

TWO REMARKABLE SKULLS FROM THE NEW HEBRIDES.—AN ANTHROPOLOGICAL AND ETHNOLOGICAL STUDY.—By JOHN CAMERON, M. D., D. SC., F. R. S. E., Professor of Anatomy, Dalhousie University, Halifax, N. S.

Introduction.—The skulls that form the subject of this memoir came from South Malekula in the New Hebrides, a group of islands which is situated about nine hundred miles in a north easterly direction from the coast of Queensland and is definitely placed by geographers and ethnologists in Melanesia. The inhabitants⁽¹⁾ of this section of Oceania are more darkly complexioned than the inhabitants of the other section of Oceania termed Polynesia, but it is remarkable how much the skin pigmentation of the Melanesians varies in the different groups of islands. The reason for this is not far to seek for it is due to the intrusion of a lighter complexioned Polynesian strain which has become mingled in varying proportions with the black aboriginal element⁽²⁾. This black aboriginal substratum is, however, everywhere dominant throughout the New Hebrides, and is characterised, in addition to the skin coloration, by crisp, curly, black hair, decided negroid features, an extreme dolichocephalic head and short stature, averaging five feet, four and one-half inches, which is decidedly lower than the Polynesian average of five feet, ten inches. The Melanesians were formerly classed by ethnologists as fierce, warlike savages, with a strong proclivity towards head-hunting expeditions and cannibalism. The language⁽³⁾ spoken in Melanesia is a heterogeneous mixture, consisting mainly of archaic forms of the Malayo-Polynesian tongue, which was probably imposed upon the inhabitants in bygone ages by their Polynesian conquerors.

It is essential that I should make some reference to the ethnology of the Polynesians as their fortunes and misfortunes have been closely bound up with those of the Melanesians.⁽⁴⁾ They are physically a very fine race, their average stature being as much as five feet, ten inches. Their features are remarkably regular, and in fact almost European in type,⁽⁵⁾ the skull being on the borderland between orthognathism and mesognathism. The complexion is light brown and the hair straight, both these features being thus in strange contrast to the corresponding condition in the Melanesians. Moreover their mentality, their standard of civilization, and their codes of ethics are all of a decidedly higher⁽⁶⁾ order. Their speech is a distinct offshoot of the ancient Malayo-Polynesian stock language. The extent of dialectic diversity in all the Archipelagoes of Polynesia is remarkably slight showing that close intercourse must have been maintained between the various groups of islands, which, it may be recollected, are separated in many cases by hundreds of miles of vast ocean. The Polynesians possess quite an elaborate mythology as those who have read Sir G. Grey's classic work⁽⁷⁾ on the subject will testify. This will be found to have an important bearing on the two skulls which form the subject of this memoir. Their traditions are likewise of a remarkably high order and their arts and crafts have their own distinctive, though frequently crude qualities. These characteristics, racial attributes, and gifts will also be found referred to more fully in other sections of this memoir.

The skulls were presented to Dalhousie University by the Rev. Dr. Joseph Annand, a graduate of Pine Hill, who was a Canadian Presbyterian Missionary to the New Hebrides for the long period of forty years, from 1873 to 1913. I wish to express my indebtedness to this gentleman, as also to Dr. John Forrest and President A. S. Mackenzie of Dalhousie University, for the opportunity, thus obtained, of having studied two very unique anthropological specimens. On

removing the skulls from their box, I found that they presented quite a remarkable appearance, for on each there had been moulded in clay or some similar medium, with no small display of skill, the supposed facial features of the deceased. On investigating them further, it was seen that they exhibited many points of more than passing interest which were deemed worthy of being placed on record.

I wrote a letter to Dr. Annand inquiring about the racial characteristics of the New Hebridean inhabitants, and he very courteously sent me by return mail a very interesting account, in the course of which he stated that they were mainly Melanesian with some Polynesian admixture. His letter contained so many points bearing on the subject of this memoir that I decided to reproduce it *in extenso*.

“Your letter of yesterday asking for information relating to two New Hebrides skulls is before me. The history of the “clay facial masks” is, so far as the New Hebrides is concerned, non-existent. However I will mention some facts that may aid you in forming an opinion regarding them. The skulls were brought home to show a custom that prevails on South and South West Malekula only of the New Hebrides, namely the binding of the head in infancy to produce “long heads”. Why this was first done no one now knows; but it continues because their fathers did it. It is the fashion. The clay mask is not essentially connected with the long skull for on other parts of the same island the human body is thus encased with clay and lime into mummy form. Some bodies have been taken from the island that passed as mummies. The chief preservative is lime (burned coral). The moulding of the masks is done over the body soon after death, and placed over a fire to dry and smoke. There is no burial where this custom prevails. The corpse is put up on a platform in a house or roof erected for the purpose. After the days of mourning are over (from fifty days and upward) the body gets no

more care. This manner of treating the corpse is not practised anywhere else in the New Hebrides group. On Aneityum (in the South) the bodies of all the common people were thrown into the sea. On some other islands burial was practised, but sometimes in very shallow graves. In other places bodies were put upon a kind of stage and left to decay away, and then the bones were used for tipping spears and arrows. The bodies of those killed were generally eaten.

"The New Hebrides are Melanesian with a very few traces of Polynesian tribes among them. A few canoes drifted at different times from the Eastern Islands (Tonga and Samoa) and never returned home against the prevailing east winds. On Malekula there is no trace of any Polynesian influence. The Maoris never have had any intercourse with the New Hebrideans.

"I should say that all or nearly all the different methods of disposing of the dead bodies arose from their belief regarding the future life. They appear in the Spirit World as they leave this, so ornamentation and ceremony must correspond with a man's social position.

"I am sorry that I cannot give you all the information desired."

The Sex of the Skulls.—Both skulls belong definitely to the male sex. The lines of muscular and ligamentous attachment in each are excessively developed, much more so, indeed, than in the average European skull. For example the curved lines of the occipital bone stand out prominently in the form of rough ridges. The external occipital protuberance projects markedly while the external occipital crest forms a thin obtrusive blade of bone. One would gather that they belonged to very muscular warriors. At any rate the owners must have led very strenuous active lives. Other sexual features prominently displayed are the large mastoid processes and the strongly projecting superciliary ridges, indicating of course an enormous degree of development

of the frontal air sinuses, which are such a marked feature of the Melanesian skull.

The Approximate Age of the Skulls.—The sutures in both are for the most part obliterated on the interior of the skulls, which would indicate an age somewhat beyond middle life. The outlines of all the sutures can be traced on the outer surface of both skulls. In No. 1 the sagittal, the coronal, and the upper portion of the lambdoid suture have become synostosed. In No. 2 on the other hand the whole of the lambdoidal suture is still markedly distinct, an interesting reminder of the fact that its period of obliteration usually follows that of the sagittal or coronal. One would gather from this that No. 2 skull belonged to a slightly younger individual, a statement which is supported by the fact that the teeth in No. 1 skull are more worn than those in No. 2. The squamous sutures, as one would expect, are still remarkably distinct and separate in both skulls, especially in No. 2.

The Cranial Capacity.—The capacity of No. 1 skull was found to be 1368 c. cm. It thus approached the lower limit of the mesocephalic class, but is well above the aboriginal Australian average of 1300 (Flower)⁽⁸⁾ though it is decidedly below the Polynesian average of 1469 (Duckworth)⁽⁹⁾. The capacity of No. 2 skull proved to be 1395 c. cm. It is therefore slightly better than that of No. 1, though still comparatively low in the mesocephalic class.

The Horizontal Cranial Circumference.—The horizontal cranial circumference was measured over the glabella according to the plan of Sir William Turner⁽¹⁰⁾. It was 52.07 cm. in No. 1 skull and 53.49 in No 2 which would accord with the difference in capacity given in the preceding paragraph. The taking of this measurement proved somewhat difficult owing to marked flattening of the frontal regions of the skulls. It will be noted that these measurements are practically the same as that of the average European male skull

which is about 52.5 cm. (Quain)⁽¹¹⁾. This high figure may be partially explained by the undue prominence of the superciliary ridges. Apart from this it is evident that the skulls of definitely low types of mankind can frequently exhibit a horizontal circumference equal to the average European, and it teaches us one instructive fact, namely, that the increased cranial capacity of white races is due for the most part to an expansion upwards of the roof of the skull above the level of a horizontal plane passing through the glabella and the occipital point.

The Cranial Measurements.

	No. 1 Skull	No. 2 Skull
Cranial length (Glabella-inion)	19.00 cm.	19.9 cm.
Cranial breadth	12.20 cm.	12.80 cm.
Basal height of cranium	12.95 cm.	13.05 cm.
Horizontal circumference	52.07 cm.	53.49 cm.
Nasion to Basion	9.75 cm.	9.65 cm.
Basion to Alveolar Point	9.95 cm.	10.30 cm.
Nasal height	5.45 cm.	5.10 cm.
Nasal breadth	2.75 cm.	2.80 cm.
Bizygomatic breadth	14.35 cm.	13.90 cm.
Interstephantic breadth	10.50 cm.	10.00 cm.
Orbital breadth	4.15 cm.	4.10 cm.
Orbital height	3.35 cm.	3.35 cm.
Palatamaxillary length	5.50 cm.	5.85 cm.
Palatamaxillary breadth	6.35 cm.	6.55 cm.
Minimum post-frontal breadth	9.50 cm.	9.30 cm.
Glabella-bregma chord	11.15 cm.	11.35 cm.
Bregma-lambda chord	12.10 cm.	12.35 cm.
Lambda-inion chord	6.60 cm.	6.45 cm.
Maximum distance of frontal arc from chord	13.5 mm.	14.0 mm.
Maximum distance of parietal arc from chord	30.0 mm.	34.0 mm.
Maximum distance of lambda- inion arc from chord	9.0 mm.	9.0 mm.

The Cranial Indices and Angles.

	No. 1 Skull	No. 2 Skull
Spheno-maxillary angle.....	95.	97
Cephalic index.....	64.21	64.32
Index of height.....	68.15	65.57
Nasal index.....	50.4	54.9
Alveolar index.....	102.05	106.7
Stephano-zygomatic index.....	73.17	71.9
Orbital index.....	80.7	81.7
Facial index.....	50.5	54.6
Palato-maxillary index.....	115.4	111.9
Fronto-parietal index.....	77.8	72.6
Calvarial height index.....	58.4	55.7
Bregmatic angle.....	59.	55
Spheno-ethmoidal angle	151.	151
Foramino-basal angle.....	146.5	148

The Cephalic Index.—The cephalic index was 64.21 for No. 1 Skull and 64.32 in the case of No. 2. They were thus shown to be extreme examples of dolichocephaly, which is the usual condition met with in Melanesian skulls⁽¹²⁾. Of course such an excessive dolichocephalic condition may be explained partly at least by the fact that in the island of South Malekula, from which these skulls were obtained, the natives, as Dr. Annand states, deliberately apply bandages in infancy in order to produce long heads. The above indices closely approximate to the lowest recorded cephalic index the writer can find a reference to, namely, 61.9 which was found by Sir Wm. Flower⁽¹³⁾ in a Fiji islander. It may be mentioned here that the inhabitants of the latter group of islands are also definitely Melanesian, and exhibit the lowest average cephalic index of any tribe or race, namely, 66⁽¹⁴⁾.

It is important to emphasise the fact that the cephalic index taken by itself is no criterion of intellectual capacity. It is true that in the more darkly colored races of mankind, including those with the most primitive type of brain, doli-

chocephaly is the predominant form of skull and it is the condition met with in certain extinct races of mankind, such as Neanderthal or Mousterian man (cephalic index 73.9),⁽¹⁵⁾ and Cro-magnon man (cephalic index 73.3)⁽¹⁶⁾. The average cephalic index for the Anglo-saxon race is 76.1,⁽¹⁷⁾ which is usually classed as mesaticephalic. The index for the British skull, however, so closely approaches the transition point into dolichocephaly which is 75, that many anthropologists place it in a special class termed subdolichocephalic.⁽¹⁸⁾ Yet who of us will admit for one moment that the Briton is inferior to any race in either intellectual capacity or ability. Just to illustrate further how much the cephalic index fluctuates, one has only to study it amongst the anthropoid apes, where the gorilla, the most highly evolved of them, is dolichocephalic, the chimpanzee is mesaticephalic and the orang-utan is brachycephalic.⁽¹⁹⁾

It is of interest to find that the average cephalic index of the Polynesian skull is about 80,⁽²⁰⁾ and therefore tends to belong very definitely to the brachycephalic group. It is thus a somewhat striking fact to note that the inhabitants of even neighbouring groups of islands can exhibit a very distinct contrast in regard to their cephalic indices.

The Index of Cranial Height.—The index of height was calculated to be 68 in No. 1 skull, and as low as 65.6 in No. 2. These represent the lowest indices I have been able to find a definite record of. These skulls may be thus placed at the lowest limit of the tapeinocephalic class. They are decidedly lower than the height index even of the aboriginal Australian skull which averages about 71,⁽²¹⁾ and also lower than the Fijian average 74,⁽²²⁾ which may be taken as a representative Melanesian type. In the case of this index the effect of binding the head would again certainly have to be considered, and may, indeed, account in great measure for the above remarkably low indices. It may perhaps be as well to note at this point that the bandaging does not appear to

have produced any freak effects in the case of the other cranial indices.

The Nasal Index.—The study of the nasal index yielded some interesting results. Some anthropologists emphasise very strongly the importance of this index as a criterion of racial origin. It is found that the lower the type of cranium the higher is this index. That is to say, the nasal aperture of the skull is broadest in the lower races. Applying this idea to the two skulls in question it was found that the nasal index in No. 1 skull was 50.4, and in No. 2 as high as 54.9. Thus the latter was definitely platyrrhine, being above 53, and the other almost leptorrhine. Another significant fact to be recorded was that the index in No. 2 skull practically corresponded to the Melanesian average of 55,⁽²³⁾ whilst the other approximated to the Polynesian index of 48.⁽²⁴⁾ Thus the nasal index, taken in conjunction with the cephalic index and the index of height, again demonstrates the marked racial inferiority of No. 2 skull, and certainly suggests that there must be a strong admixture of Melanesian and Polynesian types in the New Hebrides. It is rather remarkable that two skulls collected at random should indicate such marked racial differences.

The Alveolar or Gnathic Index.—The alveolar index proved to be even more significant than the preceding; for in No. 1 skull it was found to be 102, while in No. 2 it reached the high figure of 106.7. The latter represents the most extreme condition of prognathism the writer has ever met with. It certainly greatly exceeds the average of the aboriginal Australian of today which is supposed to represent the lowest type of skull extant, and is, according to Flower 104,⁽²⁵⁾ though some anthropologists do not place it so high as that. For example Duckworth⁽²⁶⁾ gives it as 101.1. In any case an investigation of the alveolar index of these two skulls indicated that both were of the Melanesian type, though No. 1 approximated to the Polynesian average index

of 98.6 whilst No. 2 was shown to be pronouncedly Melanesian.

The Stephano-zygomatic Index.—The stephano-zygomatic index was found to present some features of striking interest. In No. 1 skull it was 73.17 and in No. 2, 71.9. Both were evidently at the lowest level for this index in man and were thus markedly phaenozygous, No. 2, as usual, representing the lower type. Compare these results with the index of 90.7 found in the adult European male or the 94.6 of the European female.⁽²⁷⁾ It is of interest to note that this index may rise as high as 116 in the infant skull of white races, which is thus remarkably cryptozygous. In the gorilla this index goes down to zero owing to the meeting of the temporal lines to form the prominent median crest along the line of the sagittal suture.

The Orbital Index.—There has been much discussion among anthropologists regarding the value and significance of the orbital index, many having seriously challenged its general utility as an indication of race. It certainly shows a wide range of variation not only throughout the hominidæ, but also in persons belonging to the same race. This fact is well exemplified in these two skulls, for No. 2 which in the case of the previously recorded indices has consistently shown an inferior degree, is in a slightly elevated position to No. 1 in regard to the orbital index, the figures being respectively 81.7 and 80.7. They both, however, exhibit a definitely low type, being markedly microsemic, though they do not reach the low ebb indicated by 75,⁽²⁸⁾ as found in certain aboriginal Tasmanian skulls. In Polynesians, on the other hand, as in all mongoloid races, this index is remarkably high, being usually above 89⁽²⁹⁾. They are therefore classed as megasemic. However variable the orbital index may be, it certainly indicates to us that the vertical dimensions of the orbital aperture are greatest in the mongoloid races and least in the aboriginal Australians and Melanesians,⁽³⁰⁾ with

the European races occupying an intermediate position. Now it is a very significant fact that the frontal air sinuses and also the superciliary ridges are relatively large in the lowest types of modern hominidæ, and I hope to be able to prove that the greatest influence on the modelling of the orbital contour is exerted by the degree of development of the air sinuses of the skull. A remarkable feature of the orbital index is that it is consistently higher in the female skull of any given race.⁽³¹⁾ Surely this supports the statement just made; for it is well known that the frontal sinuses and the superciliary ridges are always better developed in the male than in the female. Another significant fact is that the orbital index is always relatively high in the infant, in whom it is to be again noted the superciliary ridges are not yet developed, seeing that the frontal sinuses do not begin to make their appearance until after infancy. As a result of these observations it appears to the writer that the orbital index deserves a more prominent position in physical anthropology than that accorded to it by some investigators on the subject.

The shape of the orbital margin has also been neglected somewhat by anthropologists. The general impression I have gained from a study of it is, that in the higher types of skull the opening is rounded in character, while in the lowest types (aboriginal Australians for example) the outline tends to be somewhat quadrangular, owing apparently to a flattening of the upper and lower margins. The writer's attention was first directed to the orbital contour in 1908, when studying the skulls belonging to two ancient Egyptian skeletons of the XIIth dynasty. One of these was of a highly evolved orthognathous type, all its indices actually comparing favourably with those of the modern European skull. The other was of a distinctly lower order, some of its indices being distinctly negroid in character. For example, the alveolar index was 104.3. These two mummies, according to the hieroglyphs on their coffins were brothers and a full

discussion of their supposed ancestry will be found in the memoir⁽³²⁾ dealing with them. One of the most striking points of difference in these two ancient Egyptian skulls was the shape of the orbital margins. In the finely modelled orthognathous skull, with small frontal sinuses, these were decidedly rounded or circular in character, with the high orbital index of 92.6, in fact the highest I have ever found. In the second or negroid type of skull, which exhibited relatively large frontal sinuses and prominent superciliary ridges, the orbital margins had the peculiar quadrangular outline noted above, with the relatively low index of 82. On pursuing the investigation further, I found that this quadrangular contour was best marked in low types of skulls, being particularly well exhibited in the aboriginal Australian and Melanesian types. It is clearly shown in the two New Hebridean skulls, and this feature would place them definitely in the Melanesian group. The next point to be determined is, "What is the causation of this characteristic outline in low types of skulls?" The suggestion I would offer is, that the excessive development of the frontal air sinuses and the maxillary sinuses that one finds in these skulls has the effect of producing a flattening of the upper and lower orbital margins, owing to the encroachment of the expanding bone upon them, thus lowering the orbital index, and at the same time imparting the quadrangular contour. There can be no doubt that the degree and direction of development of the air sinuses of the skull must exert a profound effect upon its architecture and general configuration.⁽³³⁾

The Facial Index.—The facial index was found to be 50.5 in No. 1 skull and 54.6 in No. 2. They were both above 50 and were thus to be classed as dolichofacial, as one would be led to expect in two skulls which were so pronouncedly dolichocephalic, seeing that long headed skulls are also usually long faced, though this is by no means a constantly concomitant occurrence.

The Fronto-parietal Index.—This index is one that has not received the attention it deserves from anthropologists and evolutionists. Indeed it is only during recent years that its importance and significance have been really appreciated. So far as the bibliography at my disposal indicates, Schwalbe⁽³⁴⁾ appears to have been one of the pioneers in exploiting its application to craniometry, for he makes full use of it in his classic memoir on the Neanderthal skull, though he takes care to emphasise the fact that the index is not always an infallible means of demarcating the anthropoid apes from examples of fossil hominidæ such as the Neanderthal specimen. For example, the fronto-parietal index of the Krapina skull which represents a type of Neanderthal or Mousterian man, has been calculated by Kramberger⁽³⁵⁾ to be 64.7, this being actually less than that of the skull of the Java man-ape, which works out at 65.4.⁽³⁶⁾ Figure 1 is an outline of the skull of the Java man-ape viewed from above and drawn to scale. It shows how intense is the degree of post-frontal constriction which, according to the index, is 65.4% of the maximum parietal breadth. For purposes of comparison, the outline of No. 2 skull seen from above is shown in Figure 1, which is also drawn to the same scale. The fronto-parietal index of No. 2 skull was as low as 72.6, that is to say, it was actually less than that of the Neanderthal skull (see Figure 2) which has been calculated as 73.1, and was much below the average index for the aboriginal Australian of to-day which has been given as 77.⁽³⁷⁾ The corresponding index in No. 1 skull, as was to be expected, was decidedly higher than that of No. 2, namely 77.8, and, as would be noted, a little above the aboriginal Australian average. Another important point emphasised in Fig. 1 is the marked phaenozygous condition exhibited by No. 2 skull.

The Calvarial Height Index.—This is another cranial index

which has secured the attention it deserves only within recent years. It is essentially a study of the degree of flattening of the cranial roof, and would therefore naturally be expected to yield most striking results. The index is usually taken as the proportion which the maximum height of the calvaria bears to the glabella-inion length (the line GI in Fig. 4). In this Figure the calvarial height is the greatest distance to the cranial roof measured perpendicularly from the line GI. The index of calvarial height was found to be 58.4 for No. 1 skull and 55.7 for No. 2. These results when interpreted showed of course that the calvarial height of both was slightly more than half the maximum cranial length. In the skulls of the higher races of mankind this index is, of course, always well over fifty. It is interesting to compare this with the extreme degree of flattening of the cranial roof of the Java man-ape, represented by an index of 34.3,⁽³⁸⁾ and the flattening of the cranial arc in the Neanderthal skull, represented by an index of 40.4⁽³⁹⁾. Figure 4 has been designed for the purpose of still further emphasising the importance of this index. The curves represent the antero-posterior outlines of the roofs of four skulls in the sagittal plane. The line GI is the glabella-inion length and from it the calvarial height was measured. The horizontal planes of the skulls, are only approximately denoted for all four, as an average had to be taken. The cranial curves are all drawn to scale. The lowest curve indicates the outline of the cranial arc of the Java man-ape. The upper two cranial arcs become very definitely separated, in front, the lower of the two indicating an outline of the frontal part of the roof of No. (1) skull, while the upper is that of an average Canadian skull taken at random for purposes of comparison. The Figure demonstrates what an enormous degree of expansion the cranial roof has undergone since the evolutionary stage represented by the Java man-ape, and, indeed, makes one seriously question whether

the latter ought really to be regarded as an ancestral type. The calvarial height in both No. 1 and No. 2 skulls, as Fig. 4 shows, was found to be as great as that of a Canadian skull. Therefore what might not inaptly be termed the intellectual expansion of the skull of the higher races has been practically confined to the frontal segment of the cranial arc. This conclusion certainly supports the current idea that the higher intellectual centres of the brain are mainly centered in the frontal lobes.

The Palato-maxillary Index.—The palato-maxillary index was 115.4 in No. 1 skull which therefore proved to be brachyuranic. In No. 2 it was found to be 111.9 thus classing this skull as mesuranic. The palate in No. 1 skull was therefore relatively broader than that of No. 2, though not absolutely so, seeing that its measurement was 6.35 cm., that of No. 2 being 6.55 cm. The importance and significance of this index have not been worked out yet with any degree of certainty, so that it will be sufficient to place the above measurements on record for future reference and comparison.

The Bregmatic Angle.—This is an angular cranial measurement which has likewise come to assume a position full of importance and significance only within comparatively recent years. It demonstrates in a very effective and telling manner, the degree of flattening or otherwise of the frontal portion of the cranial arc. As it is not mentioned much in books, and as there appears to be some ambiguity regarding its exact mode of application, and method of measurement, I may state that I adopted the plan utilised by Schwalbe⁽⁴⁰⁾ in his study of the Neanderthal skull. He took the angle between two lines, one passing from the glabella to the inion, and the other from the glabella to the bregma, as shown in Figure 6, where the line IG is the occipito-glabellar, and BG the bregma-glabellar. The bregmatic angle was found to be 59° in No. 1 skull, and 55° in No. 2. These results were thus well within the range of variation for modern hominidæ,

which is given by Duckworth⁽⁴¹⁾ as from 53° to 66° , and their average closely corresponded to that of 56° found by Berry and Robertson⁽⁴²⁾ as the result of examining forty-five aboriginal Tasmanian skulls, and is, on the other hand, slightly higher than the average of 54.7° found by the same two observers,⁽⁴³⁾ after investigating the bregmatic angle in a series of one hundred aboriginal Australian skulls. It is significant to note once more, that No. 1 skull, as usual, exhibits a definitely superior type of index. Indeed, it is a rather fortuitous circumstance that these two Melanesian skulls, which were obtained in quite a random way, should have consistently shown approximations to the maximum and minimum limits, respectively, in the range of variation of their cranial indices with one exception, the orbital, which recorded practically the same result in both. This all goes to show how mixed is the race that inhabits the New Hebridean group of islands, the admixture of a higher grade Polynesian strain being, no doubt, the cause of this wide range of difference. An examination of two skulls thus proved sufficient to substantiate the statement in Dr. Annand's letter regarding this fact, but of course the writer knows and recognises the necessity for an investigation extending over hundreds or even thousands of crania in order to secure analytical results that would adequately satisfy anthropologists on this matter.

The Glabella-Bregma Chord and the Curvature of the Frontal Cranial Arc.—The glabella-bregma chord was estimated to be 11.15 cm. in No. 1 skull and 11.35 cm. in No. 2, results which correspond very closely with those of Berry and Robertson⁽⁴⁴⁾ who record 11.08 cm. as the average for one hundred aboriginal Australian skulls, and 10.95 cm. as the average result in the case of fifty aboriginal Tasmanian skulls. It may be of interest to mention also that the glabella-bregma chord in the Spy-Neanderthal race measured about 11 cm. on the average, while the writer calculated that it was 11.13 cm. in Smith Woodward's reconstruction of it

the Piltdown skull. It is evident then that the length of the glabella-bregma chord exhibits no very striking points of significance, as it is apparently a fairly constant factor both in fossil and in modern hominidæ. It is a very different story, however, with regard to the maximum distance between it and the frontal cranial arc. This was calculated to be 13.5 mm. (at a point about midway between the glabella and the bregma) in No. 1 skull, and 14 mm. (at a point about two thirds of the way from the glabella to the bregma) in No. 2 skull, distances which compared in the most striking degree with 25 mm., which the writer found in the case of a Canadian skull taken at random (this, it may be mentioned, is a medium figure for the skulls of white races). Figure 6 has been designed to demonstrate the fact that the evolution of the frontal cranial arc is due in least degree to the elongation of the glabella-bregma chord, and in very marked degree to the expansion of the Bregmatic angle and the increase in the curvature of the frontal cranial arc. It may be mentioned that the writer calculated the maximum distance of the frontal cranial arc from the glabella-bregma chord to be 25 mm. in Smith Woodward's reconstruction of the Piltdown skull, which was thus nearly twice that in these two Melanesian specimens. In fact the latter were to be intimately compared to such lowly evolved skulls as those of the Spy-Neanderthal race where the above average distance was found to be 14.3 mm.⁽⁴⁵⁾

The Bregma-lambda Chord and the Parietal Arc.—The bregma-lambda chord was 12.1 cm. in length in No. 1 skull and 12.35 cm. in No. 2, measurements which are both slightly higher than the average for one hundred aboriginal Australian skulls, which was found by Berry and Robertson⁽⁴⁶⁾ to be 11.46 cm., and likewise higher than the average for forty-eight aboriginal Tasmanian skulls which was calculated by the same two observers⁽⁴⁶⁾ to be 11.3 cm. The maximum distance of the chord from the parietal arc was 30 mm. in

No. 1 skull and 43 mm. in the case of No. 2. These are excessively high figures when compared with the measurements found by Buchner⁽⁴⁶⁾ in aboriginal Australian and Tasmanian skulls which were 23.2 mm. and 23.3 mm. respectively. This intense degree of curvature of the parietal arc imparted an extraordinary appearance to these two New Hebridean skulls, when studied in mesial section, the arching of the vault in both being very abrupt and sudden indeed in this region.

The Lambda-inion Chord and Arc.—The lambda-inion chord was 66 mm. long in No. 1 skull and 64.5 mm. in No. 2, measurements which, like the parietal chord, are very much above the averages for aboriginal Australian and Tasmanian skulls, given by Buchner⁽⁴⁶⁾ as 55.2 and 55.5 respectively. The maximum distance of the chord from the arc was the same for both No. 1 and No. 2 skulls, namely 9 mm. This was likewise very decidedly above the average of 6.1 mm. found by Buchner⁽⁴⁶⁾ in aboriginal Australian and Tasmanian skulls.

The Spheno-maxillary Angle.—This angle constitutes a useful and at the same time fairly constant index of the degree of prognathism, and is in many ways preferable to Camper's facial angle and the Frankfort facial angle. It therefore proved to be a most valuable cranial measurement in the case of these two skulls. It was found to be 95° in No. 1 and 97° in No. 2 skull, figures which closely approximated to Huxley's results in a Melanesian skull, viz. 99°. It should be noted, however, that Huxley⁽⁴⁷⁾ who initiated the use of this angle in the course of his researches on the cranio-facial axis utilised the akanthion as his anterior point, while I employed the prosthion.⁽⁴⁷⁾ This may account for the slight difference in the results. These figures contrast very strongly with 75° which was the average result obtained by Duckworth⁽⁴⁷⁾ in the measurements of two European skulls and the angles calculated by the same observer in

orang-utan and gorilla skulls which were 145° and 125° respectively. It is quite obvious, then, that as regards prognathism, these two New Hebridean skulls are definitely situated in a position intermediate between the anthropoid skull and that of modern white races.

The Spheno-ethmoidal Angle.—This is another useful angular cranial measurement, the condition of which in these two skulls is well worth recording. It, like the spheno-maxillary angle, was apparently first employed by Huxley,⁽⁴⁷⁾ and is therefore usually associated with his name. It really yields quite instructive results, for it shows us how much the cranio-facial axis has become bent upon itself during the evolution of the skull. For example, if one studies a mesial section of the skull of an anthropoid ape, like the orang-utan, it will be noticed that the cribriform plate of the ethmoid, the body of the sphenoid and basilar portion of the occipital bone are practically in the same straight line, thus placing the spheno-ethmoidal angle somewhere in the vicinity of 180° in the apes. As a matter of fact it may be a little above or below this figure. On examining a mesial section of the modern human skull it will be noticed that a profound alteration has taken place, for while the cribriform plate of the ethmoid has remained practically horizontal, the sphenoid and occipital bones have been very definitely forced downwards, thus reducing the size of the angle. It will therefore be recognised that the higher the type of skull, the smaller is the size of this angle. The spheno-ethmoidal angle was found to be the same in both of these New Hebridean skulls, namely 151° , which closely approximates to the figure of 153° , found by Duckworth⁽⁴⁷⁾ in the case of two aboriginal Australian skulls. The same observer⁽⁴⁷⁾ gives 138° as the average result in two European skulls, so that evidently there is a substantial difference between the size of the angle in the highest and lowest races of modern mankind.

The Foramino-basal Angle.—This angular cranial measurement is usually associated with the name of Sir William Turner⁽⁴⁷⁾ who made extensive use of it in measuring the Challenger collection of skulls. It was found to be 146.5° in No. 1 skull and 148° in No. 2. This closely approximates to the figure of 147° which was estimated by Huxley⁽⁴⁷⁾ in a Melanesian skull. Duckworth⁽⁴⁷⁾ gives $149^{\circ} 30'$ as the average size of this angle in two European skulls. It is evident therefore that the size of the foramino-basal angle varies very slightly throughout all types of modern hominidæ. Indeed its range of variation is so small that it cannot by itself be utilised as a determining factor in a comparative study of the human race. It is very serviceable however in comparing the skull of man with that of lower animals, where it appears to become consistently smaller the further down the Mammalian series one goes. This profound alteration is due to the fact that the foramen magnum which in man lies practically in a horizontal plane, comes to look more and more backwards as one descends the animal scale. For example Duckworth⁽⁴⁷⁾ records a foramino-basal angle of 120° in the gorilla and one of 108° in the dog.

Some Additional Features of the Two Skulls.—No. 1 skull was remarkably thin, the upper part of the frontal bone being only 4.5 mm. in thickness. No. 2 skull, on the other hand possessed a thickness twice as great on the average as that of No. 1. The lower parts of the temporal fossæ in both skulls were remarkably capacious, the distance between the inner surface of the xygoma and the bottom of the fossa being as much as 25.5 mm. in No. 2 skull and 24 mm. in No. 1. These large gaps indicated of course that the temporal muscles had been very powerfully developed, as one would have expected in a race addicted to cannibalism and unconventional mastication. The various air sinuses were remarkably large. Those in the frontal bone were very spacious, their influence in producing the excessively

prominent superciliary ridges being very well demonstrated in mesial sections of the skulls. The sutures were arranged on a very simple plan, there being few of the elaborate sinuosities encountered in the skulls of white races. No suggestion of metopism was to be detected in either skull. There was a fronto-squamous suture at the pterion on the right side in No. 1 skull. The styloid processes were remarkably short as in aboriginal Australian skulls, but the anomalies so frequently found in that race in the region of the foramen magnum were not present. Prenasal grooves were marked features of both skulls thus rendering the lower margins of the nasal apertures very indistinct in appearance. The nasal bones met at an obtuse angle, a condition which is in striking contrast to Polynesian skulls where the union occurs at an acute angle.

THE DENTITION.

The teeth were markedly worn in No. 1 skull and very slightly so in No. 2, from which fact one may safely gather that No. 1 skull had belonged to a somewhat older individual, a conclusion which was confirmed by an examination of the degree of synostosis of the sutures as stated on page 407. In the case of No. 1 skull it was noticed that the right molars were much more worn than those of the left side. On showing this condition to my colleague, Dr. Frank Woodbury, he at once pointed out the cause, which was a pyorrhoea alveolaris round the first left molar of the upper jaw, which had loosened the fangs of that tooth and no doubt made it very tender on pressure. The alveoli of this tooth were almost obliterated by the disease, and the tooth itself was missing from the skull.

The upper central incisors in both skulls had been lost, probably during the period of inhumation, but were replaced by neatly modelled wooden pegs, made as far as possible of the size and shape of the missing teeth. These were apparently put in to form a background against which the lips

of the facial masks could be more accurately moulded into shape. It required a close inspection of these pegs to convince oneself that they were not the actual teeth and their true character was only found out by accident when one of them happened to drop out of its socket one day.

The dental index could not be calculated for No. 1 skull, as the 3rd molars had never developed in either jaw. In the case of No. 2 skull it proved to be 41.9 which placed it definitely in the microdont class. This disclosed a very anomalous condition, since the index for Melanesians is usually above 44, thus placing that race in the megadont class. This conclusion was supported by an examination of the molar teeth.

In No. 1 skull the number of molar cusps was as follows:

	Upper Jaw	Lower Jaw
1st Molar	4 cusps	5 cusps
2nd Molar	4 cusps	4 cusps
3rd Molar	not developed	not developed

In No. 2 skull the number of molar cusps was as follows:

	Upper Jaw	Lower Jaw
1st Molar	4 cusps	5 cusps
2nd Molar	4 cusps	4 cusps
3rd Molar	3 cusps	4 cusps.

The third upper molars in No. 2 skull only showed three cusps, due, as was to be expected, to the loss of the hypocone, thus showing a tendency to trituberculism. Indeed, the molar teeth in both skulls exhibited this tendency to a reduction in the number of cusps, an interesting condition, especially when one considers the primitive race to which they belonged. For example, the 1st molars of the lower jaws were the only teeth that showed five cusps, while in one case the 3rd molars had not even been developed in either jaw. It is thus a notable fact that in these two low grade skulls the upper molar teeth were found to be in process of transition into the

three cusped type, and the lower molars from the five cusped into the four cusped pattern; and demonstrates very definitely that this reduction process is by no means confined to the higher races of mankind.

In regard to the size of the molar teeth, it was noted that in No. 1 skull the 2nd upper molars were definitely smaller than the 1st, while the 2nd lower molars were a very slight degree smaller than the 1st. In the case of No. 2 skull, the 3rd upper molars were distinctly smaller than the 2nd molars, while the 3rd lower molars were practically of the same size as the 2nd and both were smaller than the 1st, on each side of the jaw. It will be noted from what has been stated that the dentition was somewhat anomalous in these skulls and may explain why the lower jaws displayed so little evidence of prognathism. Some anthropologists, amongst whom may be specially mentioned Sir. W. Flower, have laid great emphasis on the comparative study of the molar teeth. He showed that they tended to be larger in the primitive races, where they may occupy in the dental arches relatively the same compass as in an anthropoid ape like the chimpanzee. Moreover in these lower races the 2nd and 3rd molars tend to approximate to the size of the first, thus showing a reversion to primitive ancestral types. For example, in the lower jaw of the chimpanzee the three molars are all of the same size. In the jaw of Heidelberg man, who stands at a very low level in the human family tree, the three molars are again found to be all practically of the same size. In Neanderthal or Mousterian man, who was also closely allied to Heidelberg man, the 2nd and 3rd molars were as large as the first. The 2nd molar of the Piltdown man was slightly smaller than the first. His 3rd molar was never discovered. In the upper and lower jaws of No. 1 skull the 2nd and 3rd molar teeth were likewise certainly smaller than the 1st. Note further that in the jaws of the chimpanzee, Heidelberg man, and

Piltown man, the front teeth have plenty of accommodation in the alveolar arch, a condition which, it may be noted, is associated in all three examples with the absence of a chin. In modern man, on the other hand, the chin has developed and the teeth have become closely packed together, thus threatening to crowd out the 3rd molars altogether, a condition which is certainly going on in the upper jaw as well as the lower, especially in the higher races of modern mankind. It may further be asked, "Are the reduction of the dental arch and the evolution of the chin to be regarded as two closely associated phenomena?" A study of man's ancestry would certainly appear to suggest this fact.

In confirmation, as it were, of the superior type of dentition in these two New Hebrides skulls, the upper alveolar arches in both do not show the U shape which is the usual condition in a low race like the Melanesians, but the parabola-like curve of the arch that is found in the higher races of mankind. I am bound to say that the dentition and the modelling of the jaws of these two New Hebrides skulls show some very anomalous features which appear worthy of being placed on record.

THE FACIAL MASKS.

The facial masks were of a peculiar iron-rust tint with coloured decorations superadded. Their outline in both cases followed the lower borders of the mandibles and extended upwards from this along the posterior edges of the rami and crossed the roots of the zygomatic arches just in front of the external auditory meatuses. They covered the lower parts of the temples. The upper edges swept across to the opposite side along the line of what would have been the junction of the forehead with the roots of the hair. They were thus strictly limited to the facial portions of the skulls. In one case the posterior edge had attached to it a model of the front margin of the external ear. This fact suggests that the clay masks may have covered the whole skull at

one time, but the line of demarcation is so definite in both cases that I am inclined to believe they never at any time covered more than the faces.

The brow of each mask is rather finely modelled, the arching eyebrows being very well worked out. They do not show any bulging to represent the prominence of the superciliary ridges, though the latter are well marked in the skulls. The aperture of the eye is rather small in both masks, and its long axis is set obliquely, though this axis is inclined downwards and outwards instead of upwards and outwards as in the Mongolian type of face.

The nose in No. 1 mask tends to be of the European, or, at any rate, Polynesian type. It is sharp and straight in outline with the exception of a light bump at the junction of the nasal bones with the cartilaginous portion, which is of course a common feature of the nose of white races. On the whole, it is moulded on rather fine lines, if one may except an increased roominess of the nasal apertures, and a slightly greater width between the alae, when compared with the average European type. The nose of No. 2 mask shows more of the negroid type, for it is slightly concave from above downwards, and is wider and flatter than that of No. 1. Moreover, the alæ are also larger, and the capacity of the nasal apertures greater. This fact is of interest when compared with the persistently lower cranial indices of No. 2 skull as compared with No. 1.

The ridge of the nose when examined in profile is, in both masks, almost exactly in line with the backward slope of the forehead thus emphasising the latter to a marked degree (Figure 9).

The cheeks of both masks are rather prominent, this effect being exaggerated by a marked hollowing of the lower parts of each. The mouth in both instances is much larger than in the European type of countenance. The lips are, however, not of the thickened negroid type; in fact they are

very neatly modelled; but they are strongly everted, an arrangement which gives the mouth a half open appearance. The chin and the lower part of the face generally are in both masks modelled on rather attractive lines.

The Decorations on the Masks.—The decorations on No. 1 mask consist of a circular target-like design, painted on each cheek, on the centre of the forehead, and on the chin. The circle on each cheek is better preserved than the others. It is 45 mm. in diameter and consists of an outer ring 10 mm. in width painted white. The inner circle demarcated in this way is 25 mm. in diameter, and painted a pale pink. This had become somewhat faded but was apparently the colour adopted for all the inner circles.

The circle on the brow is 36 mm. in diameter, and consists of an outer belt of white 10 mm. in width enclosing an inner circle, painted pale pink, 16 mm. in diameter.

The circle on the chin extends from the edge of the lower lip to the tip of the chin. It is 31 mm. in diameter, and is surrounded as usual by a white band 10 mm. in width enclosing an inner pale pink central portion 11 mm. in diameter.

The scheme of decoration adopted for No. 2 mask is rather peculiar and striking. The outer portions are entirely coloured a pale blue, reminding the writer strongly of the blue clay with which housewives in Scotland, especially in fishing villages of the east coast, are so fond of decorating their door steps and window ledges. The line of demarcation of this outer blue area from the iron-rust brown coloured part of the mask is very sharply defined, and runs symmetrically in a downward and inward direction on the forehead towards the root of the nose, where the two edges are separated merely by a gap of 9 mm. From this point the lines follow the lateral margins of the nose, thus mapping it out very definitely from the rest of the mask. The lines then run downwards just clear of the angles of the mouth,

from which they are continued downward and very slightly inward to the lower edge of the mask, where they are separated by a distance of 9.1 c. m. measured over the tip of the chin.

The question of the meaning and significance of these masks provides much material for thought and reflection. I can find no reference to them in "The Life of Dr. John Geddie," which otherwise gives an elaborate account of the habits, customs, beliefs, and superstitions of the inhabitants of the New Hebrides.⁽⁴⁸⁾ Dr. Annand in his letter (see page 405) mentions that in some Islands the body is encased in clay immediately after death. In the case of these skulls, however, it is quite evident that the masks had been moulded directly on the bone surface, which meant that the skulls had probably lain in the earth for years. They certainly look as if they had been inhumed for a prolonged period of time, and this theory is supported by the loss of several of the teeth from both skulls, their sockets being left intact. Besides, the cocoanut fibre which formed the background of the masks is tucked under the zygomatic arches and into the orbits, while a plug exactly fits the anterior nasal aperture of both the skulls. A few dried shreds representing decayed scalp could be noted adhering to the parietal and occipital regions of No. 2 skull.

The first point that strikes one on studying the decorations on the mask of No. 1 skull is their resemblance in some ways, to the circular design found tattooed on the foreheads, cheeks, and chins of Maori chiefs nowadays. The Maoris, it may be noted, are Polynesians. The heads of many of these great chiefs were afterwards embalmed and carefully preserved as relics. With the knowledge of this Polynesian custom in one's mind it was certainly remarkable to find that No. 1 skull which possessed definite Melanesian cranial indices was provided with a clay mask exhibiting Polynesian facial features, and decorated in a style also suggesting Polynesian influence and inspiration. It is possible then,

that No. 1 skull was that of a prominent chief, whose countenance, it was arranged, should be immortalised in clay many years after his death. This theory is strengthened by the fact that the bodies of the common people in the New Hebrides were usually thrown into the sea, a fact which is mentioned in Dr. Annand's letter (see page 405) and also in the life of Dr. John Geddie.

The writer was able to glean much suggestive information bearing upon these skulls from the extensive writings of Sir J. G. Frazer, and was particularly impressed by the following remarks⁽⁴⁹⁾ regarding the customs of the inhabitants of New Guinea, who it may be mentioned, are usually classed as Melanesians: "The preservation of the skulls and bones of chiefs and other noteables for years . . . must apparently be designed to propitiate or influence in some way the ghosts of the persons to whom the skulls and bones belonged in their lifetime." Again, in another of his works,⁽⁵⁰⁾ the same authority makes the significant statement that the head of a chief is held in the greatest sanctity throughout Polynesia. It was no doubt this fact which inspired the idea of preserving his head and features as a possible means of protection against misfortune and the influences of evil.

The moulding of the facial features in No. 1 skull, and the subsequent decorative scheme certainly suggests to the writer that some Polynesian influence was at work here.

On now studying the condition in No. 2 skull, it will be noted that this showed extreme Melanesian cranial indices, while the moulding of the facial features was also undoubtedly Melanesian. The decoration also shows a marked difference from that in No. 1, there being no suggestion of the characteristic circular design. Professor Falconer of Pine Hill College very kindly showed me an elaborately painted wooden god from the New Hebrides which seemed to offer a clue to this style of decoration, for on the right half of the forehead and on the left cheek were patches of blue of exactly the same

tint and apparently the same chemical nature as that in No. 2 mask. Certainly the study of these masks is pregnant with suggestion, and as I am unable at present to find any references to ethnological literature dealing with these, I am publishing my own personal impressions in order that they may inspire some controversial discussion on the subject.

Professor E. Mackay of Dalhousie University has very kindly made a chemical examination of the material constituting the facial masks, and he reports that the vegetable fibre which forms a sort of basis "is cemented together by material which is very largely organic, containing a small amount of ochre-like substance which is chiefly an oxide of iron."

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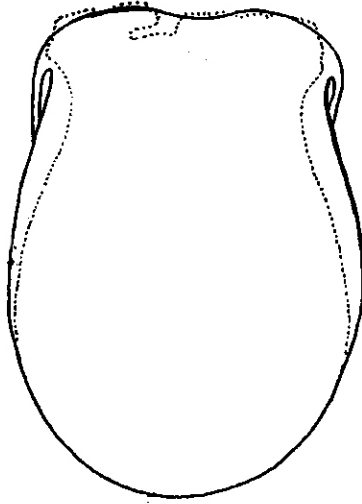


Fig. 1 shows No. 2 skull and the Java calvaria (in dotted outline) both drawn to the same scale and viewed from above. This mode of comparison intensifies the post-orbital construction in the Java specimen. Both outlines were found to coincide posteriorly.

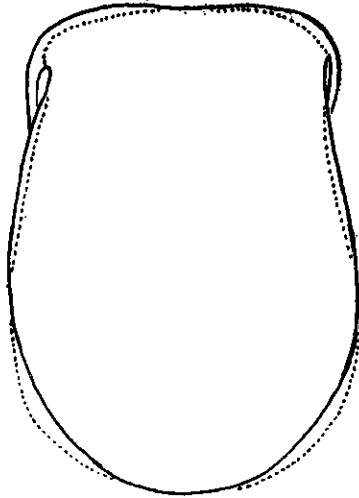


Fig. 2 shows No. 2 skull and the Neanderthal calvaria (in dotted outline) both drawn to the same scale and viewed from above. Note that the post-orbital constriction and the maximum parietal breadth are practically the same in both specimens.

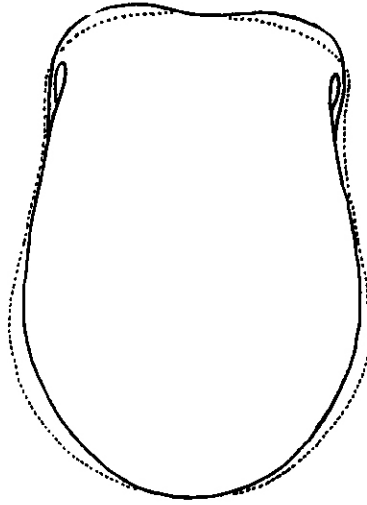


Fig. 3 shows No. 2 skull and the Piltown skull (in dotted outline) both drawn to the same scale and viewed from above. Note that the post-orbital constriction and the maximum parietal breadth both compare unfavourably with those of the Piltown specimen.

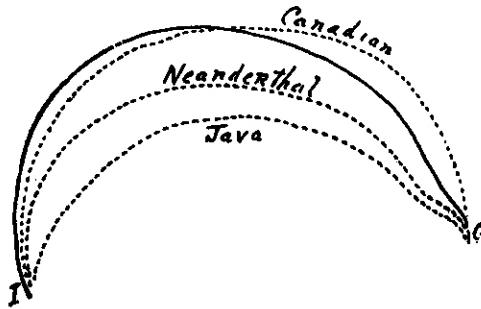


Fig. 4 shows No. 1 skull (in continuous outline), the Java calvaria, the Neanderthal calvaria and a modern Canadian skull all drawn to the same scale for purposes of comparison from the evolutionary standpoint. Note the deficiency of the frontal cranial arc of No. 1 skull and the bulging of the parieto-occipital arc. Note also the "fallen in" appearance of the frontal cranial arc in the lower forms and its obliteration in the Canadian cranium.

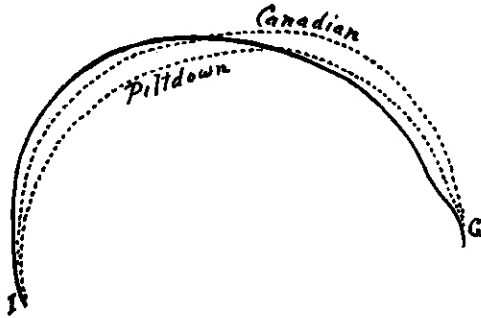


Fig. 5 shows No. 1 skull (in continuous outline), the Piltdown skull and a modern Canadian cranium all drawn to the same scale. Observe the deficiency of the frontal cranial arc of No. 1 skull when compared with the Piltdown and Canadian specimens. G. represents the glabella and I the inion.

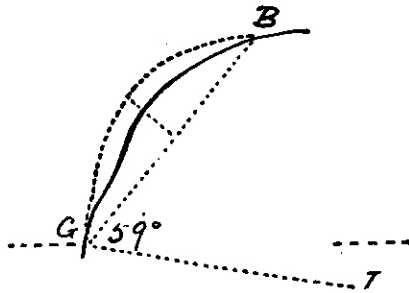


Fig. 6 has been devised to compare the frontal arc of No. 1 skull with that of a modern Canadian cranium possessing the same bregmatic angle (59). The maximum distances of the arc from the glabella-bregma chord were 13.5 and 22 mm. respectively.

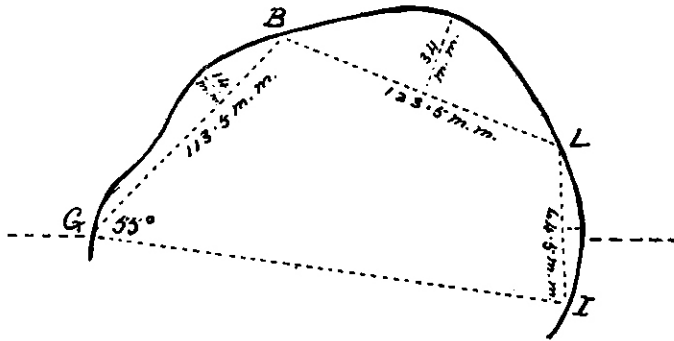


Fig. 7 shows outlines of No. 1 skull (below) and No. 2 skull (above) to illustrate the various cranial curvatures and chords and represent their respective dimensions. The bregmatic angle is also shown. The exceptional height of the parietal curvature is a striking feature.

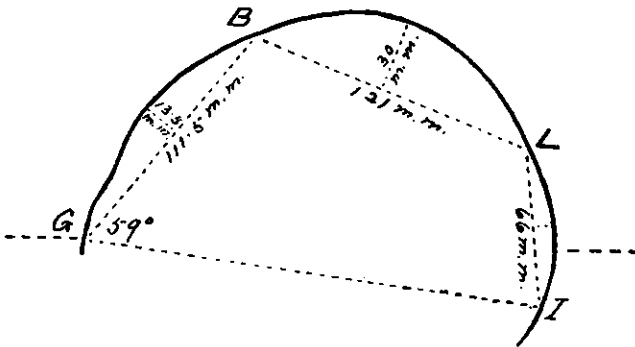


Fig. 7 shows outline of No. 1 skull (below) and No. 2 skull (above) to illustrate the various cranial curvatures and chords and represent their respective dimensions. The bregmatic angle is also shown. The exceptional height of the parietal curvature is a striking feature.

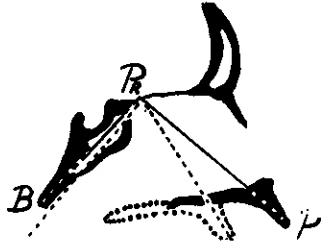


Fig. 8 shows the sphenomaxillary angle (B-P-R-P) of No. 1 skull compared with that of a modern Canadian skull (between the dotted lines) which was 75°. The Fig. illustrates the effect which a reduction in the size of this angle has in producing the orthognathous type of cranium.

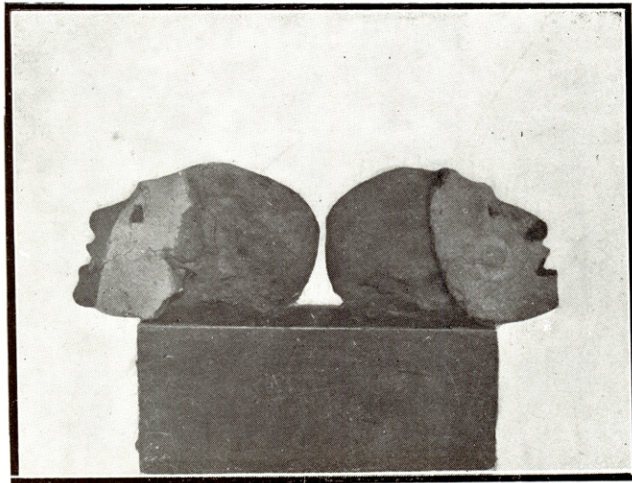


Fig. 9. Profile view of the masks. (No 2 to the left, No. 1 to the right).

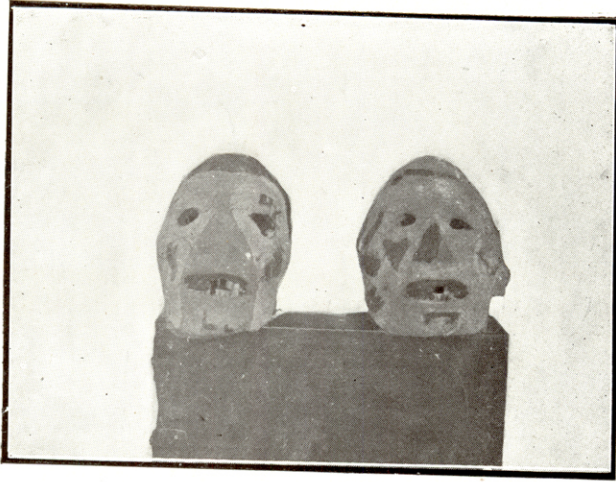


Fig. 10. Full face view of the masks. (No. 2 to the left, No. 1 to the right).



Fig. 11. Three-quarter profile view of the masks. (No. 2 to the left, No. 1 to the right).

I wish to express my indebtedness to Mr. Gordon Smith for taking the photographs of the masks.