XII.—The Evolution of the Eyebrow Region of the Forehead, with Special Reference to the Excessive Supraorbital Development in the Neanderthal Race.

By Professor D. J. Cunningham, F.R.S. (With Three Plates.)

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One of the most striking features of the famous Neanderthal cranium consists in the strong projection which is exhibited in the glabellar and the supraorbital or eyebrow regions of the frontal bone. This character is rendered all the more important from the fact that all the specimens which have been collected since the Neanderthal cranium was discovered (1857), and which have been shown to belong to the same remote geological period, possess the same, or at least very much the same, remarkable prominence in the eyebrow region. These specimens are not very numerous, but, inasmuch as they represent the earliest remains of man with which we are acquainted, they possess a very special interest. In addition to the Neanderthal cranium, the group includes the two Spy crania, the Gibraltar skull, and the recently discovered Krapina remains. The Krapina remains are in a very fragmentary condition, but they apparently consist of portions of the skeletons of ten individuals, and the frontal bones all present the character in question.

It is curious that, although all of the many observers who have written upon the Neanderthal race have dwelt upon the supraorbital projection and have recognised in it one of the leading peculiarities of the group, no one, with the exception of SCHWALBE, has subjected the eyebrow region to a searching and critical examination. In his recent important papers upon the so-called *Pithecanthropus erectus* and on prehistoric man, SCHWALBE has thrown much light upon the value to be attached to the eyebrow projection, and has stimulated further research in the same field (5 to 11).*

In the present investigation I have had the great advantage of having been afforded the privilege of studying the splendid collection of anthropoid and lower ape skulls in the British Museum. This privilege I owe to the kindness of Mr OLDFIELD THOMAS, to whom I cordially offer my most grateful acknowledgments. To the British Museum specimens must be added the numerous anthropoid and lower ape crania in the Museum of the University of Edinburgh, which were also at my disposal. The full range of the investigation, in so far as the ape is

* Professor SCHWALBE has had the inestimable advantage of having recently been permitted to study at his leisure and in his own laboratory the Neanderthal remains. These he has described with great care (8), and has placed in the hands of other observers particulars in regard to these specimens of very great value.

concerned, can best be appreciated by the following list of the specimens which have come under my notice :—

Gorilla	18	
Chimpanzee . . .	33	
		10 young
		23 adult
Orang	46	
		19 young
		27 adult
Gibbon	27	(including 9 species)
Semnopithecus . . .	18	(„ 5 „)
Nasalis	4	
Colobus . . .	44	
Cercopithecus . . .	33	
Cercocebus . . .	20	
Macacus . . .	27	(including 15 species)
Cynopithecus . . .	1	
Cynocephalus . . .	50	
Cebus	12	

The large collection of human crania, including somewhere about 1500 specimens, in the Museum of the University of Edinburgh has more than sufficed for my purpose. I do not pretend to have examined all of these skulls from this point of view. I have chiefly directed my attention, for reasons that will be afterwards apparent, to the group of Australian crania (130 in number), and of these I selected the Victoria and Queensland specimens for special study.

Degree of Projection of the Glabellar Part of the Frontal Bone.

Schwalbe estimates the extent and degree of projection of the glabellar part of the eyebrow-region by measuring by the callipers the chords of the glabellar and cerebral curves or arcs of the frontal bone, and expressing the former as a percentage of the latter, thus :

$$\frac{\text{Glabellar chord} \times 100}{\text{Cerebral chord}}$$

When dealt with in this way, the Neanderthal cranium gives an index of 44·2, and the Spy cranium No. 1 an index of 41·5. According to Schwalbe, the index in recent man rarely reaches 30, and varies between the limits of 21·4 and 31·8 (8, p. 29).

A New South Wales Australian cranium (xxix. B. 1) in the ethnological collection of the University gives an index of 30·7, and another Australian skull from the Riverina district (xxix. B. 12), with a still more prominent glabellar region, yields an index of 34. But I believe that even this index may be exceeded. Recently I received from Dr W. Ramsay Smith, of Adelaide, the head of an aboriginal Australian named Boco, in which there was an excessive development of the glabellar and supraorbital regions of the forehead (2). It had been carefully preserved by formalin injection, and measured over the soft parts the index reached the high figure of 52·3. Of course this cannot

be taken as being comparable with those indices obtained from measurements of the skull, but there is reason to believe that if the calvaria of Boco were denuded of the scalp covering it would give an index at least as high as that of the Neanderthal cranium.

But what is the value of this glabello-cerebral index of SCHWALBE? Can we rely upon it giving a true and proper idea of the relative extent and degree of projection of the pars glabellaris of the cranium? I do not think that we can, and I look upon the figures given above as being of little value, and in certain respects misleading. If the mesial length of the frontal bone, measured either by the tape or the callipers, from the nasion to the bregma were relatively (even approximately) the same in different skulls, some reliance might be placed on the index; but when we find in three skulls so similar in the degree of glabellar projection as the Neanderthal, Spy 1, and Riverina the total frontal length, as ascertained by the tape, so very different as 133 mm., 120 mm., and 147 mm. respectively, it is evident that in these cases the index expresses variations in the length of the cerebral part of the frontal bone more than variations in the length of the glabellar part. Indeed, no index is necessary. The proper comparison to institute is one between the absolute measurements of the glabellar part made by the tape over its curvature from nasion to ophryon in different skulls. When this is done in the crania under consideration we obtain the following figures, and from these we can best realise the extent and degree of glabellar projection :—

New South Wales cranium (xxix. B. 1) . . .	31 mm.
Spy No. 1 „	40 „
Riverina skull (xxix. B. 12)	41 „
Neanderthal cranium	43 „
Boco (over scalp tissues)	50 „

We are thus enabled to conclude that the high degree of glabellar development which is seen in the Neanderthal group, and which in it constitutes a distinct and definite racial character, may nevertheless be attained as an occasional variation in certain individuals of other races—notably the Australian race.

GIUFRIDA-RUGGERI (4), in a suggestive and well-reasoned paper, likewise expresses his dissatisfaction with SCHWALBE'S glabello-cerebral index. He refers to the variability in the position of the bregma due to differences in the form of the coronal suture,* and then he goes on to remark: "Even the position of the nasion varies according as the fronto-nasal suture is semilunar, triangular, or horseshoe-shaped, and this exercises an influence on the length of the glabellar chord. I have obtained higher indices in certain Melanesian skulls in which the bregma was not much displaced backwards." He gives five examples in which the index varied from 30·2 to 33·3, and then remarks: "Finally, in the skull 760, which is one of the most interesting in the Anthropological Museum in Rome, I obtained an index of 39·7, to which I would draw the attention of Professor SCHWALBE."

* This is merely another way of stating that the variations in the position of the bregma are due to variations in the extent of the frontal field of the cranial wall.

But while the glabellar region in individual cases in recent man may assume proportions quite as great as those which are seen within the Neanderthal group, I would not have it supposed that I attach undue importance to the agreement in this respect. Certain suggestive and significant points of difference will be brought out in the course of this paper. To one of these we may refer at the present time. The depression above the glabellar and supraorbital regions in the Neanderthal and Spy crania is much more extensive than in the case of any recent skull or in the skulls of any other prehistoric race. This constitutes a marked and highly important distinction, and one which brings the Neanderthal type of cranium into closer relation with that of the chimpanzee and the gorilla. SCHWALBE fully recognises the significance of this character. The forward expansion of the cerebral part of the frontal bone in response to the increased develop-

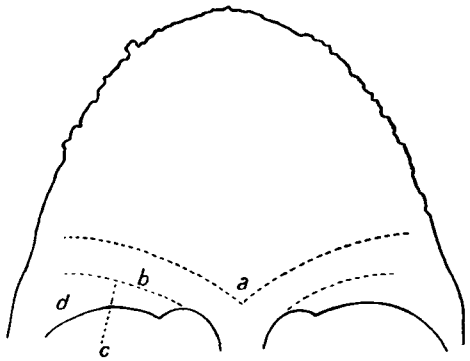

FIG. 1.—This figure is reproduced from SCHWALBE's article upon "Das Schädelfragment von Brüx, etc." (p. 109). It is an outline representation of the supraorbital region of a mandrill (*Cynocephalus mormon*).

a. Fossa supraglabellaris.
b. Arcus superciliaris.
c. Groove between *b* and
d. Arcus supraorbitalis.

ment of the brain in recent man has to a large extent obliterated this highly suggestive cranial feature in the Neanderthal forehead.

FORM AND MORPHOLOGICAL CONSTITUTION OF THE EYEBROW REGION.

SCHWALBE has given a large amount of attention to the form and morphological constitution of the eyebrow region of the forehead in the Neanderthal race (6, 8, 10), and although I cannot accept certain of the conclusions at which he has arrived, it should be recognised that in this field of work he has broken new ground and has added greatly to our knowledge of the evolution of this part of the skull. He holds that the supraorbital region in the Neanderthal group is distinctive of that race, and that it differs in form and mode of construction from the same region in any other race, either past or present. He elaborates this point with much ability in several of his writings, and gives this feature a leading place amongst the characters which are peculiar to the crania of that primitive group.

In briefly stating the views of SCHWALBE, I shall follow the description which he gives

in his recent paper on "Das Schädelfragment von Brüx und verwandte Schädelformen" (10). He takes as a type the condition presented by the frontal bone of the mandrill (*Cynocephalus mormon*), and he recognises, above the nasion and the margin of the orbital opening, two regions, viz. (1) the superciliary ridge (arcus superciliaris), which extends upwards and outwards from the glabellar swelling (fig. 1, *b*); and (2) a lateral area situated below and to the outer side of the superciliary ridge. This area he terms the arcus supraorbitalis (fig. 1, *d*). It stretches from the supraorbital notch to the

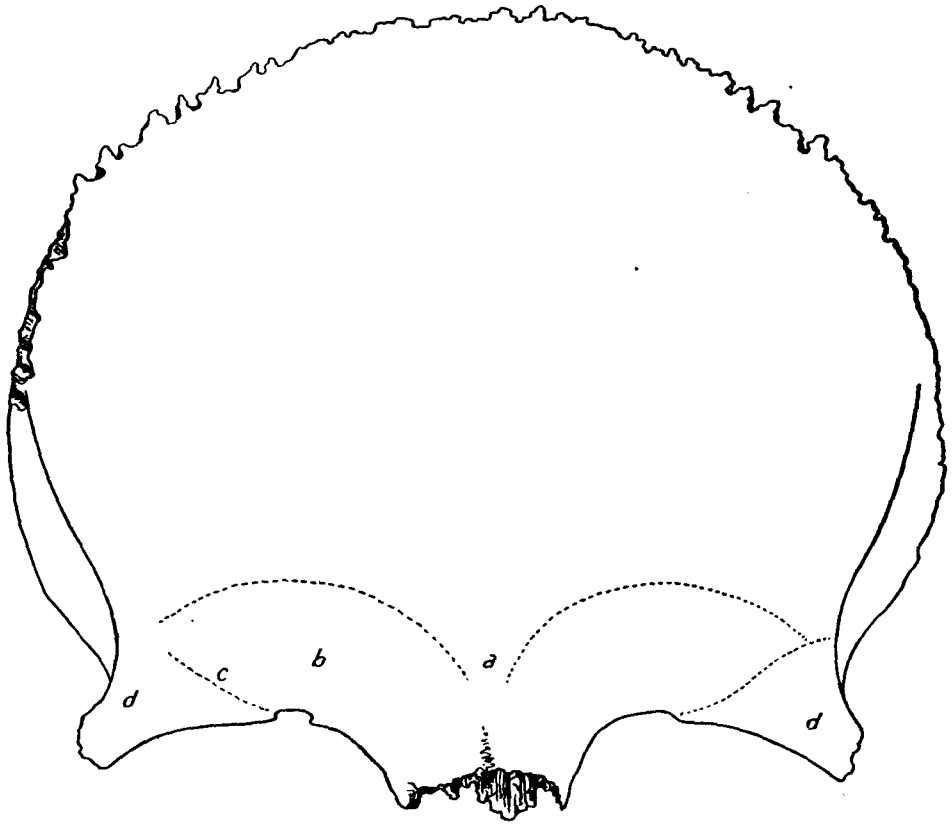

FIG. 2.—The frontal bone of an Alsatian, with strongly marked superciliary eminences (from SCHWALBE, "Das Schädelfragment von Brüx, etc.," p. 110).

a. Fossa supraglabellaris.
b. Superciliary eminence.
d. Trigonum supraorbitale.
c. Groove between *b* and *d*.

external angular process of the frontal bone, and forms a three-sided field between the superciliary ridge above and the margin of the orbital opening below.

SCHWALBE further states that the same parts, in very much the same relationship to each other, may be seen in the eyebrow region of recent man, and he gives outline sketches of the frontal bone of a mandrill and of an Alsatian to illustrate this point. These figures I have taken the liberty to reproduce, so as to make his position on this matter absolutely clear (figs. 1 and 2). In both of these drawings it can be seen that there is an arcus superciliaris (*b*) and an arcus supraorbitalis (*d*), and that these are separated from each other by an oblique furrow, the sulcus supraorbitalis (*c*), which ascends from the supraorbital notch in an outward and upward direction.

The arcus supraorbitalis (*d*) by its lower border forms the greater part of the upper portion of the margin of the orbital opening, and in the recent human skull, according to SCHWALBE, it presents a depressed or flattened field. For this reason he suggests that it should be termed the planum or trigonum supraorbitale. The latter name, in the vast majority of recent human skulls, admirably expresses its general characters.

To the inner side of the supraorbital notch the margin of the orbital opening is formed by the inner portion of the superciliary ridge (arcus superciliaris) as it runs into the glabella. The supraorbital notch, therefore, is an important landmark; to its inner side the orbital margin is formed by the superciliary ridge; to its outer side it is formed by the lower border of the trigonum supraorbitale.

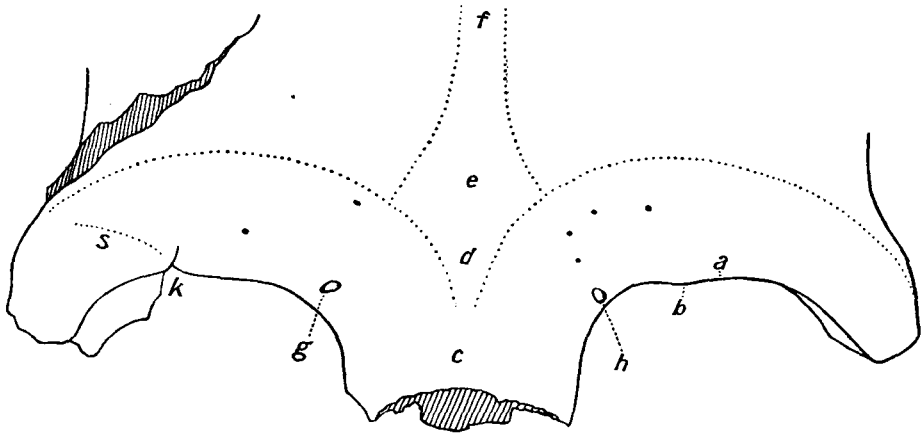

FIG. 3.—Outline sketch of the supraorbital region of the Neanderthal cranium, taken from SCHWALBE's article on "Der Neanderthalschädel," p. 11.

a. Slight notch (supraorbital notch (?)).
b. Slight elevation on the left supra-orbital border.
c. Glabella.
d. Fossa supraglabellaris.
e. Eminentia supraglabellaris.
f. Median frontal ridge.
g and *h*. Foramina supratrochlearia.
k. Notch on right supraorbital border (supraorbital notch).

Such is SCHWALBE's account of the supraorbital region in recent man and in all primitive races, with the single exception of the Neanderthal race. There cannot be a doubt that the description accurately conveys the condition which is present in the majority of recent skulls, and that it reproduces the type which exists not infrequently in the young mandrill and many other different forms of ape. But SCHWALBE falls into error in asserting (1) that this is the only form of supraorbital region which exists in recent man; and (2) that the form of the eyebrow region which is seen in the Neanderthal, Spy, and Krapina crania is never met with in the crania of the present day.

In the Neanderthal cranium the supraorbital region is developed in the form of a strongly projecting continuous arch, which extends from the glabella to the external angular process (fig. 3). I am in complete agreement with SCHWALBE as to the constitution of this arch. The superciliary eminence and the trigonum supraorbitale have

become fused together so as to produce the striking arcuate elevation which distinguishes the eyebrow region in this cranium. Further, the term, torus supraorbitalis, which SCHWALBE suggests should be applied to it appears to me to be both useful and appropriate. Indeed, I only take exception to the assertion that, while in the Neanderthal cranium the two elements, the arcus superciliaris and the trigonum supraorbitale, run together and become fused into one continuous arch, these elements invariably remain separate in the crania of recent man.

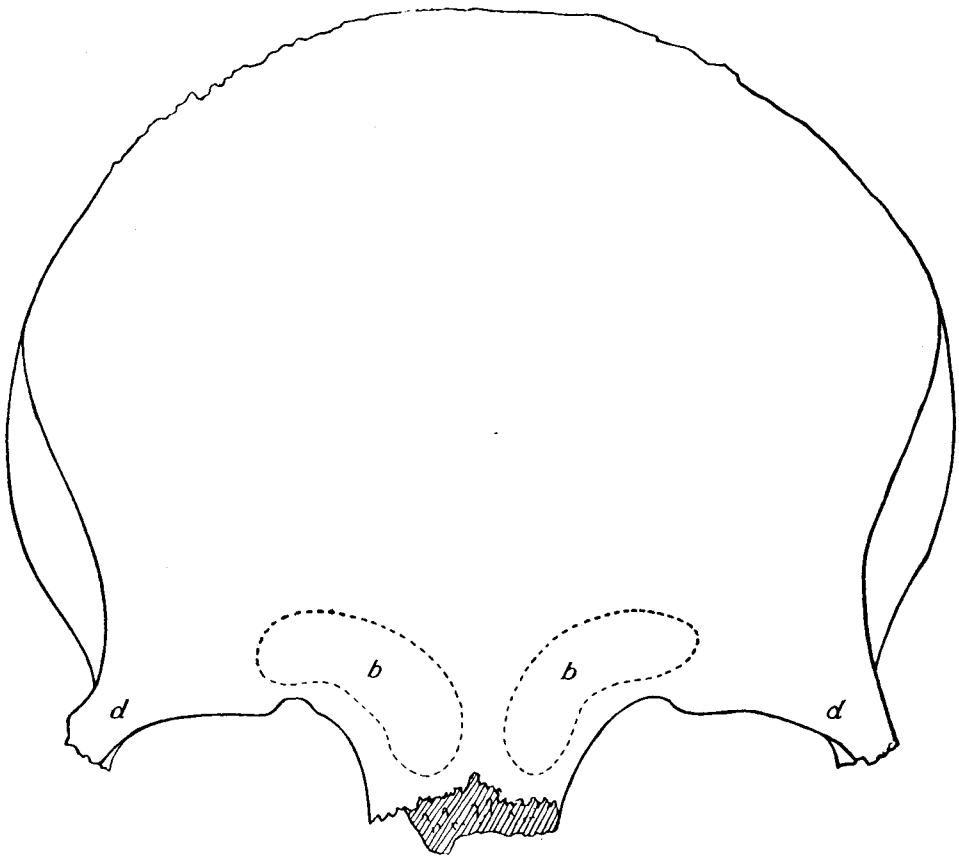

FIG. 4.—Outline tracing of the frontal region of a French skull.
b. Arcus superciliaris. *d*. Trigonum supraorbitale.

In studying the eyebrow region in man and the ape it will be convenient to look upon the elements which are typically present as being three in number. These elements are represented by the following parts :—

1. The supraorbital margin or the frontal part of the rim of the orbital opening.
2. The superciliary arch or ridge.
3. The trigonum supraorbitale.

According to the manner in which these three elements are arranged with reference to each other, three types of the supraorbital region may be distinguished.

At the same time, however, it should be recognised that the three elements are not always present, either separate and distinct from each other, or in combination with each

other. There are certain ape crania in which the arcus superciliaris is absent, and in every large collection of human crania a few specimens will be found in which the same deficiency may be observed. In the latter the glabella and the region above the orbital opening are flat and vertical, and similar in appearance to what is seen in the forehead of the European child before the superciliary ridges and the frontal air sinuses are developed. This form of supraorbital region would seem to occur most frequently in certain African races. The only skull in the University collection in which there is absolutely no trace of a superciliary eminence or of a glabellar fulness is that of a male Nupé from

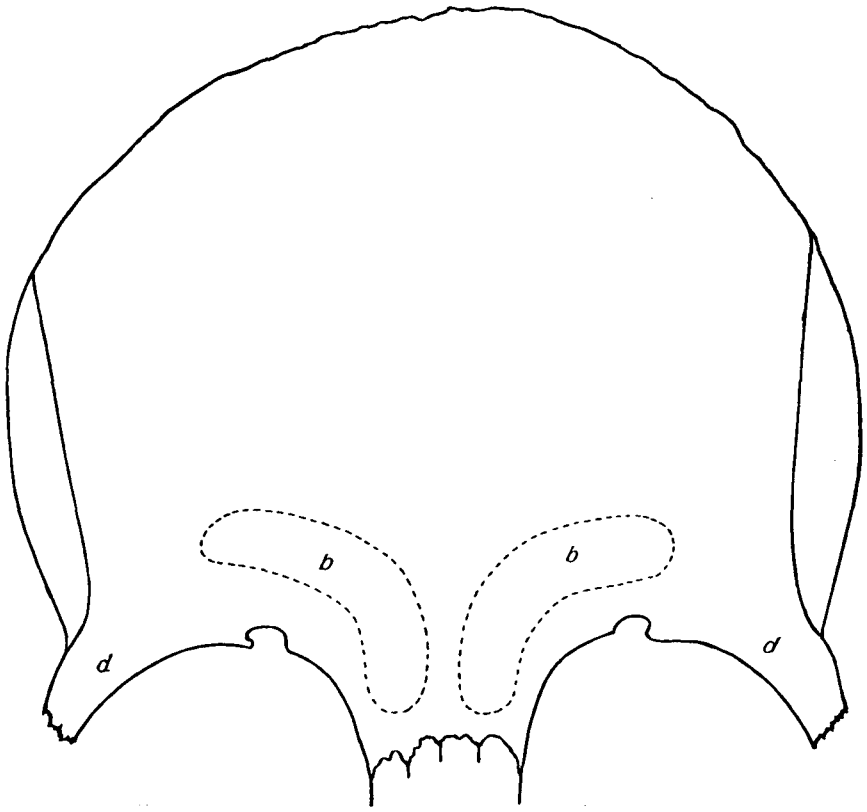

FIG. 5.—Frontal region of a Kham warrior from Thibet (Museum, No. xxiv. A. 2).
b. Superciliary eminence. *d*. Trigonum supraorbitale.

Nigeria which I received from my friend and former pupil, Dr HOWARD ENSOR. There are several specimens (*e.g.* an Andaman skull, the skull of an adult Negress, a West African skull presented to me by my colleague Professor H. LITTLEJOHN, the skull of a Ba-Mbala native given to me by Mr E. E. TORDAY, etc., etc.) which at first sight appear to be devoid of glabellar and superciliary eminences; but when these specimens are inspected in a proper light it is noticed that there is a general fulness in this region, and perhaps a scarcely perceptible indication of the arcus superciliaris. In all there is an appreciable flattening in the region of the trigonum supraorbitale.

TYPE I.—There are many human crania in many different races in which the three elements of the supraorbital region are distinct and separate. The same also may be observed in certain species of ape.

The *supraorbital margin* extends in a continuous and arch-like manner from the fronto-malar suture on the outer side to the fronto-maxillary suture on the inner side. It is divided into a long outer part and a shorter inner portion by the supraorbital notch. The outer portion is a projecting and sharply defined edge; the inner part, quite distinct from the superciliary arch, sweeps downwards immediately in front of the trochlear pit, and although much less prominent than the outer part is yet quite obvious (fig. 4).

The *superciliary ridge* or *arcus superciliaris* is a semilunar, smooth elevation which lies above the inner part of the inner portion of the supraorbital margin (fig. 4). Its inner end curves downwards into the glabella, and is separated from the corresponding eminence of the opposite side by a narrow, shallow median depression; its outer end fades away as it approaches the trigonum supraorbitale.

The *trigonum supraorbitale* lies to the outer side of the superciliary eminence. It is a triangular depressed field, with its apex at the fronto-malar suture, which is included between the outer part of the margo supraorbitalis and the anterior prominent part of the temporal ridge.

Fig. 4 is taken from a lecture specimen of the frontal bone which I am in the habit of using for class purposes. Fig. 5 is the frontal bone of a Kham warrior from Thibet, in which Type I. of the supraorbital region is particularly well marked. Owing to the somewhat unusual length and strongly curved character of the superciliary arches, the supraorbital region in this skull presents a striking appearance. The trigonum supraorbitale is very depressed.

This type of eyebrow region does not appear to be distinctive of, nor indeed more frequently present in, any one race more than another. It occurs in most, if not in all, recent races, and even amongst Australian skulls it is not infrequently met with, as will be seen from the following figures:—

Number of Times present in a Group of 25 *Australian Skulls.*

Natives of Victoria	— 8 males . . .	1
	5 females . .	2
Natives of Queensland	—10 males . . .	1
	2 females . .	0

In this small group of Australian skulls, therefore, Type I. of the eyebrow region occurred four times, or in 16 per cent. of the specimens.

This type of the supraorbital region is also seen in certain apes, although probably in no case is it to be regarded as distinctive of any particular species. Still, it should be noted that it was present in a very definite manner in each of the three specimens of *Macacus cyclops* which I had the opportunity of studying.

The specimens in which it occurred were the following :—

Macacus cyclops	3 times
Macacus nemestrinus	4 ,,
Macacus rhesus	2 ,,
Macacus speciosus	1 ,,
Cercopithecus	3 ,,
Cercocebus	1 ,,
Cynocephalus niger	1 ,,
Cynocephalus porcarius . . .	1 ,,

The skull of a young specimen of *Macacus cyclops* is figured in Pl. I., fig. 14. It exhibits a somewhat unusual condition, and the supraorbital region in two other skulls belonging to the same species presented a similar appearance. A slightly raised oval field above and behind the glabella and inner part of the supraorbital margin represents the superciliary eminence. It is quite isolated, and stands apart from the glabella and the margo supraorbitalis.

The skull of an older specimen of macaque monkey (*Macacus rhesus*) is seen in Pl. I., fig. 15. In this specimen the three elements of the eyebrow region are also distinct from each other, but the superciliary projection is very different in form and in its degree of prominence. It forms a pronounced, elongated eminence which runs outwards above the margin of the orbital opening, and presents a different texture from that of the surrounding bone. Its outer extremity runs into the trigonum supraorbitale and reaches the anterior part of the temporal ridge, with which it in part fuses. Throughout its whole length it is separated from the margo supraorbitalis by a strongly marked groove, whilst its inner end remains distinct and does not run into the glabella nor fuse with its fellow of the opposite side.

A somewhat similar arrangement is seen in the skull of an adult specimen of the black ape of the Celebes (*Cynocephalus niger*). The superciliary eminence is in the form of a sharply marked ridge placed above the margin of the orbital opening, and separated from it by a deep sulcus. Its outer end remains free and ends in the trigonum supraorbitale. In the median line there is a small rounded prominence which lies between the inner ends of the two superciliary ridges, and probably represents the glabella.

In the young chacma baboon (*Cynocephalus porcarius*) we sometimes meet with a condition which presents a strong resemblance to what is seen in cases where Type I. of this region is present in the human skull (Pl. I., fig. 17). The strongly marked superciliary eminences are semilunar in outline and curve upwards and outwards from the region of the glabella to the temporal ridge on either side. The eminences remain distinct from each other, but turn downwards into the glabella. A broad, shallow groove separates the superciliary ridge from both the inner and outer parts of the margo supraorbitalis.

It must be clearly understood that I do not put forward these specimens, all of which fall clearly within the limits of Type I., as being characteristic of the species of ape to which they belong. As in the case of the same form of eyebrow region in the

human skull, they must be looked upon as being merely peculiar to certain individuals and as occurring sporadically in several different genera and species of ape.

Anyone who studies the ape skull can readily satisfy himself that within one species several different forms of the supraorbital region may be encountered. To some extent this is apparently the result of the vagaries of individual development, but it is probably more frequently due to changes which occur with the advance of age. As adult life is approached, there appears to be a tendency towards a partial or complete fusion of the three elements, and thus amongst the apes the same individual may present very different types of eyebrow region at different periods of life.

TYPE II.—In Type II. are included those skulls which exhibit that condition of the supraorbital region which SCHWALBE has described as being peculiar to recent man, and also to the mandrill and other species of ape. The superciliary projection has coalesced with the part of the supraorbital margin which lies to the inner side of the supraorbital notch. On the outer side of the notch the eminence extends outwards with a varying degree of prominence and for a varying distance towards the trigonum supraorbitale. From the latter it is separated by a faint groove which ascends obliquely upwards and outwards from the supraorbital notch. The trigonum supraorbitale, which varies in its extent according to the degree of development of the arcus superciliaris, is, as a rule, depressed and flattened. This form of the supraorbital region occurs in all races, past and present, with the exception of the Neanderthal race, and is undoubtedly the condition which is most distinctive of man.

In the group of 25 Australian skulls to which I have already referred, Type II. of the supraorbital region occurred no less than 18 times, or in 72 per cent.

Natives of Victoria	— 8 males . . .	5 times
	5 females . . .	3 „
Natives of Queensland	—10 males . . .	8 „
	2 females . . .	2 „

As SCHWALBE has shown, Type II. of the supraorbital region also appears in the mandrill (6 and 10), but the form which he has figured (fig. 1, p. 286) only occurs in young specimens. In the adult skull there is a tendency towards the coalescence of the different elements and the formation of a torus which is morphologically equivalent to what is seen in the gorilla and the chimpanzee. Still, this is not by any means the invariable result of advancing age in the mandrill. In the largest and most characteristic skull of this ape in the British Museum, the form presented by the supraorbital region falls clearly within Type II., although the massive superciliary eminence is restricted to the inner part of the region and does not stretch outwards in the form of an elongated ridge, as in the young specimens of the same species.

It is in the genus Cynocephalus that we find the closest approximation to Type II. as it is exhibited in the human skull. Probably this is the only group of apes in which this type of eyebrow region is almost invariably present. Young specimens may be found in which Type I. occurs (Pl. I., fig. 17); these are rare. Again, as age advances

there is undoubtedly a tendency for the elements of the region to fuse together to form a torus; but in the fifty specimens I have examined I have not seen a skull in which the coalescence is complete. There is always a trace of the groove which intervenes between the superciliary eminence and the trigonum supraorbitale. Figs. 18 and 19, Pl. I., represent the usual appearance which is presented in this genus. In the middle line the two superciliary arches are completely fused to form the glabellar eminence, and here also they coalesce with the part of the orbital margin which lies to the inner side of the supraorbital notch. From the glabella the two superciliary ridges arch outwards like the two limbs of the letter Y, and, gradually tapering, each ends in the neighbourhood of the temporal ridge. A strongly marked groove separates the superciliary eminence from the trigonum supraorbitale. The term "trigonum" is hardly appropriate for the part of the region which lies below and to the outer side of this groove. It is true that it is a somewhat triangular area, but it is not flattened and depressed as is usually the case in the human skull; it is prominent, ridge-like, and highly curved in accordance with the curvature of this part of the orbital opening. This may be regarded as an approach to the condition termed by SCHWALBE a "torus supraorbitalis." By the disappearance of the intervening groove and the consequent coalescence of the superciliary eminence and the trigonum supraorbitale, the form distinctive of the Neanderthal race, the gorilla, chimpanzee, etc., would be produced.

The condition seen in the New Hebrides skull figured in Pl. III., fig. 23, presents a striking resemblance to the form of supraorbital region which we have described as distinctive of the baboon. Two points of difference, however, are noticeable. The two superciliary arches have drawn away from each other in the glabellar region, and their inner ends are separated from each other by a shallow median groove. This is due to the broadening of the forehead in man, and the coincident widening of the glabellar region and of the interval which separates the orbits. In the baboon the narrow forehead is associated with a narrow glabella and a narrow root of the nose, and thus the superciliary ridges are brought together in the middle line. The second point of difference is in the trigonum supraorbitale. This area is flat and depressed in the New Hebridean skull, although there is seen a tendency for the outer part of the supraorbital margin to form an arched prominence as in the baboon.

Although not distinctive of any other group of apes, Type II. frequently occurs in individuals of other genera and species. I have noted its presence in the following specimens:—

Semnopithecus (in two species, viz. *auratus* and *cristatus*)	4 times
Nasalis lanatus	1 „
Cercopithecus	5 „
Cercocebus	5 „
Macacus (in eight different species)	14 „
Presbytes maurus	1 „
Cebus (in four different species)	5 „

In certain of the nine specimens entered in the above list as belonging to the genera

Semnopithecus and Cercocebus the fusion of the three elements of the supraorbital region was very nearly complete, but in the region of the trigonum the superciliary element showed as a distinct ridge above the outer part of the orbital margin. In these cases the supraorbital notch fails as a guide to the line of separation between the superciliary and other parts of the region.

SCHWALBE gives a careful and accurate account of the supraorbital region in the cranium of *Pithecanthropus erectus*, in so far as this can be studied in the plaster cast of the specimen, and he supplements his remarks by a drawing. I have had the advantage of being able to examine two casts of this cranium, one of which was presented to me by Dr EUGENE DUBOIS when he visited Dublin, and another which he gave to Sir WILLIAM TURNER. Both of these specimens are in the Anatomical Museum of the University of Edinburgh. They are sharp and excellent casts, and they agree in every particular with SCHWALBE'S description. I am thus able to confirm SCHWALBE'S view that the eyebrow region presents the form which I have included under Type II. It should be noted, however, that the fusion between the superciliary and the supraorbital elements is very nearly complete, and the condition is one which closely corresponds to that which is frequently seen in the aged Anubis baboon. Indeed, from the appearance of the eyebrow region I think we may conclude with some degree of certainty that the cranium of *Pithecanthropus erectus* is that of an aged individual.

As SCHWALBE points out, it is an important and significant fact that it is to the baboon, much more than to the gorilla or chimpanzee, that *Pithecanthropus erectus* shows a resemblance in this respect (6).

TYPE III.—In this form of the supraorbital region all the three elements which enter into its formation become fused together so as to constitute a continuous arch, the torus supraorbitalis, which bounds the orbital opening above and forms a varying amount of the fore-part of the roof of the orbital cavity. This arch extends from the glabella to the fronto-malar suture, and in its typical condition it shows no trace of the constituent elements of which it is composed, so completely have these become blended the one with the other. Of such a nature is the supraorbital region in the adult chimpanzee, in the gorilla, and in a large number, if not the majority, of the lower apes of the Old World. Still, it is not correct to suppose that even in the gorilla and the chimpanzee this is the only condition of the eyebrow region which may be present, and that there never occurs an approach to the form distinctive of Type II. In young specimens of the chimpanzee the superciliary eminence, although fused with the supraorbital torus and not marked off on its outer side by any distinct groove, is yet as a rule easily discernible, not only by the greater degree of prominence of this part of the arch, but also by a difference in its texture. The same also may be occasionally seen in the adult chimpanzee. In such cases the supraorbital notch, which SCHWALBE takes as the demarcation between the supraorbital and superciliary elements, fails to be a true guide. The superciliary element extends outwards in the torus far beyond this point. In the beautiful illustrations of anthropoid crania which are given by SELENKA,

there is the figure of the skull of a young female gorilla in which the superciliary element of the torus supraorbitalis is distinctly seen (12, fig. 112, p. 102). It is still more evident in the skull of an adult male chimpanzee in the Anatomical Museum of the University of Edinburgh. The photograph of this skull is given in Pl. I., fig. 15. Transition forms between Type II. and Type III. of the supraorbital region are thus met with in both the chimpanzee and the gorilla.

Of the nineteen skulls of the adult chimpanzee which I had the opportunity of studying in the British Museum, three presented this transition form. In one (Museum No. 2, c. 1130) the condition was particularly strongly marked. The torus supraorbitalis was divided into two distinct parts, the inner two-thirds, which contained the superciliary element, being very prominent as compared with the outer third.* This is to be looked upon as being merely the retention of a juvenile character. It is the rule in the young chimpanzee for the brow-ridges to begin to assume form at the time when the milk-teeth erupt. In the early stages it is generally possible to distinguish the superciliary element in the torus supraorbitalis; but, as a rule, after the second molar tooth has made its appearance the superciliary eminence becomes completely blended with the other elements which build up the torus, and the supraorbital projection assumes its typical form.

In the adult gorilla, the amalgamation of the different elements in the torus supraorbitalis is so complete that little indication of the composite character of the latter can be detected. Still, when the arch is viewed from above a general fulness in the superciliary region points to the presence of the superciliary element. I have not had the opportunity of studying the condition in the skull of the young gorilla.

The supraorbital region in the Neanderthal, Spy, and Krapina remains presents features which place it within Type III. As SCHWALBE has shown, the different elements have become blended in a strongly projecting torus supraorbitalis, in which there is little or no indication of its composite character. This undoubtedly forms one of the leading features of the race, but SCHWALBE is in error in concluding that the possession of an eyebrow region of this formation is the exclusive property of the Neanderthal group. Individuals are met with in recent races in whom the same formation may be seen in different degrees of development, and many specimens occur which present transition forms between Type II. and Type III.

In all large collections of Maori and New Guinea crania individual specimens which belong to Type III may be found; but in these cases the torus supraorbitalis, while showing a complete fusion of the superciliary and supraorbital elements and the formation of a continuous and uniform arch above the orbital opening, does not attain a great degree of projection, nor does it take much share in the formation of the orbital roof.

Amongst the Australian crania the case is different. Occasional specimens will be

* In another specimen (Museum No. 2A) the appearance presented by the supraorbital region strongly resembles the form usually seen in the aged baboon. A very evident groove (most evident on the left side) limits the superciliary element on its outer side.

found which present a torus supraorbitalis very similar to that present in the Neanderthal and Spy crania. The skull in the University collection which shows this character in the most pronounced form is figured in Pl. II., fig. 20. It is from a native of New South Wales (xxix. B. 1), and in general form and external configuration the eyebrow region exhibits a marked resemblance to the corresponding region in the Neanderthal cranium. A massive projecting bony arch, composed of the fused superciliary and supra-orbital elements, extends from the glabella to the fronto-malar suture.

Upon the right supraorbital torus of the Neanderthal cranium there is an oblique furrow which extends upwards and outwards for a distance of about 12 mm. (fig. 3, *s*). This groove is visible on the cast; and by both SCHAFFHAUSEN and VIRCHOW it was thought to be of traumatic origin. SCHWALBE, however, has shown that, although not continuous with, it yet lies in the line of a notch on the supraorbital margin, around which the supraorbital or outer branch of the frontal nerve had no doubt turned in its passage to the forehead (fig. 3, *k*). This naturally suggests the possibility that the groove in question is not the result of a wound, but is the pathway of the nerve. Against this conclusion must be reckoned the position and direction of the furrow. It courses over the outer third of the torus supraorbitalis, and its direction is so oblique that, if continued outwards, it would strike the temporal ridge about 14 mm. above the fronto-malar suture. It would seem unlikely, therefore, that the supraorbital nerve or one of its branches would pursue such an initial course on reaching the forehead. Still, it should be noted that in the Neanderthal cranium the supraorbital notch is situated much further out than usual. It interrupts the margin of the supraorbital arch much nearer its outer than its inner end (viz. 27 mm. from the fronto-malar suture, and 35 mm. from the fronto-maxillary suture). That this represents the notch in question there cannot be a doubt, because SCHWALBE has shown that on the roof of the orbit a distinct nerve-groove leads to it (fig. 6).

I have alluded to these features in the Neanderthal cranium because we find on the right side in the cranium of the New South Wales native (xxix. B. 1) a condition which in some respects is similar. The supraorbital notch cuts into the supraorbital margin about its mid-point, and from this two sharply defined grooves pursue a short divergent course on the under aspect of the torus supraorbitalis (figs. 20 and 21, Pl. II.). Immediately above the outer of these furrows and in a line with it is a shallow oblique sulcus on the front face of the torus. This recalls the groove on the right torus of the Neanderthal specimen; but its position is different. It does not lie so far out, and it is not so oblique in its direction.

I am inclined to think that in both the Neanderthal and New South Wales crania the groove in question is of the same nature, although I am satisfied that in neither case was it the pathway of a nerve. I believe that it represents in both cases the line of fusion between the superciliary and supraorbital elements of the torus. In the Australian skull, where the groove is faintly marked, and also in the Neanderthal cranium, where it is strongly marked, the condition resembles the appearance which is presented by the torus in those chimpanzee crania in which the superciliary element is not completely

blended with the supraorbital element. As has been already noted, a distinct groove is present in one of the British Museum specimens in this situation (Museum No. 2A).

On each side and at precisely the same place the supratrochlear nerve grooves the under aspect of the inner part of the torus supraorbitalis of the New South Wales cranium (Pl. II., figs. 20 and 21). In the Neanderthal cranium these nerves have been conducted to the forehead through two short canals which occupy precisely similar positions (fig. 6). It is interesting to note that, while the supratrochlear notches (when they exist) in the human skull show a great constancy in point of position, the supraorbital notches vary considerably in this respect.

In all questions relating to the district of the frontal bone under consideration the area immediately above the glabella and the eyebrow eminences is of high morphological import-

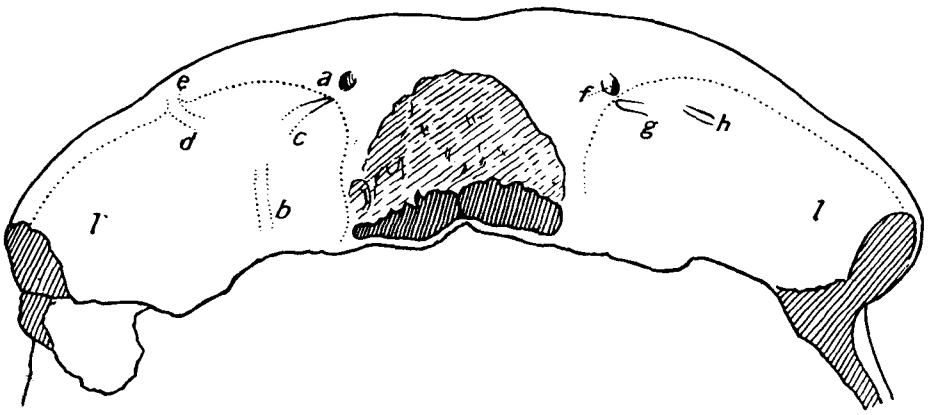

FIG. 6.—Orbital and nasal aspect of the Neanderthal cranium, from SCHWALBE ("Der Neanderthal Schädel," p. 38, fig. 10, 1).

e. Supraorbital notch.
a. Supratrochlear foramen.
c. Groove on roof of orbit for supratrochlear nerve.
d. Groove on roof of orbit for supraorbital nerve.
b. Groove on roof of orbit for frontal nerve.
f. Supratrochlear foramen.
g. Groove for supratrochlear nerve.
h. Groove for supraorbital nerve (?).
l. Lachrymal fossa.

ance. In this area SCHWALBE recognises three parts, viz. a median portion which he terms the facies supraglabellaris, and two lateral depressed portions which he calls the sulci supraciliares. The width and extent of the sulci supraciliares in the Neanderthal cranium constitute two of the most pithecoid characters in the Neanderthal and Spy crania. The massive eyebrow projection is separated from the curved frontal plate which covers the frontal extremity of the cerebrum by a wide depression which in some degree resembles the extensive depressed area which occupies a similar position in the adult chimpanzee and gorilla. This condition is associated with a low and flattened forehead, and bespeaks a feeble development of the frontal lobes of the cerebral hemispheres. As these lobes assume the massive rounded form distinctive of recent man, the cerebral part of the frontal bone assumes a higher degree of curvature for their proper accommodation, and its lower part advances towards the eyebrow region, and thus tends to diminish the

extent of the sulci supraciliares and also at the same time to tilt them forward, so that in the higher types of forehead their surfaces no longer look upwards as in the gorilla, but almost directly to the front. In this respect there cannot be a doubt that the Neanderthal cranium occupies an intermediate position between, say, the chimpanzee and the vast majority of recent skulls; but occasionally a recent skull is met with which shows an approximation to the Neanderthal condition, and which, so to speak, occupies the gap which exists in this respect between the Neanderthal race and man of the present day.

The New South Wales cranium is a specimen of this kind. It possesses tori supraorbitales similar in form and constitution to those of the Neanderthal cranium, but it differs from the latter in the extent of the sulci supraciliares. These, it is true, have an unusual width and extent for recent man, being 10 mm. wide on the right side and 13 mm. wide on the left side; but they fall far short of the corresponding sulci in the Neanderthal cranium, which are 18 mm. wide on the right side and 19 mm. wide on the left side. Further, this broad sulcus in the Neanderthal cranium is more depressed, and its surface looks more directly upwards, than in the New South Wales specimen.

Associated with this approximation of the eyebrow region to the Neanderthal type, the New South Wales skull presents a low and degraded forehead. The bregma-nasion-inial angle is only 53°, and the index of the frontal curve is so low as 18 (3).

Amongst Australian crania it is possible to find specimens in which the eyebrow region conforms in every respect with the requirements of Type III., and yet possess, associated with this, a degree of frontal curvature as bold as that which is characteristic of the European skull. In Pl. II., fig. 22, there is reproduced the photograph of the skull of a male Queenslander. In this specimen the B.N.I. angle is no less than 64°—the average angle in the Australian being 60°, and in the Scottish 61°. Further, the index of the frontal curvature in the Queensland skull in question reaches the high figure of 24·5 (3). In this skull the eyebrow ridges form two continuous arches as in the Neanderthal cranium, but the supraciliary depressions are narrow grooves and look almost directly forward.

The two Australian skulls which I have selected as examples of Type III. of the supraorbital region exhibit this condition in a more marked degree than any other specimens in the ethnological collection of the University. In the twenty-five Australian skulls specially examined, Type III. occurred in three cases, all of which were males, viz. in two natives of Victoria and in one native of Queensland. I have not seen this type of supraorbital region in any female skull.

Amongst the Australians, transitional forms of the eyebrow region between Type II. and Type III. are very common. One of the most remarkable instances of this is to be seen in the skull from the Riverina district to which reference has already been made (xxix. B. 12). In this specimen the eyebrow eminences are very pronounced (Pl. III., fig. 24). As mentioned before, the glabellar part of the frontal bone measures over the curvature 41 mm., or only 2 mm. less than the correspond-

ing part of the Neanderthal cranium. The eyebrow projections form an almost continuous arch from the glabella to the extremity of the external angular process of the frontal bone; still, the line of fusion between the superciliary and supraorbital elements is clearly indicated by a faint groove. There is no trigonum supraorbitale. A specimen such as this is very instructive, because it shows that the arched eyebrow elevation (the torus supraorbitalis) distinctive of Type III. is not merely formed by a strengthening of the superciliary eminence and by its fusion with the supraorbital part, but also by a great development of the latter as well. These changes lead to an obliteration of the trigonum supraorbitale—the feature which SCHWALBE considers distinctive of all recent skulls. This increased development of the supraorbital element is also evident in the baboon, although the projecting arch-like elevation which it forms is sharply cut off from the superciliary eminence by a pronounced sulcus. The study of the ape skull as well as a large series of human crania thus renders evident the steps by which the three different types of the supraorbital region have been evolved, and more especially do we see the manner in which Type II., which is chiefly characteristic of recent man, may be transformed into Type III., which is distinctive of the gorilla, the chimpanzee, the Neanderthal race, and also of a few exceptional individuals of the present day.

SUPRAORBITAL REGION IN THE ORANG AND THE GIBBON.

Had our survey been extended over the entire range of the order Primates, it would have been necessary to have recognised other types besides the three which we have stated include all human skulls and the majority of ape skulls. The condition in the orang, for example, is interesting in so far that there is no evidence of the presence of a superciliary element. The supraorbital elements gradually develop into a projecting rim for the upper part of the orbital opening. In the young skull this makes its appearance about the same time as the milk-teeth. At first it is very feebly expressed and separated from the cerebral part of the frontal bone by a narrow groove. Towards the glabella it is extremely narrow, but as it is traced outwards it broadens, and as age advances it becomes more and more projecting and rough, until ultimately in the adult its outer part occupies the whole field of the trigonum supraorbitale. It presents the appearance at this stage as if it were something superadded to the frontal bone, and might be compared to the upper segment of an oval frame attached to the frontal portion of the margin of the orbital opening. Inasmuch as it does not contain a superciliary element, it is not a true torus supraorbitalis, and further, it does not take a large share in the formation of the roof of the orbit.

In certain aged specimens of the orang skull the narrow inner end of this supraorbital projection may be seen to expand in the glabellar region into a rounded knob-like eminence. Such cases are not common, and they suggest the possibility of this expansion being the representative of a superciliary eminence. I do not think, however, that it can be reckoned as such.

There are some forms of gibbon in which it is impossible to detect a superciliary

element, and in which the supraorbital region presents a close resemblance to the condition present in the orang. In most cases, however, there is a strong tendency exhibited for the inner end of the supraorbital arch to swell out into a bulbous extremity at the glabella. This in all probability is the superciliary element; indeed, it may sometimes be seen to partially disengage itself from the supraorbital arch and present a condition which may be classed under Type II.

Relation of the Supraorbital Region to the Orbit.

Schwalbe rightly lays stress upon the fact that in the majority of apes the supra-

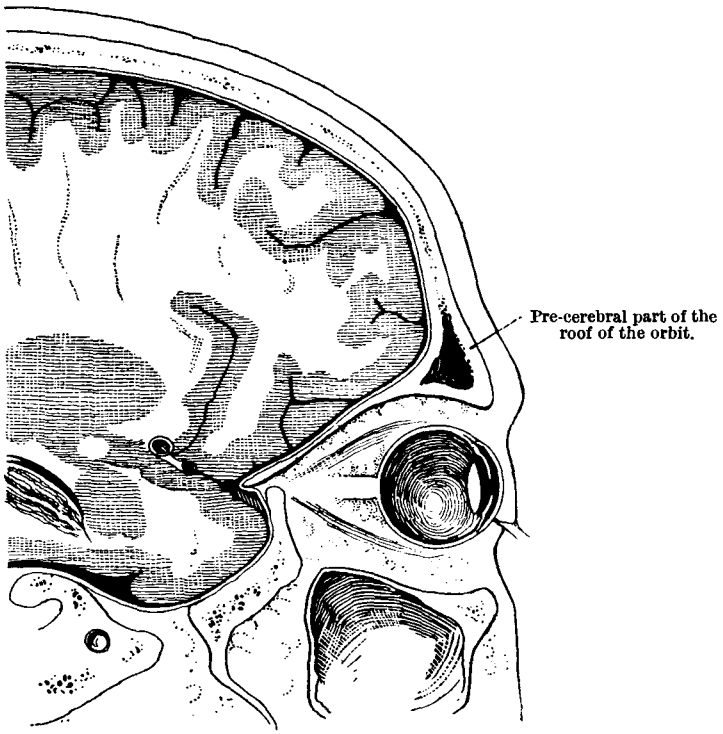

Fig. 7.—Tracing from a sagittal section through a frozen male head (Irish), in a plane corresponding to the mid-point of the supraorbital arch (reduced).

orbital eminence, which juts forward in a shelf-like manner from the front of the true brain-capsule, forms a considerable part of the roof of the orbit. The degree of prominence to which this condition may attain varies in different groups, and may be demonstrated by making a sagittal section through the frozen head in a plane which passes through the mid-point of the supraorbital arch. This method has the further advantage of showing the relation which this pre-cerebral part of the roof of the orbit presents to the eyeball.

In the adult male gorilla the torus supraorbitalis may form as much as the anterior half of the orbital roof, and a similar relationship may also be seen in a pronounced form in the chimpanzee, baboon, and other forms of ape. This character is strictly correlated with the extent of the area to which we have applied Schwalbe's term of

sulcus supraciliaris. As the brain advances in its phylogenetic growth, it reduces the width of this sulcus, encroaches upon the eyebrow projection, and extends the area of the orbital plate of the frontal bone which intervenes between the cerebrum and the orbital cavity.

At the same time it should be noted that even in the European a considerable part of the orbital roof may be formed by the supraorbital projection of the frontal bone. In fig. 7 is shown a sagittal section through the head of an Irish subject in which the eyebrow region was somewhat prominent. It will be seen that very nearly one-third of the orbital roof is formed by the under surface of this part of the frontal bone. Further, it will be noted that three-fourths of the eyeball lie in front of the brain and under shelter of this portion of the bone.

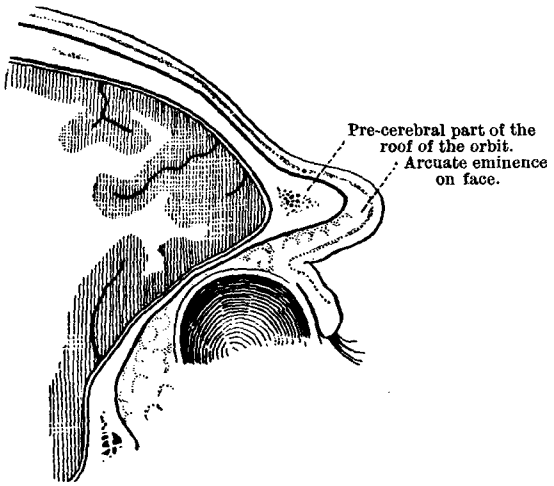

FIG. 8.—Sagittal section through the frozen head of a young male chimpanzee, in a plane to the outer side of the mid-point of the supraorbital arch.

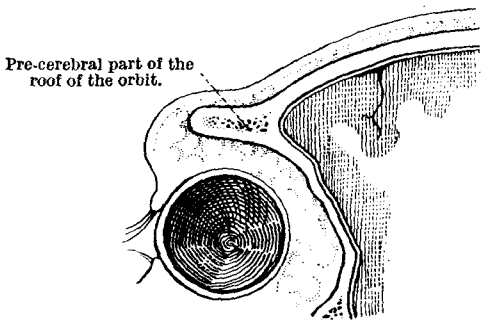

FIG. 9.—Sagittal section through the frozen head of an adult gibbon (*Hylobates agilis*) in a plane corresponding to the mid-point of the supraorbital arch. Note the large share which the torus supraorbitalis takes in the formation of the roof of the orbit.

Those familiar with the facial aspect of the gorilla and chimpanzee know that the torus supraorbitalis is not only concerned in forming a large part of the wall of the orbit, but also in producing a strong arch-like projection which juts forward on the face above and in front of the eyeball. Fig. 8 was obtained from a tracing of a sagittal section of a young chimpanzee (probably about three or four years old); the torus is thus far from having attained its full degree of development. Still, the manner in which it forms the facial feature referred to is manifest. In one respect this section cannot be compared with the other sections shown in figs. 7 and 9. The impression which it gives of the relation presented by the roof of the orbit and the brain to the eyeball is somewhat misleading. It will be noticed that the section has been made through a different plane. Had it passed through the same plane as in the case of the human head, the relation presented by the eyeball to the roof of the orbit and the brain would not have been markedly different from what we

see in the other figures (see fig. 1, Pl. X., *Cunningham Memoir* No. 2, Royal Irish Academy, 1886).

Instructive tracings of the frontal bone, which show in some measure the relation of the torus supraorbitalis to the roof of the orbit, are given by SCHWALBE for the Neanderthal cranium and by SOLLAS for the Gibraltar cranium. In these the outline of the posterior surface of the bone is not represented, and thus it is not possible to estimate the precise extent of orbital wall which is formed by the torus. Still, by these tracings, and also by an examination of the cast of the Neanderthal cranium, it is evident that in this respect the Neanderthal race presents a very marked approach to the pithecoid type. On this point I am in complete agreement with SCHWALBE. In no recent human cranium is the orbital roof so largely formed by the supraorbital projection of the frontal bone.

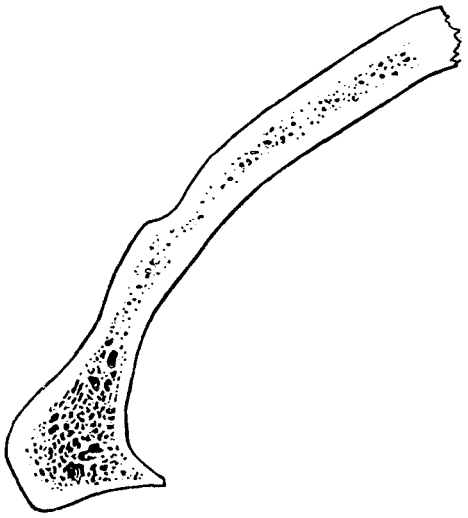

FIG. 10.—Sagittal section through the mid-point of the supraorbital arch of the New South Wales cranium (xxix. B. 1).

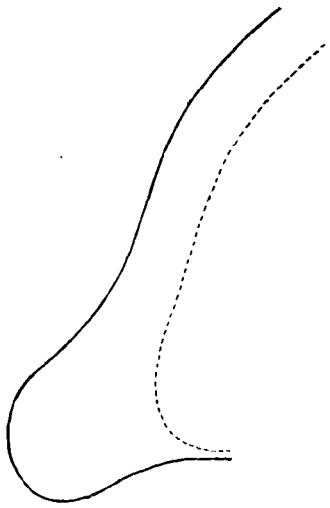

FIG. 11.—Tracing of the frontal bone of the Neanderthal cranium at the mid-point of the supraorbital arch. (From SCHWALBE, "Zur Frage der Abstammung des Menschen," fig. 4, p. 22.)

Nevertheless, specimens are met with which present some similarity to the Neanderthal cranium in this character. The New South Wales cranium (xxix. B. 1) to which we have so frequently referred is a case in point. A section through the frontal bone of this specimen in a sagittal plane corresponding to the mid-point of the torus supraorbitalis is shown in fig. 10, and when this is compared with SCHWALBE'S tracing of the same region in the Neanderthal cranium (fig. 11) a decided resemblance is apparent. To SCHWALBE'S tracing I have added by a dotted line what may be regarded as indicating the approximate position of the posterior surface of the frontal bone, or in other words the outline of the cerebrum. If this has been accurately represented (and I think that, when it is contrasted with the drawing of the New South Wales specimen, it will be admitted that it cannot be very far wrong), the maximum length of the pre-cerebral part of the roof of the orbit in the Neanderthal is 20 mm., and in the New South Wales cranium 16 mm.

Relation of the Superciliary Eminence to the Frontal Air-Sinus.

That the degree of prominence of the glabellar and supraorbital regions of the human skull is not necessarily determined by the degree of development of the frontal air-sinus is proved by the writings of Bianchi (1), Zuckerkandl (15), Logan Turner (14), and Schwalbe (6, 8, 10). Further, the topographical independence of the area represented by the air-sinus and that occupied by the superciliary eminence is a well-established fact. Two questions, however, of much difficulty remain to be considered: (1) Can any morphological connection be established between the superciliary eminence and the frontal air-sinus? and (2) if no such relationship exists between these two factors, what is the morphological significance of the superciliary eminence, and how can its presence in so large a number of the members of the primate group be explained?

In considering these problems it should first be noted that where the superciliary eminence fails the air-sinus is also usually absent. We may take the orang as an example of this. As we have noted, there is apparently no morphological equivalent of the superciliary eminence in the orang. It is not correct to say, however, that in this animal the frontal air-sinus is never developed. In the British Museum I had the opportunity of making a tracing of the bisected skull of an adult orang in which a small sinus was present.

But the absence of the sinus in cases in which there is no superciliary eminence proves very little. On the other hand, we are confronted with the fact that there are numerous catarrhine apes in which the superciliary eminence is highly developed, and yet in which there is not a trace of the sinus. Further, it should be borne in mind that, as Dr Logan Turner has so clearly demonstrated, the sinuses are not infrequently absent in individuals of apparently all races of man. According to this authority, they are absent in 7·5 per cent. of European skulls.

It would almost appear, therefore, that there is no morphological connection between the superciliary eminence and the frontal air-sinus, and yet when we make a vertical section through the region in one of the lower apes (as, for example, the baboon or the macaque) we see that the eminence is due to a separation of the two tables of the frontal bone and the replacement, between them, of the ordinary diploe by open cancellous tissue. Indeed, the condition is identical to the changes which occur in the young human frontal bone preparatory to the extension into the region of the nasal cavity to form the frontal air-sinus (fig. 12). No doubt this is suggestive, but I am afraid we cannot conclude from this fact alone that any clear connection exists between the condition present in these apes and the subsequent step which leads to the formation of an open air-sinus in certain of the anthropoids and man. Still, it is just possible that the condition may indicate in these apes the phylogenetic step by which the sinus formation has been reached.

If, then, as seems likely, there is no morphological connection to be traced between the superciliary eminence and the frontal air-sinus, how can we account for the presence of the former? It is not required for the formation of an efficient torus supraorbitalis;

this can be formed without its aid. As we have seen, the superciliary eminence frequently appears as an isolated eminence, standing absolutely independent of, and apart from, the other elements of the region. I suspect that this problem must remain, for the meantime at least, unsolved. It may be that, by adding to the volume of the supraorbital projection, the superciliary eminence increased the aspect of ferocity, which is generally associated with projecting brows, and thus contributed to the face a feature which would no doubt have been a decided advantage in those early struggling days. Little gain, however, is to be acquired by following a line of thought so highly speculative.

As is well known, the torus supraorbitalis in the gorilla and the chimpanzee is chiefly composed of dense bone. The frontal air-sinuses are relatively small, and are

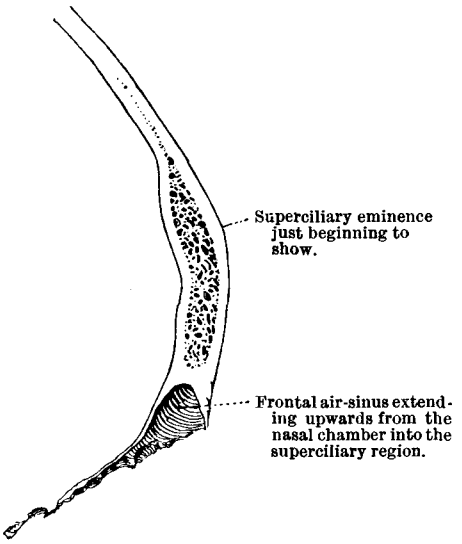

FIG. 12.—Sagittal section through the frontal bone of a child, in the *region of the superciliary eminence.*

situated at the base of the torus, close up against the inner table of the cranial wall. Further, they are chiefly confined to the glabellar region, and do not extend for any distance outwards into the superciliary part of the torus. Much interest is therefore attached to the observation of Professor SCHWALBE (8) that in the Neanderthal cranium the air-sinuses lie well back, and that a thick layer of condensed bone forms their anterior wall. It is usual to find a similar pithecoid condition in the supraorbital region of the native Australian. The frontal air-sinuses, in this race, are as a rule relatively small, and they lie behind a mass of condensed bone. Thus Dr LOGAN TURNER (14) was only able to map out these sinuses by the illumination method in less than a third of the Australian skulls he examined (in 20 out of 69 skulls), and in a very large number (30·4 per cent.) he found both sinuses totally absent. Amongst the Maori skulls, which, as we have noted, also show a tendency to Type III. of the eyebrow region, the same observer states that both sinuses were absent in 37 per cent. of the specimens he examined. These are striking facts, and undoubtedly point to an important affinity in this

respect between the native Australians and the Neanderthal race on the one hand, and of both of these to the chimpanzee and the gorilla on the other hand.

The Supraorbital Notch and its Relation to the Eyebrow Eminence.

Schwalbe has pointed out that the supraorbital notch bears an important relation to the eyebrow eminence. A glance at figs. 17, 18, and 19, Pl. I., which exhibit the region in the baboon, shows that this notch is the starting-point on the margin of the orbital opening from which the oblique groove, which intervenes between the superciliary and supraorbital elements, proceeds. Even in Type III. of this region, where the different elements are massed together with no external indication of their separate identity, Schwalbe takes the supraorbital notch as giving the only clue to the demarkation of the superciliary and supraorbital elements of the eyebrow projection. Schwalbe has failed to appreciate, however, that the supraorbital notches in man and the lower apes are not morphologically equivalent, nor yet similarly placed on the margin of the orbital opening. In other words, the disposition of the frontal nerve in man and the ape is different.

In man the frontal branch of the ophthalmic division of the trigeminal nerve pursues a straight course within the orbit upon the upper surface of the levator palpebræ superioris, and about midway between the inner and outer walls of the cavity. At a variable point it gives off its supratrochlear branch and is continued onwards as the supraorbital nerve. The supratrochlear nerve inclines inwards towards the inner wall of the orbit, and finally turns round the inner part of the orbital margin above the trochlea of the superior oblique muscle to gain the forehead. As a rule it leaves no mark upon the bone as it winds on to the forehead; sometimes, however, its path is indicated by a groove, as in the New South Wales cranium (figs. 20 and 21, Pl. II.), and at other times it may pass through a foramen, as in the case of the Neanderthal cranium (fig. 3, p. 288, and fig. 6, p. 298). These markings are more frequently present in the crania of lower races, and more especially in those with a projecting glabellar and eyebrow region.

The supraorbital nerve, or the continuation of the frontal trunk, reaches the forehead by turning upwards in the supraorbital notch or foramen. This notch is variable in position, but usually it lies a little to the inner side of the mid-point of the supraorbital margin.

Mr Ninian Bruce, B.Sc., has kindly made dissections for me of the orbital cavity in three chimpanzees, one orang, one yellow baboon, and in several species of the genus Macacus. These have shown that the frontal nerve in the ape does not present the same relations within the orbital cavity as is the case in man.

In the baboon and the macaque the frontal nerve does not divide into two branches within the orbit, but issues from that cavity in the form of one undivided trunk. Further, this nerve courses through the orbit in close relationship to its inner wall, and

turns round a wide and conspicuous notch on the inner part of the supraorbital margin and immediately to the outer side of the glabella (fig. 19, Pl. I.). It follows from this that the supratrochlear nerve in man is the representative of the whole nerve in the baboon and macaque, and that the occasional groove or foramen on the orbital margin associated with it is the morphological equivalent of the large single notch in the lower ape. The new position of the frontal nerve in man (on the upper surface of the levator palpebræ superioris and midway between the outer and inner walls of the orbit) and the passage of the greater number of its fibres through a new nerve (the supraorbital) is a condition which has probably been brought about by the increase in the breadth of the human forehead, which renders it necessary for the greater number of the group of nerve-fibres which go to supply the skin of this area to be shifted in an outward direction. Like most acquisitions of recent phylogenetic origin, the condition is one which is liable to considerable variation. Not only is the relative size of the two branches of the frontal nerve in man subject to variation, but also the position of the supraorbital notch on the orbital margin is very far from being constant.

The arrangement of the frontal nerve in the orbit of the chimpanzee and orang is slightly different from that which was seen in the baboon and macaque. The nerve still clings to the inner wall of the orbit, but when it comes to the region above the trochlea it divides into two branches, which no doubt correspond to the supratrochlear and supraorbital branches in man. This division takes place below the front part of the torus, and the supratrochlear is carried onwards in an upward and inward direction around the inner part of the supraorbital arch and immediately to the outer side of the glabella. The outer branch or the supraorbital nerve turns sharply outwards on the under surface of the torus, and then winds on to the forehead in an oblique and often very obscure groove, which is the representative of the supraorbital notch in man.

This arrangement of the nerve can usually be made out in a very distinct manner in the skull of the adult gorilla. From the markings on the bone it becomes evident that the main portion of the nerve turns over the torus close to the inner wall of the orbit in a very shallow groove which partakes more of the nature of a smooth pathway. This lies above and in front of the trochlear pit.

In nine out of eleven gorilla skulls there was evidence that the frontal nerve had divided close to the margin of the orbital opening, and further, that the outer branch (*i.e.* supraorbital) had diverged from the inner branch almost at a right angle before turning round the supraorbital margin. The two shallow pathways for these nerves are distinctly marked on the bone, and in a large male skull they were separated at the points at which they turned upwards by an interval of 10 mm. As a rule they are separated from each other by a low spine-like projection upon the under surface of the torus.

In no sense either in the chimpanzee or the gorilla can either of these grooves be taken as giving an indication of the line of fusion between the superciliary and supraorbital elements of the torus supraorbitalis. This can be seen in those young specimens

of chimpanzee skulls to which we have referred as showing in more or less distinct outline the superciliary element as a part of the torus.

The foregoing facts are important in connection with SCHWALBE'S views in regard to the supraorbital notch, and they are also of high interest when we apply them to the information we possess regarding the eyebrow region in the Neanderthal cranium.

SCHWALBE has given us a most careful account of the orbital roof and supraorbital margin in the Neanderthal cranium (8), and has supplemented his description by an instructive outline drawing (fig. 6, p. 298) and a photograph (fig. 7, Pl. I.) of the under surface of the frontal bone. From these it is apparent that to a large extent the human arrangement of the frontal nerve has been present in the Neanderthal race. The division of the nerve-trunk is clearly indicated by groovings on the orbital roof, and the presence of a foramen for the supratrochlear part and a notch for the supra-

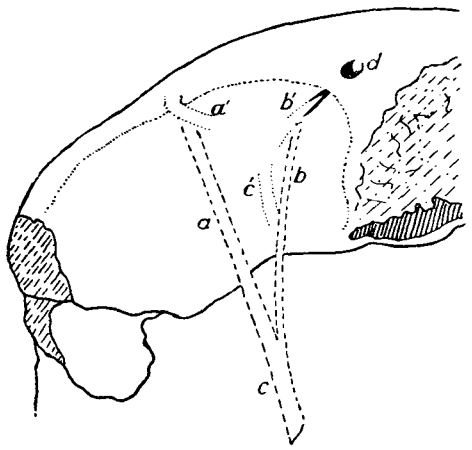

FIG. 13.—Diagram to show position of frontal nerve and its branches in the Neanderthal specimen and in recent man.

a. Supraorbital nerve (recent man).
a', *b'*, *c'*. Markings on roof of orbit of Neanderthal cranium.
b. Supratrochlear nerve (recent man).
c. Frontal nerve (recent man).
d. Supratrochlear foramen.

orbital part are clearly delineated—more especially on the right side. But whilst this is the case, certain pithecoid characters are evident: (1) the groove on the orbital roof which conveyed the frontal nerve lies nearer to the inner wall than we are in the habit of seeing it in recent man; (2) the two branches of the nerve diverge widely and abruptly from each other like the limbs of the letter Y, and of the two the supratrochlear branch seems to lie more in the line of the parent trunk than the supraorbital; (3) the groove and the foramen for the supratrochlear branch show that this nerve must have been unusually large, *i.e.* judged from the human standpoint. These features bespeak a nearer approach to the ape; but in making this statement we must not lose sight of the fact that in several Australian crania in the Museum of the University there are markings which also point to pithecoid leanings of a somewhat similar nature.

But the interest in the nerve-markings is not exhausted by a study of the supra-

trochlear and supraorbital grooves, notches, and occasional foramina. Anyone who makes a comparative study of the region will be naturally led to inquire, in the case of Type II., whether the sulcus which separates the superciliary and the supraorbital elements is not in great part produced by the supraorbital nerve in the first part of its course on the forehead. When I began my investigation this view appealed strongly to me, and gained force from a dissection which I made of a young yellow baboon, in which the nerve undoubtedly occupied the whole length of the sulcus in question. Subsequent research, however, has shown that, while the nerve may turn outwards in the groove for a short distance, the sulcus cannot in any sense be regarded as a nerve pathway.

Having now taken a general survey of the morphological characters of the eyebrow eminences in man and the apes, we are in a position to discuss the view expressed by Professor SCHWALBE that these features alone are sufficient to constitute a specific difference between the Neanderthal race and all other races of mankind. In coming to this conclusion, it seems to us that SCHWALBE in some degree exaggerates the importance of the features in question, and has failed to take into account the numerous individual crania of recent races which are found to some extent filling up the gap which exists in this respect between the Neanderthal cranium and the crania typical of the races of the present day.

The leading peculiarities of the Neanderthal eyebrow region are :—

1. Its striking degree of prominence.
2. Its external configuration and its morphological constitution.
3. Its relation to the cerebral part of the frontal bone and to the roof of the orbit.

In so far as 1 and 2 are concerned, the Neanderthal cranium may be said to fall within the limits of the races which exist at the present day. As we have seen, individual crania are found amongst the Australians which exhibit very nearly, if not quite, as great a prominence in the glabellar region. Nor are the general configuration and the constitution of the eyebrow projection which are characteristic of the Neanderthal group peculiarities which belong to this race alone. In these respects they are associated in Type III. with many individuals of other existing races.

As SCHWALBE has recognised, it is in the relation of the supraorbital projection to the cerebral and the orbital cavities that the most important distinction lies. But even in this respect we find in recent man transition forms, and we have indicated the New South Wales cranium as a case in point. Further, it has long been known that in the Australian, notwithstanding the projection of the eyebrow region, the tendency is towards the formation of frontal air-sinuses of small size. In the Australian skull, as in the Neanderthal cranium, the eyebrow eminence is as a rule largely formed by a massing of the bone in front of the air-chamber.

It is doubtful if much profit can be derived from a discussion as to whether the

eyebrow characters in the Neanderthal cranium are to be accorded a specific value or not. A question of this kind is decided on more or less conventional grounds, and must be answered by each one for himself according to the interpretation which he puts upon the word "specific." At the same time it must be admitted that if we examine the basis on which zoological classification rests we shall find many cases in which species are determined upon evidence more slender than that which SCHWALBE brings forward in favour of establishing the species of *Homo primigenius* for the reception of the Neanderthal people.

There cannot be a doubt that the formation of such a species would be convenient in many ways; but even allowing for the vague and indefinite understanding which exists amongst biologists regarding the determination of what characters should be elevated to the plane of specific importance and what characters should not, I can hardly bring myself to believe that we would be justified in adopting this course from the characters presented by the supraorbital region in the Neanderthal race.

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EXPLANATION OF PLATES.

PLATE I.

Fig. 14. Skull of a young *Macacus cyclops*. The superciliary eminences are seen in the form of two isolated, oval, slightly raised areas. (Type I.)

Fig. 15. Skull of *Macacus rhesus*. Superciliary eminence strongly marked, elongated, and separated from the supraorbital margin in its whole length. (Type I.)

Fig. 16. Skull of adult chimpanzee (Goodsir series). Torus supraorbitalis well marked, but it will be noticed that the superciliary eminence has not been completely absorbed into it. The general outline of the superciliary eminence is distinct, and it also presents a distinctive texture. (Type II. merging into Type III.)

Fig. 17. Skull of a young chacma baboon (*Cynocephalus porcarius*, Turner series). The superciliary eminences stand clear of the supraorbital margin. (Type I.)

Fig. 18. Skull of an adult baboon (species doubtful). The superciliary eminences by their inner parts are confluent with the inner parts of the supraorbital margins. (Type II.)

Fig. 19. Skull of an adult Anubis baboon (*Cynocephalus anubis*). Shows a nearer approach to the fusion of the superciliary and supraorbital elements of the region than in fig. 18.

PLATE II.

Fig. 20. New South Wales cranium (xxix. B. 1, Turner series). Tori supraorbitales well marked. (Type III.) *a*, supratrochlear grooves; *b*, supraorbital notches.

Fig. 21. New South Wales cranium (xxix. B. 1). Orbital aspect of the frontal bone. *a*, supratrochlear grooves; *b*, supraorbital notches. Note how the interorbital region is pinched in between the two supratrochlear nerves.

Fig. 22. Australian skull from the Queensland district (xxix. A. 10, Turner series). Tori supraorbitales with a steep and highly curved forehead. (Type III.)

PLATE III.

Fig. 23. Skull of a native of New Hebrides Islands (xxvii. C. 3, Turner series). Type II. of the supraorbital region. Contrast with fig. 18, Pl. I.

Fig. 24. Skull of native of Australia from Riverina district (xxix. B. 12, Turner series). Very projecting supraorbital region; transition condition between Type II. and Type III.

Professor D. J. Cunningham on "The Evolution of the Eyebrow Region of the Forehead."—Plate I.

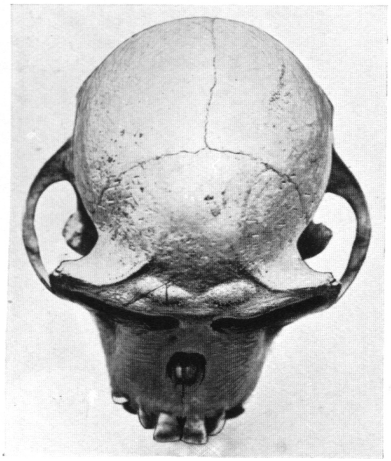


Fig. 14.

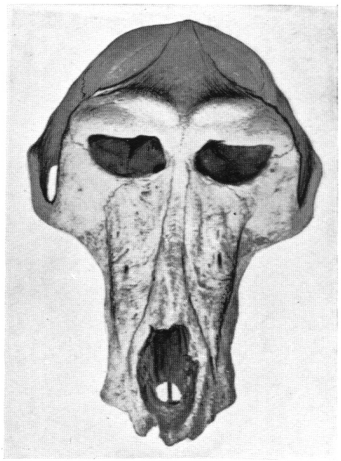


Fig. 17.

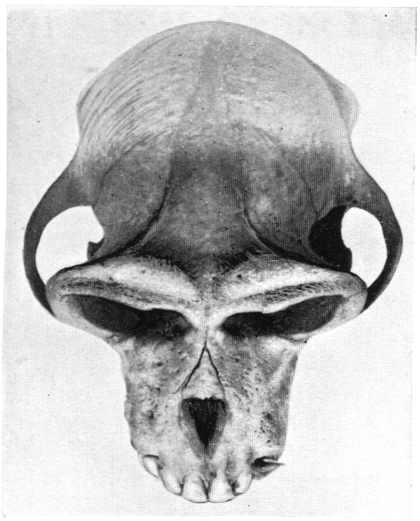


Fig. 15.

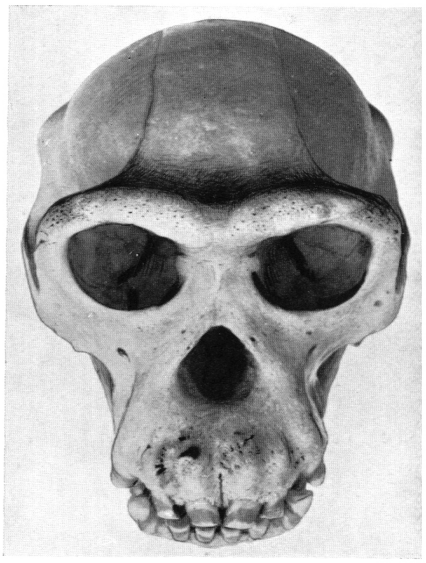


Fig. 16.

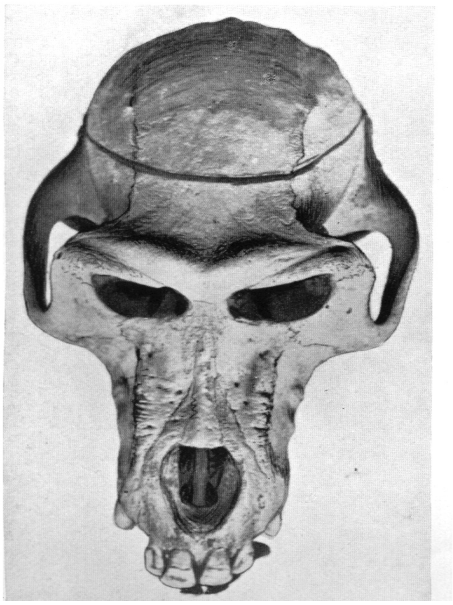


Fig. 18.

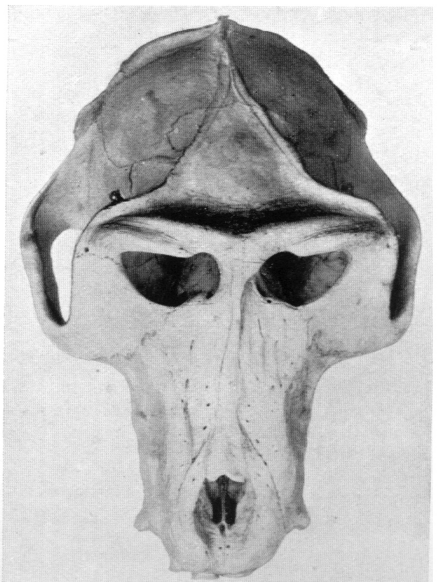


Fig. 19.

Professor D. J. CUNNINGHAM on "The Evolution of the Eyebrow Region of the Forehead."—PLATE II.

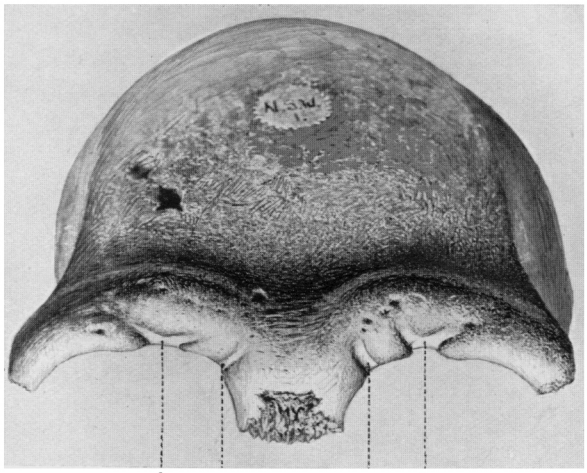


FIG. 20.

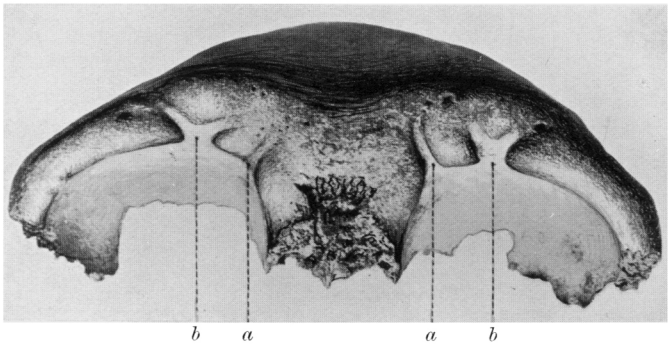


FIG. 21.

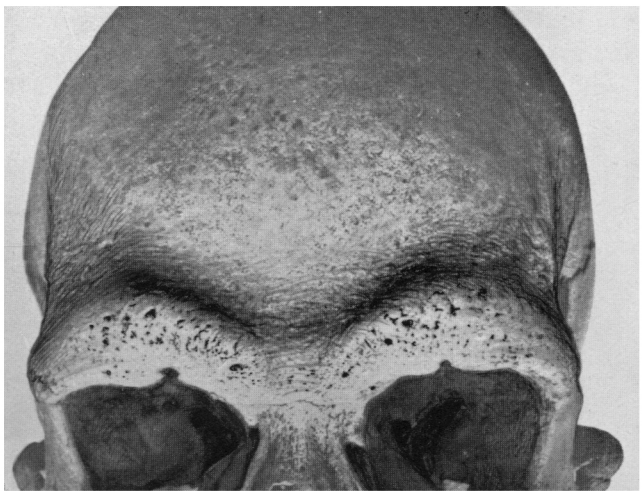
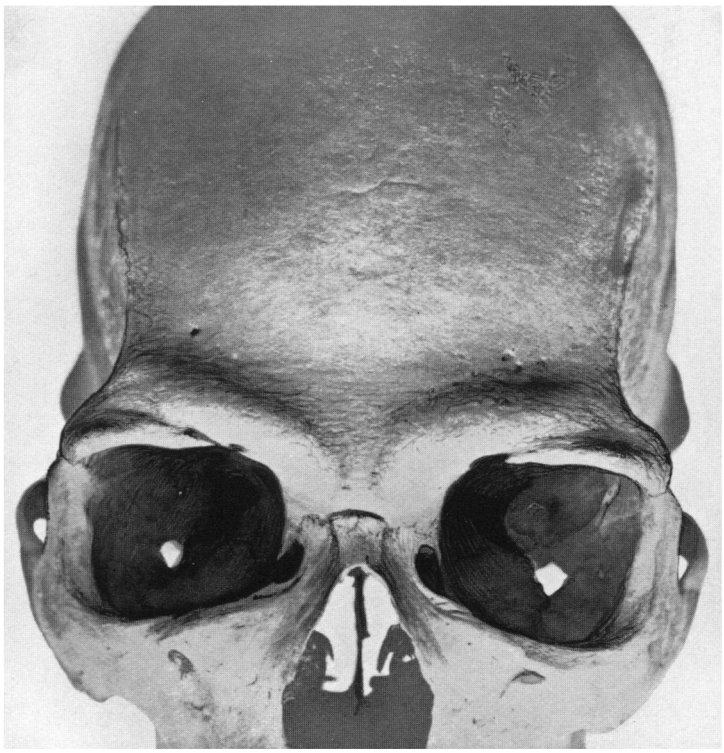


FIG. 22.

Professor D. J. CUNNINGHAM on "The Evolution of the Eyebrow Region of the Forehead."—PLATE III.



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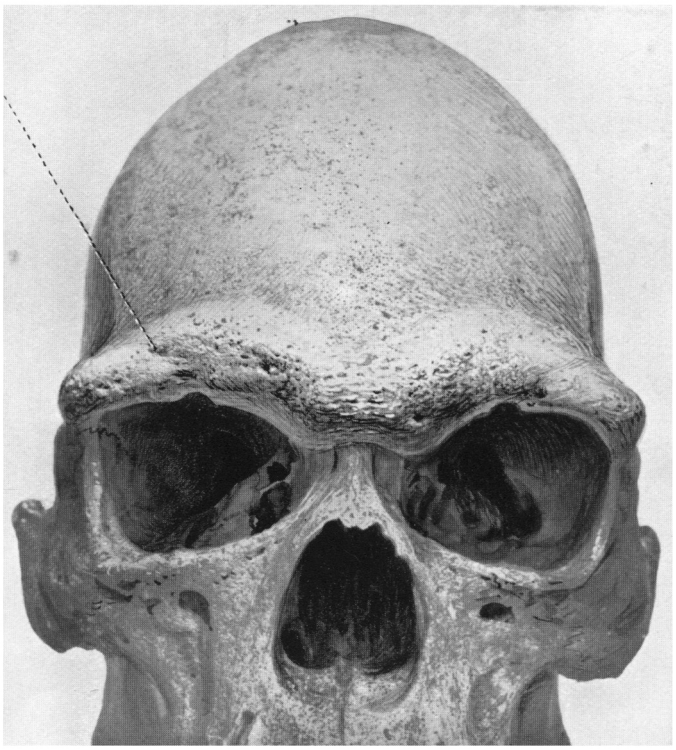

FIG. 24.