THE BUSHMAN BRAIN

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INTRODUCTION

The anthropology of the brain, as Ariëns Kappers indicates (1), is a subject which is worthy of being elevated from its present state of neglect. The present investigation was inspired by Woollard's paper on the Australian brain (2). Further grounds for recording this enquiry are the paucity of knowledge concerning the brain of this most interesting race, and the inevitability that such brains will become more and more difficult to procure. All that is known of the brain in Bushmen and Hottentots is represented by the papers of Tiedemann, Marshall, Koch, Sergi and Rawitz.

THE MATERIAL

The material available in the Anatomy Department of the University of Cape Town consists of two complete brains of Bushmen and one half-brain of a Bushwoman. These are the only brains from Bushman types met with in a series of almost 900 cadavers mostly native and coloured. All the brains were preserved in 10 % formalin.

Brain 1. This is a complete brain of a male, whose age was said to be 108. This specimen unfortunately presents a certain amount of hydrocephalus. Further the right hemisphere of the cerebrum is markedly smaller than the left. In the cerebellum the right lobe is slightly larger than the left.

Brain 2. Left half of brain of a female. This specimen is exceptionally small (*v.i.*).

Brain 3. Complete brain of male. Age 34. Left hemisphere of cerebrum is slightly longer than right. Right lobe of cerebellum larger than left. The veins of this brain were exceptionally well shown and consequently produced marked indentations on the surface of the brain. The arachnoid and pia mater were also very closely adherent to the brain surface.

This investigation falls naturally into two sections:

A. Description of various features—Encephalology.
B. Measurement of certain data—Encephalometry.

A. ENCEPHALOLOGY

I. General description

All three brains are small as compared with normal European brains, brain 2 being particularly diminutive. This is in keeping with the general smallness of Bushman body features. The parietal eminences are particularly well-marked in brain 3.

The Sylvian region and the insula. Exposure of the insula

The insula is exposed in both hemispheres of brain 1, and in both hemispheres of brain 3, but not in brain 2.

In brain 1 the exposure is more marked on the right hemisphere, and in brain 3 the exposure in both cases is mainly at the anterior extremity. In these two brains the exposure is due to defective orbital and frontal opercula.

Anterior rami of lateral fissure

The anterior rami of the lateral fissure are very variable. Both rami definitely emerge from the fossa in only three out of the five hemispheres, for in the left hemisphere of brain 1 the anterior ascending ramus is not shown definitely, and in the left hemisphere of brain 3 the anterior horizontal is very short and does not completely emerge from the fossa.

The two rami emerge in a common stem in the right hemispheres of brains 1 and 3, thus enclosing a V-shaped frontal operculum between them. In brain 2 the two rami come out of the fossa separately. The anterior ascending ramus runs slightly backwards as well as upwards so that we have a wide interval between the two, which is divided by a little sulcus into two more or less equal parts.

Gyri breves and gyrus longus

In the three hemispheres of brains 1 and 2 some of the gyri breves are almost equal to the gyrus longus in length. Several gyri breves join each other.

In both hemispheres of brain 3 the gyri breves unite at their lateral extremities to form a gyrus which is parallel to the gyrus longus. In this brain the insula is comparatively large, especially anteriorly.

Temporal area

Acoustic gyri. (*Transverse temporal gyri of Heschl.*) In the right hemisphere of brain 1, in brain 2 and in the right hemisphere of brain 3, the sulcus between these two gyri is deficient medially, where the gyri therefore fuse.

In the left hemisphere of brain 3 they fuse laterally.

Only in one hemisphere, therefore, viz. the left hemisphere of brain 1, are the two gyri definitely marked off from each other along their whole length. In the right hemisphere of brain 3 the anterior gyrus is larger than the posterior.

With the exception of the left hemisphere of brain 3 there is no sulcus or indentation separating the acoustic gyri from the lateral surface of the superior temporal gyrus in any of the hemispheres. In the one exception the two gyri are separated from that surface of the superior temporal gyrus by a sulcus which extends posteriorly on to the superior surface of the temporal lobe, i.e. the surface in the lateral fossa of Sylvius.

Superior temporal sulcus and gyrus. In two hemispheres (right of brain 1 and right of brain 3) the superior temporal sulcus is not interrupted superficially (i.e. it is interrupted only by sunken gyri). In the remaining three hemispheres, the sulcus is completely interrupted into two parts, in addition to the presence of sunken gyri. In these cases therefore the superior temporal gyrus unites with the middle temporal gyrus.

Width of the superior temporal gyrus. Woollard (2) records a marked reduction in the width of the superior temporal gyrus in one of his Australian brains. The same reduction is seen in brain 3 of this collection of Bushman brains.

Width about middle of posterior ramus of lateral fissure (in mm.)

	Brain 1	Brain 2	Brain 3
Right hemispheres	14	—	6
Left hemispheres	13	15	8

Middle temporal sulcus. This sulcus is in two definite parts in four hemispheres of the five (all except brain 2).

In the left hemisphere of brain 1 the anterior part joins the superior temporal sulcus.

In the right hemisphere of brain 3, the larger anterior part runs right to the temporal pole, and the smaller posterior part runs obliquely upwards to terminate close to the superior temporal sulcus, to which it is joined by a deep indentation caused by a vein.

In brain 2 this sulcus is continuous in its whole length except for a very small anterior part at the temporal pole.

Inferior temporal sulcus. This sulcus is continuous in three hemispheres (brains 1 and 2). In all three cases the anterior ends are more or less parallel to the rhinal fissure. In both hemispheres of brain 1, the sulcus terminates posteriorly by turning over the inferolateral border to the superolateral surface.

In brain 2 it is joined posteriorly by the collateral sulcus.

In both hemispheres of brain 3 the inferior temporal sulcus is interrupted into two parts at about its middle. In both hemispheres, the posterior part is more or less parallel to the collateral fissure; but whereas the anterior part in the right hemisphere is more or less parallel to the rhinal fissure and gives off a little sulcus to join it, in the left hemisphere the anterior part converges on the rhinal fissure and terminates in close proximity to it.

The posterior extremity of the posterior part in the right hemisphere and the anterior extremity of the posterior part in the left hemisphere present bifurcations, the upper limbs of which both turn round the inferolateral border to the superolateral surface.

Rhinal and collateral sulci. The collateral sulcus does not join the rhinal fissure in any one of the hemispheres. In brain 2 it joins the inferior temporal sulcus. In the right hemisphere of brain 3 the rhinal fissure is connected to the anterior part of the inferior temporal sulcus by a communicating sulcus.

The *uncus* is very prominent in all three brains.

(In brain 1 the isthmus of the gyrus fornicatus presents a well-marked elevation. This is in all probability due to the brain substance being pushed over the edge of the tentorium cerebelli. The condition of hydrocephalus is responsible for the expansion of third and lateral ventricles, the attenuation of the substance of the corpus callosum and its increase in length, the displacement of the fornix from the corpus callosum right from the splenium and the consequent great increase in extent of the septum pellucidum.)

Size of temporal lobe. In all three brains, the temporal lobe appears to be small on the whole. In brain 3 it is noticeably smaller on the right than on the left hemisphere.

Occipital region

Calcarine fissure and sulcus lunatus. The anterior and posterior calcarine fissures are well shown in all the brains. The lateral calcarine sulcus is only typically present in the two cases in which the sulcus lunatus is typical or almost typical, viz. left hemispheres of brains 1 and 2. In both these cases, however, the lateral calcarine sulcus is interrupted before it terminates by being surrounded by a sulcus lunatus.

In the other three hemispheres, atypical lateral calcarine and lunate sulci may be made out by piecing together irregular sulci.

The *sulcus lunatus* is typical in only one out of the five hemispheres—brain 2. It is almost typical in the left hemisphere of brain 1 (*v.i.*).

The *sulci limitans superior and inferior and the sulcus sagittalis lingualis* are present in some form or other in all the hemispheres.

The *sulcus paracalcarinus and the arcus intercuneatus* do not present any consistent features.

The *sulcus praelunatus* extends forwards irregularly from the sulcus lunatus (typical and atypical) to end either in close proximity to or actually in connection with the anterior occipital sulcus, the sulcus angularis, and so to the termination of the superior temporal sulcus.

The *occipital poles* of the right hemisphere of brain 1 and both hemispheres of brain 3 present well-marked depressions due to the superior sagittal blood sinus.

Parietal region

Sulcus centralis: junction with lateral fissure of Sylvius. In two out of the five hemispheres (viz. in the left hemispheres of brains 1 and 2) the sulcus centralis joins the lateral fissure directly. In the remaining three hemispheres the only connection is an indirect one—through the sulcus subcentralis anterior. In fact, in the right hemisphere of brain 1, there is no actual junction with the sulcus subcentralis anterior. In the right hemisphere of brain 3, the central sulcus is connected to the sulcus subcentralis anterior just by a shallow sulcus, and in the left hemisphere of this brain, where this junction is more definite, the sulcus subcentralis anterior does not completely join the Sylvian fissure.

Relation to superomesial border. The sulcus centralis cuts the superomesial border and extends on to the medial surface for about ½ inch in four out of the five hemispheres. In the one exception, viz. the right hemisphere of brain 3, it does not even reach the superomesial border.

The *paracentral lobule* is well defined in all the hemispheres except the left one of brain 1, where the sulcus paracentralis is defective.

Sulcus intraparietalis proprius. This sulcus joins the postcentral sulcus in all five hemispheres. The four genetically distinct parts of this sulcus fused superficially and were divided only deeply by annectant gyri in both hemispheres of brain 1 and in brain 2. In brain 3 this sulcus is split up into two parts in the right hemisphere (one parietal and one occipital) and three parts in the left hemisphere (two parietal and one occipital).

Frontal region

The striking feature of this region in these brains is the highly convoluted appearance due to the large number of small irregularly disposed gyri.

Precentral sulcus. The superior and inferior precentral sulci are confluent in only two hemispheres—the two of brain 1. In no hemisphere is this sulcus directly continuous with the lateral fissure of Sylvius. In the right hemisphere of brain 1, it is connected by a shallow groove to the sulcus subcentralis anterior and hence indirectly to the Sylvian fissure. In the right hemisphere of brain 3, the precentral sulcus is joined to the fissure of Sylvius by the sulcus subcentralis anterior, and in the left hemisphere of brain 3, the precentral sulcus is joined to the central sulcus of Rolando by a shallow transverse connecting sulcus.

The sulcus precentralis medius is separate from the sulcus precentralis superior in only one hemisphere, viz. the right hemisphere of brain 3, but even in this case they are very close to each other and seem to join when looked at casually. It should be noted also that in brain 2 there is a small sulcus above the superior precentral, which cuts the superomedial border and extends for about ½ inch on both the medial and superolateral surfaces.

Sulcus subcentralis anterior. This little sulcus is present in all cases except in brain 2.

The *sulcus radiatus of Eberstaller* seems to be present in all five hemispheres, as also is the *sulcus frontomarginalis.*

Superior frontal sulcus. This sulcus is continuous almost to the frontal pole in four of the five hemispheres studied. In the one exception, viz. the right hemisphere of brain 3, it is interrupted into a longer posterior part and a shorter anterior part.

It is directly continuous with the superior precentral sulcus in all the hemispheres except the left one of brain 1. (In the right hemisphere of brain 3 it is continuous with the sulcus precentralis medius.)

The superior frontal sulcus terminates by joining the frontomarginal sulcus in only one case—brain 2.

Sulcus frontalis medius. This sulcus is completely absent in brain 2, and in brain 1 is only represented by a number of irregular little sulci. In brain 3 it is present in both hemispheres but interrupted into a well-defined longer posterior part which is not continuous with the precentral sulcus and an irregular anterior part which fuses with the frontomarginal sulcus.

Superior frontal gyrus and lateral and medial paramesial sulci. The lateral and medial paramesial sulci which divide the superior frontal gyrus into two parts on superolateral and medial surfaces respectively are best shown in brain 2, where they are represented by short continuous longitudinal furrows running parallel to the superomedial border. The medial paramesial is the smaller of the two. In both hemispheres of brain 1 and both hemispheres of brain 3, these sulci are represented only by a large number of irregularly disposed little sulci on both the lateral and medial surfaces.

Sulcus cinguli and gyrus cinguli. This sulcus is present in its normal form in all cases except brain 2 where it is interrupted by a small gap anteriorly. From this point anteriorly the gyrus cinguli is divided longitudinally into two parts by a small sulcus parallel to the curved part of the sulcus cinguli. (In brain 1, the gyrus cinguli is very narrow, due to the hydrocephalus.)

II. Special features which have been used as criteria for comparison

Narrow width of frontal lobes (or rather pronounced parietal width). This feature which is conspicuous in both Marshall's and Koch's Bushwomen's brains (Kappers (1)) is also well shown in the present collection, particularly in brain 3. This is in keeping with the characteristic shape of the Bushman cranium.

Frontal and occipital flatness, as shown by Marshall's brain, is also manifest in this series, particularly in brain 2 (which seems to be the most primitive brain). There is also a tendency to a "*square-cut*" *contour at the occipital end,* particularly in brains 2 and 3—a feature which Duckworth (3) says appears in lowly human brains and in brains of gorillas and other Simiidae and which he found distinct in one hemisphere of his Australian brains.

Gyration. Like Koch's Bushwoman's brain, the present series display strong gyration, the frontal lobe being particularly highly convoluted.

In no case are the convolutions infantile and lacking the fulness of complexity (a feature of Bushman brains recorded by Duckworth (4)), although there is a tendency in this direction in brain 2.

Rostrum orbitale. This feature, regarded by Duckworth (3) as a Simian characteristic, is particularly well shown in brain 3, less so in brain 2 and still less so in brain 1. In fact only in brain 3 can it be said to exceed the normal. Koch found it particularly pronounced in his Bushwoman's brain. Kappers (1) found this also in Neanderthal endocranial casts.

Anastomosis of ramus posterior of lateral fissure with superior temporal sulcus. This feature which may be considered primitive (Kappers (1)) is shown in

Sergi's Hottentot brain and also occasionally in Hereros. It is not shown in any of the present series.

Continuity of sulcus frontalis medius. This is regarded as a primitive feature. Sergi found this sulcus more frequently continuous in Hereros than in Europeans, and Kappers observed this also in palaeolithic brains, viz. Neanderthal endocranial casts. In the present collection this sulcus is present with any degree of continuity only in brain 3. In fact it is completely absent in brain 2.

Curvature of the rhinal fissure. A boldly curved rhinal fissure is according to Duckworth (3) evidence of lowly affinities. Duckworth (3) and Woollard (2) each found this feature once in their Australian brains. In this present collection of Bushman brains, this fissure is boldly curved only in brain 2 and slightly so in three other hemispheres.

Exposure of the insula. This character, regarded by Woollard and Duckworth as a distinctive feature of the Australian aboriginal brain, is well shown in these Bushman brains, being present in four hemispheres out of five (all except brain 2).

Discontinuity of sulcus intraparietalis proprius. Duckworth (3) considers this a primitive feature, particularly the separation of this sulcus from the postcentral sulcus. In this present collection, the sulcus intraparietalis proprius is joined to the postcentral sulcus in all five hemispheres, and is completely continuous in three hemispheres out of five.

Retrocalcarine fissure and sulcus lunatus. The importance of these sulci has been shown by Elliot Smith, and Woollard goes so far as to state that "in the identification of these fissures, Elliot Smith has discovered so far the only reliable criterion of a primitive human brain."

Woollard (2) concludes that the primitive condition of these fissures is present in practically all pure-blooded Australian aboriginals and Shellshear (4) found a similar primitive arrangement in the occipital area of Chinese brains. In the present collection of Bushman brains, the perfectly typical condition of these sulci is found in only one hemisphere, although it is practically typical and easily identifiable in one other hemisphere.

B. ENCEPHALOMETRY

Introductory note

The use of measurements of the brain as criteria of comparison cannot be claimed to be on a definite stable scientific basis as long as there are no fixed universal standards in use with regard to the nature and strength of the preservative solution, the duration of preservation and the time of drying before measurement. Variations in these important factors no doubt cause discrepancies in the results obtained. It is therefore to be hoped that before long international standards will be established and adopted by all investigators.

The present collection of brains was preserved in 10 per cent. formalin. Before being weighed, each brain was allowed to drain for 20–30 minutes.

I. *Weights*

		Total brain gm.	Right hemisphere of cerebrum gm.	Left hemisphere of cerebrum gm.
Brain 1		965	381	456
Brain 2	Half	425	—	362
	Whole	850 approx.		
Brain 3		1097	480	471

From the above figures it is clear that the Bushman brain has (as one would expect from its small size) an exceedingly small weight. For comparison we may cite Woollard's figures for three Australian brains: 1138·0, 1123·0, and 1044·6 gm., and Kappers' average figure for Southern Chinese brains—1239 gm., and for Dutch males 1322 gm. Villiger (6) gives the following list of average weights for different races:

Caucasian	1335 gm.
Chinese	1332 ,,
Sandwich Islander	1303 ,,
Malay and Indian	1266 ,,
Negro	1244 ,,
Australian	1185 ,,

It is of interest to note that Kappers determines from Pittard's figures for the capacity of the Bushman-Hottentot cranium that the average brain weight for males is 1343 gm. and for females 1196 gm. He records that Sergi's Hottentot brain weighed 1201 gm., and in a footnote states that the reported weights of Marshall's and Koch's Bushwomen's brains (872 and 844 gm. respectively) are "too small." The value of this statement is greatly diminished by the fact that brain 2 (the only female of this series) has an approximate weight of 850 gm. (*vide supra*). Furthermore, the average of the two male brains (1031 gm.) is also well below the figure given by Kappers for male Bushmen (1343 gm.).

Indubitably, therefore, the weight of the Bushman brain is lower than that of any other living race of Man as yet recorded.

II. *Indices*

$$\text{Brain index } \frac{\text{Greatest diameter}}{\text{Greatest length}}$$

		Greatest diameter mm.	Greatest length mm.	Brain index
Brain 1		118	174	67·82
Brain 2	Half	52	145	(71·72)
	Whole	104 approx.		
Brain 3		114	166	68·67
			Mean	69·40

This index therefore shows a high degree of dolichocephaly, very much greater than that shown by Woollard's Australian brains (average 73·27) and Kappers' Dutch brains (75·2–80·3).

Following Kappers' suggestion, the remaining indices were calculated from measurements taken on photographs of the brains. In determining the frontal height and frontal length indices, I have used his more recent system involving the chiasma perpendicular, as set forth in *The Evolution of the Nervous System in Invertebrates, Vertebrates, and Man* (1929). A full description of the way in which the various lines are drawn, measurements taken, and indices calculated, may be obtained from that volume.

		General height index	Occipital index	Temporal depth index
Brain 1:	Right hemisphere	0·539	1·237	0·132
	Left ,,	0·470	1·121	0·167
Brain 2:	Left ,,	0·538	1·271	0·154
Brain 3:	Right ,,	0·506	1·174	0·138
	Left ,,	0·508	1·209	0·122
	Mean	0·512	1·202	0·143

		Temporal length index	Frontal length index	Frontal height index	Callosum index
Brain 1:	Right hemisphere	0·742	0·348	0·494	0·325
	Left ,,	0·744	0·327	0·414	0·335
Brain 2:	Left ,,	0·771	0·290	0·473	0·319
Brain 3:	Right ,,	0·744	0·316	0·459	0·327
	Left ,,	0·734	0·364	0·464	0·312
	Mean	0·747	0·329	0·461	0·324

General height index (0·512)

A very impressive fact is that in spite of the hyperdolichocephaly of these Bushman brains, the general height index is higher than those of Marshall's Bushwoman (0·469), of Kappers' dolichocephalic Dutchmen (0·491) and of Woollard's Australians (0·502) and approaches more nearly that of Kappers' brachycephalic Dutchmen (0·522). The Chinese brain has a still greater height index (0·535) which approaches nearest to the foetal figure (0·586).

It should be noted that the mean value of the general height index of the present collection is lowered particularly by the comparatively low value of this index in one of the five hemispheres, viz. the left hemisphere of brain 1 (0·470).

Occipital index (1·202)

This index is larger in the present collection than in Woollard's collection of Australian brains (1·008), indicating a steeper occipital slope. Marshall's Bushwoman's brain has an occipital index of 1·275—very slightly higher than that of the present collection to which the average value for Dutch dolichocephalics is almost equal (1·190). All these values are however considerably below the figures for Dutch brachycephalics (1·45), foetuses and neonati (1·47) and Chinese (1·56), brains of which have therefore much steeper occipital slopes. It should be noted again that in the left hemisphere of brain 1 this index is considerably lower than the remaining four figures.

Temporal depth index (0·143)

This index does not show any marked difference from the values obtained for Marshall's Bushwoman (0·137) or for Dutch dolichocephalics (0·145). It is however definitely larger than the figure for Woollard's Australians (0·127), indicating a relatively wider temporal area and smaller than the figures for Dutch brachycephalics (0·160), foetuses (0·157) and Chinese (0·166), indicating a relatively narrower temporal area.

The left hemisphere of brain 1 shows a very high temporal depth index (0·167) and the left hemisphere of brain 3 a particularly low one (0·122).

Temporal length index (0·747)

The relative length of the temporal area as indicated by this index is almost equal to that of Dutch dolichocephalics (0·748). It is relatively slightly shorter than the temporal area of Marshall's Bushwoman's brain (0·755) and still more so than that of Dutch brachycephalics (0·760) and Chinese (0·780). The lowest value in the present series is that of the left hemisphere of brain 3 (0·734), which coupled with its very low temporal depth index (*vide supra*) gives this hemisphere the relatively smallest temporal area.

Frontal length index (0·329)

This is considerably less than the corresponding figure for Marshall's Bushwoman (0·362), Kappers' Australian cast (0·356), dolichocephalic Dutch (0·346), brachycephalic Dutch (0·363) and Chinese (0·343). Interesting is the fact that the nearest values are those for foetuses and neonati (0·326) and for Rhodesian man (0·332?). One would therefore conclude that these Bushman brains present a relatively shorter frontal area. It should be noted however that the average is lowered considerably by the particularly low value for brain 2 (0·290), which appears to be the most primitive brain of this series (*vide supra*).

Frontal height index (0·461)

As compared with the corresponding figures for Marshall's Bushwoman (0·408), Kappers' Australian cast (0·426) and dolichocephalic Dutch (0·443), this index is comparatively high and therefore indicative of a relatively larger frontal height. It is however lower than the index for Dutch brachycephalics (0·473), foetuses (0·503) and Chinese (0·470).

Again it must be pointed out that in the left hemisphere of brain 1 (the most dolichocephalic of the hemispheres) this index is very low (0·414) and is very high in the right hemisphere of the same brain (0·494).

Callosum index (0·324)

This index is of the same order of magnitude as the corresponding indices for Marshall's Bushwoman's brain (0·320) and for dolichocephalic Dutch brains (0·321). All these three are greater (indicating a relatively higher corpus callosum) than the figure for Woollard's Australians (0·310), but are considerably smaller than the corresponding indices for brachycephalic Dutch (0·382), Chinese (0·383) and foetuses (0·402).

The lowest value for the present series is given by the left hemisphere of brain 3 (0·312).

III. *Sylvian and Rolandic angles*

These were also measured, using Kappers' system:

		Sylvian angle	Rolandic angle
Brain 1:	Right hemisphere	61°	23°
	Left „	62°	25°
Brain 2:	Left „	66·5°	26°
Brain 3:	Right „	59·5°	29°
	Left „	62°	24°

IV *Depth of fissures*

As a certain amount of importance has been attached to the depths of fissures, some of the more important ones were measured, viz.:

		Parieto-occipital sulcus mm.	Calcarine fissure mm.	Central sulcus mm.	Intraparietal sulcus mm.
Brain 1:	Right hemisphere	20	18	18	19
	Left „	21	15	20·5	19
Brain 2:	Left „	16·5	21	24	22
Brain 3:	Right „	22	18	21	21
	Left „	23	19	21	22

An interesting fact which emerges is that the calcarine fissure is deepest and the parieto-occipital sulcus shallowest in brain 2, which has been regarded as the most primitive brain of the series (*vide supra*).

The intraparietal sulcus is consistently neither deeper nor shallower than the central sulcus, the mean values being 20·6 and 20·9 mm. respectively. Duckworth (3) found the intraparietal deeper than the central sulcus in Australian brains, as also did Cunningham (7) in Anthropoids.

SUMMARY

1. The most outstanding so-called primitive feature which appears constantly in these brains is the exposure of the insula.

2. There is a tendency towards other primitive features shown particularly well in one or two of the five hemispheres, but not consistently in all, viz. pronounced rostrum orbitale, curvature of the rhinal fissure, retention of the sulcus lunatus.

3. The general appearance and proportions are such as one would expect

from the characteristic configuration of the Bushman cranium, e.g. pronounced parietal width, frontal and occipital flatness.

4. There is a high degree of dolichocephaly.

5. The total brain weights and the weights of the hemispheres are very small, being lower than that of any other living race recorded.

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EXPLANATION OF PLATES I TO V

Plate I

Brain 1. Lateral and medial aspects of right hemisphere.

Plate II

Brain 1. Lateral and medial aspects of left hemisphere.

Plate III

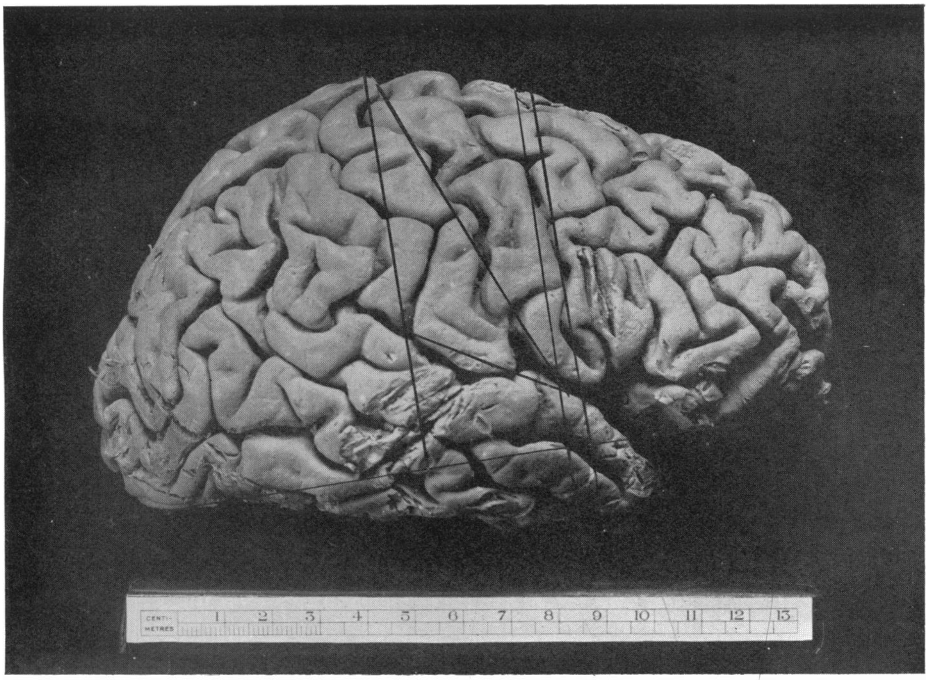
Brain 2. Lateral and medial aspects of left hemisphere.

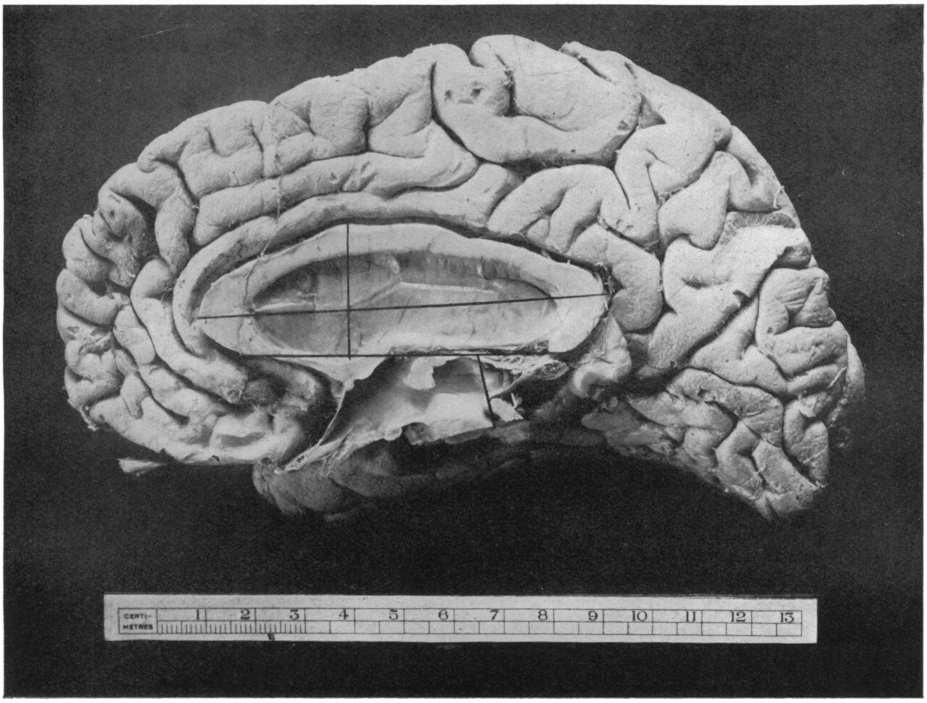
Plate IV

Brain 3. Lateral and medial aspects of right hemisphere.

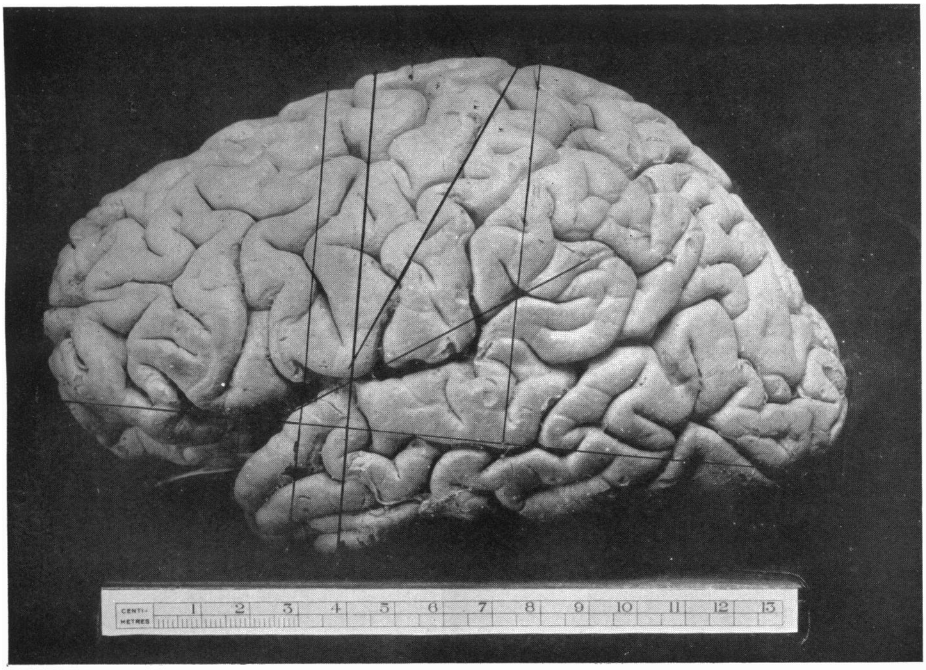
Plate V

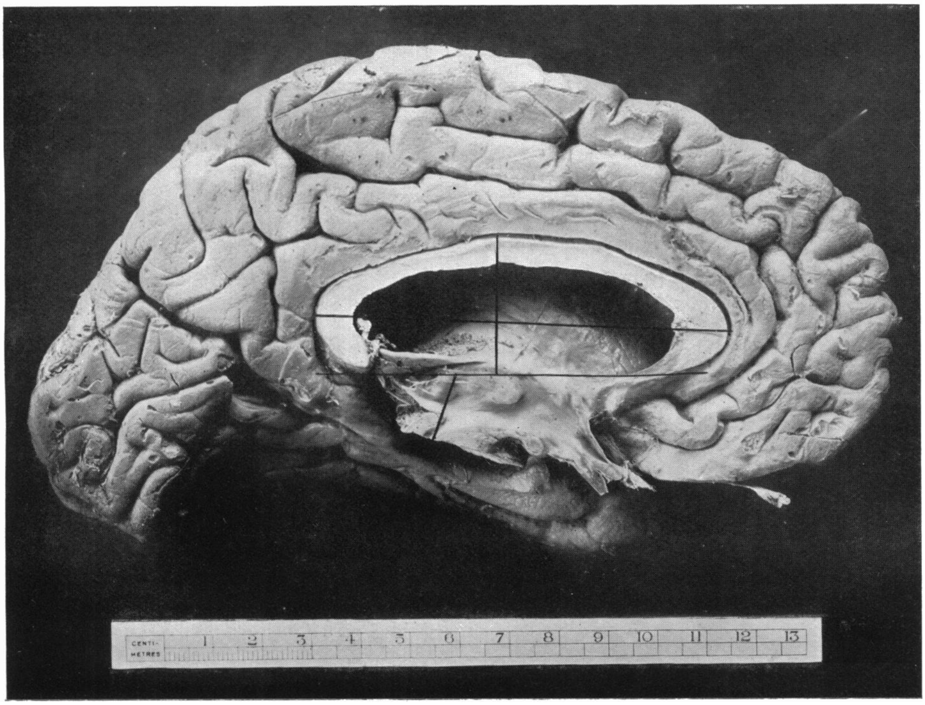
Brain 3. Lateral and medial aspects of left hemisphere.



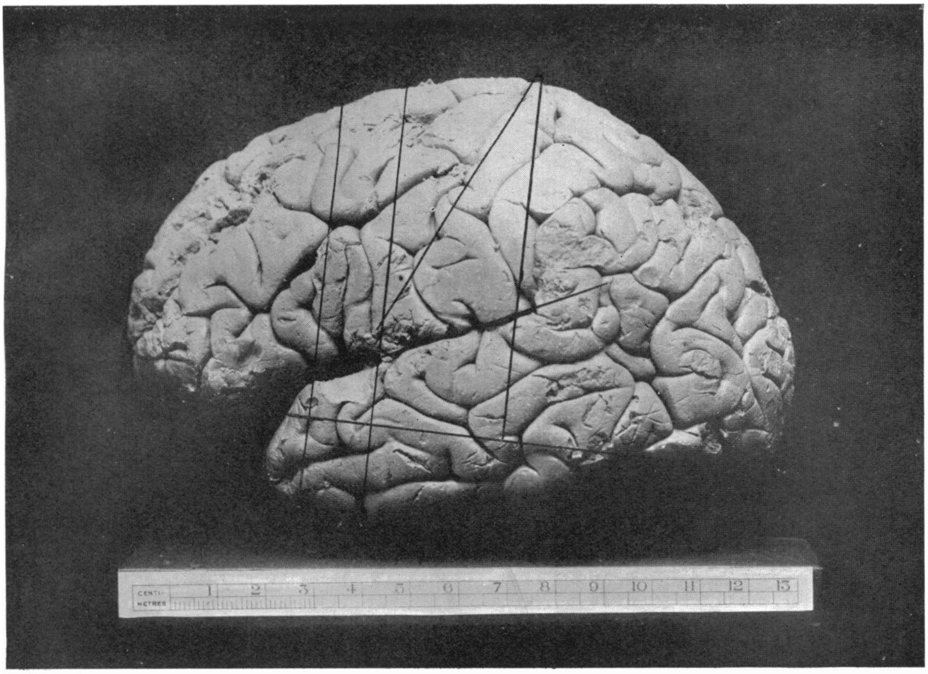


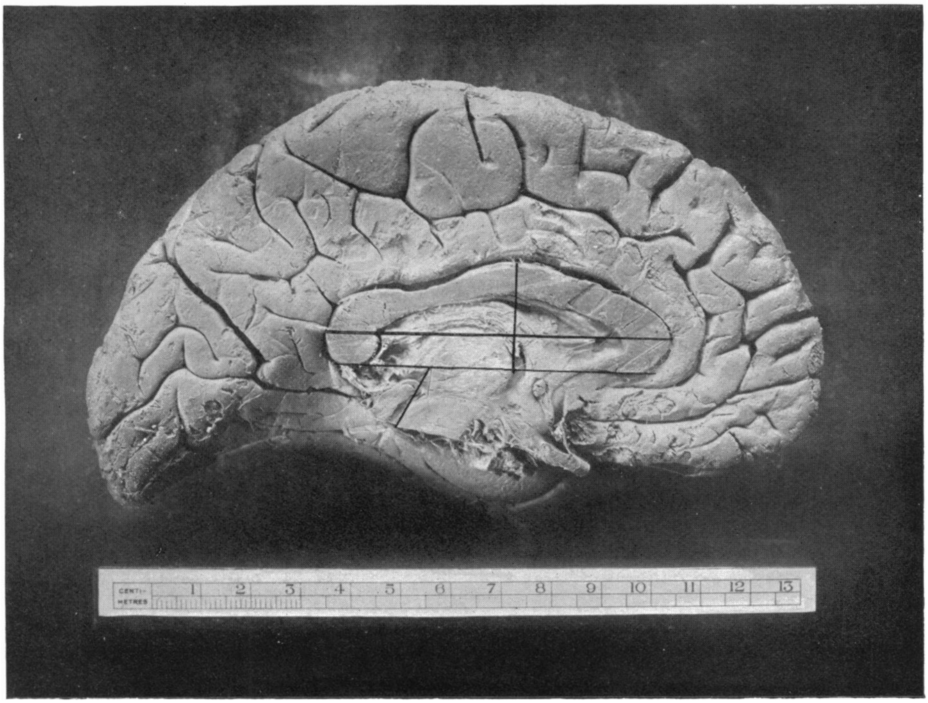
SLOME—The Bushman Brain





SLOME—The Bushman Brain





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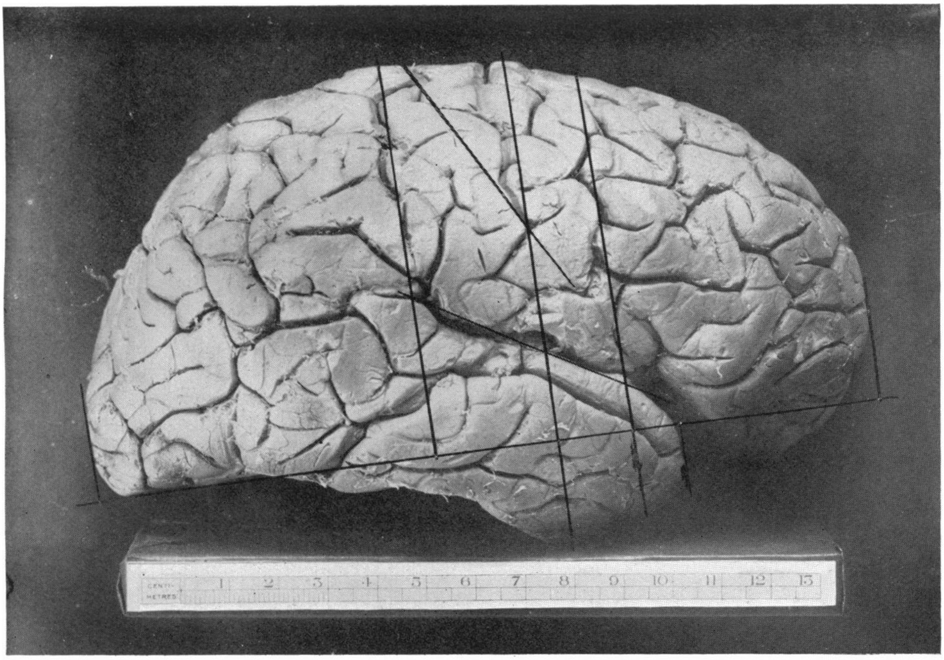
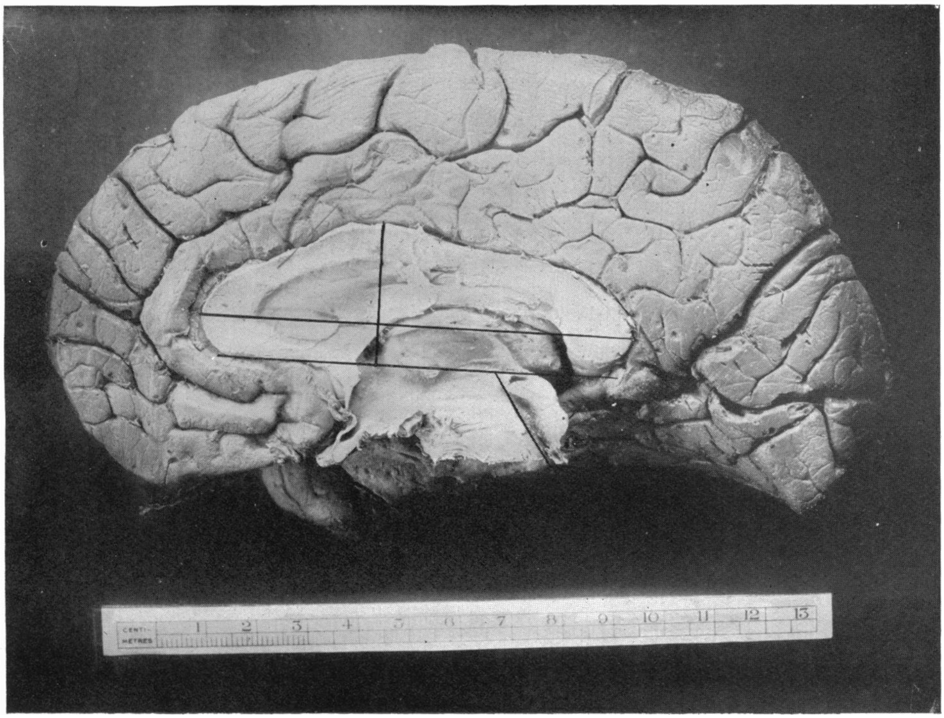
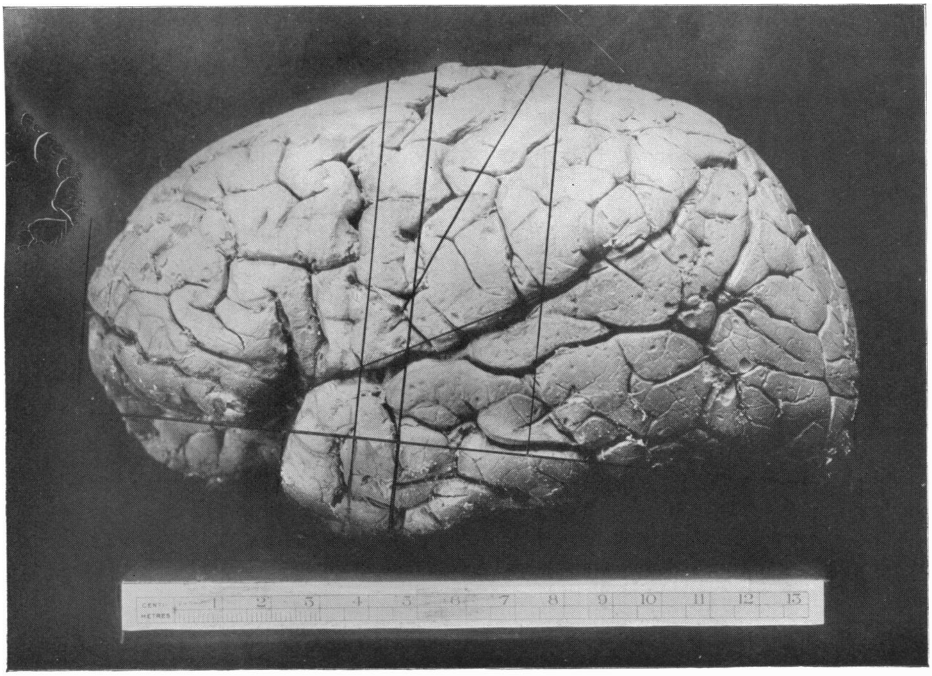
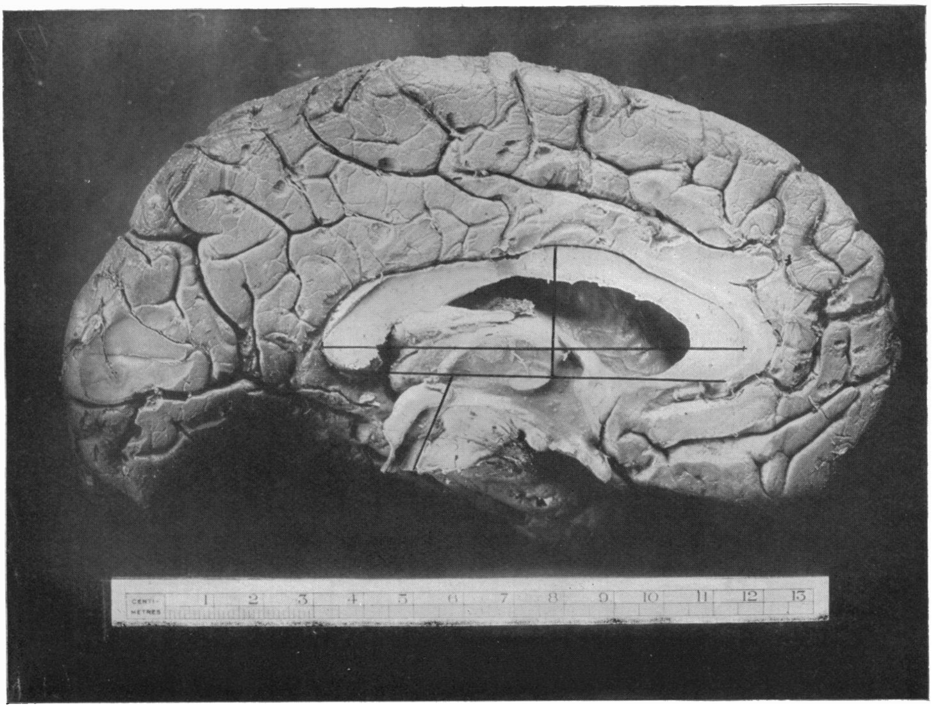




SLOME—THE BUSHMAN BRAIN





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