 | 188 | 144 | 76.6 | 56 | 37 | 66.1 | 122 | 69 |
| 6 | 250 | 17 | 1656 | 178 | 134 | 75.3 | 50 | 34 | 68.0 | 118 | 65 |
| 7 | 175 | 17 | 1588 | 171 | 130 | 76.0 | 47 | 30 | 63.8 | 101 | 66 |
| 8 | 145 | 17 | 1588 | 196 | 146 | 74.5 | 44 | 38 | 86.4 | 130 | 60 |
| 9 | 289 | 17 | 1544 | 190 | 144 | 75.8 | 47 | 28 | 59.6 | 115 | 64 |
| 10 | 76 | 17 | 1642 | 182 | 138 | 75.8 | 49 | 37 | 75.5 | 112 | 62 |
| 11 | 120 | 17 | 1610 | 176 | 150 | 85.2 | 57 | 33 | 57.9 | 110 | 66 |
| 12 | 143 | 17 | 1662 | 186 | 136 | 73.1 | 44 | 34 | 77.3 | 118 | 57 |
| 13 | 44 | 17 | 1708 | 182 | 140 | 76.9 | 47 | 33 | 70.2 | 112 | 63 |
| 14 | 253 | 18 | 1746 | 172 | 140 | 81.4 | 53 | 34 | 64.1 | 134 | 65 |
| 15 | 141 | 18 | 1768 | 196 | 146 | 74.5 | 46 | 35 | 76.1 | 118 | 63 |
| 16 | 132 | 18 | 1610 | 182 | 148 | 81.3 | 45 | 35 | 77.8 | 110 | 60 |
| 17 | 258 | 18 | 1602 | 184 | 138 | 75.0 | 49 | 28 | 57.1 | 114 | 66 |
| 18 | 86 | 18 | 1636 | 192 | 140 | 72.9 | 50 | 39 | 78.0 | 118 | 64 |
| 19 | 191 | 18 | 1660 | 174 | 150 | 86.2 | 53 | 34 | 64.1 | 114 | 71 |
| 20 | 160 | 18 | 1570 | 183 | 145 | 79.2 | 39 | 34 | 87.2 | 121 | 51 |
| 21 | 251 | 18 | 1574 | 180 | 138 | 76.7 | 52 | 37 | 71.1 | 116 | 64 |
| 22 | 94 | 18 | 1580 | 186 | 146 | 78.5 | 40 | 40 | 100.0 | 126 | 57 |
| 23 | 288 | 19 | 1638 | 190 | 140 | 73.7 | 50 | 37 | 74.0 | 120 | 69 |
| 24 | 277 | 19 | 1636 | 174 | 132 | 75.9 | 43 | 33 | 76.7 | 117 | 62 |
| 25 | 294 | 19 | 1634 | 185 | 149 | 80.5 | 50 | 36 | 72.0 | 120 | 68 |
| 26 | 66 | 19 | 1630 | 186 | 144 | 77.4 | 51 | 34 | 66.7 | 108 | 64 |
| 27 | 286 | 19 | 1626 | 170 | 136 | 80.0 | 44 | 32 | 72.7 | 122 | 62 |
| 28 | 298 | 19 | 1614 | 184 | 142 | 77.2 | 51 | 37 | 72.5 | 111 | 68 |
| 29 | 53 | 19 | 1604 | 180 | 142 | 78.9 | 44 | 35 | 79.5 | 110 | 58 |
| 30 | 75 | 19 | 1586 | 184 | 140 | 76.1 | 50 | 36 | 72.0 | 114 | 65 |
| 31 | 238 | 19 | 1458 | 174 | 138 | 79.3 | 51 | 33 | 64.7 | 109 | 68 |
| 32 | 226 | 19 | 1768 | 190 | 148 | 77.9 | 51 | 35 | 68.6 | 125 | 68 |
| 33 | 4 | 19 | 1768 | 188 | 144 | 76.6 | 47 | 33 | 70.2 | 122 | 58 |
| 34 | 151 | 19 | 1760 | 190 | 132 | 69.5 | 47 | 38 | 80.8 | 122 | 64 |
| 35 | 295 | 19 | 1744 | 183 | 142 | 77.0 | 50 | 33 | 66.0 | 120 | 69 |
| 36 | 174 | 19 | 1718 | 180 | 141 | 78.3 | 50 | 31 | 62.0 | 112 | 72 |
| 37 | 299 | 19 | 1705 | 202 | 146 | 72.3 | 49 | 39 | 79.6 | 134 | 69 |
| 38 | 6 | 19 | 1706 | 180 | 140 | 77.8 | 50 | 38 | 76.0 | 118 | 62 |
| 39 | 56 | 19 | 1780 | 189 | 134 | 70.9 | 45 | 35 | 77.8 | 126 | 58 |
| 40 | 146 | 19 | 1674 | 188 | 150 | 79.8 | 51 | 34 | 66.7 | 110 | 66 |

TABLE I.—INDIVIDUAL MEASUREMENTS FOR ANGLO-INDIANS—*contd.*

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|------------|----------|------|----------|--------------|---------------|--------------|---------------|----------------|--------------|----------------|--------------------|
| Serial No. | Card No. | Age. | Stature. | Head Length. | Head Breadth. | Ceph. Index. | Nasal Length. | Nasal Breadth. | Nasal Index. | Zygo. Breadth. | Upper Face Length. |
| 41 | 176 | 19 | 1686 | 172 | 152 | 88.4 | 57 | 35 | 61.4 | 108 | 67 |
| 42 | 73 | 19 | 1668 | 184 | 136 | 73.9 | 46 | 37 | 80.4 | 114 | 64 |
| 43 | 246 | 19 | 1550 | 170 | 148 | 84.1 | 52 | 30 | 57.7 | 120 | 67 |
| 44 | 26 | 19 | 1646 | 182 | 151 | 93.2 | 54 | 33 | 61.1 | 122 | 66 |
| 45 | 140 | 19 | 1644 | 166 | 146 | 87.9 | 51 | 34 | 66.7 | 118 | 70 |
| 46 | 91 | 19 | 1640 | 198 | 144 | 72.7 | 43 | 35 | 81.4 | 124 | 55 |
| 47 | 46 | 20 | 1716 | 192 | 142 | 74.0 | 53 | 34 | 64.1 | 118 | 65 |
| 48 | 110 | 20 | 1712 | 188 | 148 | 78.7 | 56 | 37 | 66.1 | 118 | 66 |
| 49 | 142 | 20 | 1710 | 182 | 152 | 83.5 | 46 | 34 | 73.9 | 115 | 64 |
| 50 | 235 | 20 | 1700 | 182 | 138 | 75.8 | 49 | 34 | 69.4 | 125 | 70 |
| 51 | 8 | 20 | 1680 | 182 | 143 | 78.6 | 46 | 33 | 71.7 | 109 | 63 |
| 52 | 176 | 20 | 1670 | 179 | 140 | 78.2 | 52 | 36 | 69.2 | 110 | 67 |
| 53 | 14B | 20 | 1673 | 178 | 145 | 81.5 | 46 | 37 | 80.4 | 129 | 69 |
| 54 | 168 | 20 | 1664 | 174 | 138 | 79.3 | 51 | 34 | 66.7 | 128 | 67 |
| 55 | 241 | 20 | 1638 | 186 | 148 | 79.6 | 58 | 35 | 60.3 | 122 | 74 |
| 56 | 156 | 20 | 1622 | 192 | 141 | 73.4 | 49 | 34 | 69.4 | 104 | 51 |
| 57 | 280 | 20 | 1622 | 178 | 144 | 80.9 | 54 | 30 | 55.6 | 120 | 63 |
| 58 | 248 | 20 | 1562 | 164 | 138 | 84.1 | 46 | 29 | 63.0 | 111 | 58 |
| 59 | 65 | 20 | 1500 | 178 | 144 | 80.9 | 48 | 37 | 77.1 | 114 | 62 |
| 60 | 275 | 20 | 1510 | 164 | 128 | 78.0 | 44 | 33 | 75.0 | 107 | 62 |
| 61 | 217 | 20 | 1514 | 170 | 138 | 81.2 | 49 | 33 | 67.3 | 116 | 69 |
| 62 | 152 | 20 | 1610 | 181 | 140 | 77.3 | 45 | 33 | 73.3 | 111 | 69 |
| 63 | 67 | 20 | 1650 | 190 | 136 | 71.6 | 51 | 37 | 72.5 | 120 | 59 |
| 64 | 219 | 20 | 1620 | 176 | 140 | 79.5 | 53 | 35 | 66.0 | 115 | 67 |
| 65 | 172 | 20 | 1658 | 170 | 143 | 84.1 | 48 | 34 | 70.8 | 120 | 65 |
| 66 | 107 | 21 | 1626 | 168 | 146 | 86.9 | 49 | 34 | 69.4 | 114 | 64 |
| 67 | 102 | 21 | 1636 | 182 | 132 | 72.5 | 46 | 38 | 82.6 | 110 | 58 |
| 68 | 111 | 21 | 1650 | 174 | 148 | 85.0 | 48 | 35 | 72.9 | 122 | 62 |
| 69 | 237 | 21 | 1654 | 180 | 146 | 81.1 | 49 | 40 | 81.6 | 120 | 72 |
| 70 | 234 | 21 | 1656 | 186 | 130 | 69.9 | 52 | 30 | 57.7 | 117 | 73 |
| 71 | 99 | 21 | 1708 | 178 | 134 | 75.3 | 49 | 38 | 77.5 | 126 | 64 |
| 72 | 133 | 21 | 1730 | 186 | 160 | 80.6 | 50 | 37 | 74.0 | 118 | 63 |
| 73 | 101 | 21 | 1768 | 187 | 152 | 81.3 | 50 | 34 | 68.0 | 120 | 59 |
| 74 | 51 | 21 | 1768 | 182 | 152 | 83.5 | 50 | 36 | 72.0 | 120 | 67 |
| 75 | 106 | 21 | 1704 | 179 | 146 | 81.6 | 51 | 39 | 76.3 | 124 | 66 |
| 76 | 10 | 21 | 1694 | 182 | 140 | 76.9 | 49 | 36 | 73.5 | 119 | 65 |
| 77 | 281 | 21 | 1696 | 180 | 140 | 77.8 | 52 | 32 | 61.5 | 125 | 60 |
| 78 | 28 | 21 | 1672 | 184 | 136 | 73.9 | 53 | 36 | 67.9 | 120 | 63 |
| 79 | 227 | 21 | 1678 | 186 | 128 | 68.8 | 54 | 41 | 75.9 | 126 | 64 |
| 80 | 267 | 21 | 1624 | 180 | 134 | 74.4 | 53 | 31 | 58.5 | 122 | 56 |

TABLE I.—INDIVIDUAL MEASUREMENTS FOR ANGLO-INDIANS—*contd.*

| (1) Serial No. | (2) Card No. | (3) Age. | (4) Stature. | (5) Head Length. | (6) Head Breadth. | (7) Ceph. Index. | (8) Nasal Length. | (9) Nasal Breadth. | (10) Nasal Index. | (11) Zygo. Breadth. | (12) Upper Face Length. |
|-------------------|-----------------|-------------|-----------------|---------------------|----------------------|---------------------|----------------------|-----------------------|----------------------|------------------------|----------------------------|
| 81 | 88 | 21 | 1628 | 184 | 148 | 80.4 | 45 | 40 | 88.9 | 126 | 58 |
| 82 | 9 | 22 | 1730 | 181 | 140 | 77.3 | 49 | 36 | 73.5 | 122 | 65 |
| 83 | 148 | 22 | 1726 | 162 | 140 | 86.4 | 50 | 39 | 78.0 | 112 | 67 |
| 84 | 74 | 22 | 1716 | 190 | 148 | 77.0 | 52 | 34 | 65.4 | 136 | 64 |
| 85 | 180 | 22 | 1700 | 180 | 140 | 75.3 | 51 | 35 | 68.6 | 109 | 63 |
| 86 | 149 | 22 | 1700 | 180 | 149 | 82.8 | 50 | 36 | 72.0 | 112 | 65 |
| 87 | 108 | 22 | 1684 | 184 | 142 | 77.2 | 54 | 41 | 75.9 | 118 | 73 |
| 88 | 103 | 22 | 1688 | 184 | 146 | 79.3 | 48 | 33 | 68.7 | 120 | 63 |
| 89 | 170 | 22 | 1677 | 182 | 135 | 74.2 | 49 | 33 | 67.3 | 124 | 66 |
| 90 | 72 | 22 | 1650 | 184 | 140 | 76.1 | 50 | 42 | 84.0 | 118 | 67 |
| 91 | 96 | 22 | 1568 | 182 | 142 | 78.0 | 45 | 40 | 88.9 | 120 | 57 |
| 92 | 43 | 22 | 1576 | 178 | 148 | 83.1 | 56 | 35 | 62.5 | 134 | 70 |
| 93 | 177 | 22 | 1608 | 180 | 143 | 79.4 | 45 | 31 | 68.9 | 100 | 57 |
| 94 | 25 | 22 | 1644 | 170 | 140 | 82.3 | 47 | 34 | 72.3 | 112 | 57 |
| 95 | 68 | 22 | 1644 | 184 | 142 | 77.2 | 54 | 37 | 68.5 | 118 | 69 |
| 96 | 7 | 22 | 1636 | 174 | 134 | 77.0 | 50 | 37 | 74.0 | 111 | 67 |
| 97 | 136 | 22 | 1636 | 190 | 142 | 74.7 | 48 | 35 | 72.0 | 108 | 67 |
| 98 | 134 | 22 | 1616 | 182 | 152 | 83.5 | 58 | 35 | 60.3 | 120 | 67 |
| 99 | 243 | 22 | 1654 | 190 | 150 | 78.9 | 55 | 34 | 61.8 | 122 | 75 |
| 100 | 62 | 22 | 1658 | 182 | 136 | 74.7 | 50 | 42 | 84.0 | 124 | 64 |
| 101 | 40 | 23 | 1692 | 186 | 146 | 78.5 | 49 | 34 | 69.4 | 128 | 68 |
| 102 | 11 | 23 | 1692 | 184 | 142 | 77.2 | 45 | 34 | 75.6 | 116 | 68 |
| 103 | 265 | 23 | 1680 | 174 | 142 | 81.6 | 49 | 37 | 75.5 | 119 | 68 |
| 104 | 12D | 23 | 1775 | 202 | 131 | 64.8 | 51 | 36 | 70.6 | 126 | 74 |
| 105 | 64 | 23 | 1472 | 160 | 132 | 82.5 | 45 | 31 | 68.9 | 92 | 56 |
| 106 | 61 | 23 | 1572 | 188 | 146 | 77.7 | 45 | 39 | 86.7 | 118 | 56 |
| 107 | 269 | 23 | 1624 | 192 | 140 | 72.9 | 55 | 34 | 61.8 | 125 | 72 |
| 108 | 42 | 23 | 1646 | 190 | 134 | 70.5 | 48 | 38 | 79.2 | 114 | 67 |
| 109 | 224 | 24 | 1592 | 181 | 130 | 71.8 | 45 | 42 | 93.3 | 127 | 61 |
| 110 | 45 | 24 | 1610 | 180 | 148 | 82.2 | 44 | 45 | 102.3 | 120 | 59 |
| 111 | 54 | 24 | 1620 | 170 | 146 | 85.9 | 48 | 37 | 77.1 | 122 | 58 |
| 112 | 297 | 24 | 1690 | 172 | 142 | 82.6 | 52 | 36 | 69.2 | 126 | 73 |
| 113 | 50 | 24 | 1670 | 182 | 142 | 78.0 | 48 | 37 | 77.1 | 114 | 64 |
| 114 | 1 | 24 | 1684 | 192 | 151 | 78.6 | 50 | 37 | 74.0 | 129 | 63 |
| 115 | 13 | 24 | 1696 | 184 | 142 | 77.2 | 53 | 33 | 62.3 | 124 | 65 |
| 116 | 230 | 24 | 1634 | 192 | 138 | 71.9 | 55 | 38 | 69.1 | 122 | 71 |
| 117 | 284 | 24 | 1596 | 184 | 156 | 84.8 | 50 | 34 | 68.0 | 118 | 64 |
| 118 | 276 | 24 | 1636 | 184 | 140 | 76.1 | 54 | 41 | 75.9 | 124 | 64 |
| 119 | 47 | 24 | 1644 | 192 | 142 | 74.0 | 48 | 38 | 7.2 | 124 | 65 |
| 120 | 57 | 25 | 1738 | 186 | 152 | 81.7 | 57 | 37 | 64.9 | 122 | 74 |

TABLE I.—INDIVIDUAL MEASUREMENTS FOR ANGLO-INDIANS—*contd.*

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|------------|----------|------|----------|--------------|---------------|--------------|---------------|----------------|--------------|----------------|--------------------|
| Serial No. | Card No. | Age. | Stature. | Head Length. | Head Breadth. | Ceph. Index. | Nasal Length. | Nasal Breadth. | Nasal Index. | Zygo. Breadth. | Upper Face Length. |
| 121 | 262 | 25 | 1513 | 178 | 140 | 78.6 | 54 | 33 | 61.1 | 114 | 68 |
| 122 | 54 | 25 | 1680 | 180 | 146 | 78.5 | 54 | 35 | 64.8 | 120 | 62 |
| 123 | 285 | 25 | 1619 | 186 | 140 | 75.3 | 49 | 35 | 71.4 | 123 | 64 |
| 124 | 48 | 25 | 1630 | 190 | 154 | 81.0 | 53 | 36 | 67.9 | 124 | 63 |
| 125 | 3 | 25 | 1634 | 172 | 150 | 87.2 | 52 | 37 | 71.1 | 120 | 63 |
| 126 | 293 | 26 | 1644 | 171 | 142 | 83.0 | 59 | 36 | 61.0 | 114 | 80 |
| 127 | 240 | 26 | 1638 | 178 | 134 | 75.3 | 49 | 32 | 65.3 | 119 | 65 |
| 128 | 282 | 26 | 1656 | 180 | 136 | 75.6 | 49 | 42 | 85.7 | 128 | 70 |
| 129 | 263 | 26 | 1730 | 199 | 146 | 73.4 | 60 | 38 | 63.3 | 134 | 82 |
| 130 | 2 | 26 | 1710 | 180 | 142 | 78.9 | 40 | 37 | 62.5 | 110 | 60 |
| 131 | 60 | 26 | 1604 | 182 | 148 | 81.3 | 48 | 37 | 77.1 | 130 | 66 |
| 132 | 58 | 26 | 1628 | 174 | 148 | 85.1 | 56 | 33 | 58.9 | 130 | 64 |
| 133 | 231 | 26 | 1616 | 172 | 144 | 83.7 | 56 | 31 | 55.4 | 129 | 71 |
| 134 | 63 | 27 | 1522 | 180 | 142 | 78.9 | 46 | 34 | 73.9 | 122 | 54 |
| 135 | 27 | 27 | 1700 | 194 | 142 | 73.2 | 50 | 34 | 68.0 | 126 | 64 |
| 136 | 119 | 27 | 1692 | 173 | 140 | 80.9 | 51 | 35 | 68.6 | 121 | 66 |
| 137 | 38 | 27 | 1770 | 190 | 138 | 72.6 | 50 | 39 | 78.0 | 120 | 66 |
| 138 | 39 | 27 | 1776 | 212 | 152 | 71.7 | 51 | 39 | 76.5 | 128 | 69 |
| 139 | 29 | 27 | 1796 | 184 | 142 | 77.2 | 48 | 36 | 76.0 | 114 | 67 |
| 140 | 187 | 27 | 1840 | 184 | 156 | 84.8 | 48 | 30 | 81.2 | 125 | 67 |
| 141 | 20 | 27 | 1656 | 180 | 150 | 83.3 | 60 | 34 | 56.7 | 109 | 64 |
| 142 | 14 | 27 | 1650 | 181 | 140 | 77.3 | 42 | 27 | 64.3 | 110 | 59 |
| 143 | 31 | 28 | 1610 | 178 | 148 | 83.1 | 49 | 41 | 83.7 | 122 | 68 |
| 144 | 232 | 28 | 1636 | 174 | 144 | 32.8 | 54 | 30 | 55.6 | 125 | 70 |
| 145 | 223 | 28 | 1754 | 180 | 146 | 81.1 | 59 | 36 | 61.0 | 124 | 77 |
| 146 | 32 | 28 | 1662 | 196 | 162 | 77.5 | 49 | 36 | 73.5 | 118 | 60 |
| 147 | 78 | 28 | 1662 | 189 | 134 | 70.9 | 48 | 33 | 68.7 | 130 | 60 |
| 148 | 271 | 29 | 1780 | 192 | 146 | 76.0 | 57 | 35 | 61.4 | 133 | 75 |
| 149 | 268 | 29 | 1584 | 156 | 138 | 88.5 | 52 | 35 | 67.3 | 118 | 62 |
| 150 | 36 | 29 | 1730 | 186 | 146 | 78.5 | 54 | 33 | 61.1 | 119 | 67 |
| 151 | 278 | 29 | 1722 | 181 | 134 | 74.0 | 53 | 41 | 77.4 | 120 | 70 |
| 152 | 247 | 29 | 1620 | 170 | 144 | 84.7 | 56 | 38 | 67.9 | 127 | 71 |
| 153 | 33 | 29 | 1608 | 190 | 146 | 76.8 | 52 | 33 | 63.5 | 120 | 67 |
| 154 | 279 | 29 | 1562 | 186 | 140 | 75.3 | 46 | 35 | 76.1 | 121 | 67 |
| 155 | 55 | 29 | 1578 | 194 | 148 | 76.3 | 50 | 35 | 70.0 | 134 | 64 |
| 156 | 35 | 30 | 1656 | 178 | 142 | 79.8 | 50 | 39 | 78.0 | 120 | 67 |
| 157 | 135 | 30 | 1712 | 184 | 138 | 75.0 | 49 | 32 | 65.3 | 114 | 68 |
| 158 | 22 | 30 | 1734 | 180 | 154 | 85.6 | 49 | 38 | 77.5 | 134 | 67 |
| 159 | 34 | 30 | 1760 | 192 | 144 | 75.0 | 45 | 37 | 82.2 | 124 | 61 |
| 160 | 260 | 30 | 1708 | 176 | 144 | 81.8 | 62 | 37 | 59.7 | 115 | 71 |

TABLE I.—INDIVIDUAL MEASUREMENTS FOR ANGLO-INDIANS—*concl'd.*

| (1) Serial No. | (2) Card No. | (3) Age. | (4) Stature. | (5) Head Length. | (6) Head Breadth. | (7) Ceph. Index. | (8) Nasal Length. | (9) Nasal Breadth. | (10) Nasal Index. | (11) Zygo. Breadth. | (12) Upper Face Length. |
|-------------------|-----------------|-------------|-----------------|---------------------|----------------------|---------------------|----------------------|-----------------------|----------------------|------------------------|----------------------------|
| 101 | 216 | 30 | 1684 | 188 | 138 | 73.4 | 68 | 34 | 50.0 | 120 | 75 |
| 102 | 232 | 30 | 1640 | 190 | 140 | 73.7 | 56 | 36 | 64.3 | 125 | 71 |
| 103 | 229 | 30 | 1628 | 172 | 136 | 79.1 | 53 | 35 | 66.0 | 121 | 67 |
| 104 | 77 | 30 | 1614 | 184 | 144 | 78.3 | 48 | 35 | 72.9 | 124 | 65 |
| 105 | 18 | 30 | 1572 | 186 | 139 | 74.7 | 44 | 36 | 81.8 | 120 | 63 |
| 106 | 266 | 30 | 1694 | 176 | 140 | 79.5 | 58 | 35 | 60.3 | 115 | 80 |
| 107 | 37 | 30 | 1698 | 182 | 139 | 76.4 | 48 | 34 | 70.8 | 120 | 65 |
| 108 | 283 | 31 | 1716 | 190 | 143 | 75.3 | 56 | 35 | 62.5 | 131 | 75 |
| 109 | 220 | 32 | 1640 | 188 | 140 | 74.5 | 50 | 34 | 68.0 | 128 | 68 |
| 110 | 97 | 32 | 1606 | 182 | 138 | 75.8 | 47 | 40 | 85.1 | 120 | 59 |
| 111 | 105 | 32 | 1592 | 180 | 142 | 78.9 | 50 | 37 | 74.0 | 120 | 63 |
| 112 | 19 | 32 | 1714 | 189 | 142 | 75.1 | 45 | 38 | 84.4 | 120 | 61 |
| 113 | 201 | 32 | 1720 | 191 | 142 | 74.3 | 46 | 40 | 86.9 | 122 | 64 |
| 114 | 70 | 32 | 1734 | 198 | 154 | 77.8 | 59 | 44 | 74.6 | 124 | 72 |
| 115 | 159 | 33 | 1617 | 181 | 152 | 81.0 | 54 | 34 | 63.0 | 104 | 66 |
| 116 | 264 | 33 | 1624 | 170 | 150 | 88.2 | 51 | 32 | 62.7 | 130 | 70 |
| 117 | 93 | 33 | 1788 | 190 | 148 | 77.9 | 48 | 30 | 62.5 | 124 | 62 |
| 118 | 79 | 35 | 1704 | 184 | 144 | 78.2 | 49 | 35 | 71.4 | 134 | 64 |
| 119 | 155 | 35 | 1722 | 190 | 153 | 80.5 | 50 | 35 | 70.0 | 123 | 69 |
| 120 | 17 | 35 | 1670 | 194 | 144 | 74.2 | 44 | 38 | 86.4 | 120 | 62 |
| 121 | 71 | 38 | 1644 | 180 | 139 | 77.2 | 52 | 37 | 71.1 | 120 | 65 |
| 122 | 82 | 39 | 1610 | 190 | 142 | 74.7 | 50 | 37 | 74.0 | 128 | 63 |
| 123 | 92 | 39 | 1714 | 186 | 140 | 75.3 | 50 | 40 | 80.0 | 118 | 67 |
| 124 | 252 | 40 | 1848 | 186 | 154 | 82.8 | 52 | 35 | 67.3 | 127 | 70 |
| 125 | 131 | 41 | 1638 | 164 | 142 | 86.6 | 50 | 35 | 73.0 | 120 | 62 |
| 126 | 49 | 42 | 1704 | 202 | 154 | 76.2 | 54 | 39 | 72.2 | 126 | 74 |
| 127 | 52 | 42 | 1756 | 178 | 140 | 78.6 | 52 | 35 | 67.3 | 114 | 66 |
| 128 | 165 | 43 | 1540 | 173 | 132 | 76.3 | 43 | 35 | 81.4 | 110 | 65 |
| 129 | 15 | 44 | 1610 | 190 | 150 | 78.9 | 52 | 36 | 69.2 | 122 | 71 |
| 130 | 5 | 45 | 1598 | 170 | 144 | 84.7 | 55 | 36 | 65.4 | 110 | 66 |
| 131 | 95 | 48 | 1574 | 182 | 138 | 76.8 | 47 | 35 | 74.5 | 126 | 62 |
| 132 | 98 | .. | 1554 | 176 | 142 | 80.7 | 47 | 37 | 78.7 | 134 | 60 |
| 133 | 16 | .. | 1586 | 185 | 140 | 75.7 | 52 | 40 | 70.9 | 120 | 62 |
| 134 | 228 | .. | 1032 | 176 | 138 | 78.4 | 59 | 34 | 57.6 | 111 | 65 |
| 135 | 30 | .. | 1654 | 186 | 146 | 78.5 | 46 | 39 | 84.8 | 126 | 66 |
| 136 | 12 | .. | 1670 | 191 | 143 | 74.9 | 45 | 35 | 77.8 | 127 | 62 |
| 137 | 150 | .. | 1690 | 170 | 140 | 82.3 | 51 | 36 | 70.6 | 120 | 67 |
| 138 | 118 | .. | 1694 | 189 | 136 | 71.9 | 49 | 35 | 71.4 | 120 | 62 |
| 139 | 112 | .. | 1700 | 189 | 142 | 75.1 | 54 | 37 | 68.5 | 118 | 72 |
| 140 | 6B | .. | 1711 | 205 | 150 | 73.2 | 53 | 36 | 67.9 | 130 | 70 |

TABLE II.—STATISTICS OF HEAD LENGTH.

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|--------------------------------|------------|--------------------------|----------------------------------|----------------------------|---------------------|-----------------------------------|-------------------------|
| Reference. | Serial No. | Name of Sub-Group. | Total No. of Individuals. (n) | Standard Deviation. (σ) | Log _e G. | Co-efficient of Variation. (V) | Mean Head Length (M) |
| Hrdlicka (18), 1912. | 1 | Kharga Oasis . | 150 | 5.05 ± .20 | 1.6194 | 2.67 ± .10 | 189.0 ± .28 |
| S—1. AMERICAN TRIBES. | | | | | | | |
| Boas and Livingston (4), 1898. | 2 | Nasa River Indians. | 27 | 6.18 ± .57 | 1.8213 | 3.17 ± .29 | 195.26 ± .80 |
| | 3 | Halda . . . | 9 | 5.30 ± .84 | 1.6677 | 2.72 ± .43 | 194.78 ± 1.19 |
| | 4 | Tsimshian . . | 15 | 4.69 ± .58 | 1.5454 | 2.43 ± .30 | 193.40 ± .82 |
| | 5 | Nkamtcineinq . | 23 | 5.27 ± .52 | 1.5620 | 2.79 ± .28 | 188.78 ± .74 |
| | 6 | Billqula . . . | 26 | 6.05 ± .57 | 1.8001 | 3.20 ± .30 | 188.73 ± .80 |
| | 7 | Spuzzum . . . | 12 | 6.94 ± .96 | 1.9373 | 3.68 ± .51 | 188.33 ± 1.35 |
| | 8 | Lilloet (Fraser River). | 17 | 4.98 ± .68 | 1.6054 | 2.65 ± .31 | 188.12 ± .82 |
| | 9 | Ntlakypamuqoc | 27 | 4.69 ± .43 | 1.5454 | 2.51 ± .23 | 186.89 ± .61 |
| | 10 | Utankt . . . | 18 | 4.96 ± .56 | 1.6014 | 2.67 ± .30 | 186.72 ± .79 |
| | 11 | Chilcotin . . . | 36 | 4.59 ± .37 | 1.5235 | 2.46 ± .20 | 186.58 ± .52 |
| | 12 | Stlemqolequmq | 48 | 4.45 ± .31 | 1.4929 | 2.39 ± .17 | 186.07 ± .44 |
| | 13 | Harrison Lake | 15 | 4.77 ± .59 | 1.5623 | 2.61 ± .32 | 183.13 ± .83 |
| | 14 | Lilloet (Anderson Lake). | 20 | 5.48 ± .58 | 1.7011 | 3.01 ± .32 | 181.75 ± .83 |
| S—2. BORNEO AND JAVA (3). | | | | | | | |
| Garett (14), 1912 | 15 | Sundanese . . | 37 | 5.28 ± .42 | 1.6639 | 3.93 ± .33 | 176.9 ± .59 |
| | 16 | Javanese . . . | 17 | 4.66 ± .42 | 1.5433 | 2.63 ± .32 | 177.6 ± .77 |
| | 17 | Banjerese . . . | 33 | 6.22 ± .52 | 1.8278 | 3.44 ± .29 | 181.2 ± .73 |
| | 18 | Lycian Gypses | 53 | 5.73 ± .38 | 1.7457 | 3.25 ± .21 | 176.33 ± .53 |
| Dudley Buxton (8), 1920(a). | 19 | Aino | 95 | 5.88 ± .29 | 1.7716 | 3.03 ± .15 | 193.78 ± .41 |
| S—3. EAST AFRICAN TRIBES. | | | | | | | |
| Lays and Joyce (23), 1913. | 20 | Somali | 27 | 4.75 ± .44 | 1.5581 | 2.48 ± .23 | 191.81 ± .62 |
| | 21 | Masai | 91 | 5.28 ± .26 | 1.6639 | 2.71 ± .14 | 194.67 ± .37 |
| | 22 | Njemps | 11 | 4.90 ± .70 | 1.5892 | 2.57 ± .37 | 191.27 ± 1.00 |
| | 23 | Kamasia | 20 | 6.66 ± .71 | 1.8961 | 3.46 ± .37 | 192.70 ± 1.00 |
| | 24 | Suk | 15 | 4.24 ± .62 | 1.4446 | 2.34 ± .29 | 185.80 ± .74 |
| | 25 | Nandi | 14 | 4.06 ± .52 | 1.4012 | 2.15 ± .27 | 189.29 ± .73 |
| | 26 | Turkama | 9 | 4.46 ± .71 | 1.4953 | 2.36 ± .38 | 189.00 ± 1.00 |
| | 27 | Nilotic Kavirondo. | 37 | 6.31 ± .49 | 1.8421 | 3.35 ± .26 | 188.38 ± .70 |
| | 28 | Bantu Kavirondo. | 24 | 5.04 ± .49 | 1.6174 | 2.65 ± .26 | 189.88 ± .69 |
| | 29 | Baganda | 44 | 7.48 ± .54 | 2.0109 | 3.91 ± .28 | 191.30 ± .76 |
| | 30 | Kaseri | 12 | 6.06 ± .83 | 1.8017 | 3.19 ± .46 | 190.08 ± 1.19 |
| | 31 | Sukuma | 21 | 6.46 ± .67 | 1.8656 | 3.37 ± .35 | 191.43 ± .95 |

TABLE II.—STATISTICS OF HEAD LENGTH—*contd.*

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|------------------------|--------------------|---------------------------|---------------------|-----------------|----------------------------|-------------------|
| Reference. | Serial No. | Name of Sub-Group. | Total No. of Individuals. | Standard Deviation. | Loge σ . | Co-efficient of Variation. | Mean Head Length. |
| | | | (n) | (σ) | | (V) | (M) |
| S—3. EAST AFRICAN TRIBES— <i>contd.</i> | | | | | | | |
| Leys and Joyce (23), 1913.— <i>contd.</i> | 32 | Manyena . . | 42 | 6.85 ± .50 | 1.7664 | 3.63 ± .27 | 188.62 ± .71 |
| | 33 | Nyasa . . | 21 | 5.87 ± .61 | 1.7699 | 3.10 ± .32 | 189.57 ± .86 |
| | 34 | Segeju . . | 36 | 5.29 ± .43 | 1.5872 | 2.76 ± .23 | 191.91 ± .61 |
| | 35 | Ajawa . . | 16 | 4.89 ± .58 | 1.6658 | 2.53 ± .30 | 192.94 ± .82 |
| | 36 | Segua . . | 12 | 6.49 ± .89 | 1.8703 | 3.36 ± .46 | 192.92 ± 1.27 |
| | 37 | Swahili . . | 53 | 7.22 ± .47 | 1.9769 | 3.81 ± .25 | 189.38 ± .67 |
| | 38 | Lamu . . | 26 | 4.68 ± .44 | 1.5433 | 2.51 ± .23 | 186.65 ± .61 |
| | 39 | Rabai . . | 13 | 7.25 ± .96 | 1.9810 | 3.84 ± .51 | 188.69 ± 1.35 |
| | 40 | Digo . . | 15 | 6.75 ± .83 | 1.9095 | 3.59 ± .44 | 188.13 ± 1.18 |
| | 41 | Duruma . . | 67 | 5.09 ± .35 | 1.7901 | 3.18 ± .14 | 188.39 ± .46 |
| | 42 | Giriama . . | 24 | 5.00 ± .57 | 1.7750 | 3.15 ± .31 | 187.13 ± .81 |
| | 43 | Nyika . . | 18 | 5.75 ± .65 | 1.7492 | 3.06 ± .34 | 188.06 ± .91 |
| | 44 | Chaga . . | 18 | 5.08 ± .57 | 1.6253 | 2.71 ± .30 | 187.33 ± .81 |
| | 45 | Kikuyu . . | 384 | 6.13 ± .14 | 1.8132 | 3.25 ± .08 | 188.72 ± .21 |
| | 46 | Kamba . . | 128 | 5.24 ± .22 | 1.6563 | 2.79 ± .12 | 187.80 ± .31 |
| | 47 | Embu . . | 110 | 6.52 ± .41 | 1.8749 | 3.45 ± .31 | 189.08 ± .44 |
| | 48 | Wanyamwezi . | 101 | 5.67 ± .27 | 1.7352 | 2.97 ± .14 | 191.01 ± .38 |
| | 49 | Kachamega . | 100 | 6.19 ± .30 | 1.8229 | 3.36 ± .16 | 184.22 ± .42 |
| | Malcolm (28), 1925. | 50 | Egag (W. Africa). | 100 | 6.28 ± .29 | 1.8374 | 3.27 ± .18 |
| S—4. MODERN EGYPTIANS. | | | | | | | |
| Orensteen (33) | 51 | Alexandria . . | 643 | 5.99 ± .11 | 1.7901 | 3.16 ± .06 | 189.74 ± .16 |
| Craig(7),1915- 1917. | 52 | Cairo . . | 802 | 5.06 ± .10 | 1.7851 | 3.13 ± .05 | 190.46 ± .14 |
| | 53 | Canal . . | 127 | 5.74 ± .24 | 1.7475 | 3.01 ± .13 | 190.61 ± .34 |
| | 54 | Beheira . . | 526 | 5.89 ± .12 | 1.7732 | 3.08 ± .06 | 191.18 ± .17 |
| | 55 | Gharbia . . | 1104 | 6.01 ± .09 | 1.7934 | 3.15 ± .05 | 190.97 ± .12 |
| | 56 | Menufia . . | 717 | 6.04 ± .11 | 1.7984 | 3.16 ± .06 | 191.06 ± .15 |
| | 57 | Daquahlia . . | 504 | 6.65 ± .14 | 1.8946 | 3.49 ± .07 | 190.35 ± .20 |
| | 58 | Sharqla . . | 515 | 6.16 ± .13 | 1.8180 | 3.23 ± .07 | 190.79 ± .18 |
| | 59 | Qualiubda . . | 295 | 5.90 ± .16 | 1.7749 | 3.09 ± .09 | 190.82 ± .23 |
| | 60 | Giza . . | 326 | 5.75 ± .15 | 1.7492 | 3.00 ± .08 | 191.66 ± .22 |
| | 61 | Fayum . . | 413 | 5.92 ± .14 | 1.7783 | 3.09 ± .07 | 191.20 ± .20 |
| | 62 | Benisuef . . | 384 | 5.65 ± .14 | 1.7317 | 2.95 ± .07 | 191.70 ± .19 |
| | 63 | Minia . . | 491 | 5.71 ± .12 | 1.7422 | 2.98 ± .06 | 191.73 ± .17 |
| | 64 | Assiut . . | 887 | 5.84 ± .09 | 1.7647 | 3.06 ± .05 | 190.91 ± .13 |
| | 65 | Girga . . | 610 | 6.03 ± .12 | 1.7967 | 3.15 ± .06 | 191.51 ± .16 |
| | 66 | Qena . . | 824 | 6.01 ± .10 | 1.7934 | 3.15 ± .05 | 191.19 ± .14 |
| 67 | Aswan . . | 262 | 6.00 ± .18 | 1.7918 | 3.15 ± .09 | 190.44 ± .25 | |

TABLE II.—STATISTICS OF HEAD LENGTH—*contd.*

| (1) Reference. | (2) Serial No. | (3) Name of Sub-Group. | (4) Total No. of Individuals. (n) | (5) Standard Deviation. (σ) | (6) Log _e σ . | (7) Co-efficient of Variation. (V) | (8) Mean Head Length. (M) |
|---|------------------------------|---|---|---|---------------------------------------|---|--|
| S-4. MODERN EGYPTIANS— <i>contd.</i> | | | | | | | |
| Brit. Assoc. Rep. (5), 1905. | 68 | Egyptian Mos- lems. | 359 | 6.09 ± .15 | 1.8066 | 3.13 ± .08 | 194.56 ± .21 |
| Harmon 1926. (10). | 69 | English, General Sample. | 4721 | 6.26 ± .04 | 1.8342 | 3.20 ± .02 | 195.56 ± .0 |
| Macdonell (27), 1901-02. | 70 | Cambridge Stu- dents. | 1000 | 6.16 ± .09 | 1.8181 | 3.18 ± .05 | 193.51 ± .13 |
| S-5. CAMBRIDGE STUDENTS. | | | | | | | |
| Pearson (35), 1906. | 71 | 1st Class Hons. | 153 | 5.89 ± .23 | 1.7733 | 3.02 ± .12 | 195.07 ± .32 |
| | 72 | 2nd Class Hons. | 182 | 6.03 ± .21 | 1.7967 | 3.10 ± .11 | 194.51 ± .30 |
| | 73 | 3rd Class Hons. | 189 | 6.21 ± .22 | 1.8262 | 3.20 ± .11 | 194.38 ± .30 |
| | 74 | Poll-men | 487 | 6.11 ± .13 | 1.8099 | 3.16 ± .07 | 193.33 ± .19 |
| Schuster (40), 1911-12. | 75 | Oxford Students | 959 | 6.23 ± .09 | 1.8294 | 3.17 ± .05 | 196.05 ± .13 |
| v. Luschan, E. and F. (25), 1914. | 76 | English (Brit. Association). | 84 | 6.16 ± .32 | 1.8181 | 3.20 ± .17 | 198.51 ± .45 |
| Macdonell (27), 1901-02. | 77 | English, Non- habitual Crimi- nals. | 3000 | 6.05 ± .05 | 1.8001 | 3.15 ± .03 | 191.66 ± .08 |
| Goring (15), 1913 | 78 | English, Habitu- al Crimi- nals. | 2348 | 6.39 ± .06 | 1.8547 | 3.34 ± .03 | 192.45 ± .09 |
| S-6. SWEDISH GROUPS. | | | | | | | |
| Lundborg and Linders (26), 1922. | 79 | Swedish North, Agricultural. | 2,993 | 6.05 ± .08 | 1.8001 | 3.12 ± .03 | 193.74 ± .07 |
| | 80 | Swedish North Mixed. | 1,059 | 6.10 ± .13 | 1.8033 | 3.16 ± .05 | 192.95 ± .13 |
| | 81 | Swedish North, Industrial. | 406 | 6.05 ± .21 | 1.8001 | 3.15 ± .07 | 191.90 ± .20 |
| | 82 | Swedish North, Urban. | 337 | 6.35 ± .24 | 1.8485 | 3.30 ± .09 | 192.61 ± .23 |
| | 83 | Swedish West, Agricultural. | 7054 | 6.00 ± .05 | 1.7918 | 3.08 ± .02 | 194.69 ± .05 |
| | 84 | Swedish West, Mixed. | 3,200 | 6.10 ± .08 | 1.8033 | 3.14 ± .03 | 194.54 ± .07 |
| | 85 | Swedish West Industrial. | 1,245 | 6.41 ± .13 | 1.8579 | 3.30 ± .04 | 194.36 ± .12 |
| | 86 | Swedish West, Urban. | 1,723 | 6.02 ± .10 | 1.7951 | 3.10 ± .04 | 193.91 ± .10 |
| | 87 | Swedish East, Agricultural. | 6,496 | 6.23 ± .05 | 1.8294 | 3.21 ± .02 | 194.12 ± .05 |
| | 88 | Swedish East, Mixed. | 4,642 | 6.27 ± .07 | 1.8358 | 3.24 ± .02 | 193.74 ± .06 |
| 89 | Swedish East, Industrial. | 1,894 | 6.28 ± .10 | 1.8374 | 3.24 ± .04 | 193.59 ± .10 | |
| 90 | Swedish East, Urban. | 2,465 | 6.20 ± .09 | 1.8245 | 3.20 ± .03 | 193.54 ± .08 | |

TABLE II.—STATISTICS OF HEAD LENGTH—*contd.*

| (1) Reference. | (2) Serial No. | (3) Name of Sub-Group. | (4) Total No. of Individuals. (n) | (5) Standard Deviation. (σ) | (6) Log _e σ | (7) Co-efficient of Variation. (V) | (8) Mean Head Length. (M) |
|---|-------------------|------------------------------|---|--|----------------------------------|--|---------------------------------|
| S—6. SWEDISH GROUPS— <i>contd.</i> | | | | | | | |
| Lundborg and Lin'ers (26). 1126— <i>contd.</i> | 91 | Swedish South, Agricultural. | 3,687 | 6.06 ± .07 | 1.8017 | 3.13 ± .02 | 193.62 ± .07 |
| | 92 | Swedish South, Mixed. | 2,665 | 6.04 ± .08 | 1.7984 | 3.13 ± .03 | 193.01 ± .08 |
| | 93 | Swedish South, Industrial. | 625 | 6.02 ± .17 | 1.7951 | 3.12 ± .06 | 193.13 ± .16 |
| | 94 | Swedish South, Urban. | 1,737 | 6.00 ± .10 | 1.7918 | 3.10 ± .04 | 193.23 ± .10 |
| | 95 | Swedish Four Big Cities. | 4,755 | 6.27 ± .06 | 1.8358 | 3.24 ± .02 | 193.31 ± .06 |
| S—6. GREEK (COMBINED) (2). | | | | | | | |
| Schliff (39), 1914 | 96 | Greeks from Mani. | 99 | 6.01 ± .29 | 1.7934 | 3.32 ± .16 | 187.03 ± .41 |
| Brit. Assoc. Rep. (6), 1912. | 97 | Greek Youths . | 99 | 6.35 ± .31 | 1.8485 | 3.45 ± .17 | 183.60 ± .43 |
| Pösch (38), 1925 | 98 | Ukrainians . | 249 | 6.02 ± .18 | 1.7951 | 3.27 ± .10 | 184.10 ± .26 |
| Brezina & Wastl (4), 1929. | 99 | Austrians . | 192 | 6.03 ± .21 | 1.7967 | 3.17 ± .11 | 190.16 ± .29 |
| S—7. CHINESE TURKESTAN. | | | | | | | |
| Joyce (19), 1912 | 100 | Kafir . . . | 18 | 5.48 ± .61 | 1.7011 | 2.87 ± .32 | 100.72 ± .87 |
| | 101 | Chitrail . . . | 22 | 6.42 ± .65 | 1.8594 | 3.61 ± .36 | 186.64 ± .92 |
| | 102 | Mastuji . . . | 28 | 6.50 ± .59 | 1.8718 | 3.50 ± .32 | 185.64 ± .83 |
| | 103 | Sarikoli . . . | 40 | 4.85 ± .37 | 1.5790 | 2.65 ± .20 | 188.23 ± .52 |
| | 104 | Bagh-Jigda . . | 12 | 6.38 ± .89 | 1.8532 | 3.46 ± .48 | 184.42 ± 1.24 |
| | 105 | Pakhpo . . . | 5 | 5.72 ± 1.22 | 1.7440 | 3.06 ± .65 | 186.88 ± 1.73 |
| | 106 | Nissa . . . | 9 | 4.62 ± .78 | 1.5304 | 2.44 ± .39 | 189.56 ± 1.04 |
| | 107 | Kökyar . . . | 37 | 5.69 ± .45 | 1.7387 | 3.18 ± .25 | 179.19 ± .63 |
| | 108 | Karanghu-tagh | 21 | 8.72 ± .91 | 2.1656 | 4.55 ± .47 | 191.67 ± 1.07 |
| | 109 | Korla . . . | 14 | 5.06 ± .64 | 1.6213 | 2.74 ± .35 | 184.21 ± .91 |
| | 110 | Wakhl . . . | 9 | 6.15 ± .08 | 1.8164 | 3.63 ± .53 | 184.74 ± 1.38 |
| | 111 | Turfan . . . | 72 | 5.13 ± .29 | 1.6351 | 2.70 ± .16 | 183.64 ± .41 |
| | 112 | Khotan . . . | 67 | 6.24 ± .36 | 1.8310 | 3.42 ± .20 | 180.50 ± .52 |
| | 113 | Hami . . . | 21 | 4.80 ± .50 | 1.5686 | 2.56 ± .38 | 187.70 ± .72 |
| | 114 | Charklik . . . | 12 | 9.11 ± 1.25 | 2.2093 | 4.78 ± .66 | 190.67 ± 1.78 |
| | 115 | Loplik . . . | 38 | 6.78 ± .52 | 1.9139 | 3.60 ± .27 | 193.97 ± .74 |
| | 116 | Chinese . . . | 20 | 5.18 ± .55 | 1.6448 | 2.17 ± .23 | 192.45 ± .78 |
| | 117 | Kerliya . . . | 21 | 7.25 ± .75 | 1.9810 | 4.03 ± .42 | 179.96 ± 1.07 |
| | 118 | Niya . . . | 18 | 4.96 ± .56 | 1.6014 | 2.78 ± .31 | 178.44 ± .79 |
| 119 | Polu . . . | 31 | 6.83 ± .59 | 1.9213 | 3.14 ± .28 | 185.45 ± .83 | |

TABLE II.—STATISTICS OF HEAD LENGTH—*contd.*

| (1) Reference. | (2) Serial No. | (3) Name of Sub-Group. | (4) Total No. of Individuals. (n) | (5) Standard Deviation. (σ) | (6) Log _e σ | (7) Co-efficient Variation. (V) | (8) Mean Head Length. (M) |
|---------------------------------------|-------------------|-----------------------------|---|-----------------------------------|---------------------------|---------------------------------------|---------------------------------|
| S-7. CHINESE TURKESTAN— <i>contd.</i> | | | | | | | |
| Joyce (10), 1912 — <i>contd.</i> | 120 | Aksu . . . | 13 | 7.25 ± .96 | 1.9801 | 4.17 ± .55 | 173.92 ± 1.35 |
| | 121 | Falzabad . . . | 12 | 6.30 ± .87 | 1.8406 | 3.46 ± .48 | 181.02 ± 1.23 |
| | 122 | Kelpin . . . | 15 | 7.58 ± .03 | 2.0255 | 4.20 ± .52 | 180.47 ± 1.32 |
| | 123 | Dolan . . . | 16 | 6.24 ± .74 | 1.8310 | 3.52 ± .44 | 182.20 ± 1.12 |
| | 124 | Kirghiz . . . | 38 | 6.48 ± .50 | 1.8687 | 3.59 ± .28 | 180.50 ± .70 |
| Boas (2), 1924 | 125 | Armenians . . . | 75 | 6.30 ± .35 | 1.8406 | 3.38 ± .19 | 186.5 ± .49 |
| S-8. SCOTTISH INSANE. | | | | | | | |
| Tocher (46), 1906 -07. | 126 | Scottish. General Insane. | 4,381 | 0.55 ± .05 | 1.8705 | 3.55 ± .03 | 195.44 ± .07 |
| | 127 | Scottish. Insane Criminals. | .. | | .. | .. | .. |
| | 128 | Scottish. Aberdeen Students | 493 | 5.73 ± .12 | 1.7457 | 2.94 ± .06 | 194.80 ± .17 |
| S-9. POLYNESIAN. | | | | | | | |
| Sullivan 1921. | (41), 129 | Samoa . . . | 68 | 5.60 ± .33 | 1.7387 | 2.98 ± .17 | 190.6 ± .46 |
| Sullivan 1922. | (42), 130 | Marquesas | 79 | 7.00 ± .38 | 1.9459 | 3.60 ± .19 | 193.2 ± .53 |
| Sullivan 1923. | (43), 131 | Tongan . . . | 117 | 6.85 ± .55 | 1.9301 | 3.60 ± .16 | 191.0 ± .43 |
| Sullivan and Wissler 1929. | (44), 132 | Hawaiian (29-50). | 206 | 6.78 ± .23 | 1.9140 | 3.61 ± .12 | 187.86 ± .32 |
| Sullivan and Wissler 1929. | (44), 133 | Hawaiian ? (29-50). | 47 | 6.37 ± .44 | 1.8516 | 3.42 ± .24 | 186.00 ± .63 |
| S-10. EASTERN MEDITERRANEAN. | | | | | | | |
| Dudley Buxton (10), 1922. | 134 | Malta . . . | 561 | 6.63 ± .13 | 1.8016 | 3.51 ± .07 | 188.70 ± .19 |
| Dudley Buxton (10), 1922. | 135 | Gozo . . . | 82 | 6.55 ± .34 | 1.8705 | 3.57 ± .19 | 185.38 ± .49 |
| Dudley Buxton (9), 1920(b). | 136 | Cyprus . . . | 586 | 7.00 ± .14 | 1.9459 | 3.87 ± .08 | 180.81 ± .20 |
| v. Luschan (24) 1913. | 137 | Crete . . . | 320 | 7.24 ± .19 | 1.9756 | 3.78 ± .10 | 191.76 ± .52 |
| Kubo (21), 1913 | 138 | Korcans . . . | 552 | 7.10 ± .14 | 1.9601 | 3.91 ± .08 | 181.37 ± .20 |
| Libzelter 1923. | (22), 139 | Serbians . . . | 196 | 7.33 ± .20 | 1.9918 | 4.03 ± .14 | 181.91 ± .35 |

TABLE II.—STATISTICS OF HEAD LENGTH—*concl'd.*

| (1) Reference. | (2) Serial No. | (3) Name of Sub-Group. | (4) Total No. of Individuals. (n) | (5) Standard Deviation. (σ) | (6) Log_e σ | (7) Co-efficient of Variation. (v) | (8) Mean Head Length. (M) |
|--|----------------------|------------------------------|---|---|-----------------------------------|---|------------------------------------|
| S—10. EASTERN MEDITERRANEAN— <i>concl'd.</i> | | | | | | | |
| Dudley Buxton (11), 1926. | 140 | Inner Mongolia | 52 | 7.57 ± .50 | 2.0242 | 4.00 ± .26 | 188.27 ± .71 |
| Herskovits (17), 1927. | 141 | American Negroes. | 961 | 6.51 ± .10 | 1.8733 | 3.31 ± .05 | 196.50 ± .14 |
| S—11. POLYNESIAN MIXED. | | | | | | | |
| Sullivan and Wessler (44), 1929. | 142 | Hawaiian—Asiatic. | 33 | 6.61 ± .55 | 1.8886 | 3.59 ± .29 | 183.91 ± .78 |
| Sullivan and Wessler (44), 1929. | 143 | Hawaiian, South European. | 19 | 8.69 ± .95 | 2.1622 | 4.86 ± .53 | 187.16 ± 1.34 |
| Sullivan and 4 Wessler (44) 1929. | 144 | Hawaiian, North European. | 70 | 6.76 ± .39 | 1.9110 | 3.56 ± .20 | 189.63 ± .54 |
| Sullivan and Wessler (44), 1929. | 145 | Hawaiian, All European. | 69 | 7.29 ± .37 | 1.9865 | 3.85 ± .19 | 189.10 ± .52 |
| | 146 | Anglo-Indians. | 200 | 8.63 ± .20 | 2.1552 | 4.73 ± .16 | 182.45 ± .41 |