On the Glabella Prominence of the Human Cranium

By T. L. Woo

I. *Introductory.* The degree of the glabella prominence of the human skull has long been recognised by physical anthropologists as an important character in aiding the discrimination or grouping of human races. For the purpose of studying the individual or racial differences of specimens in this particular feature, some investigators have suggested the use of a diagrammatic scale[1] and others use descriptive terms. Although both methods give a general description of the feature for different varieties of man, yet neither of them is quantitative and the data thus obtained cannot be treated with precision. Some years ago, Dr. Morant suggested a useful index[2] derived from the mean measurements of the horizontal type contour for measuring the frontal flattening of the cranium. The section represented is one through the glabella parallel to the Frankfort horizontal and the index gives a measure of the frontal curvature anterior to the temporal lines. It is obvious that although the index of frontal flattening is closely related with the degree of projection of the glabella, yet it depends also on the width of the frontal diameter and the position of the bending of the temporal lines. The main purpose of the present study is to make a quantitative survey of the degree of projection of the glabella region in the median sagittal plane in a sample of some of the principal races. We are concerned, then, in this paper with measurements which are designed to give accurate estimates of the antero-posterior projection of the region in question, not with its transverse flattening. The part referred to is confined to the glabella region. Four new absolute measurements and two indices are designed for the purpose in view. The definitions of these are given in the next section. The data dealt with can easily be collected either by direct measurement or from the average sagittal type contour.

II. *The Material Measured.* The cranial series measured are:

(1) Chinese: Sui-T'ang dynasties. 15♂ and 6♀. These specimens were excavated some years ago by Dr. Li Chi and Mr. Tung Tso-pin of the Archæolo-

---

[1] See Martin, R.: *Lehrbuch der Anthropologie.* Zweiter Band, p. 873, (1928).

[2] The index is defined to be $100\frac{\frac{1}{2}[T_r(x)+T_l(x)]}{T_r(y)+T_l(y)}$. See *Biometrika*, Vol. XIV, pp 193–260, (1923).

gical Section, Institute of History and Philology, Nanking, from several ancient graves of the Sui-T'ang dynasties (A.D. 581–899) at Hsiao T'un, Anyang, Honan. More than 30 specimens of both sexes belonging to the same period were obtained, but measurements were only taken of the complete crania.

(2) Chinese: in general. 99♂ and 66♀. These crania were collected by the writer in 1936 from graves at Hsiu Chiu Shan near the vicinity of Hsia Kuan, Nanking. The majority of them represent the poor class. Most came from the eastern part of the country but several are from unknown localities.

(3) Chinese: Southern. 73♂. These specimens came either from various localities on the southeast coast of China or from the south of the country.

(4) Burmese. 32♂. These specimens came from different parts of the country. Those belonging to the primitive tribes of Burma were excluded.

(5) Javanese. 40♂. These came from various parts of Java and the Island of Madura.

(6) Dayak. 13♂. These crania came from Borneo and they are catalogued as Dayak.

(7) Andamanese. 17♂. The majority of these specimens came from the Great Andaman Islands.

(8) English. 44♂. These crania came from a single cemetery at Portugal Street, London. They were probably of eighteenth century date.

(9) Italian. 50♂. These specimens came from 12 provinces in the northern and central parts of Italy. Measurements were only taken of a random sample of 50 male crania.

(10) Swedish. 31♂. They came from various parts of Sweden.

(11) Finnish. 22♂. These crania came from various localities of Finland, several of them belong to a Seaman's Hospital collection.

(12) Punjabi. 81♂. This series comprises all specimens inscribed as either Mohammedan or Hindus from the province of Punjab.

(13) Hindu: Bihar and Orissa. 37♂. The majority of these specimens came from the Patna district in the northwest of Bihar.

(14) Singalese. 24♂. These crania came from various parts of Ceylon, especially from Colombo.

(15) Australian. 71♂. The series came from the following parts of the country, viz. Western Australia, New South Wales, Victoria and South Australia. Those from the Northern Territory and Queenland were not included. According to the recent studies of Dr. Morant and the writer,[1] the feature of

---

[1] T. L. Woo and G. M. Morant: "A Biometric Study of the 'Flatness' of the Facial Skeleton in Man." *Biometrika*, Vol. XXVI, pp. 212–214, (1934), and also see Morant's Study of the Australian Skull. *Biometrika*, Vol. XIX, pp. 417–440, (1927).

the crania from the regions firstly mentioned was not significantly different from one another, so it may be justifiably assumed that they form a racially homogeneous sample. Consequently, the means of all the specimens from these parts have been pooled together for the present comparative purpose.

(16) Kanaka. 52♂ and 54♀. These crania came from the Islands of Oahu and Hawaii.

(17) Maori. 40♂. These were collected in different parts of New Zealand.

(18) Moriori. 33♂ and 21♀. These specimens came from various parts of Chatham Islands.

(19) Guanche. 16♂. Nearly all these crania came from Teneriffe.

(20) Eskimo. 33♂. These came from various parts of Greenland and the neighbouring islands.

(21) Fuegian. 11♂. These came from the southwest coast of Tierra del Fuego.

The specimens of the first two Chinese series are preserved in the Museum of the Institute of History and Philology. The writer measured them in 1936. Those of the remaining series are all preserved in the Museum of the Royal College of Surgeons, London, and they were measured by the writer in 1934 when he was investigating other craniological problems. He is greatly indebted to the authorities of the two Institutions, namely, Professors Fu Ssû-nien and Li Chi, and Miss M. L. Tildesley, for granting him every facility for pursuing this study. With the exception of the first Chinese series belonging to the 5th-8th century period, all other series are of modern date. The specimens dealt with in this paper total 834 male and 147 female grouped in twenty-one male and four female series representing some of the principal races in different parts of the world. It is clear that the Oriental and Oceanic races are better represented than the other groups. It is regrettable that there are none from Central Asia, South Africa or Egypt. The numbers of crania forming the series in several cases are too small to give reliable means for comparison, but they may still be of value in a preliminary study.

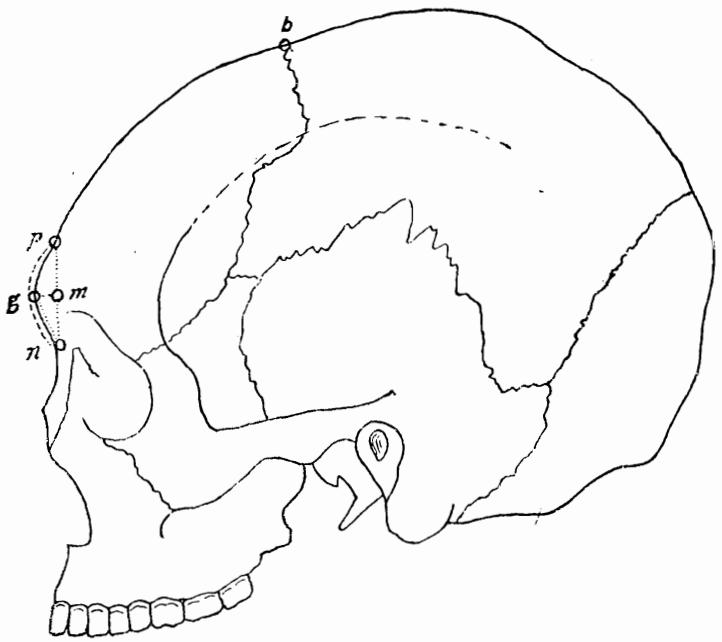
III. *Definitions of Measurements Taken.* The points from which the measurements are taken are shown in Fig. 1, the points *n* and *g* being the *nasion* and *glabella* defined in the usual way. *P* is a point above the *glabella* in the median sagittal section and the distance *gp* is equal to *ng*. This is usually found to be a little below the *ophryon* which is in some cases not easy to be determined accurately. Furthermore, the reason for which the arbitrary point *p* is employed instead of *o* (ophryon) is that the former point can also be accurately marked on the sagittal type contour. M is the point where the perpendicular

from g meets the line np. It is also the midpoint of the line np. The measurements taken are:

(1) The chord from n to g measured with small calipers.

(2) The chord from n to p, the latter point having been previously marked as a pencil one.

Fig. 1. Showing the Points Where Measurements Were Taken



(3) The subtense of the *glabella* from the chord np.

The measurements 2 and 3 were taken at the same time with the aid of a pair of co-ordinate calipers which has been described by the writer.[1]

(4) Minimum arc from n to p measured with a steel tape.

Two indices which provide a measure of the projection of the glabella can be derived from pairs of these absolute measurements. They are:

(5) The subtense-chord index = 100 subtense to np/chord np.

(6) The chord-arc index = 100 chord np/arc np.

Readings of the subtense and chord were taken to the nearest 0.1 of a millimetre and those of the arc to the nearest 0.5.

IV. *Sexual Comparisons.* Table I gives the means for the four absolute measurements and the two indices together with their probable errors. For comparative purpose the weighted means of the characters for each racial group

[1] T. L. Woo and G. M. Morant: *loc. cit.*, pp. 196–250.

Table I. Mean Measurements of Glabella Projection and Their Probable Errors

Series	Sex	N	Absolute Measurements (in mm.) (1) Chord ng	(2) Chord np	(3) Subtense to np	(4) Arc np	Indices (5) 100 Sub. np / Chord np	(6) 100 Chord. np / Arc np
Asiatic:								
(*a*) *Oriental*								
Chinese (Sui-T'ang dynasties)	♂	15	12.53±.42	22.86±.52	2.19±.01	24.06±.53	9.57±.36	95.00±.30
Chinese (in general)	,,	99	11.79±.13	22.34±.26	2.33±.06	23.62±.28	10.43±.23	94.56±.11
Chinese (Southern)	,,	73	10.27±.10	19.99±.20	2.14±.05	20.83±.20	10.74±.29	95.94±.17
Burmese	,,	32	10.52±.13	20.56±.27	2.17±.08	21.70±.26	10.59±.39	94.65±.27
Javanese	,,	40	10.29±.12	20.13±.25	2.25±.09	21.25±.25	11.36±.48	94.62±.35
Dayak	,,	13	11.61±.22	21.93±.60	2.18±.16	23.83±.58	9.89±.69	91.99±1.06
Weighted Means	,,	272	11.04	21.18	2.23	22.33	10.62	94.85
(*b*) *Indian*								
Andamanese	,,	17	10.60±.16	20.95±.32	1.34±.10	21.88±.31	6.49±.49	95.73±.49
Punjabi	,,	81	8.66±.12	16.66±.22	2.20±.06	17.77±.22	13.26±.30	93.74±.30
Indian (Bihar and Orissa)	,,	37	9.51±.16	18.76±.29	2.20±.09	20.16±.29	11.90±.51	92.95±.31
Singalese	,,	24	10.08±.23	19.23±.37	2.28±.10	20.89±.40	12.02±.57	92.19±.62
Weighted Means	,,	159	9.28	18.00	2.12	19.24	12.03	93.53
European:								
English	,,	44	10.08±.15	19.15±.30	3.01±.09	20.25±.31	15.88±.48	94.58±.26
Italian	,,	50	9.01±.10	16.68±.17	2.59±.07	18.67±.18	15.46±.33	89.39±.40
Swedish	,,	31	9.58±.12	18.84±.27	2.87±.09	21.00±.24	15.26±.51	89.72±.59
Finn	,,	22	9.70±.13	18.83±.28	2.86±.13	20.56±.30	15.25±.69	91.66±.49
Weighted Means	,,	147	9.55	18.20	2.82	19.92	15.51	91.35
Oceanic:								
Australian	,,	71	11.13±.13	20.34±.24	4.28±.11	22.55±.27	21.02±.44	90.28±.30
Kanaka	,,	52	11.96±.16	22.30±.30	3.93±.13	24.34±.33	17.59±.50	91.79±.36
Maori	,,	40	11.62±.16	21.95±.29	3.36±.13	23.83±.33	15.17±.47	92.37±.34
Moriori	,,	37	10.46±.21	20.37±.41	2.87±.13	22.02±.45	13.76±.52	92.39±.40
Weighted Means	,,	198	11.34	21.19	3.76	23.20	17.69	91.46
African & American:								
Guanche	,,	16	8.84±.20	16.78±.50	2.31±.18	18.04±.52	13.40±.95	93.00±.57
Eskimo	,,	33	12.84±.17	24.72±.34	3.04±.11	26.40±.35	12.39±.42	93.66±.45
Fuegian	,,	11	13.01±.29	25.38±.84	4.24±.30	28.16±1.03	16.64±1.02	90.48±.94
Weighted Means	,,	60	11.80	22.72	3.07	24.49	13.44	92.90
Chinese (Sui-T'ang dynasties)	♀	6	12.82±.60	24.68±.99	1.70±.12	25.60±.97	6.95±.47	96.30±.59
Chinese (in general)	,,	66	11.68±.16	22.55±.33	1.58±.06	23.47±.32	7.01±.26	95.99±.14
Kanaka	,,	54	10.97±.12	21.16±.21	2.04±.07	22.43±.23	9.70±.35	94.42±.32
Moriori	,,	21	10.65±.15	20.99±.32	2.03±.07	21.99±.30	9.80±.37	95.36±.35

are also given in the same table. There are only three series—viz. the Chinese in general, the Kanaka and the Moriori—which are long enough for the purpose of examining sexual differences. The sex ratios (male mean/female mean) which are derived from the means given in Table I are provided in Table II. Of the

Table II. Sex Ratios of the Absolute Measurements and Indices for Three Racial Series

	Characters \ Series	*Chinese (in general)*	*Kanaka*	*Moriori*	*Average Ratios*
Absolute Measurements	*Chord ng*	1.01	1.09	.98	1.03
	Chord np	.99	1.05	.97	1.00
	Sub. to np	1.47	1.93	1.41	1.61
	Arc np	1.01	1.09	1.01	1.03
Indices	$100\frac{Sub.\ np}{Chord\ np}$	1.49	1.81	1.40	1.57
	$100\frac{Chord\ np}{Arc\ np}$	.99	.97	.97	.98

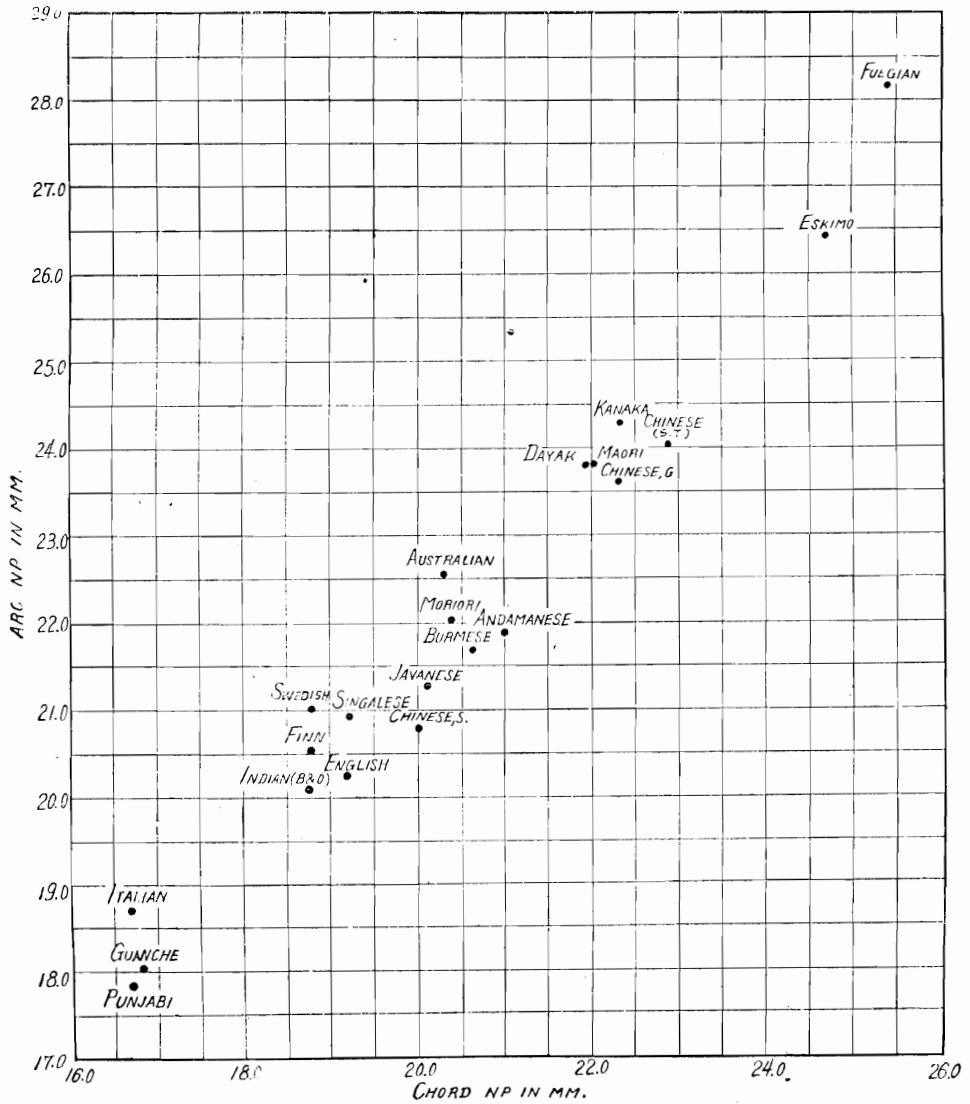
six characters, four—viz. the two chords, the arc and chord-arc index—show only slight sexual differentiation. The ratios for these range from .97 to 1.09, the male being the greater in nine cases and the position being reversed in the other seven. Judging from such slender evidence, there is no suggestion that these ratios are significantly different for different races. However, sex ratios for the remaining constants—the subtense and subtense-chord index—for the three series are considerably higher, varying from 1.40 to 1.93. It has been shown in earlier studies of facial flattening[1] and of the malar bones[2] that for any racial series the ratios for facial subtenses tend to be greater than those for facial chords. The same is true for the measurements of the glabella projection. The measurements confirm the common supposition that the forward projection of the glabella region is, on the average, decidedly more marked for male than for female crania. The subtense and the index derived from it might prove to be of value in sexing individual crania by metrical means when they are considered in conjunction with other characters.

[1] T. L. Woo and G. M. Morant: *loc. cit.*, pp. 196–250.

[2] T. L. Woo: "A Biometric Study of the Human Malar Bone," Biometrika, XXIX, pp. 113–123, (1937).

V. *Racial Comparisons of Mean Measurements.* The mean measurements for different characters from which racial comparison can be made are given in Table I. The number of male series represented is not large, but it is sufficient to give a fairly good estimate of the value of the new characters for the purpose of racial classification. Figs. 2–5 give distributions of the constants taken in pairs.

Fig. 2. Inter-racial Correlation of the Chord np and Its Arc (Male Means)



Abbreviations: S. T. = Sui-T'ang Dynasties, G = In General, S = Southern, and B. & O. = Bihar and Orissa.

Fig. 2 shows the inter-racial correlation of the chord *np* and the corresponding arc. Except for the Fuegian and Dayak series which comprise 11 and 13 skulls respectively, all the male means are based on 15 or more individuals. It is clear that the inter-racial correlation between the two characters is very high. The same is true for the intra-racial coefficient between the same constants (see Table V). In both measurements the Fuegian and Eskimo types have the largest values and these differ from all the others with marked significance. The means of Oriental and Oceanic races are larger than those of European and Indian ones, but no clear distinctions can be made between the Oriental and Oceanic series on the one hand, and between the European and Indian ones on the other. In several cases, however, differences between the means for series representing the same family of races are statistical significant. Both measurements are capable of making many clear distinctions between different races but they fail to differentiate all pairs of the families of races from one another.

Fig. 3 shows the inter-racial correlation of the chord *np* and the subtense. The arrangement given is more interesting. The five racial groups—American, Oceanic, European, Indian and Oriental—are seen to occupy their own respective

Fig. 3. Inter-racial Correlation of the Chord np and Its Subtense (Male Means)

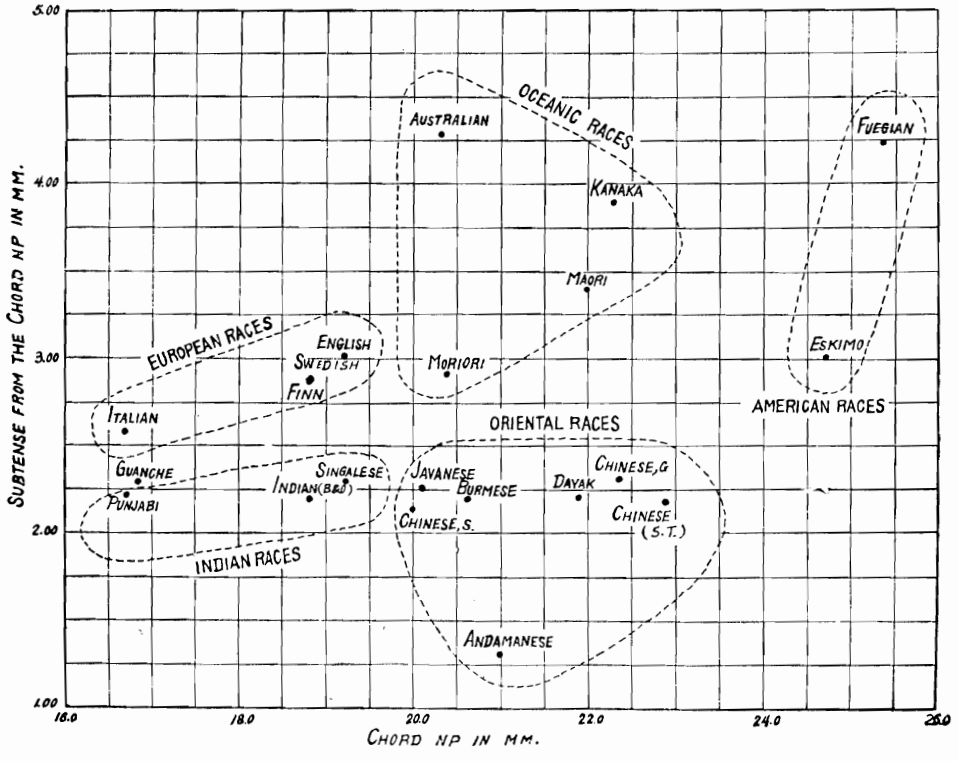
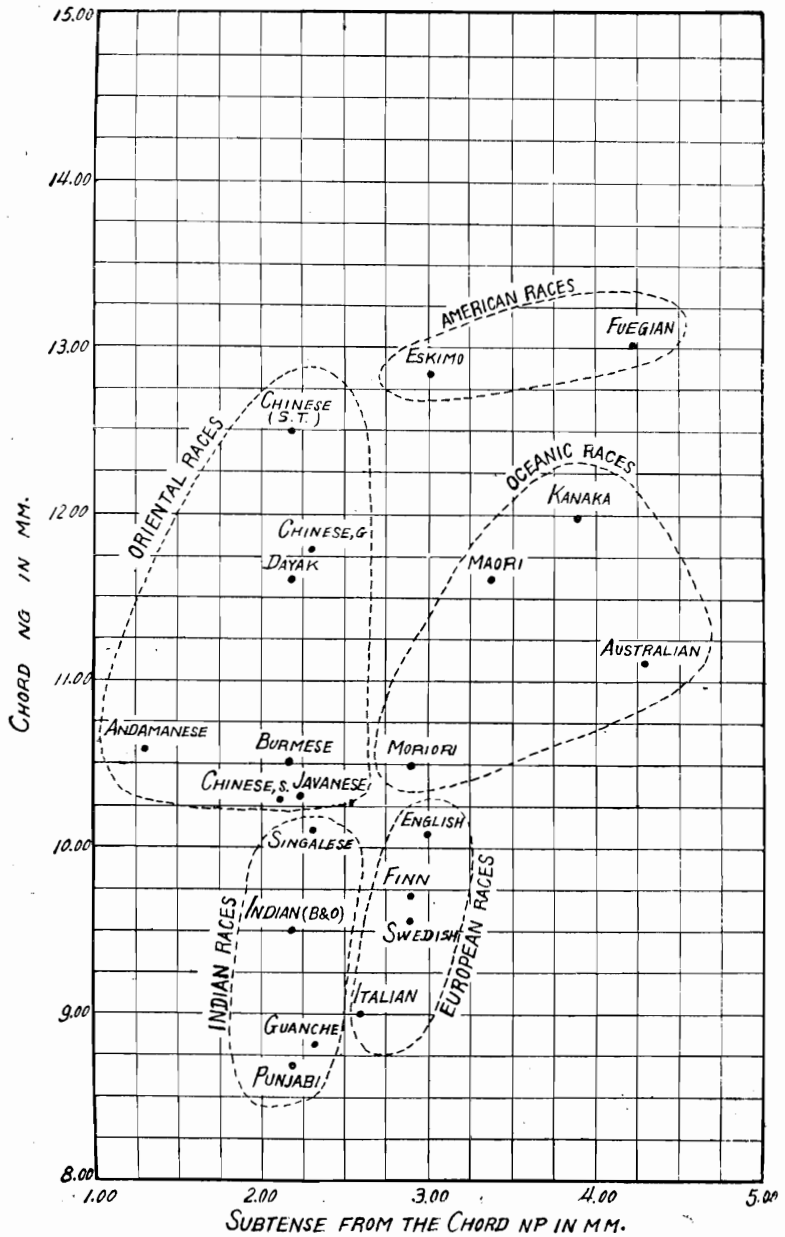
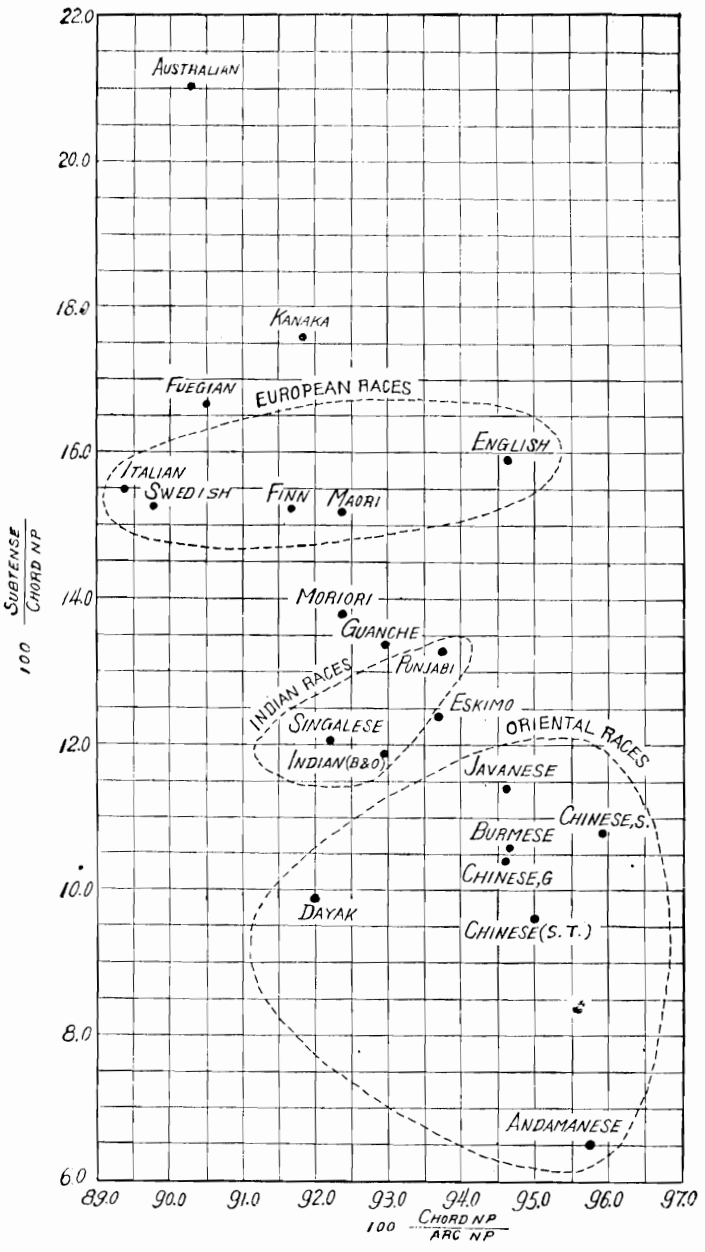


Fig. 4. Inter-racial Correlation of the Chord ng and Subtense from the Chord np (Male Means)



areas without any overlapping for the material available, although the series represented in each group are quite few in number. It should be noted that

Fig. 5.



if each character is considered separately no such clear inter-group distribution is made such as that shown in Fig. 3. Judging from the subtense measurement only, Australian and Fuegian crania have the most projecting glabella as was anticipated. The subtense for European races, being intermediate in position between the two extremes, is definitely higher than those for both Indian and

Oriental races. The means of the subtense for the three Indian and six Oriental series are very similar if the Andamanese series is excluded. It is of interest to note that the Andamanese type has the lowest subtense which is widely removed from those for other Oriental types. It is clear that the subtense measurement and its chord considered together are capable of providing a suggestive inter-group arrangement. They are also in some cases capable of differentiating clearly some pairs of races belonging to the same family.

Fig. 4 shows the distribution of the series given by the means for the chord *ng* and the subtense to the *np*. It shows that the arrangement provided by these two constants is very similar to that in Fig. 3, except that the two American series are closer to the Oceanic and Oriental series. Hence it is clear that the two chords *ng* and *np* are of almost equal value for the purpose of arranging races.

A distinct but negative and spurious inter-racial correlation is found between the two indices which are treated in Fig. 5. It is obvious that the indices arrange the races in somewhat similar orders, but the subtense-chord index discriminates them far more clearly than any other index does. Considering the index involving the subtense first, the arrangement provided is quite interesting. The range for the four Oceanic races varies considerably from 13.6 to 21.1. The Australian series stands at the top of the distribution as appeared in the case of the subtense, and the point indicated is widely removed from those for the other three Oceanic series. Three racial groups—the European, Indian and Oriental—are seen to occupy discrete ranges, showing that the European glabella region is, on the average, more protruding than the Indian and still more so than the Oriental. It is not without interest to note that the means for the Guanche and Eskimo series are not significantly differentiated from those for the Indian races. The position of the Fuegian type is within the range for the Oceanic group. The mean for the Andamanese skull is again extreme. We may conclude that the subtense-chord index may be counted as a valuable criterion, since it shows many clear intra-group differences, and it also makes several clear inter-group distributions. The chord-arc index fails to make any clear distinctions between the different groups of races, and it fails, too, to provide any intra-group arrangements to which significance can be attached. The relative value of the two indices can be further compared by considering some additional data. The following table shows the weighted means of the two indices for palæolithic skulls of both sexes compared with the modern ones. In the majority of cases the values were derived from mean measurements of sagittal type contours [illegible] in *Biometrika* and other journals. It is clear that

Table III. Variabilities of Measurements

Series	Standard Deviations					
	Measurements				Indices	
Male	(1) chord ng	(2) Chord np	(3) Subtense to np	(4) Arc np	(5) 100 Sub. np / Chord np	(6) 100 Chord np / Arc np
Chinese (in general) ..	1.94±.09	3.89±.19	0.84±.04	4.07±.20	3.33±.16	1.63±.08
Chinese (Southern)	1.24±.07	2.47±.14	0.67±.04	2.52±.14	3.62±.20	2.19±.12
Burmese	1.17±.10	2.26±.19	0.69±.06	2.14±.18	3.29±.28	2.30±.19
Javanese	1.17±.09	2.31±.17	0.84±.06	2.30±.17	4.53±.34	3.30±.25
Punjabi	1.56±.08	2.87±.15	0.75±.04	2.88±.15	4.06±.22	3.97±.21
Indian (Bihar and Orissa)	1.41±.11	2.63±.21	0.80±.06	2.57±.20	4.63±.36	2.79±.22
Singalese	1.67±.16	2.66±.26	0.76±.07	2.90±.28	4.16±.40	4.52±.44
English	1.48±.11	2.94±.21	0.89±.06	3.09±.22	4.76±.34	2.60±.19
Italian	1.00±.07	1.77±.12	0.71±.05	1.85±.12	3.43±.23	4.16±.28
Swedish	0.95±.08	2.02±.17	0.77±.07	1.97±.17	4.18±.36	4.84±.42
Finn	0.89±.09	1.92±.20	0.93±.09	2.10±.21	4.83±.49	3.41±.35
Australian	1.61±.09	2.94±.17	1.35±.08	3.35±.19	5.50±.31	3.79±.22
Kanaka	1.71±.11	3.19±.21	1.35±.09	3.51±.23	5.30±.35	3.89±.26
Maori	1.49±.11	2.74±.21	1.17±.09	3.12±.24	4.38±.33	3.14±.24
Moriori	1.80±.15	3.48±.29	1.14±.09	3.84±.32	4.44±.37	3.41±.28
Eskimo	1.47±.12	2.93±.24	0.92±.08	2.98±.25	3.54±.29	3.82±.32
Female						
Chinese (in general)	1.92±.11	3.95±.23	0.77±.05	3.91±.23	3.15±.19	1.70±.10
Kanaka	1.28±.08	2.30±.15	0.81±.05	2.54±.16	3.81±.25	3.48±.23
Moriori	1.05±.10	2.20±.23	0.45±.05	2.03±.21	2.52±.2	2.41±.25

of the Projection of the Glabella

Coefficients Variation

Measurements				*Indices*	
(1) *Chord ng*	(2) *Chord np*	(3) *Subtense to np*	(4) *Arc np*	(5) *100 Sub. np / Chord np*	(6) *100 Chord np / Arc np*
16.45±.79	17.41±.83	36.05±1.73	17.23±.83	31.93±1.53	1.72±.08
12.07±.68	12.36±.70	31.31±1.91	12.10±.69	33.39±2.06	2.28±.13
11.12±.94	10.99±.93	31.80±2.68	9.86±.83	31.07±2.62	2.43±.20
11.37±.86	11.48±.87	37.33±2.82	10.82±.82	39.88±3.01	3.49±.26
18.01±.95	17.23±.91	34.09±1.81	16.21±.86	30.62±1.62	4.24±.22
14.83±1.19	14.02±1.12	36.46±3.21	12.75±1.02	38.91±3.48	3.00±.24
16.57±1.61	13.83±1.35	33.33±3.24	13.88±1.35	34.61±3.37	4.90±.48
14.68±1.08	15.35±1.13	29.57±2.30	15.26±1.12	29.97±2.34	2.75±.20
11.10±.75	10.61±.72	27.41±1.85	9.91±.67	22.19±1.50	4.65±.31
9.92±.86	10.72±.93	26.83±2.30	9.38±.81	27.39±2.34	5.39±.46
9.18±.93	10.20±1.04	32.56±3.31	10.21±1.04	31.67±3.22	3.72±.38
14.47±.84	14.45±.84	31.54±1.96	14.86±.86	26.17±1.58	4.20±.24
14.30±.95	14.30±.95	34.35±2.27	14.42±.95	30.13±1.99	4.24±.28
12.82±.95	12.48±.96	34.82±2.93	13.09±1.00	28.87±2.35	3.40±.26
17.21±1.43	17.08±1.42	39.72±3.30	17.44±1.45	32.27±2.68	3.69±.31
11.45±.95	11.85±.98	30.26±2.51	11.29±.94	28.57±2.37	4.08±.34
16.44±.97	17.52±1.03	48.73±2.86	16.66±.98	44.94±2.64	1.77±.10
11.67±.76	10.87±.71	39.71±2.58	11.32±.73	39.28±2.55	3.69±.24
9.86±1.03	10.48±1.09	22.17±2.31	9.23±.96	25.71±2.67	2.53±.26

the subtense-chord index distinguishes the racial types, the two sexes and specimens of different periods far more clearly than the other index does.

Specimens	Palaeolithic Crania*		Modern Crania	
Sex	Male	Female	Male	Female
Subtense-chord Index	21.21 (15)‡	15.00 (9)	11.27 (1600)	7.68 (486)
Chord-arc Index	90.49 (15)	92.00 (9)	96.62 (1600)	98.40 (486)

* Materials nearly all derived from Morant's papers on Studies of Palaeolithic Man published in the *Annals of Eugenics*, London (1926–1930).

‡ Figures in brackets give the number of specimens pooled.

VI. *Comparison of Variability and Correlation.* Table III gives the standard deviation and coefficients of variation for all the racial distributions of absolute measurements and indices made up by 20 or more crania. The sexual differences in variability may be considered first. For the measurements of size, variability is usually judged by the coefficient of variation, while for the measurements of shape it is judged by the standard deviation. For these constants, out of 18 possible comparisons there are only 7 cases in which the difference of corresponding male and female values exceeds 3.0 times its probable error. In six cases the male constant is in excess of the female and there is only one case for which the reverse position is observed. This seems to indicate that the male variation shows, on the average, a distinct tendency to be greater than the female. However, as few series are available for comparison no definite conclusions of this kind can be drawn. Racial comparisons of the male constants of variability may be considered next. The percentages of significant differences —viz. for cases for which the ratio of the difference between two constants to its probable error is greater than 3.0—between pairs of series arranged in three groups are shown in Table IV. It is clear that the percentages in each horizontal row are not markedly different, but those in each vertical column are quite different. In other words, the differences of the variabilities of the same character are not markedly different for different kinds of racial comparisons, but those of different characters vary considerably. The percentage of significant differences is highest for the chord-arc index, and for the two chords, one arc and subtense-chord index, the percentages gradually decrease in this order. The subtense measurement has the smallest percentage. It should be noted that the variation of the last character is the least inter-racially, but its intra-racial variation, as judged by the coefficient of variation, is the largest among the characters compared. (See Table III).

Table IV Percentages of Significant Differences ($\frac{\Delta}{P.E. \text{ of } \Delta} > 3.0$) in Variability for the Six Constants (Male Series)

Characters	*Percentages of Significant Differences in Variability between Series of:*		
	the Same Family (21 comparisons)	*Different Families (99 comparisons)*	*All Races (120 comparisons)*
Chord ng	24.0	28.4	27.5
Chord np	28.0	22.1	23.3
Sub. to np	00.0	4.2	3.3
Arc np	24.0	30.5	29.2
$100\frac{\text{Sub. np}}{\text{Chord np}}$	16.0	12.6	13.3
$100\frac{\text{Chord np}}{\text{Arc np}}$	36.0	43.2	41.7
All Characters	21.3	23.5	23.1

Table V. Intra-racial Correlations of the Measurements of Glabella Prominence

Male Series	*No. of Crania*	*Pair of Characters*			
		Chord and Subtense*	*Chord* and Arc*	*Subtense and Arc*	*Two Indices*
Chinese (in general)	99	0.41±.06	0.98±.003	0.68±.04	−0.51±.05
Javanese	40	0.48±.08	0.95±.01	0.61±.07	−0.68±.06
Punjabi	81	0.41±.06	0.96±.01	0.52±.05	−0.42±.06
English	44	0.44±.08	0.98±.004	0.55±.07	−0.57±.07
Australian	81	0.51±.06	0.96±.01	0.65±.05	−0.67±.04
Kanaka	52	0.44±.08	0.94±.01	0.66±.05	−0.82±.03
Moriori	33	0.69±.06	0.97±.01	0.77±.05	−0.53±.08

* Referring to the chord np.

Table V gives the intra-racial correlations between certain pairs of the five constants for some of the larger male series. It will be seen that the coefficients for the same pair of characters do not differ with marked significance, while those for different pairs of character vary considerably. The results appear to be similar to those found in the case of variabilities. It might have been anticipated that since the arc and the subtense both provide a measure of the curvature of the glabella region they would be highly correlated with one another But in fact the highest correlation is found for the chord *np* and the corresponding arc. The coefficients range from .94 to .98 and they are appreciably higher than any others in the table. In other words, intra-racially the larger the chord is, the greater is its corresponding arc. A high but negative and spurious correlation is found between the two indices considered, simply due to the fact that both have a common component of the chord *np*.

VII. *Conclusions*. The metrical material dealt with in this paper is ample enough to show that racial types of cranium differ quite appreciably in both the size and shape of the glabella region. On the basis of the analysis given above some tentative conclusions in connection with this feature may be drawn as follows:

(1) For the subtense measurement and the index involving the subtense the sexual differences are large. This indicates that the glabella region of the frontal bone is, on the average, definitely more protruding in the male than in the female as is generally supposed. For the other characters considered the sex ratios are of the usual order.

(2) Judging from the few series available the male variation shows a tendency to be greater than the female.

(3) Of the characters considered the subtense-chord index is the most valuable racial character, and it shows many significant differences between different racial series; it makes several distinctions between family groups of races and it also distinguishes modern man from early prehistoric ones. It is of the same nature as skin colour, the nasal index, measures of prognathism, of the 'flatness' of the facial skeleton and certain measurements of the malar bones. Hence it is suggested that this index might be included with advantages in the routine descriptions of racial series of crania.

(4) The chord-arc index shows some significant differences between the means of racial series, but it fails to make clear distinctions between the different groups of races. It thus appears to be of little value for purposes of racial classification.

(5) The four absolute measurements, especially the subtense, seem to distinguish the racial types in much the same way as most of the usual cranial characters do. They are capable of giving clear and suggestive arrangement when the means are considered in pairs by constructing bivariate distributions.

(6) In the case of the variation and correlation there are no marked differences between the different groups of races compared.

Finally, the writer wishes to thank Dr. Morant of University College, London, for giving him many suggestions in connection with the technique of measurements.