STUDIES OF PALAEOLITHIC MAN.

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II. A BIOMETRIC STUDY OF NEANDERTHALOID SKULLS AND OF THEIR RELATIONSHIPS TO MODERN RACIAL TYPES.

CONTENTS.

1. *Introduction.*

THE literature dealing with Lower Palaeolithic human skeletal remains has accumulated so rapidly within the past fifty years that some apology may be thought necessary for adding to its unwieldy bulk. The present study was undertaken by the writer at the suggestion of Professor Karl Pearson. The skulls of the Neanderthal type with which it deals are preserved in various museums in different countries and, though each has been studied in detail by one or several anthropologists, yet no single worker has previously examined them all in detail. The need for a uniform treatment was felt acutely when the published measurements were compared. For several of the earlier studied ones, numerous measurements given by the greater number of present-day craniometricians had apparently never been determined, and where measurements had been taken by individuals who were followers of different schools of craniometric technique the question whether they were truly comparable or not was continually arising. The writer has attempted to allay such doubts by re-measuring the following cranial remains of Mousterian man*. He would wish to acknowledge most gratefully his indebtedness to the curators of the museums in which these valuable relics are preserved.

(*a*) *La Chapelle.* Muséum National d'Histoire Naturelle. Galerie de Paléontologie, Paris. (Professor Marcellin Boule.)

(*b*) *La Quina Adult.* The same museum and curator.

* He was enabled to measure the remains in foreign museums while holding a Senior Studentship awarded by the Royal Commissioners for the Exhibition of 1851.

(*c*) *Spy I and II.* The private collection of M. Max Lohest. Liège.

(*d*) *Neanderthal.* Provinzial Museum, Bonn. (Professor Hans Lehner.)

(*e*) *Le Moustier.* Museum für Völkerkunde, Berlin. Vorgeschichtliche Abteilung. (Dr Unverzagt.)

(*f*) *Gibraltar.* Museum of the Royal College of Surgeons, London. (Professor Sir Arthur Keith.)

Of the above skulls the Neanderthal and Gibraltar could not be dated owing to the lack of associated remains, but the others are of proved Mousterian age. Some use has also been made of measurements of a cast of the Galilee skull fragment in the Museum of the Royal College of Surgeons and of a cast of the juvenile skull discovered by Dr Henri Martin at La Quina in 1915. The latter cast is in the Musée Broca (Paris) and the writer is indebted to the late Professor Manouvrier for permission to measure it. The Galilee and La Quina child's skulls are of Mousterian age. The measurements dealt with in the present paper (see Appendix I) include all those normally taken by workers in the Biometric Laboratory and a few others. Excellent plaster casts of the more important palaeolithic skulls are exhibited in numerous museums, but a comparison of the measurements of several of them with the measurements of the original specimens has shown repeatedly that the former cannot be relied upon unless checked by that comparison. A few measurements of McGregor's restored cast of the Gibraltar skull in the Royal College of Surgeons are included in the tables below, but it is not suggested that they are more than crude approximations to the true, and now indeterminable, values. Some use has also been made of Gorjanović-Kramberger's measurements of the fragmentary Krapina remains. The three standard cranial contours of the above specimens, with the exception of the last, were drawn when practicable and they are reproduced here. The method of drawing was precisely similar to that used by workers in the Biometric Laboratory when dealing with series of modern skulls. Their inclusion is fully justified by the fact that they check a number of direct measurements and provide others which cannot easily be found by direct methods.

Ignoring the Krapina remains, there are 9 Palaeolithic skulls, or casts of skulls, of which measurements are used in the following pages: 7 are adult, 1—the Le Moustier—adolescent, and the last is the cranium of a child about 8 years old. The view is now generally accepted that the authentic skeletal remains of Mousterian man, and the undated Gibraltar and Neanderthal specimens, belong to a single homogeneous type which is usually considered specifically distinct from that of *Homo sapiens.* The detailed anatomy and general conformation of the skulls suggests that the population was hardly more variable than a single race of modern man. Some writers have attempted to arrange them in an ascending series, the higher members being supposed closer to the types found in Upper Palaeolithic and recent times, but no uniformity of opinion has been reached in that way, and the idea that any such hierarchical arrangement may represent an evolutionary trend is perhaps an entirely erroneous one. The measurements suggest, rather, that the small group known to us is not more variable than a sample drawn from a single homogeneous and contemporaneous population might well be, although the remains were widely separated in both space and time. There is evidently a definite hiatus between the type of Mousterian man and that of modern man, and our endeavour has been to determine all the salient differences between the two which can be detected by a comparison of the usual measurements of the cranium. An attempt has been made to represent modern man by a large number of races, and almost all the mean measurements quoted are based on adequately long series of skulls. The number of mean cranial measurements of homogeneous racial types that are all based on a statistically adequate number of crania—say at least 30 of one sex—and which are available

for more than five or six races, is not large, and the present paper may claim to provide an adequate comparison between the Mousterian type and modern types for such characters. Many of the comparisons previously made have been grievously defective from a statistical point of view and, indeed, no other investigation can claim to have paid due regard to the factors of intra- and inter-racial variation. Reference has only been made to the supposed sex of the Neanderthaloid skulls in the sections dealing with the contours. The generally accepted view that the La Chapelle, Neanderthal and Spy I specimens are ♂ and the Gibraltar, La Quina and Spy II ♀ is partly confirmed by the measurements, but it cannot be considered proved while the total number of skulls is so small, as the differences might be racial as well as sexual. The comparative material available for the contours is far less ample than that for direct measurements and hence the conclusions derived from the former are of a more tentative nature.

A comparison was first made by considering the measurements one by one, the available values for the individual Mousterian skulls being compared with the means for modern racial series (Sections 2–11 below). The assumption that all the Neanderthaloid specimens are variants of a single type is made throughout. There are far too few of them to provide reliable mean measurements of even that type, but either together, or singly where only one is available, their measurements may be considered to give crude first approximations to the true means. On that assumption it has been supposed possible to make an inter-racial comparison; the best means of the Neanderthaloid type that can be obtained being compared, one by one, with the means of modern racial series. That procedure has emphasized the fact that the modern multi-racial population is a continuous and homogeneous one from which the Mousterian type is clearly separated. The characters which differentiate the archaic skulls are noted. But, acknowledging that there is a distinct hiatus between the two species, the question whether the extinct one resembles more closely some modern races than others is one of great importance. The comparison of single measurements does not provide a definite answer to it, so a generalised criterion providing a measure of the divergence of the Neanderthaloid type from that of any particular modern race was used. That criterion, like the coefficient of racial likeness, expresses by a single number the divergences of several independent measurements. As the La Chapelle is the only Mousterian skull for which almost all the commonly-used cranial measurements are available, it was alone used in that comparison.

Like all the previous craniometric studies which have emanated from the Biometric Laboratory, the present one owes its being and character to Professor Karl Pearson.

2. *Length Measurements of the Calvaria.*

From the known remains of Mousterian man it is evident that his type had a greater mean skull length than any modern race of man. Only extreme individual skulls of recent races approach the Neanderthaloid specimens in that respect. The greatest mean lengths found are given in Table I. For an English Neolithic skull Schuster has given both L and F as 208 mm. and L's of over 200 are also recorded for Papuan, Guanche, Loyalty Islander, Eskimo, Australian and a few Western European male crania. It is clear that the character is no sure criterion of the primitive status of a modern racial type, although nearly all primitive types have longer calvariae than the mean for all races. The length (F) measured from the ophryon—defined to be the point in the median plane on the least arc between the temporal ridges—provides a better measure of cerebral length than the glabella-occipital chord. It is probable that the mean F for the Mousterian type would fall within the range of mean values for modern races. The difference between L

and F provides a rough measure of the development of the superciliary ridges (Table I). It is invariably greater for ♂ than for ♀ means and is practically zero for juvenile skulls. In addition to the differences given in the table we have: Nepalese 0·8 (47), Tibetans A 0·8 (37), Swiss (Pittard) 1·0 (385), Burmese A 1·1 (44), Basques 1·2 (39), Congo Negroes 1·5 (50), New Caledonians 1·7 (93), Berbers 1·8 (29), Gaboon Negroes 1·9 (50), Late Predynastic Egyptians (Naqada) 1·6 (127), Maltese 2·3 (466), Egyptians of 26th–30th Dynasties 2·5 (895)*. The greatest individual differences observed are 8·0 for 2 Australian skulls and 7·5 for a Moriori and the means for those two races are by far the greatest, although other primitive types, such as the New Caledonians and Negroes, are not distinguished in the same way. The differences for the Neanderthaloid skulls clearly differentiate them from all of a modern type.

Table I. *Skull Lengths. Mousterian and Male Means of longest Modern Races.*

		Glabella-Occipital Length (L)	Ophryo-Occipital Length (F)	$L-F$
Mousterian Skulls[1]	La Chapelle	207·7	193·2	14·5
	La Quina	204·2	186·5	17·7
	Spy I	200·6	187·1	13·5
	Spy II	200·0??	185·1	14·9??
	Neanderthal	199·2	186·4	12·8
	Gibraltar	192·5?	183·3?	9·2?
	Krapina[2]	About 178	—	—
	Le Moustier (Adolescent)	195·9	187·7	8·2
	La Quina (Child)[3] ...	171·4	168·1	3·3
Western European dolicho-cephalic Races	French Neolithic ...	195·0 (21)	—	—
	British Neolithic ...	193·7 (53)	193·6 (118)	—
	Anglo-Saxons	190·6 (58)	188·9 (94)	1·7
	East German Neolithic	190·6 (44)	—	—
	Reihengräber	189·4 (234)	—	—
	Farringdon St. English ...	188·8 (139)	186·1 (140)	2·7
Oceanic Races	Loyalty Islanders ...	191·3 (35)	189·4 (35)	1·9
	Papuans (Mantegazza)...	188·5 (50)	—	—
	Australians (Duckworth)	187·6 (29)	183·4 (29)	4·2
	Moriori	186·9 (35)	182·0 (35)	4·9
	Maori	185·5 (43)	—	—
Other Races	Fuegians	192·0 (34)	—	—
	Kaffirs	190·6 (38)	—	—
	Eskimo	188·4 (192)	—	—

[1] The lengths given for the Mousterian skulls are the greatest glabella- and ophryo-occipital in the median sagittal plane, though, owing to the peculiar form of the occiput, greater lengths are found to the right and left of that plane (see the table of individual measurements in Appendix I).

[2] Gorjanović-Kramberger's estimated length for skull C (ref. in Appendix II below, 1906, p. 96).

[3] Measurements of a cast.

The La Chapelle nasio-basion length (LB) of 123·4 and the uncertain Le Moustier value of 124·0—measures not available for the other archaic skulls†—are further removed from the distribution for modern races than the glabella-occipital length. The greatest ♂ mean observed is 105·9 for 190 Eskimo skulls and the greatest individual measurement for that population is 118. The LB's of almost all primitive races are decidedly greater than those of more advanced types, the following being among the greatest ♂ means: Aino 105·4, Egyptian Aeneolithic Type 105·5, Kaffirs 105·1, Moriori 104·7, Loyalty Islanders 104·2, Maori 103·9, Berbers 103·6, New Caledonians 103·5, Australians 101·4, and other means greater than 102 mm. are apparently only shown by

* The numbers of skulls on which the means of modern races are based are generally not given in the text and tables below but they can be found approximately on referring to the bibliography (Appendix III, below).

† The Gibraltar LB is about 110 and the La Quina child's, from a cast, is 94·9.

Negro and Western European dolichocephalic races. It might be thought that the ratio of *LB* to *L* would provide a measure of the primitive nature of the type, supposing it to be greater as the *foramen magnum* is further removed from the face, but that is not the case. The La Chapelle index (100 *LB*/*L*) of 59·4 and the Le Moustier of 63·3 exceed the greatest mean for a modern race (Malays, 100 *LB*/*L* = 57·0), but no significance whatever can apparently be attached to the order in which this index arranges races.

Turning from characters for which the Mousterian skulls occupy positions close to the fringe of the greatest values for all modern skulls, we find another measurement of length in the sagittal plane for which they are nearly at the other extreme of the distributions. The sagittal circumference from nasion to opisthion of the La Chapelle skull (*S* = 355·5)* is hardly greater than the smallest mean for a modern race. The lowest ♂ means observed are: Telenghites 357·1, Hindus (Bengal) 365·9, Torgods 356·3 and Andamanese 351·4. The pygmy races of Africa would almost certainly have sagittal arcs less than 360 and probably less than 350 mm., but it is only among such extreme types that we can find values less than the La Chapelle. The ratio of *L* to *S* will obviously provide an index which will clearly differentiate the Neanderthaloid skulls from more advanced types, and it will be of interest to examine whether it can be used as a measure of the primitiveness of modern races. The indices for 83 races are summarised in Table II. The evident continuity of

Table II. *The Proportions of Sagittal Lengths to the Nasio-Opisthion Arc. Male Means.*

	100 *L*/*S*	100 *LB*/*S*
11 Oriental Races	47·7–48·7	26·8–27·5
6 Slavonic Races	47·9–48·9	27·4–27·9
Filipinos—Negritos	47·9 (36)	27·6 (36)
Filipinos—Non-Negritos	47·9 (75)	26·9 (73)
Telei (Solomon Islands) unsexed[1]	48·0 (42)	26·3 (42)
8 Western European brachycephalic Races (100 *B*/*L* greater than 80)	48·3–49·5	26·6–27·9
5 Mediterranean Races	48·6–50·4	26·9–27·6
10 Egyptian Types	48·8–50·1	26·7–27·6
Tibetans *B*	49·0 (14)	26·2 (14)
Papuans (Mantegazza)	49·1 (50)	25·8 (50)
Papuans (Meyer) unsexed[1]	49·0 (128)	—
6 American Races	48·8–51·1	26·8–28·3
11 Western European dolichocephalic Races (100 *B*/*L* less than 80)	49·2–50·3	26·0–27·4
5 Siberian Races	49·2–50·3	27·7–28·8
7 Negro Races	49·2–50·1	27·1–27·8
Maori	49·1 (43)	27·5 (43)
New British	49·2 (114)	27·1 (112)
New Caledonians	49·2 (89)	27·6 (72)
Veddahs	49·3 (30)	27·0 (30)
Tasmanians unsexed[1]	49·4 (31)	26·2 (31)
Loyalty Islanders	49·4 (33)	26·9 (30)
Aino	49·8 (77)	28·3 (77)
Moriori	50·2 (66)	28·1 (66)
Australians (Pöch) unsexed[1]	50·1 (39)	27·9 (39)
Australians (Duckworth)	50·6 (27)	27·3 (25)
83 Modern Races	47·7–51·1	25·8–28·8
Gibraltar Original	About 56·3	About 32·0
Restored Gibraltar Cast (McGregor)	55·7	31·7
La Chapelle	58·4	34·7

[1] For all the longest series available the sexual differences between the indices are small and only slightly, if at all, significant. The Egyptian *E* Series gives: 100 *L*/*S*, ♂ 49·8 (884), ♀ 49·2 (583); 100 *LB*/*S*, ♂ 27·3 (884), ♀ 26·8 (583).

the distribution of mean indices is a fact of prime importance. It may be said that 100 *L*/*S* is fairly constant for members of the same family of races, while the order in which those families

* The Gibraltar *S* is about 340.

are arranged is one which indicates in a rough way their primitive nature. But, taken by itself, such a criterion is obviously quite incapable of determining the status of a particular race. A similar index formed by expressing the nasio-basial length as a percentage of the sagittal arc (100 LB/S) shows again a continuous distribution for the mean values of modern races and a wide gap between them and the Neanderthaloid skulls. There seems to be no very high inter-racial correlation between the two indices. Like 100 L/S, 100 LB/S is reasonably constant for members of the same family of races, but it leads to a re-arrangement of those families. It certainly cannot be said that all primitive races have a higher 100 LB/S index than the mean for all races.

The proportions that the frontal, parietal and occipital arcs of the median sagittal section bear to the total circumference from nasion to opisthion show little variation among modern racial types. For 40 races examined the mean values of the index 100 S_1/S ranged from 33·4 to 35·8 and the La Chapelle value of 33·9 (the only one available for a Neanderthaloid skull) falls within that range. The same is found for 100 S_2/S (La Chapelle = 33·3), which shows means between 32·9 and 35·6. The index 100 S_3/S has racial extremes of 29·5 and 32·9, the La Chapelle value being 32·7 and the Gibraltar 31·0??. These three indicial measurements show perfectly continuous inter-racial distributions, and they seem to be quite incapable of furnishing orders which are at all similar to any which would be given by considering the supposed relative degrees of primitiveness of the types.

The component occipital arcs from lambda to inion and inion to opisthion are available for 10 races (see Table III). The upper segment of the La Chapelle skull is decidedly greater than any ♂ mean available, and the proportions it bears to the total sagittal arc and the occipital arc from lambda to opisthion are even more clearly differentiated. But the occipital bone of the Gibraltar skull—and probably the occipital bones of all the other Neanderthaloid skulls too—has not the same peculiarity.

Table III. *Arcs and Chords of the Occipital Bone. Male Means.*

	Lambda to Inion			Inion to Opisthion		
	Arc	Chord	100 Chord/Arc	Arc	Chord	100 Chord/Arc
La Chapelle	74·0	66·2	89·4	42·5?	41·5	97·6?
La Quina	66·3	57·8	87·2	—	—	—
Le Moustier (Adolescent)	63·0	57·2	90·8	—	—	—
Gibraltar	60·0?	54·6?	91·0?	46·0?	44·6?	97·0?
Neanderthal	57·2	53·9	94·2	—	—	—
Spy I	58·5	55·1	94·2	—	—	—
Spy II	55·0	52·5	95·5	—	—	—
Reihengräber[1]	71·5	66·0	92·4	—	—	—
Basques	71·4	66·5	93·2	48·2	46·7	96·9
Early Dynastic Egyptians (Toldt)	67·1	63·0	93·9	48·5	47·2	97·3
Australians (Pöch) unsexed	62·55	58·9	94·1	48·1	46·6	97·0
Middle Dynastic Egyptians (Toldt)	66·0	62·3	94·4	48·9	47·4	96·9
Turks	62·0	58·7	94·6	49·8	49·5	99·4
Berbers	66·2	62·9	95·0	49·7	47·9	96·4
Greeks	61·8	59·1	95·6	50·8	49·4	97·3
Slovenes	56·7	55·0	97·0	52·7	50·0	94·9
Serbo-Croatians	59·25	57·6	97·2	52·95	51·05	96·4
Telei (Solomon Islands) unsexed	61·4	60·1	97·9	51·6	48·7	94·4

[1] The Reihengräber means given are for 43 ♂ skulls. For 39 ♀ Reihengräber skulls the lambda to inion index is 92·8.

Measurements of the curvature of segments of the total median sagittal arc are usually considered of great importance when early Palaeolithic skulls are being compared with modern racial types. Many such measurements can be deduced from the sagittal contour and a few

from direct measurements are frequently provided. The curvature of the occipital arc from lambda to opisthion has been investigated for a considerable number of races by forming the so-called Occipital Index $\left(Oc.\ I. = 100\,\frac{S_3}{S_3'} \times \sqrt{\frac{S_3}{24\,(S_3 - S_3')}}\right)$ which was suggested by Professor Karl Pearson. The mean values of the index for 50 races—some being based on small numbers of crania—were provided in *Biometrika*, Vol. XVI, 1924, pp. 334 and 335. They range from 68·3 to 58·1 and are highest—indicating a more flattened bone—for Negro and lowest for Western European races. The La Chapelle index of 56·0, the Gibraltar of 55·0? and the Krapina child's of 57·3 (*B* skull)* would thus indicate more rounded occipital bones than any modern mean types as yet observed. But in applying the Occipital Index the assumption is made that the curvature of the arc is continuous and that is reasonable enough in the case of modern skulls but is hardly justified when dealing with the two Mousterian specimens having complete supra-occipital sections. Measuring the curvature of the component segments by the ratio of the chords to the arcs, as in Table III, it is seen that the differences between the two measurements of curvature are distinctly greater for the La Chapelle and Gibraltar skulls than for modern mean types. Their arcs from lambda to inion are characteristically rounded while from inion to lambda the section is almost flat. That the greater curvature of the upper segment is a distinguishing feature of the archaic type of skull is more or less confirmed by the measurements of the less complete Neanderthaloid crania, but they differ less from modern skulls than the La Chapelle type does, while the Spy and Neanderthal indices actually fall within the distribution of modern mean values.

The parietal sector of the total sagittal arc has normally a more uniform curvature than the occipital. While a better measure would be an index similar to the occipital index, it will suffice for our present purposes to estimate that curvature from the ratio of the arc and chord from bregma to lambda (S_2 and S_2' respectively). Mean values for modern races are compared with the indices for Neanderthaloid skulls below, and it is seen that the lesser curvature of the latter provides, in general, a clearly distinguishable character that can be easily measured.

Values of $100\ S_2'/S_2$:

Mousterian Skulls: La Quina 96·3, Spy II 94·8?, La Chapelle 94·3, Neanderthal 93·7?, La Quina child (cast) 93·0?, Krapina skull cap† 92·8, Spy I 91·2, Le Moustier (adolescent) 89·7?.

Modern Races (Male Means): Moriori 91·2, 3 Siberian Races 90·9–87·9, 4 Western European dolichocephalic Races 90·4–89·6, Guanches 90·5, 4 Oriental Races 90·3–88·7, Tibetans *B* 90·2, Egyptians (1st Dynasty) 89·8, Australians unsexed‡ (Pöch) 89·7, 3 Negro Races 89·6–88·7, 6 Slavonic Races 89·9–88·0, Swiss (Reicher) 89·1, New British 88·4, Telei (Solomon Islands) unsexed‡ 88·2.

The curvature of the frontal median sagittal arc cannot be estimated in the same way from the arc and chord measurements because of the abrupt changes in direction of the section of the superciliary ridge. The ratio of the maximum subtense to the nasio-bregmatic chord will serve that purpose, however, and it will be considered later.

It has been shown that the proportions of the frontal, parietal and occipital arcs to the total sagittal arcs are indices which do not distinguish the La Chapelle skull from the mean types of modern races, but we should anticipate that the proportions of the corresponding chords to the

* From Gorjanović-Kramberger's measurements (1906), p. 91. † *Ibid.* (1902), p. 192.

‡ There appears to be no sexual difference for the index $100\ S_2'/S_2$. For Czechs mean values are found, ♂ 89·9 (101) and ♀ 89·9 (51), and for Reihengräber skulls, ♂ 89·6 (45) and ♀ 89·1 (40).

glabella-occipital length would all be characteristically small for the archaic skulls. The comparison of the indices for the Mousterian skulls with those of 29 modern races is made in Table IV. There is a clear distinction between the Neanderthaloid and the modern types and it would probably be most marked for the combined indices $\{100\ (S_1' + S_2' + S_3')/L\}$. Both the adolescent Le Moustier skull and that of the child's from La Quina are differentiated in the same sense as the adults but to a less marked degree. The inter-racial distributions for the modern races are again found to be continuous and the indices lead to arrangements which show little resemblance to any which might be supposed to represent their gradation in primitiveness.

Table IV. *Proportions of the Frontal, Parietal and Occipital Sagittal Chords to the Glabella-Occipital Length. Male Means.*

	$100\ S_1'/L$	$100\ S_2'/L$	$100\ S_3'/L$	$100\ (S_1' + S_2' + S_3')/L$
La Chapelle	51·5	53·8	43·9	149·2
La Quina	52·1	50·4	—	—
Gibraltar	—	—	42·1?	—
Spy I	51·2?	57·3	—	—
Spy II	—	54·5??	—	—
Neanderthal	58·9?	51·7?	—	—
Le Moustier (Young adult) ...	55·2?	55·7?	—	—
La Quina Child (Cast)	55·5?	53·9?	—	—
4 European dolichocephalic Races	59·3–60·6	60·6–62·6	51·5–52·4	172·1–174·6
Moriori	60·0	59·8	53·3	173·1
Guanches	60·4	60·7	52·6	173·7
Australians (Pöch[1] unsexed) ...	60·9	61·9	52·1	174·9
3 Siberian Races	61·9–63·6	59·6–60·8	51·9–52·8	173·4–177·2
3 Egyptian Types	59·8–61·4	62·3–63·8	51·9–53·5	174·0–177·9
New British	59·5	63·5	52·2	175·2
Tibetans *B*	60·8	61·3	54·1	176·2
2 Negro Races	61·7	62·2–64·1	53·4–54·2	178·1–179·2
6 Slavonic Races	62·4–64·3	62·5–64·5	52·4–54·6	177·3–183·1
Swiss (Reicher)	64·6	60·8	53·3	178·7
Telei (Solomon Islands) unsexed[1]	61·7	65·0	55·3	182·0
4 Oriental Races	61·7–64·7	62·8–64·5	53·4–56·5	179·0–184·4
29 Modern Races	59·3–64·7	59·6–64·5	51·5–56·5	172·1–184·4

[1] For the longest series available the sexual differences between the indices shown in the table appear to be small and probably insignificant.

A comparison of calvarial measurements in the median sagittal plane has shown that:

(i) The glabella-occipital and nasion-basionic lengths of the Neanderthaloid type are distinctly greater than those of any modern race.

(ii) At the same time, the chords (S_1', S_2' and S_3') and arcs (S_1, S_2 and S_3) of the frontal, parietal and supra-occipital bones and the total arc (S) are hardly greater than the smallest means that can be found.

(iii) The proportions of the component arcs to the total sagittal arc are not distinctive.

(iv) The greater difference between the glabella-occipital and ophryo-occipital lengths (measuring the development of the superciliary ridge), the greater flattening of the parietal arc, the indices $100\ L/S$ and $100\ LB/S$ and the proportions of the sagittal chords to the glabella-occipital length ($100\ S_1'/L$, $100\ S_2'/L$ and $100\ S_3'/L$) clearly differentiate the Neanderthal type from all modern ones*.

* It may be suggested that the differentiation of the indices of which L is one component is due simply to the great extension of that diameter consequent on the growth of the superciliary ridges and that if that were avoided by using the ophryo-occipital length (F) instead there would be no such distinctions. It was not possible to use F as it has been

(v) The arc from lambda to inion of the Neanderthaloid type appears to be peculiarly rounded; the total occipital arc from lambda to opisthion may also be distinguished by its greater curvature.

(vi) For all the characters differentiating the Neanderthaloid skulls from the mean types of modern races, the latter show continuous distributions and there is no clear suggestion that the primitive races stand nearer to the archaic type than the advanced ones do.

3. *Breadth Measurements of the Calvaria.*

It is probable that the Neanderthaloid type had a mean calvarial breadth at least as great as that of any modern race. Among existing peoples, mean B's of 150 to 152 mm. are shown by several European and Siberian races and the measurements of all the archaic skulls yet known to us fall well within the distributions for those populations. It will be shown later that the association of great calvarial breadths with dolichocephaly is a condition which clearly differentiates the Mousterian type from all recent ones. The least frontal breadths (Table V, column 3) are distinctly removed from the modern means and the La Chapelle B' (109·2) is only exceeded by quite extreme skulls*. The internal biorbital width measurements are even more distinctively great, but the greatest frontal breadths (measured on the coronal suture) fall more clearly within the modern range than the parietal breadths. The forward transverse measurements of the calvaria, then, immediately behind and in front of the superciliary ridges, are peculiarly great, but the hinder ones are not so. It might be thought that such a condition would furnish some distinctive inter-breadth ratios which might be supposed due to the more pronounced growth of the superciliary ridges for Mousterian man, but a direct comparison of the indices (Table VI) fails entirely to establish such a hypothesis. For the six compared in the table almost all the individual values for Neanderthaloid skulls fall within the range of modern means, and the means of the archaic type would almost certainly do so in all cases. There are 49 races having mean values of both $100\,B/L$ and $100\,B'/B$ based on 50 or more skulls and for them a correlation is found of $-0{\cdot}731 \pm {\cdot}045$ between the indices. It is spurious as B is common to both. The points for the Mousterian skulls all fall within or very close to the swarm of means. The indices $100\,IOW/B$, $100\,B'/B''$ and $100\,IOW/B''$ also appear to be highly correlated with the cephalic index but, from the meagre data available, there is no suggestion of a significant inter-racial correlation between $100\,B/L$ and the ratio of the two forehead breadths $100\,B'/IOW$ or between $100\,B/L$ and the ratio of the two parietal breadths $100\,B''/B$. None of these inter-breadth indices appear to be more closely associated with the primitive status of a racial type than the cephalic index is (see p. 329). All the distributions of mean values are continuous. The excessive growth of the superciliary ridges on Neanderthaloid skulls does not endow them with any peculiar breadth ratios as far as we can see†.

provided for so few modern races. Substituting it for L would certainly reduce the gap between these indices for the Neanderthaloid and modern mean types, but it would not bridge it. The indices $100\,F/S$ for the La Chapelle and Gibraltar skulls, for example, are 54·3 and 53·6?? respectively and they are still distinctly greater than any mean $100\,L/S$ index for a modern race (see Table II), while the means for the modern races would also be reduced by substituting F for L.

* The largest B' we have observed is 111 mm. given by Fürst and Hansen for an Eskimo ♂ skull.

† Some significant sexual differences between inter-breadth indices may be expected as a consequence of the greater growth of the superciliary ridges of the ♂ skull. Confining our attention to series for which both ♂ and ♀ means are available for more than 50 skulls, the following differences (♂–♀) are found. They are apparently significant for $100\,B'/B''$ and $100\,B''/B$, but so small as to be almost negligible.

	Eskimo	New British	Patagonians	Reihengräber	Swiss (Pittard)	Messinians	Egyptians *E*
$100\,B'/B$	+0·2	−0·8	−0·3	−0·1	−0·6	−0·4	+0·2
$100\,B''/B$	+0·9	+0·3	+0·9	+0·5	0·0	+1·2	—
$100\,B'/B''$	−0·8	−1·3	−1·4	−0·6	−0·8	−1·8	—

Table V. *Calvarial Breadths.*

	Greatest Parietal Breadth (*B*)	Least Frontal Breadth (*B'*)	Greatest Frontal Breadth (*B''*)	Internal Biorbital Width (*IOW*)
La Chapelle	156·2	109·2	123·6	113·5
Spy II	153·2	107·9	125·9	—
Le Moustier (Adolescent)	150·1	107·4	121·2?	105·9?
Neanderthal	146·7	105·0?	122·3	110·8
Gibraltar	About 149	102·5?	About 122·5	106·1?
Spy I	144·3?	101·1?	—	109·0?
La Quina	138·3?	101·2	108·3?	100·9
Galilee[1]	—	98·1	113·9	110·8
Krapina *C*[2]	—	98·5	—	—
La Quina (Child)[1]	131·8	88·0	109·1	83·7
Racial Means (Male Skulls) Greatest ...	151·5	101·0	128·4	101·7
Racial Means (Male Skulls) Least ...	128·8	90·9	107·9	94·4
Racial Means (Male Skulls) Range ...	22·7	10·1	20·5	7·3
Racial Means (Male Skulls) No. of Races	87	78	32	12

[1] Measurements of a cast.

[2] Gorjanović-Kramberger's measurement (1906), p. 96.

Table VI. *Frontal and Parietal Inter-Breadth Indices.*

	100 *B/L*	100 *B'/B*	100 *B''/B*	100 *IOW/B*	100 *B'/B''*	100 *IOW/B''*	100 *B'/IOW*
La Quina	67·7?	73·2?	78·3?	73·0?	93·4?	93·2?	100·3
Spy I	71·9?	70·1?	—	75·5?	—	—	92·8?
Neanderthal	73·6	71·6?	83·4	75·5	85·9?	90·6	94·8?
La Chapelle	75·2	69·9	79·1	72·7	88·3	91·8	96·2
Spy II	76·6??	70·4	82·2	—	85·7	—	—
Le Moustier (Adolescent)	76·6	71·6	80·7?	70·6?	88·6?	87·4?	101·4?
Gibraltar	About 77·5	About 69·0	About 82·0	About 71·2	About 83·7	About 86·5	96·6?
Galilee[1]	—	—	—	—	86·1	97·3	88·5
La Quina (Child)[1] ...	76·9	66·8	82·8	63·5	80·7	76·7	105·1
Racial Means (Male Skulls)							
Greatest	86·4	73·5	86·4	77·3	87·3	92·5	103·1
Inter-racial Mean ...	77·3	68·6	83·2	70·9	82·8	84·4	98·4
Least	68·1	62·4	78·0	65·7	76·1	76·9	94·2
No. of Races	87	78	32	12	32	9	12

[1] Measurements of a cast.

A striking feature of Neanderthaloid skulls is the fact that the greatest breadth of the brain-box is peculiarly far back. It will be shown from a comparison of horizontal contours that for such a character there is a clear distinction between them and modern types. The only direct measurement of occipital breadth is provided by the biasterionic diameter and it is only available for a few races. Means are given in Table VII. The absolute value of the mean biasterionic diameter for the Mousterian skulls would seem to be considerably greater than that of any modern race and the ratio it bears to the parietal breadth is also distinctively great. The indices 100 Biast. *B/B* and 100 *B/L* are evidently highly, though spuriously, correlated, and only extremely dolichocephalic modern skulls will have the former measurement approaching the Neanderthaloid values. A more marked distinction is found for the index 100 Biast. *B/B''*, i.e. the ratio of the occipital and frontal widths of the parietal bones. From the meagre data available, there is no suggestion of a significant correlation between that and the cephalic index, although the latter is quite highly correlated with such an index as 100 *B'/B''*. It may be that the biasterionic breadth is inter-racially almost independent of the other calvarial breadths, though all others seem to be highly correlated with one another.* Judging from the 17 racial values of the index 100 Biast. *B/B''*

* It may be seen from columns 2 and 6 of Table VII that there is no suggestion of a significant inter-racial correlation between the biasterionic breadth and the cephalic index and the correlation for the former and the greatest parietal breadth would seem to be no higher.

given, it seems to be true, in a general way, that the more primitive types have the higher indices and thus stand closer to the archaic Neanderthaloid skulls, but the positions of the Angoni Negroes and Zulus are markedly discordant, so the measurement is not a reliable guide*. In spite of the doubtful La Quina value, there is probably a clear distinction between the index 100 B'/Biast. B for the Neanderthaloid type and all the means of modern races. That index appears to be quite uncorrelated with 100 B/L. It is probable that the ratio of the biasterionic to the internal biorbital width (*IOW*) will also serve to differentiate the Mousterian skulls; so the occipital breadth is, for them, peculiarly great both absolutely and in proportion to all other calvarial breadths.

Table VII. *Biasterionic Breadth Indices. Male Means.*

	Biasterionic Breadth	100 Biast. B/B	100 Biast. B/B''	100 B'/Biast. B	100 B/L
Spy II	131·2?	85·6?	104·2?	82·2?	76·6?
Spy I	121·2?	84·0?	—	83·4?	71·9?
La Chapelle	130·5	83·5	105·6	83·7	75·2
La Quina	112·4?	81·3?	103·8?	90·0?	67·7?
Australians (Duckworth)	108·5	82·2	—	87·2	70·3
Australians (Pöch)[1] unsexed ...	103·5	81·5	96·4	89·3	71·4
Kaffirs	110·9	80·7	94·5	91·0	72·1
New British	108·0	81·3	97·2	86·4	72·2
Angoni Negroes	105·8	78·6	90·2	92·6	73·1
Reihengräber	113·2	80·5	94·1	86·3	73·3
Berbers	108·8	79·7	94·3	88·8	73·4
Middle Dynastic Egyptians (Toldt)	103·9	77·4	95·1	87·0	73·7
Zulus	106·3	77·6	89·7	93·9	74·3
Early Dynastic Egyptians (Toldt)	104·4	76·8	93·7	88·8	74·4
Mediaeval Slavs	112·1	79·8	94·4	87·4	75·0
Tasmanians unsexed[1]	108·2	80·3	100·9	84·7	75·0
Basques	113·2	78·9	94·6	85·8	77·2
Guanches	111·2	76·1	92·5	87·4	77·4
Etruscans	111·3	77·5	91·1	86·4	78·6
Chinese (Haberer)	107·4	76·6	94·5	87·0	78·7
Venezuelians	111·6	78·9	—	86·8	79·4
Italians (Sienna)	112·3	79·6	—	88·6	80·2
Greeks	108·9	76·1	—	89·2	81·2
Rumanians	110·8	76·3	—	86·4	82·8
Czechs	111·2	74·6	88·8	87·6	82·8
Slovenes	108·4	74·2	—	90·0	83·4
Turks	109·8	75·3	—	86·0	83·5
Serbo-Croats	110·0	74·6	—	89·3	84·0
Swiss (Pittard)	113·85	75·4	90·5	87·5	85·0

[1] There appear to be no sexual differences for the three indices given in the table involving the biasterionic breadth.

The only other calvarial breadth measurement available for any number of present-day races is the biauricular diameter. It can only be given with any certainty for the La Chapelle, Spy II and Le Moustier skulls and their values probably exceed the ♂ means of all modern races, but they appear to bear no distinctive proportions to the other breadths except the biasterionic. The peculiarly great value of the latter diameter for the La Chapelle skull is not associated with a proportionally great biauricular diameter.

The comparison of breadth measurements has suggested that:

(i) The greatest parietal and greatest frontal breadths of the Neanderthaloid type fall within the range of modern mean values; the least frontal and internal biorbital widths are greater than the modern means, but within the distributions of individual skulls; the biasterionic breadth is greater than that of all modern skulls.

* The hiatus between the Tasmanian index (100·9)—the mean of 42 unsexed skulls—and the next greatest (97·2) is great, but the sample is too small a one to warrant the supposition that the inter-racial distribution is not continuous.

(ii) Mean breadths as great as those of the Neanderthaloid type are only found for markedly brachycephalic modern races.

(iii) The biasterionic breadth is peculiarly great in proportion to all others, but no other distinctive inter-breadth ratios have been observed.

(iv) No direct breadth measurements or inter-breadth indices are of any value as criteria of the primitive status of modern races. Many of the indices are inter-racially highly, though spuriously, correlated with the cephalic index.

4. *Length-Breadth Indices of the Calvaria.*

There can be no doubt that the cephalic index has been more discussed by physical anthropologists than any other single measurement of the human skull. It appears to have a greater inter-racial variability than almost all other cranial indices and is often the character which most clearly distinguishes closely allied races. The mean values for the 87 races used for comparative purposes in the present paper range (for ♂ means) from 68·1 (Loyalty Islanders) to 86·4 (Telenghites) and the extremes for present-day European races are almost as far removed from one another*. It is clear that $100\,B/L$ is, by itself, no reliable criterion of primitiveness, although it is undoubtedly true that almost all primitive modern types have lower cephalic indices than the average for all races. The mean for Neanderthaloid skulls is probably between 72·0 and 76·0 (see the individual indices given in Table IX)†; thus it is rather less than the modern average, and would approach the inter-racial mean more closely for the index formed by using the ophryo-occipital $100\,B/F$ in place of the glabella-occipital length ($100\,B/L$). Confining our attention to the ♂ means based on 50 or more skulls, the following inter-racial correlations are found for 59 races:

$$\text{(i)}\quad L \text{ and } B \qquad : r = -\cdot 433 \pm \cdot 072,$$
$$\text{(ii)}\quad L \text{ and } 100\,B/L : r = -\cdot 759 \pm \cdot 038,$$
$$\text{(iii)}\quad B \text{ and } 100\,B/L : r = +\cdot 950 \pm \cdot 008.$$

It is interesting to note that the inter-racial correlation of L and B is distinctly negative, while the intra-racial correlation is known to be of the same order but positive‡. Table VIII is the correlation table for B and $100\,B/L$. The superimposed points for the adult Neanderthaloid skulls all fall on the same side of the regression line and well away from it, or, in other words, no modern types are found with breadths as great and, at the same time, cephalic indices as low as those of the archaic skulls. In the same way the association of other calvarial breadths of great size with a low cephalic index would seem to differentiate clearly the Neanderthaloid type from all modern

* They are 71·5 for Sardinians and 85·3 for Swiss (Reicher).

† By reconstructing the Krapina skull *C* (1906, p. 89) Gorjanović-Kramberger finds a cephalic index of 83·5. The reconstruction of the *D* skull (*Ibid.* p. 118) would apparently give much the same value as he gives, 85·5, for the ratio of *B* to the glabella-inion length, which would be slightly less than the glabella-occipital. Both estimates are extremely doubtful.

‡ That has been shown for several series. The following correlations are given for the longest racial ♂ series available, viz. the Egyptian *E* comprising 900 ♂ 26th–30th Dynasties skulls (Pearson and Davin, "On the Biometric Constants of the Human Skull," *Biometrika*, Vol. XVI, 1924, Table V):

$$\text{(i)}\quad L \text{ and } B \qquad : r = +\cdot 397 \pm \cdot 019,$$
$$\text{(ii)}\quad L \text{ and } 100\,B/L : r = -\cdot 490 \pm \cdot 017,$$
$$\text{(iii)}\quad B \text{ and } 100\,B/L : r = +\cdot 589 \pm \cdot 015.$$

The high inter- and intra-racial correlations of the component lengths with the index are, of course, spurious.

ones, and there is not the slightest suggestion that primitive races diverge from the regression lines in the same sense as the Mousterian skulls more than advanced races*. It is merely expressing the same relationship in other words to say that the association of great glabella-occipital lengths with great breadths and the possession of abnormally great lengths with normal cephalic indices are characteristics which clearly distinguish the Neanderthaloid skull†.

TABLE VIII. THE INTER-RACIAL CORRELATION OF THE CEPHALIC INDEX AND PARIETAL BREADTH.

Scale of Parietal Breadth. B.

Scale of Cephalic Index 100 B/L	130·0	135·0	140·0	145·0	150·0	155·0	TOTALS
			La Quina ⊙				0
70·0	1·5						1·5
	0·5	3	1	1	Spy I ⊙		5·5
		1	1	1·5	Neanderthal ⊙		3·5
75·0		3	4	1·5	4	1	La Chapelle ⊙ 13·5
				2·5	4·5	1	Le Moustier ⊙ Spy II ⊙ 8
				1·5	2·5	3	1 ?? Gibraltar 9
80·0					1	2	2 2 1 8
							2 2·5 1 1·5 7
85·0							0·5 1·5 2
							1 1
TOTALS	2	4	4	5	8	12	7 3 6 3 5 0 0 0 59

* It may be suggested again (cf. footnote to p. 325) that the divergences in these cases are merely due to the effect that the great growth of the superciliary ridge has on the glabella-occipital length and hence on the cephalic index. That factor, however, does not seem to account entirely for the observed facts. The 7 Neanderthaloid skulls in Table VIII have a mean 100 B/F index of 79·3 and a mean B of 148·3. These still give a point distinctly above the regression line for B and 100 B/L, while that line itself would be shifted downwards to a certain extent if F were substituted for L.

† The points for the Mousterian skulls all fall well away from the inter-racial regression line for B and L, and the points for B and F are still on the same side of that line.

The ratios of the lengths and breadths of the separate bones of the brain-box are likely to be of more value for our present purpose than the cephalic index. It has been seen that all the breadths are great compared with the means for modern races, while the sagittal lengths of the single bones are small both absolutely and in proportion to the glabella-occipital length. Indices for a number of races are compared with the values for Neanderthaloid skulls in Table IX. In

Table IX. *Length-Breadth Indices of Individual Bones of the Calvaria. Male Means.*

	Frontal		Parietal		Occipital	Cephalic
	Least Breadth $100\ B'/S_1'$	Greatest Breadth $100\ B''/S_1'$	Frontal Breadth $100\ B''/S_2'$	Biasterionic Breadth $100\ \frac{\text{Biast. } B}{S_2'}$	Biasterionic Breadth $100\ \frac{\text{Biast } B.}{S_3'}$	$100\ B/L$
La Chapelle	102·2	115·6	110·6	116·7	143·1	75·2
Le Moustier (Adolescent)	99·3?	112·0?	111·0?	—	—	76·6
Spy I	98·3?	—	—	105·5?	—	71·9?
Spy II	—	—	115·5	120·4?	—	76·6?
La Quina	95·1	101·8?	105·2?	109·2?	—	67·7?
La Quina (Child)[1]	92·5	114·7	118·2	—	—	76·9
Gibraltar	About 97	About 106	—	—	—	About 77·5
Neanderthal	89·4?	104·2?	118·9	—	—	73·6
Galilee[1]	86·1	100·0	—	—	—	—
Czechs	88·7	—	—	101·1	120·6	82·8
Swiss (Reicher)	88·3	113·1	120·2	—	—	85·3
Cameroon Negroes	87·1	106·5	105·5	—	—	76·8
Reihengräber	87·0	106·4	101·4	95·4	114·2	73·3
Swedish Neolithics	86·6	101·9	—	—	—	74·4
Guanches	86·5	107·0	106·6	98·6	113·8	77·4
Basques	86·2	106·3	105·1	99·4	116·9	77·2
Telei (Solomon Islands) unsexed[2]	85·4	103·8	98·6	—	—	75·5
New British	85·2	101·4	95·0	92·4	112·4	72·2
Australians (Pöch) unsexed[2]	84·8	98·7	97·1	93·5	111·1	71·4
New Caledonians	84·7	99·3	—	—	—	71·9
Telenghites	84·6	111·2	116·4	—	—	86·4
Eskimos	84·3	96·6	—	—	—	71·3
Berbers	84·0	100·3	98·1	92·5	113·7	73·4
Chinese (Haberer)	82·7	100·5	98·8	93·4	106·6	78·1
Early Dynastic Egyptians (Toldt)	82·6	99·2	97·7	91·7	106·7	74·4
Middle Dynastic Egyptians (Toldt)	81·7	98·8	94·1	89·4	106·8	73·7
17 Other Races	89·9–83·3	—	—	—	—	83·4–73·8

[1] Measurements of a cast.

[2] As far as can be seen, the sexual differences for the length-breadth indices of the single bones are negligibly small if at all significant.

the second column are given the least frontal breadths expressed as percentages of the nasio-bregmatic chords and the index for the Galilee skull alone falls within the distribution of modern mean values. The index formed by using the greatest breadth of the frontal bone is less capable of distinguishing the Mousterian type, but its mean is still only approached by those of extreme modern races. The same is true for the index $100\ B''/S_2'$, but for the two involving the biasterionic diameter—which has been shown to be peculiarly great for the Neanderthaloid skulls—there is a most definite hiatus between the archaic and recent skulls. These five indices appear to be correlated to a certain extent with one another, but lowly, if at all significantly, with the cephalic index. They appear to be more constant for members of the same family of races than does the cephalic index, and there is not the slightest suggestion of a *rapprochement* between the primitive modern types and the Mousterian skulls*. We arrive, then, at the conclusion that the calvariae of the Neanderthaloid skulls, though dolichocephalic when considered as a whole, are made up of bones which are peculiarly broad in proportion to their sagittal lengths. Three of the breadth

* The mean indices closest to those of the Neanderthaloid skulls are actually those of European brachycephalic races.

indices (100 B'/S_1', 100 Biast. B/S_2' and 100 Biast. B/S_3') place the archaic type outside the distribution of modern racial types and, as far as we can judge at present, these characters are not peculiarly accentuated on the skulls of any primitive existing races.

5. *Calvarial Heights, Height Indices and Foraminal Measurements.*

The basio-bregmatic height (H') of the La Chapelle skull is 130·0 mm. and that measurement cannot be determined with certainty on any other of the Mousterian specimens, although the queried Le Moustier height of 128·5 is certainly close to the true value. Mean ♂ H''s less than 130 have been given for Aleutians (127·6), Venezuelians (127·6), Farringdon St. English (129·7), Kalmucks (129·7) and Telenghites (129·8). The extremely brachycephalic Siberian races and many of the Western European brachycephalic races are characterised by low calvarial heights, but the inter-racial correlation with the cephalic index is certainly small and probably not at all significant. For an Australian series (Duckworth) the low ♂ mean of 130·7 is found, but other primitive races such as the Eskimo (138·2), New Caledonians (139·3) and Loyalty Islanders (140·1) have basio-bregmatic heights as great as those of any races in the world. The height-length indices, 100 H'/L (La Chapelle = 62·6, Le Moustier = 65·6?), fall entirely outside the distribution of means for modern races—the only ones under 70 being 68·6 for the Farringdon St. English, 69·8 for Australians (Duckworth) and 69·8 for Aleutians—and only most extreme modern skulls are less than they*. We may expect to find a high inter-racial correlation between the indices 100 H'/L and 100 L/S as they have a common component and are both measures of the flattening of the cranial vault. The order in which the former arranges the racial types is substantially the same as that shown in Table II for 100 L/S. The Western European dolichocephalic races and Northern Mongols occupy positions closer to that of the Neanderthaloid type than many which would generally be considered more primitive than they.

The indices 100 B/H' (La Chapelle = 120·2, Le Moustier = 116·8?) do not place both archaic skulls outside the range of modern mean values as a value of 118·1 is given for Aleutian skulls. The Siberian and some American races have the highest means. There is evidently a high correlation between 100 B/H' and 100 B/L and the primitive dolichocephalic races are as far removed from the Neanderthaloid skulls as any. An index 100 $(B - H')/L$ has been provided for several racial types, but it is very highly correlated with 100 B/H' and it gives no new data of particular interest. The La Chapelle (12·6) and Le Moustier (11·0?) indices are equalled by those for Aleutians (12·6) and Telenghites (12·3). In the case of all the indices which are highly correlated with the cephalic index the points for the Mousterian skulls are widely removed from the regression lines.

The index formed by expressing the basio-bregmatic height in terms of the sagittal arc from nasion to opisthion (100 H'/S) shows little variation for modern races. It is lowest (34·2) for the Farringdon St. English series, low for Tasmanians and Australians and highest for Negro and Oriental races, the highest ♂ mean observed being 37·3 for Malays. The La Chapelle index of 36·6 is within the modern range. It has been observed that the La Chapelle and Le Moustier height-length indices (100 H'/L) fall entirely outside the distribution of racial means. The same is found for 100 H'/LB for which the La Chapelle skull gives a value of 105·3, and the only means found less than 130 are for Australians (Duckworth) 128·9, Kalmucks 129·0, 1st Dynasty Egyptians 129·5, Moriori 129·7 and Buriats 129·7.

The following auricular heights (OH) can be given for Neanderthaloid skulls†: La Chapelle

* Both Pöch and Duckworth have given indices for Australian skulls between 63 and 64.

† The measurements of casts are probably about 1% greater than the true skull measurements.

114·1 (from Boule's first cast), Spy II 113·5?, Spy I 111·2?, Le Moustier 112·5?, La Quina 111·1? (from a cast), Gibraltar 106·0 (from McGregor's restored cast), La Quina child 106·0 (from a cast). These values are all extraordinarily close to one another. A mean auricular height of 110·0 has been given for 76 English (Farringdon St.) ♂ skulls, but the heights of the Mousterian skulls are all peculiarly small in proportion to their calvarial lengths. The proportions that their *OH*'s bear to *H'* (the basio-bregmatic height) are much the same as for all modern skulls.

The foraminal measurements are the only other ones of the calvaria commonly taken and the La Chapelle is the only adult Mousterian skull for which they are available. The length of 48·9 is at least 10 mm. greater than any mean racial value and it is also peculiarly large in proportion to the glabella-occipital and nasio-basionic lengths. There seems to be a zero inter-racial correlation between *fml* and *L*. The greatest ♂ mean observed is for the short-skulled Buriats (38·1). The Australians (35·3), Moriori (35·4) and Maori (35·2) have peculiarly short foramines. The La Chapelle foraminal breadth of 32·4 is only just, if at all, greater than the largest ♂ mean for a modern race; the Guanche measurement being 31·8. The inter-racial correlation between *fmb* and *B* is small if at all significant. The Neanderthaloid skull has the extraordinary index of 66·2: no modern race can be found with a mean index less than 80. The order in which the foraminal indices arrange the races is one of peculiarly little suggestiveness. Buriats, Kaffirs and Zulus are less than 81; the Australian mean of 83·6 is close to the mean for all races and the highest means are shown by the Moriori and Maori.

Several height indices of the calvaria and the foraminal measurements entirely dissociate the archaic race from the homogeneous group of modern man and we can only conclude that the search for calvarial characters, whether absolute or indicial, which will serve to arrange the modern types in any order approaching one which might be supposed to indicate their primitive nature, or which will even show a closer approach to the Neanderthaloid characters for all modern primitive than for all modern advanced races, has hitherto proved a perfectly barren one.

6. *Measurements of the Facial Bones.*

Nearly all the facial measurements ordinarily taken can be given with accuracy for the La Chapelle skull, many are available for the Gibraltar specimen and a few for the La Quina adult, the Le Moustier adolescent and the Krapina *C* fragment. We may also use measurements of casts of the La Quina child's and the Galilee skull. It is evident that the facial skeletons of the adult individuals are greater than the mean types for all recent races of man, but extremely large individual modern skulls may be found which will equal, in one way or another, almost all the lengths of the Neanderthaloid specimens. Exceptions to that rule are found in the La Chapelle nasio-alveolar ($G'H$ = 87·8?) and basio-alveolar (GL = 124·8?) lengths, which are almost certainly well outside the distributions for all modern skulls. The queried $G'H$ of 78·5 may be given for the Gibraltar skull and 58·0 for the La Quina child. It is curious that both extremes of mean facial heights are shown by primitive races: the greatest are the Tibetans *B* (76·5), Moriori (76·2), Eskimo (74·9) and Northern Mongols, and among the smallest are the Veddahs (61·9) and almost all Negro types. The Australian height of 67·1 (Duckworth) is below the mean for all modern races. The proportion of the nasal height (NH')—Broca's measurement from the nasion to the base of the anterior nasal spine, so that it is in the same plane as $G'H$—to the facial height ($G'H$) is low for the La Chapelle (69·4) and Gibraltar (70·7) skulls*, indicating a proportionately great extension of the sub-nasal chord of the maxillae from nasal spine to alveolar point, but still lower

* The index for the La Quina child cast is 77·4, but it is evidently not comparable with measurements of adult skulls.

values are found for Zulus (68·0) and Angoni Negroes (69·0). The index is highest for Veddahs (76·1) and unsexed Tasmanians (74·9), and is decidedly high for the Moriori (74·0), Maori (74·2) and Australians (73·2—Duckworth).

The facial breadths available for a considerable number of modern races are the nasal (*NB*), the zygomatic (*J*), the breadth between the lowest points of the malar-maxillae sutures (*GB*) and the upper facial breadth, or internal biorbital, between the points where the fronto-malar sutures cross the external margins of the orbits (*IOW*). The last measurement can be given for several of the Neanderthaloid adult skulls and all, with the exception of the La Quina value*, are greater than the recorded ♂ means of modern races (see Table V). The nasal breadths of the La Chapelle (33·9) and Gibraltar (34·2) crania are close to, but probably greater than, the greatest recorded breadth for an individual modern skull: the greatest ♂ mean found is 28·1 for Burmese of the *A* type. Mean ♂ facial breadths *GB* greater than 100 mm. are only found for Oriental, Siberian and American races and for the Moriori who have a *GB* of 103·2 which is the greatest racial mean observed. The Gibraltar measurement of 96·0 is thus well within the range for *Homo sapiens* and the La Chapelle of 110·0 would only be equalled by extreme skulls. The uncertain zygomatic breadths of *circa* 152 for the La Chapelle skull and 148 for the Le Moustier specimen are equally extreme, as mean ♂ *J*'s greater than 140 are only shown for American and Siberian races and none exceed the Kalmuck breadth of 141·6. A comparison of indices expressing these facial breadths as proportions of one another reveals the fact that for the only two adult Mousterian skulls for which nasal breadths can be given those measurements are peculiarly great. The index 100 *NB/GB* is 30·8 for the La Chapelle specimen and 35·6 for the Gibraltar, while no racial means are found greater than 29·3. The proportion of the nasal breadth to the zygomatic breadth 100 *NB/J* is 22·3 for the La Chapelle skull, and the greatest mean found is 21·7 for unsexed Tasmanians†. The index 100 *NB/IOW* makes the same distinction, but the other inter-breadth ratios do not differentiate the Neanderthaloid skulls from the population of racial means.

The median sagittal section of the facial skeleton may be represented by the triangle of which the nasion, alveolar point and basion are the apices—the so-called fundamental triangle. It has already been observed that the three sides—*G'H*, *GL* and *LB*—are peculiarly large for the Neanderthaloid adult skulls both absolutely and in proportion to almost all other facial measurements. The very similar nasal, alveolar and basal angles of the La Chapelle and Gibraltar crania are very close to the mean for all modern races (Table X), so the shape of their fundamental triangles is in no way distinctive. The nasal angle arranges the modern races in a most suggestive order which might well be illustrative of their primitive status if the positions of the Moriori and Maori are ignored. The low nasal indices of these two seem to detach them entirely from the predominating Oceanic type. For the other groups of allied races the inter-racial variability is small. The practical identity of the Siberian and American types is a point of particular interest. While the nasal index increases as we pass from advanced to primitive races, both alveolar and basal angles decrease, though in a less regular way, and the two latter do not arrange the races

* For reasons given on p. 342 below the writer has concluded that the restoration of the fragmentary upper facial skeleton of the La Quina adult skull is too uncertain to give any reliable measurements.

† The indices expressing *NB* as a percentage of other facial breadths all arrange the modern races in substantially the same order as that given by the nasal index (see Table XI), so the ones standing nearest to the Neanderthaloid skulls are the prognathous races of Oceania and the Negroes, but the Maori, Moriori, Eskimo and other American races are not distinguished from Europeans. There appears to be a sexual difference for the index 100 *NB/J*. Considering only the series for which both ♂ and ♀ means are based on 40 or more crania, the ♀ indices all exceed the ♂ by the following amounts: Etruscans 0·12, Reihengräber 0·23, Bavarians 0·40, Aino 0·40, Egyptians of 26th–30th Dynasties 0·56, Badensians 0·86, New Caledonians 0·88, Czechs 0·92.

in nearly such suggestive orders as that given by the nasal angle. The inter-racial correlations between the three might be expected to be all negative, but the following are found for 53 series, taking only ♂ means based on 30 or more crania*:

$$N\angle \text{ and } A\angle: r = -\cdot 835 \pm \cdot 028,$$
$$N\angle \text{ and } B\angle: r = -\cdot 820 \pm \cdot 031,$$
$$A\angle \text{ and } B\angle: r = +\cdot 421 \pm \cdot 076.$$

The inter-racial standard deviations are:

$$N\angle: \sigma = 3\cdot 16 \pm \cdot 21; \qquad A\angle: \sigma = 2\cdot 06 \pm \cdot 14; \qquad B\angle: \sigma = 1\cdot 69 \pm \cdot 11\dagger.$$

It is clear that the nasal angle plays a rôle which clearly distinguishes it from the other two, and a statistically adequate study of the inter-racial correlations of the sides and angles of the fundamental triangle would promise to be a most interesting one. In spite of the discordant positions of the Moriori and Maori, the order in which the nasal angles arrange the racial types is apparently a more significant one than that given by any other single measurement, and the Neanderthaloid type has not that extreme character which distinguishes modern primitive races.

Table X. *Angles of the Fundamental Triangle. Male Means*[1].

	$N\angle$		$A\angle$		$B\angle$	
La Chapelle	69°·8		68°·4		41°·7	
Gibraltar restored cast (MacGregor)	67°·0		71°·5		41°·5	
La Quina Child (cast[2])	61°·5		81°·5		37°·0	
	Range	Mean	Range	Mean	Range	Mean
6 Slavonic Races	62°·4–65°·5	64°·1	71°·0–75°·6	73°·9	40°·6–43°·0	42°·1
Moriori	—	64°·8	—	71°·8	—	43°·4
15 Western European Races ...	61°·9–66°·5	65°·0	71°·5–75°·3	73°·3	40°·3–43°·2	41°·7
10 Egyptian Types	63°·9–67°·5	65°·3	71°·0–74°·1	73°·0	40°·9–43°·6	41°·7
8 Oriental Races[3]	65°·5–68°·2	66°·8	70°·1–76°·4	72°·1	36°·8–42°·6	41°·1
Maori	—	67°·0	—	72°·4	—	40°·6
2 Siberian Races	66°·8–68°·0	67°·4	69°·4–70°·2	69°·8	41°·8–43°·8	42°·8
4 American Races[4]	67°·9–69°·8	68°·5	67°·3–71°·2	69°·5	40°·9–42°·9	42°·0
Aino	—	70°·2	—	71°·2	—	38°·6
6 Negro Races	69°·3–73°·1	71°·0	68°·9–72°·8	70°·6	36°·5–39°·9	38°·4
Loyalty Islanders	—	71°·5	—	69°·0	—	39°·5
Telei (Solomon Islands) unsexed[1] ...	—	72°·0	—	68°·9	—	39°·1
Australians (Duckworth)	—	72°·2	—	69°·8	—	38°·0
Tasmanians unsexed[1]	—	72°·5	—	69°·5	—	38°·0
Australians (Pöch) unsexed[1] ...	—	72°·8	—	67°·7	—	39°·5
New Caledonians	—	75°·4	—	67°·0	—	37°·6
New British	—	75°·8	—	66°·3	—	37°·9

[1] All means given are based on 20 or more skulls and the majority are on more than 50 skulls. Measurements of a few unsexed series are included, the sexual differences for the longest series available being negligibly small if at all significant.

[2] The measurements of the fundamental triangle of this juvenile specimen are, of course, not comparable with those of adult skulls.

[3] Including the Veddah means: $N\angle = 66°\cdot 8$, $A\angle = 76°\cdot 4$, $B\angle = 36°\cdot 8$.

[4] Including the Eskimo means: $N\angle = 68°\cdot 1$, $A\angle = 70°\cdot 0$, $B\angle = 41°\cdot 9$.

It is found that the nasal index (Table XI) is also reasonably constant for members of the same family of races and, in spite of the association of the Moriori and Maori with the advanced types, the sequence provided by that character is of peculiar significance. It is very similar to the one given by the nasal angle, the change in position of the American races being alone marked. The

* Including two unsexed series: see footnote 1 to Table X.

† It should be realised that these inter-racial constants have no final value owing to the fact that the population from which they were drawn contains too great a proportion of European and Egyptian races.

♂ means of 48 races (all being based on 30 or more crania) together with the unsexed means of 4 others give the following inter-racial correlations*:

$$100\,NB/NH' \text{ and } N\,\angle: r = +\cdot747 \pm \cdot040,$$
$$100\,NB/NH' \text{ and } A\,\angle: r = -\cdot538 \pm \cdot067,$$
$$100\,NB/NH' \text{ and } B\,\angle: r = -\cdot706 \pm \cdot047.$$

Table XI. *Nasal and Facial Indices. Male Means*[1].

	100 *NB/NH'*			100 *G'H/GB*	
Gibraltar	61·6		Gibraltar	81·8?	
La Chapelle	55·7		La Chapelle	79·8?	
La Quina Child (cast)	51·4		—	—	
	Range	Mean		Range	Mean
Moriori	—	45·7	Moriori	—	74·1
5 American Races	[2]43·2–49·6	46·8	Eskimo	—	73·0
22 Western European Races ...	44·7–48·7	47·4	16 Western European Races ...	69·5–78·9	74·8
4 Slavonic Races...	47·1–48·8	47·7	6 Slavonic Races...	72·2–76·8	74·7
Maori	—	48·6	—	—	—
12 Egyptian Types	47·9–51·1	49·6	11 Egyptian Types	72·3–76·8	74·0
2 Siberian Races	48·9–51·4	50·2	2 Siberian Races	68·8–72·5	70·7
10 Oriental Races	45·9–53·5	50·5	8 Oriental Races	67·6–75·2	71·0
Ainos	—	51·4	Aino	—	68·4
Papuans (Mantegazza)	—	52·9	—	—	—
Filipinos: Negritos	—	53·7	—	—	—
Filipinos: Non-Negritos ...	—	54·3	—	—	—
New British	—	54·7	New British	—	71·3
New Caledonians	—	54·8	—	—	—
Telei (Solomon Islands) unsexed[1]	—	55·5	Telei (Solomon Islands) unsexed	—	68·0
Australians (Duckworth) ...	—	55·6	Australians (Duckworth) ...	—	71·5
Australians (Pöch) unsexed[1] ...	—	56·7	Australians (Poch) unsexed ...	—	71·7
6 Negro Races	55·9–58·1	56·8	6 Negro Races	66·9–72·2	69·7
Tasmanians unsexed[1]	—	59·6	—	—	—

[1] All means given in the table are based on 20 or more skulls and the majority are of more than 50 skulls. Measurements of a few unsexed series are included, the sexual differences for the longest series available being negligibly small if at all significant. The nasal indices given are those deduced from Broca's height (*NH'*) measured from the nasion to the base of the anterior nasal spine which is usually slightly less than the Frankfurt height from the nasion to the lowest point on the border of the pyriform aperture (*NH*, *R* or *L*). The equation $100\,NB/NH' = 100\,NB/NH\ (R \text{ or } L) + 0{\cdot}7$ was used to find Broca's index where only the Frankfurt had been given. The difference of 0·7 is that found between the indices of 81 ♂ Farringdon St. English skulls.

[2] The mean for 190 ♂ Eskimo skulls.

The two Neanderthaloid skulls, having nasal angles close to the mean for all races and nasal indices as great as those of the extreme primitive types, appear to be dissociated from the homogeneous modern population by such a combination of characters but far more data would be needed to establish such a supposition. As intra-racially, so there is an appreciable negative inter-racial correlation (see Table XI) between the nasal ($100\,NB/NH'$) and facial ($100\,G'H/GB$) indices due, in all probability, to the fact that the component lengths "cover" one another. But the facial index is slightly, if at all, correlated with the angles of the fundamental triangle and the range for European races is almost as great as for all modern races so it is a most uncertain criterion of the primitive nature of a type.

The Mousterian skulls, having nasal and facial indices that are both large, fall well away from the swarm of points on the inter-racial correlation table for the two indices, and they are not closer to primitive than to advanced types. The La Chapelle facial index formed by using the zygomatic in

* It may be noticed that the nasal index and the angles of the fundamental triangles are partly influenced by a common factor as the nasio-alveolar chord covers the nasal height.

place of the GB breadth (100 $G'H/J$ = 57·8) also just exceeds all the racial means; the greatest found is 57·6 for an Egyptian series and the smallest are for Negro and prognathous Oceanic races.

It is curious that several writers have laid emphasis on the supposed large size of the orbital cavities of Mousterian man; implying that they are both absolutely and proportionally larger than for *Homo sapiens*. A comparison of the measurements fails entirely to confirm this supposition. The few available are given in Table XII.

Table XII. *Orbital Measurements of Neanderthaloid Skulls*[1].

	Orbital Length		Orbital Height		Orbital Indices	
	Right O_1R	Left O_1L	Right O_2R	Left O_2L	100 O_2/O_1, R	100 O_2/O_1, L
La Chapelle ...	46·9	46·7	37·1	37·2	79·1	79·7
La Quina	—	—	36·0?	37·2?	—	—
Galilee (cast) ...	44·2	—	34·9	—	79·0	—
Gibraltar	46·1	44·7	38·9?	37·9	84·4?	84·9
Krapina C[2]	42	—	38	—	90·4	—
La Quina Child (cast)	33·9	38·9	35·9	31·1	105·9	79·9

[1] In the writer's opinion the orbital measurements of the Le Moustier skull are too uncertain to be of any value.

[2] Measurements given by Gorjanović-Kramberger (1906), p. 102.

The orbital lengths of the Neanderthaloid skulls are of the same order as the greatest ♂ racial means, the greatest observed being 44·0 for Tibetans of the B type and 44·2 for Burmese A. The heights are not more exceptional as ♂ means greater than 36·0 are given for Eskimos (36·3), Tibetans of the B type (36·5) and the Moriori (37·0). The smallness of the orbital measurements in proportion to almost all others of the facial skeleton is, indeed, a feature on which some stress may be laid. It will suffice to consider the ratio of orbital height (O_2L) to the nasio-alveolar chord ($G'H$). That is 42·4 for the La Chapelle skull and 48·3 for the Gibraltar, while for 51 races the lowest ♂ mean found was 42·3 (1st Dynasty Egyptians) and the highest 54·6 (Congo Negroes). The orbital indices of the Mousterian skulls are not peculiar: advanced types such as 1st Dynasty Egyptians (78·2), Burmese A (79·1), Nepalese (79·3), Whitechapel English (77·7) and Anglo-Saxons (78·3) have the lowest ♂ means and among the races with the roundest orbits are the Eskimo (85·0), Kalmucks (85·2), Aino (85·3), Moriori (87·7) and Maori (86·1). The Negro races have intermediate indices.

There is not a single Mousterian skull on which both dacrya can be located with any certainty. The La Chapelle dacryal chord is about 23·0 which is close to the ♂ mean for all modern skulls and hence small in proportion to almost all other facial measurements. The least breadth of the two nasal bones—the simotic chord (SC)—is approximately 13·8 on the cast of the Galilee skull fragment and 13·9 on the Gibraltar skull. The greatest mean recorded appears to be 11·45 for 17 ♂ Nubian skulls*. The simotic subtense (SS)—that being the greatest subtense to the SC chord—can only be given for the Gibraltar skull, its measurement of 4·4 being somewhat doubtful†. The resulting simotic index (100 SS/SC) of 31·7 is within the modern range of mean values, the lowest being 25·6 for Negroes (*loc. cit.*) and the highest 50·8 for the Whitechapel English.

Not one of the Mousterian skulls possesses a complete palate. The widths between the inner alveolar walls of the second molars (G_2) are 43·8 and 50·0 for the La Quina and Le Moustier

* Given by Ryley, Bell and Pearson: "A Study of the Nasal Bridge in the Anthropoid Apes and its Relationship to the Nasal Bridge in Man," *Biometrika*, Vol. IX, 1913, pp. 392–445.

† The Krapina C skull would furnish simotic measurements but none have yet been given. Its nasal bones are broad and flat and apparently very similar to those of the Gibraltar skull.

specimens respectively. For the Gibraltar skull the same measurement is approximately 45·0 and the La Chapelle reconstructed palate gives 50·7. The greatest ♂ mean observed is 43·6 for Tibetans of the *B* type, so the Neanderthaloid skulls have palates that are broader than those of modern man, but the breadths are not peculiarly great in proportion to others of the facial skeleton. The commonly taken palate lengths cannot be given for any of these imperfect crania*. The depth of the palate below the chord joining the mid-points of the inner alveolar rims of the second molars (*EH*) is 11·7 for the Le Moustier skull. Both greater and smaller means have been found for ♂ series of modern skulls. But the index 100 EH/G_2 has the low value of 23·4 for the Neanderthaloid skull, indicating a more shallow palate than that of any of the available types.

One other facial measurement may be commented on. The profile angle—i.e. the angle between the Frankfurt horizontal plane and the line joining the nasion to the alveolar point—is 87°·9 measured on the sagittal contour of the restored La Chapelle cast and 89°·3 for the McGregor's restored Gibraltar cast†. Among modern races the greatest profile angles are all shown by European types and no mean is found greater than that of 88°·7 for ♂ Basques. So measured in that way, the Neanderthaloid skulls are as orthognathous as any advanced modern types, while they are clearly distinguished from the modern primitive prognathous races.

It will be convenient to summarise the conclusions arrived at from a comparison of facial measurements.

(*a*) The facial skeletons of the Neanderthaloid skulls are distinctly larger than those of any modern types, and one or two selected measurements of the largest specimens exceed the greatest observed for any individual modern skull.

(*b*) Their nasal breadths are peculiarly great in proportion to other facial breadths and heights.

(*c*) They have facial indices (100 $G'H/GB$) as great as any means observed and are, at the same time, as platyrhine as any modern races.

(*d*) Measured by the nasal angle they are mesognathous, and by the profile angle orthognathous.

(*e*) Their orbital cavities are *small* in proportion to other parts of the facial skeleton but the indices are not distinctive.

(*f*) Their nasal bones are peculiarly broad and flat.

(*g*) Several facial indices and angles—notably the nasal angle and the nasal index—are capable of arranging all modern types in orders which indicate, in a rough way, the intensity of their primitive nature and which appear to serve that purpose far better than any calvarial measurements. For some such, the Mousterian skulls are classed with the most primitive types, but for others, they are not distinguished from the intermediate and advanced races. Numerous fairly high correlations—many of them being spurious—are found between facial direct and indirect measurements and in almost every case the points on the regression diagrams for the archaic skulls fall clearly away from the swarm of points representing the modern races.

(*h*) The above relationships appear to dissociate the Neanderthaloid skulls from the homogeneous group of modern man, but it cannot be said that the *ensemble* of their facial characters is more similar to the primitive than to the advanced type. There seems, in fact, to be no closer resemblance between the archaic type and any one modern race than between the archaic type and any other modern race.

* When excavated by Hauser the bony palate of the Le Moustier skull was complete and it was still intact when Klaatsch made his first restoration of the skull. In its present form the posterior nasal spine and a considerable part of the hinder edges of the palate bones are defective.

† For the cast of the juvenile La Quina child the profile angle is 91°·9, but it ought not to be compared with measurements of adult skulls.

(*i*) Finally, it may be noted that the fragmentary remains of the facial skeletons of Mousterian man known to us resemble one another remarkably closely, so that the sample may reasonably be considered to be specifically and even racially homogeneous.

7. *The Proportions of Facial and Calvarial Measurements.*

In comparing skulls of the Neanderthaloid type with the modern population, the relatively great size of the facial skeleton at once arrests attention as being a character which will clearly distinguish the archaic specimens. Measurements taken in the median sagittal plane can be most conveniently compared. It has been shown that the facial chords of that section are peculiarly great in proportion to facial breadths for the La Chapelle and Gibraltar skulls, while the calvarial section, though having a great length, is of small circumference. The proportions of the facial heights from nasion to alveolar point ($G'H$) and lengths from alveolar point to basion (GL) to the glabella-occipital lengths are uniquely great for the two Mousterian skulls, while both extremes for the modern population are shown by primitive peoples for the index $100\,G'H/L$. But a far more suggestive measurement is given by the area of the fundamental triangle of which the apices are the nasion, alveolar point and basion. Male means for 51 races are compared with the areas of Neanderthaloid skulls in Table XIII, and the greater size of the latter places them entirely outside the modern range. Supposing that the area of the calvarial section is proportional to the square of the sagittal arc from nasion to opisthion (S), it may be compared with the facial area as in column 4 of the table, and the La Chapelle and Gibraltar skulls become still more markedly differentiated. The proportion of the facial to the calvarial area arranges the modern types in a more suggestive order than does the absolute size of the facial triangle. The races having facial sections relatively greatest and hence nearest to the extreme type of the Mousterian skulls are, in order, the Siberian races, Moriori, American races and Aino, and they are precisely those

Table XIII. *The Area of the Median Sagittal Section of the Facial Skeleton. ♂ Means.*

	Area of Fundamental Triangle A	Arc Nasion to Opisthion S	$100\,A/S^2$
La Chapelle	5095	355·3	4·04
Restored Gibraltar cast (McGregor)	3905	343·0	3·32
La Quina Child (cast)	2516	—	—
Moriori	3559	372·2	2·57
Mean of 4 American Races	3493	373·1	2·51
Loyalty Islanders	3492	386·9	2·33
Ainos	3462	372·8	2·49
Tibetans *B*	3458	378·6	2·45
New Caledonians	3432	374·4	2·45
Kaffirs	3429	380·8	2·36
Mean of 4 Siberian Races	3426	361·6	2·62
Maori	3421	378·1	2·39
New British	3355	374·3	2·39
Zulus	3328	372·4	2·40
Cameroon Negroes	3240	365·4	2·43
Australians (Duckworth)	3236	371·0	2·35
Mean of 5 Oriental Races	3210	365·0	2·38
Mean of 6 Egyptian Types	3206	372·3	2·31
Mean of 10 Western European Races	3200	371·1	2·34
Filipinos: Non-Negritos	3189	372·1	2·30
Gaboon Negroes	3146	364·3	2·37
Mean of 6 Slavonic Races	3142	363·4	2·38
Filipinos: Negritos	3137	360·4	2·42
Congo Negroes	2917	361·8	2·23
Veddahs	2788	363·1	2·11

which are distinguished from other primitive types by having small nasal angles (cf. Table X) and low nasal indices (cf. Table XI). The platyrhine and prognathous races of Oceania and the Negroes are hardly distinguished from advanced races in this respect. The inter-racial distributions of these characters seem to be perfectly continuous and, as far as we can tell, uni-modal.

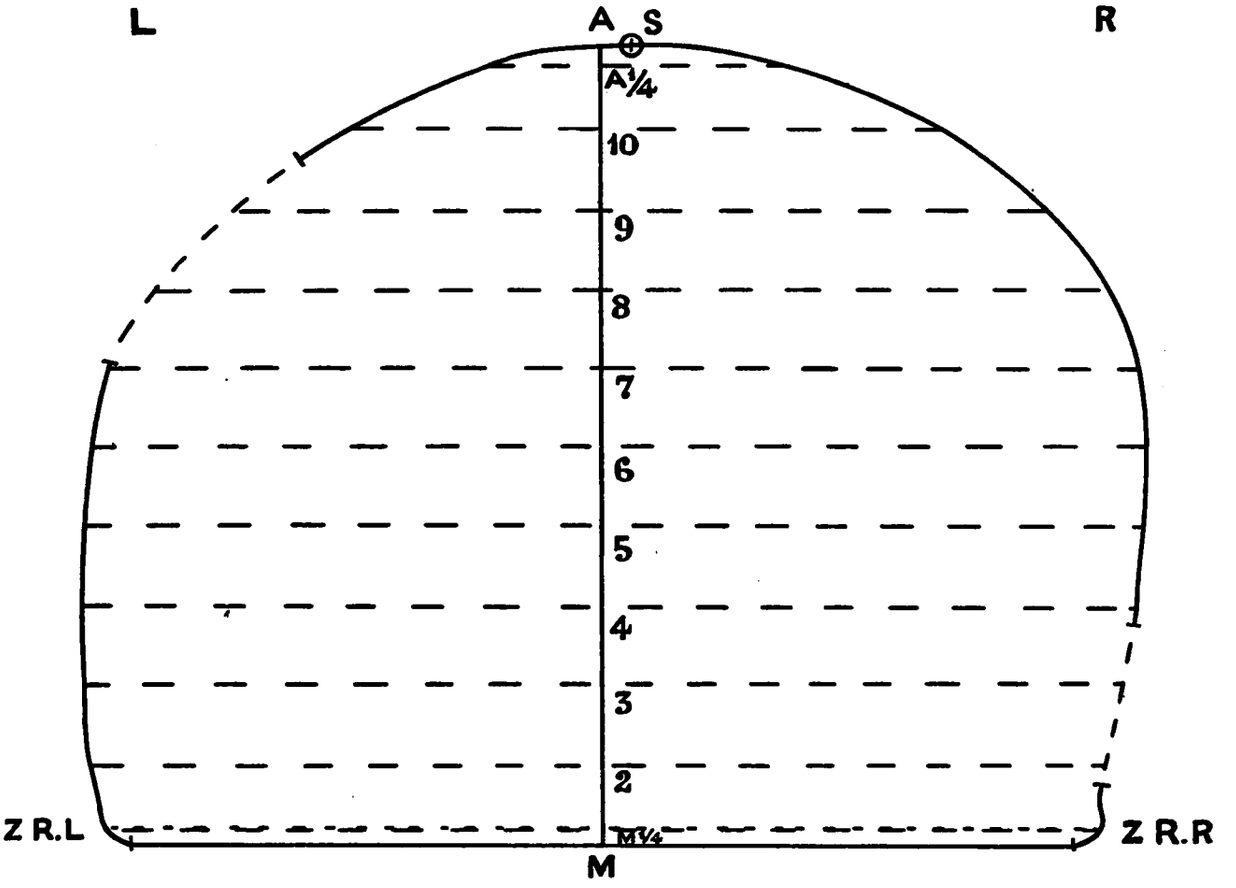
It has been observed that the proportions that calvarial breadths bear to one another and the proportions that facial breadths bear to one another are indices which do not, in general, distinguish the Neanderthaloid skulls from all modern types, and neither do they furnish criteria which can be supposed to indicate the primitive nature of a modern race. Exceptions are found in the biasterionic breadths which are great in proportion to other calvarial breadths, and the nasal breadths which are great in proportion to other facial breadths, but there is no suggestion that the same characteristics will serve to differentiate between primitive and advanced modern types. Having examined in detail the relations of facial to calvarial breadths, we may say with confidence that, with some few exceptions, the proportions of facial to calvarial transverse diameters do not distinguish the Lower Palaeolithic skulls. The sole exceptions are dependent on the fact that their nasal breadths are peculiarly large in proportion to all calvarial, as well as to other facial, breadths, while the biasterionic diameter bears a peculiarly large proportion to the zygomatic breadth but not to other facial breadths. It has often been stated that primitive modern races are characterised by having prominent zygomatic arches. Measuring that feature by the ratio of the zygomatic to the parietal breadth ($100\,J/B$), it is found to be exaggerated for all the prognathous races of Oceania and least emphasized for the European and Egyptian types, but Negro races are not distinguished from many advanced ones. The ♂ means range from 89·7, found for two European brachycephalic races*, to 105·0 for Loyalty Islanders, while the somewhat doubtful La Chapelle and Le Moustier indices are 97·2 and 98·6 respectively†. The horizontal measurements of the facial bones of the Neanderthaloid skulls appear to bear the same proportions to the horizontal measurements of the calvaria as for *homo sapiens*, and the horizontal sections of the skull considered as a whole are remarkably similar in shape, though not in size, for the two species. The most profound differences are found between the median sagittal sections and it would be easy enough to devise combinations of measurements not considered above which will serve to differentiate the archaic skulls from the distributions for modern man. Such, for example, are the indices formed by expressing the basio-alveolar length as a percentage of the glabella-occipital length—$100\,GL/L$, a measure highly correlated with the nasal angle—and the facial height as a percentage of the basio-bregmatic height ($100\,G'H/H'$), but the elaboration of differentiating criteria of that kind can be of little further value. It is the peculiar combination of a number of characters, all aberrant when compared with modern man, which dissociates the Neanderthal type entirely from the modern relatively homogeneous population. To conclude this comparison of direct measurements and the indices and angles deduced from them, we may recall the fact that the facial measurement which provides the most satisfactory criterion of the primitive nature of a racial type is the nasal angle, while no calvarial measurement performs the same function so effectively; a suggestive order is, however, given by the index $100\,L/S$. Between $N\angle$ and $100\,L/S$ an inter-racial correlation of $-0{\cdot}024 \pm {\cdot}099$ is found for 45 races and it cannot be said that the points in the swarm representing modern races nearest to the points for the Neanderthaloid skulls which lie right outside it are more primitive in type than the others.

* The inter-racial correlation between $100\,J/B$ and $100\,B/L$ is not high.

† The very doubtful La Quina index is 91·5.

8. *The Transverse Vertical Section.*

Drawings of the transverse vertical contours of the original Spy I and II and the Le Moustier skulls were made with the Klaatsch contour tracer in the way commonly practised in the Biometric Laboratory. For the La Chapelle and La Quina adult and juvenile skulls projections of casts can be given and it must be remembered that they are slightly greater than the original specimens.



S = crossing of sagittal suture

— — — reconstructed surfaces of skull

Fig. I. Transverse Contour of a Cast of the La Chapelle Skull.

The transverse contour of McGregor's greatly restored cast of the Gibraltar skull is also given though its measurements are of less value. The section is one through the auricular points perpendicular to the Frankfurt horizontal plane. From the sagittal contours, it was found that the transverse vertical plane cuts the sagittal suture 34 mm. behind the bregma on the La Chapelle cast and 30·5 behind it on the Le Moustier skull. On the Spy skulls the horizontal cannot be directly determined owing to the defect of the facial skeletons and the points were chosen

arbitrarily 34 mm. behind the bregma. For the supposed ♀ La Quina cast the transverse vertical section was drawn through a point 30 mm. behind the bregma. The planes determined in that way are probably very close to the true vertical ones and an error of 2 or 3 mm. in the placing of the apex would make hardly any difference to the outlines. The contours (Figs. I–VII) were divided up in the usual way by bisecting the auricular axis at right angles (*MA*) and drawing parallels to it, dividing *MA* into 10 equal parts.

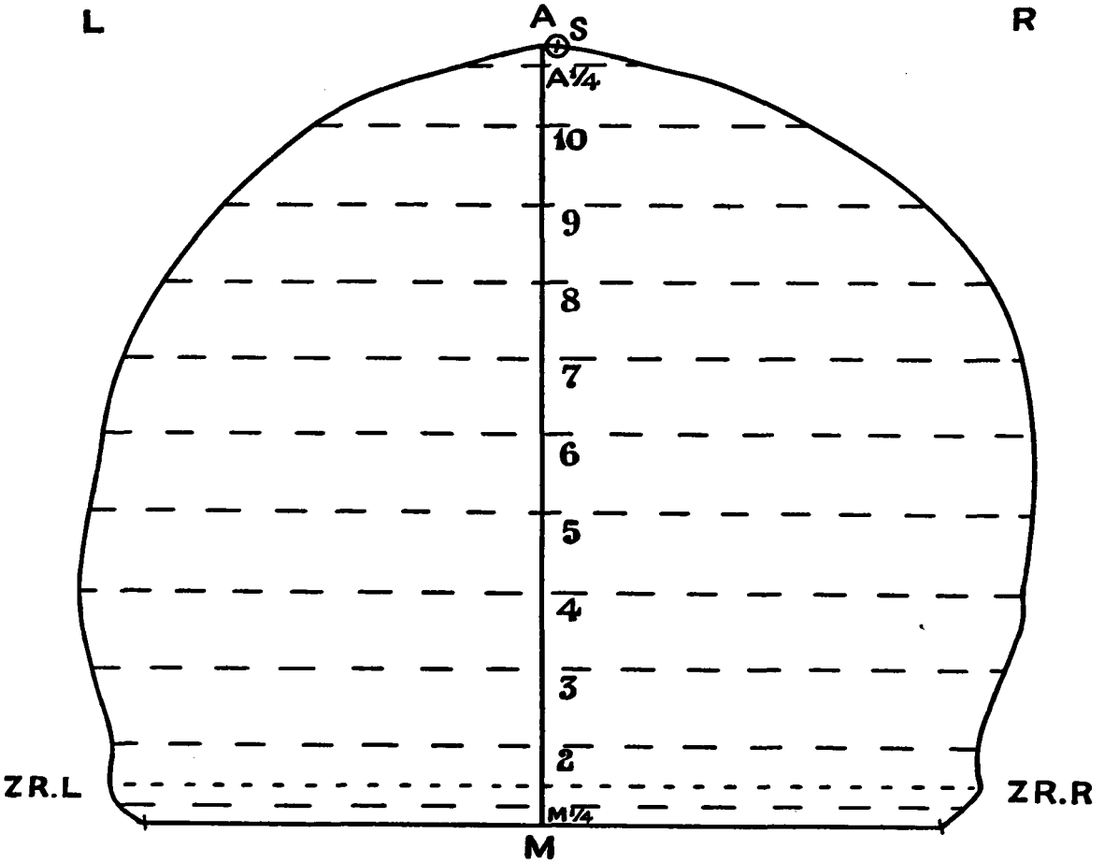
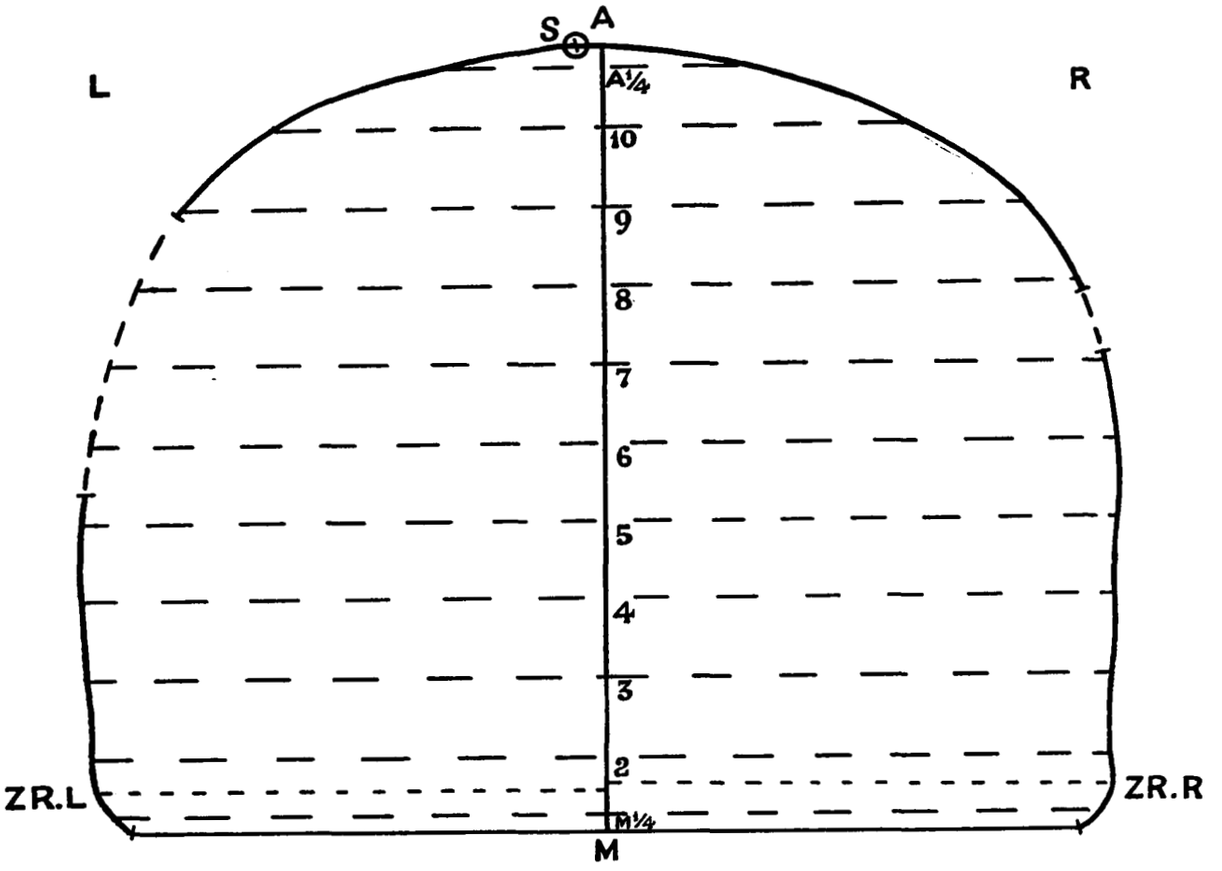


Fig. II. Transverse Contour of a Cast of the La Quina Skull.

In general appearance the La Chapelle, Le Moustier, Spy II and Gibraltar outlines are remarkably similar, being distinguished from type contours for modern races by their more vertical walls and flatter vaults. But the La Quina and Spy I have those characters less accentuated and, in the writer's opinion, this is due, in the case of the former at least, to the fact that the temporal bones as reconstructed are too close to one another. Owing to the complete absence of the bases of these two skulls, the positions of the temporal fragments could not be determined with any certainty whatever, and they could as easily have been placed to give more vertical calvarial

walls similar to those of the La Chapelle skull which is the only Neanderthaloid specimen as yet fully described having an almost complete base.

Comparable type contours for modern races have been given for series of skulls studied by workers in the Biometric Laboratory and published in various papers in *Biometrika* but the material is extremely meagre compared with that used in the earlier part of this paper. For all



S = crossing of sagittal suture

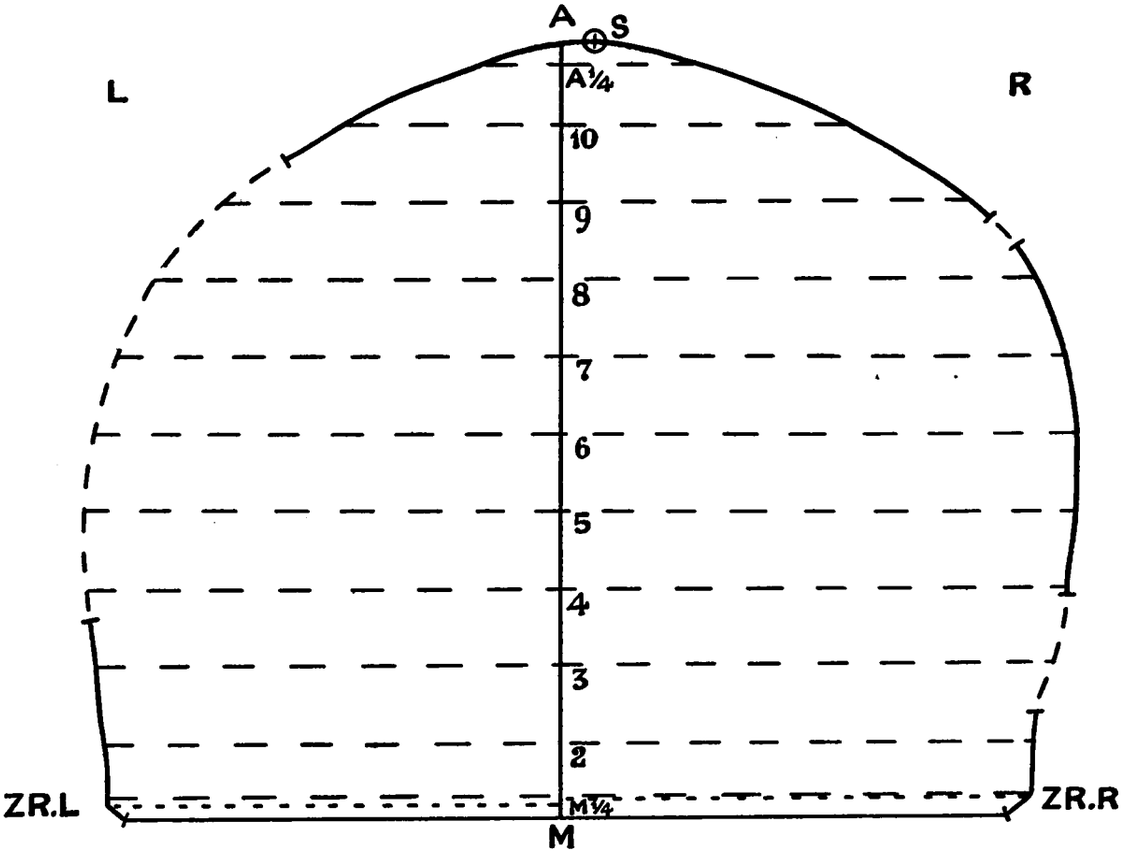
– – – – reconstructed surfaces of skull

Fig. III. Transverse Contour of Le Moustier Skull.

available transverse types it has been found that the greatest breadths parallel to the auricular axes lie between the 4th and 6th parallels and almost all are between the 4th and 5th. The greatest breadths of sections of the Neanderthaloid skulls are all closest to the 5th parallel. The six adult specimens have auricular widths exceeding their auricular heights as is usual for modern skulls. Their indices expressing the height as a percentage of the width are: Gibraltar cast 81·1, Spy II 83·9, Le Moustier 84·1, La Chapelle cast 86·3, Spy I 88·8?, La Quina cast 98·3??* and the following

* The index for the cast of the skull of the La Quina child is 108·8, but that is evidently not comparable with measurements of adult skulls.

values can be given for ♂ type contours: Eskimo 89·2, Whitechapel English 91·1, Guanches 91·8, Tibetans *B* 93·3, Farringdon St. English 93·8, Egyptians of the 26th–30th Dynasties 93·9, Tibetans *A* 95·5, 1st Dynasty Egyptians 96·6, Congo Negroes (1864 Series) 97·3, Anglo-Saxons 97·6, Burmese *A* 98·6, Nepalese 99·6*†. The order in which the modern races are arranged is not a suggestive one, but there is a clear distinction between the Mousterian skulls and all modern types



S = crossing of sagittal suture

– – – – reconstructed surfaces of skull

Fig. IV. Transverse Contour of Spy Skull N°I

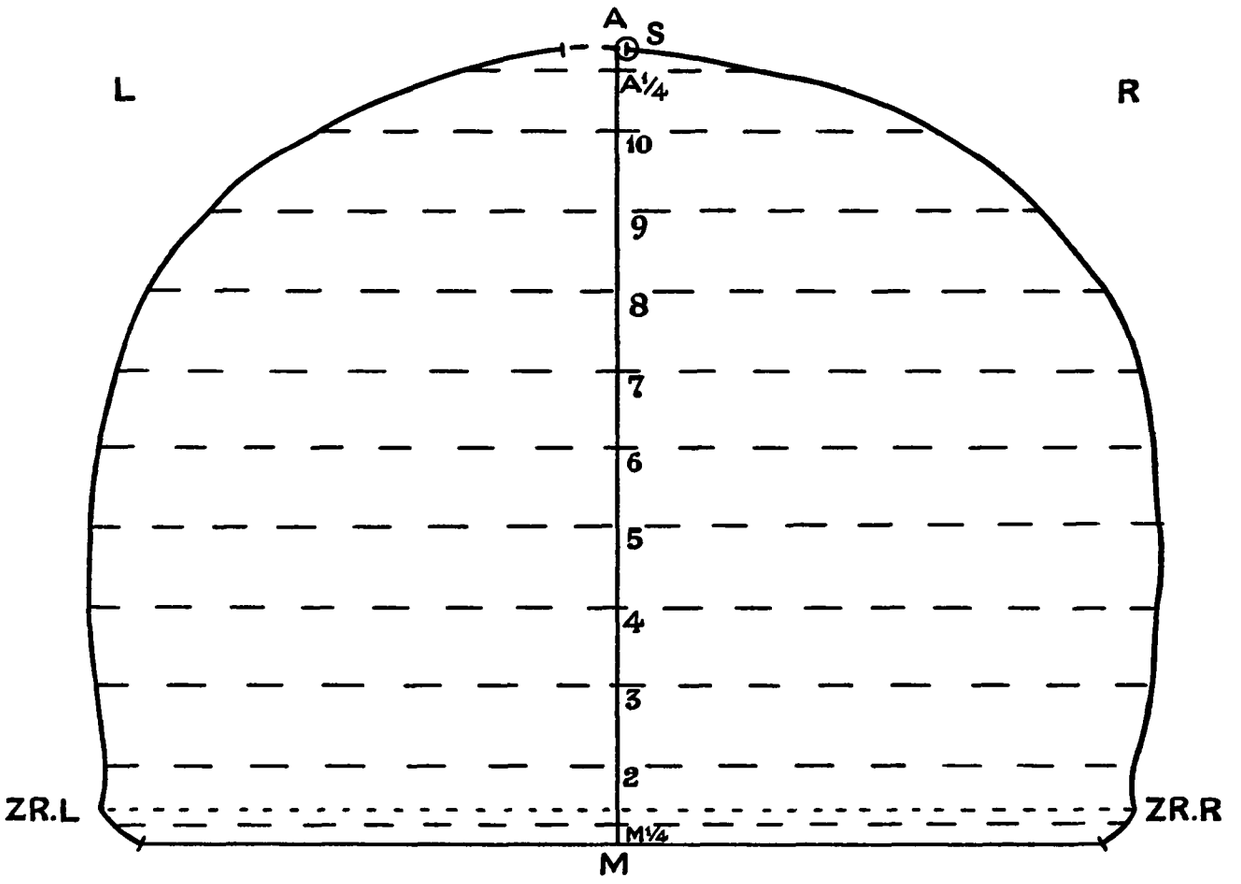
and the same was found when comparing the ratios of the similar direct measurements of basio-bregmatic height and parietal breadth.

The flattening of the transverse section of the vault is another character of particular interest which can be measured with the aid of this contour. The ratio of the total length of the 7th

* For references to papers in which the type contours are given see p. 379.

† The following ♂ and ♀ values are found for these indices: Farringdon St. English ♂ 93·8 (75), ♀ 95·5 (67); Anglo-Saxons ♂ 97·6 (32), ♀ 100·0 (31); Burmese *A* ♂ 98·6 (44), ♀ 98·4 (38). The first two would suggest a clear sexual difference, but it is curious that the third does not confirm it.

parallel to the distance of that parallel from the apex *A* gives the following indices*: Gibraltar cast 30·5, La Chapelle cast 31·4, Spy II 31·6, Le Moustier 32·2?, Spy I 33·1?, La Quina child cast 34·2, La Quina cast 35·3?? and for ♂ type contours: Farringdon St. English 34·1, Guanche 34·2, Egyptians of the 26th–30th Dynasties 34·4, Congo Negroes (Batetelu) 34·4, Burmese *A* 34·5, 1st Dynasty Egyptians 34·5, Anglo-Saxons 34·9, Congo Negroes (Fernand Vaz 1880) 35·0, Congo



S= crossing of sagittal suture

— — — — reconstructed surface of skull

Fig. V. Transverse Contour of Spy Skull No II

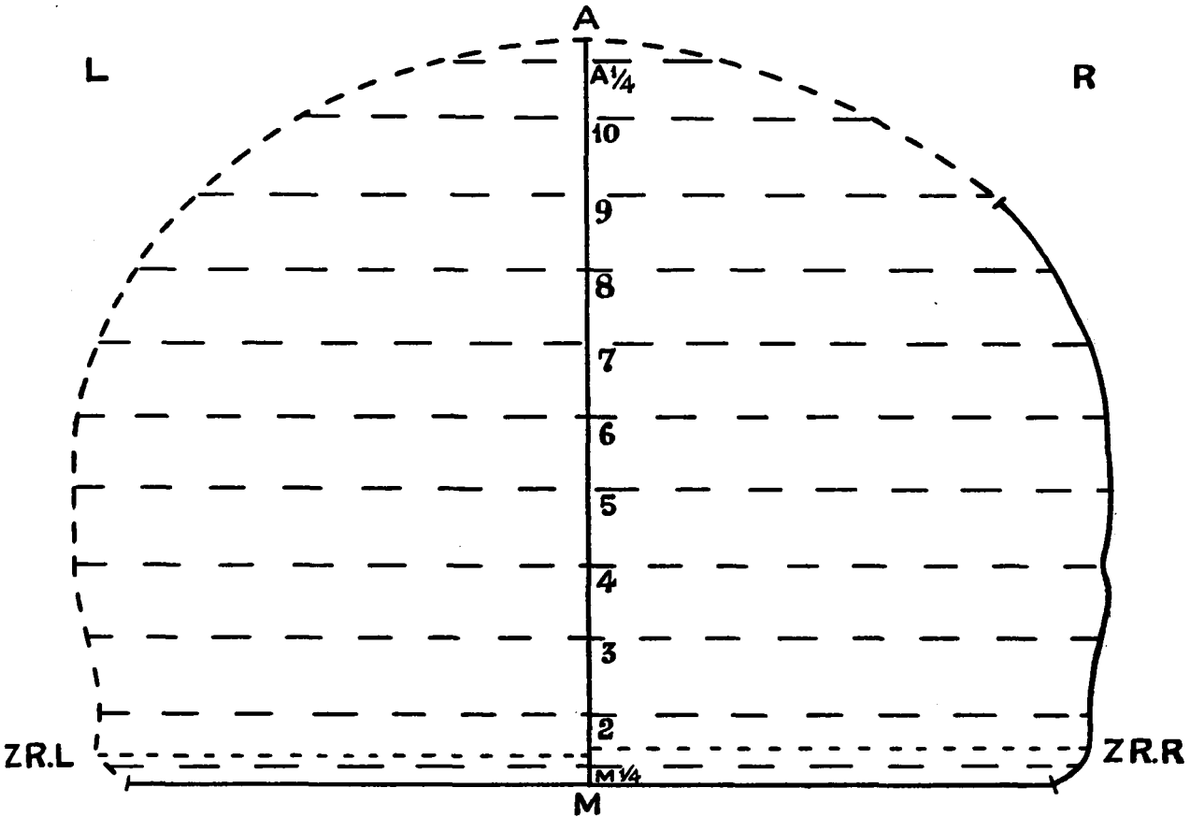
Negroes (Fernand Vaz 1864) 35·5, Hokien (Chinese) 35·2, Tibetans *A* 35·5, Tibetans *B* 35·8, Tamil 36·4, Eskimo 36·8, Nepalese 37·5†. While the transverse flattening of the Neanderthaloid brain-box distinguishes the type from those of all modern races, as does its flattening in the sagittal plane, the same character does not seem to make a distinction between modern primitive and advanced races.

* The Neanderthal skull cap appears to be quite as flattened transversely as the La Chapelle and Spy skulls as can be seen from the photograph in *norma occipitalis* provided in the plates. The transverse contour cannot be drawn as both temporal bones are missing.

† The sexual difference for this index would seem to be negligibly small if at all significant.

9. *The Glabella Horizontal Section.*

The horizontal contour is drawn through the glabella parallel to the Frankfurt horizontal plane. The drawings taken of the La Chapelle, Gibraltar, La Quina child and La Quina adult casts and of the original Neanderthal and Spy I and II skulls are reproduced in Figs. VIII–XIV*. The gamma—i.e. the occipital point in the median sagittal plane on the horizontal plane through the nasion—was determined from the sagittal section in the case of the first three and orientation



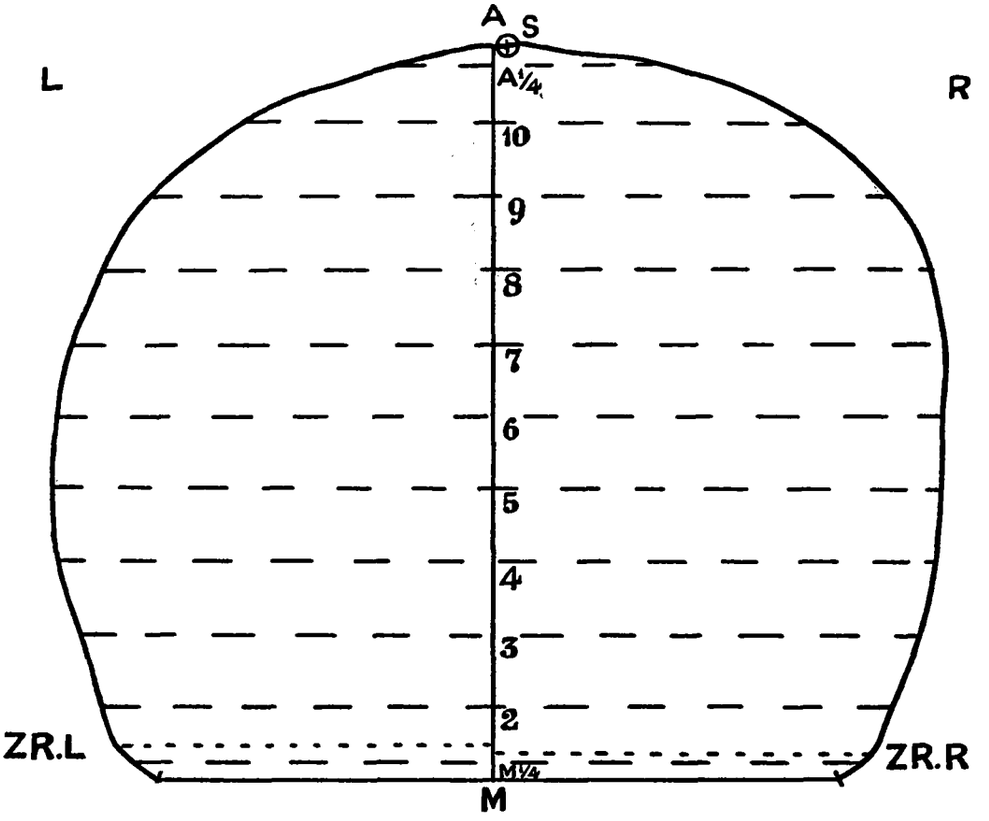
– – – – reconstructed surface of cast

Fig. VI. Transverse Contour of Mc Gregor's restored Cast of the Gibraltar Skull.

was made by making both the nasio-gamma and the auricular axes parallel to the drawing-board. On the La Chapelle cast the gamma was found to be 17 mm. above the inion and points at the same distance above the inion were accepted as arbitrary gammas to give an approximate orientation in the case of the Neanderthal and the two Spy skulls. For the case of the La Quina adult specimen the gamma was chosen 15 mm. above the inion. We may feel confident that the contours of these four represent sections which are very approximately parallel to the standard plane. The points

* The horizontal contour of the original Le Moustier skull could not be drawn as the specimen is fastened to a wooden support.

ordinarily marked on the contours are the glabella (F), the points where the temporal ridges are crossed (T_R and T_L) and a point O vertically below the lambda. In measuring individual drawings the axis FO is accepted as a base line and it is found to divide the type contour into two equal parts. Owing to the rather marked asymmetry of the La Chapelle and La Quina specimens, those axes do not bisect the sections though that would seem to be due less to the true asymmetry of the outlines than to the disharmonic positions of the points. Accordingly other axes were con-



S= crossing of sagittal suture

Fig. VII. Transverse Contour of a Cast of the La Quina Child's Skull.

structed in the following way to give base lines more comparable with those of the symmetrical type contours. The method also provides an axis for the Spy skull No. II on which the glabella region is defective. The mid-point of the chord $T_R - T_L$ was joined to the mid-point of the greatest diameter parallel to that chord and the points (F' and O') where that axis meets the outline are the terminals of the accepted base-line. The $F'O'$ axis was divided into 10 equal parts in the usual way and the lengths of the parallels right and left of $F'O'$ are perhaps as nearly equal as any axis would make them. On the contour of the La Chapelle cast a point I' is marked above the inion. For the other specimens, having more symmetrical occiputs, the inions are vertically below the lambdas, so both are represented by the same point on the section.

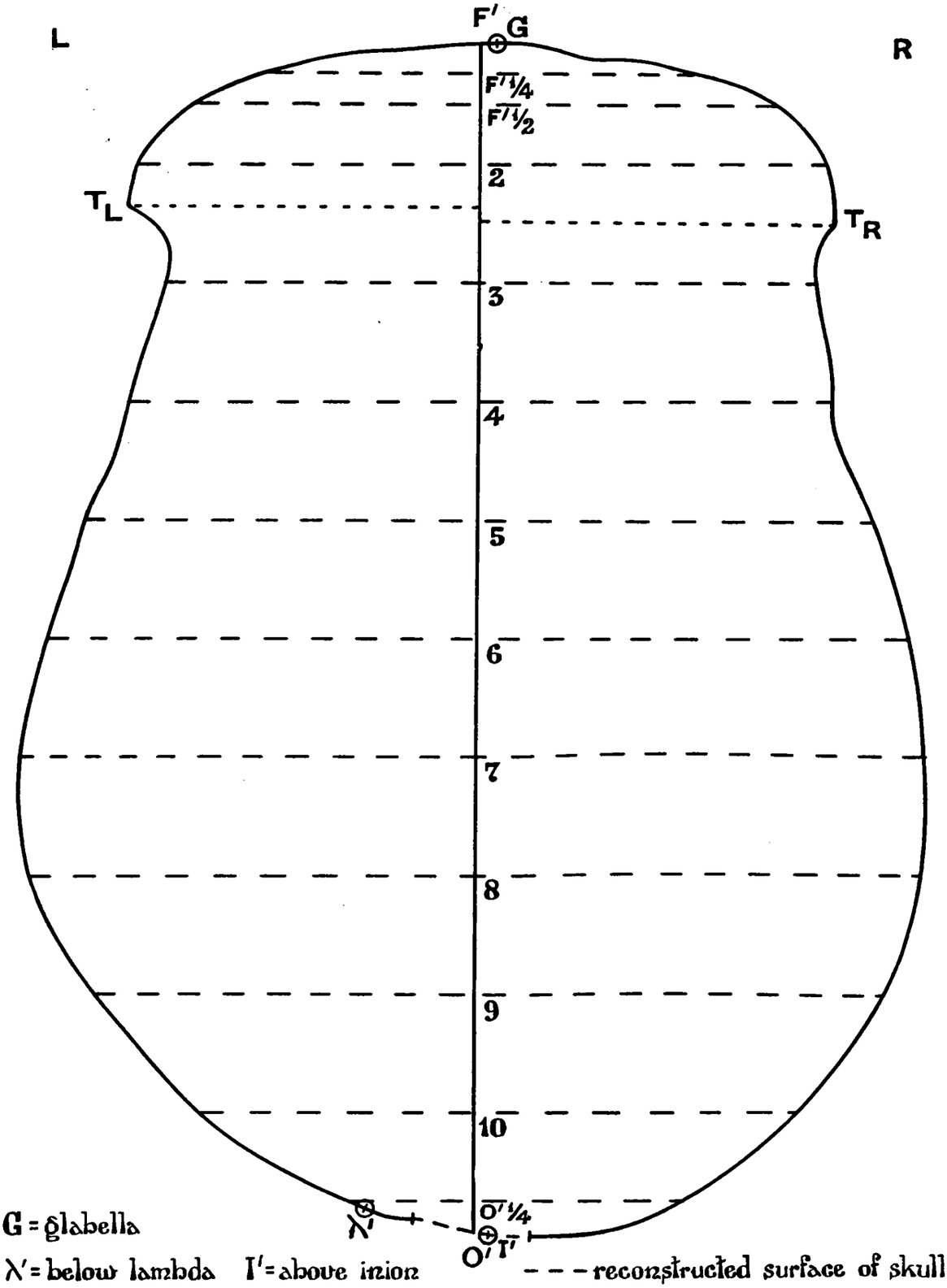
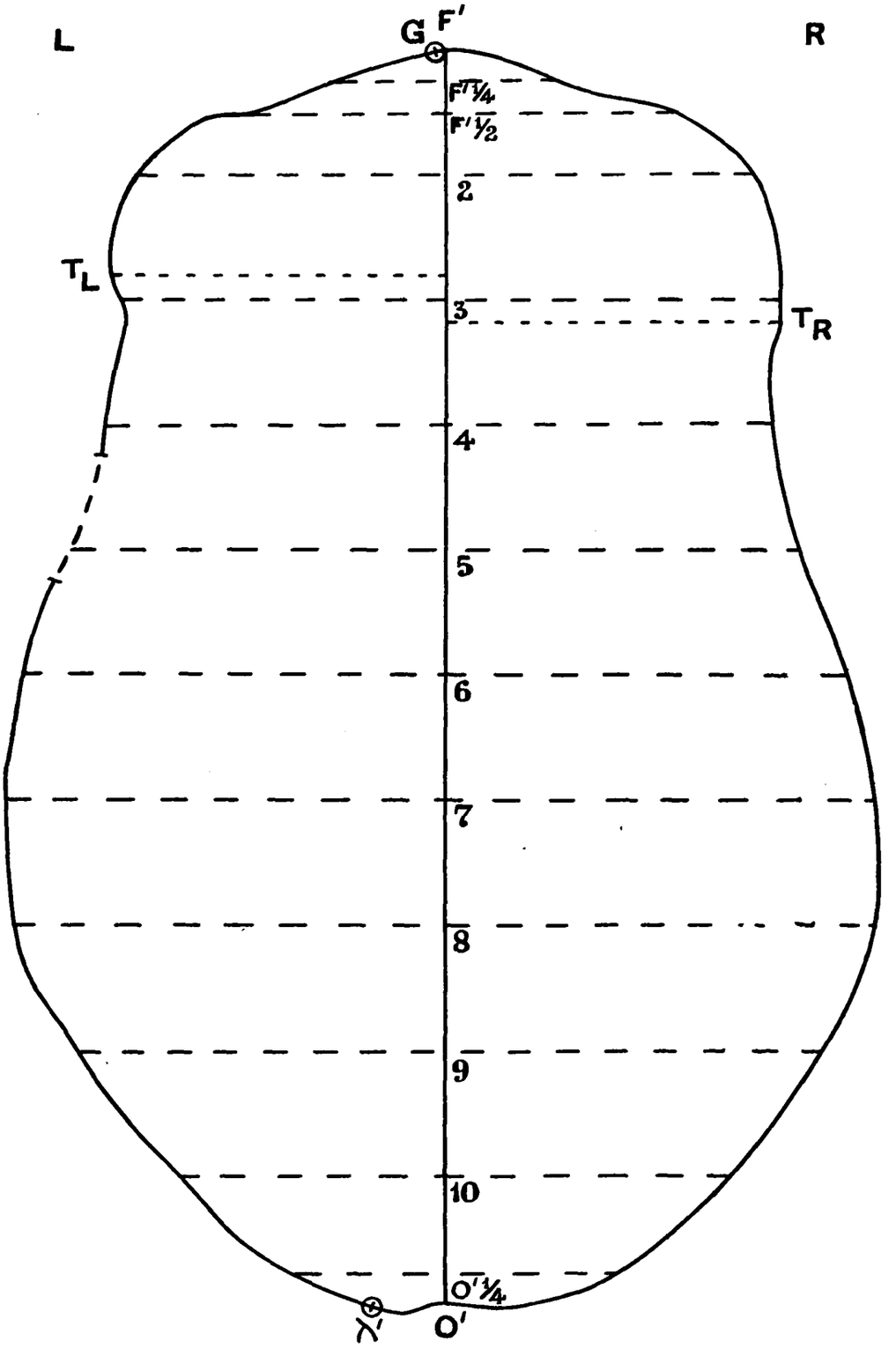
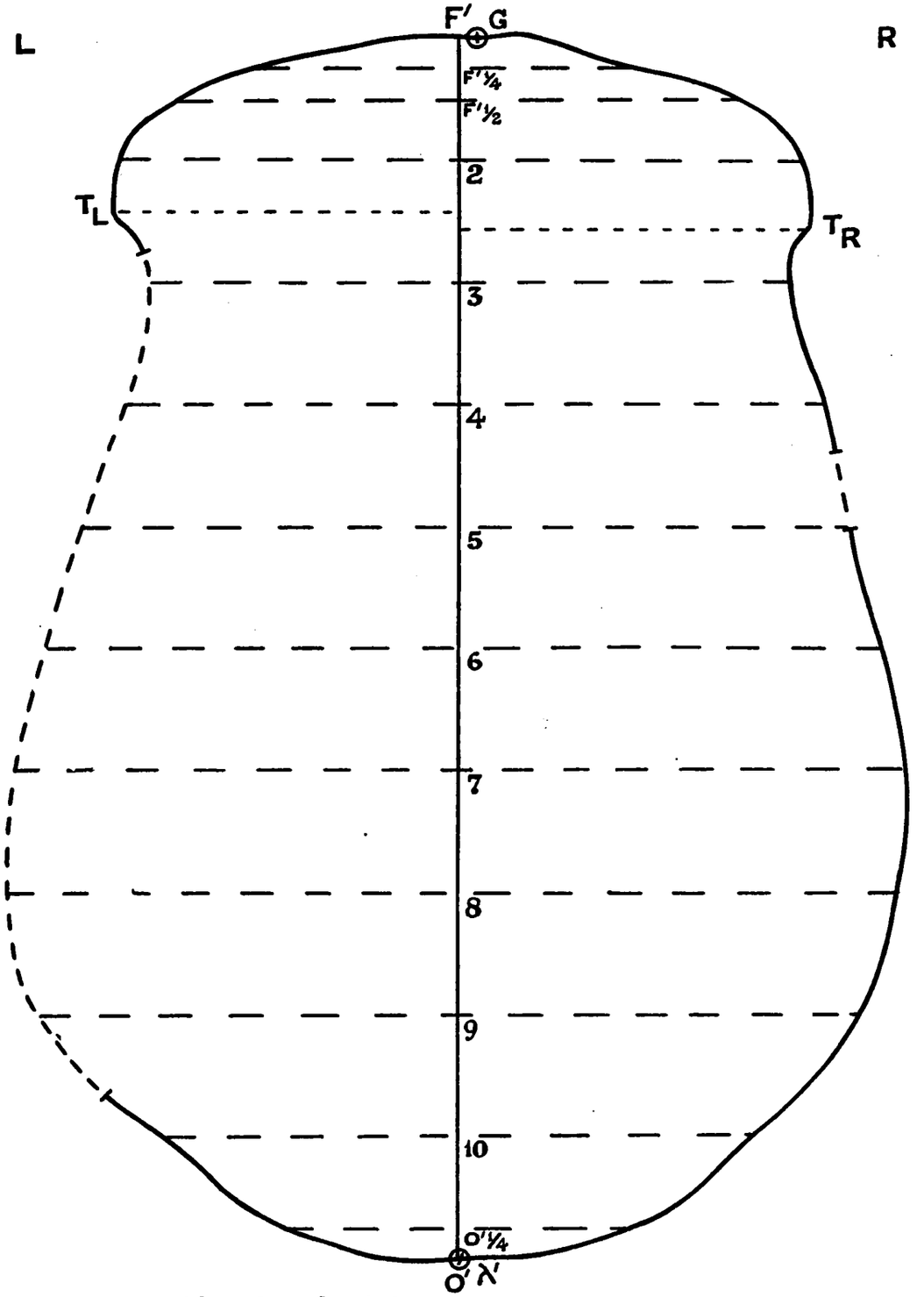


Fig. VIII. Horizontal Contour of a Cast of the La Chapelle Skull.



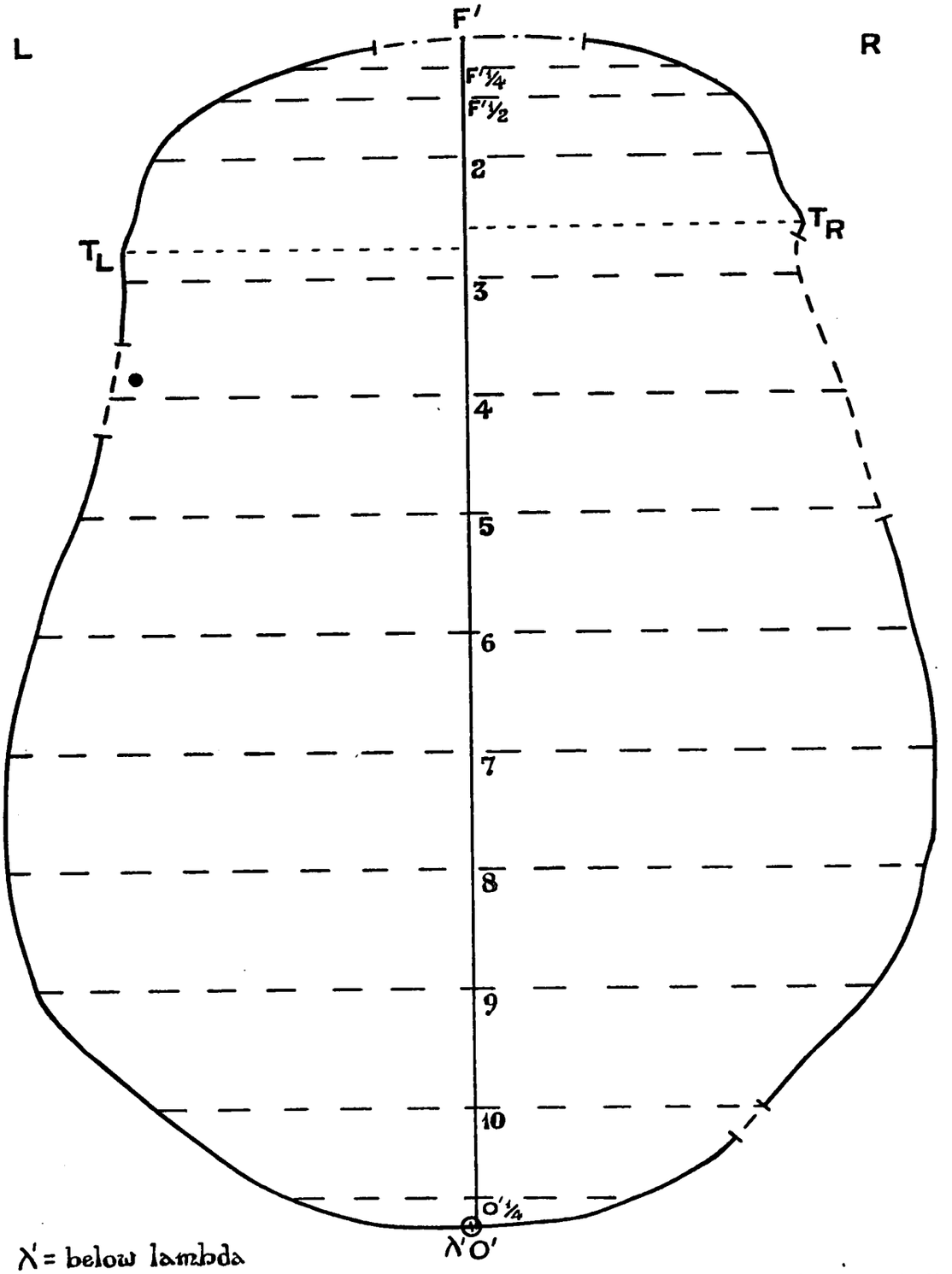
G = glabella λ′ = below lambda — — — reconstructed surface of skull

Fig. IX. Horizontal Contour of a Cast of the La Quina Skull.



G= glabella λ= below lambda – – – – reconstructed surfaces of skull

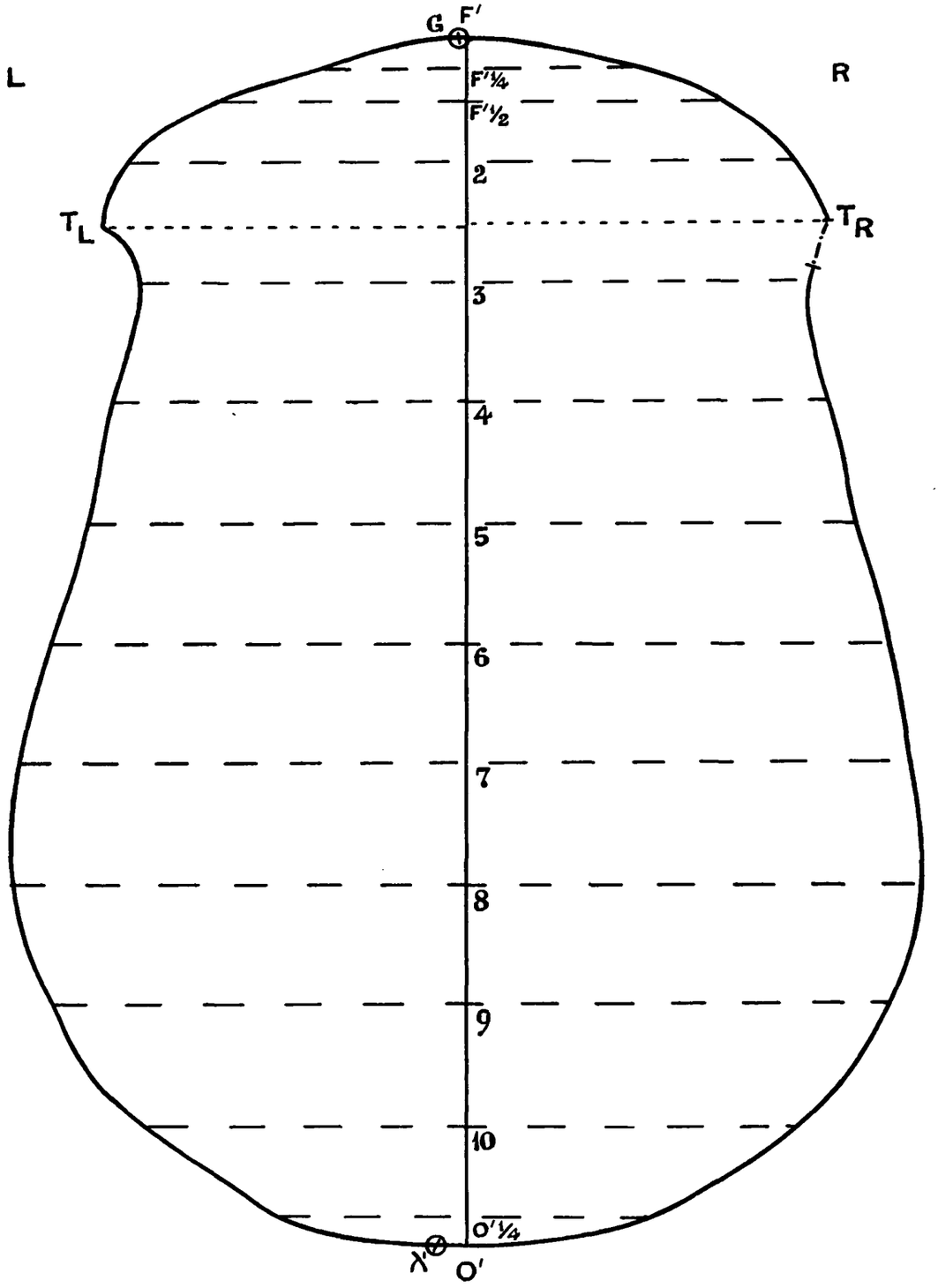
Fig. X. Horizontal Contour of Spy Skull No I



λ' = below lambda

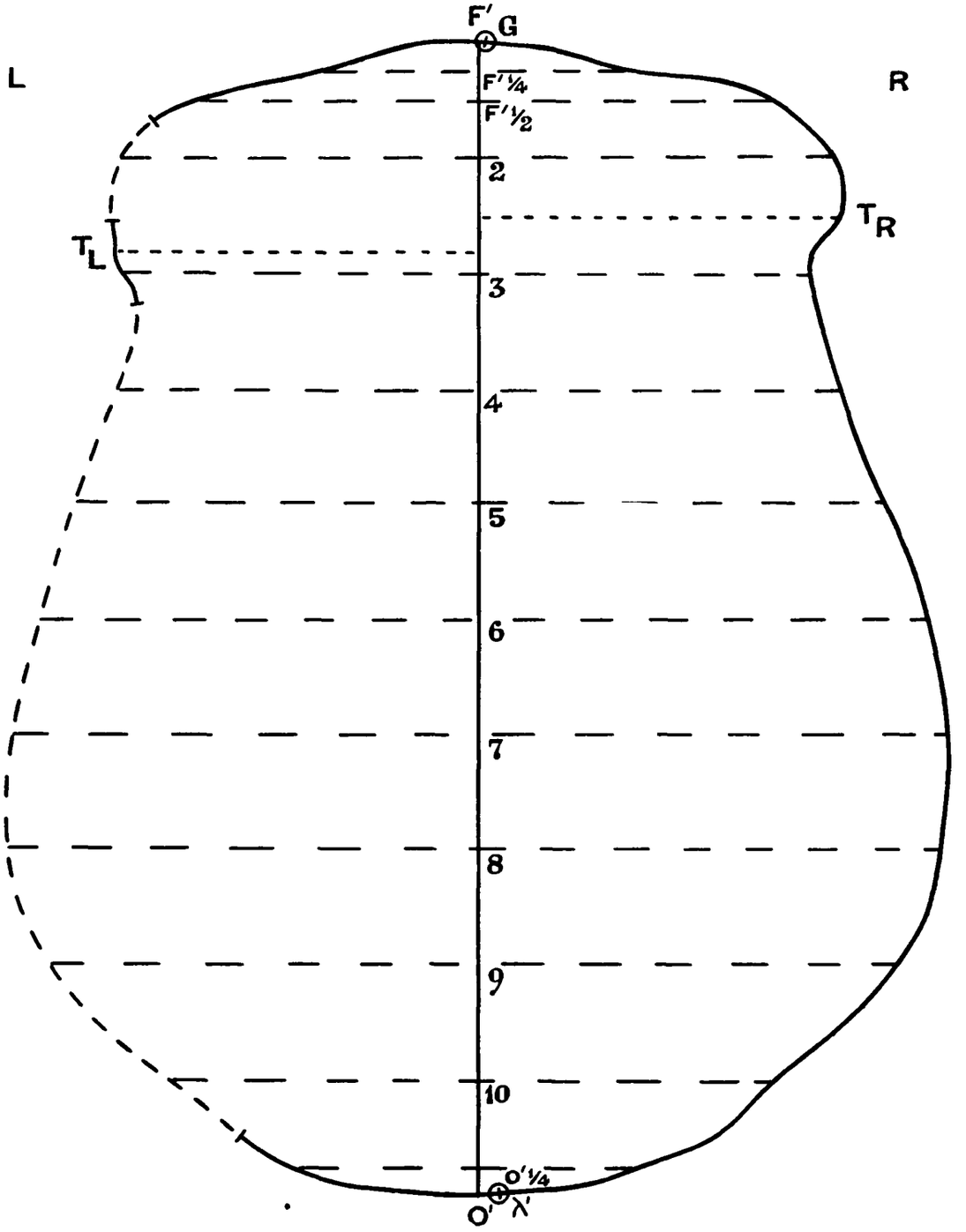
— · — · — Defective surface of skull – – – – reconstructed surfaces of skull

Fig. XI. Horizontal Contour of Spy Skull No II



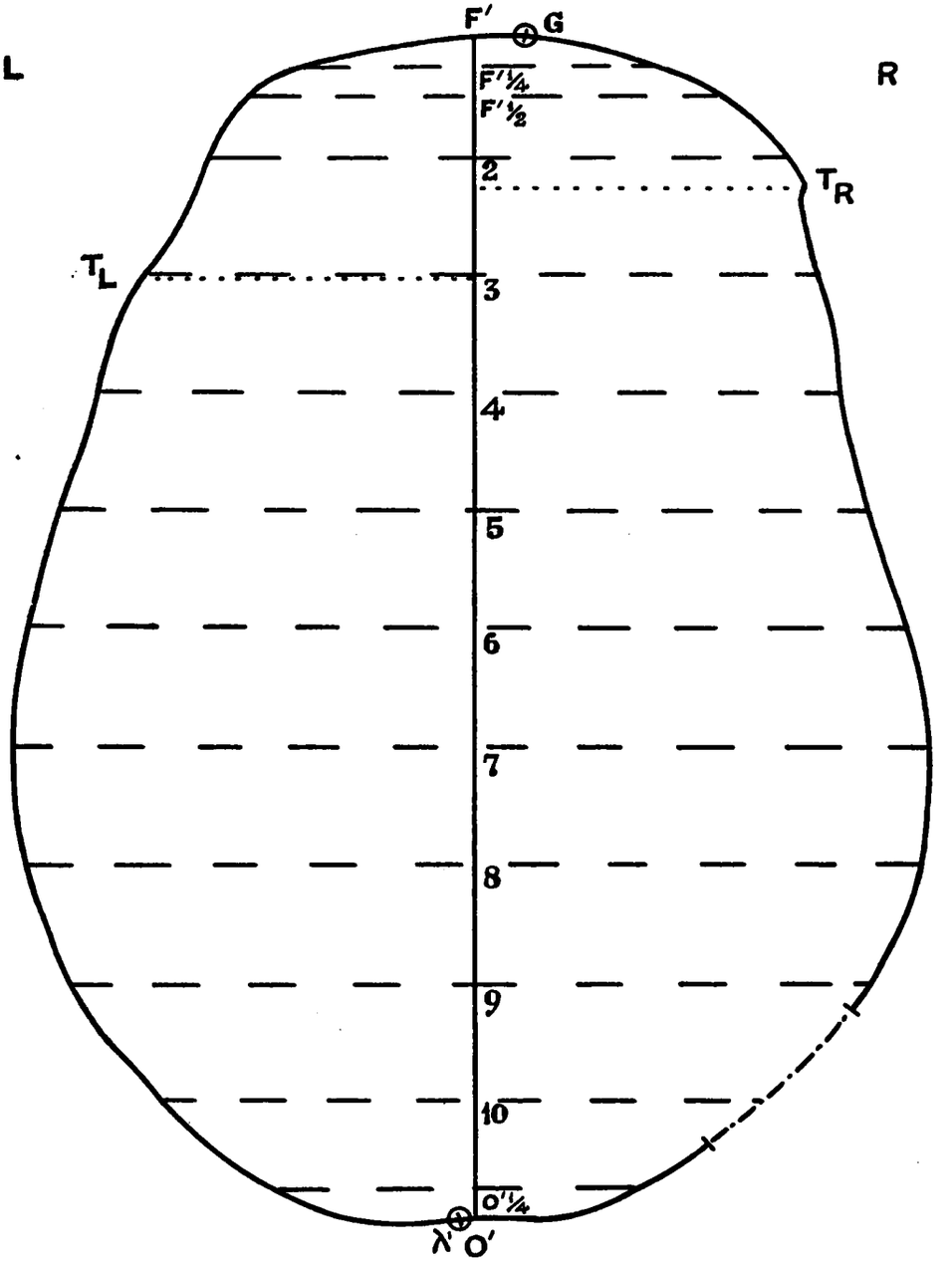
· — · defective surface of skull G = glabella λ′ = below lambda

Fig. XII. Horizontal Contour of the Neanderthal Skull.



G = glabella λ′ = below lambda — — — reconstructed surfaces of cast

Fig. XIII. Horizontal Contour of Mc Gregor's restored Cast of the Gibraltar Skull.



— · — defective surface of cast G= glabella λ′= below lambda

Fig. XIV. Horizontal Contour of a Cast of the La Quina Child's Skull.

The horizontal contours of the adult Neanderthaloid skulls resemble one another closely and they are most clearly distinguished from sections of modern skulls by the greater extension in front of the temporal lines and the greater breadth of the hinder section. The temporal fossae are not marked and the outlines are everywhere "well-filled." The forward extension of the superciliary ridge can be measured by expressing the distance of the temporal diameter from the front of the section as a percentage of its total length as in Table XIV.

Table XIV. *The Index of Frontal Flattening.*

	$100 \times \frac{\frac{1}{2}\{T_R(x)+T_L(x)\}^1}{FO}$	
	♂?	♀?
La Chapelle (cast) ...	14·4	—
Spy I	14·9	—
Neanderthal	15·3	—
Gibraltar (cast) ...	—	16·6
Spy II	—	16·7?
La Quina (cast) ...	—	19·8?
La Quina Child (cast)...	16·4	
	♂	♀
Tibetans *B*	9·6 (15)	—
Tibetans *A*	10·4 (35)	—
Burmese *A*	10·6 (44)	10·5 (39)
Nepalese	10·7 (46)	11·7 (6)
Moriori	10·7 (33)	11·6 (21)
Farringdon St. English	10·8 (72)	11·2 (65)
Anglo-Saxons... ...	10·8 (39)	11·4 (40)
1st Dynasty Egyptians	11·0 (30)	11·2 (10)

[1] For the Neanderthaloid skulls the axis *F'O'* was used in place of *FO*.

The indices for Neanderthaloid skulls clearly distinguish them from the few modern types with which comparison can be made and the inter-racial differences for the latter are surprisingly small. For the modern types, there is a clear suggestion of a sexual difference which accords with a much more marked one between the supposed ♂ and ♀ Mousterian skulls. It is important to notice that the extension in front of the temporal diameter is relatively greater for ♀ than for ♂ skulls and also that it is greater for the immature La Quina specimen than for the adult ♂'s. The ratio of the width between the temporal lines to the subtense of that chord from the glabella may also be expected to make similar distinctions. Measurements are given in Table XV, p. 356.

The greater extension of the frontal bone anterior to the temporal diameter expressed as a proportion of that width provides another index which clearly distinguishes the Neanderthaloid skulls from the homogeneous modern population, and the sexual differences between the supposed ♂ and ♀ archaic skulls are of the same sign but of greater magnitude than those found for type contours of the two sexes. But a measure of frontal flattening of the more forward and flatter arc of the contour, such as that given in the last two columns of Table XV, makes neither distinction.

A temporal index, formed by expressing the percentage that the 3rd parallel is of the length of the section, was suggested by E. Y. Thomson *. It is decidedly smaller for the Moriori type contour, indicating more marked temporal fossae, than for any other yet available. The indices for the Mousterian skulls are hardly comparable with those of the types of modern races as the 3rd parallel falls further forward on a different anatomical portion of the skull, but it is clear that the

* *Biometrika*, Vol. XI, pp. 82–135.

form of the temporal region is not a character which will differentiate the primitive skulls from all modern types. The horizontal sections—like the transverse, but unlike the sagittal—are "well-filled" and in that way they resemble modern advanced races more than the Moriori.

Table XV. *Measurements of Frontal Development.*

	$100 \times \frac{\frac{1}{2}\{T_R(x)+T_L(x)\}}{T_R(y)+T_L(y)}$		$100 \times \frac{\frac{1}{20}\text{th of } FO^1}{\text{Length of parallel } F\frac{1}{2}}$	
	♂?	♀?	♂?	♀?
La Chapelle (cast) ...	24·5	—	10·4	—
Neanderthal	25·7	—	12·3	—
Spy I	26·3	—	11·0	—
Gibraltar (cast) ...	—	26·8	—	10·1
Spy II	—	29·7?	—	11·6?
La Quina (cast) ...	—	38·4?	—	14·1?
La Quina Child (cast)	29·6		12·6	
	♂	♀	♂	♀
1st Dynasty Egyptians	20·9 (30)	21·3 (10)	13·1 (30)	13·2 (10)
Anglo-Saxons	20·9 (39)	21·3 (40)	13·5 (39)	13·4 (40)
Moriori	20·8 (33)	22·4 (21)	13·3 (33)	14·1 (21)
Farringdon St. English	20·6 (72)	21·2 (64)	13·3 (72)	13·2 (65)
Nepalese	19·6 (46)	21·0 (6)	12·8 (46)	12·8 (6)
Burmese *A*	18·9 (44)	19·1 (39)	11·5 (44)	12·2 (39)
Tibetans *A*	18·9 (35)	—	12·1 (35)	—
Tibetans *B*	17·9 (15)	—	11·7 (15)	—

[1] *F'O'* was used in place of *FO* for the Neanderthaloid skulls.

Table XVI. *Breadth Indices of the Horizontal Section.*

	$100 \times \frac{\text{Distance of greatest breadth from temporal diameter}^1}{\text{Total length from temporal diameter}}$		$100 \times \frac{\text{Greatest breadth of section}}{\text{Total length from temporal diameter}}$		Cephalic Index
	♂?	♀?	♂?	♀?	♂ or ♀
Neanderthal	62·2	—	87·8	—	73·6
Spy I	59·2?	—	85·5?	—	71·9?
La Chapelle (cast) ...	57·8	—	89·2	—	75·2
Spy II	—	57·8	—	91·9	76·6?
Gibraltar (cast) ...	—	56·9?	—	95·9?	About 77·5
La Quina (cast) ...	—	53·8	—	85·2	67·7?
La Quina Child (cast)	52·9		91·6		76·9
	♂	♀	♂	♀	♂
Burmese *A*	52·8 (44)	53·5 (39)	92·1 (44)	91·4 (39)	82·9
Anglo-Saxons ...	52·5 (37)	54·1 (39)	81·1 (37)	82·9 (39)	74·7
1st Dynasty Egyptians	52·4 (32)	54·8 (10)	81·3 (32)	83·4 (10)	73·8
Farringdon St. English	52·2 (69)	53·5 (64)	84·4 (69)	85·2 (64)	75·4
Moriori	52·2 (33)	54·1 (21)	81·9 (33)	84·9 (21)	76·2
Tibetans *B*	50·7 (15)	—	83·2 (15)	—	75·3
Nepalese	50·5 (46)	49·8 (6)	84·7 (46)	86·3 (6)	75·1
Tibetans *A*	50·3 (35)	—	89·1 (35)	—	79·2

[1] These measurements were taken in the following manner. All antero-posterior lengths were taken along the *FO* axes in the case of the type contours and along the *F'O'* axes in the case of the contours of Neanderthaloid skulls. The meet of the line joining T_R to T_L with the axis gave the anterior terminal (*A*). The greatest breadth was considered to be the line joining the most lateral points left and right with regard to the axis. The point where that diameter of greatest breadth met the axis gave another terminal (*B*). The indices in columns 2 and 3 of the table are thus 100 *AB*/*AO'* or 100 *AB*/*AO*.

In comparing the direct measurements of calvarial breadths, the feature most definitely distinguishing the Neanderthaloid skulls from all of a modern type was found to be the peculiarly

great biasterionic diameter when considered in proportion to all other transverse measurements. That peculiarity is evidently associated with the fact that the greatest parietal breadths are peculiarly far back in the case of the Mousterian skulls. It has been observed that for all the horizontal type contours of modern crania as yet constructed the greatest transverse breadths are between the 6th and 7th parallels: for all the Neanderthaloid contours the greatest breadths are between the 7th and 8th parallels. But the greater recession of the maximum diameter as measured in that way will be caused partly by the greater forward extension in front of the temporal lines and, to avoid that factor, measurements may be taken from the temporal diameter instead of from the glabella, as in Table XVI.

When lengths are measured from the temporal diameter the greatest breadths of the Neanderthaloid skulls are still appreciably farther back than those of modern racial types. The proportions of the greatest breadths of the sections to the lengths measured from the temporal diameter are also given in Table XVI. For the modern types that index gives almost the same order as the cephalic index, but there are great changes in the positions of the Mousterian specimens. Judging by the post-temporal breadth index, they are as round headed as the Tibetans and more round headed than several mesocephalic modern types. The enormous development of the superciliary region is responsible for the low cephalic indices of the adult Mousterian skulls.

10. *The Median Sagittal Section.*

The sagittal contour is that of the section passing through the nasion, bregma and lambda which is defined to be the median sagittal plane. On the perfectly symmetrical skull it will also pass through the inion, opisthion and alveolar point. If the last three are not precisely in the median plane, the pointer of the tracer is raised or lowered gradually so that it passes through them. The asymmetry revealed in that way was only marked in the case of the cast of the La Chapelle skull, for which the inion and opisthion were found to be 8 mm. to the right of the sagittal plane, and for the cast of the La Quina adult skull having the same points 4 mm. to the right of that plane*. In addition to these two, contours were drawn of the Neanderthal, the Le Moustier, the Spy I and II skulls, and of the casts of the Galilee, Gibraltar and La Quina child specimens; they are reproduced in Figs. XV–XXIII. For the imperfect Spy II skull-cap the bregma, lambda and inion were used to determine the median sagittal plane, and for McGregor's cast of the Gibraltar skull the nasion, lambda and opisthion served the same purpose. The cast of the Galilee frontal bone was orientated by aligning the nasion and supposed bregma and adjusting the specimen on the stand until it appeared correctly placed. In dividing up individual sagittal contours for the purpose of obtaining mean measurements from which the type figure can be constructed, the adopted base-line is one through the nasion parallel to the Frankfurt horizontal plane—the so-called $N\gamma$ line, γ being the point where it meets the section of the occiput. With a complete specimen the gamma is ordinarily located upon the skull while it is on the craniophor and then marked upon the contour. The same method could not be used when dealing with the Palaeolithic original specimens and casts. The line representing the horizontal in each case had to be determined from the projections on the contour of the left sub-orbital and auricular points, then the parallel through the nasion gives the gamma and the base-line. The drawings of the La Quina child, La Chapelle, Gibraltar and Le Moustier specimens could be treated in that way but not the others as they lack either the sub-orbital or auricular point or both. For the supposed ♂

* That the asymmetry of the casts is also a feature of the original skulls is shown by a number of bilateral measurements not dealt with in the present paper.

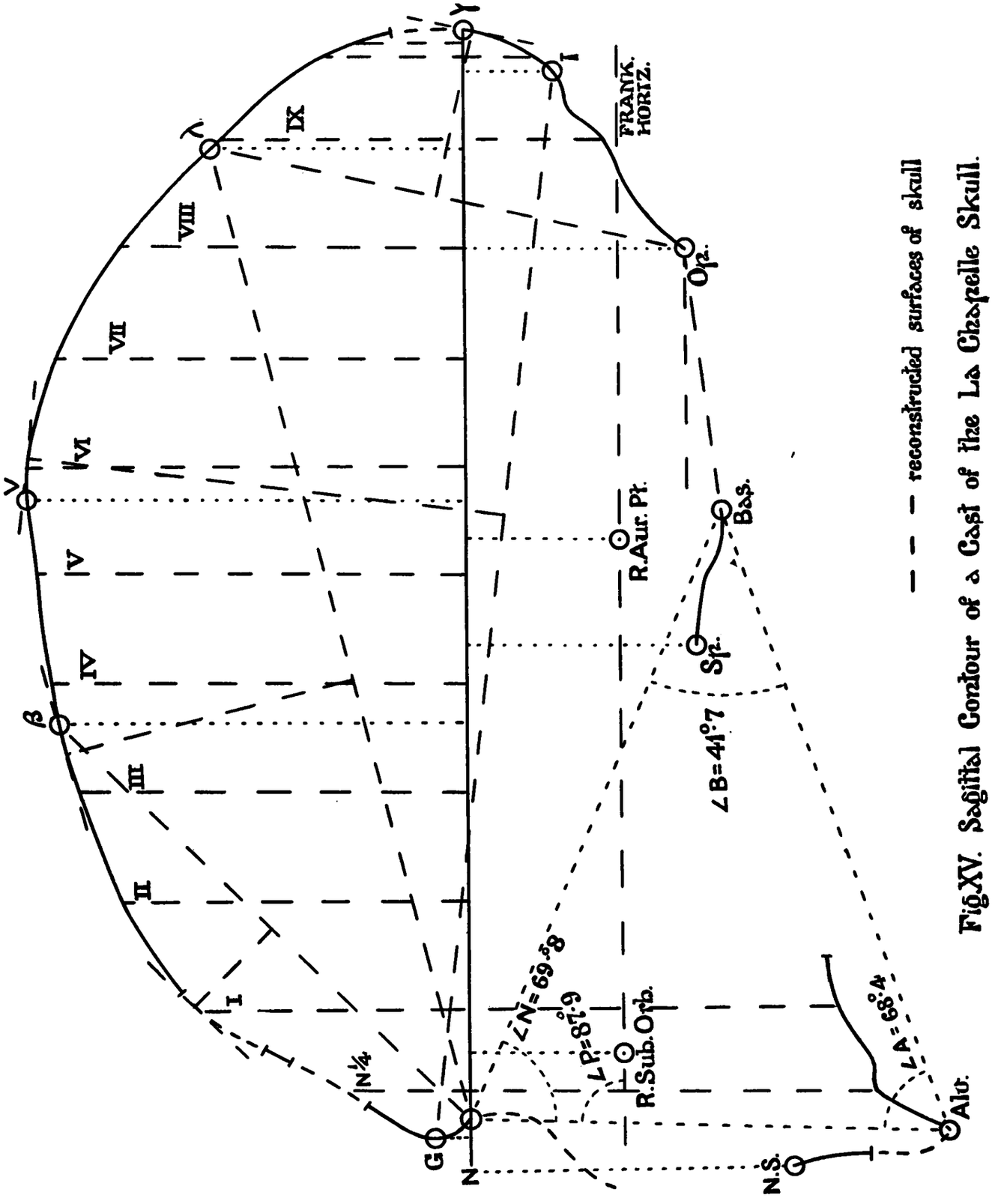


Fig. XV. Sagittal Contour of a Cast of the La Chapelle Skull.

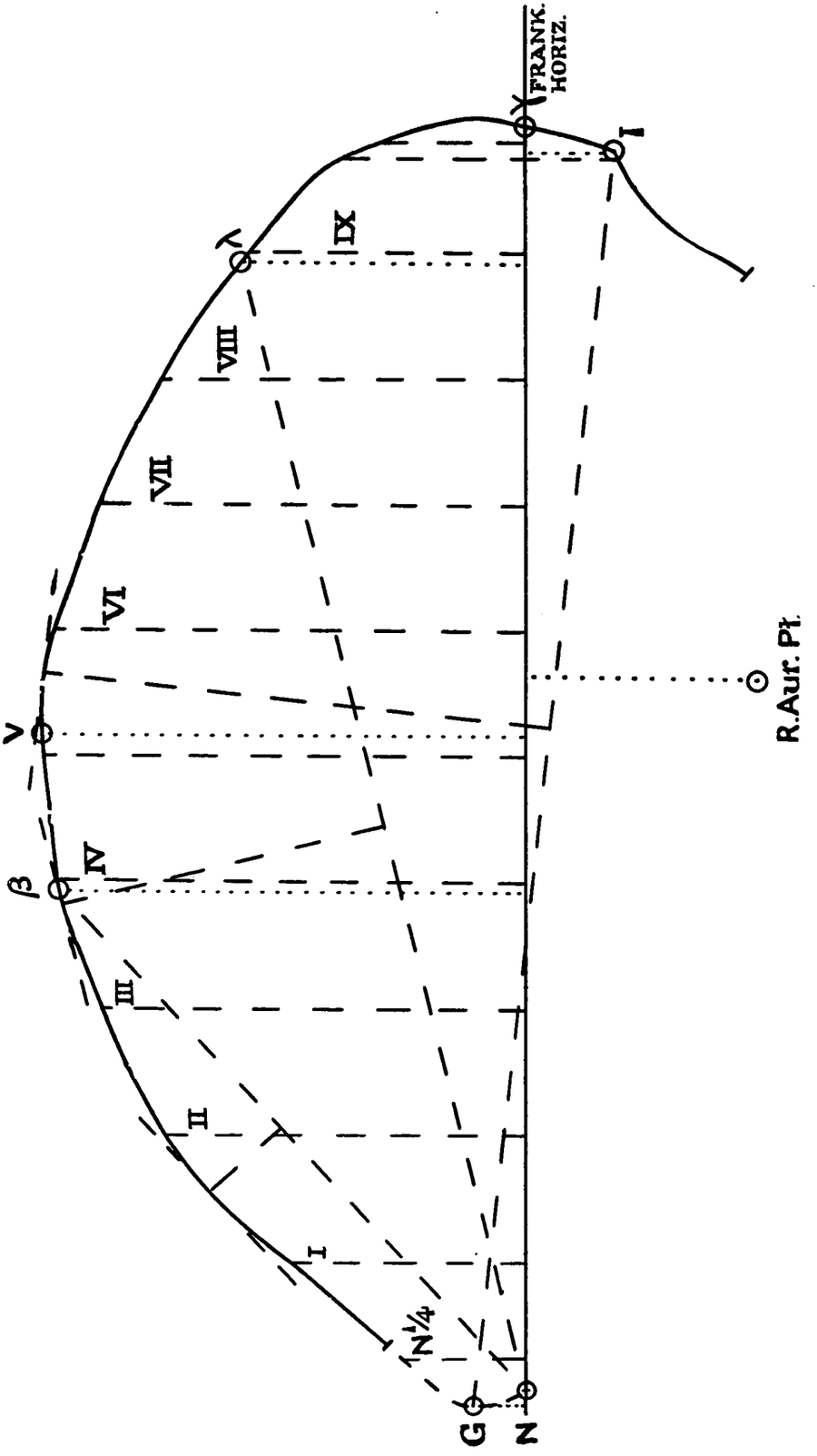


Fig. XVI. Sagittal Contour of a Cast of the La Quina Skull.

– – – reconstructed surface of skull

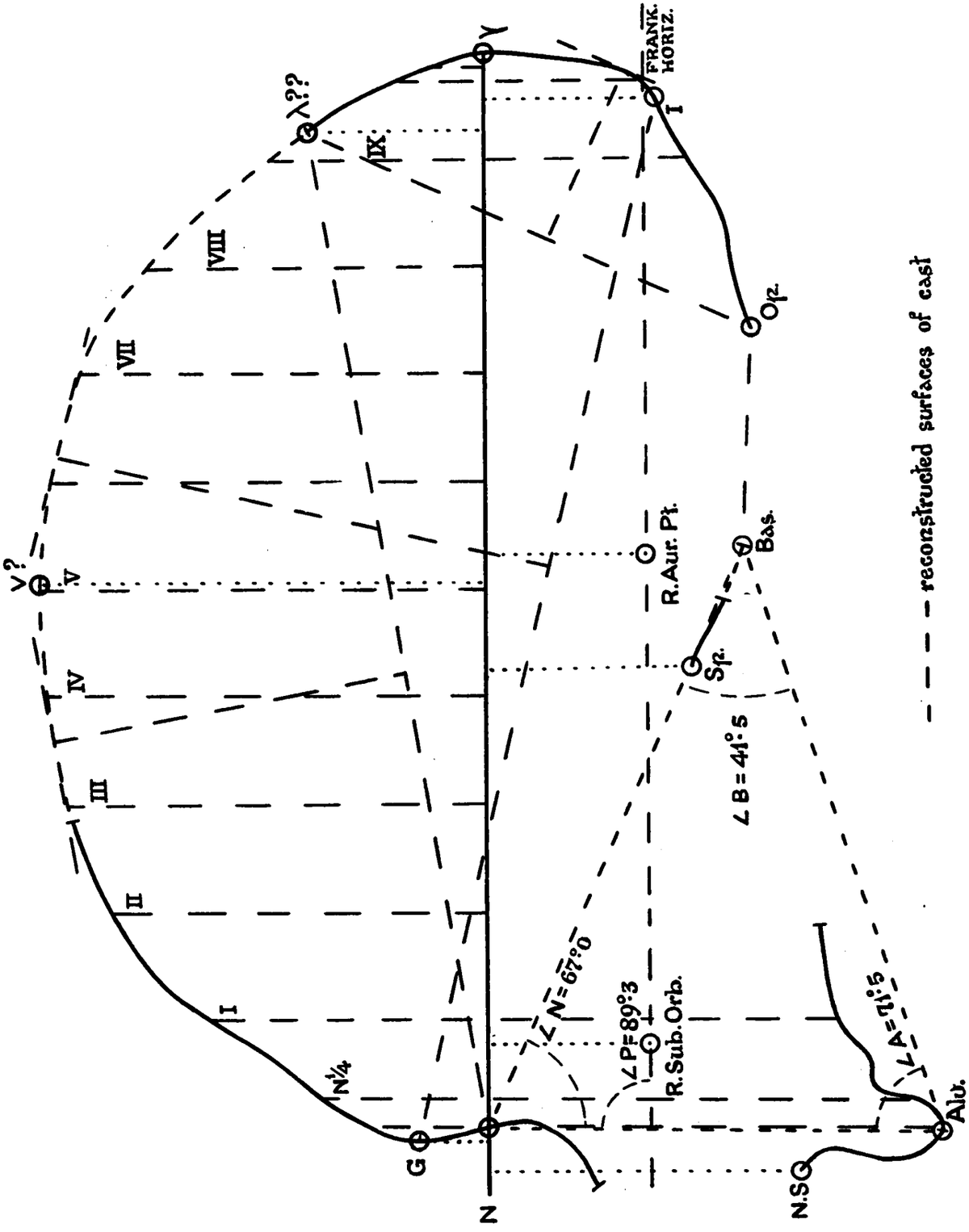


Fig. XVII. Sagittal Contour of Mc Gregor's restored Cast of the Gibraltar Skull.

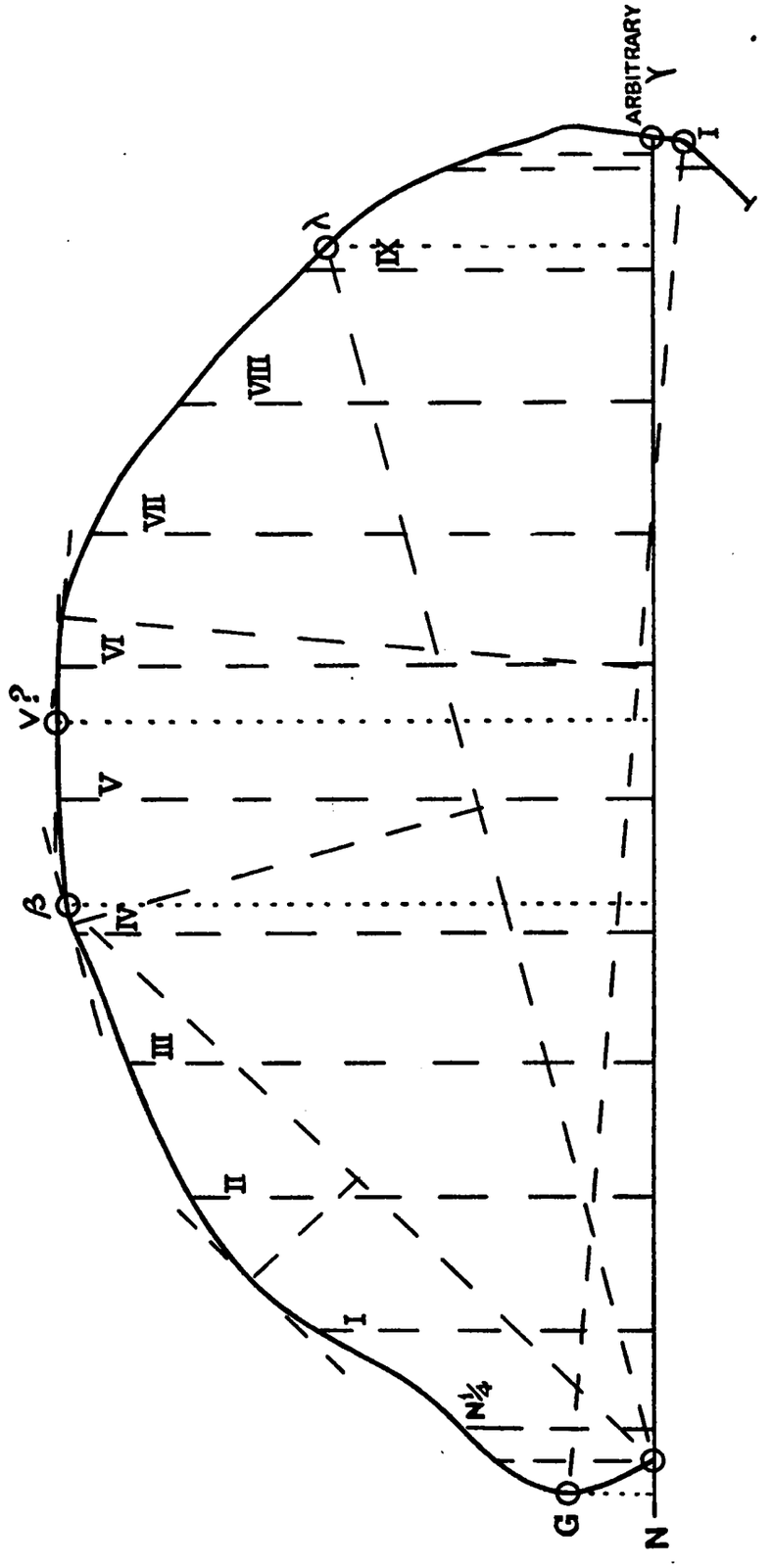


Fig. XVIII. Sagittal Contour of the Neanderthal Skull.

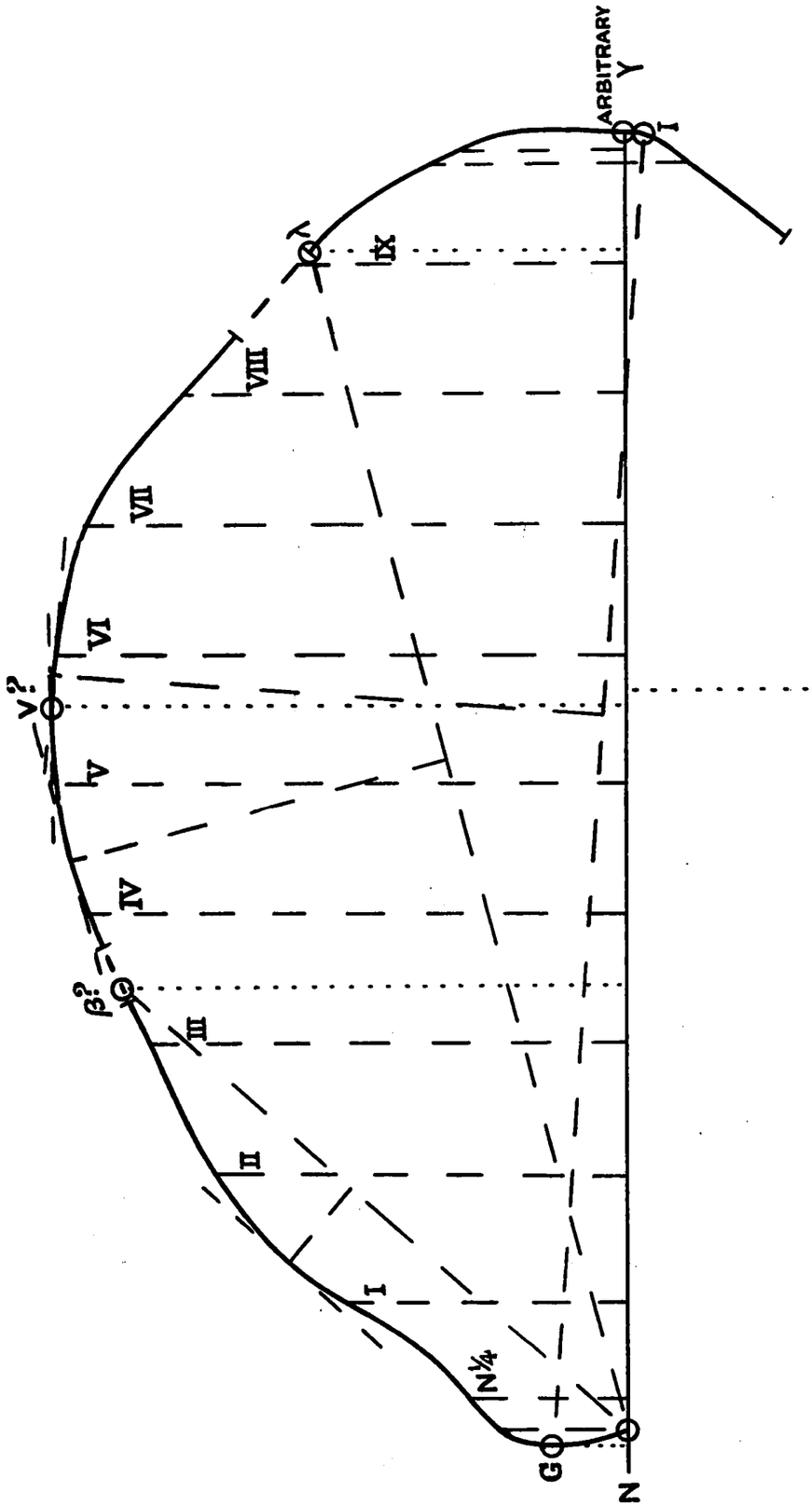


Fig. XIX. Sagittal Contour of the Spy Skull No I

Neanderthal and Spy I skulls an approximation to the horizontal was obtained by making $\angle \lambda N\gamma = 14°{\cdot}6$, that being its value for the contour of the La Chapelle cast. On the La Quina drawing the same angle was made equal to $14°{\cdot}0$ as the few reliable racial type contours available for the two sexes suggest that there is a difference between them of the order $0°{\cdot}6$ though it is probably insignificant. No approximation to the horizontal can be made on the very incomplete contours of the Spy II and Galilee skulls. Nearly all the more salient and primitive characters

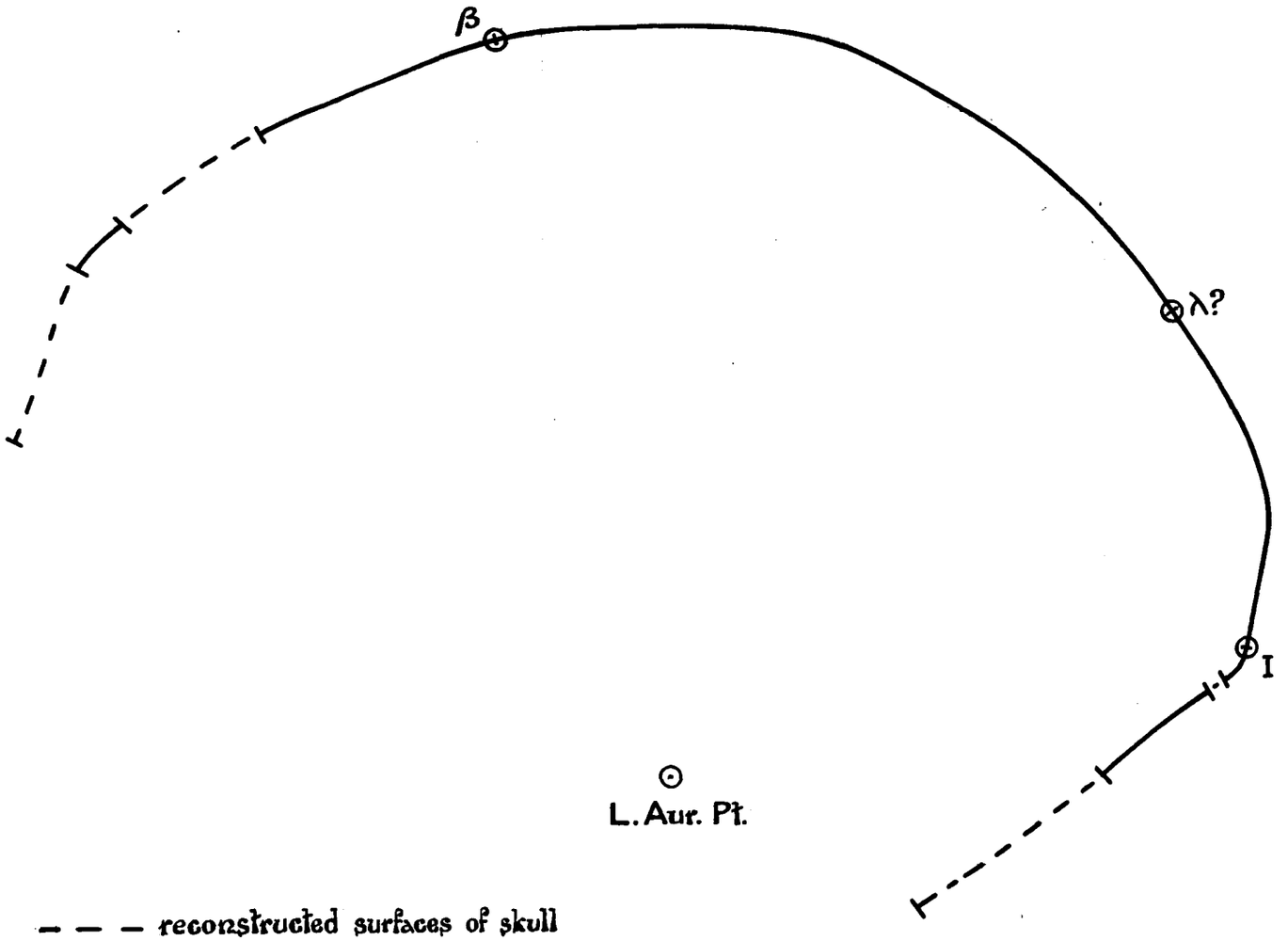


Fig. XX. Sagittal Contour of the Spy Skull No II

of the Neanderthaloid type can be appreciated from these figures, conspicuous among which are the large size of the facial portion, the markedly retreating frontal bone and depressed vault, the flatness of the sections of the frontal and parietal bones and the backward position of the *foramen magnum*. The absence of marked prognathism is an equally striking feature. It has been possible to compare several characters of the median sagittal section by the aid of direct measurements on the crania, and estimates, although fewer in number, of several others can now be made from these contours. No satisfactory measure of the flattening of the frontal bone can be deduced from

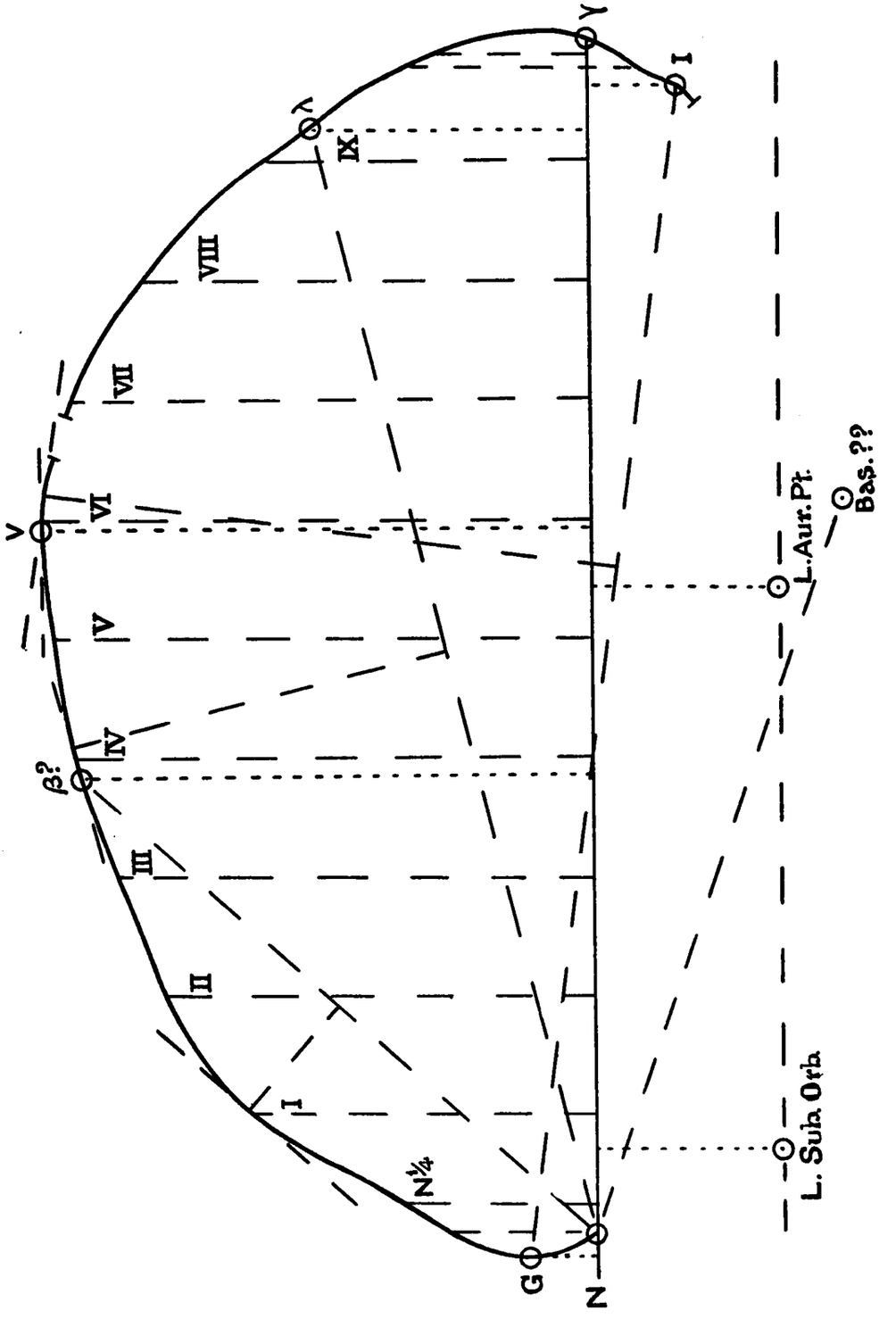


Fig. XXI. Sagittal Contour of the Le Moustier Skull.

the direct measurements owing to the uneven curvature of the arc, but the index expressing the length of the greatest subtense from the $N\beta$ chord to the frontal section as a percentage of $N\beta$ will serve that purpose. Comparative values are given in column 4 of Table XVII (p. 367). The mean index for adult Neanderthaloid skulls is almost certainly less than the mean for any modern racial type, but individual skulls of advanced races may easily be found with frontal bones as flat as that of the La Chapelle cranium. The Moriori values are peculiarly low but, otherwise, no distinction is made between primitive and advanced types. The angle that the point of maximum subtense to the frontal bone and the β subtend at the nasion has been called the angle of frontal bone flatness and it is evidently highly correlated with the index. The inclination

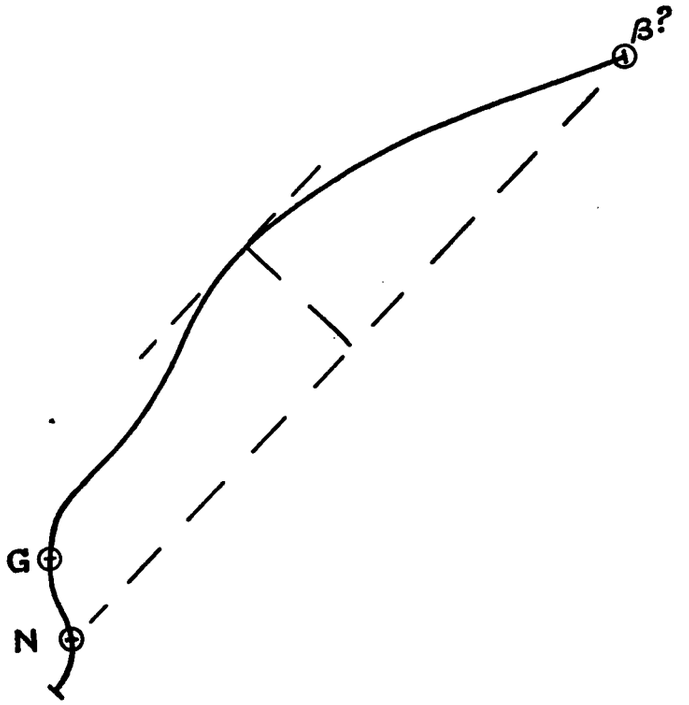


Fig. XXII. Sagittal Contour of a Cast of the Galilee Skull.

of the base of the frontal bone to the horizontal ($\angle\ \beta N\gamma$, Table XVII, column 6), however, shows little correlation with those measurements and no distinction is made between the Mousterian skulls and several modern types. Curiously enough the lowest angles are all shown by advanced races. The objection may be made that the Frankfurt horizontal line is of too artificial a nature to be used in such comparison but the substitution of either the nasio-lambda or nasio-inion lines for it would lead to precisely the same relations. The physiognomic angle of flatness is defined to be the sum of the two preceding and for it there is a clear distinction between the Neanderthaloid and all modern types, yet apart from the low standing of the Moriori—and that is less extreme than for one Egyptian type—there is no suggestion whatever of a grading of the more and less primitive races. But for no one of these characters is the differentiation of the Mousterian type and modern skulls of a marked order and there would be no difficulty in finding individual

skulls, even of advanced races, exhibiting more extreme characters. The skull of Sir Thomas Browne with its markedly retreating frontal bone may be taken as an illustration*. Its index of frontal flattening, being 20·2, just exceeds the La Chapelle value and the angle of 27°·2 for frontal bone flatness is more normal. But its angle of rotation of the frontal bone is as low as 38°·8 so that the physiognomic angle of flatness (66°·0) is less than the La Chapelle value.

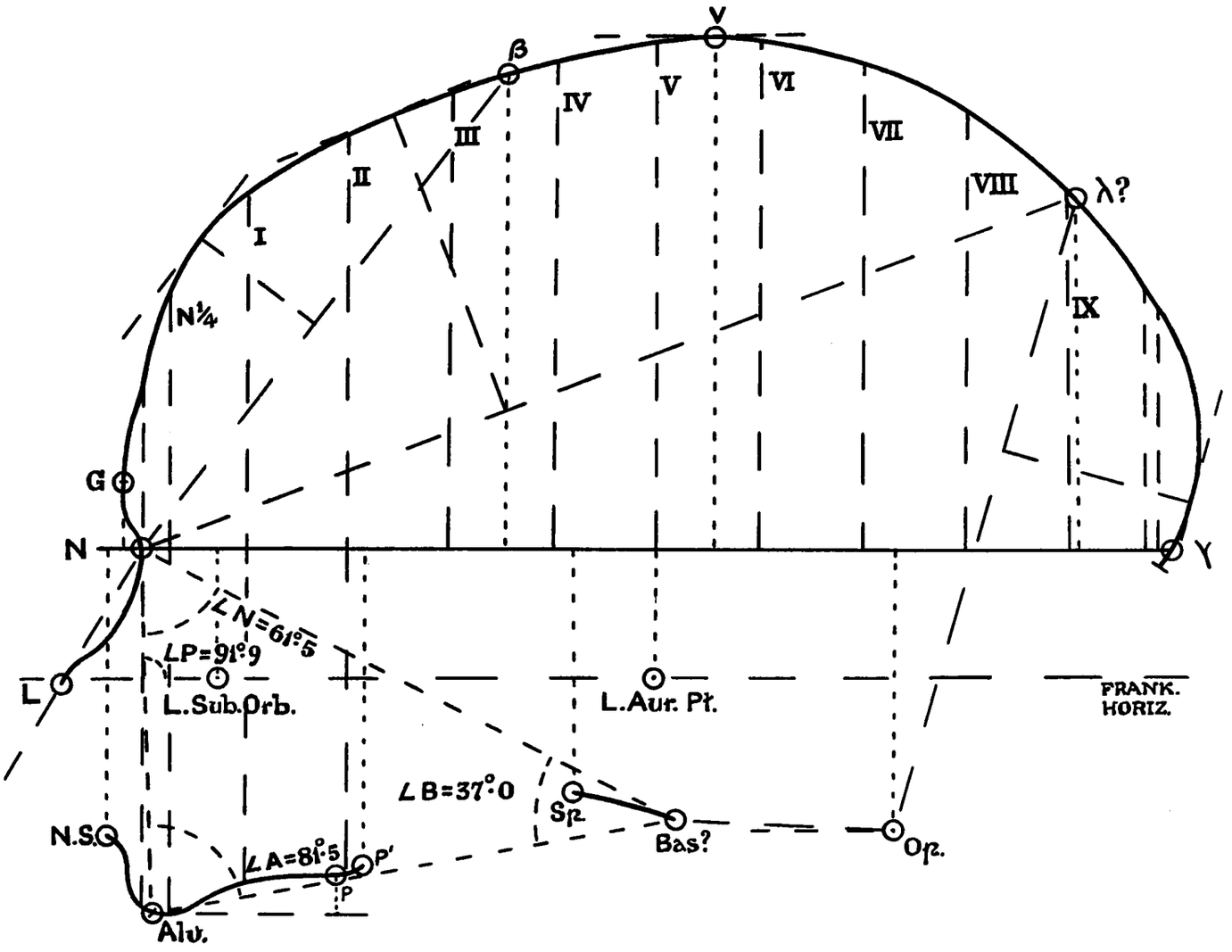


Fig. XXIII. Sagittal Contour of a Cast of the La Quina Child's Skull.

In comparing skulls of fossil man with those of anthropoids and modern human races Schwalbe made use of a measurement of the degree of flattening of the median sagittal section obtained by expressing the length of the greatest subtense from the glabella-inion chord as a percentage of that chord†. Comparative values are given in column 4 of Table XVIII (p. 368) and for a similar

* M. L. Tildesley, "Sir Thomas Browne: his Skull, Portraits and Ancestry," *Biometrika*, Vol. xv, 1923, pp. 1–76.

† G. Schwalbe, "Studien über Pithecanthropus erectus Dubois," *Zeitschrift für Morphologie und Anthropologie*, Bd. 1, 1899, pp. 16–228.

Table XVII. *Measurements of the Sagittal Section.*

	Sex	No. of Skulls	$100 \times \frac{\text{(Subtense to } N\beta)}{N\beta}$	Angle of Frontal Bone Flatness	Rotation of Base of Frontal Bone $\angle \beta N \gamma$	Physiognomic Angle of Flatness	$100 \times \frac{\text{(Subtense to } N\lambda)}{N\lambda}$	$\angle \lambda N \gamma$
La Chapelle (cast) ...	♂?	1	19·1	21°·8	45°·3	67°·1	29·1	14°·6
Neanderthal	♂?	1	17·9	19°·5	46°·0?[1]	65°·5?[1]	33·1	—
Spy I	♂?	1	14·2	14°·6	48°·1?[1]	62°·7?[1]	31·3	—
Galilee (cast)	♀?	1	18·1?	19°·5?	—	—	—	—
Gibraltar (cast) ...	♀?	1	—	—	—	—	34·8?	10°·0
La Quina (cast) ...	♀?	1	14·3	15°·1	43°·6?[1]	58°·7?[1]	28·1	—
Le Moustier Adolescent	?	1	20·2	22°·0	47°·9	69°·9?	33·3	14°·1
La Quina Child (cast) ...	?	1	23·9	26°·7	52°·9	79°·6	32·1	21°·0
Moriori	♂	33	19·3	22°·3	49°·3	71°·6	36·2	13°·5
Moriori	♀	21	21·0	23°·3	49°·6	72°·9	36·8	13°·6
3 Negro Series	♂	111	22·4–22·8	25°·9–27°·4	48°·9–50°·2	75°·1–76°·7	39·3–39·8	9°·8–11°·2
2 Egyptian Series ...	♂	131	22·3	24°·9–25°·8	46°·1–47°·2	71°·0–73°·0	38·3–39·1	8°·2– 8°·9
3 Oriental Series[2] ...	♂	116	22·5–23·4	26°·6–27°·1	50°·4–51°·9	77°·4–79°·0	41·7–42·5	10°·3–10°·7
Burmese *A*	♂	44	23·2	26°·9	51°·2	78°·1	43·4	11°·6
Burmese *A*	♀	39	23·7	27°·4	51°·2	78°·6	42·7	11°·1
Tibetans *B*	♂	15	23·1	26°·4	48°·2	74°·6	39·8	8°·8
Tamils	♂	36	24·4	28°·6	51°·0	79°·6	42·7	9°·8
Eskimos	♂	31	23·0	28°·4	51°·1	79°·5	39·1	13°·1
Guanches	♂	14	22·6	26°·9	48°·0	74°·9	37·8	10°·4
Whitechapel English...	♂	100	22·4	27°·2	47°·1	74°·3	37·9	9°·9
Farringdon St. English	♂	70	22·7	28°·6	45°·1	73°·7	38·1	7°·8
Farringdon St. English	♀	63	23·7	30°·3	43°·1	73°·4	37·2	7°·4
Anglo-Saxons ...	♂	41	23·4	27°·6	47°·2	74°·8	39·2	8°·6
Anglo-Saxons ...	♀	42	24·2	29°·0	49°·5[3]	78°·5	40·7	9°·5

[1] Measurements taken from arbitrary γ (see text).

[2] Nepalese, Tibetans *A* and Chinese (Hokien).

[3] The following additional mean values of this angle can be given: New Caledonians ♂ 52°·8 (90), ♀ 52°·8 (56); Loyalty Islanders ♂ 51°·2 (35), ♀ 52°·9 (27); Eskimos (Fürst and Hansen) ♂ 50°·0 (172), ♀ 50°·5 (149); Guanches (Detloff von Behr) ♂ 43°·5 (77), ♀ 42°·5 (41).

index, using the nasio-lambda chord as base line, in column 8 of Table XVII. As for the measurements of flattening deduced from direct measurements, the distinction between the Neanderthaloid skulls and modern mean racial types is perfectly clear and these contour measurements do not arrange the modern races in orders which are more suggestive than that given by such an index as $100\ H'/L$. In the last column of Table XVII are the angles which the lambda-gamma chords subtend at the nasion. From the direct measurements it was suggested that the arc between lambda and inion bears a greater proportion to the total sagittal arc for the Mousterian skulls than for modern man, but this angular measurement is less distinctive. The means closest to the values for the archaic skulls are those of the Moriori and Eskimos and the European races are as far removed as any, but the material is too scanty to decide whether that order has any true significance or not. The position of the *foramen magnum* is a factor of prime evolutionary importance: it may be measured conveniently by the angle between the nasio-lambda and lambda-opisthion chords (Table XVIII, column 6, p. 368). For that, and for the similar angle between the nasio-lambda and lambda-inion chords, there is a marked distinction between the Neanderthaloid skulls and all modern types but there is little to suggest that the grading of the latter is associated with their relative degree of primitiveness. A measurement which has been more often considered is the angle between the foraminal sagittal axis—the chord passing through the basion and opisthion—and the horizontal. The material given in column 7 of Table XVIII and in the footnote suggests the following arrangement, allowance being made for the significant sexual difference: Moriori—Eskimos—Negroes—New Caledonians—Australians—Oriental . Races—Egyptians—Northern Mongols—European Races—Tibetans *B*. Apart from the position of the *B* type Tibetans, which

are represented by an inadequately short series, this order is clearly one of peculiar suggestiveness. The meagre data for Neanderthaloid skulls may be taken to assign them to a position beyond but close to the Moriori end of the scale. The angle between the axis of the *foramen magnum* and the glabella-inion chord, for which there is far less material, might have been expected to give

Table XVIII. *Further Measurements of the Sagittal Section.*

	Sex	No. of Skulls	$100 \times \frac{(\text{Subtense to } GI)}{GI}$	$\angle N\lambda I$	$\angle N\lambda Op.$	Angle between[1] axis of *foramen magnum* and $N\gamma$	Angle between[2] axis of *foramen magnum* and GI
La Chapelle (cast) ...	♂?	1	43·7	89°·1	63°·5	− 6°·3	−14°·0
Neanderthal	♂?	1	42·7	92°·1	—	—	—
Spy I	♂?	1	41·2	94°·6	—	—	—
Gibraltar (cast) ...	♀?	1	46·7?	85°·5?	55°·8?	+ 2°·0?	−11°·4
La Quina (cast) ...	♀?	1	39·3	92°·5	—	—	—
Le Moustier Adolescent	?	1	48·1	83°·1	—	—	—
La Quina Child (cast)	?	1	—	—	53°·4?	+ 2°·7?	—
Moriori	♂	33	59·4	67°·5	50°·0	− 2°·5	−11°·6
Moriori	♀	21	59·3	69°·1	52°·5	0°·0	− 9°·2
Eskimos[3]	♂+♀	300	—	78°·6	51°·8	+ 2°·0	—
Tamils	♂	36	58·9	75°·5	51°·0	+ 7°·9	− 6°·0
Tibetans *B*	♂	15	55·2	78°·6	48°·9	+12°·5	− 3°·1
Tibetans *A*	♂	35	59·1	74°·5	50°·0	+ 8°·6	− 5°·3
Burmese *A*	♂	44	60·7	73°·6	51°·4	+ 6°·0	− 7°·7
Burmese *A*	♀	39	60·5	72°·9	50°·5	+ 8°·1	− 6°·8
Nepalese	♂	46	61·4	72°·9	50°·5	+ 8°·4	− 6°·5
Chinese (Hokien) ...	♂	35	60·1	74°·0	47°·7	+ 5°·4	− 8°·6
1st Dynasty Egyptians	♂	31	57·2	72°·9	48°·8	+ 5°·6	− 8°·4
Anglo-Saxons ...	♂	21	56·0	76°·1	49°·0	+ 7°·0	− 7°·8
Anglo-Saxons ...	♀	18	56·3	74°·5	48°·8	+ 7°·9	− 7°·4
Farringdon St. English	♂	70	58·4	71°·9	46°·5	+ 6°·5	−10°·1
Farringdon St. English	♀	62	58·1[3]	69°·5	45°·2	+10°·5[4]	− 7°·0

[1] This angle is positive if the opisthion is further removed from the $N\gamma$ line than the basion.

[2] This angle is positive if the opisthion is further removed from the GI line than the basion.

[3] The following additional mean values can be given for Schwalbe's index: Eskimos (Fürst and Hansen) ♂ 55·2 (182), ♀ 56·1 (158); Reihengräber (Hauschild) ♂ 57·2 (38), ♀ 57·1 (34); Prehistoric Swedish (Retzius and Fürst) ♂ 56·3 (41); Alsatians (Schwalbe, *loc. cit.* p. 39) ♂ 59·8 (21), ♀ 59·8 (10); Dschagga Negroes ♂ + ♀ 59·8 (23).

[4] The following additional mean values can be given for this angle: New Caledonians (Sarasin and Roux) ♂: + 3°·7 (87), ♀: + 6°·7(46); Australians (Pöch) ♂: + 3°·8 (19), ♀: + 6°·2 (12); Loyalty Islanders (Sarasin and Roux) ♂: + 6°·0 (33), ♀: + 9°·0 (26); Guanches (Detloff von Behr) ♂: + 7°·7 (73), ♀: + 7°·3 (39); Bavarians (Ranke, *Beiträge zur Anthropologie und Urgeschichte Bayerns*, Bd. x (1892), pp. 93–4) ♂: + 11°·9 (56). Reicher gives: Telenghites ♂: + 9°·1 (51), ♀: + 10°·8 (11); Buriats ♂: + 8°·0 (14), Kalmucks ♂: + 8°·7 (16), Torgods ♂: + 11°·8 (11). Lüthy (*Archiv für Anthropologie*, Bd. xxxix (1912), p. 35) provides the following means for unsexed series: Cameroon Negroes: + 1°·8 (36), Battaks (Sumatra): + 4°·5 (33), Dschagga Negroes: + 5°·1 (25); Swiss (Bündner): + 11°·1 (43).

a similar order but actually it makes hardly any distinction between the Moriori and an English series. The material is at present too meagre to warrant any definite conclusions. It may be noticed that for the angle $N\lambda I$, a criterion which makes a clear distinction between the Neanderthaloid and modern races, the Moriori are as far removed from that more primitive type as any for which data are available, so that the conclusions drawn from a comparison of angles involving the inion are entirely different from others suggested by a comparison of the angles $N\lambda Op.$, or that between the axis of the *foramen magnum* and the horizontal. While such a noticeable lack of correlation is found between very similar measurements we must needs hesitate before deciding to place our faith in one more than another.

11. *Summary of the Comparison of Single Measurements.*

The observed relationships between the measurements of skulls of the Neanderthaloid type and of modern racial types may be summarised as follows:

(*a*) *Size.* In absolute size nearly all the direct measurements of the adult Neanderthaloid skulls are greater than the mean values, for the same sex, that are recorded for modern races. Hence it is not surprising to find that a few characters of the larger individual specimens are distinctly removed from the distributions for all modern crania. The lengths differentiated in that way are, notably, the nasio-basion, nasio-alveolar and alveolar-basion chords, the nasal breadth, foraminal length and biasterionic breadth of the La Chapelle skull, which is probably of a larger size than the mean ♂ Neanderthaloid type; the biasterionic breadth of the Spy II skull and the nasio-alveolar length and nasal breadth of the Gibraltar skull if it be supposed ♀. On the other hand, there are certain calvarial measurements of the Mousterian crania—such as the basio-bregmatic height, the sagittal arc from nasion to opisthion and its three component arcs—which are peculiarly small so that few racial means are smaller than they. No new determinations of the cranial capacities are broached in this paper, but, from the various, and often widely differing estimates, given by anthropologists, it appears probable that the mean ♂ and ♀ capacities of the Neanderthaloid crania would fall within the inter-racial distributions for modern man. A comparison of the sizes of the facial skeleton and the brain-box is of great importance owing to its evolutionary significance. The area of the median sagittal section of the face is indicated well enough by the area of the fundamental triangle having nasion, basion and alveolar points as apices and it is markedly greater for the Neanderthaloid skulls than for any race of modern man. Its proportion to the area of the median sagittal section of the calvaria makes a still clearer distinction between the species. For these two characters—the absolute and proportional areas—the inter-racial distributions for modern man seem to be perfectly continuous and primitive races are not closer than advanced races to the aberrant Mousterian type. But the calvaria of the latter, though appearing strikingly wanting when seen in sagittal section, is "well-filled" transversely and the proportions of horizontal areas of the facial skeleton to the corresponding horizontal areas of the calvaria would seem to be no greater than for modern races. Judging from the length and breadth measurements, the orbital cavities of the Neanderthaloid skulls are no greater than those of the types of *Homo sapiens* with the largest faces and they are peculiarly *small* in proportion to the size of the face as a whole*. The palates also are not peculiarly large in proportion to the facial skeleton. In a general way, it may be said that these skulls are larger than all modern racial type skulls and they are particularly characterised by the absolutely and relatively large sizes of their facial skeletons.

(*b*) *Facial and Calvarial Breadths.* The proportions of calvarial breadths to one another, the proportions of facial breadths to one another and the proportions of facial to calvarial breadths furnish a number of indices of considerable importance and the greater number of them make no distinction between Mousterian and modern man. The only distinguishing features are found in the relatively greater biasterionic and nasal breadths of the more primitive skulls and, from a comparison of horizontal contours, it would seem that the former condition is associated with the fact that the greatest parietal breadth is peculiarly far back, though not higher or lower than

* In spite of the fact that this relation is confirmed by the measurements of all the Mousterian skulls which have the facial skeleton preserved, it is being continually stated that skulls of the Neanderthal type are characterised by their *large* orbits.

is usual for modern skulls. In view of their greater size, it is not surprising to find that calvarial breadths as great as those of the Neanderthaloid skulls are only found for markedly brachycephalic modern races. The marked falling in of the temporal areas which is a characteristic of many primitive types is not a feature of the archaic skulls and the peculiarly great extension of their superciliary ridges is not associated with any peculiar inter-breadth ratios. Not one of those indices, nor single absolute breadth, appears to be of any value as a criterion of the primitive status of modern racial types.

(*c*) *The Median Sagittal Section of the Calvaria.* The marked sagittal flattening of the Neanderthaloid skulls can be measured in a variety of ways: from the direct measurements—by the height-length indices and by expressing the glabella-occipital length as a percentage of the sagittal arc from nasion to opisthion—or, from the contours by using Schwalbe's index deduced from the glabella-inionic chord and the length of the greatest subtense from that chord to the vault and a similar index using the nasio-lambda chord, or, again, by angular measurements of the sagittal section. Nearly all such measures relegate the Mousterian skulls to positions which are entirely outside the inter-racial distributions for modern man although extreme individual specimens may be found having those characters almost, if not quite, as attenuated as the archaic crania. The same measurements arrange the modern races in orders which only indicate their primitive nature very roughly. In association with the extreme sagittal flattening of the vault when considered as a whole, the sections of the frontal and parietal bones are flatter than for all racial types, but individual modern skulls may be found having those characters equally extreme. The arcs from lambda to inion of the Neanderthaloid skulls appear to be peculiarly rounded and the total arcs from lambda to opisthion would also seem to be distinguished by their greater curvature. The Moriori type has flatter sagittal sections of the frontal and parietal bones than any other with which comparison has been made, but, in general, those two characters and the shape of the occipital bone are quite unreliable guides to the relative degrees of primitiveness of recent types. The proportions of the three segments of the total sagittal arc from nasion to opisthion to that arc and to one another do not differentiate the Mousterian skulls, but their arcs from lambda to inion may be peculiarly great in proportion to the total sagittal arc. The corresponding chords of the Mousterian skulls, however, are all peculiarly small in proportion to the glabella-occipital length—consequent on the greater flattening of the vault—and it cannot be said that primitive races stand closer in that respect to the archaic type than others. The position of the *foramen magnum* is a feature of prime evolutionary importance. From the sagittal contours it can be seen to be further back for the Mousterian skulls than for modern types and its axis for them is more rotated so that the basion is further removed from the cranial vault than the opisthion. The difference is not due to the smaller size of the occipital bone but to its rotation. Of the few type contours with which comparison can be made, that of the most primitive race—the Moriori—most resembles the contours of the Neanderthaloid skulls as regards the slope of the foraminal axis but not as regards the rotation of the occipital bone. The measurements of the median sagittal sections of the early Palaeolithic skulls show an intensification of the characters which are commonly recognised as primitive when shown by modern races, though it would seem that those characters are lowly correlated inter-racially and no combination of them can apparently provide a criterion which is any sure guide to the primitive nature of a modern type.

(*d*) *The Transverse Section of the Calvaria.* The Neanderthaloid skulls are apparently distinguished from all modern types by having a greater transverse flattening of the vault, more

vertical walls and a height that is peculiarly small in proportion to the breadth. There is no evidence to suggest that those characters distinguish modern primitive from advanced races.

(*e*) *The Proportions of Calvarial Lengths and Breadths.* The cephalic indices of the Mousterian skull exceed the means given for several modern races, but their low values are largely due to their peculiar increase in length due to the excessive development of the superciliary ridges. The horizontal sections behind the temporal diameter are similar, in their proportions of length and breadth, to those of modern races having cephalic indices close to the mean for all races. The possession of calvarial breadths which are peculiarly great by skulls having such low cephalic indices—whether the length measurement covers the supra-orbital region or not—is a feature which clearly differentiates the Neanderthaloid specimens. Another clear distinction is made by considering the breadth-length indices of the separate frontal, parietal and occipital bones: some fall entirely outside the inter-racial range for modern skulls and the others are only equalled by the indices of the most markedly brachycephalic types. The same measures for modern races do not seem to be in any way associated with the primitive nature of the types and we may conclude that the peculiar shaping of the component bones of the vaults of the archaic skulls is a feature which dissociates them entirely from the homogeneous group of modern man. When seen in sagittal section the cranial vaults of the Mousterian skulls are of a markedly depressed type, but the limitation of brain growth in that plane was compensated for by a peculiar development in the transverse and horizontal directions which allowed—in those directions—a greater growth of the brain than do modern crania. The foraminal index can only be given for the La Chapelle specimen and its extraordinarily low value seems to be well removed from the distribution for all modern skulls.

(*f*) *The Median Sagittal Section of the Facial Skeleton.* The measure of prognathism provided by the nasal angle—i.e. the angle subtended at the nasion by the basion and alveolar point—would seem to provide a better criterion of the primitive* nature of a modern racial type than any other single measurement of the skull. The few angles available for Mousterian crania are close to the mean for all races and the same is found for the other angles of the fundamental triangle. Judging by the profile angle, they are orthognathous. The proportion of the area of the facial section to the area of the median sagittal section of the calvaria is markedly greater for these skulls than for all of a modern type, as has been noted, and that proportion is greatest not for the most prognathous races, which are usually supposed the most primitive ones, but for several having intermediate nasal angles. Such are the Eskimos, Ainos, Northern Mongols, Moriori, Maori and Tibetans of the *B* type, and all would be classed among the more primitive races of mankind. The proportions of the nasal and sub-nasal chords to the upper facial height are again not distinctive, so a skull with a facial section precisely similar in *shape* to that of the La Chapelle individual might well be found among a modern population not possessing extreme characters.

(*g*) *Other Facial Measurements.* The nasal indices of the Mousterian skulls are high, but their mean would seem to be exceeded by those of most Negro and several Oceanic races. An inter-racial correlation of $+ 0{\cdot}747 \pm {\cdot}040$ is found between the index and the nasal angle and the points for the archaic skulls lie close to the regression line. The Mousterian upper facial indices ($100\ G'H/GB$ or $100\ G'H/J$) are distinctly greater than any recorded mean values for *H. sapiens*, the upper facial height being peculiarly great in proportion to all facial breadths. But inter-racially there is a *negative* correlation between the nasal and upper facial indices—supposed due

* The word *primitive* is used in this paper in the usual vaguely defined sense of *less evolved* and it is not for a moment suggested that it may be supposed synonymous with primigenious.

to "covering-factors"—so the points for the Neanderthaloid skulls are entirely removed from that regression line and there is nothing to suggest that primitive races diverge from the line in their direction any more than advanced races do. The orbital indices are within the range of mean values and the heights and breadths of the orbits are decidedly small in proportion to other facial chords. The nasal bones would seem to be peculiarly broad and flat. A comparison of these common measurements is sufficient to show that the form of the facial skeleton of Neanderthaloid man dissociates the type from the homogeneous one of modern man, and there is little, if any, suggestion that its peculiar proportions, when considered as a whole, are approached by those of primitive more than advanced modern races.

12. *To what Modern Races is the Mousterian Type most nearly allied?*

In comparing skulls which obviously occupy a lower position in the evolutionary scale than all those of recent man, it is of the utmost importance to bear in mind a fact which may have been long recognised but which has not yet been statistically proved. No study of any permanent value of the inter-racial distributions and correlations of cranial measurements has as yet been made. Judging from the material dealt with in the present paper, it would seem that the inter-racial distributions of all such characters—direct, angular and indicial—are continuous, uni-modal and possibly normal, though little stress can be laid on the last point as we cannot suppose that the sample considered represents even an approximately random one from the existing world-population of all racial types. We thus gain a conception of a single zoological type of which the modern races of man are variants and which is homogeneous in the same way that a population of individuals all of the same race is homogeneous. The relations of that type, which is usually labelled with the specific title *Homo sapiens*, to the type of Mousterian man are such that:

(i) For a considerable number of characters measuring the shape of the skull there is no distinction between the two. Such are notably the cephalic index, almost all the inter-breadth indices of the calvaria and face, the shape of the median sagittal section of the facial skeleton, the orbital and nasal indices and the inclination of the base of the frontal bone to the horizontal. For all such measurements the values available for Neanderthaloid skulls fall within the inter-racial distributions.

(ii) For a few measurements, *all of which are confined to the median sagittal section of the calvaria*, the values for the Neanderthaloid type fall outside the inter-racial distributions and there is a suggestion of a closer approach to the archaic type shown by modern primitive than by modern advanced races. The characters belonging to this class have reference to the flattening of the sagittal section of the vault as a whole and of the frontal and parietal segments of that arc, to the inclination of the sagittal axis of the *foramen magnum* to the horizontal and apparently to the backward rotation of the base of the occipital bone (the nasion-lambda-opisthion angle). For all these characters the distributions of mean values for modern races are perfectly continuous and there is no very clear distinction between advanced and primitive racial types.

(iii) For a somewhat larger number of characters the Mousterian skulls are clearly differentiated from the homogeneous modern population but there is not the slightest suggestion that modern primitive races are any closer to the aberrant type than modern advanced races are. Such are, notably, the length-breadth indices of the frontal, parietal and occipital bones, the foraminal index, the upper facial index, the association of facial and nasal indices that are both large, the transverse flattening of the vault, the nasion-lambda-inion angle and, it may be added, the absolute size.

And, fourthly, there is another consideration of importance. If single measurements, or

combinations of measurements, can be found which will indicate, in a more or less satisfactory way, the relative degrees of primitiveness of modern racial types, then how do they compare with the measurements of the Neanderthaloid skulls? Of the calvarial measurements to which craniometricians have hitherto restricted themselves, those indicating the sagittal flattening of the vault and the angle between the sagittal axis of the *foramen magnum* and the horizontal are the only ones which appear to perform that function in even the roughest way and for them the Neanderthaloid skulls show values which indicate an intensification of the characters most commonly met with among primitive races. But better criteria are furnished by the nasal angle and—to a lesser extent—by the nasal index and for these two the Neanderthaloid values fall within the inter-racial distributions and they are not far removed from the means for all races.

The characters falling in the first of the classes above are sufficiently numerous to demonstrate the close zoological relationship of Neanderthaloid and modern man. There is a distinct danger in laying too great a stress on the characters of the second class. We get from them a conception of a linear arrangement of all human types which may not correspond at all to any evolutionary reality and no one of them is capable of arranging the modern types in as suggestive an order as that given by the nasal angle. When confronted with the relations of the third class we are tempted to conclude that they warrant the removal of the Neanderthaloid type from the single plane in which all modern races may be supposed to lie to an entirely different one. That conclusion, which we have reached by using purely statistical methods, may well be summarised in the words of one of the greatest living authorities on fossil man who has investigated these problems from a different point of view.

"Un premier fait est que le type fossil diffère beaucoup plus de tous les types d'aujourd'hui que ceux-ci ne diffèrent entre eux. On constate, entre les termes extrêmes de la série des crânes actuels, toutes les formes de passage, tandis que cette série se sépare nettement du groupe des crânes fossiles par une sorte d'hiatus correspondant à une véritable rupture morphologique." *

Admitting that there is an hiatus between the two types which is wide enough to make it necessary to relegate them to different species, the question whether any particular modern type resembles the Neanderthaloid more closely than the remaining races do may still be asked. From the foregoing comparison of single measurements one receives a strong impression that there is no particular one more than another which has a complex of characters indicating a peculiarly close approach to the type of the Mousterian skulls. But to answer the question with precision it will be necessary to make a further statistical comparison. Of the ♂ Neanderthaloid skulls there is only one—the La Chapelle—for which nearly all the usual measurements can be given. A coefficient based on a number of those measurements and expressing the divergence of the archaic skull from the mean type of a particular race will serve the required purpose. If L be a measurement of the La Chapelle skull and M_A and σ_A are the ♂ mean and standard deviation respectively for a particular race A, then $(M_A - L)/\sigma_A$ may be taken to indicate a significant difference if it be greater than 3. If n measurements be compared then $\frac{1}{n} \times \Sigma_n \frac{(M_A - L)^2}{{\sigma_A}^2} = \beta$, say, will provide a suitable measure of the divergence of the Neanderthaloid skull from the mean type of that race. The n characters chosen should, if possible, be little correlated one with another†. As

* Marcellin Boule, *Les Hommes Fossiles*, 2nd edition, Paris, 1923, p. 243.

† The following 24, or as many of them as were available for the particular race, were used in this comparison. Definitions of the measurements are given in Appendix I. 100 B/L, 100 H'/L, 100 B/H', *Oc. I.*, 100 $G'H/GB$, 100 NB/NH, R or 100 NB/NH', 100 O_2/O_1, R or 100 O_2/O_1', 100 *fmb/fml*, $N \angle$, $A \angle$, L, B, B', H', S, U, LB, O_1R or $O_1'R$, O_2R, $G'H$, NH, R or NH', NB, *fmb*, *fml*.

standard deviations have only been given for a few of the series, it is advisable to use the same set in calculating all the β's. The constants for the longest series available, namely: the Egyptian series of 26th–30th Dynasties skulls (reference 24 (*i*) in Appendix III), were selected for that purpose. The following values of β were found for 23 racial series. Not all the 24 characters were available for some of the series, but no coefficient is given based on fewer than 18.

7–8	Moriori (7·65), Anglo-Saxons (7·81)
8–9	Farringdon St. English (8·02), Fuegians[1] (8·52), Reihengräber (8·68), Kaffirs (8·83)
9–10	Telenghites (9·02), Guanches (9·27), 26th–30th Dynasties Egyptians (9·88), Aino (9·92)
10–11	Maori (10·32), Cameroon Negroes (10·84), British Neolithic (10·93), Australians (Duckworth) (10·94)
11–12	Eskimos (11·15), Loyalty Islanders (11·29), Swiss (Pittard) (11·51), Czechs (11·58), Southern Chinese (11·62), New Caledonians (11·92), Gaboon Negroes (11·93)
Over 12	Congo Negroes (12·57), Veddahs (16·22)

[1] Revised and unpublished pooled means were used in this comparison.

The values of the coefficient β calculated for the La Chapelle skull show an unexpectedly great range, but they form a series which is quite continuous. There is no one race or group of races which is characterised by possessing characters peculiarly similar to those of the Neanderthaloid type. The fact that the latter diverges least from the Moriori would seem at first to be suggestive, but then the next closest resemblance is found to European types. The Australians* come nearly in the middle of the scale and the New Caledonians and some Negro types are particularly far removed. The coefficient fails entirely to distinguish between the different families of allied races and this suggests, perhaps, that no great significance can be attached to the order in which it arranges the individual races. The Neanderthaloid type seems to stand appreciably closer to some modern racial types than to others, but it would be rash to suppose that any difference in the intimacy of the blood relationship is indicated by that fact. The evidence is sufficient, at any rate, to dispose of the idea that modern primitive races, considered as a group, form a link between the Neanderthaloid type and modern advanced races. Without a knowledge of the forms leading to the Upper Palaeolithic skull, it is not possible to determine the relationship of the two species. The links may already be preserved in our museums or they may be waiting discovery in late Quaternary deposits.

13. *Conclusions.*

(*a*) The available measurements of the skulls of Mousterian man indicate that the type was remarkably homogeneous.

(*b*) Between it and all modern racial types there is a distinct hiatus, which may be taken to indicate a specific difference.

(*c*) There are four salient ways in which the cranium of *H. sapiens* is distinguished from the crania of non-human species: the frontal bone is more vertical, the facial skeleton is smaller compared with the size of the brain-box, the *foramen magnum* slopes slightly forwards instead of backwards and the face descends almost vertically instead of projecting in the form of a muzzle.

* The supposed peculiar resemblance of the Australian skull to the type represented by the Neanderthal skull cap was suggested by Huxley and accepted by de Quatrefages at a time when the comparative material was extremely scanty. No Neanderthaloid skull possessing the facial skeleton was considered known as the Gibraltar was not recognised to be of that type. The hypothesis has been worked to death by some later writers who give the impression that they consider the Australian to be an ultra-primitive type which is distinguished from all others by its inferior characters. Judging by the cranial measurements dealt with in earlier sections of this paper, and others collected since they were prepared, there is no statistical justification whatever for that supposition. The Australian skull is certainly a primitive one, but it is a true member of the homogeneous group of modern man. The close similarity of Australian skulls to the Mousterian specimens is evident when *some calvarial* characters are considered, but it breaks down entirely when comparison is also made between the facial skeletons.

For the first two, and possibly the third also, the Neanderthaloid skull is of a form intermediate between those of *H. sapiens* and the sub-human types. For the fourth, however—the prognathism of the jaws—no distinction is made between Mousterian and modern man. The last happens to be the character which seems to be most capable of distinguishing primitive and advanced modern races.

(*d*) Some modern races resemble the Neanderthaloid type more closely than others do, but there is no race, or group of races, which is particularly distinguished in that way. Without further evidence, it cannot be supposed that a closer resemblance to that type is any criterion of closer blood relationship.

(*e*) The working hypothesis that Mousterian man is equally related to all races of *H. sapiens* would seem to be the safest to adopt in the present state of our knowledge. In that case it is impossible to decide whether *H. neanderthalensis* has been a stage in the direct line of human descent or not. The discovery of transitional forms between the two species could alone decide that question.

APPENDICES.

I. INDIVIDUAL MEASUREMENTS OF NEANDERTHALOID SKULLS.

In the following table are given original measurements of the La Chapelle, Neanderthal, Spy I and II, Gibraltar, La Quina and Le Moustier skulls and of plaster casts of the Galilee and juvenile La Quina specimens. They comprise all for which adequate comparative modern material is available. The technique of measurement employed was precisely similar to that of workers in the Biometric Laboratory, with some additions, except that the craniophor measurements could not be taken owing to the fragility and preciousness of the material. Good approximations to several of those measurements could be obtained from the sagittal contours. The numbers of the measurements according to the instructions of the late Professor Rudolf Martin (*Lehrbuch der Anthropologie* (1914), pp. 504–574) are given in the third column and, with one or two exceptions, they are identically the same in definition and actuality as those of the biometric scheme. Our auricular points (meas. (xx), (xxii) and (lxiii) in the table below) are the true *Frankfurt Verständigung* points from which the standard horizontal plane is determined: they are the porions of Martin (p. 512) and not his auricular points. The orbital breadths (xxxvi) were found by Fawcett's curvature method (*Biometrika*, Vol. I (1902), p. 430 and Vol. VIII (1912), pp. 311–12). Martin's measurement No. 51 is taken from the point—his *maxillofrontale*—where the pencil line used in the curvature method crosses the fronto-maxillary suture. In general that could not be determined on the abraded Neanderthaloid skulls but, when it was possible to locate it, the chord was identically the same as the one determined by the biometric method. The true alveolar point (see Karl Pearson, "The Definition of the Alveolar Point," *Biometrika*, Vol. XVII (1925), pp. 53–6), i.e. the lowest mesial point or tip of the process of bone between the middle incisors, was used for measurements (xlvii), (xlix) and (liii); Martin uses the same point for the upper facial height but his prosthion for the other two. Measurements followed by one question mark may be considered close approximations to the true values; doubly queried ones are very uncertain and many of them are inaccurate, in the writer's opinion owing to faulty reconstruction. The chords or arcs marked with an asterisk (*) have one or both terminals on a surface restored with plaster: a dagger (†) denotes that one terminal is not on the extant bone or plaster. The following remarks refer to the location of doubtful "points."

La Chapelle. The positions of both asteria are uncertain. Following Boule, the accepted lambda was a point, near the centre of the small ossicle of lambda, marking the join of the continued lines of the two halves of the lambdoid suture. The transverse occipital ridges of all the Neanderthaloid skulls are very similar in conformation and characteristically different from the form usually found on skulls of a modern type. The accepted inions were determined "en absence de protubérance occipitale externe, par le point de réunion des lignes courbes supérieures. Le changement de courbure ne coïncide donc pas avec l'inion externe, comme chez tous les singes anthropoïdes et, semble-t-il, chez le Pithécanthrope; il y a une importante saillie sus-iniaque" (Boule (1911), p. 33)*.

Neanderthal. The position of the bregma is uncertain as the sagittal suture is almost completely closed, though the coronal can be clearly traced. The positions of the asteria cannot be found with any approach to accuracy.

Spy I. There are small restored surfaces at both lambda and bregma, so the positions of those points are not definitive, but they can be approximated to with fair accuracy. The left wall of the skull-cap is almost entirely restored with plaster which gives the whole a symmetrical outline. The nasal process of the frontal bone is apparently complete down to the naso-frontal suture so the nasion can be taken to be a point on the extant bone. The position of the fragment of the outer wall of the right orbit is extremely doubtful: it is joined to the frontal above but has no contact with it behind. The positions of the asteria are very doubtful. The accuracy of the reconstruction of the calvarial walls may be questioned (see p. 342 above).

* This reference is given in Appendix II below.

Measurements of Neanderthaloid Skulls.

Measurements	Bio-metric Labor-atory Index Letter	Martin's No.	La Chapelle	Neander-thal	Spy I	Spy II	Gibraltar	La Quina	Le Moustier: Adolescent	Galilee: Cast	La Quina Child: Cast
Supposed sex	—	—	♂	♂	♂	♀	♀	♀	?	?	?
(i) Glabella-occipital Length:											
(*a*) Median Sagittal	*L*	1	207·7	199·2	200·6	200·0??	192·5?	204·2	195·9	—	171·4
(*b*) Greatest	—	—	209·8 (*R*)	201·1 (*R*)	202·1 (*L*)	—	192·5?	204·2	196·7 (*R*)	—	171·4
(ii) Ophryo-occipital Length:											
(*a*) Median Sagittal	*F*	1 *b*	193·2	186·4	187·1	185·1	183·3?	186·5	187·7	—	168·1
(*b*) Greatest	—	—	197·0 (*R*)	188·2 (*R*)	188·5 (*L*)	186·6 (*L*)	184·4?(*L*)	186·5	188·6 (*R*)	—	168·1
(iii) Greatest Parietal Breadth	*B*	8	156·2	146·7	*144·3?	153·2	*149·0???	138·3?	150·1?	—	131·8
(iv) Least Frontal Breadth	*B′*	9	109·2	105·0?	*101·1??	107·9	†102·5??	101·2	107·4	98·1	88·0
(v) Chord Nasion to Bregma	S_1'	29	106·9	117·4?	102·8?	—	—	106·4?	108·2?	113·9?	95·1?
(vi) Chord Bregma to Lambda	S_2'	30	111·8	102·9?	114·9?	109·0	—	102·9?	109·2?	—	92·3?
(vii) Chord Lambda to Opisthion	S_3'	31	91·2	—	—	—	81·1?	—	—	—	—
(vii *a*) Chord Lambda to Inion	—	31 (1)	66·2	53·9	55·1?	52·5	54·6?	57·8	57·2	—	—
(viii) Chord Inion to Opisthion	—	31 (2)	41·5	—	—	—	44·6?	—	—	—	—
(ix) Arc Nasion to Bregma	S_1	26	120·5	133·0?	110·0?	—	—	116·3	120·2?	125·0?	107·5?
(x) Arc Bregma to Lambda	S_2	27	118·5	109·8?	126·0?	115·0	—	106·9?	121·8?	—	99·2?
(xi) Arc Lambda to Opisthion	S_3	28	116·3?	—	—	—	106·0?	—	—	—	—
(xii) Arc Lambda to Inion	—	28 (1)	74·0	57·2	58·5?	55·0	60·0?	66·3	63·0	—	—
(xiii) Arc Inion to Opisthion	—	28 (2)	42·5?	—	—	—	46·0?	—	—	—	—
(xiv) Arc Nasion to Opisthion	*S*	25	355·5	—	—	—	*342·0???	—	—	—	—
(xv) Horizontal Circumference through Ophryon	*U*	23 *a*	563·0	537·5	*538·5?	545·5	*522·0??	524·0	534·0??	—	484·0
(xvi) Horizontal Circumference through Glabella	—	23	602·5	578·0?	*589·0??	—	—	558·0	—	—	—
(xvii) Greatest Frontal Breadth	*B″*	10	123·6	122·3	—	125·9	†122·5???	†108·3??	121·2??	113·9	109·1
(xviii) Inner Biorbital Breadth	*IOW*	43 (1)	113·5	110·8	109·0?	—	106·1?	100·9	105·9?	110·8	83·7
(xix) Outer Biorbital Breadth	*EOW*	43	119·6	118·8?	119·4?	—	115·0?	108·9?	115·7?	119·9?	—
(xx) Biauricular Breadth	—	—	132·0	—	124·2??	135·0	—	112·1??	133·3	—	95·8
(xxi) Biasterionic Breadth	—	12	130·5	—	121·2??	131·2??	—	112·4??	—	—	—
(xxii) Transverse arc from Auricular Point to Auricular Point through Bregma	—	24	314·5	—	300·0??	315·5	—	301·5	—	—	283·5
(xxiii) 100 *B*/*L*	—	—	75·2	73·6	71·9?	76·6??	77·4???	67·7?	76·6	—	76·9
(xxiv) 100 *B*/*F*	—	—	80·8	78·7	77·1?	82·8	81·3??	74·2?	80·9	—	78·4
(xxv) 100 *B′*/*B*	—	—	69·9	71·6?	70·1?	70·4	68·8???	73·2?	71·6	—	66·8
(xxvi) 100 S_2'/S_2	—	—	94·3	93·7?	91·2?	94·8	—	96·3	89·7?	—	93·0?
(xxvii) Occipital Index	*Oc. I.*	—	56·0	—	—	—	55·0?	—	—	—	—
(xxviii) Basio-Bregmatic Height	*H′*	17	130·0	—	—	—	—	—	128·5??	—	122·3?
(xxix) Vertical Height from Basion	*H*	18	?	—	—	—	—	—	127·2??	—	124·8?
(xxx) 100 *H′*/*L*	—	—	62·6	—	—	—	—	—	65·6??	—	71·4?
(xxxi) 100 *H*/*L*	—	—	?	—	—	—	—	—	64·9??	—	72·8?
(xxxii) 100 *B*/*H′*	—	—	120·2	—	—	—	—	—	116·8??	—	107·8?
(xxxiii) 100 *B*/*H*	—	—	?	—	—	—	—	—	118·0??	—	105·6
(xxxiv) Chord Nasion to Basion	*LB*	5	123·4?	—	—	—	—	—	124·0??	—	94·9
(xxxv) Bizygomatic Breadth	*J*	45	151·9??	—	—	—	—	126·5??	148·0??	—	—
(xxxvi) Orbital Breadths by Curvature Method	*R*	O_1R	46·9?	—	—	—	46·1	—	—	44·2	33·9
	L	O_1L	46·7?	—	—	—	44·7	—	—	—	38·9

(xxxvii) Orbital Heights perpendicular to O_1R and O_1L	R	O_2R	52	37·1	—	—	—	38 9?	36·0?	—	34·9	35·9
	L	O_2L	52	37·2	—	—	—	37·9	37·2?	—	—	31·1
(xxxviii) 100 O_2/O_1, R		—	—	79·1?	—	—	—	84·4?	—	—	79·0	105·9
(xxxix) 100 O_2/O_1, L		—	—	79·7?	—	—	—	84·8	—	—	—	79·9
(xl) Simotic Chord: least Breadth of Nasal Bones		SC	57	—	—	—	—	13·9	—	—	13·8??	—
(xli) Palate Breadth between Mid-Points of inner alveolar walls of 2nd Molars		G_2	63	—	—	—	—	45·0??	43·8	50·0	—	—
(xlii) Palate Length from Base of Posterior Nasal Spine to line tangential to inner Alveolar Walls of Middle Incisors		G_1'	62	—	—	—	—	—	—	56·8??	—	—
(xliii) Depth of Palate below Chord (xli): with Uraniscometer		EH	—	—	—	—	—	—	—	11·7	—	—
(xliv) 100 G_2/G_1'		—	—	—	—	—	—	—	—	88·0??	—	—
(xlv) 100 EH/G_2		—	—	—	—	—	—	—	—	23·4	—	—
(xlvi) Breadth between lowest points of Malar-maxillary Sutures		GB	46	110·0?	—	—	—	96·0?	78·0???	—	—	—
(xlvii) Upper Facial Height from Nasion to Alveolar Point		$G'H$	48	87·8?	—	—	—	78·5??	—	—	—	58·0
(xlviii) 100 $G'H/GB$		—	—	79·8?	—	—	—	81·8??	—	—	—	—
(xlix) Chord from Tip of Anterior Nasal Spine to Alveolar Point		PH	—	29·3?	—	—	—	25·2??	—	—	—	13·9
(l) Nasal Height from Nasion to Base of Anterior Nasal Spine		NH'	55	60·9	—	—	—	55·5	—	—	—	44·9
(li) Nasal Height from Nasion to Lowest Border of Aperture	R	NH,R	—	62·2	—	—	—	57·9	—	—	—	44·9
	L	NH,L	—	62·9	—	—	—	57·8	—	—	—	46·8
(lii) Nasal Breadth		NB	54	33·9	—	—	—	34·2	—	—	—	23·1
(liii) Chord from Basion to Alveolar Point		GL	—	124·8?	—	—	—	—	—	—	—	84·7
(liv) 100 NB/NH'		—	—	55·7	—	—	—	61·6	—	—	—	51·4
(lv) 100 NB/NH, R		—	—	54·5	—	—	—	59·1	—	—	—	51·4
(lvi) 100 NB/NH, L		—	—	53·9	—	—	—	59·2	—	—	—	49·4
(lvii) Angle subtended at Nasion by Basion and Alveolar Point		$N\angle$	—	69°·8?	—	—	—	—	—	—	—	61°·5
(lviii) Angle subtended at Alveolar Point by Nasion and Basion		$A\angle$	—	68°·4?	—	—	—	—	—	—	—	81°·5
(lix) Angle subtended at Basion by Nasion and Alveolar Point		$B\angle$	—	41°·7?	—	—	—	—	—	—	—	37°·0
(lx) Length of *foramen magnum*		*fml*	7	48·9?	—	—	—	—	—	—	—	34·2
(lxi) Breadth of *foramen magnum*		*fmb*	16	32·4?	—	—	—	—	—	—	—	—
(lxii) 100 *fmb/fml*		—	—	66·2?	—	—	—	—	—	—	—	—
(lxiii) Vertical Transverse Arc from Auricular Point to Auricular Point		Q'	24 *b*	?	—	—	—	—	—	—	—	296·5
(lxiv) Orbital Breadth from Dacryon	R	$O_1'R$	—	45·9	—	—	—	42·2??	—	—	—	—
	L	$O_1'L$	—	45·9??	—	—	—	—	—	—	—	—
(lxv) 100 O_2/O_1', R		—	—	80·8	—	—	—	92·2??	—	—	—	—
(lxvi) 100 O_2/O_1', L		—	—	81·0??	—	—	—	—	—	—	—	—
(lxvii) Chord Dacryon R to Dacryon L		DC	49 *a*	23·0?	—	—	—	24·8??	—	—	—	—
(lxviii) Subtense of Simotic Chord (xl)		SS	—	—	—	—	—	4·4?	—	—	—	—
(lxix) 100 SS/SC		—	—	—	—	—	—	31·7?	—	—	—	—

Spy II. The glabella region is defective but the ophryon is apparently a point on the extant bone. The positions of both asteria are very uncertain. As restored, the left parietal and frontal bones are wider apart than they can have been on the perfect skull.

Gibraltar. Sutures difficult to trace owing to abrasion of bone and covering with deposit. The nasion can be accurately found. The lowest points of the malar-maxillary sutures are uncertain and the one on the left side was taken just off the extant bone. The accepted alveolar point was one in the air nearly 5 mm. below the lowest point on the extant bone. The positions of the dacrya are extremely uncertain: the left dacryon is covered with deposit. The opisthion can be located with certainty. A section having been cut through the bone round the inion the point is now in the air, but it is only just off the extant bone. The accepted lambda was the highest point of the existing occipital fragment in what was judged to be the median sagittal plane; its position is uncertain.

La Quina. The accepted nasion was a point in the air 1 mm. below the eroded edge of the frontal bone. The positions of the asteria are uncertain. The accuracy of the reconstruction of the calvarial walls may be questioned (see p. 342 above) and, if inaccurate, all breadth measurements would be affected. The outer fragments of the orbits as restored are certainly too close to one another and the facial breadth measurement (xlvi) is probably much too small.

Le Moustier. The position of the bregma is very uncertain and as at present reconstructed (by Weinert) the frontal may be too far removed from the parietals. The left side of the calvaria, consisting of temporal, frontal and occipital fragments, is detached from the remainder, the only contact being made by a short length of the occipital bone. All calvarial breadth measurements are hence uncertain. When found, the palate was complete, but owing to successive reconstructions the posterior spine has vanished and the hinder border has become considerably abraded so that no accurate palatal lengths can be taken.

Galilee Cast. The hinder border of the frontal bone is complete so the bregma was taken to be the point on it in what was judged to be the median sagittal plane.

La Quina Child Cast. However excellent a cast may be the "points" on it are nearly always uncertain, as the reproduction of the lines of the sutures is never perfect, and it is difficult to estimate the reliability of the reconstruction. The positions of both nasion and lambda on this cast are particularly uncertain.

II. REFERENCES TO PAPERS GIVING MEASUREMENTS OF NEANDERTHALOID SKULLS.

The following list gives the titles of the earlier papers providing the most complete measurements of the Mousterian skulls. Many of the measurements previously published—often without being queried—are so uncertain that it was thought better not even to approximate to them. The abbreviations are the same as those used in the bibliography of modern racial series (Appendix III below).

Galilee. Sir Arthur Keith: Report on the Galilee Skull, in *Researches in Prehistoric Galilee*, 1925–6, by F. Turville Petre, British School of Archaeology in Jerusalem, London, 1927.

Gibraltar. W. J. Sollas: On the Cranial and Facial Characters of the Neanderthal Race. *Philosophical Transactions of the Royal Society of London*, Series B, Vol. CXCIX, 1908. G. L. Sera: Nuove Osservazioni ed Induzioni sul Cranio di Gibraltar. *A.p.A.* Vol. XXXIX, 1909.

Krapina. Gorjanović-Kramberger: Der paläolithische Mensch und seine Zeitgenossen aus dem Diluvium von Krapina in Kroatien. *M.A.G.W.* Bd. XXXI, 1901; Bd. XXXII, 1902. Gorjanović-Kramberger: *Der diluviale Mensch von Krapina. Ein Beitrag zur Palăoanthropologie.* Wiesbaden, 1906.

La Chapelle. Marcellin Boule: L'Homme fossile de La Chapelle-aux-Saints. Paris. Offprinted from *Annales de Paléontologie*, T. VI, 1911; T. VII, 1912; T. VIII, 1913.

La Quina. Henri Martin: *Recherches sur l'évolution du moustérien dans le gisement de La Quina* (Charente). T. III, *L'Homme fossile*, T. IV, *L'enfant fossile de La Quina*, Paris, 1923 and 1926.

Le Moustier. Hans Weinert: *Der Schädel des eiszeitlichen Menschen von Le Moustier in neuer Zusammensetzung.* Berlin, 1905. (Weinert gives full references to papers providing measurements of the earlier reconstructions of the Le Moustier skull.)

Neanderthal. R. Virchow: Untersuchung des Neanderthal-Schädels. *Z.f.E.* Bd. IV, 1872. *Verhandlungen*, pp. 157–165.

G. Schwalbe: Studien über Pithecanthropus erectus Dubois. *Z.f.M.* Bd. I, 1899.

Spy. Julien Fraipont and Max Lohest: La Race Humaine de Néanderthal ou de Canstadt en Belgique. Recherches ethnographiques sur les ossements humains, découverts dans des dépôts quaternaires d'une grotte à Spy et détermination de leur âge géologique. *Bulletins de l'Académie royale de Belgique*, 3ième série, T. XII, No. 12, 1886.

III. BIBLIOGRAPHY OF BOOKS AND PAPERS GIVING MEASUREMENTS OF MODERN RACIAL SERIES OF SKULLS.

In the following list references are given to all the sources from which measurements of modern cranial series used in this paper were taken. The skulls are of Neolithic or later date. The numbers of skulls given for each series are the totals measured, but several of the means, particularly of facial measurements, are based on rather smaller populations. Few were used which were not represented by 30 or more skulls. The numbers of ♀'s are only given for series long enough to provide fairly reliable sexual differences. All measurements which are doubtful owing to inadequate definitions of the methods by which they were taken were excluded.

The following abbreviations are used: *A.f.A.* = Archiv für Anthropologie, *A.p.A.* = Archivio per l'Antropologia e la Ethnologia, *A.S.D.* = Die Anthropologischen Sammlungen Deutschlands, being supplements to *A.f.A.*, *Bm.* = Biometrika, *B.S.A.P.* = Bulletins de la Société d'Anthropologie de Paris, *C.E.* = Crania Ethnica. Les Crânes des Races Humaines, 1882, *J.A.I.* or *J.R.A.I.* = Journal of the

Anthropological Institute, or Journal of the Royal Anthropological Institute, *M.A.I.S.* = Mémoires de l'Académie Impériale des Sciences de St Pétersbourg, *M.A.G.W.* = Mitteilungen der Anthropologischen Gesellschaft in Wien, *Z.f.M.* = Zeitschrift für Morphologie und Anthropologie.

1. *Abyssinians.* Sergio Sergi: *Crania Habessinica. Contributo all' Antropologia dell' Africa Orientale,* 1912. 70 ♂ from Tigre district; means given in *Bm.* Vol. XVII (1925), p. 36.

2. *Aino.* (*a*) Koganei: Beiträge zur physischen Anthropologie der Aino. *Mitteilungen aus der medicinischen Facultät der k. j. Universität.* Tokio, Bd. II (1894). 88 ♂ and 63 ♀.

(*b*) Tarenetzky: Beiträge zur Craniologie der Ainos auf Sachalin. *M.A.I.S.* VII^e série, T. XXXVII (1890). 25 ♂ giving some characters not measured by Koganei.

3. *Aleuts.* Hrdlička: Catalogue of Human Crania in the United States National Museum Collections. *Proceedings of the United States National Museum,* Vol. LXIII (1924). 25 ♂.

4. *Alsatians.* (*a*) *A.S.D.* Strassburg Katalog. 34 ♂.

(*b*) Adams: Über postembryonale Wachstumsveränderungen und Rassenmerkmale im Berichte des menschlichen Gesichtsschädels. *Z.f.M.* Bd. XX (1917). 95 ♂ and 53 ♀.

5. *Anglo-Saxons.* Morant: A First Study of the Craniology of England and Scotland from Neolithic to Early Historic Times, with Special Reference to the Anglo-Saxon Skulls in London Museums. *Bm.* Vol. XVIII (1926). 112 ♂.

6. *Angoni Negroes.* Shrubsall: A Study of A-Bantu Skulls and Crania. *J.A.I.* Vol. XXVIII, 1898. Means given *Bm.* Vol. VIII (1912), p. 299. 25 ♂.

7. *Annamese.* Means reduced from measurements of various writers. *Bm.* Vol. XVI (1924), p. 48.

8. *Arabs.* Quatrefages and Hamy: *C.E.* p. 514. 28 ♂.

9. *Ashanti Negroes.* Shrubsall: Notes on Ashanti Skulls and Crania. *J.A.I.* Vol. XXVIII (1898). 58 unsexed.

10. *Australians.* (*a*) Duckworth: A Critical Study of the Collection of Crania of Aboriginal Australians in the Cambridge University Museum. *J.A.I.* Vol. XXIII (1893). 29 ♂.

(*b*) Quatrefages and Hamy: *C.E.* p. 323. 22 ♂.

(*c*) Pöch: Studien an Eingeborenen von Neu-Südwales und an australischen Schädeln. *M.A.G.W.* Bd. XLV (1915). 21 ♂, 11 ♀, 9 unsexed. Combined means used.

11. *Austrians.* Weisbach: Beiträge zur Kenntniss der Schädelformen österreichischer Völker. *Zeitschrift der k. k. Gesellschaft der Ärzte in Wien. Medizinische Jahrbücher.* XX Jahrgang. 1 Bd. (1864). 50 ♂.

12. *Badensians. A.S.D.* Heidelberg Katalog (1896). 99 ♂.

13. *Basques.* Unpublished measurements of 39 ♂ skulls in Musée Broca, Paris.

14. *Bavarians.* (*a*) Ranke: *Beiträge zur physischen Anthropologie der Bayern,* Bd. I (1892?), being offprints from *Beiträge zur Anthropologie und Urgeschichte Bayerns* (1883, etc.). Altbayerisch. 100 ♂ and 99 ♀.

(*b*) *Ibid.* pp. 222–5. Waischenfeld. 57 ♂ and 42 ♀.

15. *Berbers.* Unpublished measurements of 29 ♂ skulls in Musée Broca, Paris.

16. *British Iron Age.* Morant: *loc. cit.* (5). 102 ♂. Reduced means.

17. *British Neolithic.* Morant: *loc. cit.* (5). 116 ♂. Reduced means.

18. *Buriats.* Reicher: Untersuchungen über die Schädelform der alpenländischen und mongolischen Brachycephalen. *Z.f.M.* Bd. XV (1913) with additions. Reduced means *Bm.* Vol. XVI (1924), p. 67. 31 ♂.

19. *Burmese A.* Tildesley: A First Study of the Burmese Skull. *Bm.* Vol. XIII (1921). 45 ♂ and 39 ♀.

20. *Cameroon Negroes.* Drontschilow: Metrische Studien an 93 Schädeln aus Kamerun. *A.f.A.* Bd. XL (1913). 90 ♂.

21. *Chinese.* (*a*) Koganei: Kurze Mitteilung über Messungen an männlichen Chinesen-Schädeln. *Internationales Centralblatt für Anthropologie und Verwandte Wissenschaften,* Bd. VII (1920). Means *Bm.* Vol. XVI (1924), p. 48. 70 ♂.

(*b*) Reduced means of other Northern Chinese skulls. *Bm.* Vol. XVI (1924), p. 48. 46 ♂.

(*c*) Harrower: A Study of the Hokien and Tamil Skull. *Transactions of the Royal Society of Edinburgh,* Vol. LIV, No. 13 (1926). 36 ♂.

(*d*) Reduced means of other Southern Chinese skulls. *Bm.* Vol. XVI (1924), p. 48. 120 ♂.

22. *Congo Negroes.* Benington: A Study of the Negro Skull with Special Reference to the Congo and Gaboon Crania. *Bm.* Vol. VIII (1912). 50 ♂.

23. *Czechs.* Schiff: Beiträge zur Kraniologie der Czechen. *A.f.A.* Bd. XXXIV (1912). 108 ♂ and 53 ♀.

24. *Egyptians.* Where not provided by writers who published individual measurements, means given by Morant: A Study of Egyptian Craniology from Prehistoric to Roman Times. *Bm.* Vol. XVII (1925).

(*a*) *Aeneolithic.* Fouquet in J. de Morgan's *Recherches sur les Origines de l'Egypte.* (1) L'Age de la Pierre et les Métaux (1896). (2) Ethnographie Préhistorique et Tombeau Royal de Négadah (1897). Pooled means of Kawamil, Beit-Allam and Naqada South skulls. 60 ♂.

(*b*) *Naqada Predynastic.* Fawcett: A Second Study of the Variation and Correlation of the Human Skull with Special Reference to the Naqada Crania. *Bm.* Vol. I (1902). 140 ♂ and 185 ♀.

(*c*) *Late Predynastic.* Thomson and MacIver: *The Ancient Races of the Thebaid* (1905). 127 ♂ and 137 ♀.

(*d*) *First Dynasty.* Motley in *Bm.* Vol. XVII (1925), p. 24. 37 ♂.

(*e*) *Early Dynasties.* Toldt: Anthropologische Untersuchung der Menschlichen Ueberreste aus den Altägyptischen Gräberfeldern von El-Kubanieh. *Denkschriften der Akademie der Wissenschaften in Wien. Mathematisch-naturwissenschaftliche Klasse.* Bd. XCVI (1919). El-Kubanieh South series. 70 ♂ and 50 ♀.

(*f*) *Middle Dynasties.* Toldt: *Ibid.* El-Kubanieh North series. 37 ♂.

(*g*) *18th–20th Dynasties.* Stahr: *Die Rassenfrage im antiken Aegypten.* Leipzig (1907). 59 ♂.

(*h*) *18th–21st Dynasties. A.S.D.* Leipzig Katalog (1887). 169 ♂ and 77 ♀.

(*i*) *26th–30th Dynasties.* Davin and Pearson: On the Biometric Constants of the Human Skull. *Bm.* Vol. XVI (1924). 935 ♂ and 628 ♀.

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26. *English: 17th Century.* (*a*) Macdonell: A Study of the Variation and Correlation of the Human Skull, with special reference to English Crania. *Bm.* Vol. III (1904). Whitechapel series. 138 ♂ and 147 ♀.

(*b*) Macdonell: A Second Study of the English Skull with special reference to the Moorfields Crania. *Bm.* Vol. V (1906). 44 ♂.

(*c*) Hooke: A Third Study of the English Skull with special reference to the Farringdon Street Crania. *Bm.* Vol. XVIII (1926). 153 ♂ and 201 ♀.

27. *Eskimo.* (*a*) Fürst and Hansen: *Crania Groenlandica. A Description of Greenland Eskimo Crania.* Copenhagen (1915). Means in *Annals of Eugenics,* Vol. I (1926), p. 259. 192 ♂ and 165 ♀.

(*b*) Hrdlička: *loc. cit.* (3). St Lawrence Island Eskimo. 158 ♂ and 87 ♀.

28. *Etruscans. A.S.D.* Leipzig Katalog (1887). 87 ♂ and 41 ♀.

29. *Filipinos.* Koeze: Crania Ethnica Philippinica. Ein Beitrag zur Anthropologie der Philippinen. *Veröffentlichungen des niederländischen Reichsmuseums für Völkerkunde,* Serie II, No. 3, Haarlem (1901–4). Negritos 38 ♂, Non-Negritos 80 ♂.

30. *French. A.S.D.* München Katalog (1892). Means given *Bm.* Vol. III (1904), p. 208. 56 ♂.

31. *French Neolithic.* Topinard: Mensurations des Crânes de la Caverne de Beaumes Chaudes (Epoque Néolithique) d'après des registres de Broca. *Revue d'Anthropologie,* 3ième série, T. I (1886). 21 ♂.

32. *Fuegians.* Reduced means for a few characters given by Thomson. *Bm.* Vol. XI (1915), p. 98.

33. *Gaboon Negroes.* Benington: *loc. cit.* (22). 50 ♂.

34. *German Neolithic.* Reche: Zur Anthropologie der jüngeren Steinzeit in Schlesien und Böhmen. *A.f.A.* Bd. XXXV (1908). 27 ♂.

35. *Greeks.* Weisbach: Die Schädelform der Griechen. *M.A.G.W.* Bd. XI (1881). 95 ♂.

36. *Guanches.* Detloff von Behr: *Metrische Studien an* 152 *Guanchenschädeln.* Stuttgart (1908). 83 ♂ and 44 ♀.

37. *Hindus* (Bengal). (*a*) Reduced means given by Tildesley: *Bm.* Vol. XIII (1921), p. 239. 69 ♂.

(*b*) Danielli: Studio sui crani Bengalesi. *A.p.A.* T. XXII (1892), 42 ♂.

38. *Japanese.* Reduced means given *Bm.* Vol. XVI (1921), p. 48. 77 ♂.

39. *Kaffirs.* Shrubsall: *loc. cit.* (6). Means given *Bm.* Vol. VIII (1912), p. 299. 38 ♂.

40. *Kalmucks.* Reduced means given *Bm.* Vol. XVI (1925), 65 ♂.

41. *Loyalty Islanders.* Sarasin and Roux: *Nova Caledonia. Forschungen in Neu-Caledonien und auf den Loyalty-Inseln. C. Anthropologie.* Berlin (1916–22). 35 ♂.

42. *Malays. A.S.D.* Leipzig Katalog (1887). Means given *Bm.* Vol. XIII (1921), p. 239. 77 ♂.

43. *Maltese.* Buxton: The Ethnology of Malta and Gozo. *J.R.A.I.* Vol. LII (1922). Mediaeval series. 468 ♂.

44. *Maori.* Scott: Contribution to the Osteology of the Aborigines of New Zealand and of the Chatham Islands. *Transactions of the New Zealand Institute,* Vol. XXVI, Wellington (1894). Means given *Bm.* Vol. XI (1915), p. 93. 43 ♂.

45. *Maravar.* Reduced means given by Tildesley: *Bm.* Vol. XIII (1921), p. 239. 38 ♂.

46. *Mongols.* Hrdlička: *loc. cit.* (3). 113 ♂ and 75 ♀.

47. *Moriori.* Thomson: A Study of the Crania of the Moriori, or Aborigines of the Chatham Islands, now in the Museum of the Royal College of Surgeons. *Bm.* Vol. XI (1915). 35 ♂.

48. *Nepalese.* Morant: A Study of Certain Oriental Series of Crania including the Nepalese and Tibetan Series in the British Museum (Natural History). *Bm.* Vol. XVI (1924). 48 ♂.

49. *New British.* Müller: Beiträge zur Kraniologie der Neu-Britannier. *Mitteilungen aus dem Museum für Völkerkunde in Hamburg. Beiheft zum Jahrbuch der Hamburgischen wissenschaftlichen Anstalten,* XXIII (1905), Th. 5. 114 ♂ and 53 ♀.

50. *New Caledonians.* (*a*) Sarasin and Roux: *loc. cit.* (41). 97 ♂ and 56 ♀.

(*b*) Quatrefages and Hamy: *C.E.* p. 287. 75 ♂ and 60 ♀.

51. *Papuans.* (*a*) Meyer: *Ueber Hundert Fünf und Dreissig Papua-Schädel von Neu Guinea und der Insel Mysore* (*Geelvinksbai*). 135 unsexed.

(*b*) Mantegazza: *Studii Antropologici ed Etnografici sulla Nuova Guinea.* Florence (1877). 50 ♂ and 50 ♀.

52. *Patagonians.* Marelli: Contribución a la Craneología de las Primitivas Poblaciones de la Patagonia (Observaciones Morfobiométricas). *Annales del Museo Nacional de Historia Natural de Buenos Aires,* T. XXVI (1913). Ancient series, 117 ♂ and 82 ♀. Modern series, 56 ♂ and 45 ♀.

53. *Peruvians.* MacCurdy: Human Skeletal Remains from the Highlands of Peru. *American Journal of Physical Anthropology,* Vol. VI (1923). 72 ♂, undeformed.

54. *Polynesians.* Quatrefages and Hamy: *C.E.* p. 459. 39 ♂.

55. *Pompeians.* Nicolucci: *Crania Pompeiana.* Naples (1882). 55 ♂ and 45 ♀.

56. *Prussians. A.S.D.* Konigsberg Katalog. 9 characters only, 204 ♂ and 62 ♀.

57. *Reihengräber.* Unpublished means reduced from measurements of Hauschild, Gildemeister, Hölder, Kollmann, Ecker, etc. 235 ♂ and 164 ♀.

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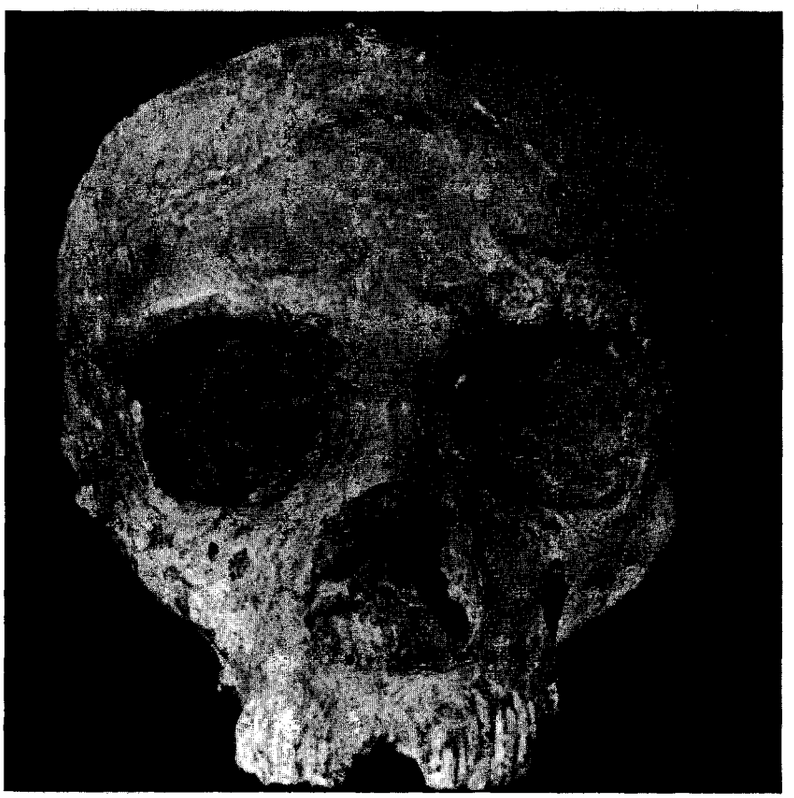
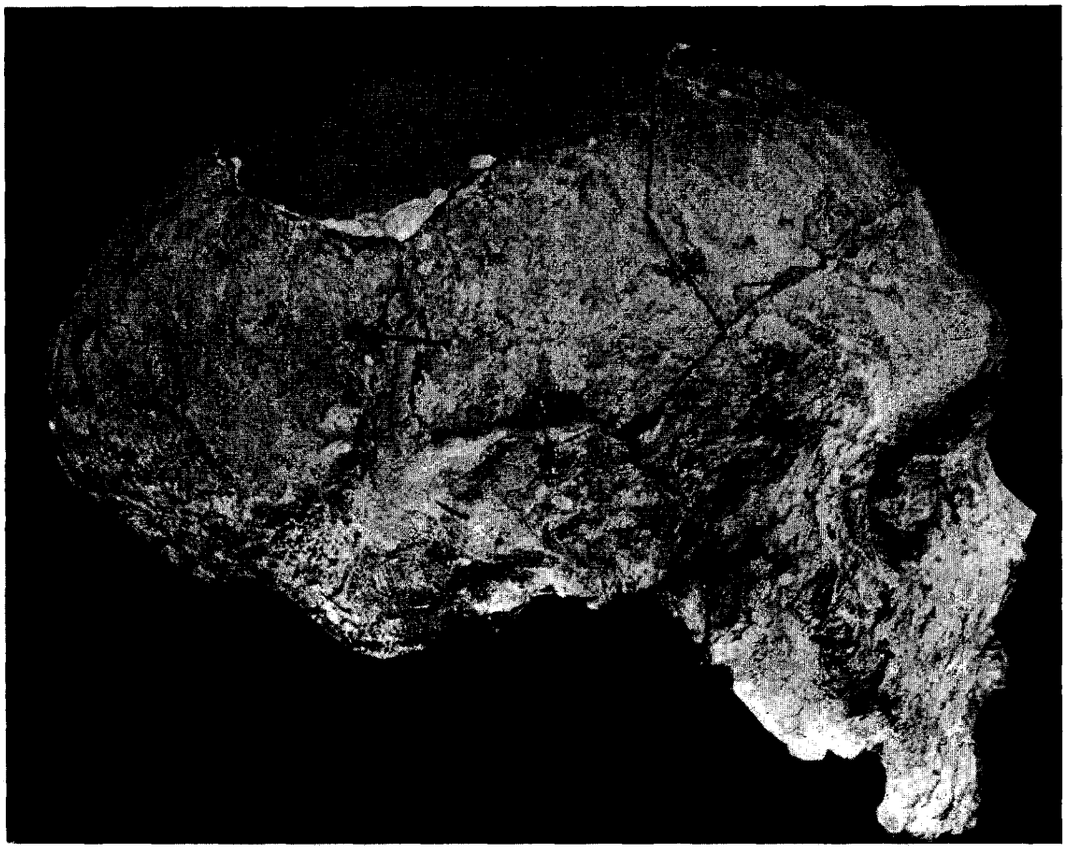
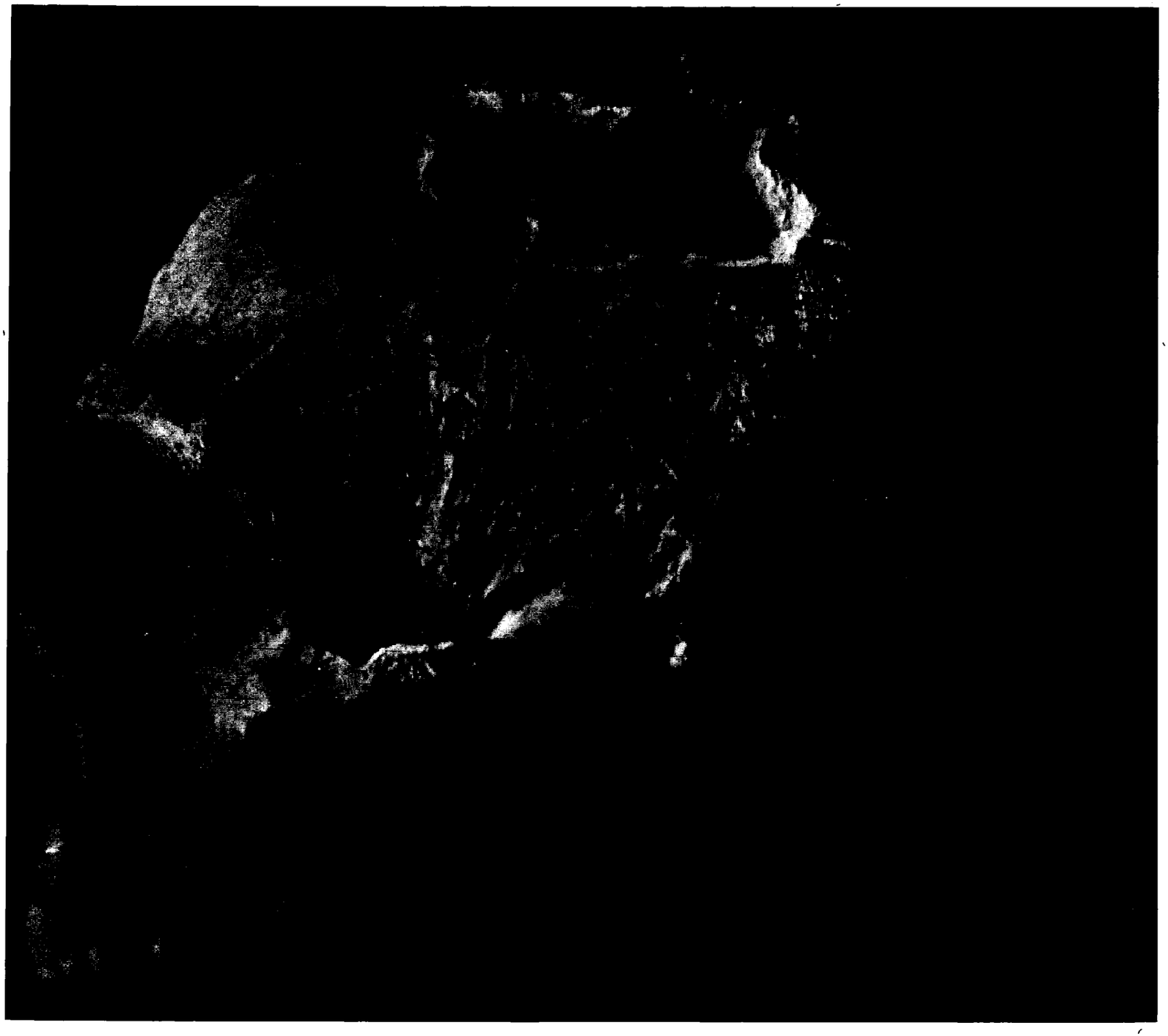


(*a*) *Norma facialis.*

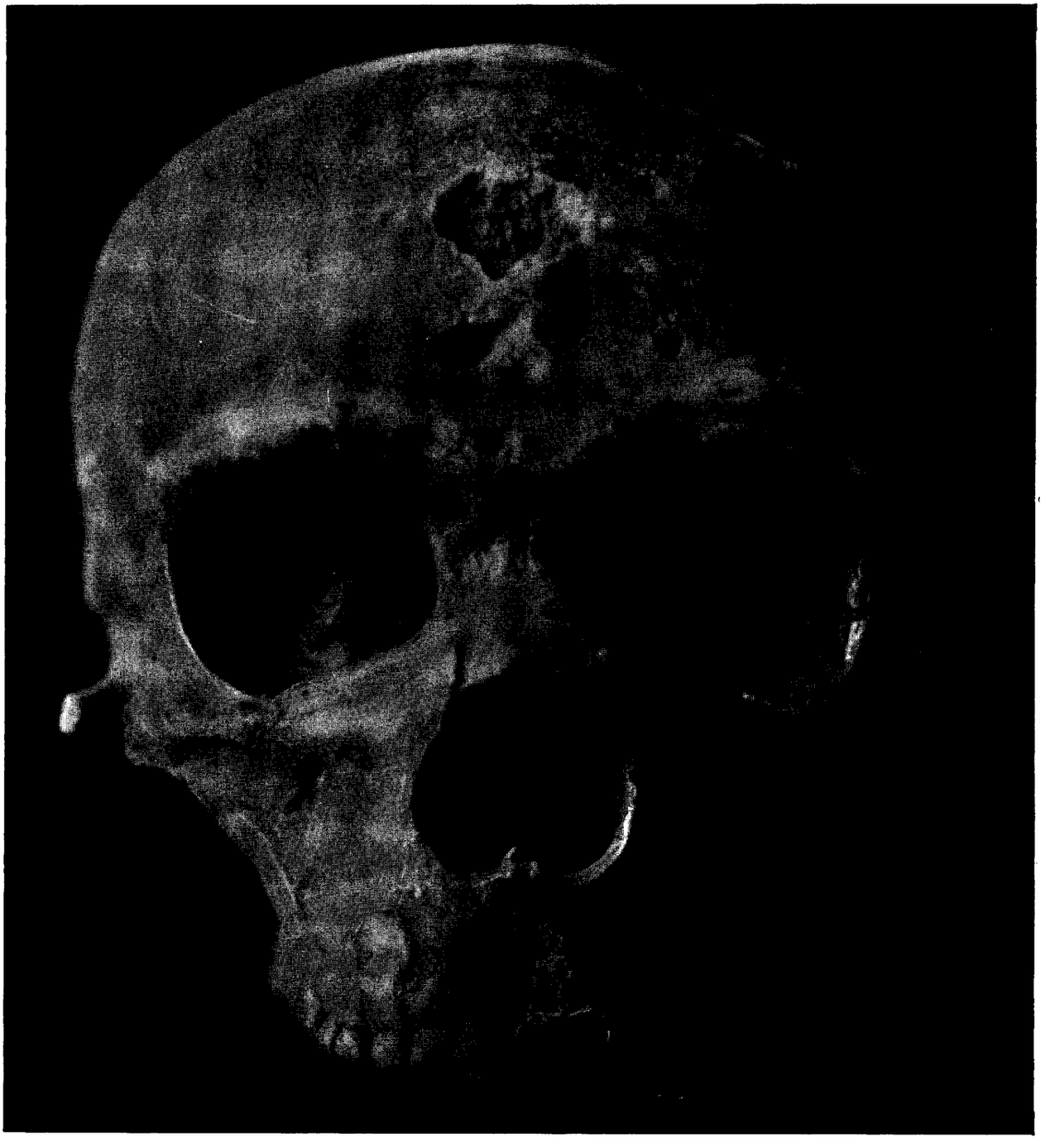


(*b*) *Norma lateralis* (right profile).

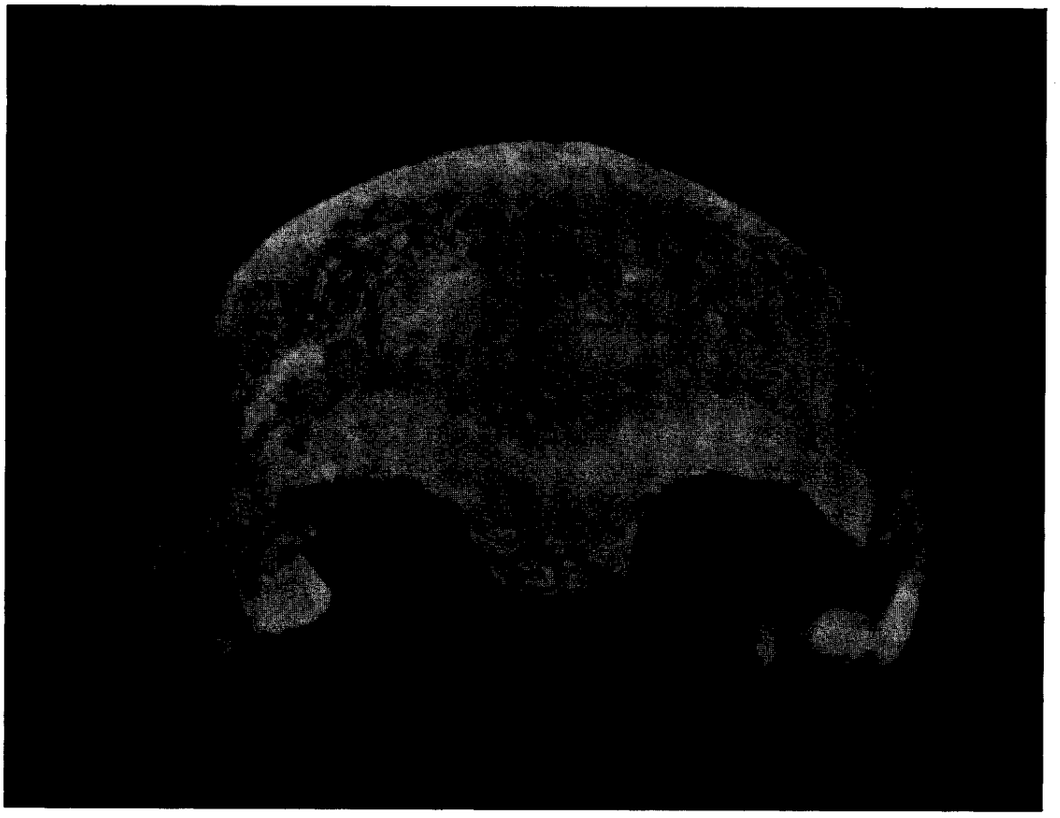
The Gibraltar Skull (with restored vault).



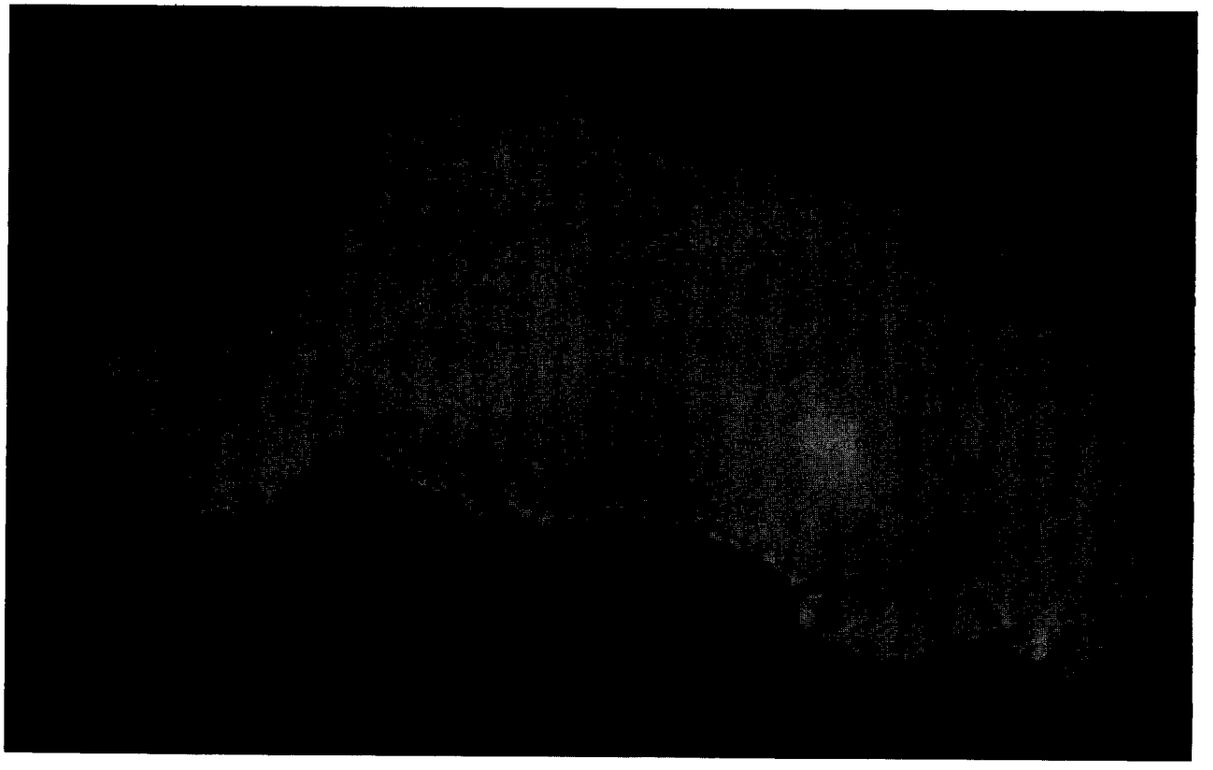
The La Chapelle Skull from M. Boule's cast with restored facial skeleton: *Norma lateralis* (left profile).



The La Chapelle Skull from M. Boule's cast with restored facial skeleton: *Norma facialis.*



(*a*) *Norma facialis.*



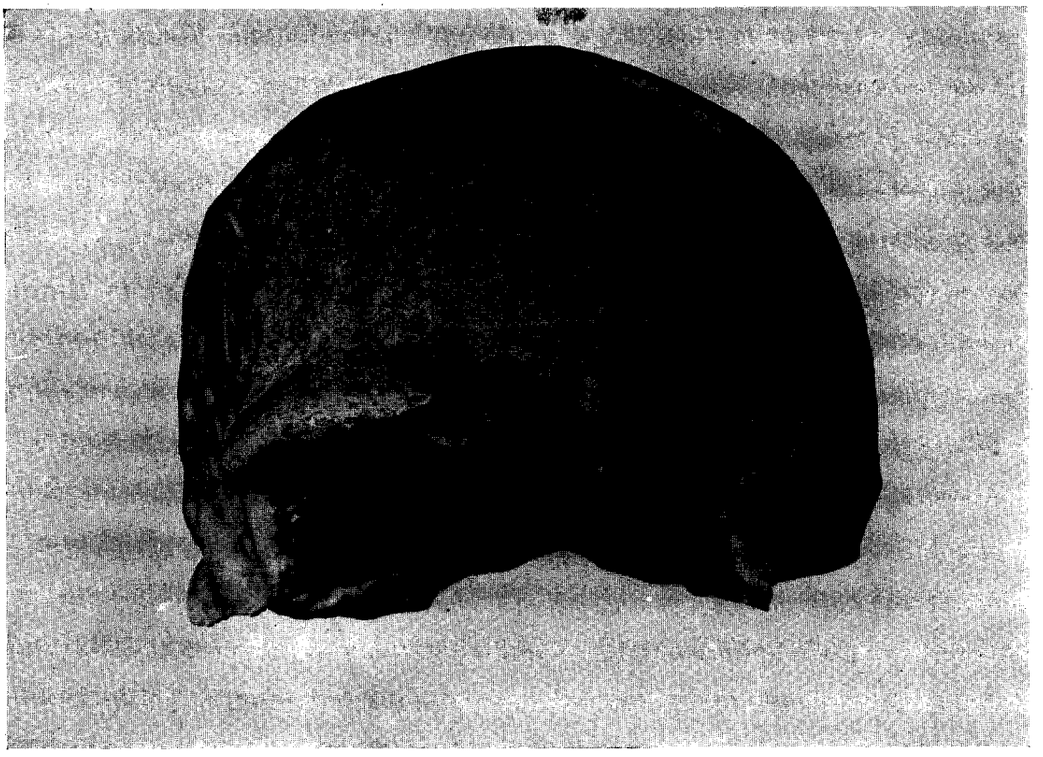
(*b*) *Norma lateralis* (left profile).

The Neanderthal Skull.

(*a*) *Norma facialis.*

(*b*) *Norma lateralis* (right profile).

The Spy Skull, No. I.

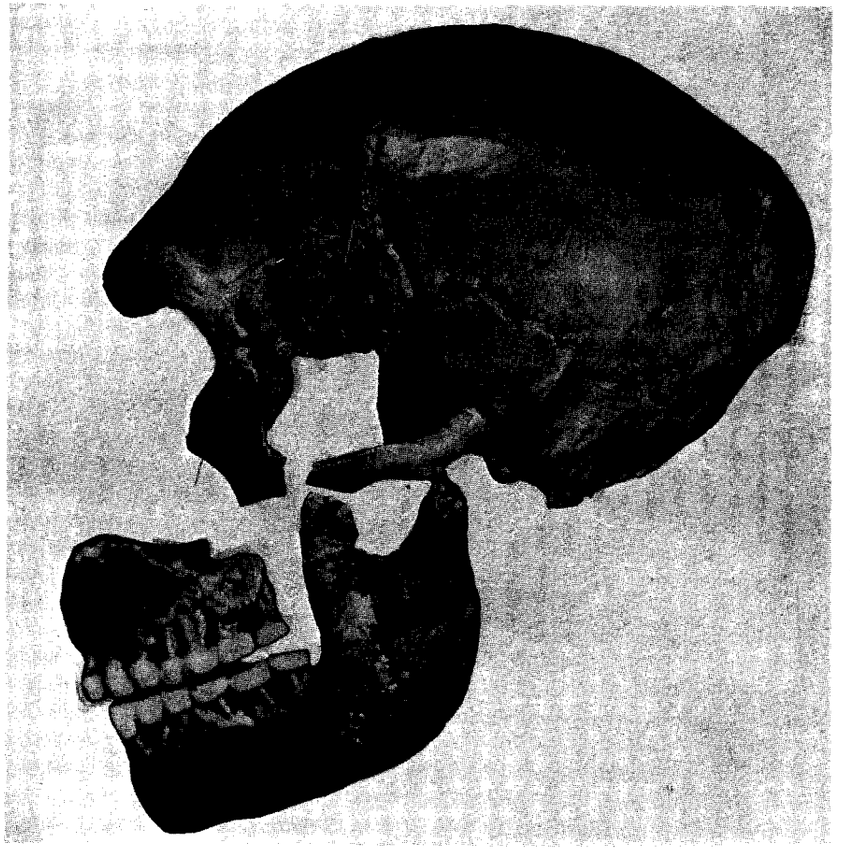


(*a*) *Norma facialis.*

(*b*) *Norma lateralis* (right profile).

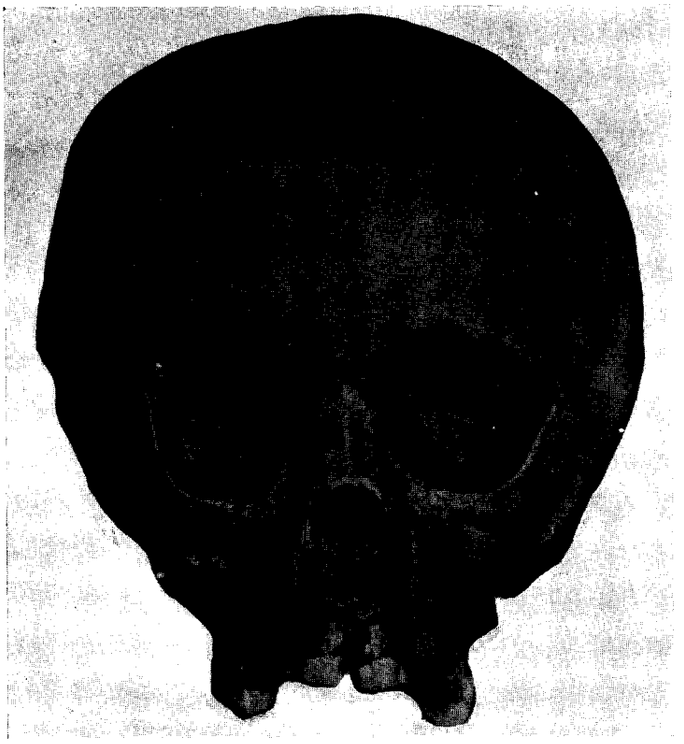
The Spy Skull, No. II.

(*a*) *Norma facialis.*

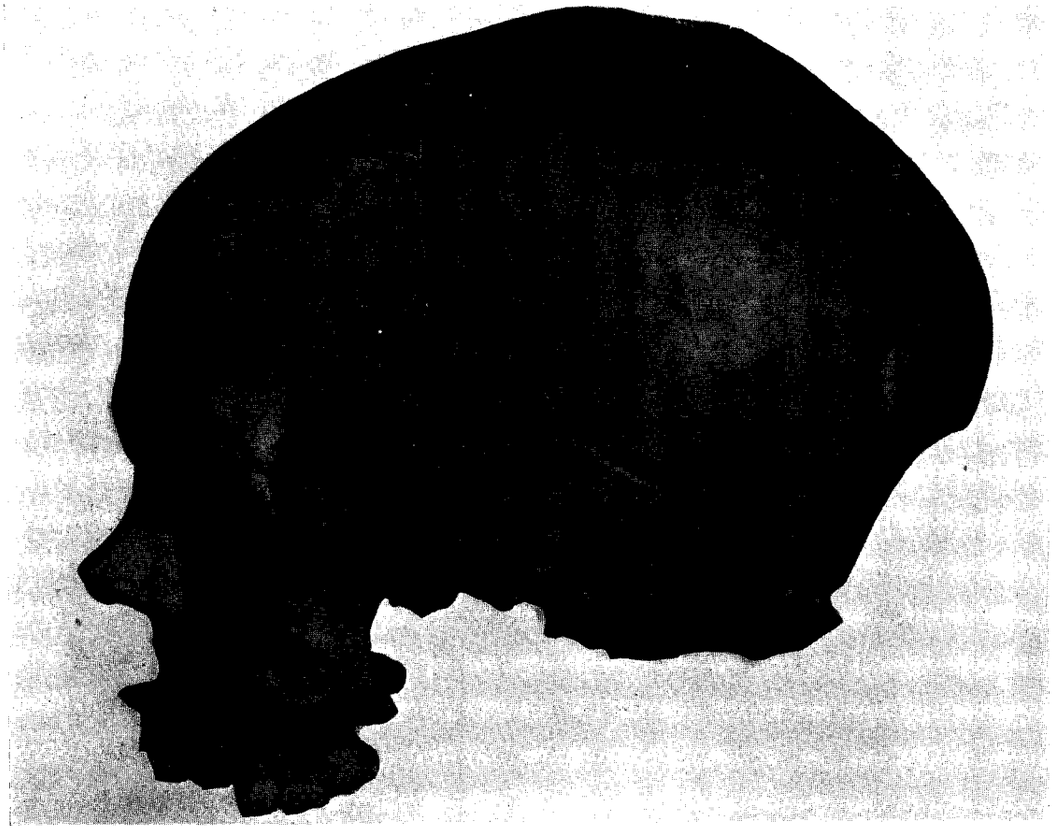


(*b*) *Norma lateralis* (left profile).

The La Quina Adult Skull from a cast.



(*a*) *Norma facialis.*



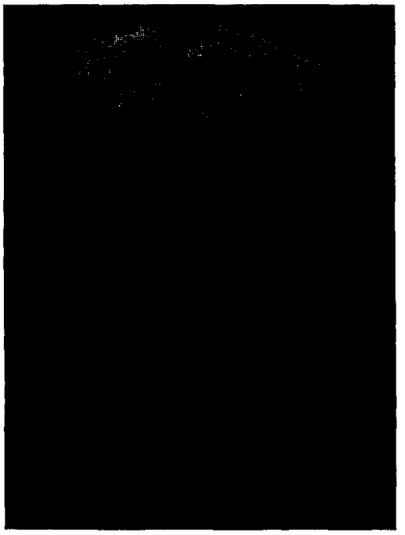
(*b*) *Norma lateralis* (left profile).

The La Quina Child's Skull from a cast.

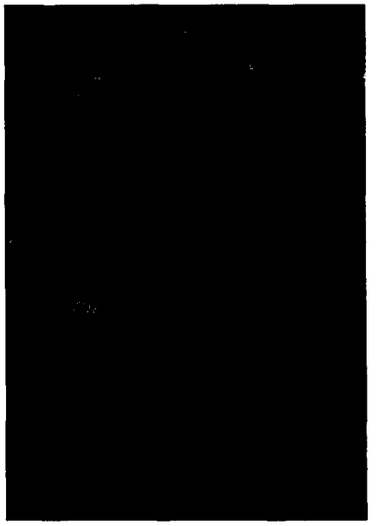
(*a*) *Norma facialis.*

(*b*) *Norma lateralis* (right profile).

The Galilee Skull from a cast.



(*a*) The Spy I Skull.

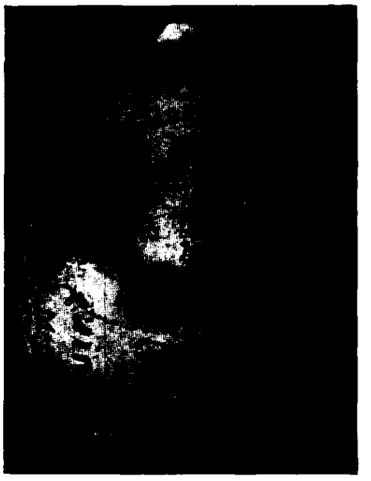


(*b*) The La Quina Skull (cast).

(*c*) The Spy II Skull.

(*d*) The La Chapelle Skull (cast).

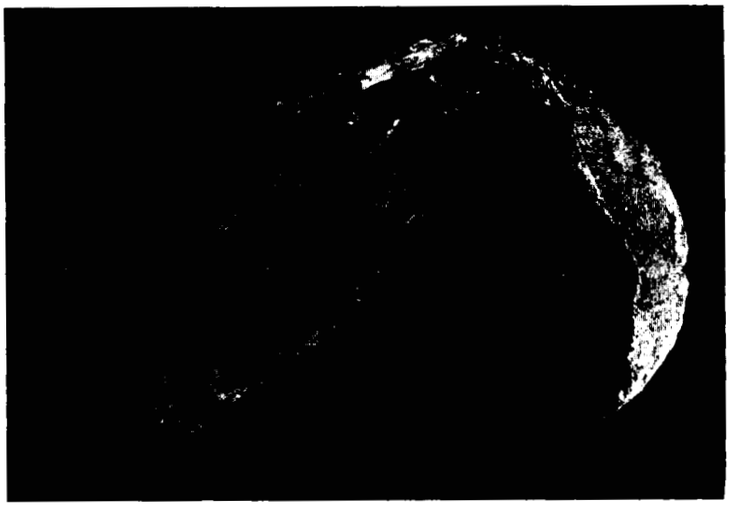
(*e*) The Neanderthal Skull.



(*f*) The La Quina Child's Skull (cast).

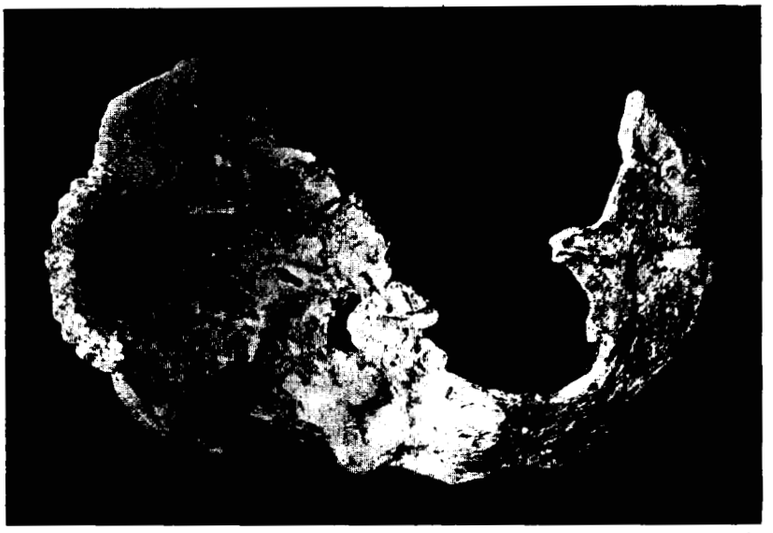
(*g*) The Galilee Skull (cast).

Neanderthaloid Skulls in *Norma verticalis*.

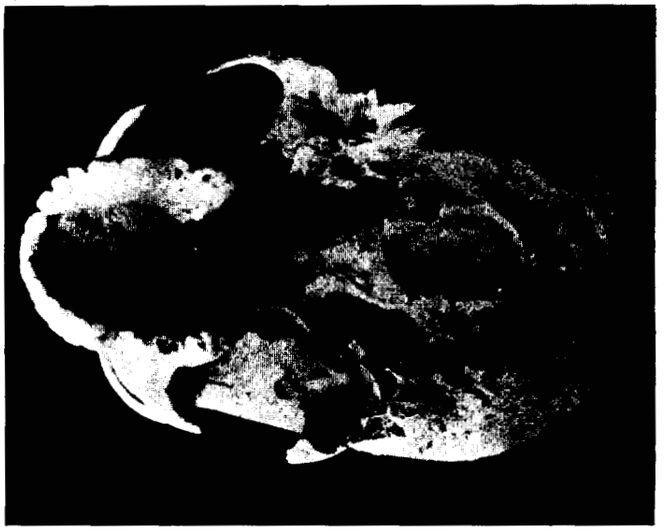


(*a*) The Gibraltar Skull: *N. verticalis.*

(*b*) The Gibraltar Skull (with plaster vault): *N. verticalis.*



(*c*) The Gibraltar Skull: *N. basalis.*

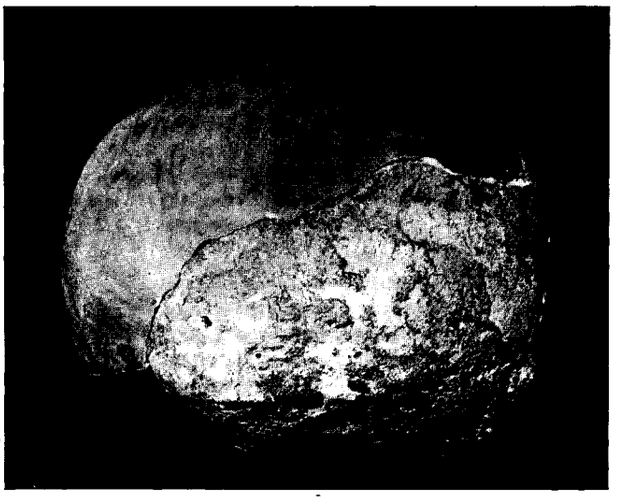


(*d*) The La Chapelle Skull (cast): *N. basalis.*

(*e*) The Gibraltar Skull (with plaster vault): *N. basalis.*

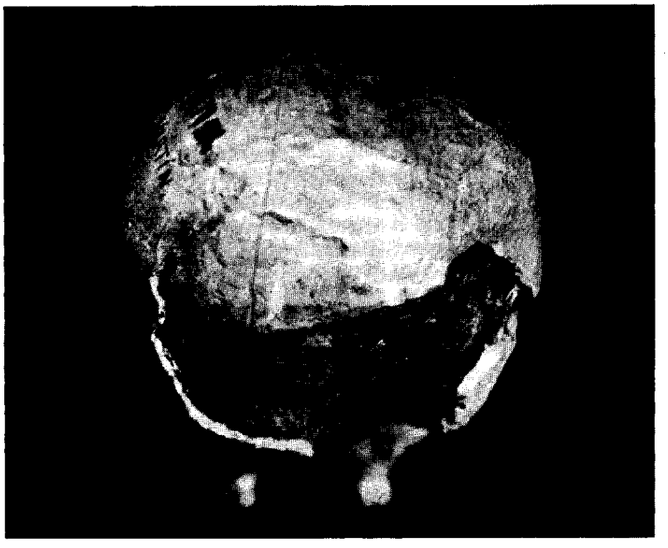
(*f*) The La Quina Child's Skull (cast): *N. basalis.*

Neanderthaloid Skulls in *Norma verticalis* and *Norma basalis.*



(*a*) The Gibraltar Skull (with plaster vault).

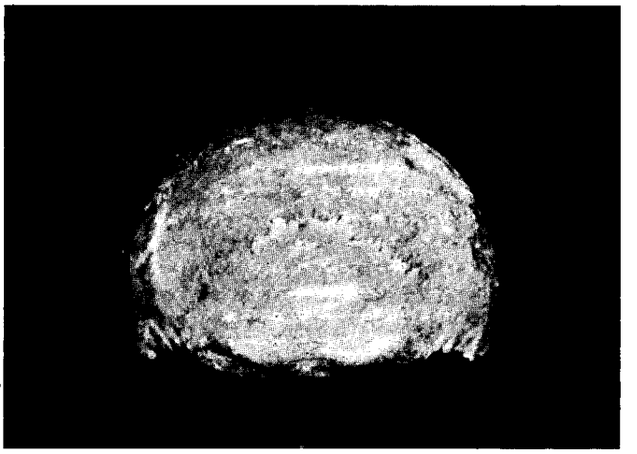
(*b*) The Gibraltar Skull.



(*c*) The La Quina Child's Skull (cast).

(*d*) The La Chapelle Skull (cast).

(*e*) The La Quina Skull (cast).



(*f*) The Neanderthal Skull.

Neanderthaloid Skulls in *Norma occipitalis*.

59. *Russians.* Tarenetzky: Beiträge zur Craniologie der grossrussischen Bevölkerung der nördlichen und mittleren Gouvernements des europäischen Russlands. *M.A.I.S.* VII^{ième} série, T. XXXII (1884). 157 ♂.

60. *Sardinians.* Duckworth: A Study of the Craniology of the Modern Inhabitants of Sardinia. *Z.f.M.* Bd. XIII (1911). 70 ♂.

61. *Serbo-Croatians.* Weisbach: Die Serbokroaten der adriatischen Küstenländer. *Zeitschrift für Ethnologie.* Supplement (1884). 80 ♂.

62. *Sicilians.* Mondio: Studio sopra duecento teschi messinesi. *A.p.A.* Vol. XXVII (1897). 107 ♂ and 93 ♀.

63. *Siennese.* Vincenzo: Il cranio fetale ed il cranio adulto. *A.p.A.* Vol. XLVIII (1918). 50 ♂ and 50 ♀.

64. *Slavs* (Mediaeval). Toldt: Die Schädelformen in den österreichischen Wohngebieten der Altslawen—einst und jetzt. *M.A.G.W* Bd. XLII (1912). 50 ♂.

65. *Slovenes.* Weisbach: Die Schädelform des Slowenen. *M.A.G.W.* Bd. XLII (1912). 60 ♂.

66. *Swedish Prehistoric.* Retzius: Crania Suecica (1900); and Fürst: Zur Kraniologie der Schwedischen Steinzeit. *Kungl. Svenska Vetenskapsakademiens Handlingar,* Bd. XLIX (1912). 72 ♂.

67. *Swiss.* (*a*) Pittard: *Crania Helvetica. I. Les Crânes Valaisans de la Vallée du Rhône.* Geneva (1909–10). Means excluding Sierre series used. 385 ♂ and 289 ♀.

(*b*) Reicher: *loc. cit.* (18). 41 ♂.

68. *Tamils.* Harrower: *loc. cit.* (21 *c*). 35 ♂.

69. *Tasmanians.* Berry, Robertson and Büchner: The Craniometry of the Tasmanian Aboriginal. *J.R.A.I.* Vol. XLIV (1914). 52 unsexed.

70. *Telei* (*Solomon Islands*). Frizzi: Osteometrische Befund an Schädeln und Skeletteilen der sogenannten Telei in Süd-Bougainville. *A.f.A.* Bd. XL (1913). 46 unsexed.

71. *Telenghites.* Reicher: *loc. cit.* (18). Means *Bm.* Vol. XVI (1924), p. 67. 62 ♂.

72. *Tibetan A.* Morant: *loc. cit.* (48). 37 ♂.

73. *Tibetan B.* Morant: A First Study of the Tibetan Skull. *Bm.* Vol. XIV (1922). 15 ♂.

74. *Turks.* Weisbach: Die Schädelform der Türken. *M.A.G.W.* Bd. III (1873). 78 ♂.

75. *Tyrolese.* (*a*) Holl: Ueber die in Tirol vorkommenden Schädelformen. *M.A.G.W.* Bd. XIV (1884). 149 ♂.

(*b*) Holl: Ueber die in Vorarlberg vorkommenden Schädelformen. *M.A.G.W.* Bd. XVIII (1888). 394 ♂ and 292 ♀.

76. *Veddahs.* Means reduced from measurements of P. and F. Sarasin and others. *Bm.* Vol. XVI (1924). 40 ♂.

77. *Venezuelians.* Marcano: *Ethnographie précolombienne du Venezuela. Région des Raudals de l'Orénoque.* Paris (1890). Cerro de Luna series. 50 ♂ and 31 ♀.

78. *Württemberger. A.S.D.* Tübingen Catalogue (1902). Means given *Bm.* Vol. III (1904), p. 208. 97 ♂.

79. *Zulus.* Shrubsall: *loc. cit.* (6). Means given *Bm.* Vol. VIII (1912), p. 299. 20 ♂.

Type Contours. The Moriori, Burmese, Nepalese, Tibetan *A*, Tibetan *B*, Chinese (Hokien), Tamil, English (Farringdon St.), Anglo-Saxon and 1st Dynasty Egyptian type contours are given in the papers to which references are given above. The Eskimo, English (Whitechapel), Guanche, 26th–30th Dynasties Egyptian and 3 Congo Negro figures are in the first paper which dealt with the method of construction of type contours, that method having been used, with certain additions, by all later workers in the Biometric Laboratory. R. Crewdson-Benington (paper prepared for the press by Professor Karl Pearson): Cranial Type Contours, *Bm.* Vol. VIII (1911).

IV. PHOTOGRAPHS OF NEANDERTHALOID SKULLS.

Photographs of the original Neanderthaloid skulls or casts dealt with in this paper, with the exception of the Krapina and Le Moustier specimens, are given in Plates I–XII. They were taken with a telephoto lens at a distance of over 2 metres, so the distortion is negligible. All are of aspects parallel or perpendicular to the Frankfurt horizontal plane which was judged as well as could be in the case of skulls lacking the facial skeleton and after comparison with the more complete specimens. The extreme importance of adopting a standard method of orientation in order to make photographs truly comparable is not yet realised by a number of prominent living anthropologists.

Plate I. The Gibraltar Skull (with plaster vault). (*a*) *N. facialis;* (*b*) *N. lateralis.*

Plate II. Boule's Cast of the La Chapelle Skull with restored facial skeleton. *N. lateralis.*

Plate III. *Ibid. N. facialis.*

Plate IV. The Neanderthal Skull. (*a*) *N. facialis;* (*b*) *N. lateralis.*

Plate V. The Spy I Skull. (*a*) *N. facialis;* (*b*) *N. lateralis.*

Plate VI. The Spy II Skull. (*a*) *N. facialis;* (*b*) *N. lateralis.*

Plate VII. A Cast of the La Quina Skull. (*a*) *N. facialis;* (*b*) *N. lateralis.*

(N.B. In the writer's opinion the maxillary fragment and mandible of this cast have been fixed at far too great a distance from the lower edge of the frontal bone.)

Plate VIII. A Cast of the La Quina Child's Skull. (*a*) *N. facialis;* (*b*) *N. lateralis.*

Plate IX. A Cast of the Galilee Skull. (*a*) *N. facialis;* (*b*) *N. lateralis.*

Plate X. Neanderthaloid Skulls in *N. verticalis.* (*a*) The Spy I Skull; (*b*) The La Quina Skull (cast); (*c*) The Spy II Skull; (*d*) The La Chapelle Skull (cast); (*e*) The Neanderthal Skull; (*f*) The La Quina Child's Skull (cast); (*g*) The Galilee Skull (cast).

Plate XI. Neanderthaloid Skulls in *N. verticalis* and *N. basalis.* (*a*) The Gibraltar Skull, *N. verticalis;* (*b*) The Gibraltar Skull (with plaster vault), *N. verticalis;* (*c*) The Gibraltar Skull, *N. basalis;* (*d*) The La Chapelle Skull (cast), *N. basalis;* (*e*) The Gibraltar Skull (with plaster vault), *N. basalis;* (*f*) The La Quina Child's Skull (cast), *N. basalis.*

Plate XII. Neanderthaloid Skulls in *N. occipitalis.* (*a*) The Gibraltar Skull (with plaster vault); (*b*) The Gibraltar Skull; (*c*) The La Quina Child's Skull (cast); (*d*) The La Chapelle Skull (cast); (*e*) The La Quina Skull (cast); (*f*) The Neanderthal Skull.