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STUDIES OF PALAEOLITHIC MAN.

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I. THE CHANCELADE SKULL AND ITS RELATION TO THE MODERN ESKIMO SKULL*.

THE questions with which Eugenics has hitherto been primarily concerned are those of heredity in individuals, so that it is often inferred that the solution of such problems is the primary aim and object of the science. That the scope of Eugenics should be restricted to the study of individual development is, however, quite contrary to the original conception of Sir Francis Galton. Anthropology, with its concern to solve similar problems relating not to the individual but to the race or nation, was to him a correlative study which should be regarded by the eugenists as of equal importance and interest. No excuse, then, should be needed for the appearance in the *Annals of Eugenics* of a study such as the following which might, in a narrow sense, be called a purely anthropological one. The most direct approach to the wider problems of the ancestry of man and of racial heredity and development is to be made, at present, by studying the ever-increasing number of prehistoric skeletal remains which have been preserved. It is by knowing what man was that we may best understand what he is at present and will be in the future. Our acquaintance with the remote past is still slight, but it has already proved potent enough to overthrow all previous concepts of the mental and physical history of humanity.

1. *Introduction.*

In this paper skull measurements are indicated by the following index letters. Fuller descriptions of many of the measurements are given in *Biometrika*, Vol. XIV, pp. 196–200. Horizontal and vertical have reference to the standard horizontal plane determined by the auricular axis and the lowest point on the left orbital margin. L = glabella-occipital length; B = maximum parietal breadth; B' = least forehead breadth; B'' = greatest frontal breadth; EOW = internal bi-orbital breadth; H' = basio-bregmatic height; H = basio-vertical height; OH = vertical auricular height; LB = basion to nasion; Q' = transverse vertical arc terminating at the auricular points; S = sagittal arc nasion to opisthion; S_1 = arc nasion to bregma; S_2 = arc bregma to lambda; S_3 = arc lambda to opisthion; S_1' = chord nasion to bregma; S_2' = chord bregma to lambda; S_3' = chord lambda to opisthion; U = horizontal circumference through ophryon; PH = alveolar point to tip of anterior nasal spine; $G'H$ = nasion to alveolar point; GB = breadth between lowest points on zygomatic maxillary sutures; J = zygomatic breadth; NH, R and L = nasion to lowest point on edge of pyriform aperture R and L; NH' = nasion to base of anterior nasal spine; NB = nasal breadth; O_1, R and L = breadths of orbits using Fawcett's curvature method; O_1', R and L = breadths of orbits using Broca's dacryon; O_2, R and L = heights of orbits perp. to O_1, R and O_1, L; G_1 = palate length from tip of *spina nasalis posterior* to an imaginary line tangential to the inner rims of the alveoli of middle incisors; G_1' = similar to G_1 from base of spine; G_2 = palate breadth between inner alveolar walls at second molars; GL = basion to alveolar point; $P\angle$ = Frankfurt profile angle; $N\angle$, $A\angle$ and $B\angle$ of triangle of which the nasion, alveolar point

* The following paper is part of the work on which the writer has been engaged while holding a Senior Studentship awarded by the Royal Commissioners for the Exhibition of 1851.

and basion are the vertices; $\theta_1 = 180° - P\angle - N\angle$; C = capacity; Schwalbe's height = greatest subtense of vault from glabella-inion chord; Schwalbe's height index = 100 subtense/chord; DC = chord, dacryon to dacryon; SC = minimum chord between naso-maxillary sutures.

2. *Measurements of Eskimo Crania.*

The first description of an Eskimo skull was given by Winslow, a Dane by birth and a professor of anatomy at Paris, as early as 1722*. Blumenbach, Morton and Retzius described a few skulls, and towards the end of the 19th century several other anthropologists provided measurements of short series. In 1875 Bessels† gave individual measurements of 100 Greenland crania, but several were different from those taken by later anthropologists and some are insufficiently defined. The value of his work was greatly vitiated by the fact that no attempt had been made to sex the material. Dr Bruno Oetteking in 1908‡ provided measurements of 14 Eskimo skulls in the Dresden museum and considered the material provided by earlier workers without restricting his survey to Greenland. No distinction was made between ♂ and ♀ skulls. From that time only minor contributions to the subject were made until the appearance of the monumental work of Profs. Carl M. Fürst and F. C. C. Hansen published at Copenhagen (in English) in 1915. Their *Crania-Groenlandica* may well claim to be one of the most complete and most valuable craniometric treatises dealing with any human race. Full individual measurements—viz. 34 direct measurements, 13 indices and 12 angles of the cranium and 7 measurements of the mandible—of 379 sexed and almost complete skulls are provided, together with a type drawing of the sagittal sections and photographs in 5 normae of 52 skulls. There are 14 juvenile specimens and 8 unsexed, but the latter bear such a small proportion to the total that they may be safely ignored. The crania were all from Greenland, the majority being in the Anatomical Museum of Copenhagen University and in museums at Lund, Upsala and Stockholm. Very little of the material had been dealt with by earlier writers. Fürst and Hansen's crania form a wide and roughly random geographical selection from the whole of Greenland, the West coast, where the population is denser, being more fully represented than the East. While being thankful that individual measurements are provided, the biometrician must needs deplore the fact that the only distributions given and the only means calculated are—with the single exception of those for the cephalic index—for combined ♂ and ♀ skulls. Some of the measurements taken should have been more clearly defined. The majority are those of the Craniometric Concordat. The horizontal circumference measured through the glabella is not comparable with the arc through the ophryon which is more usually taken. The orbital measurements (see p. 142) were taken on the left side unless that was damaged, when the right was used. The breadth measured "from the lateral to the vertical medial margin which is the direct continuation of the lower orbital margin" may be supposed the same as Fawcett's breadth taken by the curvature method (*Biometrika,* Vol. I, p. 430, and Vol. VIII, pp. 311, 312). The undefined "interorbital breadth" is almost certainly the chord from dacryon to dacryon. The nasal height would seem to be Broca's measured from the nasion to the base of the anterior nasal spine and not the NH as defined above.

* The *Historical Survey of the Craniology of the Greenland Eskimos* in Fürst and Hansen's *Crania-Groenlandica* (pp. 41–53) gives a complete bibliography of the subject.

† Emil Bessels: "Einige Worte über die Inuit (Eskimo) des Smith-Sundes nebst Bemerkungen über Inuit-Schädel," *Archiv für Anthropologie,* Bd. VIII, 1875, pp. 116–118.

‡ Bruno Oetteking: "Ein Beitrag zur Kraniologie der Eskimo," *Abhandlungen und Berichte des königl. zoologischen und anthropologischen ethnographischen Museums zu Dresden,* Bd. XII, 1908, No. 3.

The salient characters of the typical Greenland Eskimo skull are well known. It is dolichocephalic with a distinct sagittal crest, low nasal and high orbital indices, a large cranial capacity and with mastoids and a superciliary ridge that are feebly developed. After comparing the mean measurements of groups from different regions Fürst and Hansen conclude that: "The anthropological characters cannot contribute to a solution of the question as to the migration of the Eskimos in Greenland, owing to the fact that the homogeneity of their anthropological characters clearly shows that the Eskimos of both the west and the east coasts are of the same racial type" (p. 230). It will be shown in a later section of the present paper that an investigation of the variabilities and distributions of the cranial characters entirely confirms the conclusion that the Greenland Eskimos form a perfectly homogeneous population.

Table I. *Mean Measurements of Greenland Eskimo Crania*[1].

Character	Male			Female	
	Fürst and Hansen	Hrdlička	Flower, Duckworth, Bessels, etc.	Fürst and Hansen	Hrdlička
Capacity	1527·7 (175)	1558·8 (34)	1472·2 (109)??	1412·9 (147)	1347·6 (34)
L	188·4 (192)	190·5 (38)	188·2 (148)	181·8 (165)	179·9 (44)
B	134·4 (191)	135·9 (36)	134·1 (146)	131·7 (165)	129·6 (37)
B'	95·7 (190)	—	94·9 (20)	93·1 (165)	—
H'	138·2 (183)	139·5 (39)	140·0 (56)	134·0 (162)	131·5 (44)
LB	105·6 (186)	—	104·9 (39)	101·4 (165)	—
S	378·4 (186)	—	373·7 (29)	367·0 (161)	—
S_1	129·6 (187)	—	127·2 (26)	127·8 (161)	—
S_2	128·6 (183)	—	126·5 (26)	123·6 (160)	—
S_3	120·7 (181)	—	119·4 (26)	117·4 (161)	—
U	523·8 (186)[2]	—	523·4 (145)	507·7 (162)[2]	—
$G'H$	74·9 (191)	74·4 (36)	72·4 (25)	70·6 (163)	68·8 (34)
J	139·5 (180)	140·1 (30)	136·4 (101)	131·6 (159)	129·1 (29)
GB	102·7 (188)	—	100·4 (29)	96·9 (163)	—
GL	104·4 (187)	—	104·2 (23)	100·9 (161)	—
NH'	53·75 (192)	53·3 (39)	53·5 (33)	51·1 (162)	50·1 (40)
NB	23·1 (191)	22·9 (36)	23·5 (50)	22·3 (161)	21·5 (41)
O_1L	42·8 (189)	—	—	41·4 (163)	—
$O_1'L$	—	40·1 (38)	39·8 (26)	—	38·8 (42)
O_2L	36·3 (188)	36·8 (38)	35·5 (35)	35·4 (163)	35·6 (42)
fml	—	—	38·1 (14)	—	—
fmb	—	—	29·1 (14)	—	—
DC	22·2 (191)	—	21·8 (14)	21·1 (165)	—
100 B/L	71·3 (190)	71·5 (35)	{71·4 (145)}	72·7 (165)	71·9 (37)
100 H'/L	{73·4 (183)}	{73·2 (36)}	{74·2 (55)}	{73·7 (162)}	{73·1 (44)}
100 H'/B	{102·8 (183)}	{102·7 (36)}	{104·4 (56)}	{101·7 (162)}	{101·5 (37)}
100 $G'H/GB$	{72·9 (188)}	—	{72·1 (25)}	{72·9 (163)}	—
100 $G'H/J$	53·7 (184)	53·6 (28)	{53·1 (25)}	53·6 (159)	53·8 (22)
100 NB/NH'	43·2 (190)	42·9 (36)	{42·6 (23)}	43·7 (161)	43·2 (40)
100 O_2/O_1, L	85·0 (189)	—	—	85·6 (163)	—
100 O_2/O_1', L	—	91·8 (38)	{89·4 (31)}	—	91·8 (42)
100 fmb/fml	—	—	{76·4 (14)}	—	—
$N\angle$	68°·1 (185)	—	{69°·5 (23)}	69°·0 (160)	—
$A\angle$	70°·0 (185)	—	{69°·9 (23)}	70°·1 (160)	—
$B\angle$	41°·9 (185)	—	{40°·6 (23)}	41°·0 (160)	—

[1] The indices and angles in curled brackets were found from the mean values of the component lengths.

[2] Fürst and Hansen's horizontal circumference was taken through the glabella and the mean is probably greater than that of the circumference taken through the ophryon in the usual way.

Some other mean measurements of Fürst and Hansen's ♂ Eskimo crania are given in Table VI, and the following are also available: 100 DC/EOW = 22·4 (190), SC = 5·34 (184). The ♀ means other than those given above are: Glabellar-Inion = 176·3 (163), Nasion-Inion = 171·5 (163), Bregma-Inion = 149·6 (160), S_1' = 111·8 (161), B'' = 106·3 (164), H = 135·1 (164), OH = 117·0 (161), Schwalbe's calvarial height = 98·8 (162), Q' = 306·6 (162), EOW = 95·8 (164), G_1 = 54·5 (157), G_2 = 39·5 (160), SC = 5·34 (160), 100 H/L = 73·3 (164), Schwalbe's height index = 56·1 (157), 100 H/B = 102·6 (164), 100 B'/B = 70·7 (165), 100 S_1'/S_1 = 87·5 (160), 100 S_2/S_1 = 96·9 (160), 100 DC/EOW = 22·1 (163), 100 G_2/G_1 = 72·7 (157), $P\angle$ = 83°·3 (149), $N\beta I\angle$ = 80°·7 (160), $\beta NI\angle$ = 59°·4 (160), $\beta IN\angle$ = 39°·9 (160), $N\beta Bas.\angle$ = 47°·6 (161), $NBas.\beta\angle$ = 54°·7 (161), $\beta NBas.\angle$ = 77°·7 (161), θ_1 = 27°·6 (154), $\beta N\gamma\angle$ = 50°·1 (150). The notation of the foregoing angles is that used on the sagittal contour: see Fig. 1, p. 273.

In 1924 Dr Aleš Hrdlička published the first part of a catalogue of the human crania in the United States National Museum (Smithsonian Institution)*. Individual measurements of 412 Eskimo skulls are given and 40 ♂s and 44 ♀s are of Greenland origin, though the exact locality from which they came is apparently not known. Unfortunately the measurements are few in number and many which would generally be considered of essential importance are lacking. The mean measurements of the Greenland crania are quoted in Table I above. They are almost identically the same as those provided by Fürst and Hansen. Using the standard deviations of the latter series (given in Table IV below) the following Coefficients of Racial Likeness are found:

	♂	♀
14 Characters	$-0{\cdot}90 \pm {\cdot}25$	$2{\cdot}90 \pm {\cdot}25$
5 Indices	$+0{\cdot}11 \pm {\cdot}43$	$+0{\cdot}06 \pm {\cdot}43$

So there is sufficient statistical justification for considering that the two series of ♂ means represent samples drawn from identically the same population. The ♀ indices are also in perfect accord, but nearly all the ♀ direct measurements show differences that are just significant, Fürst and Hansen's means being greater than the corresponding ones given by Hrdlička. The discordance is evidently not symptomatic of a racial difference. The difficulty of sexing their material was stressed by the writers of the *Crania-Groenlandica* (see p. 56) and by others who have examined Eskimo crania. The observed differences between the means are evidently due to inaccurate sexing and we are inclined to accept as accurate the determinations of the Professors of Anatomy in the Universities of Lund and Copenhagen on account of their wider acquaintance with the racial type, the fact that they were helped in many doubtful cases by an examination of the pelvis and that their ♂ and ♀ distributions of characters are closely fitted by normal curves (see below).

In 1923 the present writer published the pooled ♂ means of Eskimo skulls, the majority of which had been measured by Bessels, and a few by Duckworth, Flower, Virchow and Quatrefages and Hamy together with six others of which measurements are given in the German anthropological catalogues†. Bessels' skulls were sexed by an approximate mathematical method and the means arrived at were of a somewhat uncertain value. The majority of the skulls were from the extreme north-west of Greenland (Smith Sound), and a comparison of that group with another composed of skulls from Labrador, Baffin Land and the Arctic Archipelago revealed no clear difference of type. The pooled means are given in column 4 of Table I. The capacity is possibly inaccurate. The following C.R.L.s are found with those means (56·7)‡, excluding C:

		All Characters	Indices and Angles
Morant's pooled means with	Fürst and Hansen's (187·4)‡	$1{\cdot}83 \pm {\cdot}22$ [19]§	$0{\cdot}89 \pm {\cdot}36$ [7]§
	Hrdlička's (35·9)‡	$1{\cdot}66 \pm {\cdot}25$ [15]§	$0{\cdot}59 \pm {\cdot}39$ [6]§

The only characters showing significant differences are J, $G'H$ and H' with Fürst and Hansen's means and O_2, L and J with Hrdlička's. The divergences may be due to different methods of measurement, or inaccurate sexing, or they may indicate that the population of the extreme north-west of Greenland is not of precisely the same type as that found in other parts of that country.

* *Proceedings of the United States National Museum*, Vol. 63, 1924, Article 12

† "A First Study of the Tibetan Skull," *Biometrika*, Vol. XIV, 1923, pp. 193–260. An account of the Eskimo material is given on pp. 220–222.

‡ These numbers in round brackets are the mean number of skulls available for the characters used in computing the Coefficients (all characters).

§ The numbers in square brackets give the number of characters on which the Coefficients are based.

Hrdlička (*loc. cit.*) has given measurements of a considerable number of Western Eskimo skulls contained in the United States National Museum at Washington. The only means of any reliability are those of the Alaskan and more easterly St Lawrence Island crania. The male values are given in Table II below together with those of a series of Alaskan Indians which show no Eskimo affinities. With the arrangement adopted there is, for the majority of the characters, an orderly sequence passing from the Greenland Eskimo type at one extreme to that of the markedly different Indians at the other. That is so for B, H', NB, $100\,B/L$ and $100\,H'/B$, and the slight divergences from that order in the case of L, J and $100\,NB/NH'$ may well be occasioned by deviations of sampling. The orbital measurements show no significant differences, so the capacity (C), the facial heights ($G'H$, NH') and the indices $100\,H'/L$ and $100\,G'H/J$ are the only characters giving other orders. The material is quite insufficient to provide a definitive solution, but there is at least a clear suggestion that the north-eastern Eskimos have been transformed from their original type by admixture with the markedly contrasted Indian peoples.

Table II. *Mean Measurements of Male Eskimo and Alaskan Crania.*

Characters	Greenland Eskimos	Alaskan Eskimos	St Lawrence Island Eskimos	Alaskan Indians
Capacity	1559 (34)	1466 (25)	1506 (129)	1529 (59)
L	190·5 (38)	182·9 (27)	184·0 (158)	181·2 (59)
B	135·9 (36)	139·0 (27)	141·4 (157)	148·8 (59)
H'	139·5 (39)	137·6 (27)	137·0 (143)	130·3 (58)
$G'H$	74·4 (36)	75·3 (24)	76·6 (144)	74·1 (55)
J	140·1 (30)	141·0 (24)	140·8 (151)	144·5 (57)
NH'	53·3 (39)	54·2 (27)	55·4 (150)	53·1 (62)
NB	22·9 (36)	23·2 (27)	24·7 (153)	26·0 (62)
$O_1'L$	40·1 (38)	40·2 (26)	40·4 (148)	40·0 (62)
O_2L	36·8 (38)	36·5 (26)	36·9 (148)	35·9 (49)
$100\,B/L$	71·5 (35)	76·0 (27)	76·9 (157)	82·1 (59)
$100\,H'/L$	{73·2 (36)}	{75·2 (27)}	{74·5 (143)}	{71·9 (59)}
$100\,H'/B$	{102·7 (36)}	{99·0 (27)}	{96·9 (143)}	{87·5 (58)}
$100\,G'H/J$	53·6 (28)	53·7 (21)	54·5 (140)	51·1 (55)
$100\,NB/NH'$	42·9 (36)	42·7 (27)	44·6 (150)	48·9 (62)
$100\,O_2/O_1', L$	91·8 (38)	90·7 (26)	91·3 (148)	89·8 (62)

Though there is no historical evidence to support such a theory, it would seem to provide a far more reasonable hypothesis than the one suggested by Hrdlička that the differences are due to environmental conditions. It is solely with the pure Eskimo type, which is apparently only represented to-day by the people of Greenland, that we are at present concerned.

3. *The Biometric Constants of Fürst and Hansen's Greenland Eskimo Crania.*

A comparison of various geographical groups of the crania measured by Fürst and Hansen suggested to them that the total population was perfectly homogeneous. Unfortunately the only distributions they considered were of combined ♂ and ♀ skulls. The usual biometric constants for the single sexes are presented below and they form an important contribution to our knowledge of racial variation as the series of 190 ♂ and 160 ♀ crania is rivalled in length by hardly any that have yet been studied.

(*a*) *The Sexual Difference.* The differences between the ♂ and ♀ mean indicial and angular measurements of the same homogeneous racial population are known to be very small so that their significance can only be estimated in the case of an adequately long series such as the present one. Between the 12 angular measurements of the sagittal section the greatest sexual difference found is 1°·1, which is not significant. There are 8 indices which show insignificant differences—the greatest being 0·9—and values for 4 others are given in Table III with comparative data for the long

XXVIth to XXXth Dynasty Egyptian series* and the Whitechapel English†. It is well known that on the average the ♀ skull is more brachycephalic than the ♂ of the same race when the length is measured from the glabella. The difference is undoubtedly due to the greater increase in the ♂ length consequent on the growth of the superciliary ridges in early adult life, and when that factor is excluded, as it may be by measuring the length from the ophryon (F), the ♂ and ♀ indices ($100\ B/F$) are found to be identical. We might expect to find a similar difference for the index $100\ H'/L$ or $100\ H/L$, but none is found, while the ♂ indices $100\ H/B$ and $100\ H'/B$ exceed the ♀, so it is difficult to avoid the conclusion that with the increase in glabellar-occipital length of the ♂ there is a corresponding increase in the basio-bregmatic height. The sexual differences between the indices $100\ S_2/S_1$ and $100\ B'/B$ are perhaps not significant. The sexual differences between the absolute lengths are only roughly proportional to those lengths. That for the calvarial breadth is peculiarly small. In absolute size the Eskimo ♂ and ♀ crania are distinctly closer to one another than the Egyptian or English, and the English series shows a greater sexual difference than the Egyptian, but it would be premature to suggest any correlation between those facts and the status of the three racial types in the evolutionary scale.

Table III. *Sexual Differences* (♂–♀).

	$100\ B/L$	$100\ H/B$	$100\ H'/B$	$100\ S_2/S_1$	$100\ B'/B$	L	B	H	H'	B'	U	C	S	$G'H$	J
Eskimo (190 ♂–160 ♀)	−1·4	+1·0	+1·1	+1·9	+2·2	+6·6	+2·7	+4·2	+4·2	+2·6	+16·1[3]	+116·8	+11·4	+4·3	+7·9
Egyptians (900 ♂–600 ♀)	−1·6	+1·2[1]	—	+0·9[1]	+0·2[1]	+8·2	+3·3	+4·9	—	+2·5	+19·0	+137·8	+12·1	+3·7	+7·8
English (130 ♂–140 ♀)	−0·5	+1·1[4]	+1·3[1]	−0·7[4]	+0·6[1]	+8·7	+6·0	+7·6[4]	+7·4	+4·9	+20·5	+177·0[2]	+14·3	+4·3[2]	+9·8[2]

[1] The differences marked with an asterisk are between mean indices calculated from the means of the component lengths instead of from individual indices.

[2] For C, $G'H$ and J both ♂ and ♀ Whitechapel English means are based on fewer than 100 crania.

[3] Fürst and Hansen measured the horizontal circumference through the glabella.

[4] These values are supplied from a long series of 17th century London crania discussed in a forthcoming paper by Beatrix Hooke.

(*b*) *Variation.* The study of the statistical constants—other than the means—of homogeneous populations of human crania is still in its infancy although Fawcett's classical memoir was published 23 years ago. A contribution of prime importance has recently been made by the authoritative discussion of the subject by Miss Davin and Professor Karl Pearson (*loc. cit.*) and the presentation of the standard deviations and coefficients of variation of the unrivalled series of 900 ♂ and 600 ♀ Dynastic Egyptian skulls. The variabilities now first computed for Fürst and Hansen's Eskimos and presented in Table IV are for some of the longest series as yet dealt with. In addition to providing the variabilities of nearly all the characters normally measured in the Biometric Laboratory they cover several others for which no comparative material is as yet available.

We will consider the sexual difference first. Out of 33 absolute measurements the ♂ Coefficients of Variation exceed the ♀ in 14 cases, for 1 they are exactly alike and for 18 the ♀ exceed the ♂. For the indices, as measured by standard deviations, 9 ♂ characters are greater and 3 ♀, and for the angles (standard deviations) 10 ♂ and 2 ♀. For the long Egyptian series the ♂ variability exceeded the ♀ in 46 cases out of 51—all the ♂ indices and angles showing greater constants

* Pearson and Davin, "On the Biometric Constants of the Human Skull," *Biometrika*, Vol. XVI, 1925, pp. 328–363.

† Macdonell, "A Study of the Variation and Correlation of the Human Skull, with special reference to English Crania," *ibid.* Vol. III, 1904, pp. 191–244.

Table IV. *Standard Deviations and Coefficients of Variation of Fürst and Hansen's Greenland Eskimo Crania.*

Character	Capacity	Calvarial Lengths						Calvarial Breadths		
		L	Glabellar-Inion	Nasion-Inion	S_1'	Bregma-Inion	LB	B	B'	B''
Standard Deviation ♂	128·80 ± 4·64	5·81 ± ·20	6·84 ± ·24	6·61 ± ·23	4·61 ± ·16	5·98 ± ·21	3·99 ± ·14	4·52 ± ·16	4·42 ± ·15	4·36 ± ·15
Standard Deviation ♀	121·85 ± 4·79	5·29 ± ·20	5·75 ± ·21	5·84 ± ·22	4·19 ± ·16	5·76 ± ·22	4·05 ± ·15	4·57 ± ·17	4·39 ± ·16	4·67 ± ·17
Coeff. of Variation ♂	8·43 ± ·30	3·08 ± ·11	3·72 ± ·13	3·72 ± ·13	4·06 ± ·14	3·85 ± ·13	3·78 ± ·13	3·36 ± ·12	4·64 ± ·16	3·97 ± ·14
Coeff. of Variation ♀	8·63 ± ·34	2·91 ± ·11	3·26 ± ·12	3·41 ± ·13	3·74 ± ·14	3·85 ± ·15	3·99 ± ·15	3·47 ± ·13	4·72 ± ·18	4·40 ± ·16

Character	Calvarial Heights				Calvarial Arcs					
	H	H'	OH	Schwalbe's Height	Glabellar U	S	S_1	S_2	S_3	Q'
Standard Deviation ♂	4·78 ± ·17	4·79 ± ·17	4·44 ± ·16	5·49 ± ·19	13·06 ± ·46	12·56 ± ·44	5·20 ± ·18	7·15 ± ·25	7·37 ± ·26	9·13 ± ·31
Standard Deviation ♀	4·67 ± ·17	4·47 ± ·17	4·18 ± ·16	5·20 ± ·19	13·05 ± ·49	15·31 ± ·58	5·50 ± ·21	7·80 ± ·29	7·75 ± ·29	10·09 ± ·38
Coeff. of Variation ♂	3·43 ± ·12	3·47 ± ·12	3·68 ± ·13	5·42 ± ·19	2·49 ± ·09	3·32 ± ·12	4·01 ± ·14	5·56 ± ·20	6·11 ± ·22	2·92 ± ·10
Coeff. of Variation ♀	3·46 ± ·13	3·33 ± ·13	3·58 ± ·13	5·27 ± ·20	2·57 ± ·10	4·17 ± ·16	4·31 ± ·16	6·31 ± ·24	6·62 ± ·25	3·29 ± ·12

Character	Facial Measurements									
	J	GB	EOW	$G'H$	GL	NH'	NB	O_1L	O_2L	DC
Standard Deviation ♂	6·52 ± ·23	6·00 ± ·21	5·07 ± ·18	4·39 ± ·15	5·40 ± ·19	3·10 ± ·11	1·75 ± ·06	2·46 ± ·09	2·03 ± ·07	2·06 + ·07
Standard Deviation ♀	5·40 ± ·20	5·13 ± ·19	4·76 ± ·18	4·30 ± ·16	5·50 ± ·21	3·23 ± ·12	1·89 ± ·07	2·22 ± ·08	1·86 ± ·07	1·87 ± ·07
Coeff. of Variation ♂	4·67 ± ·17	5·84 ± ·20	5·12 ± ·18	5·86 ± ·20	5·17 ± ·18	5·77 ± ·20	7·55 ± ·26	5·75 ± ·20	5·58 ± ·19	9·30 ± ·32
Coeff. of Variation ♀	4·10 ± ·16	5·29 ± ·20	4·97 ± ·19	6·09 ± ·23	5·45 ± ·21	6·32 ± ·24	8·47 ± ·32	5·36 ± ·20	5·26 ± ·20	8·84 ± ·33

Character	Facial Measurements	Palate		Calvarial Indices						
	SC	G_1	G_2	100 B/L	100 H/L	100 H/B	Schwalbe's Height Index	100 B'/B	100 S_1'/S_1	100 S_2/S_1
Standard Deviation ♂	2·22 ± ·08	3·58 ± ·13	3·27 ± ·11	3·00 ± ·10	2·59 ± ·09	4·83 ± ·17	3·64 ± ·13	3·48 ± ·12	1·83 ± ·06	6·43 ± ·23
Standard Deviation ♀	2·09 ± ·08	3·82 ± ·15	3·16 ± ·12	2·73 ± ·10	2·43 ± ·09	4·20 ± ·16	3·30 ± ·13	3 45 ± ·13	2·15 ± ·08	6·54 ± ·25
Coeff. of Variation ♂	41·66 ± 1·70	6·36 ± ·22	8·00 ± ·28	4·21 ± ·15	3·51 ± ·12	4·66 ± ·16	6·60 ± ·23	4·88 ± ·17	2·09 ± ·07	6·51 ± ·23
Coeff. of Variation ♀	39·11 ± 1·68	7·02 ± ·27	8·01 ± ·30	3·76 ± ·14	3·31 ± ·12	4·09 ± ·15	5·90 ± ·22	4·87 ± ·18	2·45 ± ·09	6·76 ± ·26

Character	Facial Indices				Palate Index	Angles				
	100 $G'H/J$	100 NB/NH'	100 $O_2/O_1, L$	100 DC/EOW	100 G_2/G_1	$P\angle$	$N\angle$	$A\angle$	$B\angle$	θ_1
Standard Deviation ♂	3·24 ± ·11	3·84 ± ·16	5·60 ± ·19	1·93 ± ·07	6·52 ± ·23	3°·51 ± ·12	3°·71 ± ·13	3°·13 ± ·11	2°·40 ± ·08	3°·27 ± ·12
Standard Deviation ♀	3·15 ± ·12	4·09 ± ·15	5·47 ± ·20	1·80 ± ·07	6·15 ± ·23	3°·00 ± ·12	3°·45 ± ·13	3°·19 ± ·12	2°·65 ± ·10	3°·15 ± ·12
Coeff. of Variation ♂	6·04 ± ·21	8·89 ± ·31	6·59 ± ·23	8·62 ± ·30	8·97 ± ·31	4·20 ± ·15	5·45 ± ·19	4·48 ± ·16	5·72 ± ·20	11·60 ± ·42
Coeff. of Variation ♀	5·89 ± ·22	9·35 ± ·35	6·40 ± ·24	8·17 ± ·31	8·45 ± ·32	3·61 ± ·14	5·01 ± ·19	4·56 ± ·17	6·48 ± ·24	11·40 ± ·44

Character	Angles						
	βNI	$N\beta I$	βIN	$\beta NBas.$	$NBas.\beta$	$N\beta Bas.$	$\gamma N\beta$
Standard Deviation ♂	3°·18 ± ·11	3°·80 ± ·13	1°·99 ± ·07	2°·93 ± ·10	2°·49 ± ·09	2°·17 ± ·08	3°·82 ± ·14
Standard Deviation ♀	3°·05 ± ·12	3°·50 ± ·13	1°·67 ± ·06	2°·55 ± ·10	2°·32 ± ·09	2°·10 ± ·08	3°·49 ± ·14
Coeff. of Variation ♂	5·34 ± ·19	4·65 ± ·16	5·13 ± ·18	3·74 ± ·13	4·65 ± ·16	4·51 ± ·16	7·63 ± ·28
Coeff. of Variation ♀	5·14 ± ·19	4·33 ± ·16	4·18 ± ·16	3·28 ± ·12	4·24 ± ·16	4·41 ± ·17	6·95 ± ·27

than the ♀—but for two shorter series (the Naqada and Whitechapel English) there was no clear preponderance of either sex over the other. It should be carefully borne in mind that for all these series, except the Dynastic Egyptians, the sexual difference in variability is, for almost all characters, small compared with the probable error of that difference. For the Eskimos, for example, the greater number of the differences are less than their probable error. It should be possible to give a more definite answer to this question of the sexual difference in variability, and of its possible racial significance, by comparing the constants worked out for really long series of measurements of the living than for series of skulls which must almost inevitably form small statistical populations and for which the difficulty of sexing is greater.

In considering the relative variabilities of different direct measurements for the same racial population we are at once confronted with the fact that there is a high negative correlation between the Coefficients of Variation and the absolute mean lengths. The constants for two small measurements not dealt with in the case of the other series are given for the Eskimo. The least breadth of the two nasal bones (*SC*) is the shortest chord ordinarily measured. It has a mean value of 5 mm. but a standard deviation that is half that of the parietal breadth: the Coefficients of Variation bear the proportion of 1 to 13. The next smallest measurement is the dacryal chord (*DC*), and it has the second greatest Coefficient of Variation. The decrease in relative variability as the size increases is observed whether we consider the calvarial and facial measurements as two separate groups or whether they are considered in conjunction, and this is probably due to the fact that the errors of reading or measurement are proportionately much greater for the smaller lengths and arcs.

Finally we may compare the Eskimo variabilities and those of the other racial types. For both ♂ and ♀ series the Eskimo and Whitechapel English variabilities are approximately equal: for about half the characters that can be compared the Eskimo values exceed the English, and for the other half they are less than the English. When compared in the same way the Dynastic Egyptian population is seen to be decidedly less variable than the two Western ones. There is a suggestion of a racial difference in variation for some characters, but far ampler material would be required to prove that such a difference exists. For both ♂ and ♀ populations the Eskimo standard deviations of the orbital index are significantly greater than those of the Dynastic Egyptians, Prehistoric (Naqada) Egyptians and 17th century English, while for $100\ H/L$ the Eskimo variation is less than for the other three types. The variation of the Eskimo calvarial heights (H, H' and OH) is decidedly small. It is interesting to note that their facial indices $100\ G'H/J$ have much smaller standard deviations than the indices $100\ G'H/GB$ of the other races. Schwalbe's calvarial height index is far more variable than $100\ H/L$.

(*c*) *The Nature of the Frequency Distributions.* "With series of skull measurements such as the present, which are long for the craniologist, if short for the statistician, we shall reach for most practical purposes adequate graphical representations of the frequency by using the normal curve of deviations*." The above quotation concludes the section dealing with the form of the frequency distribution in Fawcett's classical paper which was the first to deal with a population of skulls by modern statistical methods. That conclusion was confirmed by Macdonell (*loc. cit.*). The P for goodness of fit of normal curves to 14 distributions of Fürst and Hansen's Eskimo crania are given in Table V. It may be remembered that from other evidence we have been led to believe that that population is perfectly homogeneous. For the ♀ series there is evidently

* "A Second Study of the Variation and Correlation of the Human Skull with special reference to the Naqada Crania," *Biometrika*, Vol. I, 1902, pp. 408–467.

Table V. *The Goodness of Fit of Normal Curves to the Distributions of Fürst and Hansen's Eskimo Skulls.*

Character	Male		Female	
	P	No. of Groups	P	No. of Groups
L	·919	29	·926	23
B	·692	23	·931	23
H	·925	23	·769	24
$G'H$	·558	25	·807	23
$100\ B/L$	·853	16	·905	17
$100\ H/L$	·988	15	·815	14
$100\ NB/NH'$	·180	21	·883	19

ample justification for considering that the distributions of all these characters are adequately represented by normal curves. The same can be said for the ♂ series except for the nasal index, and in that case the divergence from normality is no greater than that which would occur quite frequently as the result of random sampling. We should anticipate that one sample in six would give a worse fit than that of the nasal index. It is evidently desirable to apply the goodness of fit test to more than one or two measurements when investigating the homogeneity of a racial population. From the biometric constants we find adequate confirmation of the legitimacy of considering the Greenland Eskimo population to be a racially homogeneous one.

4. *The Chancelade Skull.*

On the 1st of October 1888 MM. Féaux and Hardy discovered a skeleton in a rock shelter (*abri sous roche*) near the hamlet of Raymonden in the commune of Chancelade and the remains of that celebrated individual have since been designated by one or other of those names, but generally the latter. The site is 7 km. north-west of Périgueux. The two archaeologists were finishing their labours and had reached the bed-rock, on which the skeleton was lying in a flexed position on its left side. The total depth of the deposits at that point was 1·60 m. and above had been found three distinct Magdalenian hearths separated by sterile layers. The Magdalenian age of the individual was unequivocally demonstrated. The artifacts—flints and incised reindeer bones—and the human and animal remains—notably among the latter being fragments of the Greenland seal—are preserved in the Musée du Périgord at Périgueux*. The writer would wish to express his great indebtedness to M. Maurice Féaux, the associated finder of those important relics and their present conservator, for his kindness in granting him permission to take measurements, contour drawings and photographs of the original skeleton.

Soon after its discovery the skeleton was sent to Dr Testut, at that time professor of anatomy at the University of Lyons, and he restored it with minute care and gave a detailed description of it from both anatomical and anthropological points of view†. Judged by modern biometric standards the measurements given are too few in number and the comparative material is almost wholly inadequate, but, for the age in which Dr Testut wrote, his classical memoir is a notably comprehensive and careful study. We are only at present concerned with the skull and mandible. When found the former was in a fragmentary state: the pick of a workman had pierced the vault, the facial bones were in fragments, though almost all were recovered, and there was a large hole

* Maurice Féaux, *Catalogue des Collections Préhistoriques, Musée du Périgord*, 1905. Short notices of the excavations are given in the *Bull. de la Soc. histor. et archéol. du Périgord*, T. xv, 1888, pp. 251 and 363, and a detailed account was furnished by M. Hardy, *La station quaternaire de Raymonden* in 1891 in T. xviii of the same Journal.

† "Recherches anthropologiques sur le squelette quaternaire de Chancelade (Dordogne)," *Bulletin de la Société d'Anthropologie de Lyon*, T. viii, 1889, pp. 131–246.

in the base which could only be restored—like the vault—with plaster. The bregma (see Fig. 1 and Plate IV) falls just off the extant bone, but its position can be approximated to with considerable accuracy. The nasion, lambda and inion can be exactly found, but the opisthion has to be located on the plaster and the region of the basion is entirely restored so that little reliance can be placed on measurements taken from it. No foraminal measurements can be found. The nasal bones are missing except for their extreme upper ends and no simotic or dacryal measurements are obtainable. Testut gives, without comment, the breadth of the pyriform aperture as 26 mm., but the right maxillary border is defective, and the present writer does not believe that any accurate estimation of that breadth can be made. The only thing that can be said with certainty is that the chord is less than 27 mm.* Almost all the teeth of the upper jaw were lost before death and the alveoli had been absorbed so that palatal measurements can only be roughly approximated to. The coronal suture is simple and closing but the sagittal and lambdoid are remarkably complex and are open externally though said to be completely closed internally. Testut estimated the age at 55 to 60 years though that is perhaps rather too advanced. The sex is almost unquestionably male. All the regions of muscle attachment are well marked and the mastoid processes are strongly developed. A large area of the right temporal region (63 mm. long by 50 mm. high) was fractured during life and forced inwards so that the edges of the outer table of the fractured portion were brought on a level with the inner table of the surrounding edge of the unfractured bone. But the terrific blow that must have caused such an accident was not the cause of death for the edge had grown together completely. The frontal bone is prominent and there is a most distinct sagittal crest (see Fig. 3 and Plates II and III) of a form precisely similar to that which is characteristic of the Eskimo and but few other races of man†. That salient character immediately suggests comparison with the present-day type, and other points of similarity are found in the form of the frontal region, the great length and transverse flattening of the facial skeleton and the low nasal index. After considering the question in considerable detail and from a comparison of the whole skeleton, Testut concluded with the guarded statement: "Parmi les races actuelles, celle qui me paraît présenter la plus grande analogie avec l'homme de Chancelade est celle des Esquimaux....Elle (l'analogie) lui est de tous points favorable et élève à la hauteur d'une vérité probable, je n'ose dire d'une vérité démontrée, ce qui n'était encore qu'une simple hypothèse" (*loc. cit.* pp. 243, 244). That hypothesis has been accepted by almost all anthropologists who have examined the Chancelade remains. Our present object is to re-examine it with the aid of that more rigorous method which biometry affords and by comparison with the splendid numerical descriptions of Greenland Eskimo skulls recently given by Fürst and Hansen.

A considerable number of measurements of the Chancelade skull will be found in Table VI below and the following are additional ones for which there is no comparative Eskimo material‡: Flower's ophryo-occipital length (F) 193·1 in the median sagittal plane and 193·4 greatest (to left); S_2' 127·5; S_3' 97·5?; chord lambda to inion 59·9; chord inion to opisthion 52·6?; arc lambda to inion 64·0; arc inion to opisthion 52·8?; U 544; NH, R 57·3; NH, L 58·4?; PH 21·1??; G_1' 45·9?;

* If the breadth of 26 is accepted the nasal index is 44·8, a value close to the Eskimo mean. The Chancelade skull is certainly leptorrhine.

† See the plates to E. Y. Thomson's "Study of the Crania of the Moriori," *Biometrika*, Vol. XI, pp. 82–135.

‡ Several of the measurements I took differ from Testut's by as much as 1 or 2 mm. and where one, or both terminals, can only be approximately located such differences are to be expected. A considerable number can be checked against the measurements of the sagittal contour (Fig. 1 below). Testut's *Biorbitaire interne* measurement of 93 (p. 168) is probably a misprint for 103.

G_1'' 53·9??; O_1', R 37·8?; O_1', L 39·0?; bi-asteric chord 112·9? (Testut 109); external orbital width 110·1; bi-stephanic chord 115·0? (Testut 110); bi-mastoid chord 104·1; transverse arc through bregma 328?; Occipital Index 60·2.

The greatest glabellar-occipital length in the median sagittal plane is 193·2, but the greatest taken slightly to the left of that plane is 194·0, and I have accepted the latter as L and used it in calculating indices. Testut accepted the length 193·0. The actually greatest parietal breadth of the skull is 134·5, but the right terminal comes on the broken-in temporal. By examining the transverse section (Fig. 3 below) we may estimate that the breadth before the accident was 3·0 mm. greater and the estimated B of 137·5 is the one used in the present paper. Testut considered that the breadth was 139·0.

By filling the restored skull with mustard seed Testut found that its capacity was 1730 c.c., from which value may be subtracted 20 c.c. as the absence of the body of the sphenoid would slightly increase the volume. That estimation should be appreciably greater than the mean capacity of 1527·7 c.c. given by Fürst and Hansen for 175 ♂ Eskimo skulls as the palaeolithic calvaria is greater in length, breadth and height than the mean of the modern Eskimo. Dudley Buxton has recently given the reconstruction formula $C = {\cdot}00049\ (L \times B \times OH) + 37{\cdot}2$ which was calculated from the data given in the *Crania-Groenlandica* for 160 ♂ skulls*, and that should give a more accurate result for one individual Eskimo than any of the formulae given in the paper by Lee and Pearson† as the Eskimo skull is of a very specialised type. Applying it to the Chancelade cranium we get a C of 1660·6. Now the vertical height (H) measurement of the palaeolithic skull exceeds its auricular height by a greater amount than that which is observed for all except extreme Eskimo specimens, owing, as the writer thinks for reasons which are fully discussed below, to the fact that the basion of the reconstructed skull has been placed too low. Applying a reconstruction formula involving the basio-vertical in place of the auricular height would probably give a C almost as great as the one found by Testut using direct methods. But an estimation which is independent of the much restored base is more likely to give a correct result and we may most reasonably accept the capacity of the Chancelade skull as *circa* 1660 c.c.

5. *Is the Chancelade an Eskimo Skull?*

It should be possible to answer this question from a statistical point of view with considerable precision as we have reliable means and standard deviations of the modern Eskimo population and fairly complete and accurate measurements of the palaeolithic skull. C being the Chancelade measurement and M_E and σ_E the mean and standard deviation respectively of the ♂ Eskimo population, the value of $(C - M_E)/\sigma_E$ gives a measure of the probability (p) of a true Eskimo skull picked at random having a measurement diverging more from the Eskimo mean type than the Chancelade skull does‡. If $(C - M_E)/\sigma_E$ be less than 0·5 that probability is greater than ·6170, if less than 1·0 the p is greater than ·3174, if less than 2·0 the p is greater than ·0456, if less than 3·0 the p is greater than ·0026 and if less than 3·5 the p is greater than ·0004. Values are given for 55 characters, they being all that can be compared, in Table VI. The measurements of the Chancelade skull once queried are somewhat doubtful but are probably very close to or identical with the true

* *Man*, October, 1925, No. 97. The additional constant is there given as − 37·2, but that is probably a misprint for + 37·2.

† "Data for the Problem of Evolution in Man. VI. A First Study of the Correlation of the Human Skull," *Phil. Trans.* Series A, Vol. 196, pp. 225–264, 1901.

‡ On the assumption, of course, that the characters of the Eskimo population are normally distributed, which is a fully justified one.

Table VI. *Comparison of the Chancelade and Mean Male Eskimo Skull Measurements.*

	Character	Chancelade Skull (C)	Fürst and Hansen's Male Eskimo Crania: Mean (M_E)	Fürst and Hansen's Male Eskimo Crania: Standard Deviation (σ_E)	$(C - M_E)/\sigma_E$
	Capacity	1710·0??	1527·7	128·8	+1·3??
Calvarial Lengths	L	194·0	188·4	5·81	+0·9
	Glabellar-Inion	187·8[2]	183·7	6·84	+0·6
	Nasion-Inion	183·9[2]	177·9	6·61	+0·9
	Bregma-Inion	163·5[2]?	155·1	5·98	+1·4?
	S_1'	115·5?	113·5	4·61	+0·4?
	LB	113·5??	105·6	3·99	+2·0??
Calvarial Breadths	B	137·5?	134·4	4·52	+0·7?
	B'	100·2	95·7	4·44	+1·0
	B''	115·3	109 6	4·355	+1 3
	EOW	101·2	99 2	5·07	+0·4
Calvarial Heights	H'	148·4??	138·2	4·79	+2·1??
	H	149·1??	139·3	4·78	+2·0??
	OH	124·2	120·4	4·44	+0·9
	Schwalbe's	106·2[2]	101·3	5·49	+0·9
Calvarial Arcs	S	392·1?	378·4	12·56	+1·1?
	S_1	131·0?	129·6	5·20	+0·3?
	S_2	144·3?	128·6	7·15	+2·6
	S_3	116·8?	120·7	7·37	−0·5?
	U through Glabellar	548·5?	523·8	13·06	+1·9?
	Q'	328·0??	313·5	9·16	+1·6??
Facial Breadths	J	138·7	139·5	6·52	−0·1
	GB	92·6?	102·7	6·00	−1·7?
	O_1, R	38·8	—	—	−1·6[1]
	O_1, L	40·0	42·8	2·46	−1·1
	G_2	37·7??	40·9	3·27	−1·0??
Facial Lengths	$G'H$	77·2?	74·9	4·39	+0·5?
	NH'	58·0	53·75	3·10	+1·4
	O_2, R	33·4	—	—	−1·4[1]
	O_2, L	31·9	36·3	2·03	−2·2
	G_1	51·9?	56·25	3·58	−1·2?
	GL	97·0??	104·4	5·40	−1·4??
Calvarial Indices	$100\ B/L$	70·9?	71·3	3·00	−0·1?
	$100\ H/L$	76·9??	73·9	2·59	+1·2??
	Schwalbe's Height Index	56·5	55·2	3·64	+0·5
	$100\ H/B$	108·4??	103·6	4·83	+1·0??
	$100\ S_1'/S_1$	87·9?	87·6	1·83	+0·2?
	$100\ S_2/S_1$	107·0?	98·8	6·43	+1·3?
	$100\ B'/B$	72·9?	71·3	3·48	+0·5?
Facial Indices	$100\ O_2/O_1, R$	86·1	—	—	+0·2[1]
	$100\ O_2/O_1, L$	79·8	85·0	5·60	−0·9
	$100\ G'H/J$	55·7?	53·7	3·24	+0·6?
	$100\ G_2/G_1$	72·6??	72·8	6·52	0·0??
Angles	$P\angle$	92°·6??	83°·6	3°·51	+2·6??
	$N\angle$	57°·7??	68°·1	3°·71	−2·8??
	$A\angle$	80°·4??	70°·0	3°·13	+3·3??
	$B\angle$	41°·9??	41°·9	2°·40	0·0??
	θ_1	29°·7??	28°·2	3°·27	+0·5??
	$N\beta I\angle$	80°·5[2]	81°·7	3°·80	−0·3
	$\beta IN\angle$	38°·4[2]	38°·8	1°·99	−0·2
	$\beta NI\angle$	61°·1[2]	59°·5	3°·18	+0·2
	$NBas.\beta\angle$	50°·1[2]??	53°·6	2°·49	−1·4??
	$N\beta Bas.\angle$	49°·0[2]??	48°·1	2°·17	+0·4??
	$\beta NBas.\angle$	80°·9[2]??	78°·2	2°·93	+0·9??
	$\beta N\gamma\angle$	51°·0[2]	50°·0	3°·82	+0·3

[1] The Chancelade measurement of the right orbit is here compared with the Eskimo mean for the left orbit.

[2] These measurements were found from the sagittal contour.

values; most of the doubly queried measurements are extremely doubtful and, in the writer's opinion, several of them are undoubtedly inaccurate. There are 47 characters showing values of $(C - M_E)/\sigma_E$ less than 2·0 and, of the other 8, 6 are doubly queried. The only probably correct measurements of the Chancelade skull showing differences from the Eskimo type which are at all significant are O_2, L—but not O_2, R—and S_2. For the former, a true Eskimo skull with a more divergent length will be found among any 33 skulls picked at random and for the latter a greater divergence will be found among 1 in 111 skulls. If we may ignore the uncertain measurements, then, we cannot point to any single character among those selected for measurement which clearly distinguishes the Chancelade skull from the mean Eskimo type.

The doubly queried measurements showing values of $(C - M_E)/\sigma_E$ greater than 2·0 are LB, H', H, $N\angle$, $A\angle$ and $P\angle$ and the first five of them are dependent on the position of a single cranial point—the basion. All anatomists who have examined the Chancelade skull are agreed that it is in every way of the modern type, but in one particular it differs from all except extreme modern skulls. The base, which was very defective and had to be largely restored, projects more in the sagittal plane and is less flat than is usual for *homo sapiens*. Its greater downward extension below the horizontal plane through the nasion can be clearly seen by comparing the sagittal contour and the type "points" for Fürst and Hansen's ♂ Eskimo crania as in Fig. 1. The Chancelade auricular height (OH) measurement does not differ significantly from the ♂ Eskimo value, but both H and H' are decidedly greater. For the modern population the mean difference between H and OH is 18·9: the Chancelade difference is 24·9. Now if the base of the restored skull were moved up towards the vault to give the form of a modern skull, all the measurements H', H, $N\angle$, $A\angle$ and LB would be made to approach more nearly to the Eskimo mean values. If the basion were pushed up 5 or 6 mm.—making the difference between H and OH equal to the mean Eskimo value—the measurements which at present show the greatest differences would become quite undifferentiated. The writer believes (and he had formed that opinion before considering the measurements) that, as at present reconstructed, the basi-occipital is incorrectly placed and hence that the measurements involving the basion are inaccurate, or, at any rate, that they are too uncertain to furnish any *proof* of a real difference between the Chancelade skull and the male Eskimo type*. Rejecting them, we are left with a single character showing a difference of any consequence. That is the profile angle ($P\angle$) and there is some reason to believe that as the skull is at present restored (see the section on mandibular measurements below) this is also inaccurate. But even if its correctness be accepted we may reaffirm that, judging from the given cranial measurements only, the Chancelade appears to be an Eskimo skull differing from the mean type of that population in very few essential ways.

This matter may be examined from another standpoint.

The fact that no measured character can be found which will clearly distinguish the Chancelade skull from the Eskimo mean type is not sufficient evidence to warrant the statement that the palaeolithic skull is that of an unspecialised Eskimo. To evaluate the probability of such an event the unknown values of the correlations of characters would be required. A crude approximation to it may be made by computing the means and standard deviations of the deviations

* When found there was a large hole in the base of the Chancelade skull and hardly any of the detached pieces which had been broken away were found. Testut (*loc. cit.* p. 149) writes: "La base du crâne se trouve malheureusement fort endommagée...et nous sommes privés de toute espèce de renseignements sur les apophyses ptérygoïdes, sur le corps du sphénoïde, sur la selle turcique et sur l'apophyse basilaire, qui, sur le crâne restauré, sont représentés par du carton pâte." From the sagittal contour (Fig. 1 below) it will be seen that neither the basion nor the opisthion is located on the existing bone and all the basi-occipital in front of the *foramen magnum* is restored with plaster.

from the means measured in terms of the standard deviations ($(C - M_E)/\sigma_E$) given in Table VI. Such a method would only be absolutely legitimate if all the intra-racial correlations of characters were zero, and many of them are known to be very small though some are high. Taking all the 55 characters shown in the Table we find:

(i) Mean = ·40, while for an actual Eskimo skull it should be ·000 ± ·091 and standard deviation = 1·0136 as compared with the theoretical 1 ± ·0643.

Omitting the doubly queried characters, we have for the remaining 37:

(ii) Mean = ·29 in place of ·000 ± ·109 and standard deviation = 1·1382 in place of 1 ± ·0774.

The standard deviations for both series of characters are seen to be well within the range of values which would be shown by actual Eskimo skulls, but the mean for the 55 characters is improbable. If the doubly queried measurements be accepted as correct, then it is not reasonable to consider the Chancelade to be an undifferentiated Eskimo skull, but, if they are rejected, that probability is increased, but it is of such an order that it can only be said that the Chancelade is less like the Eskimo type than the majority of true Eskimo skulls are.

Being unwilling to accept the conclusions arrived at by Professor Testut and which almost all other anthropologists have accepted, Sir Arthur Keith has recently stated that "the Chancelade skull, while possessing a few superficial resemblances to Eskimo skulls, is in its essential character just as European as the people of England and France to-day*." Comparing the measurements of the Magdalenian cranium with the means (M_F) of a long series of ♂ 17th century London skulls in the Biometric Laboratory, of which the measurements will shortly be published, we find (using the English standard deviations):

(i) For 51 characters—they being all of the 55 shown in Table VI that are available—the mean $(C - M_F)/\sigma_F$ = ·630 while for an English skull it would be ·000 ± ·0945 and the standard deviation = 1·394 as compared with 1 ± ·067.

Omitting the doubly queried measurements the constants become:

(ii) Mean = ·578 for 33 characters as against a theoretical ·000 ± ·117, and standard deviation = 1·169 as against 1 ± ·083. The mean remains very improbable though as high a value of standard deviation would be shown by a sensible percentage of English skulls.

Thus the probability of such a skull as the Chancelade being found among the modern English population is exceedingly small and of a lower order than the probability of it being an Eskimo.

A characteristic feature of the Eskimo skull is the tapering of the vault as seen in *norma facialis*. As the facial breadth is also great—the zygomatic usually exceeding the greatest parietal—the outline of the skeleton above the zygomatic arches presents a more or less conical appearance. That feature is shown clearly by the photograph (Plate II B) of a cast of a typical Eskimo skull†. The greater filling-out of the temporal region of the Chancelade skull distinguished it from that of the average Greenlander and it was thought desirable to test by some numerical means whether that difference be significant or not. That was done by forming an index expressing the height above the nasion as a percentage of the least forehead breadth, the two lengths being read off from the orientated photographs in *norma facialis* provided by Fürst and Hansen in the *Crania-Groenlandica* of 36 ♂ Eskimo skulls. I am greatly indebted to Miss B. G. E. Hooke for taking and reducing those measurements as well as for allowing me to use elsewhere in this paper her as yet unpublished measurements of 17th century English skulls. The mean index for the Eskimos is 83·3 and the standard deviation is 5·81. The Chancelade index is 89·1 and that for the cast

* *Man*, 1924, No. 115, p. 157.

† The cast was provided by Dr F. Krantz of Bonn and is preserved in the Museum of the Biometric Laboratory.

78·05, so neither differ from the mean by more than the standard deviation. The greater transverse filling-out of the Chancelade brain-box is certainly a feature which makes it approach more closely the type of modern European man, but it is not emphasised enough to make any clear distinction from the Eskimo type. Another divergence between the Chancelade and Eskimo crania is seen in the *norma verticalis*; it strikes the eye at once (Plates IV A and IV B), but when an attempt was made to *measure* the difference, by taking an index formed from the ratio of greatest breadth at the coronal suture to greatest parietal breadth, the indices were: Chancelade 89·85, Krantz's cast 89·6, mean Eskimo 87·5, and Eskimo standard deviation 2·70. Thus neither Chancelade nor Krantz's cast differed significantly from the mean Eskimo index. Accordingly we have evidence both from the *norma facialis* and the *norma verticalis* of how easy it is for the eye to emphasise a cranial divergence, which tested numerically is found to be no mark of racial differentiation at all.

6. *The Chancelade and Eskimo Mandibular Measurements.*

In the *Crania-Groenlandica* there are individual measurements of 282 mandibles belonging to the skulls and hence sexed with considerable reliability. The ♂ and ♀ means and constants of variation of the adult specimens for the 7 characters given are in Table VII below: Fürst and Hansen combined the two sexes in calculating their means. They conclude (*op. cit.* p. 176) that the Eskimo mandible is characterised by its massiveness and large rameal breadth, symphysial height and corpus breadth (outside angles). The bicondylar width and the length of the ramus do not distinguish the type from other racial ones. The angles are often, but not invariably, bent outwards, resulting in a large variation of the biangular width (w_2). The variability of the mandibular angle is nearly twice as great as that of the most variable angle of the skull. The quite significant sexual difference for that angle has been found for other races: for Anglo-Saxons the mean ♂ angle is 120°·3 (47) and the mean ♀ 122°·6 (50)*.

Table VII. *The Chancelade and Eskimo Mandibular Measurements.*

	Eskimo						Chancelade C	$(C-M_K)/\sigma_K$
	♂ Mean (M_K)	♀ Mean	♂ Standard Deviation (σ_K)	♀ Standard Deviation	♂ Coefficient of Variation	♀ Coefficient of Variation		
Bicondylar Breadth (w_1)	125·0 (133)	120·0 (110)	5·92 ± ·24	6·29 ± ·29	4·73 ± ·20	5·24 ± ·24	121·8	−0·5
Biangular Breadth (w_2)	112·2 (128)	106·0 (106)	7·61 ± ·32	7·23 ± ·34	6·78 ± ·29	6·82 ± ·32	99·9	−1·6
Mental Height (h_1)	36·6 (140)	34·0 (121)	3·80 ± ·15	3·32 ± ·14	10·41 ± ·42	9·77 ± ·43	37·0??	+0·1
Length of Ramus, L (rl)	63·4 (138)	59·0 (114)	5·71 ± ·23	3·85 ± ·17	9·01 ± ·37	6·53 ± ·29	70·6	+1·3
Least breadth of Ramus, L (rb')	40·7 (140)	38·8 (115)	3·01 ± ·12	3·16 ± ·14	7·39 ± ·30	8·15 ± ·36	40·1	−0·2
"Condylo-Protuberal Length" [1]	128·1 (121)	123·0 (99)	4·75 ± ·24	5·44 ± ·26	3·71 ± ·16	4·42 ± ·21	—	—
Mandibular Angle	122°·8 (137)	126°·5 (112)	6°·92 ± ·28	6°·97 ± ·31	5·64 ± ·23	5·51 ± ·25	115°·7	−1·0

[1] Defined by Fürst and Hansen to be taken "from the anterior lower margin of the mandible in the middle line (gnathion?) to the external point of the mandibular condylus on the left side and, if this has been damaged, on the right side."

Of the Chancelade mandible Testut (*loc. cit.* p. 173) says: "Il ne lui manque que la partie antérieure du condyle droit, une portion de l'apophyse coronoïde du même côté et la partie antéro-interne (le quart environ) du condyle gauche. Cet os est caracterisé: 1° par son étroitesse, en rapport avec l'allongement du crâne; 2° par la force et l'épaisseur de son corps; 3° par le développement de ses branches." The alveolars of the middle incisors are also lacking, but the symphysial height would evidently have been great. The angles turn out, but not markedly. The rami are long and broad and the alveolar border of teeth is peculiarly short for such a

* From hitherto unpublished measurements of Anglo-Saxon crania.

large bone. The measurements that can be compared do not distinguish the palaeolithic mandible from the Eskimo type, so, as far as that evidence goes, it confirms the conclusions derived from cranial measurements. The following measurements of the Chancelade lower jaw were taken in the way described in detail in *Biometrika*, Vol. XIV, p. 253:

Least distance between inner rims of *foramina mentalia* (zz) 44·9; coronion to coronion ($c_r c_r$) 100·0??; least breadth of left ramus parallel to basis (rb) 43·1; breadth between inner alveolar walls at second molars (G_2') 35·6?; condylion to coronion on left side ($c_y c_r$) 39·0; gonion to gonion ($g_o g_o$) 93·3; gnathion to left gonion ($g_n g_o, l$) 95·2; gnathion to right gonion ($g_n g_o, r$) 96·8; least breadth (ant.-post.) of left condyle 11·1; distance between outer alveolar margin at middle of second molar to middle of first premolar ($m_2 p_1$): left 21·4, right 19·5?; pogonion to gnathion ($p_a g_n$) 7·0; arc from gonion to gonion through the pogonion ($g_o p_a g_o$) 220·0?; least height of incisura above plane of basis (ih): left 52·1, right 49·2; greatest depth of incisura from line joining condylion to coronion (ih'): left 16·9; height of coronion ($c_r h$): left 71·0; height of condylion ($c_y h$): left 67·2; height of outer alveolar margin at middle of second molar ($m_2 h$): left 32·4?; height of outer alveolar margin at middle of first premolar ($p_1 h$): left 37·2; length of corpus ($c_p l$) 89·0; mandibular length (ml) 114·7?; angle of condylar-coronoidal line with ramus tangent ($R \angle$) 65°·8; angle subtended at gnathion by two gonia ($G \angle$) 58°·1.

In the living it is usual for the incisor teeth of the upper jaw to overlap those of the lower jaw, and the same condition is found when the mandible of the skeleton is placed with its condyles in the glenoid fossae of the skull. The upper incisors of the Chancelade individual are missing except for one stump, but from the photograph in *norma lateralis* (Plate I) it seems probable that, if preserved, they would have been behind the incisors of the mandible*. From the excellent photographs of Eskimo skulls with Frankfurt orientation in the *Crania-Groenlandica* it appears that the most advanced point on the alveolar border between the two upper middle incisors—the prosthion—is normally well in front of the lower teeth. In only 3 cases out of 34 is it behind or on a level with them. If the peculiarity in the latter case is due to imperfect reconstruction the fault must evidently be found in the position of the upper jaw as the mandible is almost complete. The pushing forward of the upper jaw would reduce the profile angle and bring it closer to the mean Eskimo value. In the writer's opinion there is at least a great probability that the perfect Chancelade skull had a smaller profile angle than that of the much-restored specimen that is known to us. The reconstruction of the facial skeleton was undertaken with the greatest care by Dr Testut, but he says that "de cette portion de la tête, il ne restait plus, sauf les maxillaires, que de simples fragments" (*loc. cit.* p. 134), and under such circumstances it is hardly possible to re-model a perfect replica of the original.

7. *Contour Drawings of the Chancelade Skull.*

Contour drawings of the original Chancelade skull were made with a Klaatsch tracer in the way adopted by workers in the Biometric Laboratory (Figs. 1, 2 and 3). They are of the sagittal section, the horizontal section through the glabella and parallel to the standard horizontal plane and the transverse section through the auricular points and perpendicular to the horizontal†. It was found from the drawings that the Magdalenian skull is almost perfectly

* In photographing the Chancelade skull the writer took particular care not to emphasise the lack of correspondence between the two jaws. In a photograph of the *norma lateralis* taken by Dr Testut and exhibited at the *Musée du Périgord* the recession of the upper jaw is far more marked, so marked indeed that it is evidently unnatural. Professor Boule has reproduced that photograph in *Les Hommes Fossiles*, 2nd ed. 1923, p. 295.

† For an account of the methods of drawing and subdivision of the contours see *Biometrika*, Vol. XVI, 1924, pp. 73–101.

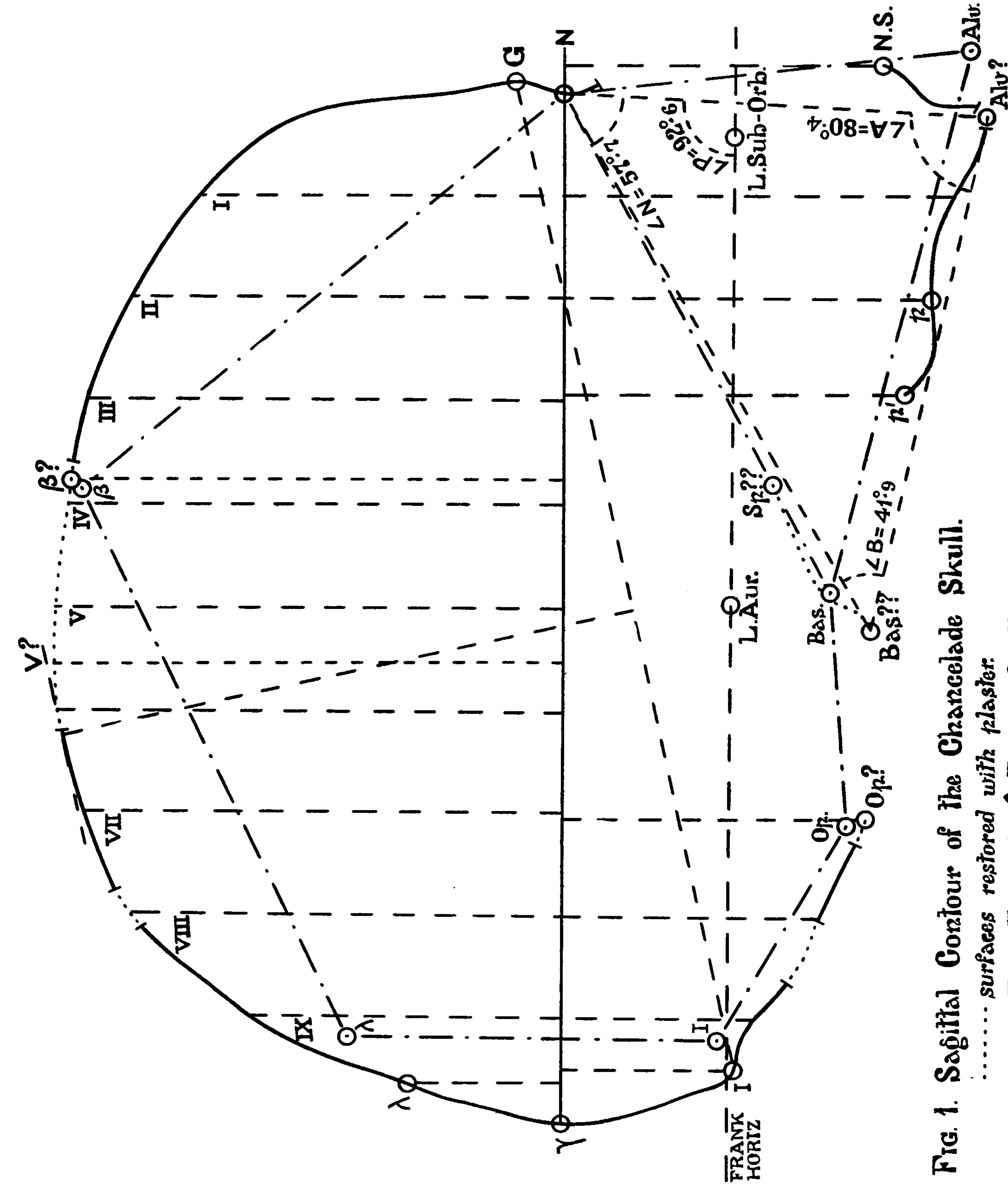


Fig. 1. Sagittal Contour of the Chancelade Skull.
.... surfaces restored with plaster.
—·—·— Type Figure for ♂ Eskimo Skulls.

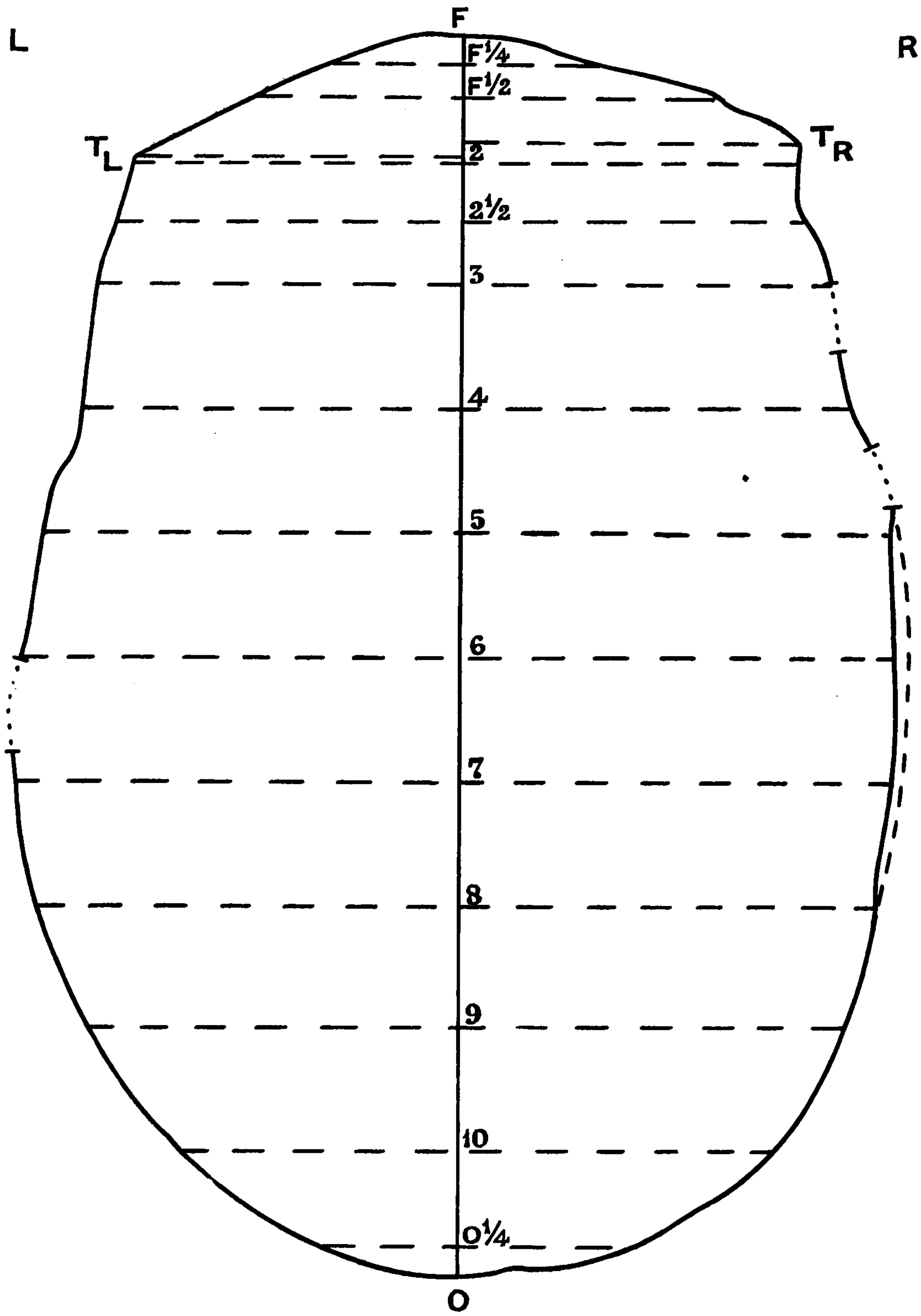


Fig. 2. Horizontal Contour of the Chancelade Skull.
······· *surfaces restored with plaster.*
– – – *possible outline of right side before fracture.*

symmetrical. There are no type contours of the horizontal and transverse sections of Eskimo skulls based on any adequately long series, but various points of the sagittal type section can be given from data provided by Fürst and Hansen. From the mean lengths and angular measurements of their ♂ skulls it is possible to locate the nasion, basion, alveolar point, bregma and inion and to plot them on the Chancelade figure with the nasions and $N\gamma$ lines coincident as in

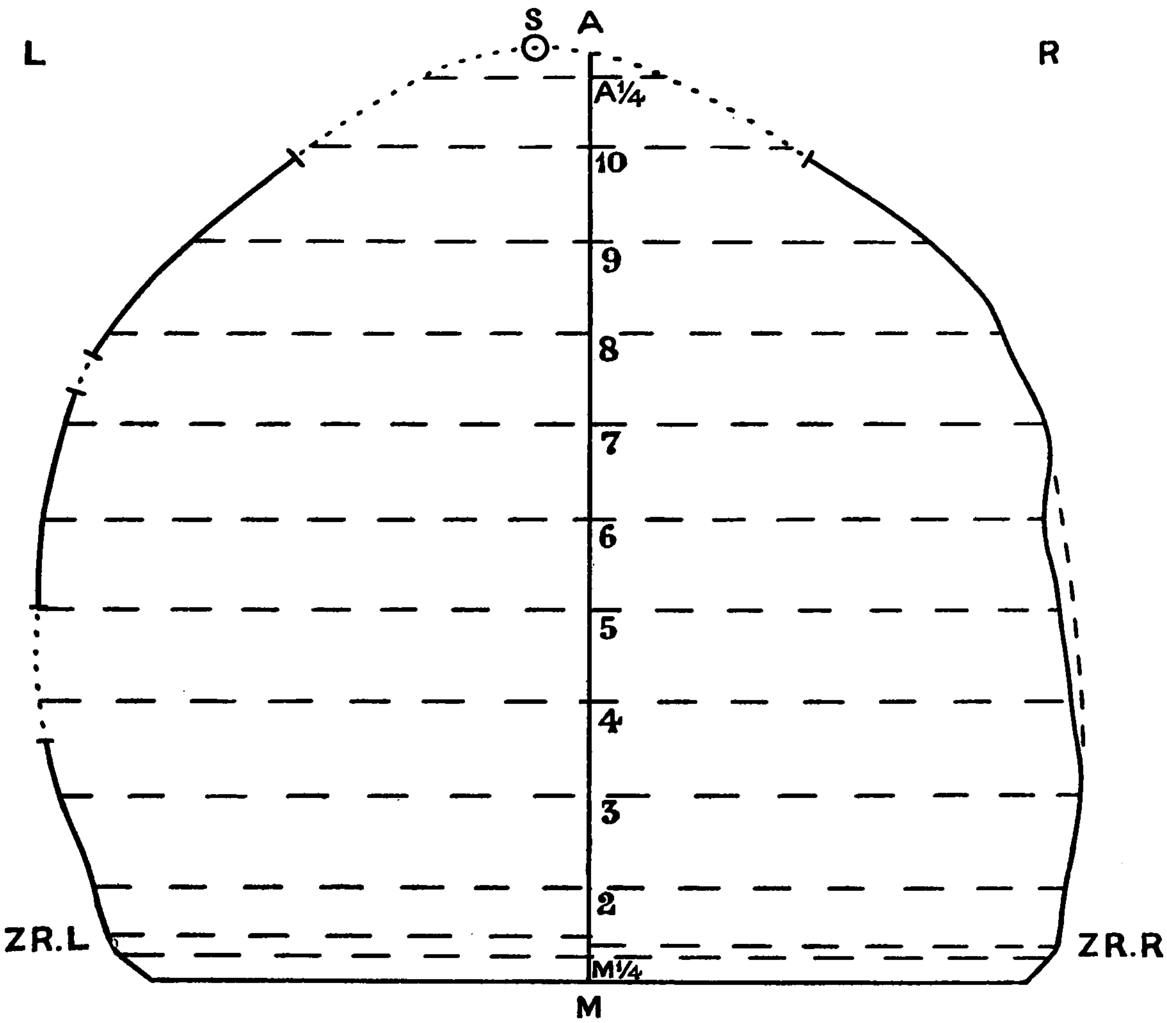


FIG. 3. Transverse Contour of the Chancelade Skull.

·······surfaces restored with plaster.

— — — possible outline of right side before fracture.

S = crossing of sagittal suture?

Fig. 1. Furthermore the writers of the *Crania-Groenlandica* had taken 300 ♂ and ♀ skulls and constructed for them, by means of projections, the type figure for those 5 points and also the lambda and opisthion (*loc. cit.* p. 209). By assuming that the sexual differences of all the angles are zero we can use Fürst and Hansen's figure for the two sexes combined and can place the two latter points on the ♂ diagram. It may be remembered that the only significant differences between the Chancelade and mean Eskimo type detected from a comparison of the direct

measurements were a few of those of the sagittal section. The comparison made in Fig. 1 shows the slight superiority in size of the palaeolithic skull, its greater parietal arc, and, most significantly, the differences between the positions of the basion and the section of the facial skeleton. It has been suggested that the last two characters are discordant because of the imperfect restoration of the much damaged facial and basal regions of the skull. Apart from them, the agreement between the Chancelade and mean Eskimo type is remarkably close.

8. *Casts of the Chancelade Skull.*

After reconstructing the skull Dr Testut had a cast made and there is one to-day in the museum of the École d'Anthropologie at Paris and one at Lyons. I have no evidence of the existence of any other replica of that first cast. The specimen at Paris is coloured a uniform dark brown, and no attempt was made to distinguish between the skull itself and surfaces restored by plaster. There is no mandible. The original cranium was recently strengthened by Prof. Boule, and he took a new cast of it and of the mandible which are coloured to show the restored parts. There is a replica of these in the museum of the Biometric Laboratory. As is always found, the casts are slightly larger than the original and apparently uniformly so in all directions. The following measurements were taken quite independently at different times.

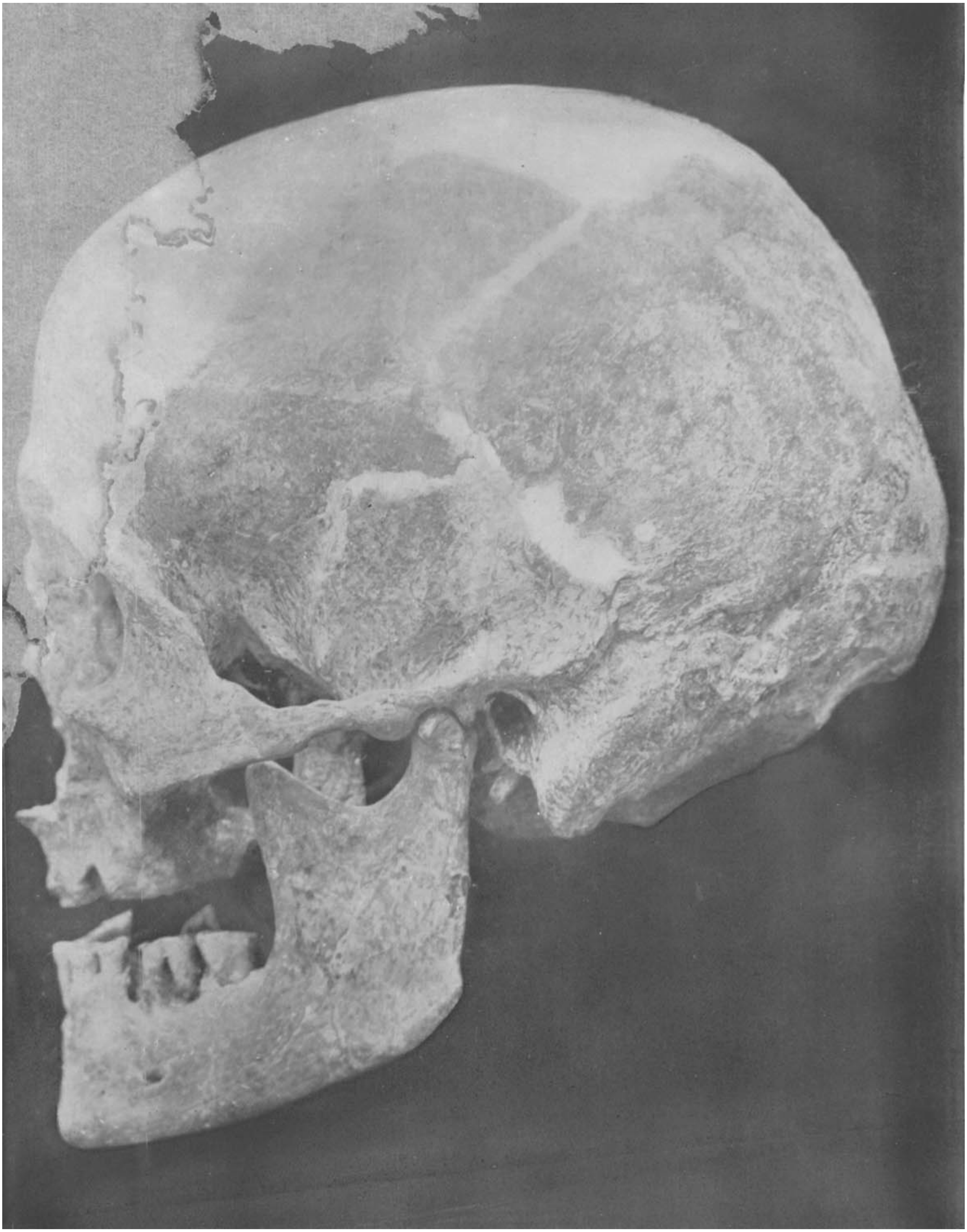
	Max. *L*	*B*	*H'*	*J*	*LB*
Original Chancelade Skull	194·0	134·5	148·4	138·7	113·5
Testut's cast at the École d'Anthropologie	196·4	136·2	151·7	140·9	115·2
Boule's casts at Muséum d'Histoire Naturelle, Paris, No. 1	194·5	136·7	151·4	139·7	115·0
Boule's casts at Muséum d'Histoire Naturelle, Paris, No. 2	194·4	136·3	151·4	140·0	115·1

9. *Conclusions.*

The above detailed comparison of the Chancelade skull and mandible with the Greenland Eskimo type has shown that the two are similar in many respects. The prehistoric skeleton is only differentiated by the low position of its basi-occipital and the greater recession of its facial skeleton. As the base of the skull is very defective and the supposed basion and the region surrounding it are restored with plaster, we are only exercising elementary caution in rejecting the measurements involving the basion as being incapable of providing evidence of a real difference in type. The accuracy of the profile angle may also be questioned. If those slight and most doubtful evidences of dissimilarity are ignored, there is statistical justification for saying that all other characters compared indicate that the Magdalenian skull is not more removed from the mean type of the modern inhabitants of Greenland than many individuals picked at random from that population are likely to be. In other words, from the evidence afforded by the skull and mandible, we may accept as a reasonable working hypothesis the statement that the Chancelade individual was distinctly closer to the Eskimo than to the modern English. We may therefore assume that in the Magdalenian period, a race of hunters existed in southern Europe, which ultimately migrated northwards following the reindeer, or was pushed to the fringe by other and invading races. That Magdalenian people was more closely allied to the fringe folk we now know as modern Eskimo than to modern West European man.

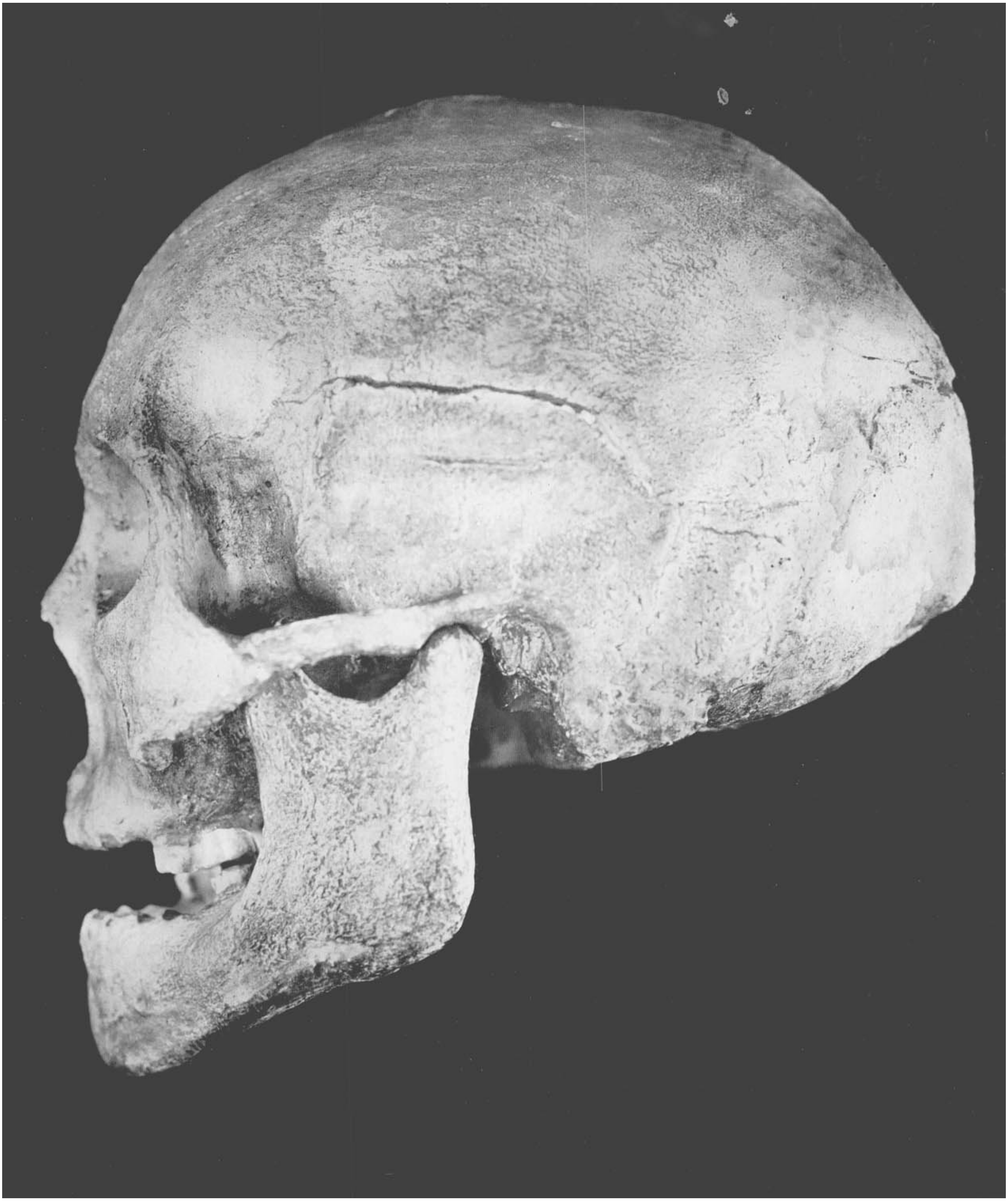
PLATES.

Five photographs of the original Chancelade skull were taken with a telephoto-lens at a distance of about 6 feet and enlarged. The distortion at that distance is practically negligible. Four of these photographs are reproduced in Plates I–IV, but the photograph of the basal aspect was a failure; it has been replaced by a photograph of Professor Boule's cast in the Biometric Laboratory. The five photographs of a typical Eskimo cranium are reproduced by kind permission of Dr F. Krantz of the Rheinisches Mineralien-Kontor, Bonn. The five normae shown are the usual ones taken parallel and perpendicular to the standard horizontal plane.

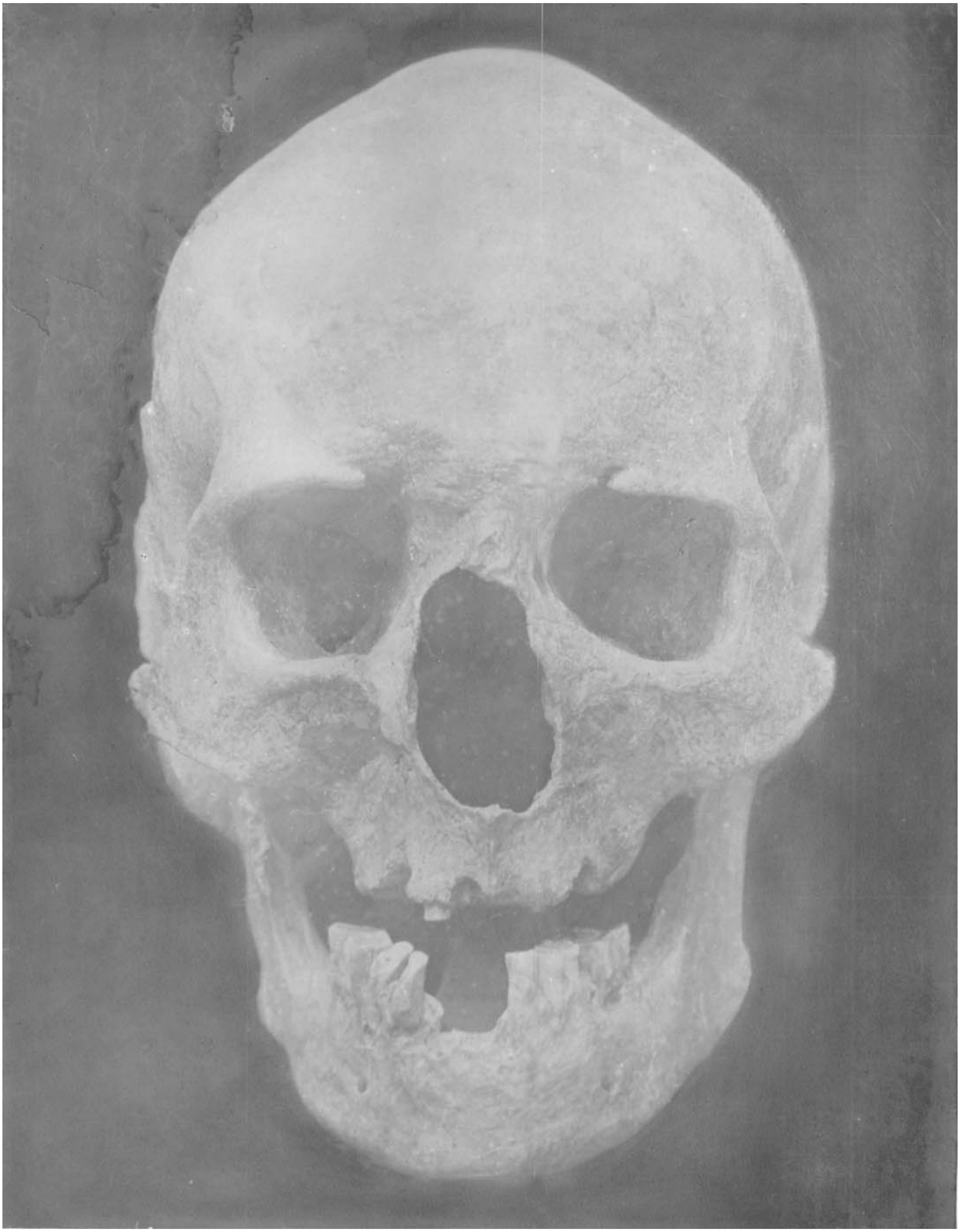


The Chancelade Skull: *Norma lateralis* (about natural size).

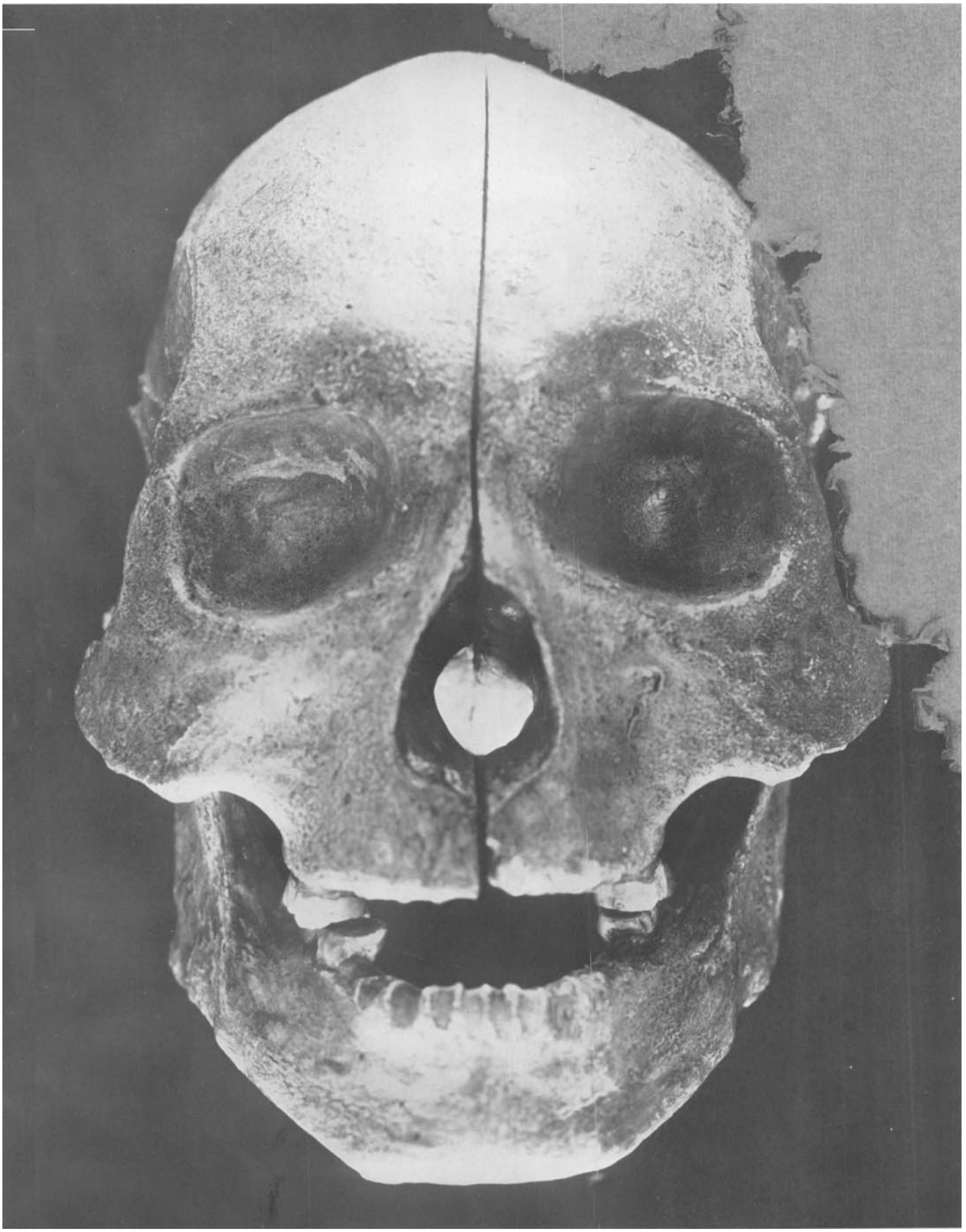
Plate I B



Typical Eskimo Skull: *Norma lateralis* (about natural size).

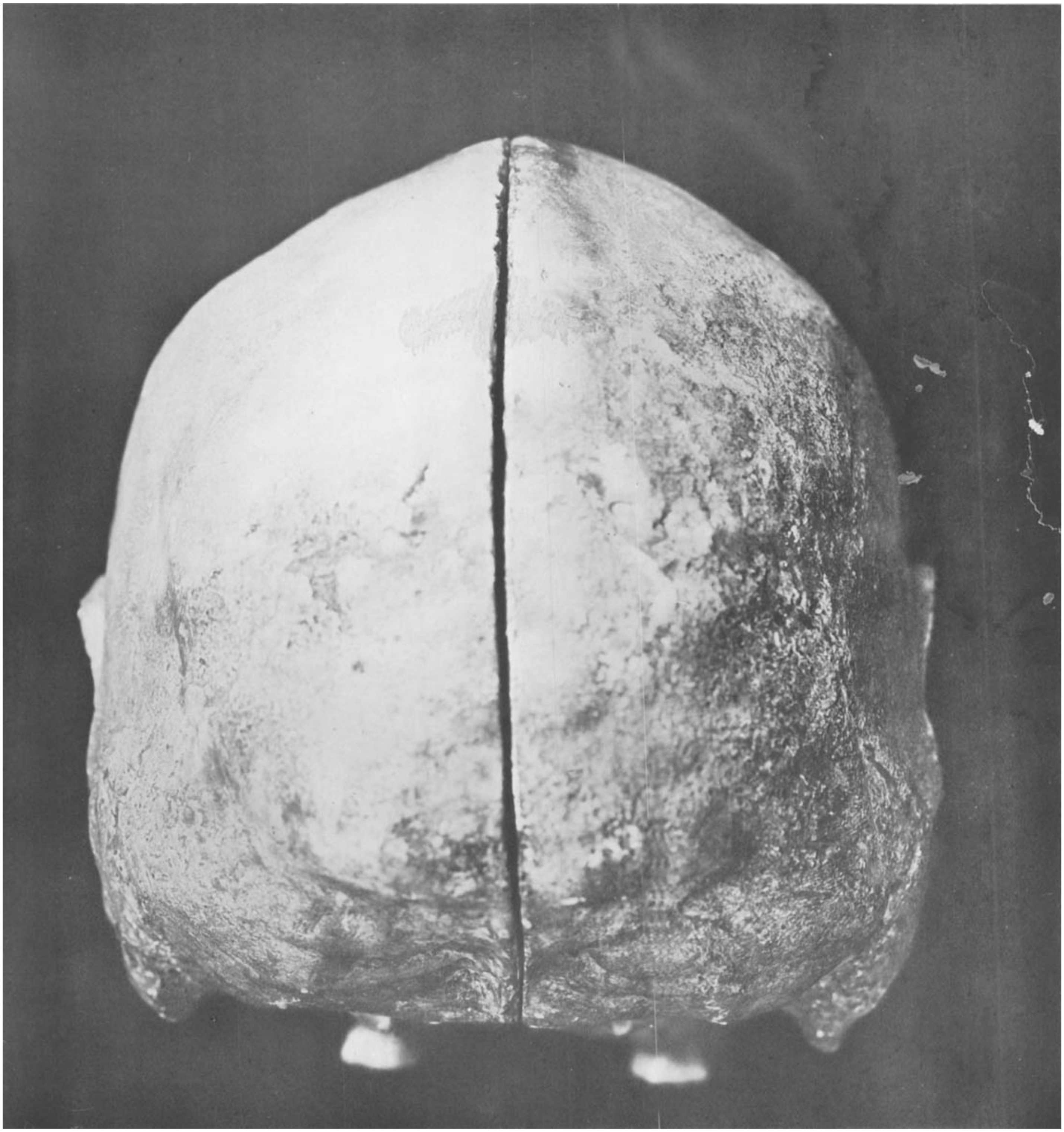


The Chancelade Skull: *Norma facialis* (about natural size).



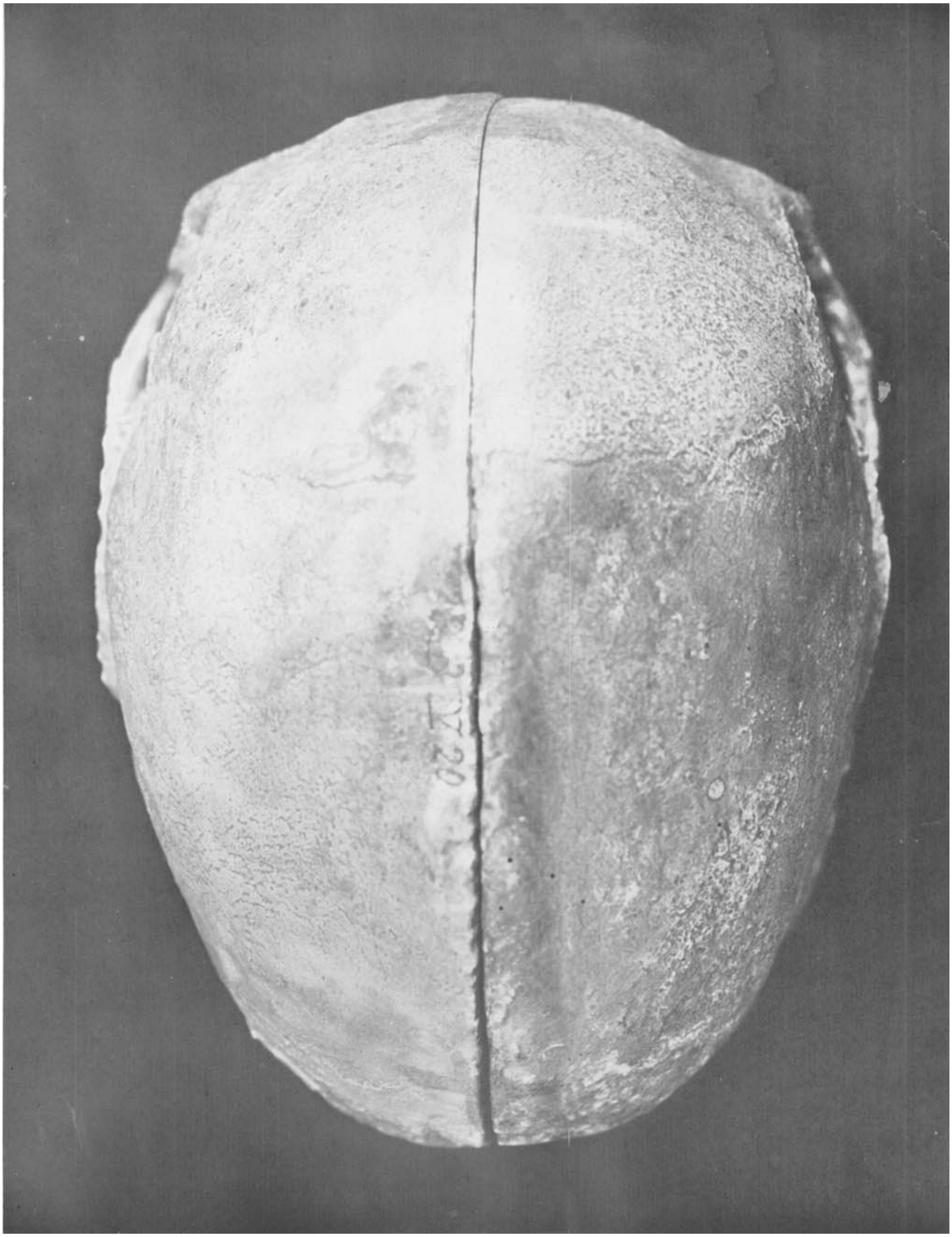
Typical Eskimo Skull: *Norma facialis* (about natural size).

The Chancelade Skull: *Norma occipitalis* (about natural size).

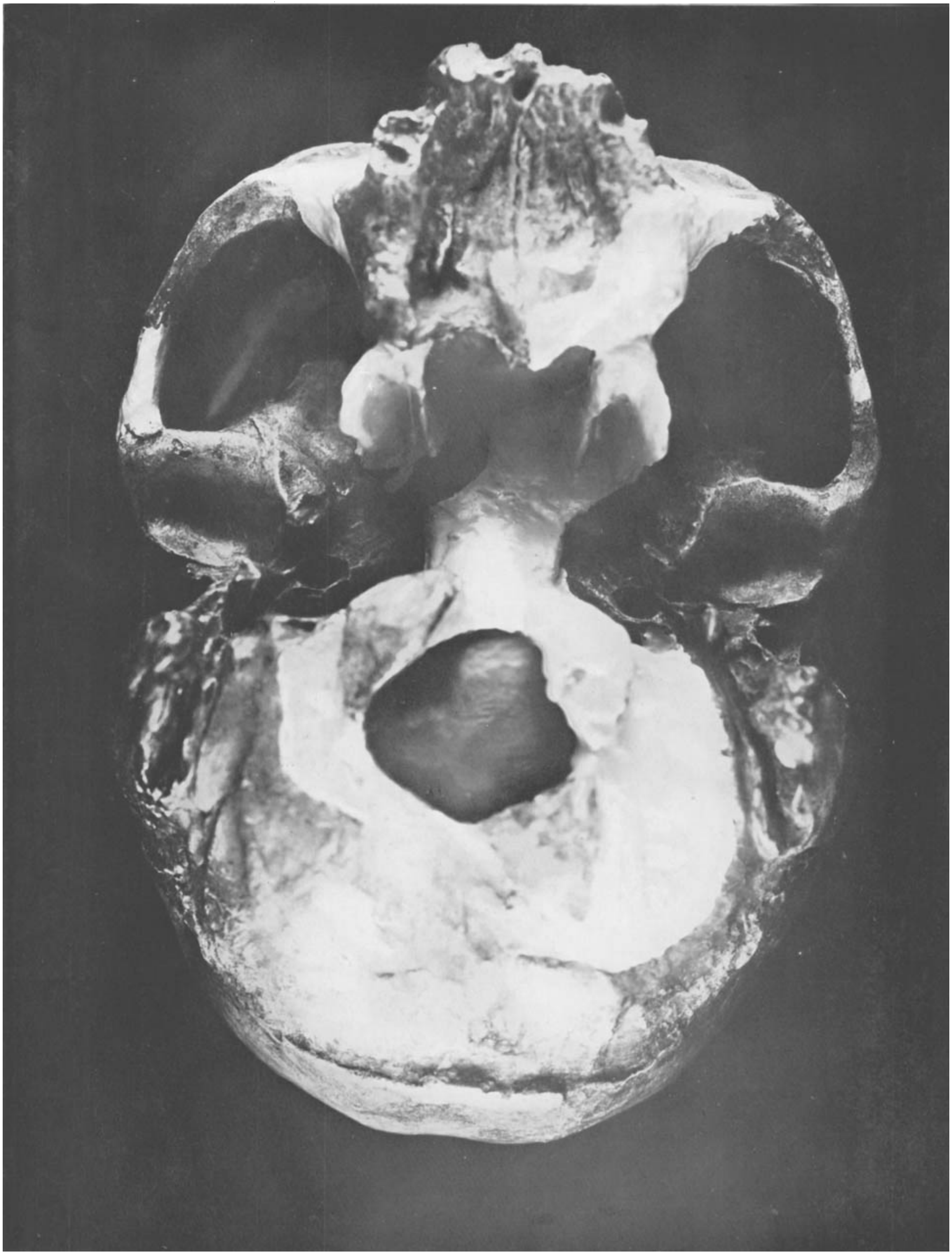


Typical Eskimo Skull: *Norma occipitalis* (about natural size).

The Chancelade Skull: *Norma verticalis* (about natural size).

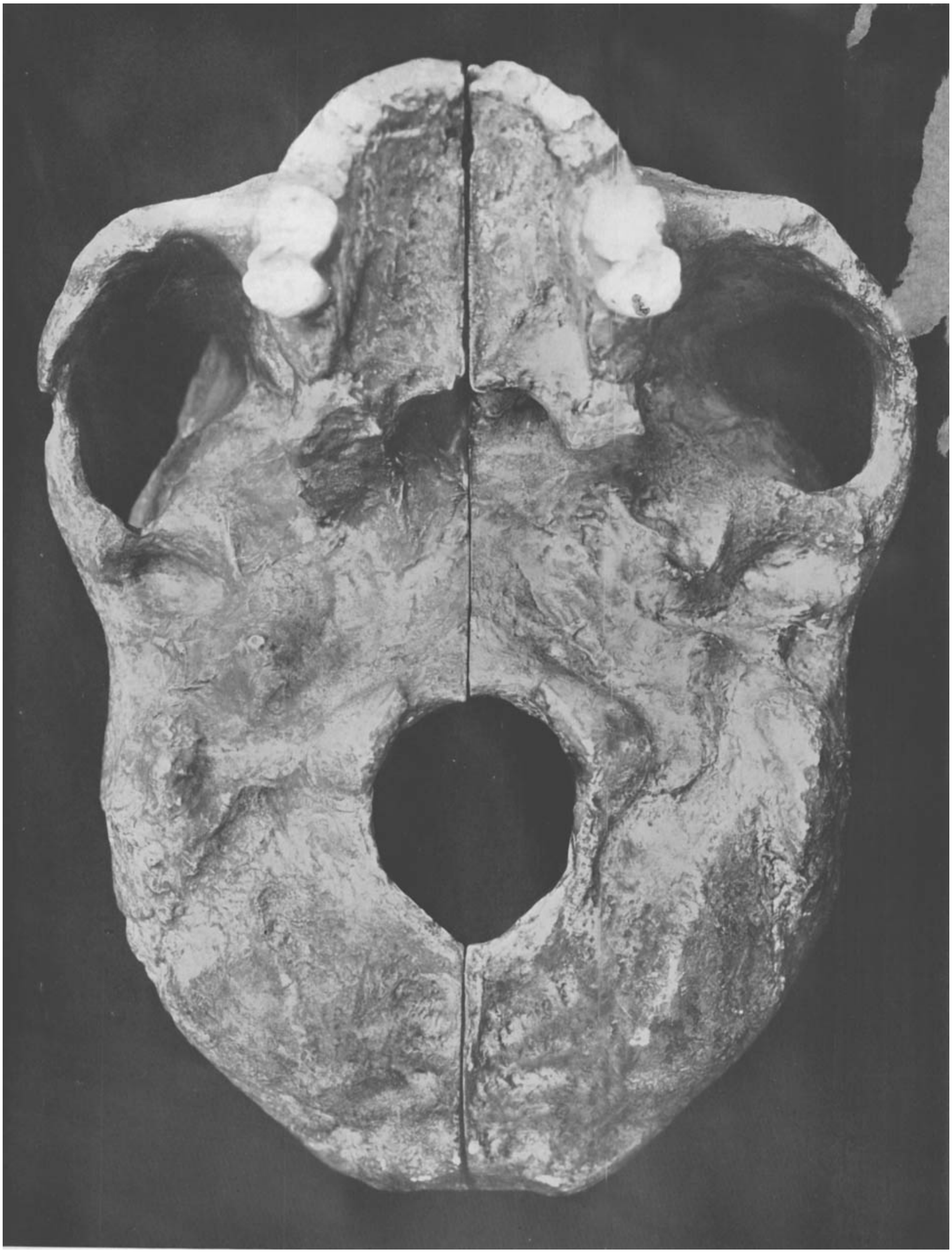


Typical Eskimo Skull: *Norma verticalis* (about natural size).



The Chancelade Skull: *Norma basalis* (about natural size).

Owing to a failure of the photograph of the original from the basal aspect, it has been needful in this case to reproduce from the cast in the Biometric Laboratory. The clear white parts are those restored.



Typical Eskimo Skull: *Norma basalis* (about natural size).