THE EXTERNAL CONFIGURATION OF THE CEREBRAL HEMISPHERES OF THE CHIMPANZEE[1]

BY A. EARL WALKER, M.D.[2] AND JOHN F. FULTON, M.D.

From the Laboratory of Physiology, Yale University School of Medicine

IT is essential to know the normal surface markings of the cerebral cortex of experimental animals which are to be employed for study of cortical functions. During the past six years the chimpanzee has been extensively used for study of the frontal lobes (Fulton, 1936). A study by one of us (A. E. W.) of the thalamic projections to the cortex of this anthropoid is also now in progress. It has seemed desirable therefore to describe in some detail the convolutional markings of the chimpanzee, but no attempt will here be made to correlate these external markings with cytoarchitecture.

Individual brains have been observed by several anatomists (Pansch, 1868; Bischoff, 1870; Wernicke, 1876; Chapman, 1879; Hervé, 1888; Müller, 1888; Giacomini, 1889; Beddard, 1895; Benham, 1895; Dwight, 1895; Parker, 1896; Retzius, 1906; Fischer, 1921), but no large series was reported until Mingazzini (1928) in an excellent survey described the topography of some fifteen chimpanzee brains. Several writers have studied the chimpanzee brain in a comparative series (Vrolik, 1841; Pansch, 1868; Hamy, 1872; Bischoff, 1877; Broca, 1888; Cunningham, 1886; Flatau & Jacobsohn, 1899; Zuckerkandl, 1908). Waldeyer (1895) gives a good review of the literature up to 1895. More recently Tilney & Riley (1928) and Ariens Kappers (1929) have made studies on the comparative anatomy of the cortical markings of the primates.

The present survey is based upon a study of seventeen chimpanzee brains, from which twenty-nine hemispheres were available for examination. The majority of the brains had been injected with formalin at autopsy and preserved in 10 per cent formalin. A few were hardened in alcohol. In order to facilitate the examination of the convolutional markings the pia was stripped from the cortex. In some of the brains cortical ablations had been made, thus rendering a portion unsuitable for study, but in many the entire cortex was intact. The majority of the chimpanzees (fifteen) were aged between 3 and 8 years; one was a 2 months old baby, and the other a mature female aged 12. The configuration of the brains of the two animals at the extremes of age did not show abnormal variations. The external configuration of the brain of the baby chimpanzee was but a miniature of that of an adult cerebral hemisphere. The terminology adopted for this paper is that employed by Mingazzini (1928).

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[2] Fellow of the Rockefeller Foundation.

I. PRIMARY FISSURES

The Sylvian fissure and insula. The Sylvian fissure, as in the human cortex, begins on the basal surface of the brain and extends laterally between the temporal and frontal lobes (Pls. I and II). In the human brain the horizontal, ascending and posterior rami may be recognized, but in the chimpanzee brain only the posterior ramus is present. Certain authors, notably Broca (1888) and Hervé (1888), have described an anterior limb, but, as Cunningham points out, the fissure which they observed does not correspond in position with the ascending limb of the Sylvian fissure in man. It cuts the operculum behind the precentral sulcus, while in man the ascending limb always lies well anterior to this sulcus. Moreover, the ascending ramus divides the frontal and orbital opercula in the human brain, while in the chimpanzee these are absent, only the temporal and fronto-parietal opercula being recognizable. In less than 20 per cent of the cases in the present series a small branch called the sulcus opercularis ascended a varying distance into the inferior part of the precentral convolution (Pl. IV, Fig. 1). A small fissure quite similarly placed, but not anastomosing with the Sylvian fissure, is occasionally present, usually when the sulcus opercularis is absent. It is the sulcus subcentralis anterior (Pl. II, Fig. 1).

The posterior branch of the Sylvian fissure extends on the lateral surface of the hemisphere for 4–5 cm., generally ending singly but occasionally bifurcating. Not infrequently a small ramus (the sulcus subcentralis posterior) is given off just behind the central sulcus. This extends superiorly for 1–1·5 cm. Usually no other branches are given off. The fissure is quite deep in its entire extent, measuring 1·5–2 cm. to the bottom.

The insula (Island of Reil, *IR*, Pl. IV, fig. 2 and Pl. V, fig. 1) is that portion of the cortex which is covered by the two opercula—parieto-frontal and temporal. As Cunningham (1886) suggests, it is likely that a portion of the insula, as it exists in man, is equivalent to the inferior part of the precentral convolution of the chimpanzee brain, which, owing to the absence of the frontal opercula, is exposed to view. The sulci and convolutions of the island of Reil are poorly developed (Pl. IV, fig. 2 and Pl. V, fig. 1). The limiting furrow is frequently indistinct anteriorly, although inferiorly it is quite deep. On the surface of the insula usually two more or less distinct sulci can be recognized. The more anterior and superior runs in the plane of the central sulcus, and is hence comparable to the sulcus centralis insulae, the second is on an oblique plane parallel to that of the Sylvian fissure. Hence there are three convolutions on the surface of the insula, a single short gyrus and two long ones. In some brains these are well defined, but in the majority the sulci are poorly developed, and the convolutions but slight ridges.

The central sulcus. This is a constant sulcus dividing the frontal from the parietal lobe (Pls. I and II). Though very deep in the chimpanzee it generally does not reach to the sagittal sulcus. Mingazzini (1928) states that it extends to the medial surface of the hemisphere in only 10 per cent of cases. Its contour is quite irregular, but in most brains two anterior angulations are present, one in the upper portion and a second near its lower end. These angles cause the middle part of the sulcus to have an anterior concavity. The fissure is quite deep, extending beneath the surface of the hemisphere for 1·5–1·8 cm. Toward the lower portion it is more superficial, reaching inward only 1 cm. The lower portion of the sulcus is not interrupted as in the human brain, and usually ends without bifurcating. No branches are given off as a rule, but occasionally near its anterior extremity a rudimentary fissure may extend forward for 5–8 mm.

The parieto-occipital fissure. This is a deep fissure which divides the parietal and occipital lobes both on the lateral and medial surfaces (Pls. I and II). On the lateral surface the sulcus is known as the sulcus parieto-occipitalis externa and on the medial surface as the parieto-occipitalis interna. The medial or internal branch descends to end just posterior to the corpus callosum on the inferior surface of the occipital lobe separated from the calcarine fissure by the gyrus cunei. The external branch extends laterally for 5·5 cm. and not infrequently gives off several branches. In 60 per cent of cases the intraparietal sulcus anastomoses with the external parieto-occipital fissure about 2 cm. from the midline. Beddard (1895) noted that the posterior wall of the external parieto-occipital sulcus is markedly convoluted. These ridges may bridge across the external parieto-occipital fissure, usually obliquely. Three ridges are frequently present, the most superior of which is quite superficial, and the other two deeply embedded in the sulcus. Gratiolet (1850) described these as "plis de passage". Many authors have since commented on them (Turner, 1866; Holl, 1907, 1908 *a*, *b*, *c*; Smith, 1904). When the bridging convolutions are well marked and superficial, the internal and external parieto-occipital fissures may not anastomose at the midline (Pl. III, fig. 1 and Pl. V, fig. 2). Tilney & Riley (1928) infer that this is the usual condition in the chimpanzee brain, but in the present series such superficial bridging convolutions were found in less than a third of the brains.

II. THE FRONTAL LOBE

The frontal lobe consists of the portion of the hemisphere anterior to the central fissure and above the Sylvian fissure. It is divided into three surfaces, a lateral, medial and inferior or orbital.

A. *Orbital* (Pl. IV, fig. 1). On the orbital surface of the brain are several constant sulci, the olfactorius, orbitalis, opercularis and orbito-frontalis. The sulcus olfactorius (Pl. IV, fig. 1, *O*) extends anteriorly along the midline of the orbital surface of the frontal lobe concealed by the olfactory tract. It is always linear and does not branch. The orbital sulci (Pl. IV, fig. 1, *OS*) just lateral to the olfactorius frequently have a Y-shape, or occasionally an irregular H-shape. They may be completely divided into two separate and roughly parallel linear sulci. On the lateral aspect of the frontal lobe are two inconstant fissures, the sulcus orbito-frontalis which runs from the posterior part of the orbital surface laterally along the lateral margin of the frontal lobe, and the sulcus opercularis which is a short sulcus quite inconstant and frequently described as a branch of the Sylvian.

B. *Lateral surface* (Pls. I and II). The lateral surface of the frontal lobe may be divided into the precentral and the frontal convolutions.

The precentral convolution. This gyrus is a large smooth convolution in front of the central sulcus bounded anteriorly by the precentral sulci. Occasionally it is divided by a sulcus cutting across its lower third. It is always larger than the postcentral convolution and always wider at its superior extremity than in the opercular region. It may be much better developed on one side than on the other.

Precentral sulci. The precentral sulci (Pl. I, fig. 2 and Pl. II, fig. 1, *PS*) con sist of two fissures, a superior and an inferior. The superior, usually short, parallels the upper part of the central sulcus and anastomoses in many cases with the posterior end of the superior frontal sulcus. It is undoubtedly homologous with the superior precentral sulcus of the macaque monkey. The inferior precentral sulcus (Pl. II, fig. 2, right, *PRI*) is very variable, being usually longer than the superior and running in a more horizontal plane. Usually it gives off from its middle the inferior frontal sulcus.

Frontal sulci (Pl. II, figs. 1, 2 and Pl. III, fig. 1). In general the more rostral sulci of the frontal lobe are roughly parallel and run anteriorly as in the human brain, and they may be readily homologized with the latter. As just mentioned, the superior frontal sulcus (Pl. II, fig. 2, right, *IF*) frequently takes origin from the superior precentral. Rarely does it extend to the frontal pole unbroken, usually bifurcating and ending 2–3 cm. in front of its origin, from in front of which an irregular sulcus extends towards the frontal pole. Not infrequently the sulcus is broken by transverse fissures. Its contours being quite irregular. The inferior frontal sulcus (Pl. II, figs. 1, 2 and Pl. I, fig. 2, *IF*) is often derived from the middle part of the inferior precentral sulcus and extends rostrally for a variable distance. It usually does not anastomose with the fronto-marginal sulcus, but runs above it almost to the tip of the frontal pole. The fronto-marginal sulcus is quite variable. It extends along the inferior border of the lateral surface to the frontal pole. Occasionally it is divided into two segments—a medial and a lateral.

The frontal gyri. As in the human brain the gyri of the frontal lobe may be divided into the superior, middle and inferior by the superior and inferior frontal sulci respectively (Pl. II). The superior frontal gyrus lies above the superior frontal sulcus, and not infrequently is derived by two roots—one from the superior part of the precentral gyrus and the second from below the superior precentral fissure. The convolution occasionally has irregular tertiary sulci. The middle frontal gyrus is bounded by the superior and inferior frontal sulci and generally is derived from one root from the precentral convolution near its upper third. It has occasional irregular tertiary sulci. The inferior frontal gyrus is divided into two parts, a posterior, pars opercularis, and an anterior, pars triangularis. The former is bounded by the sulcus opercularis posteriorly and the inferior precentral sulcus superiorly and anteriorly. It has a root from the inferior end of the precentral sulcus, and passes over anteriorly into the pars triangularis. This is a curved convolution surrounding the end of the fronto-orbital sulcus. These divisions are not constant and the opercular part may be entirely absent.

III. THE PARIETAL LOBES

The parietal lobe is bounded by the central fissure anteriorly, the parieto-occipital fissure posteriorly and the Sylvian fissure and its arbitrary posterior extension inferiorly. The lobe is divided by the postcentral and intraparietal sulci (Pls. I and II).

Postcentral sulcus. This is a deep fissure running parallel to the central sulcus from a point 6–8 mm. lateral to the interhemispheral fissure. It ends by bifurcating just above the Sylvian fissure, the anterior passing forward, and the posterior inferiorly.

In more than half the cases this is a single undivided fissure, but in the remainder the sulcus is split near the inferior third. When the sulcus is undivided the intraparietal fissure generally joins it near its middle; if divided, the intraparietal fissure joins with its inferior portion, only very rarely with the superior part.

Intraparietal sulcus. This fissure divides the parietal lobe into two parts, a superior and inferior parietal lobule. As mentioned above, it anastomoses with the middle of the postcentral fissure when the latter is single, and with the inferior postcentral sulcus when it is divided. It runs posteriorly, more or less parallel to the midline, to bifurcate near the parieto-occipital fissure, the upper branch ending singly near the latter fissure and the lower descending frequently to anastomose with the first temporal sulcus.

Postcentral convolution. This convolution is frequently poorly developed, and always much smaller than the precentral. In the inferior part the sulcus subcentralis posterior may divide off a gyrus subcentralis posterior.

Superior parietal lobule. This quadrilateral cortex bordered by the postcentral sulcus, the parieto-occipital and the intraparietal sulci varies greatly in shape and size even on the two sides. There may be one irregular, generally sagittal fissure in this lobule, the superior parietal sulcus of Retzius. It may join the postcentral fissure or the marginal branch of the calloso-marginal sulcus. The latter passes from the medial on to the lateral surface of the hemisphere just posterior to the postcentral fissure. Rarely there are other tertiary sulci in this lobule.

Inferior parietal lobule. The inferior parietal lobule is composed of two parts, the supramarginal gyrus which surrounds the Sylvian fissure and the angular gyrus about the termination of the first temporal fissure.

Supramarginal gyrus (Pl. II, fig. 2, *SM*). This gyrus has many variations. It usually receives an anterior root from the lower part of the postcentral convolution and ascends about the posterior extremity of the Sylvian fissure to the posterior part of the first temporal convolution. Its shape and size vary greatly not only in different animals but in the two hemispheres of the same animal. It rarely has tertiary fissures.

Angular gyrus (Pl. II, fig. 2, *A*). This cortex swings around the anterior end of the first temporal fissure. It lies between the intraparietal and parieto-occipital fissures. Its shape and size are quite variable.

IV. THE TEMPORAL LOBE

The temporal lobe lies inferior to the Sylvian fissure and anterior to the arbitrary continuation of the parieto-occipital fissure on the lateral surface of the hemisphere. It contains four sulci and five convolutions (Pls. I and II).

Temporal sulci. The superior temporal sulcus runs from the temporal pole parallel to the Sylvian fissure at the posterior extremity of which it turns vertically upward to end in the supramarginal gyrus in two branches. These end in the angle between the intraparietal and parieto-occipital fissures. It may anastomose with the intraparietal, parieto-occipital, or the Sylvian fissure. The middle temporal sulcus rarely runs an unbroken course from the temporal pole to the parieto-occipital fissure. It usually consists of two or three separate and irregular small fissures, thus only incompletely dividing the middle and inferior temporal gyri. The second or middle temporal sulcus is frequently related to the sulcus occipitalis inferior, a small vertical temporal gyrus. The second or middle temporal sulcus is frequently related to the sulcus occipitalis inferior, a small vertical fissure just anterior to the lower part of the parieto-occipital sulcus. When the middle temporal sulcus extends to the parieto-occipital fissure the inferior occipital is generally absent, but when the first is rudimentary the latter is well developed. The basal occipito-temporal sulci consist of the collateral sulcus and the more lateral inferior temporal or sulcus occipito-temporalis lateralis. Although earlier writers did not differentiate these sulci, Mingazzini (1928) believes that they should be distinguished. The inferior temporal is quite short and the collateral is long (Pl. III, fig. 1).

Temporal gyri. The superior temporal gyrus is a well-defined convolution lying between the Sylvian fissure and the superior temporal sulcus. On its upper surface posterior to the inferior end of the central sulcus are frequently seen one or two transverse elevations which represent the transverse temporal gyri. These may be traced to the depth of the limiting fissure of the insula (Pl. IV, fig. 2 and Pl. V, fig. 1). In two-thirds of Mingazzini's (1928) cases there were two gyri, the posterior one being the most frequently absent. Holl (1908 *b*) has noted similarly placed elevations in lower primates even in the macaque brain—a fact which is of great significance. The middle temporal gyrus is usually well differentiated although its lower margin may not be well defined owing to the division of the middle temporal sulci into several distinct fissures. The posterior part of the middle temporal gyrus is frequently divided into two roots the one going to the angular gyrus and the lower to the proximal part of the occipital lobe. The inferior temporal gyrus is poorly defined and quite variable. The occipito-temporal gyri are not well defined. The lobulus fusiformis lies between the inferior temporal and the collateral fissures, and the lobulus lingualis between the collateral and hippocampal fissures. The divisions between these are however frequently indefinite.

The rhinal fissure is readily recognized at the medial angle of the temporal lobe where it borders the hippocampal gyrus. It runs anteriorly into the Sylvian fissure.

V. THE OCCIPITAL LOBE

The occipital lobe is bounded anteriorly by the parieto-occipital fissure. It presents three surfaces, a lateral, medial and inferior. The lateral surface is relatively small as compared to the lateral surfaces of the other lobes of the cerebrum.

Sulcus occipitalis diagonalis. The lateral surface presents only one constant sulcus, the sulcus occipitalis diagonalis, which may begin at the occipital pole but frequently starts considerably in front of this point and runs obliquely forward. Its shape is quite variable; usually it is somewhat curved with its concavity medial, but it may be straight. In a considerable number of cases a branch runs mesially from its middle. Tertiary sulci are common.

Precuneus. This is bounded anteriorly by the incisura cinguli and posteriorly by the sulcus parieto-occipitalis interna. Its size is quite variable. The sulcus subparietalis is a quite constant fissure which runs ventrally from the posterior part of the cingular gyrus. Occasionally a sulcus runs vertically upward almost parallel to the internal parieto-occipital. This is known as the sulcus precunei.

Cuneus. As in the human brain this is bounded by the internal parieto-occipital and calcarine fissures. Owing to an internal bridging convolution, the gyrus cunei, these sulci rarely anastomose as they do in the human brain. This fact has been mentioned by many authors (Mingazzini, 1928; Chapman, 1879; Cunningham, 1886).

The calcarine fissure. This is a constant fissure on the inferior surface of the occipital lobe extending from a point about 1 cm. lateral to the midline beneath the splenium of the corpus callosum to the occipital pole. It reaches the lateral surface of the hemisphere and ends by bifurcating, one limb passing anteriorly and the other posteriorly. Occasionally it ends singly. Infrequently small branches are given off but usually it is linear. This fissure is quite deep, reaching inward for 1·5–2 cm.

VI. THE MEDIAL SURFACE OF THE BRAIN (EXCLUSIVE OF OCCIPITAL LOBE)

Sulcus calloso-marginalis. The medial surface of the brain presents several sulci but the most constant is the sulcus calloso-marginalis (Pl. III, figs. 1 and 2). This takes its origin just anterior to the genu of the corpus callosum, and ascending to its superior surface runs parallel to it, occasionally sending small branches to the neighbouring gyri. It ends posteriorly generally by bifurcating, one branch (incisura cinguli) ascending to the lateral surface of the hemisphere at the level of the splenium of the corpus callosum and the second branch (sulcus subparietalis) continuing posteriorly for a varying distance. Mingazzini (1928) considers that the size of the precuneus depends to some extent at least on the length of this posterior branch. Occasionally the calloso-marginal fissure is broken into two distinct sulci, the anterior one usually being the smaller.

On the medial surface of the brain anterior to the rostrum of the corpus callosum are several small more or less horizontal sulci, the sulci rostrales. Frequently there are two, being designated as dorsal and ventral. The callosal sulcus as in the human lies immediately above the corpus callosum, and rarely has branches passing to the gyrus cinguli.

Medial gyri. The gyrus fronto-parietalis medialis lies above the calloso-marginal sulcus. It is often divided by transverse sulci running from the calloso-marginal fissure. Frequently there is a sulcus passing upward—the para-rolandic—which marks the posterior limit of the paracentral lobule. The gyrus cinguli lies between the sulcus callosus and calloso-marginalis. Owing to the variations in the posterior limb the posterior portion of the calloso-marginal sulcus is quite variable.

DISCUSSION

From the foregoing description it is evident that the convolutional markings of the chimpanzee brain are quite variable. These variations are not only seen in different brains but the two hemispheres of the same brain differ greatly (Pl. II, fig. 2). While these variations are most pronounced in the secondary sulci, even the primary fissures are not constant. In most mammals and in the monkeys (excluding baboons) the cortical markings tend to be quite constant in the same species.

Certain homologies in the brain of monkeys, anthropoids and man are readily apparent. The central sulcus is a constant feature of monkey, baboon, chimpanzee, orang, gorilla and man. Likewise the Sylvian fissure is readily recognized in these animals. In the monkeys the Sylvian fissure anastomoses with the first temporal, so that the supramarginal and angular gyri are poorly developed in these species. The parieto-occipital fissure is readily recognized in the anthropoids and man and in the lower primates it is represented by the simian sulcus (Smith, 1904). The bridging convolutions are much better developed and more superficial in the orang brain and in the human brain than in the chimpanzee, so that the internal and external parieto-occipital fissures are interrupted at the midline. In the one gorilla brain at our disposal the first bridging convolution was submerged, thus conforming to the type seen in the chimpanzee.

The fissures of the frontal lobe of the chimpanzee find ready homologies in man, but less well-defined analogous structures are present in the monkeys. The superior precentral sulcus is but a small indentation in the superior portion of the precentral convolution in the macaque monkey. Even in the baboon, although better developed, it is still small; in the gibbon it is much larger. The inferior precentral sulcus in the lower primates is well developed. The frontal sulci and gyri are similar in the anthropoids and man, varying mainly in the complexity of the convolutions as the result of tertiary fissures. In the lower primates the superior frontal sulcus, like the superior precentral, is quite small, but becomes progressively larger as the phylogenetic scale is ascended.

The markings of the parietal lobe of the chimpanzee, orang and gorilla are quite comparable; in man this region is more complex. In the anthropoids the development of the supramarginal and angular gyri is out of all proportion to that of the superior parietal convolutions. In the monkeys the configuration of the parietal lobe is very simple, and it is difficult to be certain of the homologies. The intraparietal fissure of the macaque monkey probably represents both the inferior postcentral and the intraparietal sulci.

The markings of the temporal lobe are much more uniform in the various species than those of the parietal lobe, and the homologies present little difficulty. The occipital lobe, in particular the lateral surface, differs markedly in the anthropoids from that in the monkeys. Owing to the enormous development of the angular and supramarginal gyri, the striate cortex is pushed on to the medial surface of the hemisphere. In man the calcarine fissure and striate cortex reach to the lateral surface of the occipital lobe; in anthropoid brains small amount of striate cortex is present on the lateral surface. For this reason it is evident that the greater part of the lateral surface of the occipital lobe in the anthropoid and man has no homology in the lower primates (Smith, 1904). In the anthropoids the calcarine and parieto-occipital sulci do not usually anastomose, an internal bridging convolution, the gyrus cuneus, intervening. In man this gyrus is submerged in the calcarine sulcus, and the two fissures join. Except for this difference the relations of the cuneus and precuneus in the anthropoids and man are comparable.

The markings on the medial surface of the hemisphere are readily homologized in the anthropoids and man and require no special comment.

SUMMARY

1. A detailed description of the external configuration of the cerebral hemispheres of the chimpanzee is presented.
2. The homologies of these in man, anthropoids and monkeys are discussed.

ABBREVIATIONS

The following abbreviations have been used in the illustrations:

A	Gyrus angularis.	*PC*	Gyrus precentralis.
C	Sulcus centralis.	*PCC*	Gyrus postcentralis.
CF	Sulcus calcarinae.	*PCI*	Gyrus postcentralis inferior.
CI	Sulcus cinguli.	*PCS*	Sulcus postcentralis superior.
CO	Sulcus collateralis.	*PE*	Sulcus parieto-occipitalis externus.
FM	Sulcus fronto-marginalis.	*PI*	Sulcus parieto-occipitalis internus.
FPM	Gyrus fronto-parietalis medialis.	*PR*	Lobulus precunei.
F 1	Gyrus frontalis superior.	*PRI*	Sulcus precentralis inferior.
F 2	Gyrus frontalis medianus.	*PS*	Sulcus precentralis superior.
F 3	Gyrus frontalis inferior.	*R*	Sulcus rhinalis.
GC	Gyrus cinguli.	*S*	Sulcus Sylvii.
H	Gyrus hippocampi.	*SA*	Sulcus subcentralis anterior.
I	Sulcus intraparietalis.	*SC*	Sulcus calloso-marginalis.
IF	Sulcus frontalis inferior.	*SCU*	Sulcus cunei.
IT	Sulcus occipito-temporalis.	*SF*	Sulcus frontalis superior.
L	Lobulus paracentralis.	*SM*	Gyrus supramarginalis.
LP	Lobulus paracentralis.	*SP*	Lobulus parietalis superior.
MT	Sulcus temporalis medianus.	*SPR*	Sulcus subprecunealis.
O	Sulcus olfactorius.	*SR*	Sulcus rostralis.
OD	Sulcus occipitalis diagonalis.	*SRV*	Sulcus rostralis ventralis.
OF	Sulcus orbito-frontalis.	*SRD*	Sulcus rostralis dorsalis.
OI	Sulcus occipitalis inferior.	*SSC*	Sulcus subcalcarinae.
OP	Sulcus opercularis.	*ST*	Sulcus temporalis superior.
OS	Sulcus orbitalis.	*TT*	Gyrus temporalis transversus superior.
PA	Sulcus calloso-marginalis, pars ascendens.		

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EXPLANATION OF PLATES I–V

PLATE I

Fig. 1. Lateral surface of the right hemisphere of chimpanzee Edith.

Fig. 2. Lateral surface of the right hemisphere of chimpanzee Pau.

PLATE II

Fig. 1. Lateral surface of the right hemisphere of chimpanzee Josephine.

Fig. 2. Lateral surfaces of both hemispheres of chimpanzee Bonzo. Note the differences in cortical markings in the two hemispheres.

Plate III

Fig. 1. Medial surface of the right hemisphere of chimpanzee Song.

Fig. 2. Medial surfaces of both hemispheres of chimpanzee Bonzo. The variation in the cortical markings of the two hemispheres is apparent.

Plate IV

Fig. 1. Inferior surfaces of both hemispheres of chimpanzee Bonzo.

Fig. 2. To show the insula and transverse temporal convolutions of the right hemisphere of chimpanzee Bonzo.

Plate V

Fig. 1. To show the insula and transverse temporal convolutions. Right, chimpanzee Sis, left hemisphere; left, chimpanzee Josephine, left hemisphere.

Fig. 2. To show the bridging convolutions. Chimpanzee Sis, right and left occipital regions.

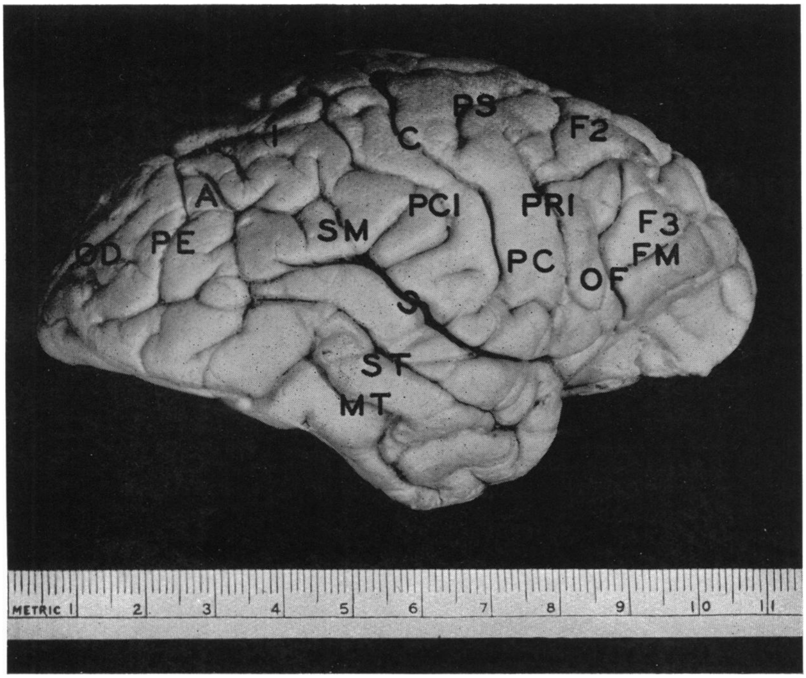
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Fig. 1.

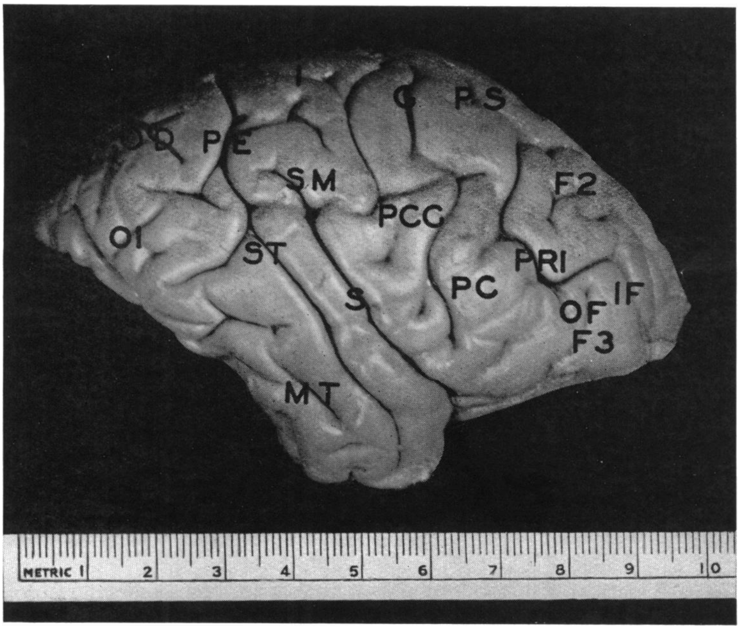
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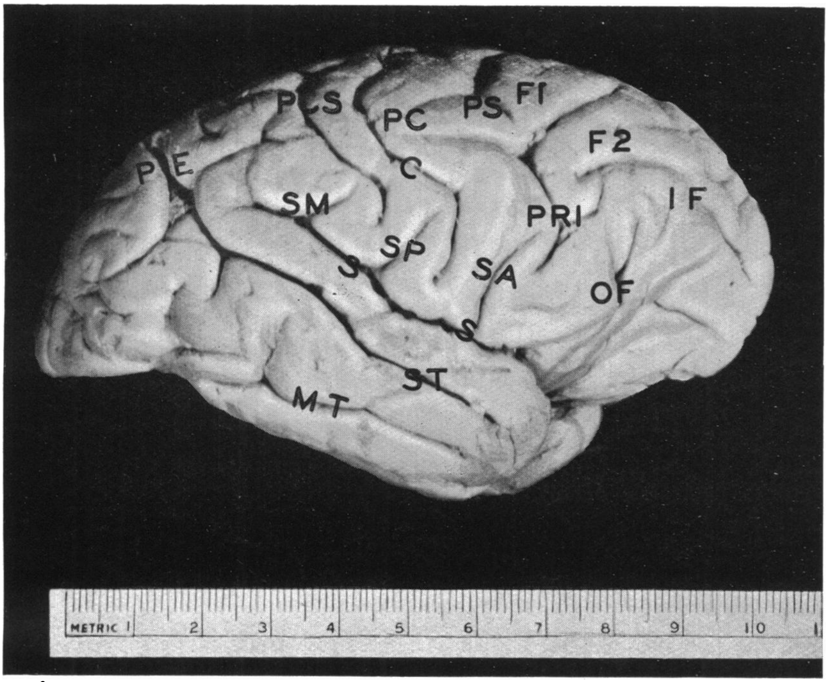
Fig. 2.



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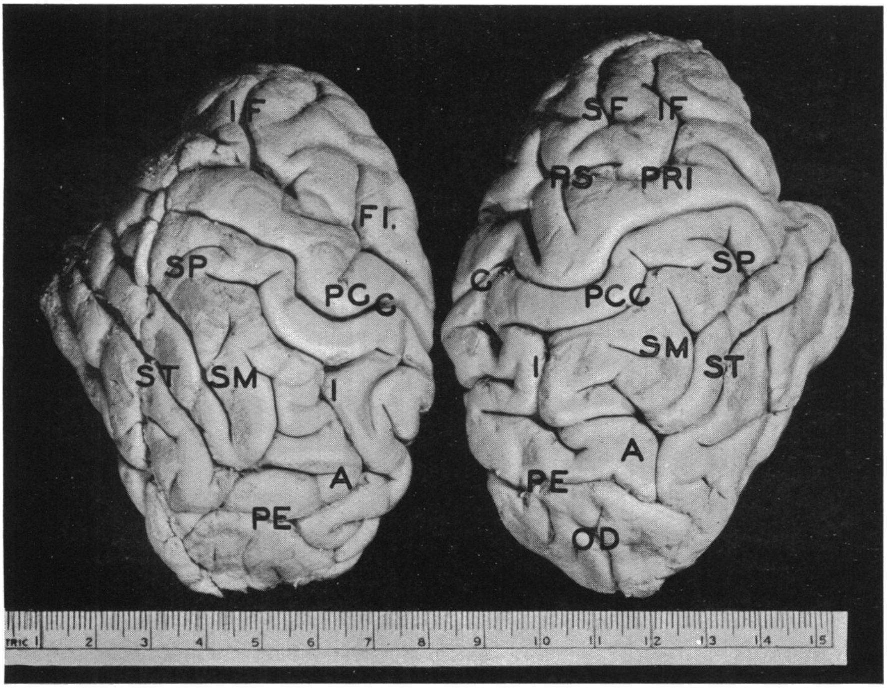
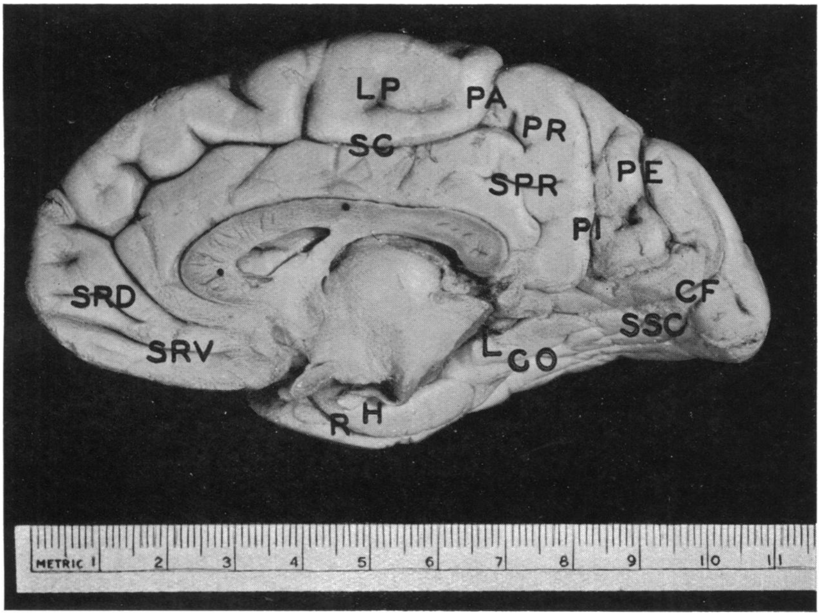


Fig. 2.

WALKER AND FULTON—CEREBRAL HEMISPHERES OF THE CHIMPANZEE



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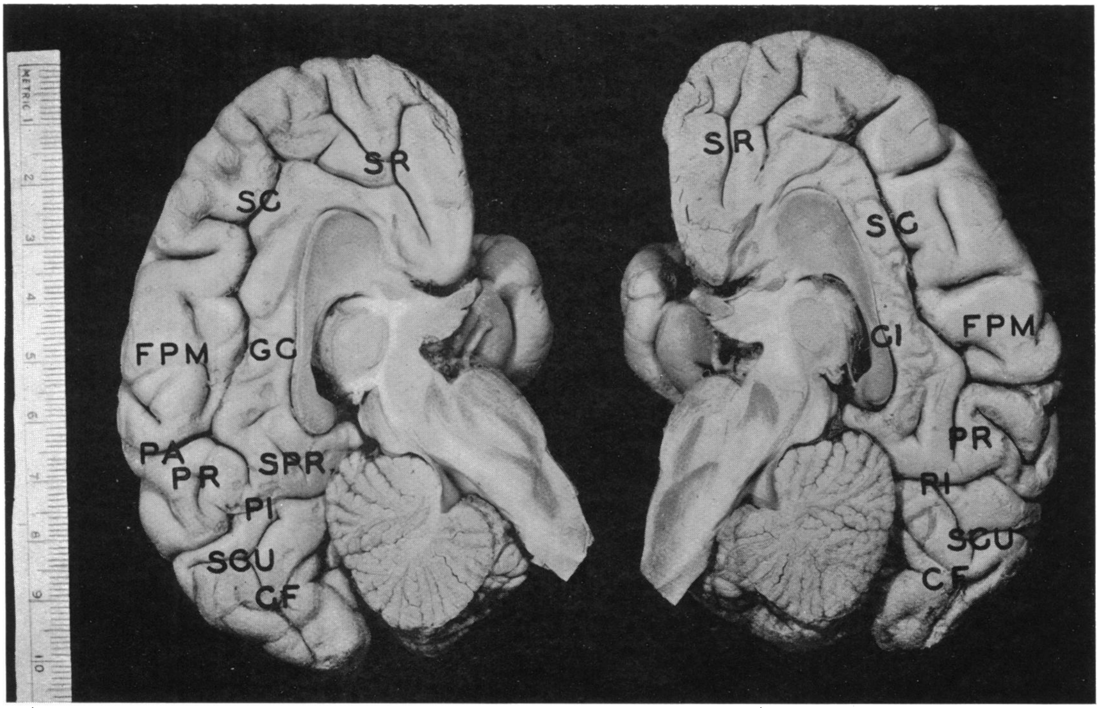
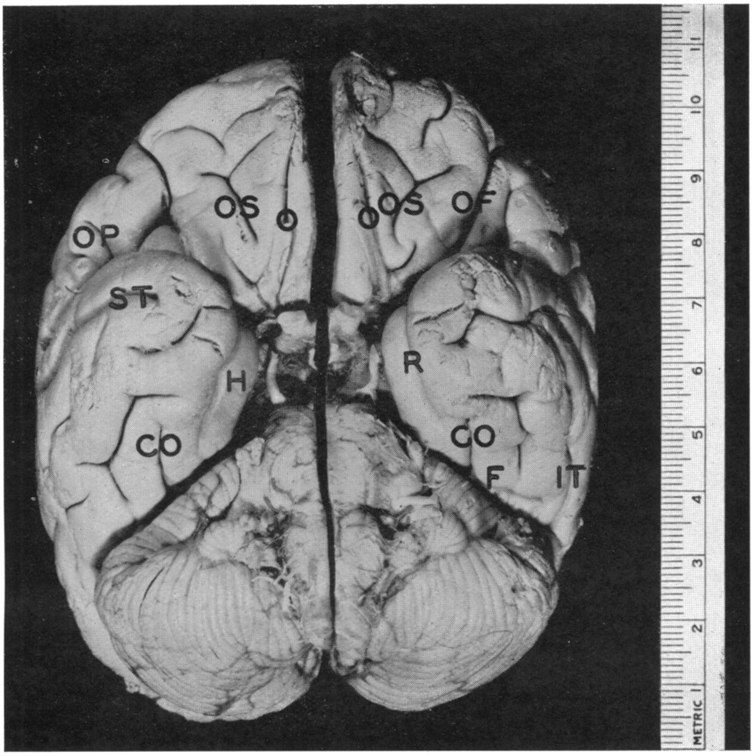


Fig. 2.

WALKER AND FULTON—CEREBRAL HEMISPHERES OF THE CHIMPANZEE



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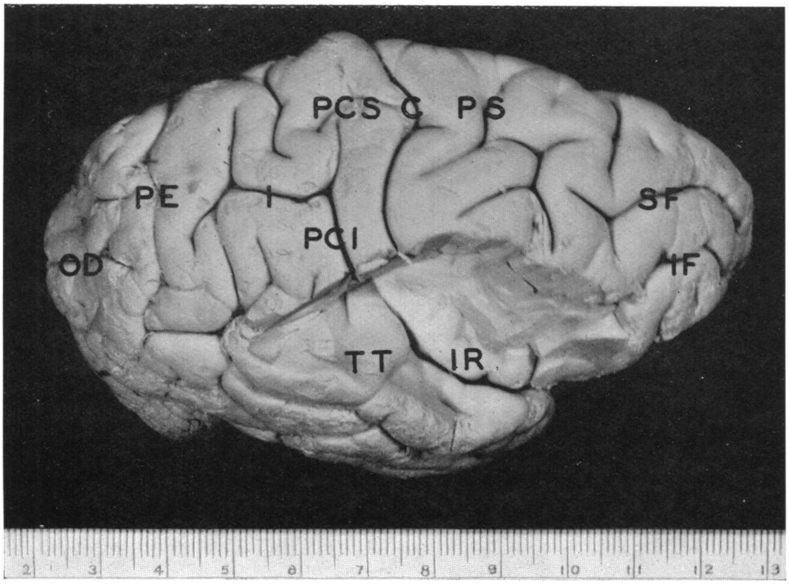

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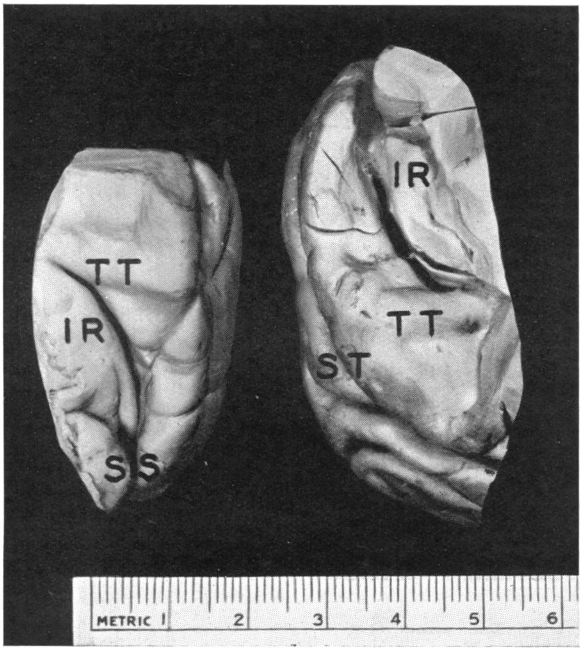
WALKER AND FULTON—CEREBRAL HEMISPHERES OF THE CHIMPANZEE



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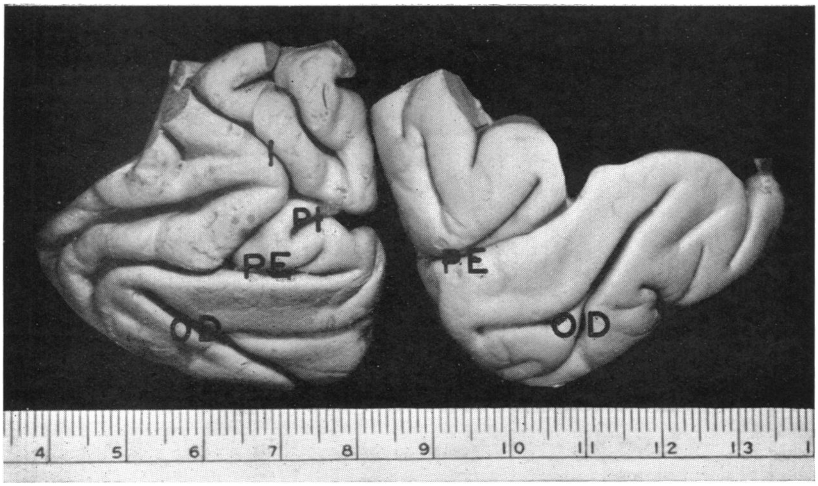

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WALKER AND FULTON—CEREBRAL HEMISPHERES OF THE CHIMPANZEE