RESULTS OF RESEARCHES ON 18 BRAINS OF BATTAKS

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BY

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The anthropological conceptions of the various authors concerning the Battaks may differ ever so much, yet the literature gives the impression that among the other inhabitants of the Dutch archipelago they more or less show a type of their own. The greatest independence has probably been attributed to them by JUNGHUHN (1874) [1], who speaks of "the race of the Battaks", which in addition to the negrito- and Malay race inhabits the archipelago. LESSON (1880) [1] regarded them as descendants of the Polynesians.

Most other authors describe the Battaks as an Indonesian people (primitive Malays, protomalays), which of old maintained its position, according to some without, according to others with more or less admixture. The SARASINS [1] and HAMY (1896) deny admixture. HAGEN (1890) thinks that it is only of recent date and has to be ascribed to Chinese settlements. The primitive Malays may have come to Sumatra after the Negritoes and Weddas (KLEIWEG DE ZWAAN, 1925); it is probably to their mixture with Wedda elements that the Battaks owe their origin. This is also the opinion of VOLZ (1909) [1] and TEN KATE (1918) [1].

It must be Wedda influence then, which occasions the frequent dolichocephaly among the Battaks (skull index after the SARASINS for Wedda men 71.6, for women 71.2). In the article by HAMY 78.7 (cranial index 76) is found for the average cephalic index of the Battaks, in that of HAGEN 80.6.

VOLZ (1900) distinguishes a subdolichocephalic and a brachycephalic type among the Battaks. Dr. H. J. T. BIJLMER, who measured 32 Battak soldiers, was so kind as to put at my disposal the graphic representation (fig. 1) relating to it, which reproduces the result of his researches in

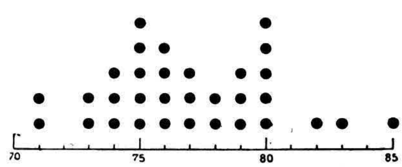

Fig. 1.

a more satisfactory manner than the mere mentioning of the average cephalic index would do.

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[1]) Quoted from KLEIWEG DE ZWAAN (1925).

Fifteen brains of Karo- and three of Toba-Battaks [1]), all collected by Dr. J. H. DE HAAS (now at Batavia) and partly received by the mediation of Professor DE BURLET, were available for research. The state of preservation was so excellent that all objects were fit for use in tracing the characteristics of the fissuration, and only three of the Karo-brains had to be excluded from the measurements. The collection may be considered sufficiently homogeneous for a collective description of the Karo-material. The three Toba-brains, owing to their small number, lend themselves to a separate discussion.

The averages of the indices and angle-measurements [2]) of the Karo-Battaks have been summarized in the following table by the side of averages of Dutch; the absolute measurements for length and breadt do not give rise to remarks.

	Karo-Battaks. Number of measured objects between brackets.	Dutch. Number of measured objects between brackets.	Difference.
Length-breadth index [3])	81.84 ± 1.32 (12)	82.19 ± 0.55 (42)	
Callosum index	0.392 ± 0.00958 (12)	0.302 ± 0.00796 (27)	0.090 ± 0.0126
Stem angle	115° ± 2°.67 (11)	105°.3 ± 1°.13 (27)	10° ± 2°.9
General height index	0.494 ± 0.007 (12)	0.464 ± 0.00585 (42)	0.030 ± 0.00912
Occipital index	0.981 ± 0.0442 (12)	1.029 ± 0.0281 (42)	
Temporal depth index	0.158 ± 0.0067 (12)	0.144 ± 0.00312 (42)	
Temporal length index	0.731 ± 0.0051 (12)	0.751 ± 0.00259 (41)	0.020 ± 0.00572
Frontal height index	0.481 ± 0.00625 (12)	0.448 ± 0.00562 (42)	0.033 ± 0.00845
Frontal length index	0.382 ± 0.00505 (12)	0.364 ± 0.00326 (42)	0.018 ± 0.00601
Rolandic angle	64°.6 (12)	54°.8 [4])	
Sylvian angle	28°.625 (12)	24°.5 [4])	
Parieto-occipital angle	58°.06 (12)	49° [5])	

The length-breadth index, the occipital index, and the temporal depth

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[1]) In the anthropological literature which has been consulted Karo- and Toba-Battaks were hardly ever distinguished. HAGEN's measurements chiefly refer to Tobas, VOLZ's data concern Karos; the latter author states that the colour of the skin of the Tobas is slightly darker and that on the whole the differences between the various tribes are very inconsiderable.

[2]) KAPPERS (1929).

The standard error has been calculated from the formula $E_A = \frac{\sigma}{\sqrt{n}}$. The measurements have been carried out directly on the brain (VAN BORK—FELTKAMP, 1933).

[3]) The length-breadth index of brains is higher than the cranial index. KEENAN (1934) compared indices of brains preserved in the skulls to the indices of the skulls from which they were taken and found an average difference of 1.3, if he measured the length on the left hemisphere (which is generally the longest). For the Battaks the greatest length of the cerebrum as a whole has been taken.

[4]) KAPPERS' average for mesocephalic Dutch.

[5]) KAPPERS' average for brachycephalic Dutch.

index do not yield values for the differences of sufficient importance with regard to the standard error to warrant a conclusion.

The callosum index attains a considerable height, even exceeding the value of the Chinese index (0.373 ± 0.00648)[1]. If, however, the form of the callosum in Battaks (fig. 2) is compared to that of Chinese, it appears that the high figure for the Chinese is connected with the strong curvature of the callosum and for the Battaks essentially with the deep

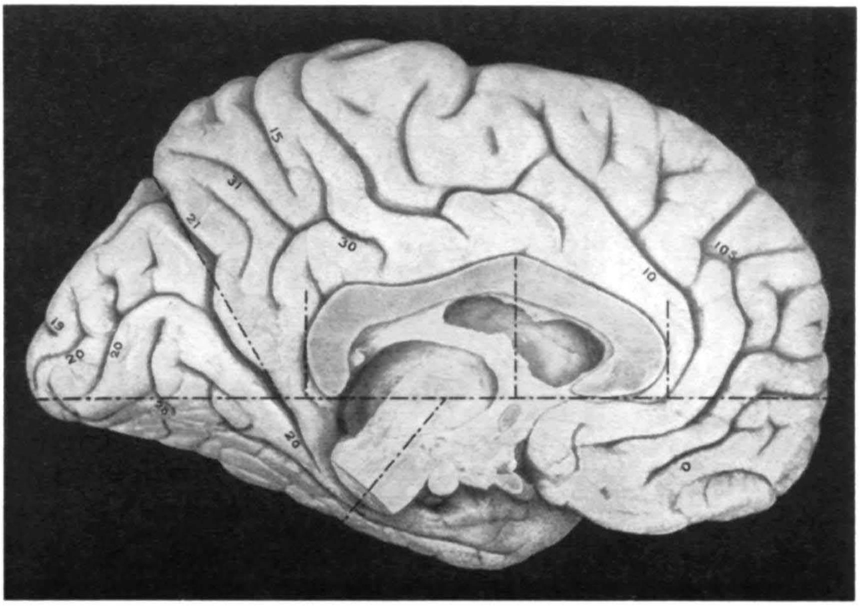

Fig. 2. Brain. 928. The cerebellum has been removed after taking the mesial measurements.

pendulous splenium. To this peculiarity it has to be ascribed that, in spite of the very high callosum index (0.392 ± 0.00958), the indices for the general and frontal height of the Battaks exceed the Dutch indices to a less extent than those of the Chinese do.

The high values of the stem angle and the parieto-occipital angle of the Battaks may be explained by the deep situation of the lower border of the splenium corporis callosi, which causes the basal callosum line to slope backwards.

The Sylvian and Rolandic angles not being delineated in a flat plane, this observation is carried out less accurately, and usually fairly different values are found. In this connection the slight difference between the Battaks and the Dutch for the Sylvian angle induces us to be careful in drawing a conclusion. It is different with the Rolandic angle, for which not only the difference is larger (9.8) but whose values for the Battaks

[1]) VAN BORK—FELTKAMP, o.c., where also may be found the distinction between Chinese A and B, who will be discussed later on in this article.

vary only from 60 ° to 68 °. From this it follows that the sulcus centralis forms a relatively large angle with the lateral horizontal (fig. 3).

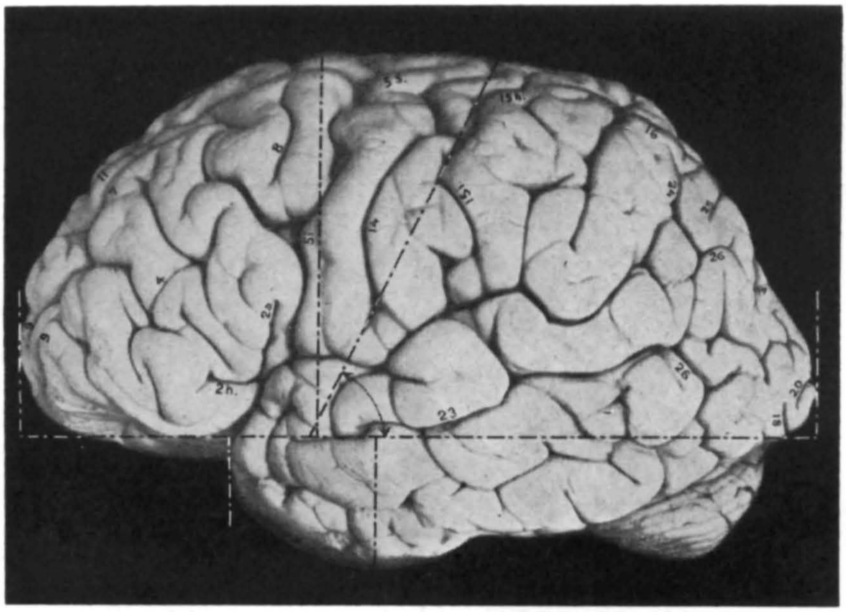

Fig. 3. Brain 924 with lateral horizontal, frontal perpendicular, insular perpendicular, chiasma perpendicular, temporal perpendicular and occipital perpendicular. The Rolandic angle is indicated.

The comparative shortness of the temporal lobe, which may be derived from the low index of the Battaks, will afterwards be discussed more in detail.

The high value of the frontal length index seems to be a phenomenon by itself; it is in direct proportion to the distance from the recessus praeopticus to the frontal pole. It is possible that the chiasm is shifted slightly backwards, owing to the large stem angle, while the outline of the mesial wall is strongly arched frontally (fig. 3), which causes the line along the frontal pole to fall rather far to the front.

The indices and angle-measurements consequently characterize the Battak cerebrum as rather high, particularly frontally, with a splenium lying deep with respect to the frontal region, a short temporal lobe and a frontal lobe of great median dimension. The general shape, however, still has a number of characteristics, which do not become apparent upon examination by means of measurements.

Fig. 4 shows that the greatest breadth lies caudal to the centre. The contour from this point to the occipital pole forms a faintly convex line; to the front the contour of the parietofrontal lobe[1]) forms a concave linie. The narrowest part of the frontal lobe is about situated at the place of the

[1]) In the picture the outline of this lobe succeeded better on the left than on the right.

s. praecentralis. From here till far to the front the contour runs nearly or wholly parallel to the median line. This makes the frontal pole blunt, the more so as the mediolateral dimension of the frontal lobe is fairly great. In the figure the left temporal lobe is seen protruding from the hollow in the outline of the frontal lobe.

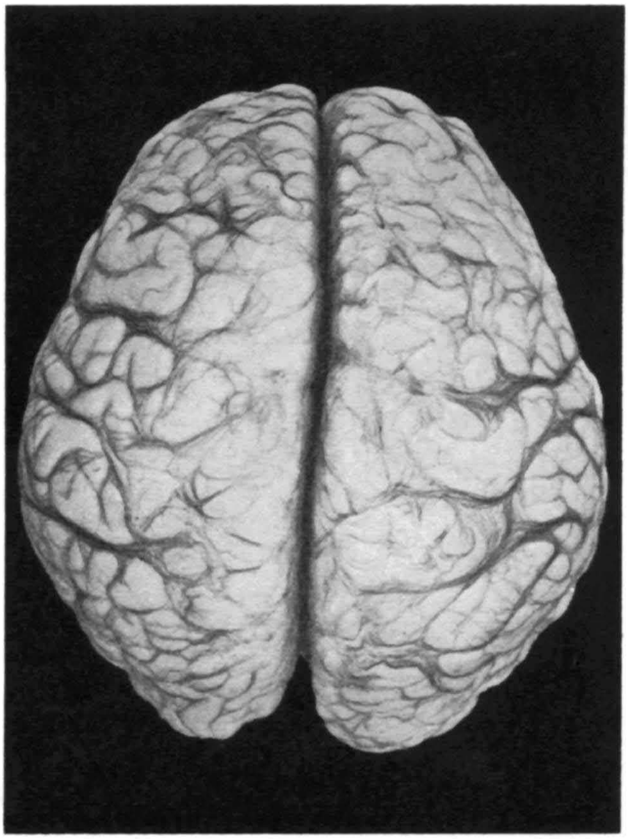

Fig. 4. Brain 924.

The facies orbitalis has no actual rostrum, but as a whole forms an inclined, slightly hollow plane (fig. 5); the bluntness of the frontal pole may be perceived here as well; medially the frontocaudal dimension is great, since the frontal lobe continues far under the knee of the callosum (fig. 2). Where the frontal margin becomes merged in the lateral outline the protuberantia gyri frontalis inferioris of SCHWALBE [1]) is to be seen on the cerebrum as an exceedingly prominent part [2]); without the temporal poles being bent particularly towards each other, the frontal lobe, owing to its own breadth, protrudes far beyond them. The anterior part of the

[1]) Cf. the description of this part of the brain under the name of cap of ANTHONY by KEITH (1927).

[2]) VOLZ (1900) describes the forehead of the Battaks as „fairly broad".

gyrus frontalis inf. is not vaulted: the cortex between the anterior part of the s. front. inf. and the f. Sylvii is practically flat and lies in a plane which more gradually than in the Dutch passes into the facies orbitalis (fig. 5).

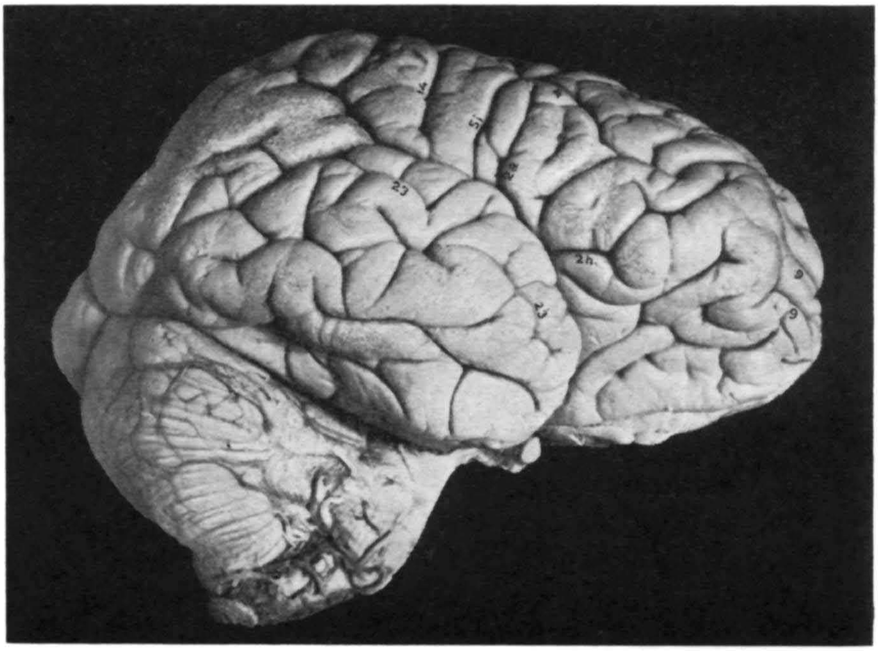

Fig. 5. Brain 924.

The facies inferior of the occipitotemporal lobe is comparatively slightly concave (fig. 2).

The cerebrum of the Battaks frequently shows the phenomenon of bathrocephaly (fig. 3, 8, 9, 10)[1]. A lecture by Dr. LUBBERHUIZEN (1933) who in Javanese with externally a smooth os occipitale internally came across an exceptionally pronounced fossa cerebralis, led the writer to examine this point also for Battaks. For this research five skulls were available in the Ethnographical Museum at Leiden, none of which from outside showed marks of bathrocephaly. Professor BARGE was so kind as to have three sawn through in his laboratory, and now it appeared that in two of these specimens a bathrocephalic excavation[2] was present[3]. Bathrocephalic shape of the brain consequently does not always coincide

1) KAPPERS (1932).

2) This is different from the "fossa corticis striatae" of ELLIOT SMITH (1907), which usually is strongly asymmetric and whose boundary coincides with the s. lunatus.

3) One of these three skulls clearly showed a faint notch corresponding to the described hollow contour of the frontal lobe, and two of them exhibited large excavations at the place of the protuberance of SCHWALBE on the brain.

with bathrocephalic shape of the skull. The question now presents itself whether the latter has to be considered as an advanced stage of the phènomenon.

It is interesting that PARSONS (1908) could determine the percentage of bathrocephaly for mediaeval skulls from Kent to be 8.6 and mentioned that MACDONELL found the feature in 5.2 % of Whitechapel skulls and in 11.6 % of Moorfields skulls.

BOLK (1916) supposed that bathrocephaly may occur if a more dolichocephalic occiput is inherited from one parent and a more brachycephalic calotte from the other.

COULOUMA (1930) states that bathrocephaly is connected with a hereditary disease described by CROUZON.

The exceptional length and position of the splenium has already been pointed out in the discussion of the callosum index; fig. 2 besides gives a notion of the pronounced impressio, frequently [1]) to be seen in the callosum of the Battaks. In contrast with the Chinese this noth then corresponds more or less with a curve in the s. callosomarginalis (10).

While studying the fissuration we find that a number of differences with the Dutch become apparent. The direction of the rostral grooves in Battaks, for example, is often ascending towards the front (fig. 2) [2]), sometimes S-shaped (c.f. fig. 20). It may also occur that in this folding-area this direction is acquired by one or several rather deep, oblique grooves, connecting the s. calloso-marginalis with the mesial border (fig. 2).

The calcarina anterior is not only less frequently connected with the fissura hippocampi (fig. 2) than in the Dutch (67.8 % to 80 %), but as a rule the gyrus fornicatus is also fairly broad. The calcarina posterior in Battaks lies rather high, i.e. far from the tentorial margin; the groove frequently displays a wide curve (ventrally concave, fig. 2), is short and usually ends in a distinct T-shape, which is sometimes reduplicated. This phenomenon as well as the superficial position of the gyrus cuneolingualis posterior (fig. 2) gives the impression of transverse elements forcing their way in the area striata. Since the calcarina posterior and its branches are pure sulci intrastriati (ELLIOT SMITH), it has to be assumed that in Battaks the part of the area striata situated on the mesial wall has a comparatively large dorsoventral expansion.

The s. lunatus (18) attains a high frequency in Battaks (in 83.3 % clear, in 10 % a remainder left, in 6.6 % absent) and in this respect exceeds the Chinese (71.1 %). It should be observed at once, however, that the lunatus is by no means conspicuous for its special development, neither is it, in

[1]) For the frequencies see the table at the end. These figures are, of course, not a criterium for the intensity of the various phenomena.

[2]) This phenomenon is, according to the pictures, also found in the cerebrum of a Bushwoman described by SHELLSHEAR (1934) and in two of five hemispheres of Bushman described by SLOME (1932).

contrast with the Chinese, situated far to the front (fig. 3, fig. 6). This, indeed, is not to be expected of the s. lunatus, regarded as boundary sul-

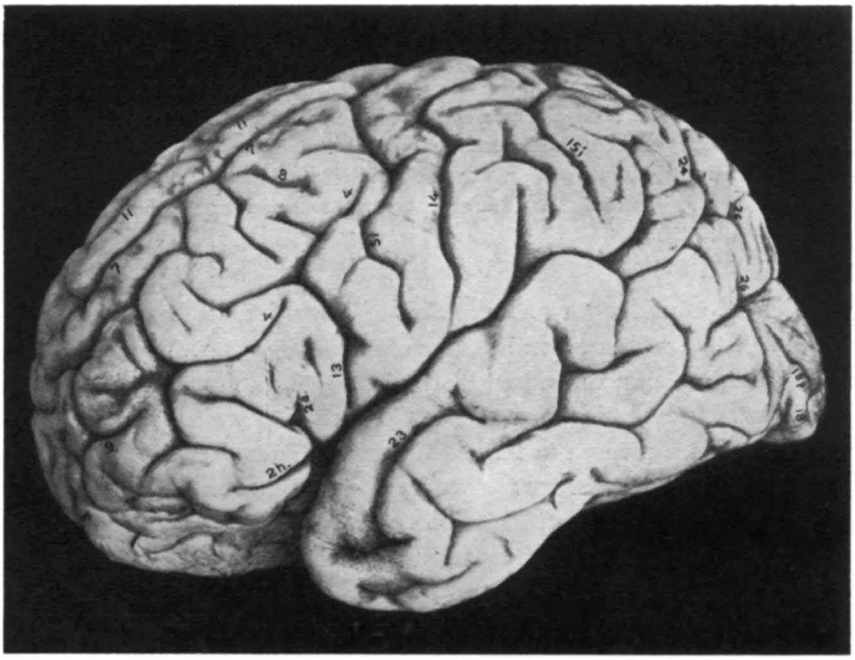

Fig. 6. Brain 930.

cus of the area striata (ELLIOT SMITH), after what has appeared of the calcarina posterior. It may be considered thus that the small part of the cortex occupied by the area striata on the convexity is compensated by the larger expansion on the mesial wall.

It is true, thrice the s. lunatus was connected with the s. occipitalis transversus (17), but it seems that this phenomenon is not brought about by frontal position of 18, but by far caudal position of 17, respectively far caudal continuation of 16 (s. interparietalis), of which 17 is the endbifurcation. This opinion is confirmed by the fact that often in Battaks the direction of 16 still continues through 17 (fig 7, fig. 8).

The sulcus praelunatus (18p) in Battaks shows a tendency to reduplication (fig. 8); besides the cases that 18 sends out more than one branch towards the front, it also occurs that in this part of the cortex in addition to 18p longitudinal grooves are found, which do not communicate with 18, It is obvious that a relation should be sought between this phenomenon and the bathrocephaly, starting from the fact that development of length in part of the brain goes together with a more intensive longitudinal folding of the cortex. In the Battaks this influence shows itself in this cortical region very locally, for in 60 % of the cases to 37 % in the Dutch a highly developed s. occipitalis anterior (26) was present in the form of a deep ventral branch (fig. 3, fig. 8, fig. 9). Here the occipital region, apparently an area of comparatively strong longitudinal folding, is bordered by the excessive

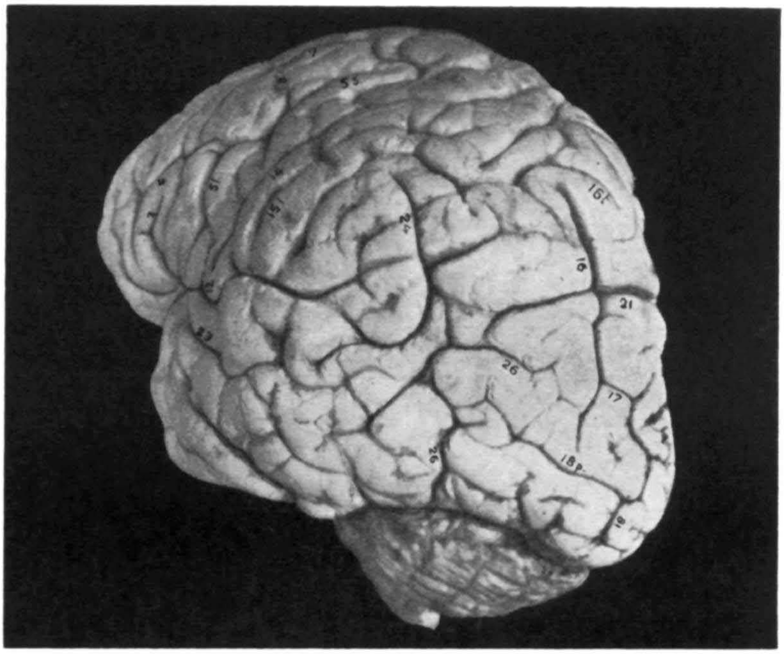

Fig. 7. Brain 935.

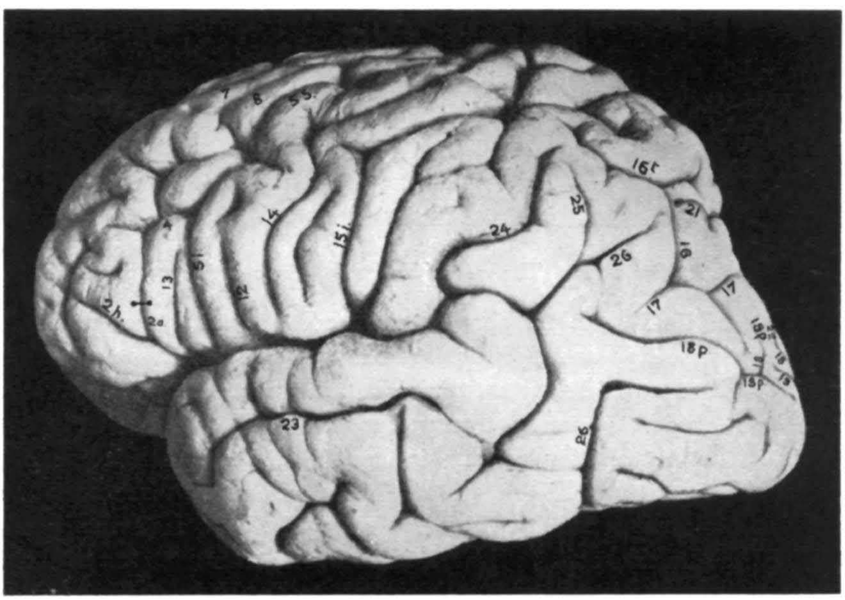

Fig. 8. Brain 928. •—• bridging convolution.

development of a transverse groove, which points to the fact that the bathrocephalic prolongation takes place in the occipital lobe. The intensive transverse folding at the frontal border of the occipital region was once also marked by continuation of the s. parieto-occipitalis (21) through 16 (fig. 7).

The direction of 21 has been traced when continuing on the convexity. For this purpose a division into three groups has been made: 1. the part on the convexity points backward (Battaks 16.6 %, Dutch 19 %); 2. there is either a bifurcation or the part on the convexity is perpendicular to the dorsal margin (Battaks 50 %, Dutch 43 %); 3. the part on the convexity points forward (Battaks 33.3 %, Dutch 38 %). In order to warrant a conclusion in this respect the differences ought to be larger.

The parietal lobe (fig. 3, fig. 8, fig. 9) exhibits the branches of the s. temporalis superior (23), described by KAPPERS and WANG (1924) and by

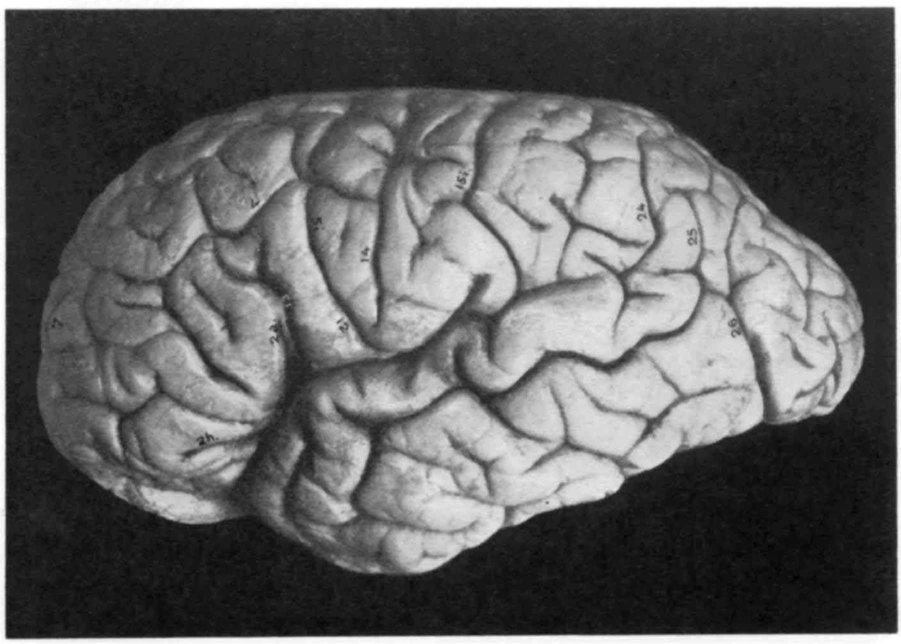

Fig. 9. Brain 932. The cap of Broca has three axillar grooves.

SHELLSHEAR (1927), viz. the above-mentioned s. occipitalis anterior (26), the s. angularis (25) and the s. parallelus superior (24). SHELLSHEAR[1] has since called attention to a transverse branch of the s. interparietalis which he named s. parietalis transversus (16t). If this groove is detached from the part of 16 which lies in front of it, the posterior part of 16 assumes the shape of an H, the legs of which are formed by the s. parietalis transversus and the s. occipitalis transversus (17). This case was found in 56.6 % of the Battaks and 44 % of the Dutch, so contributes to the obvious transverse fissuration in the parietal lobe of the Battak brain. The origina-

[1]) RUBINO (1933).

ting of the s. interparietalis (16) from the s. postcentralis (15), in 70 % of the Battaks and 72 % of the Dutch occurs practically equally often.

The sulcus centralis (14) indents the mesial border in 36.6 % of the Battaks (in 55.2 % of the Dutch), in 23.3 % the mesial border is reached (25.3 % of the Dutch), and in 40 % the mesial border is not reached (19.5 % of the Dutch) [1]. Consequently in Battaks the development of the groove at its dorsal ending is inferior to that of the Dutch, ventrally, however, we are struck by a special tendency to prolongation, in which the post- and praecentral gyri frequently take part. The phenomenon may namely present itself either as a far continuation of 14, which consequently approaches very near to the fissura Sylvii (fig. 6), or as a locally strong development of the parietofrontal operculum (fig. 3, 7, 9, 10), causing the temporal operculum to form a bent and the f. Sylvii to get a curved course [2].

The far ventral continuation of the s. centralis, perceptible in 60 % of the Battaks and in 17 % of the Dutch, is not a phenomenon by itself, but occurs also in the s. praecentralis (5) and the s. diagonalis (13) (fig. 8). Twice 5 was connected with the s. subcentralis (12) (fig. 9). The ventral continuation of 5 and 13 frequently takes place as far as into the dorsal wall of the fissura Sylvii (so that the fossa Sylvii has to be drawn open in order to look on top of the lower margin of the parietofrontal operculum) (fig. 5, fig. 8). Sometimes this is still more strongly the case with the rami anteriores, which, of course, are merged as well in this wall; however, it is scarcely necessary to draw the fissura Sylvii open in order to see the apex of the frontal operculum, as the frontal lobe protrudes far beyond the temporal operculum, owing to its great breadth at the place of the protuberance of SCHWALBE (fig. 5, fig. 9, fig. 10).

It is a striking feature of the rami anteriores fossae Sylvii that the ramus horizontalis is occasionally situated far towards the front, in which case the cap of BROCA may become very broad (fig. 5, fig. 9), while further should be mentioned that the single ramus occurred only once, the Y-shape in 20 % of the cases, and the double ramus in 76.6 %. The following table shows a comparison between Battaks, Chinese A, Chinese B, and the Dutch.

	Battaks	Chinese A	Chinese B	Dutch
Number of rami ant. < 2 (so one or in Y-shape)	23.3 %	21.1 %	23.9 %	37.9 %
Number of r. ant. 2 *or* > 2 (so including the cases 1+Y and 3)	76.6 %	78.9 %	76.1 %	62.1 %

[1]) In 64.4 % of the Chinese A 14 indents the mesial border, in 19.7 % the border is reached, in 15.8 % it is not reached. For the Chinese B these figures are 70.8 %, 13.5 %, 15.6 %.

[2]) This condition has been described by SHELLSHEAR (1934) with reference to the cerebrum of a Bushwoman.

In this manner the Battaks seem directly comparable with the Chinese B; if, however, the cases of the single ramus ant. are excluded from the

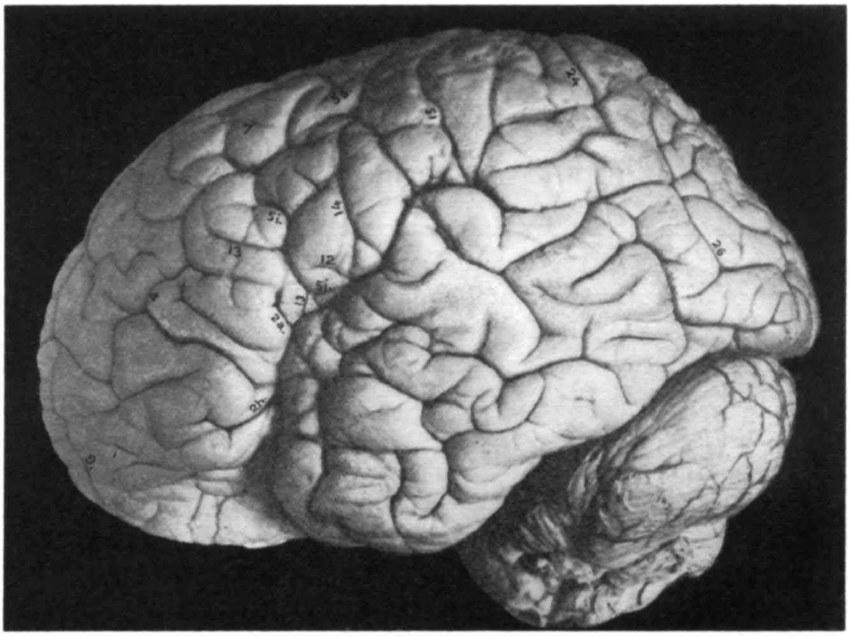

Fig. 10. Brain 922.

percentage for "< 2", the Battaks with their very small frequency (3.3 %) of this phenomenon are clearly opposed to the three other groups (Chinese A 9.2 %, Chinese B 10.4 %, and the Dutch 18.4 %) [1].

An incompletely submerged insula occurs in 13.3 % of the cases in the form known in Europeans and Chinese, so owing to imperfect development of the frontal operculum (in the Dutch in 36.7 % [2]); by the side of this, however, it is striking that in Battaks the anterior part of the insula remains partly exposed (fig. 11). This peculiarity was found in 36.6 % of the hemispheres (5 on the right, 6 on the left). The remaining exposed of the anterior part of the insula has to be attributed to imperfect development of the orbital operculum and to the relative shortness of the temporal lobe. For the variability in the development of the temporal pole KAPPERS (1929) makes us assume that this shortening takes place in the anterior part of the temporal lobe, causing the temporal operculum to have less part in the submergence of the front of the insula.

A partial exposure of the insula, owing to imperfect development of the orbital and temporal opercula, was observed by SLOME (1932) and SHELLSHEAR (1934) in Bushmen,

[1]) EBERSTALLER (1890) gives 24 % as percentage of the single ramus anterior, CUNNINGHAM (1892) 30 %, RETZIUS (1896) 14 %, and QUANJER (1902) 18 %.

[2]) The figure 37.9 % (1930, 1933) includes a case of influence of senility.

and according to reproductions published by SPITZKA (1902) and ELLIOT SMITH (1904), it is likely for Eskimoes and Negroes.

Occasionally the insula is also perceptible a little further backwards. This may be understood if it is considered that, owing to its exceptionally frontal

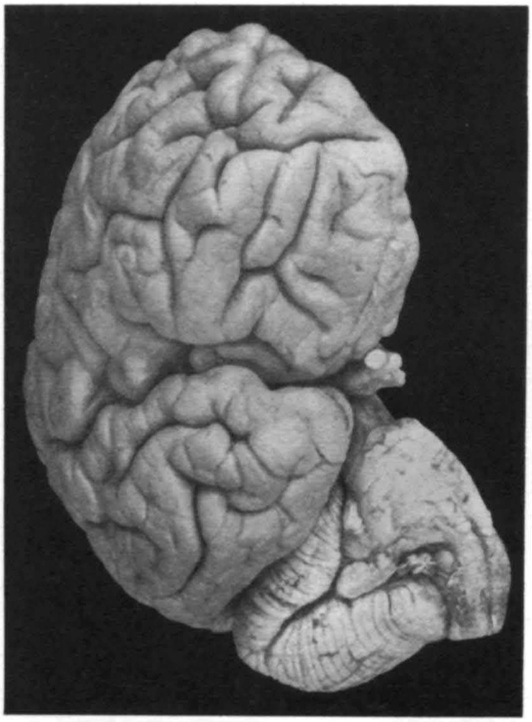

Fig. 11. Brain 931.

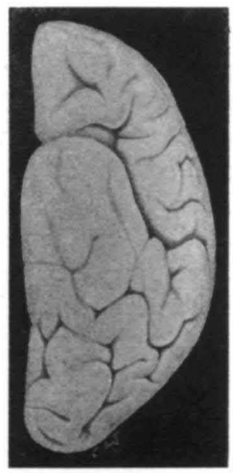

Fig. 12. Left hemisphere of a Foetus (45 c.M.).

position, the ramus horizontalis often takes its course almost through the very centre of the protuberance of SCHWALBE (fig. 9, 10), which then is formed by the common vault of the frontal and the orbital operculum. As the protuberance of SCHWALBE in Battaks is particularly prominent, this involves that the orbital operculum as well as the frontal operculum are situated far from the fissura Sylvii. The peculiar feature of the insula of the Battaks is consequently that it is often incompletely submerged, owing to the fact that the temporal lobe does not reach far enough *forward* and the anterior part of the frontal lobe not far enough *downward*. From fig. 11 it appears that the front of the insula may be exposed to such an extent that the s. limitans anterior is visible. Such a condition reminds us of an embryonic stage (fig. 12) [1], also because it is particularly in the perinatal period that the temporal pole is subject to development (KAPPERS 1929).

[1]) VAN BORK—FELTKAMP (1934).

The sulci frontales inferior (4) and medius (7) are well developed in Battaks, the superior (11) is as a rule greatly broken up. In this respect there is resemblance to the Dutch; however, it is remarkable that in 30 % of the Battaks to 12 % of the Dutch 4 does not originate from the s. praecentralis (5). Concerning this phenomenon and the far ventral continuation of 14, 5, and 13, as well as concerning the small frequency of the single ramus anterior in Battaks it has to be concluded that in the gyrus frontalis inferior the transverse fissuration exceeds that of the Dutch (fig. 8). The sulcus frontalis medius originates from 5^s equally often in either group (76.6 % and 76 %).

It seems that in Battaks the s. frontomarginalis (9) is still somewhat more clearly developed that in the Dutch; usually both the longitudinal and the transverse element of the groove are present, but the latter predominates and is frequently once or several times medially reduplicated (fig. 3, fig. 5). These reduplications alternate with the small oblique grooves on the mestal wall which have already been described.

In general the fissuration of the temporal lobe does not give rise to special comment.

Summarizing the characteristics of the Battak cerebrum, we find that the indices and anglemeasurements relating to the general form may be understood in their mutual connection; only the high figure of the frontal length index appeared not to be in accordance with this. It was remarked before that the latter is measured medially; to this may now be added that laterally the predominantly transverse fissuration of the lower frontal convolution as well as the position of the ramus horizontalis on the protuberance of SCHWALBE point to relative shortness in this cortical region. Further to the mesial border there is frontally a pronounced transverse folding on the level of 5^s and 14 changing into the reverse. If this transverse folding, which may be also connected with the absence or the small perceptibility of the s. subfrontalis, and the oblique position of the rostral grooves which often coincides with a vertical notch at their feet (fig. 2, c.f. fig. 16) might be regarded as the manifestation of a pushing of the brain-mass from the front to the back and upwards, this would give a comparatively high position to the lateral horizontal frontally [1]), which agrees with the high value of the Rolandic angle and makes that of the Sylvian angle very probable. Similarly it may be understood that the temporal depth index shows a tendency to a higher value in the Battaks without the temporal lobe appearing to be actually higher.

Compared to the brains of Chinese, which in the fissuration of practically every part display a relative shortness [2]), the Battak cerebrum is in this respect conspicuous for a certain independence of the various cortical

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1) Cf. the above-described position of the basal callosum line.

2) This shortness is not expressed in the length-breadth index, because it is not compensated by greater breadth, but by greater height.

regions: besides what has been remarked above in this connection about the frontal lobe, attention should be drawn to the tendency to reduplication of the s. praelunatus causing a longitudinal folding, which frontally as well as caudally is bounded by pronounced transverse folding. Meanwhile the characteristics of the fissuration of the various lobes may each time be connected with those of the general form. Yet, we should be on our guard against stressing too much the relation between form and fissuration type. SPITZKA (1902), for example, suggests that a convolutionary type may present itself as an anthropological phenomenon, even in those cases where the general form of the cerebrum does not correspond, and KAPPERS (1932) points out that some grooves are not influenced by the general form. Besides the general form it may be also the form of a cortical region (the area striata), which influences the convolutionary direction (VAN BORK-FELTKAMP, 1933).

Shortness alone, however, is not sufficient to occasion intensive transverse folding: there is also wanted a tendency of the cortex to grow in opposition to the shortening. Evidently this is as a rule wanting in the temporal lobe of the Battaks, for which reason this lobe is short, but does not show any peculiarities in its fissuration; the exception is formed by brain 928 (fig. 8).

An investigation as has been described above has yielded conclusive differences [1]) for the brains of the Dutch, Chinese and Battaks, in spite of the fact that the average length-breadth indices hardly differed (82.19, 81.2 and 81.84). This result is an encouragement for anthropological studies of the cerebrum.

Brains of three Toba-Battaks.

For the indices the table may be referred to. The general form does not deviate from the description given for the Karos.

With regard to the fissuration only the most conspicuous characteristics will be discussed.

933 Left side. The mesial wall (fig. 13) shows a visible fascia dentata. The calcarina posterior is placed rather high and is curved. Yet, there is an extensive continuation on the convexity (fig. 14). Dorsally the strongly developed 18 has still a detached element, confluent with 22, which medially continues as far as 21. Between 18 and the s. occipitalis inferior there is a narrow bridging convolution. The ventral branch of 26 (26^v) is more intimately connected with 25, which at the upper end is ramified, than with the dorsal element of 26 (26^d). Between the groove $25/26^v$ on the one hand and the lunatus and the part of 16 which is connected with the s. parietalis transversus (SHELLSHEAR) on the other a cortical region

[1]) These differences are already clearly perceptible in a single furrow, such as the calcarina.

is situated, characterized by a number of longitudinal grooves; to this contribute: the end of the anterior part of 16, separated by a deep convolution from the H of SHELLSHEAR, the caudal branch of 25, 26^d, the ventral

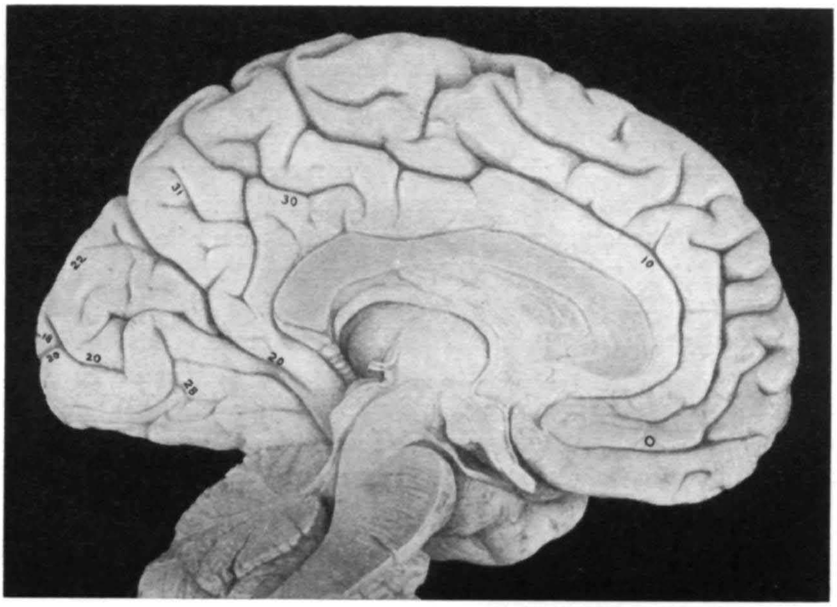

Fig. 13. Brain 933.

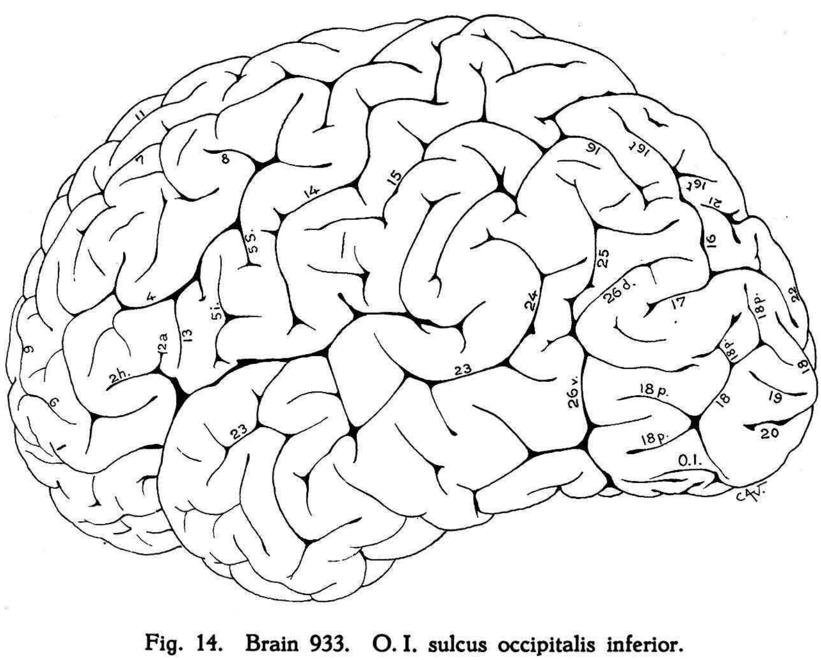

Fig. 14. Brain 933. O. I. sulcus occipitalis inferior.

branch of 17, an independent fissure, two of the sulci praelunati, the branches of 26^v alternating with them and the s. occipitalis inferior.

The other characteristics of the convexity may be sufficiently derived from the table; there is only to be mentioned the great asymmetry of the rami anteriores f. Sylvii, which on the left approach rather to the shape of a T than of a Y and on the right are, each of them, well-developed and enclose a broad cap with two axillary grooves. On the left at the foot of the T the insula is just perceptible on the right it is completely submerged (fig. 15).

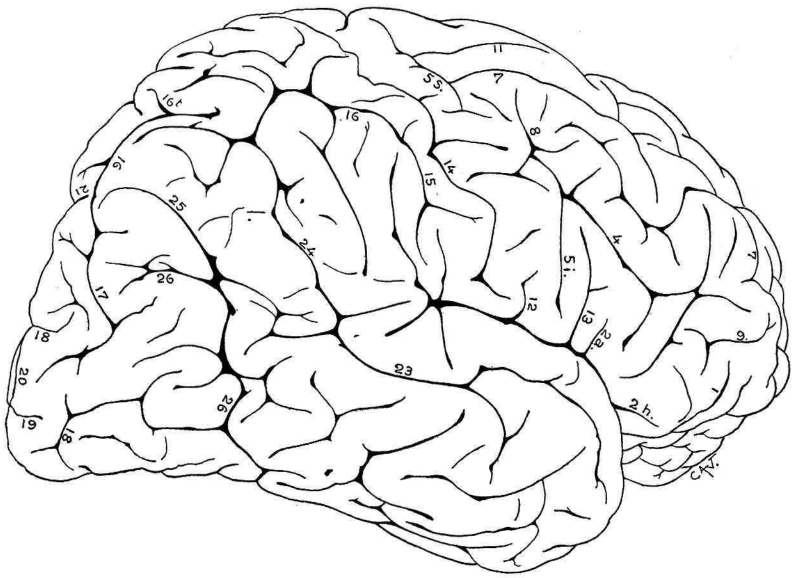

Fig. 15. Brain 933.

With regard to the foot of 14: on the left the post- and prae-central sulci have forced the temporal operculum to form a bent, on the right, however, the f. Sylvii is straight at that place.

The mesial aspect of the right hemisphere (fig. 16) is remarkable for the ascending course of the rostral grooves 0 and the detached vertical notch at their feet. The callosum has the distinct impressio and the pendulous splenium. The praecuneus is broad and in subtlety of fissuration hardly inferior to the cuneus, which again is marked by the complexity of 20. In front of the g. cuneolingualis posterior the high calcarina is provided with a double T-shaped part, and behind it continues in the form of an X, followed in its turn by a groove, which continues on the convexity (19).

On the lateral surface (fig. 15) the s. lunatus is less developed and lies closer to the occipital pole than on the left side. It is remarkable that the dorsal and the ventral part of 18 diverge and that a longitudinal groove wedges itself in between, which is confluent with 17. This is a typical transition stage when 18 disappears and a longitudinal fissuration forces its way[1]). Of the branches of 23 attention should be drawn to the strong development of 24, which communicates with the anterior part of 16.

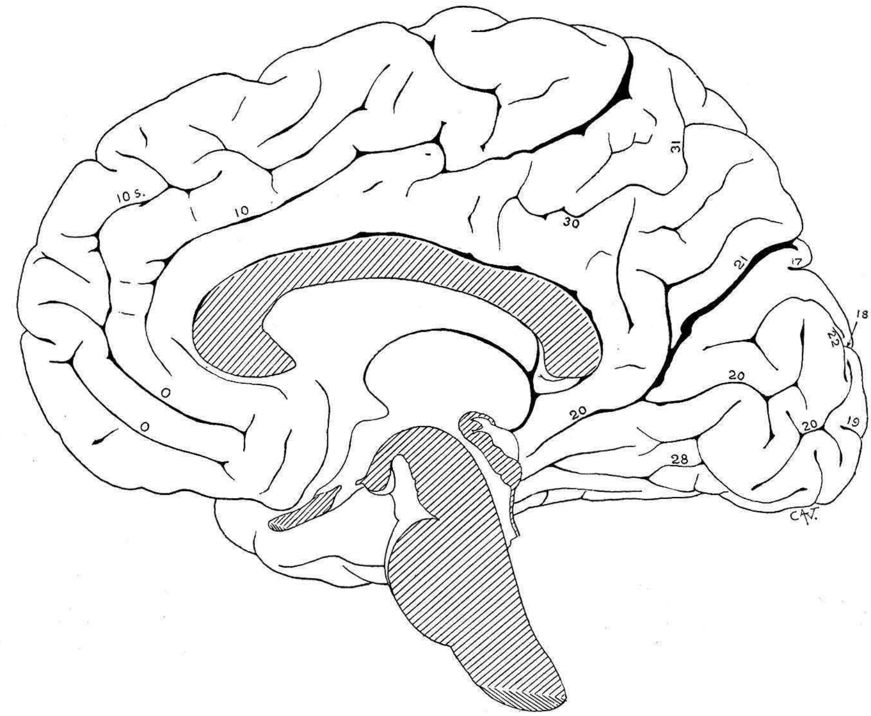

Fig. 16. Brain 933.

Between 24 and 16 lie two transverse fissures the frontal of which is an extensive continuation of the f. Sylvii and the caudal may be a reduplication of 24. The surface of the cap of BROCA lies rather against the inferior than against the lateral part of the frontal lobe.

938 Left side. As principal characteristic the mesial aspect exhibits a high position of the calcarina and two curves, each with a processus acuminis. The branch, which 20 close to the pole seemingly gives off downwards, is separated from it by a deep convolution and appears to be an extensive continuation of the s. occipitotemporalis (fig. 17).

The s. ypsiliformis of KAPPERS is represented by a fairly deep longitudinal furrow. The s. lunatus forms a somewhat pointed operculum; the furrow falls apart into three elements, of which the lower one is connected with two s. praelunati and the upper one both with 17 and 22 (fig. 18).

Just as in 933 left side, the s. praelunati form part of a longitudinal folding-system, though not quite in such a pronounced manner. To this fissuration contribute also the s. occipitalis inferior as well as 25, which has

[1]) For various modifications of 18 see SHELLSHEAR (1926), KUHLENBECK (1928), and VAN BORK—FELTKAMP (1930).

not yet reached the s. annectans of SHELLSHEAR. The imperfect development of 26 (longitudinal influence of lower 18^p) forms a contrast with the reduplication of 24.

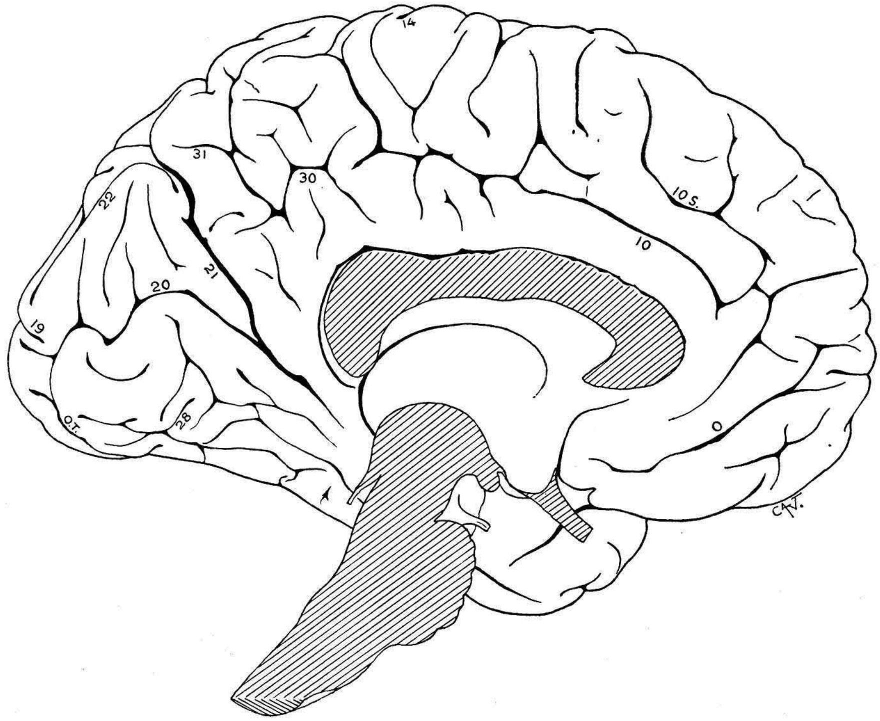

Fig. 17. Brain 938. O. T. sulcus occipitotemporalis.

The part of 16 which is connected with the s. parietalis transversus of SHELLSHEAR continues through this groove to the front.

On the frontal lobe (fig. 19) 13 is missing; there are two well-developed rami anteriores, of which the position and direction of the horizontal one are characteristic. The insula is visible, owing to the imperfect development of the frontal and orbital opercula. The frontal lobe is at the foot of 2^h thicker than along 2^a, while the lower margin of the gyrus frontalis inferior in front bends upwards from the upper border of the temporal lobe. The s. frontalis inferior is broken up and 5^i is confluent with 7 by means of the old 6 (KAPPERS).

938 Right side. It is at once obvious that this hemisphere shows the phenomenon of bathrocephaly much more clearly than the left one, which may also be perceived in the form of the cuneus (fig. 20). The mesial wall shows an S-shaped s. rostralis, the direction of which is once more repeated by the anterior part of 10 with its branch to the front. The corpus callosum has a distinct impressio and a vertical posterior border. The calcarina forms a faint curve, after a bifurcation it is continued in the form of a sulcus triradiatus, while on the convexity there is still a

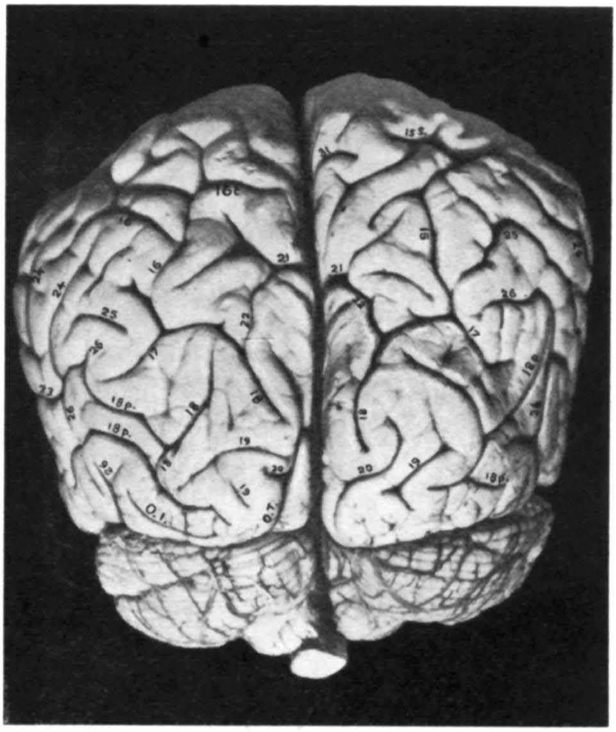

Fig. 18. Brain 938. O. I. sulcus occipitalis inferior.

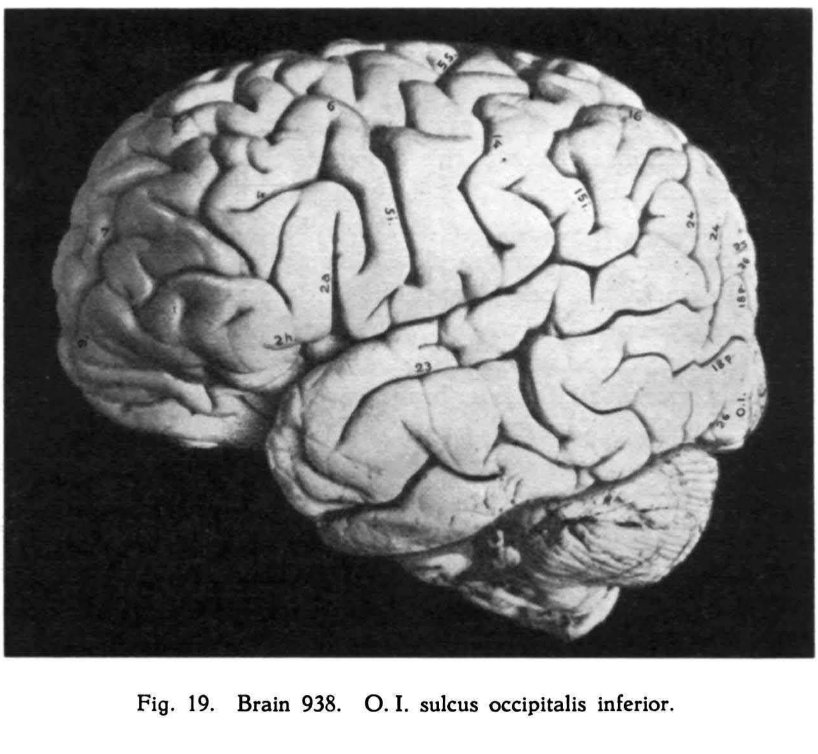

Fig. 19. Brain 938. O. I. sulcus occipitalis inferior.

separate 19. Striking again is the connection of the dorsal part of 18, not only with 22 but also with 17, which thus causes 16 to continue apparently

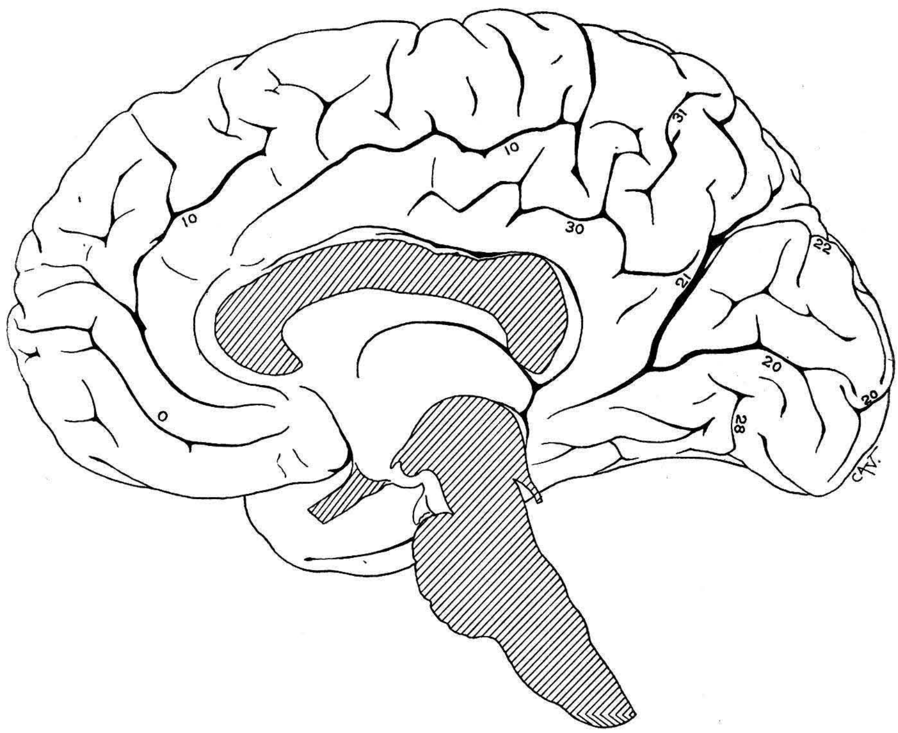

Fig. 20. Brain 938.

almost as far as the occipital pole. There are two s. praelunati (18p), the upper one of which is long and reaches nearly to 26. This groove has a strongly developed ventral part, which backwards gives of a longitudinal branch. Equally clear is 25, while 24 forms a bifurcation. The s. interparietalis (16) originates in 15, which may be traced as far as the fissura Sylvii. The same is the case with 14. In contrast with the left side 13 is present. In the same way as on the left the insula is exposed and here even the s. praecentralis Reili is perceptible (fig. 21).

The origin of 4, which is again greatly broken up, is in 5^i and contrary to the left side 7 has its origin in 5^s. The fossette 8 of KAPPERS is very complex.

926 Left side. For the special features of the mesial wall may be chiefly referred to what can be found about it in the table; to that should be added that in the calcarina posterior two bridging convolutions are perceptible on the surface (fig. 22).

Lateral aspect (fig. 23). There is a distinct 19 and a well-developed 18, the main direction of which is longitudinally stretched. On the mesial wall 22 continues almost as far as 21. There is one fully developed 18p and a smaller one. The s. interparietalis (16) is uninterrupted and originates in 15^i, wich continues nearly to the f. Sylvii. The grooves 24, 25 and 26 are easily recognized. The s. centralis (14) reaches the mesial

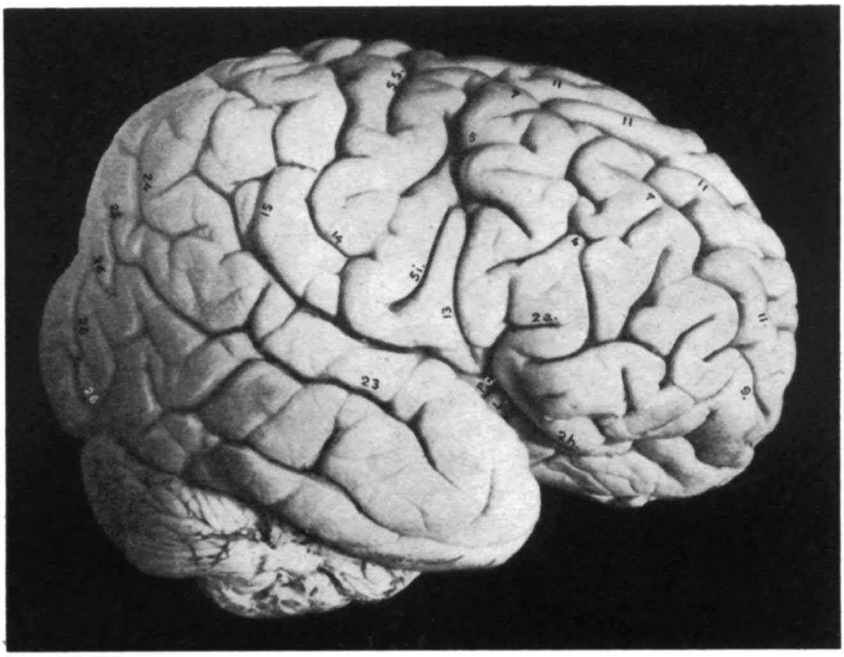

Fig. 21. Brain 938. P. C. s. praecentralis insulae. L. s. limitans anterior insulae.

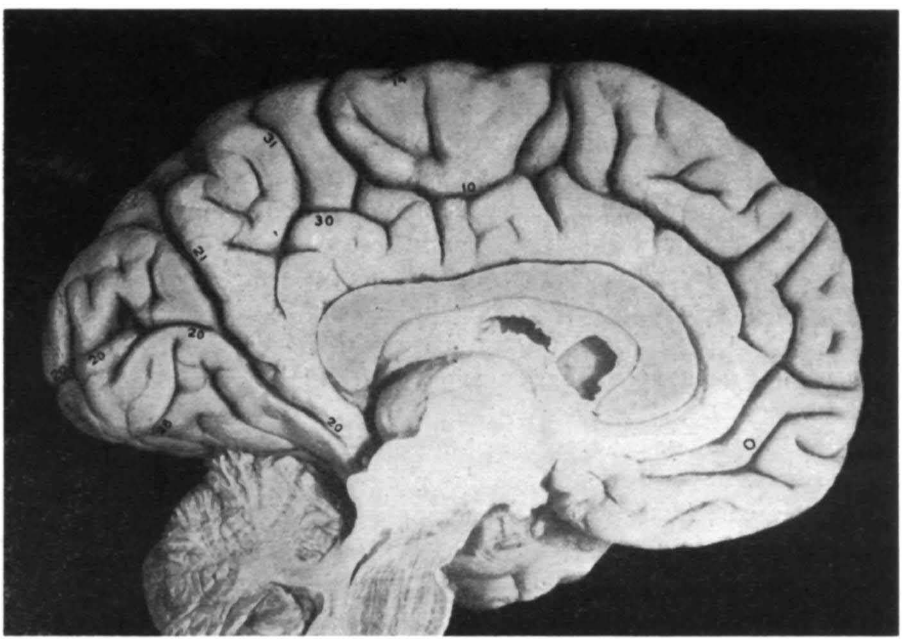

Fig. 22. Brain 926.

border; the foot of the groove is surrounded by wide convolutions, slightly bulging out in the temporal lobe. The s. diagonalis (13) continues far

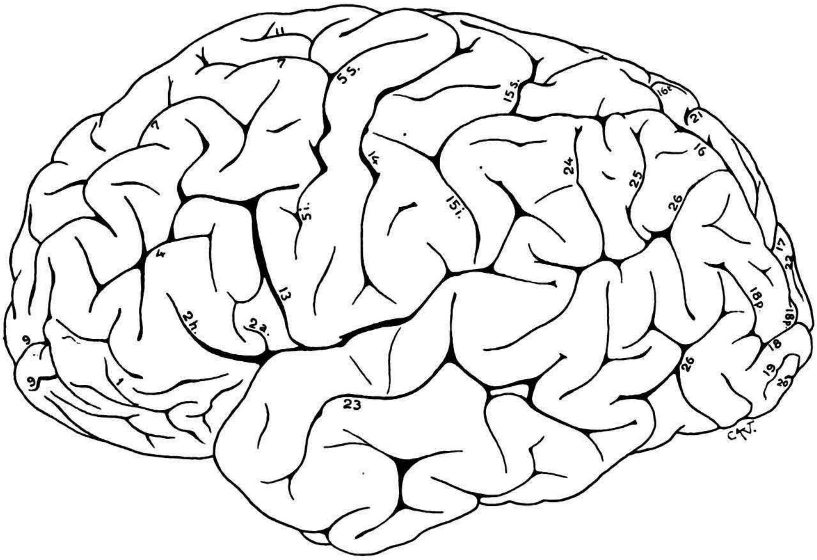

Fig. 23. Brain 926.

in the wall of the parietofrontal operculum. Of the rami anteriores 2^a is only small, 2^h points straight upwards. The narrow cap of BROCA is not fully developed, but at its apex the orbital and frontoparietal opercula touch each other; the submergence of the insula is made complete there by a curve of the gyrus temporalis superior. The frontal lobe actually posresses only two distinct longitudinal grooves, 11 being scarcely present.

Right side. The mesial wall shows no strongly upward direction of the s. rostralis, but it reveals a vertical groove at the foot of it. The gyrus cinguli is wide in front, and slightly more frontal than the impressio corporis callosi it becomes considerably narrower (fig. 24). The praecuneus is narrow, the raised 20 is again abundantly provided with complexities and continues far on the convexity. There is a well developed occipital operculum (fig. 25); 19 is represented by two parallel furrows. The dorsal part of 18, which is confluent with 22, is separated by a deep convolution from the remaining part of 18. This part is connected with three 18P, the upper one of which is remarkable for its bifurcation, lying right in front of 18. This picture is repeated one convolution further to the front on the dorsal branch of 17. The s. occipitalis anterior (26) is strongly developed and on the ventral part ramified. Similarly 24 is clearly defined and the imperfect development of 25 is compensated by the reduplication of the s. parietalis transversus (SHELLSHEAR). The latter forms part of an intensive folding along the mesial border, which likewise becomes manifest in the far continuation of 21 on the convexity and the indentation of 14. The origin of 16, which is nowhere interrupted, is situated in 15[1], which may be traced as far as the f. Sylvii.

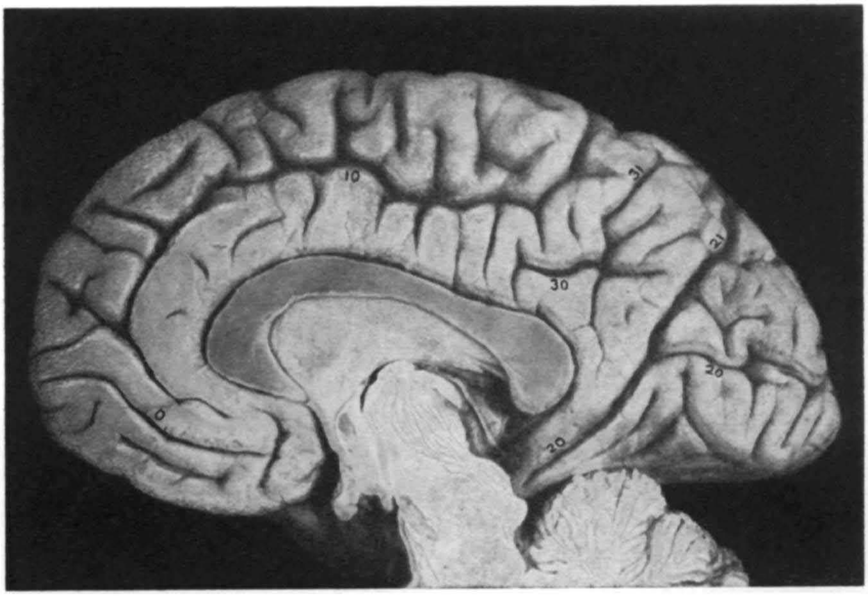

Fig. 24. Brain 926.

The s. centralis (14) is connected at the lower part with the s. subcentralis (12). The s. praecentralis inferior (5[1]) does not reach far down

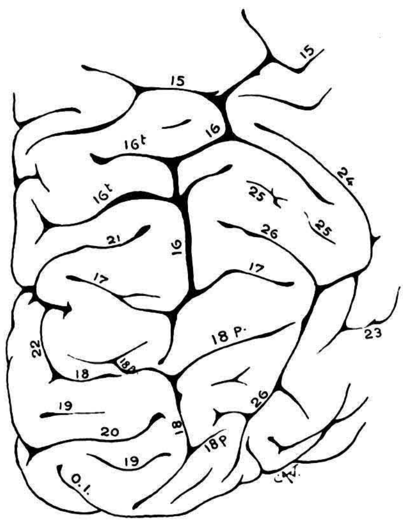

Fig. 25. Brain 926. O. I. sulcus occipitalis inferior.

(fig. 26), 13 on the other hand does. There is a broad cap of BROCA, which just reaches the temporal operculum. In front of this point of contact the insula is only just perceptible. The groove 4 falls apart into a number of pieces. Above these elements there is a furrow 8, which should be regarded

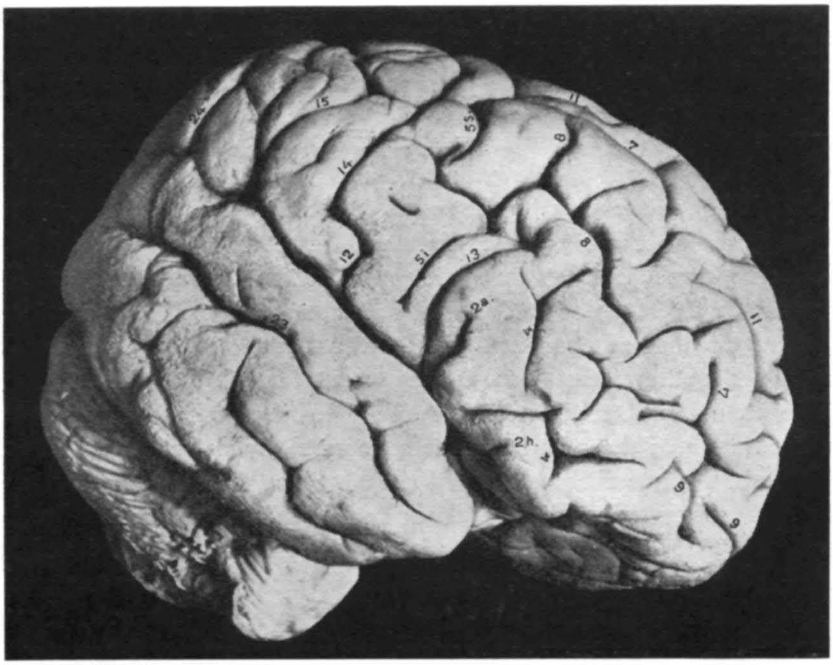

Fig. 26. Brain 926.

as a fusion of the fossettes of KAPPERS. The sulcus frontalis medius (7) does not originate in 5^s.

The longitudinal part of the s. frontomarginalis (9) is connected with the median transverse portion; the lateral part is detached.

If the characteristics, which have become manifest in the three Toba brains, are considered, it appears that they agree in many respects, not only mutually but also with the brains of the Karo-Battaks. However, to the latter resemblance the form and fissuration of the area striata make an important exception. The sulcus lunatus of the Karos is decidedly less developed and the operculum which forms the caudal lip is smaller: here a condition as in fig. 14, 18 right, and 25 occurred only twice. It is true, the calcarina posterior of the Karos is also provided with T-elements, but the groove in the three described Toba brains appears to be still more complex on the mesial wall, chiefly owing to the fact that there more bridging convolutions come close to the surface.

A comparison of the fissuration and the form of the area striata of Karo- and Toba-Battaks might lead to the supposition that the larger expansion of this cortical region in the Tobas externally is connected with the superficial position of the transition convolutions on the mesial wall, which medially makes the cortical surface of the area striata smaller.

Upon comparison of the Tobas with races, which laterally possess a fairly large operculum (Negroes, ELL. SMITH 1904, SERGI 1909; Chinese, SHELLSHEAR 1926, VAN BORK-FELTKAMP 1933) one is inclined to draw the conclusion that the calcarina posterior does not look so irregular there, notwithstanding CUNNINGHAM (1892) mentions a persisting gyrus cuneo-lingualis in 50 % of Negro brains and SERGI in 71.1 % of Hereroes. As for the Tobas brain 926 even shows on the left the exeption ELLIOT SMITH (1904) pointed out: "The sulcus retrocalcarinus may be represented by as many as three separate furrows, but it is quite exceptional to find these three sulci as independent furrows in the adult brain" [1]). Though the influence of coincidence should not be excluded, considering the small number of examined Toba brains, yet it does not seem likely that the tripartite calcarina is so very exceptional in this tribe.

The pictures obtained from these Toba hemispheres should, as far as the fissuration of the area striata is concerned, by no means be regarded as at the same time characteristic of the Karo brains, and it is very doubtful whether they are so for the Tobas: while in the literature it has been mentioned that these Battak tribes mutually differ very little and their brains in many other respects appeared to resemble each other to a remarkable degree, it is difficult to assume that in one single characteristic such a considerable difference would occur. It is to be regretted that the collection of the Tobas was not at least equally large as that of the Karos.

SUMMARY.

A research has been made on 15 brains of Karo-Battaks and 3 of Toba-Battaks. The general form is remarkable for a certain tendency to bathrocephaly which corresponds with a longitudinal fissuration pattern in the occipital lobe, and for a raised, blunt frontal pole with prominent protuberance of SCHWALBE. The latter phenomenon together with the short temporal lobe may give rise to a partial exposure of the insula in a manner which resembles an embryonic stage.

In the frontal lobe intensive transverse fissuration is to be seen along the fronto-orbital border and in the gyrus frontalis inferior; it decreases distinctly in frontocaudal and in ventrodorsal direction.

The corpus callosum is characterized by a deep pendulous splenium and a distinct impressio. This phenomenon is confirmed by peculiarities in the fissuration.

The parietal lobe has a well developed transverse convolutionary pattern.

1) Nevertheless he does not attach morphological value to the form, in which the f. calcarina presents itself.

With regard to the fissuration of the area striata and the extension of the occipital operculum the examined Karo and Toba brains differ : the calcarina posterior, though provided with distinct T-elements, is simpler in the former than in the latter, which have more transition convolutions lying near the surface. The Toba brains have a large occipital operculum with a strongly developed s. lunatus ; the Karos have a less distinct operculum and, in connection with longitudinal fissuration forcing its way, the s. lunatus falls clearly apart into two or there elements.

Since the number of examined Toba brains is very small, it is not likely that the above-described difference may be regarded as anthropological.

EXPLANATION OF THE NUMBERS IN THE FIGURES.

0. s. rostralis.
1. s. subfrontalis.
2*a*. ramus ascendens fissurae Sylvii.
2*h*. ramus horizontalis fissurae Sylvii.
4. s. frontalis inferior.
5*i*. s. praecentralis inferior.
5*s*. s. praecentralis superior.
6. junction of 5*i* and 7.
7. s. frontalis medius.
8. intermediate fosset.
9. s. fronto-marginalis.
10. s. callosomarginalis.
10*s*. s. callosomarginalis superior.
11. s. frontalis superior.
12. s. subcentralis.
13. s. diagonalis.
14. s. centralis.
15*i*. s. postcentralis inferior.
15*s*. s. postcentralis superior.
16. s. intraparietalis.
16*t*. s. parietalis transversus.
17. s. occipitalis transversus.
18. s. lunatus.
18*p*. s. praelunatus.
19. s. ypsiliformis.
20. f. calcarina.
21. s. parieto-occipitalis.
22. s. paramesialis.
23. s. temporalis superior.
24. s. parallelus superior.
25. s. angularis.
26. s. occipitalis anterior.
28. s. basalis transversus.
30. s. subparietalis.
31. s. praecunei.

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Number	Length-breadth index	Pendulous splenium	Distinct impressio corporis callosi		Callosum index	Stem angle	General height index	Occipital index	Temporal depth index	Temporal length index	Frontal height index	Frontal length index	Rolandic angle	Sylvian angle	Parieto occipital angle	10 or 10a corresponds with the impressio	Rostral fissure ascending	20 not connected with fissura hippocampi	Curve in 20	20 far from tentorial border	20 possesses a T-element	Number of ramiant. fossae Sylvii	14 shows tendency to ventral prolongation	14 indents the mesial border	4 originates from 5	7 originates from 5	16 originates from 15	H-shaped fissure of SHELLSHEAR detached	18 present	Ventral part of 26 distinctly developed	Imperfectly submerged insula	Direction of 21 on the convexity
937	76.64	+	+	left	0.344	108°	0.491	1.18	0.171	0.718	0.471	0.382	64°	27°.5	43°	±	−	+	−	+	−	Y	−	+	+	+	+	+	+	−	II	⊥
				right												+	+	+	+	+	−	2	−	+	+	+	−	+	+	+	II	⊥
936	83.2	−	−	left												−	−	+	±	+	−	2	+	−	+	+	+	−	+	−	−	⊥
				right	0.435	127°	0.506	0.931	0.187	0.743	0.489	0.364	68°	25°	68°	−	+	−	+	+	+	2	+	−	+	−	−	+	+	+	−	forward
925	72.2	−	−	left	0.376	108°.25	0.499	0.908	0.174	0.740	0.495	0.394	65°	32°	69°	−	−	+	−	−	+	2	−	±	+	−	+	−	+	+	II	backward
				right												−	±	+	−	+	+	2	−	+	+	+	+	−	+	−	−	⊥
935	84.05	+	−	left												−	+	+	−	+	+	1	+	+	−	+	−	−	+	+	−	⊥
				right	0.414	111°.5	0.516	1.01	0.153	0.735	0.506	0.385	60°	30°	55°	+	+	−	±	+	+	2	−	+	+	+	−	+	−	−	−	⊥
928	80.78	+	+	left	0.403	129.25	0.507	1.33	0.150	0.716	0.489	0.405	68°	24°	65°.3	+	+	+	+	+	+	Y	+	+	+	+	+	+	+	+	−	⊥
				right												+	±	+	−	+	+	2	+	±	+	+	+	−	r	−	II	⊥
934	82.0	−	+	left	0.333	118°.75	0.452	0.743	0.191	0.752	0.446	0.370	61°	24°	58°	−	−	+	−	+	+	2	+	−	−	−	+	−	r	+	II	forward
				right												−	+	+	+	+	−	Y	+	−	+	−	−	−	r	−	I	forward
931	82.04	+	+	left	0.377	102°.25	0.492	0.904	0.148	0.723	0.492	0.392	64°	33°	54°	+	+	+	−	+	−	2	+	−	+	+	+	+	+	±	II	backward
				right												+	+	−	−	+	+	Y	−	+	+	+	+	+	+	−	II	forward
930		−	+	left												−	−	+	−	+	+	2	+	−	−	+	−	+	+	+	−	forward
				right												+	−	+	+	+	+	2	+	−	−	+	−	+	+	+	I	⊥
922		−	+	left												+	−	+	−	−	+	2	+	−	+	−	+	+	+	+	−	⊥
				right												−	−	−	+	+	+	2	+	±	+	+	+	−	+	+	−	forward
924	86.94	−	−	left	0.421	116°	0.473	0.998	0.173	0.721	0.471	0.410	65°	23°	53°.5	−	−	+	−	−	−	Y	+	±	−	−	−	−	+	+	−	⊥
				right												+	+	−	+	+	−	2	−	±	−	+	?	+	+	+	−	forward
929	85.9	±	+	left	0.420	103.25	0.531	1.00	0.123	0.769	0.499	0.351	68°	23°	50°.5	−	+	−	+	+	+	2	−	+	−	+	+	+	+	+	−	⊥
				right												+	+	+	−	+	+	2	+	−	+	+	+	+	+	+	I	⊥
923	82.0	−	−	left	0.371	124.73	0.465	0.815	0.169	0.719	0.457	0.384	66°	25°	73°.5	−	+	+	+	−	+	2	±	±	+	−	+	+	+	+	II	backward
				right												−	+	+	+	+	+	Y	−	+	+	+	+	+	−	+	II	⊥
921	82.05	+	+	left	0.361	116°	0.471	0.871	0.151	0.729	0.451	0.358	60°	39°	57°	+	+	+	+	+	+	2	−	−	+	+	+	+	+	−	II	forward
				right												+	−	+	−	−	+	2	+	−	−	+	+	−	+	−	-	backward
932		+	+	left												+	+	+	−	−	+	2	+	+	−	+	+	−	+	+	−	forward
				right												+	+	+	−	+	+	2	−	−	+	+	+	−	+	+	II	forward
927	84.1	+	−	left	0.452		0.524	1.08	0.110	0.703	0.508	0.392	66°	38°	50°	−	±	+	+	+	+	2	+	+	+	+	+	+	+	−	−	backward
				right												−	±	+	−	+	+	2	+	±	+	+	+	−	+	−	I	⊥
Average	81.84 ± 1.32	46.6%+	60%+		0.392 ± 0.00958	115° ± 2°.67	0.494 ± 0.007	0.981 ± 0.0442	0.158 ± 0.0067	0.731 ± 0.0051	0.481 ± 0.00625	0.382 ± 0.00505	64°.6	28°.625	58°.06	46.6%+	53.3%+	80%+	40%+	80%+	76.6%+	76.6% 2	60%+	36.6%+	70%+	76.6%+	70%+	56.6%+	83.3%+	60%+	36.6% II	50% ⊥
Dutch	82.19 ± 0.55	4%+	18%+		0.302 ± 0.00796	105°.3 ± 1°.13	0.464 ± 0.00585	1.029 ± 0.0281	0.144 ± 0.00312	0.751 ± 0.00259	0.448 ± 0.00562	0.364 ± 0.00326	54°.8	24°.5	49°	17%+	40%+	67.8%+	22%+	67.8%+	62%+	62.1% 2	27%+	55.2%+	88%+	76%+	72%+	44%+	36.8%+	37%+	36.7% I	43% ⊥
amount of objects	42	50	50		27	27	42	42	42	41	42	42	mesoceph.		brachy ceph. 100	100	100	87	100	87	100	87	100	87	100	100	100	100	87	100	87	100

r remainder of s. lunatus. The numeral I represents an insula which remains perceptible owing to imperfect development of the frontal operculum. The numeral II represents an insula which remains perceptible in front.

TOBA BATTAKS.

Number	933		938		926	
Length-breadth index	73.9		76.33		85.89	
Pendulous splenium	±		+		−	
Distinct impressio corporis callosi	±		+		−	
	left	right	left	right	left	right
Callosum index	0.348		0.389		0.397	
Stem angle	94°		111°		112°.75	
General height index	0.553		0.521		0.505	
Occipital index	1.19		1.11		0.802	
Temporal depth index	0.166		0.184		0.179	
Temporal length index	0.769		0.743		0.738	
Frontal height index	0.518		0.499		0.505	
Frontal length index	0.354		0.367		0.399	
Rolandic angle	63°		68°		70°	
Sylvian angle	23°		32°		28°.5	
Parieto occipital angle	42°.75		56°.25		55°.75	
10 or 10s corresponds with the impressio	±	−	−	−	+	+
Rostral fissure ascending	−	+	+	+	+	±
20 not connected with fissura hippocampi	+	+	+	+	+	+
Curve in 20	+	+	+	+	+	−
20 far from tentorial border	+	±	+	+	+	+
20 possesses a T-element	+	+	+	+	+	+
Number of rami ant. fossae Sylvii	Y	2	2	2	2	2
14 shows tendency to ventral prolongation	+	+	±	+	+	+
14 indents the mesial border	+	±	±	−	±	+
4 originates from 5	+	+	−	+	−	−
7 originates from 5s	+	+	−	+	+	−
16 originates from 15	+	+	+	+	+	+
H-shaped fissure of SHELLSHEAR detached	+	+	+	−	−	−
18 present	+	+	+	+	+	+
Ventral part of 26 distinctly developed	+	+	+	+	+	+
Imperfectly submerged insula	I	−	=	=	−	=
Direction of 21 on the convexity	⊥	Forward	⊥	⊥	Forward	Forward