Description of the cerebral hemispheres of an adult Australian male / by H.D. Rolleston.

DESCRIPTION OF THE CEREBRAL HEMISPHERES OF AN ADULT AUSTRALIAN MALE.

BY

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LONDON:
HARRISON AND SONS, ST. MARTIN'S LANE,
Printers in Ordinary to Her Majesty.

1887.

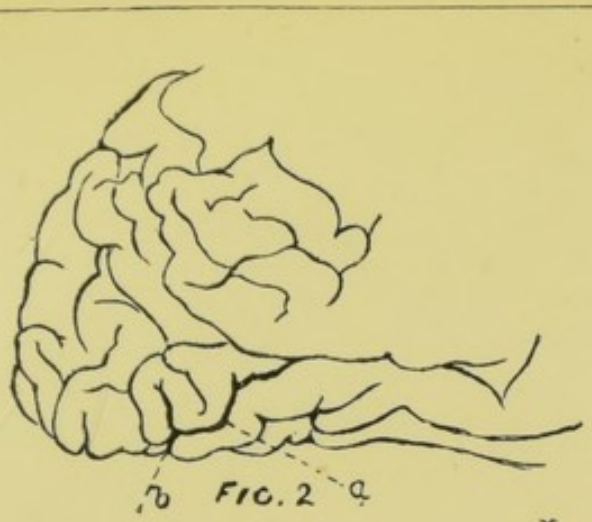

FIG. 2

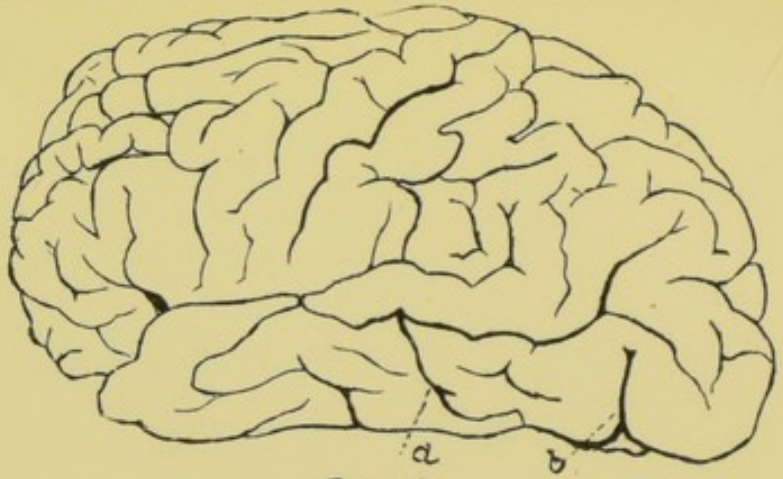

FIG. 1

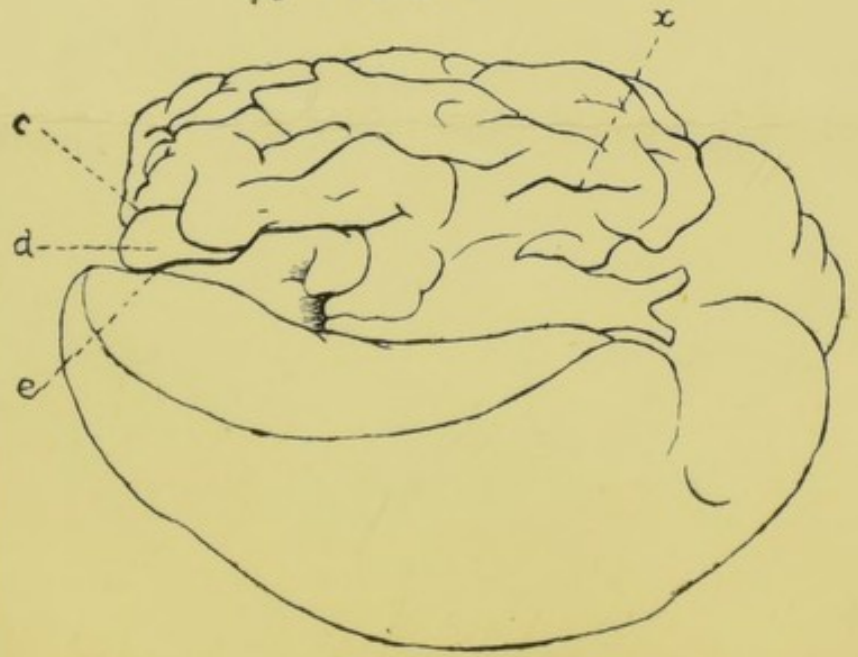

FIG. 4

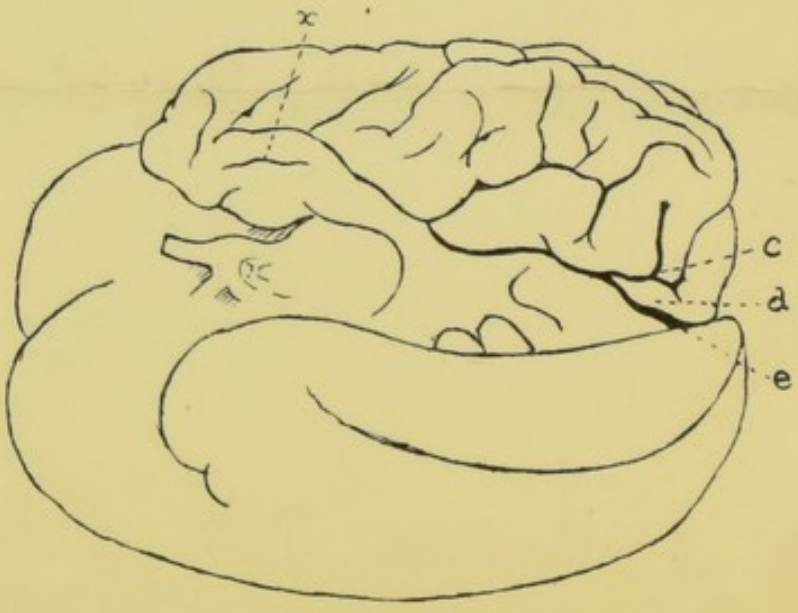

FIG. 3

BRAIN OF ADULT AUSTRALIAN MALE.

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[WITH PLATE II.]

THIS communication is divided into three parts: (1) a few general remarks; (2) a detailed summary of the two hemispheres together: and (3) a description of the two hemispheres separately, with the depths of the fissures and sulci.

General Remarks.

The interest attaching to the study and examination of the brains of the lower races of mankind is briefly summed up in the phrase, "brain as an organ of mind." The problems that come before us are attractive, and, to a certain extent, admit of an answer. What material differences are there between the brain of an educated moral man and that of a sensual, animal-like savage? What correlation is there between the physical conformation of the cerebral hemispheres and the mental development of their owner?

This brain of an adult male Australian is of interest, then, from its being that of a primitive man.

The Australian came to the hospital at Adelaide, and on his death from peritonitis, his head was cut off and despatched in spirit by Professor Watson to Professor Macalister, to whose great kindness I am indebted for this opportunity of describing such an interesting brain.

On removing the brain it was found to weigh 31 ounces. A fresh brain if weighed before and after lying in spirit will be found to lose weight. Therefore, to obtain the weight in the recent condition, a certain percentage must be added to the actual weight of a brain which has been for some time in spirit. Marshall ("Phil. Trans.," 1864) adds seven twenty-fourths (the mean between one-third and one-fourth) of the weight obtained, and thus obtains the probable weight in the recent condition. Dr. Thurnum ("Journal of Mental Science," April, 1866) allows 29 per cent. for shrinkage in spirit.

The Anthropological Society of Paris adds 38 per cent. of the weight of the brain, and this result is more likely to approximate to the truth, for it must be remembered that about 80 per cent. of the weight of a fresh brain is due to water, the removal of

which by alcohol accounts for the greatly shrunken condition of brains preserved in spirit.

Adding, then, 38 per cent. of the actual weight (31 ounces), the resulting weight of 43 ounces may be taken as representing, with a fair approach to accuracy, the weight of the brain at the time of death.

So far very few Australian brains have been weighed: the average of six was found to be 41 ounces, two of these brains, it should be noted, are those of females.[1]

The weight of the brain as a racial character is a subject which has attracted a good deal of attention, and as the result of colossal tables, it may be taken that the average European brain weight in males is 49 ounces, the average weight of the negro race is about 44·3 ounces,[2] which it will be seen is in excess of that of the primitive Australian.

The age of the Australian was unknown, but his face, which is preserved in the anatomical museum of the University of Cambridge, shows no sign of age, but appears to be that of a man about the prime of life.

If the convolutions of this Australian brain be compared with those of an average European brain the simplicity of the former is at once thrown into relief.

The convolutions of the frontal lobe, which is connected with intellectual processes, are seen to have a marked antero-posterior arrangement, to be four instead of three in number, and to be separate, not to join each other at every turn and twist, as is so notably the case in the described brains of many eminent men, and generally in the more civilised nations.

This simplicity of the frontal region is a point of importance, and may be considered as characteristic of a primitive brain. The frontal lobe being associated with higher faculties, it has been thought that the relation of amount of brain substance in front and behind the fissure of Rolando is of almost equal importance with the features mentioned above; but in this brain the relation of amount of brain substance in front and behind the fissure of Rolando was much the same as in an average European brain.

It has also been thought that the præ-auricular development of brain is of importance from the same point of view, but this requires working out.

[1] Dr. Thurnum ("On Weight of Brain," "Journal of Mental Science," April, 1866), gives the ratio of the cubic capacity of male Australian skulls to European as 85 : 100. Now, the average brain weight of an European, according to Welcker, is 49 ounces, and assuming that the relation between cubic capacity of the skull and brain weight is approximately true, the brain weight of Australians would be 41·6 ounces. It will be seen that this deduction agrees fairly well with the result obtained in the brain under notice by adding 38 per cent. of the actual weight.

[2] Thurnum: *loc. cit.*

Throughout the convolutions this defined condition will be seen, and especially is this the case as regards the occipital lobe. Gratiolet, in his "Mémoire sur les plis cérébraux de l'homme et des Primates," insisted on the importance of the "plis de passage," or annectant gyri, in a differential diagnosis between them, and it was stated that in the Chimpanzee the first and second annectant gyri were depressed below the surface of the cortex, while the third and fourth remained in a superficial position.

Leaving this somewhat disputed point,[1] it is interesting to note in the human cerebral hemispheres under discussion that there is a tendency to depression and suppression of the third and fourth annectant gyri, while the first and second annectant gyri, though small, retain their superficial situation. In the brain of the Bushwoman described by Marshall ("Phil. Trans.," 1864), the annectant gyri were found to be small and single.

The anomalous fissures in the temporo-sphenoidal lobe (more marked on the left side) which tend to cut off the temporo-sphenoidal lobe, or more exactly, the middle and inferior temporo-sphenoidal convolutions from the third and fourth annectant gyri, and in turn to separate the third and fourth annectant gyri (or the cortex representing them) from the occipital lobe, are described in detail in the following pages and figured in Pl. II, figs. 1 and 2.

An anomalous transverse fissure which divides the postero-parietal lobule into an anterior and a posterior part is noteworthy.

Perhaps the most noticeable feature in this brain is the great reduction in size of the cuneate lobule and the great development of the parieto-occipital fissure, which is seen to contain the inner part of the cuneate lobe, and also part of the calcarine fissure. *Vide* Pl. II, figs. 3 and 4.

In the plates of Marshall's "Bushwoman," the cuneus is depicted as decidedly smaller than in an European brain, but bigger than in this brain; in his description of two idiots' brains it is described as being extremely small.

After noting the simplicity of the general arrangement of the convolutions it is interesting to observe that the angular gyrus is the most convoluted part of the hemisphere, and that the uncinate gyrus, another local habitation of special sense, is not only actually bigger in this shrunken brain than in an average European, but has a blind sulcus placed in it. (Figs. 3 and 4.)

[1] *Vide* Turner, "Proc. Royal Soc. Edinburgh," 1865-6. Rolleston, "Nat. Hist. Review," 1861. Article I.

Detailed Summary of both Hemispheres.

Lobes.—Frontal, arrangement simple, tendency to have four longitudinal instead of the usual three frontal gyri is perhaps worth notice. The general absence of secondary gyri is with two other features a primitive condition.

The transverse frontal sulcus is well developed, but does not run into the horizontal limb of the fissure of Sylvius, as is often the case when well developed.

Orbital surface has its gyri simple and the sulci somewhat shallow, but asymmetrical.

Simplicity of orbital surface is characteristic of primitive brains.

The sulcus of Rolando is confluent with the longitudinal fissure.

The island of Reil is exposed on left side, this exposure is a condition found in primitive brains; thus Marshall ("Phil. Trans.," 1864) figures it in the brain of a Bushwoman, and quotes other examples. The exposure of the island of Reil implies that the surrounding gyri are ill-developed, Broca's convolution is thus shown to be defective, a point of interest in an Australian savage whose language is primitive as shown by its unclassified character.

Parietal.—The postero-parietal lobule is divided into (*a*) an anterior; and (*b*) a posterior portion, by a transverse sulcus which starts from the longitudinal fissure, 12 mm. behind the end of the calloso-marginal sulcus, and 25 mm. in front of the external parieto-occipital fissure.

The supra-marginal gyrus is cut off from the ascending parietal gyrus by the confluence of the interparietal sulcus and the horizontal limb of the fissure of Sylvius.

This continuity of the interparietal sulcus and the horizontal limb of the fissure of Sylvius is one of the many examples in this brain of the defined and separated state of the convolutions. The absence of a gyrus crossing the lower end of the interparietal sulcus and joining the ascending parietal and supra-marginal gyri, means less grey matter and therefore a lower potentiality.

A like condition is described by Gratiolet in a Bushwoman, and figured by Marshall on the left side of the Bushwoman's brain described by him ("Phil. Trans.," 1864).

The angular gyrus is the most convoluted part of the hemisphere. In Marshall's "Bushwoman" the angular gyrus was found to be decidedly defective.

Occipital.—The third and fourth annectant gyri, more especially on the left side, have but a slight connection superficially either with the occipital or the temporo-sphenoidal lobes.

The external parieto-occipital fissure is small and bifurcated at its origin. In the Quadrumana this fissure is much more marked, and in human brains it has been seen stretching two inches transversely outwards (Turner, "Convolutions of Human Cerebrum," page 12). It is of interest to note in this primitive brain no approach as regards this point to condition in Quadrumana.

The occipital lobes completely hid from view the cerebellum when the encephalon was viewed from above, at one time this was thought to be an important point in estimating brain power in different types, but it has been shown to be quite destitute of any importance.

Temporo-sphenoidal lobe.—The most notable feature is the presence on both sides of two anomalous transverse sulci, which tend to cut off the middle and inferior temporo-sphenoidal gyri from the third and fourth annectant gyri, and also to limit superficially the connection between the third and fourth annectant gyri on the one hand, and the occipital lobe on the other.

As these anomalous sulci are not entirely symmetrical, it may be as well to describe them briefly.

On the left side the anterior of these two transverse sulci (*a*, *vide* fig. 1, Pl. II) arises from the inferior temporo-sphenoidal sulcus, 7 cm. behind the most anterior extremity of the temporo-sphenoidal lobe, and runs into the parallel sulcus, thus it cuts off the middle and inferior temporo-sphenoidal gyri from their natural continuation, the third and fourth annectant gyri.

The posterior transverse sulcus (*b*, fig. 1) arises from the lateral, 3·4 cm. behind the anterior one, and runs almost into the parallel fissure, thus tending to cut off the superficial connection between the third and fourth annectant gyri and the occipital lobe.

On the right side the anterior of these sulci (*a*, fig. 2) is represented by an oblique limb of the parallel sulcus directed backwards and downwards, which joins the inferior longitudinal sulcus at the point where the posterior transverse sulcus (*b*, fig. 2) arises. This point is 9·5 cm. distant from the most anterior extremity of the temporo-sphenoidal lobe. On both sides the posterior sulcus ends blindly, but it is much smaller on the right side.

Tentorial surface of the temporo-sphenoidal and occipital lobes.—The collateral fissure is asymmetrical.

The calcarine fissure, shallow posteriorly, deepens and first joining the internal parieto-occipital fissure then becomes submerged in it. (*Vide* figs. 3 and 4.)

Depending on the rapid junction of the calcarine and internal parieto-occipital fissures the cuneate lobe is very small.

On opening the continuation of the internal parieto-occipital fissure the cuneate lobe is seen to lie submerged in it.

The fact that the uncinate gyrus was decidedly bigger than normal is noticeable. A blind sulcus ran in the anterior part of the uncinate gyrus from before backwards, and thus divided it into an internal and an external portion. (*Vide x*, in figs. 3 and 4.)

Right Hemisphere.

The greatest horizontal external circumference was 8 inches.

From the point where the sulcus of Rolando opened into the longitudinal fissure to the most anterior extremity of the frontal lobe measured 5 inches, while from the former point to the posterior extremity of the occipital lobe the distance was found to be $3\frac{3}{4}$ inches. These measurements are of importance as they roughly indicate what relation the frontal portion of the brain mass bears to the rest, the more acute the angle formed by the two fissures of Rolando opening into the longitudinal fissure the more highly are the frontal lobes developed, and presumably the higher the potential intellectual powers.

The horizontal limb of the Sylvian fissure was $3\frac{3}{4}$ inches in length, while the ascending limb measured 1 inch in length.

The external parieto-occipital fissure is bifurcated at its origin, both its limbs are three-quarters of an inch in length.

Lobes.—Frontal lobe.—The superior middle and inferior frontal gyri are all continuous anteriorly; the transverse arrangement is well shown. Tendency to be four instead of the usual three longitudinal frontal gyri.

There are no connecting bridges of cortical substance superficially.

The ascending frontal gyrus is joined superficially to the superior and inferior frontal gyri, its junction with the middle frontal gyrus is depressed, being deep in the transverse frontal sulcus.

The transverse frontal sulcus, though well developed, does not open into the horizontal limb of the fissure of Sylvius as it often does when well formed.

Orbital surface, an irregular and not very definite tri-radiate sulcus. The arrangement of the gyri is simple.

Parietal lobe.—The interparietal sulcus opens into the horizontal limb of the fissure of Sylvius (12·5 mm. deep at this point). It is not broken across at its anterior superior border by a bridge of cortical substance as it is on the left side.

The ascending parietal gyrus is connected in the operculum to the ascending frontal gyrus, but is quite cut off from the supra-

marginal gyrus by the junction of the interparietal sulcus with the horizontal limb of the fissure of Sylvius.

The postero-parietal lobule is divided into anterior and posterior portions by a sulcus parallel to and 1 inch in front of the external parieto-occipital sulcus (half an inch behind the end of the calloso-marginal sulcus). This sulcus joins the interparietal sulcus. At the bottom of this anomalous sulcus a small gyrus rising to the surface is visible. The postero-parietal lobule is connected by a bridge to the angular gyrus and by the first annectant gyrus to the superior occipital gyrus.

The supra-marginal gyrus is quite cut off from the ascending parietal gyrus by the interparietal sulcus running into the horizontal limb of the fissure of Sylvius. In common with the angular gyrus it is connected with superior temporo-sphenoidal gyrus.

Angular gyrus is more convoluted than the rest of the hemisphere, it is connected to the posterior portion of the postero-parietal lobule, and to the superior but not the middle temporo-sphenoidal gyri.

The place where the second annectant gyrus would naturally come off is injured, owing to the fact that in the recent state there was a large Pacchionian body there, but it does not look as if there had been one there.

From the angular gyrus an isolated tongue of cortical substance, with sulci 8–12 mm. deep on each side of it, runs forward between (*a*) the connecting gyrus between the superior temporo-sphenoidal and the supra-marginal and angular gyri, and (*b*) the annectant gyri from the middle and inferior temporo-sphenoidal gyri.

Occipital lobe.—The three gyri are distinct.

Of the annectant gyri the first is well developed, as to the second, owing to injury it is doubtful where it ever existed, the third annectant gyrus has no superficial origin from the middle temporo-sphenoidal gyrus. There is no fourth annectant gyrus.

Temporo-sphenoidal lobe.—The parallel sulcus (*vide* fig. 2) bifurcates posteriorly, and thus encloses what represents the third and fourth annectant gyri, the lower limb of the fissure where it crosses the middle temporo-sphenoidal gyrus is very shallow at first, but deepens (12 mm.) as it approaches the lateral boundary where it joins the inferior temporo-sphenoidal sulcus. Across this shallow limb the middle temporo-sphenoidal gyrus is continuous into the third annectant gyrus.

The third annectant gyrus is almost divided into an anterior and posterior portion by a vertical sulcus (*b*, fig. 2) which starts from the inferior temporo-sphenoidal sulcus at the point where the lower obliquely directed limb of the parallel sulcus joins the inferior temporo-sphenoidal sulcus. This vertical sulcus is 12 mm. in length. [Compare its greater development on the left side.]

Under surface of the temporo-sphenoidal and occipital lobes.—Gyri eminently antero-posterior in direction.

Collateral fissure is broken up by an irregular communicating bridge between the uncinate and inferior temporo-occipital gyri. It does not join the calcarine or the internal parieto-occipital fissures.

Calcarine fissure (*c*, fig. 4) arises posteriorly from a shallow bifurcated origin and runs first into and then becomes submerged in the internal parieto-occipital fissure, so that the internal part of the calcarine fissure does not open on the surface, but into the continuation of the internal parieto-occipital fissure.

The cuneate lobe (*d*, fig. 4) is very small owing to the junction of the calcarine and internal parieto-occipital fissures so close to posterior border of the occipital lobe, its greatest breadth is 12 mm. The cuneate lobe is submerged in the continuation of the internal parieto-occipital fissure. The cuneate lobe ends in a submerged tongue which runs across the continuation of internal parieto-occipital sulcus into the præcuneus.

The anterior part of the uncinate gyrus is divided into two portions, internal and external, by a simple blind sulcus (33 mm. long) which runs in an antero-posterior direction. This sulcus is 12 mm. in depth. This sulcus is marked with *x* in fig. 4.

The inferior occipito-temporal gyrus is more convoluted posteriorly than anteriorly, laterally it is well separated off from the inferior temporo-sphenoidal gyrus by the inferior temporo-sphenoidal sulcus.

Left Hemisphere.

The greatest horizontal circumference externally was $8\frac{1}{4}$ inches, while the maximum height was $3\frac{1}{4}$ inches.

Taking a bird's-eye view of the brain it is seen that the anterior extremity of the frontal lobe is $5\frac{1}{2}$ inches in front of the point where the fissure of Rolando runs into the longitudinal fissure, and that this latter point is $3\frac{3}{4}$ inches distant from the posterior extremity of the occipital lobe.

The fissures.—The horizontal limb of the fissure of Sylvius measured $3\frac{3}{4}$ inches in length, while the ascending limb was half an inch in length, and then bifurcated, at its origin a small portion of the insula was visible.

The external parieto-occipital fissure was bifurcated at its origin.

The interparietal sulcus opened into the horizontal limb of the fissure of Sylvius, it is bridged across at its anterior and superior border by a gyrus which joins the postero-parietal lobule.

The parallel sulcus was far from normal, $2\frac{3}{4}$ inches from the anterior extremity of the temporo-sphenoidal lobe it is joined at right angles by a sulcus (*a*, Pl. II, fig. 1) which arises from the inferior temporo-sphenoidal sulcus. The second and third temporo-sphenoidal gyri are thus separated from the third and fourth annectant gyri. [Compare with so-called bifurcation of parallel fissure on right side.]

From this point the parallel fissure is continued posteriorly for 2 inches, it then bifurcates and tends to cut off the occipital lobe from its third and fourth annectant gyri. At the point of bifurcation the sulcus is deep, the limbs, however, are shallow.

The lobes.—Frontal lobe.—The superior middle and inferior frontal gyri are blended superficially at their anterior extremity, their arrangement is otherwise simple. It may be worth while noting that there is a tendency to four instead of usual three longitudinal gyri.

The ascending frontal gyrus is connected to the superior frontal by a large bridge, and to the inferior frontal gyrus by a small bridge, otherwise it is distinct and is not connected to the middle frontal gyrus.

Orbital surface, smoother than on the right side. The tri-radiate sulcus is fairly distinct.

The parietal lobe.—The ascending parietal gyrus is quite isolated except for two small bridges of cortex which connect it, the one to the ascending frontal gyrus, the other to the postero-parietal lobule.

The postero-parietal lobule is joined by a small bridge to the supra-marginal gyrus. Running transversely into the postero-parietal lobule from the longitudinal fissure is seen a sulcus, which is, however, not so well developed as the one on the right side, it does not run into the interparietal sulcus, and hence the postero-parietal lobule is not divided into two separate halves, anterior and posterior, as is the case on the other side.

The first annectant gyrus is small superficially.

The supra-marginal gyrus is cut off from the ascending parietal gyrus by the interparietal sulcus and is joined to the superior temporo-sphenoidal gyrus by a gyrus (half an inch across). As mentioned above, a gyrus breaks across the interparietal sulcus at its anterior superior border to join the postero-parietal lobule.

The angular gyrus is distinct and is better marked off than on the right side.

The second annectant gyrus is distinct.

In common with the supra-marginal, the angular gyrus is connected to the superior temporo-sphenoidal, but not to the middle temporo-sphenoidal gyrus.

The occipital lobe.—The sulci separating the three gyri are distinct.

Of the annectant gyri the first is small while the second is plainly shown, the first annectant gyrus separates the external parieto-occipital fissure from a sulcus (1¼ inches long) directed transversely outwards.

The third and fourth annectant gyri are almost entirely cut off from the occipital lobe by a vertically directed sulcus (*b*, fig. 1), which arises from the inferior temporo-sphenoidal sulcus at the lateral boundary. This sulcus is prevented running into the posterior portion of the parallel sulcus by a narrow bridge of cortical substance, which is the whole superficial part of the third (and fourth ?) annectant gyri.

Temporo-sphenoidal lobe.—The superior temporo-sphenoidal gyrus is continuous with the supra-marginal and angular gyri, at about its centre, the superior temporo-sphenoidal gyrus is cut across by a shallow sulcus which connects the horizontal limb of the fissure of Sylvius and the parallel sulcus described above.

The middle temporo-sphenoidal sulcus, 2¾ inches from the anterior extremity of the temporo-sphenoidal lobe ; this sulcus is cut across by a vertical sulcus running from the parallel sulcus to the inferior tempero-sphenoidal sulcus. This anomalous sulcus cuts off the middle and inferior temporo-sphenoidal gyri from their natural continuations, the third and fourth annectant gyri (*a*, fig. 1).

At a distance of 1½ inches behind this anomalous sulcus there is a vertical sulcus (*b*, fig. 1) (1 inch in length) which almost entirely cuts off the occipital lobe from the third and fourth annectant gyri (*vide* under occipital lobe).

The inferior tempero-sphenoidal sulcus begins in the anterior of these two anomalous vertical sulci and runs in the lateral boundary to the posterior extremity of the brain.

The under surface of the temporo-sphenoidal and occipital lobes.—The arrangement of the gyri is eminently antero-posterior in direction.

The collateral fissure bifurcates posteriorly, the internal limb joins the calcarine fissure.

The calcarine fissure (*c*, fig. 3) is bifurcated at its origin posteriorly, it then runs into the internal parieto-occipital fissure and becomes submerged in the continuation of that fissure. The cuneate lobe is very small, its greatest breadth is a quarter of an inch, it is also submerged for part of its extent in the continuation of the internal parieto-occipital fissure. The calcarine fissure is more submerged on this side than on the right side.

The uncinate gyrus is not very easy of definition posteriorly

owing to the fact that the collateral fissure is rather broken up. The uncinate gyrus is distinctly larger than normal, it measured a quarter of an inch more than that of a well developed European brain.

Anteriorly the uncinate gyrus is divided (as on the right side) into an internal and an external portion by a blind sulcus (marked *x*, fig. 3) directed antero-posteriorly. This sulcus (25 mm. long, 6 mm. deep) is not so big as the corresponding one on the right side.

The inferior temporo-occipital gyrus is well defined laterally by the inferior temporo-sphenoidal sulcus.

Depths of Fissures and Sulci.

The fissures and sulci were measured in several places. The number put down is an average. It may be well to say that the term fissure is reserved for the so-called complete sulci, viz., the Sylvian, parieto-occipital, calcarine, collateral, and hippocampal. All the rest are sulci.

	Right hemisphere.	Left hemisphere.
Fissures:		
Sylvian	16·7 mm.	14·5 mm.
Collateral	9·5	9·4
Calcarine	14·3	12·7
Internal parieto-occipital	17·4	19·0
Hippocampal	7·9	9·5
Sulci:		
Rolando	12·7	12·7
Interparietal	13·7	12·7
Transverse frontal	12·7	13·3
Orbital surface	7·7	4·6
Parallel	16·9	15·8
Middle temporo-sphenoidal	9·5	12·7

Explanation of Plate II.

Fig. 1. Lateral view of left hemisphere of brain of adult male Australian. For explanation of sulci marked *a* and *b* in figs. 1 and 2, see text.

„ 2. Lateral view of posterior portion of right hemisphere of the same brain.

„ 3. Tentorial surface of left hemisphere of the same brain.

„ 4. Tentorial surface of right hemisphere. Reference letters to figs. 3 and 4; *c*, calcarine fissure; *d*, cuneate lobe; *e*, internal parieto-occipital fissure; *x*, an anomalous sulcus described in the text.

[*Reprinted from the Journal of the Anthropological Institute, August,* 1887.]

Harrison and Sons, Printers in Ordinary to Her Majesty, St. Martin's Lane.