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Anatomy. — “*The ape fissure — sulcus lunatus — in man*”. (By Dr. D. J. HULSHOFF POL). (Communicated by Prof. C. WINKLER).

(Communicated in the meeting of May 27, 1916).

On the appearance of an ape fissure in man, opinion is still divided.

While e.g. KOHLBRUGGE¹⁾ considers himself obliged to accept that the latter is only found in apes, ELLIOT SMITH²⁾ comes to the conclusion that the sulcus lunatus, described by him, is nothing else but the fissura simialis in apes and that this fissure constantly appears (a constant feature of the human brain).

It is, superficially seen, quite remarkable, that such a great difference in opinion exists about the appearance or not of such an importantly developed fissure.

The reason of it has to be looked for in the fact, primarily, that it is especially difficult to homologise at the occipital pole the sulci of apes with those of men, secondarily, because no count has been kept with the development of the fissura simialis in embryos of primates.

When one does not carefully examine where and how the fissura simialis develops in embryos, it will always remain a fruitless work to discuss whether between the manifold sulci and fissures on the posterior part of the human brain one can be found, which could be placed on the same level with the fissura-simialis in primates.

In my record on the development of this fissure⁴⁾ and its relation to the “*plis de passage*”⁵⁾ I explained:

- a. that the ape fissure is a *non-constant* fissure,
- b. that it is formed in foetal life, *after* the other sulci are already present,
- c. that it is formed by *the same* ape species always nearly on *the same* spot,
- d. that it can be formed in different ape species at different places,
- e. that the characteristics, by which it can be recognised from the other sulci, in the different ape species, can be totally *different*.

// If we therefore want to investigate whether in man an ape fissure is present, then one has to take with the previous results into account.

In *semnopithecii* I pointed out that in first instance the sulci are formed on the brain surface and that only afterwards, when a larger growth of the occipital part should take place, a curvature appears, which is to be taken as the beginning of the fissure. It is now the question, whether in man the same relation may be expected.

When I do not go back further than nearly half a century, ECKER⁶⁾ laid stress on the fact, that in the 9th month of foetal life all the principal sulci and principal gyri are already formed, but that the subsulci and subgyri are still missing for a great part (p. 222 sub 14). If therefore an ape fissure should be formed, then this will, being an important sulcus, be formed during foetal life.

RETZIUS came just to the same conclusion, who added to it (p. 27), that in a sufficient number of specimens out of this foetal period, one can find all the varieties, which appear on the brainsurface of adult human beings.

This report therefore also points out that in case an ape fissure should be there, it has to be demonstrated in foetal life.

The above mentioned agrees with what is found in apes, and the ape fissure in man therefore will also be best examined on foetal brains. Moreover it is of great profit that the complex of sulci before birth is not yet as complicated as in the adult state.

From the embryology, which ECKER gives to us, it appears that the development of all the principal sulci can be distinctly followed, but that there is not one among them, which leads us to suppose it the ape fissure. As the sulci till the beginning of the 9th month show a simple type, it is not difficult to come to a similar conclusion.

The only exception could possibly be made by his transitory sulci, of which some run transversally on the posterior lobe. These however cannot be compared with an ape fissure, because they are only of temporary nature and disappear in the 4th and 5th months.

RETZIUS too, who neither speaks of an ape fissure in foetal life in the embryology, described by him, does not think these transitory sulci of great importance. He e.g. points out (p. 16) that in judging the value of these sulci one has to be very careful, as a great number of the young abortised embryos carry the sign of being abnormal, what naturally has to be found back in the brains.

I believe that RETZIUS has given hereby a very important fact for the development of these sulci and it is therefore necessary not to value highly these transitory sulci.

On the other hand RETZIUS intends to draw especially attention to a sulcus, which runs from the medial junction of the fissurae parieto-occipitalis and calcarina on the lateral occipital surface. Plate XXVI, fig. 2, 3 and 4.

If one examines this sulcus, which is also drawn on page XXII, fig. 2 and plate XIII, fig. 8 and 9. then this shows a great resemblance with an ape fissure. The only thing is, that it is found in

brains, in which the other principal sulci had not yet reached their full development, so that the question remains whether not a transitory sulcus was present. RETZIUS too takes it in that way (s. description Plate XIII).

Excepting ECKER and RETZIUS, I could not find, reading through other literature, anything that indicates a fissura simialis in human embryos either.

The only exception might have been the report of KOHLBRUGGE²), who writes on p. 243: "Die Affenspalte beim Menschen halte ich also für eine im embryonalen Leben sich bildende Anomalie". This would mean, that he has found in the unborn fruit a sulcus, which should be taken for an ape fissure. As I could not find in the communications written by KOHLBRUGGE anything more in particular about this sulcus, and the question is of great importance, I addressed him personally and I received the answer, that he himself never saw such a sulcus in human foetus, but from analogy with what was found in apes, he did not want to exclude the possibility, that in man, during foetal life an ape fissure might be formed.

Summarizing what previously has been said, one must come to the conclusion that the study of the human embryos and foeti does not teach us anything about the commencement of the ape-fissure.

If one holds to the analogy in development of the sulci in men and apes, then the above said would suffice to conclude that in man no ape fissure is formed.

This consequence therefore presents itself, because we know, — in a previous report I called attention to it⁶) —, that the ape fissure in anthropoids is already much less developed than in *semnopithec*i and *macac*i.

It is therefore not strange in itself, that in human brains, which in the range of development are placed much higher than those of the anthropoids, the ape fissure does not come to development.

However while even in recent years ELLIOT SMITH and others have defended the conviction, that in man an ape fissure is surely found, I will accept for a moment, that the fissura simialis, contrary to the other principal fissures, is formed in man only after foetal life.

And I will accept this the sooner, as I showed sub *d* and *e*, that in the different ape species, this sulcus can be formed at different places and that the characteristics of these different sulci, need not be the same.

The possibility therefore is not, theoretically spoken, excluded that in man this fissura is formed under totally different circumstances, e.g. only after foetal life.

Accepting the latter, I shall examine whether the sulcus lunatus, described by ELLIOT SMITH, answers the requirements which are due to an ape fissure, it being moreover accepted as granted, that not every sulcus on the occipital pole of the brain can be called an ape fissure. It will therefore need some characteristics, by which it can be differentiated from other sulci.

This is the more necessary, as it is known to us, that the sulci on the lobus occipitalis show such a varying picture that to distinguish the most familiar fissurae already gives rise to difficulty. Thus WALDEIJER wrote: "Es gelang RETZIUS ebenso wenig wie seinen Vorgängern, eine typische Anordnung der Furchen und Windungen am Hinterlappen des Grosshirns nachzuweisen: derselbe wird also noch bis auf weiteres die Crux der Hirnanatomie nach dieser Seite hin bleiben".

It is also known that at the occipital pole through the transversally and obliquely running sulci one can find, gyri, which possess the likeness to an operculum. This "Halbringform" is described a.o. by RETZIUS on page 136, where the fissura calcarine continues on the lateral brainmantle, forming a "nach vorn-oben vorhängendes operculum."

These, let me call them *pseudo-opercula*, therefore do not develop by overgrowth, but by a confluence, or more by an oblique course of ordinary sulci.

We could compare it with a ball, of which the half of a superficial segment is cut in, forming thus a thing that looks like a fictitious operculum, a "Klappdecke".

The presence therefore of a thing that in man resembles an operculum, does not give a right to speak of an ape-fissure. This too ELLIOT SMITH⁸⁾ admits, when he writes on page 448 "...especially the sulcus occ. transversus may have a caudal opercular lip, which simulates the true stria-bearing occipital operculum".

Where this mighty means to determine an ape-fissure, falls away, there only a few characteristics remain, which can be helpful in identifying this sulcus.

The *first* is the pushing inwards or overgrowing of sulci, which under normal circumstances remain on the surface.

It speaks for itself that in connection with the previous question, it is not always very easy to make out whether a sulcus is pushed to the depth either through overgrowth of an adjoining part, or whether the arisen relation is the result of a confluence which is so often seen on the brain surface. Moreover it often happens that sulci which for the greater part are lying on the surface, can be

removed so far, that they, as it were, come to be lying in another sulcus.

In short to mention an example, KOHLBRUGGE²⁾ writes on page 70 "Auf XXI und XXII liegt der Diagonalis in der Tiefe, eingebettet in den vorderen Rand des s. praec. inf."

In semnopithecii and macaci it is different: there one finds the $m + m'$ sulcus (par. occ. lat. seu occ. transversus) on the surface. In case there is an ape fissure then that total sulcus, the caudal part of the $l + e$ sulcus (s. interparietalis) included is *pushed in a newly arisen sulcus*.

If one opens the fissure, one always finds the $m + m'$ sulcus in it. This is quite distinctly indicated in fig. II of ZUCKERKANDL's³⁾ communication.

Such striking proofs for the recognition of an ape fissure are missed in the communications of ELLIOT SMITH and MURPHY¹⁰⁾, so that I am justified in accepting that they did not find this proof present.

The *second* characteristic one could find in the "plis de passage".

I pointed out⁵⁾ that the "plis de passage" primarily are lying on the surface and only secondarily are pushed down to the depth.

Now it is not always very easy to make out whether a part of the cortex, which one finds in the depth is lying under normal circumstances on the surface. Yet it is comprehensible that under certain circumstances this can be possible, as we have seen in ape embryos.

ELLIOT SMITH does not make use of these "plis de passage" to demonstrate, that his sulcus lunatus is an ape-fissure.

The *third* characteristic could be sought in the localisation of the fissure.

In a former communication⁴⁾ I came to the conclusion, that the ape-fissure developed through augmented growth of the lobus occipitalis. As this will take place in apes of the same species always in nearly the same way, therefore too the ape fissure in the same species of apes will be formed on nearly the same place. One can understand, that when in men a *true* operculum is formed on the lobus occipitalis, this always must be found at nearly the same distance from neighbouring sulci.

ELLIOT SMITH describes to us the localisation of his sulcus lunatus on page 448 in this way:

"The sulcus lunatus is subjected to a very wide range of variation in the human brain . . . The sulcus lunatus may extend right across the lateral aspect of the hemisphere from the dorso-mesial to the ventro-lateral edge, as in most chimpansees. It may be a much

shorter furrow placed anywhere between these two extremes. It may be transverse, oblique or horizontal in direction. It is very frequently interrupted by a submerged "gyrus translunatus": and occasionally this gyrus comes to the surface and completely divides the lunate sulcus into a pars dorsalis and a pars ventralis. Either of these furrows may be joined to a sulcus praelunatus so as to form a pattern, which is at first sight somewhat perplexing."

I thought, it necessary to copy the whole of the description given by E. SMITH to make distinctly clear that in this way each sulcus on the occipital pole can be taken for a sulcus lunatus.

ELLIOT SMITH came to this description of the localisation of his sulcus lunatus, because this should form a border of the surface, over which the stria Gennari (Stria of VICQ. D'AZYR) should extend.

This conception of ELLIOT SMITH proved to be wrong later on. Not only does he himself already write on p. 440 that in many cases the area striata is always sufficiently near to the sulcus lunatus, which does not point distinctly to a border, but moreover the investigations e.g. of BRODMANN¹¹⁾ and MURPHY¹⁰⁾ make clear that in Europeans the area striata is in no way connected with the furrow which is described by E. SMITH as sulcus lunatus.

From the above said follows, that of all the characteristics, which an ape fissure could possess to be distinguished from the neighbouring furrows with regard to the sulcus lunatus of ELLIOT SMITH, not one is to be found which suffices. The sulcus lunatus, described by him, therefore can be brought back to pseudo-opercula, which frequently appear on the occipital pole and which are described e.g. by RETZIUS as "Halbringform".

CONCLUSIONS.

1. Where in anthropoids an ape fissure is still found, theoretically spoken, the possibility exists that in man too an ape fissure can develop.

2. Where in anthropoids the ape fissure is already importantly less developed than in semnopithecii, however the possibility also exists that a same furrow in men does not come into development.

3. In apes all the principal furrows develop, also the fissura simialis, during foetal life.

Where in man too all the principal furrows develop during foetal life, it may be accepted that in case an ape fissure should be formed, this should take place during foetal life.

4. However where in human foetus no ape fissure is found,

there it may be accepted, that also in the adult state no fissura simialis appears.

5. The sulcus lunatus, described by ELLIOT SMITH, for the rest possesses no properties which characterize it as an ape fissure.

6. The sulcus lunatus therefore is nothing but an ordinary sulcus or confluence of a few of them, by which a pseudo-operculum arises, thus a "Halbringform" in the sense of RETZIUS.

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2. Id. Die Gehirnfurchen der Javanen. Verhandelingen der Koninkl. Akademie v. Wetenschappen te Amsterdam. 1906.

3. SMITH, J. ELLIOT. The so-called "Affenspalte" in the Human (Egyptian) Brain. Anatomischer Anzeiger 1904.

4. HULSHOFF POL, D. J. The fissura simialis in embryos of semnopithecii. These Proc. XVIII p. 1571.

5. Id. The relation of the plis de passage of GRATIOLET to the ape fissure. These Proc. p 104.

6. ECKER, A. Zur Entwicklungsgeschichte der Furchen u. Windungen der Grosshirn-Hemisphären im Foetus des Menschen Archiv f. Anthropologie. 1868.

7. RETZIUS, GUSTAF. Das Menschenhirn. Stockholm. 1896.

8. SMITH, G. ELLIOT. The morphology of the Occipital Region of the Cerebral Hemisphere in Man and the Apes. Anat. Anzeiger. 1904.

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10. MURPHY, J. B. Note on the sulcus lunatus in negro and white brains and its relation to the area striata. The anatomical Record. 1910.

11. BRODMAN, H. Histologische Lokalisation. Journal für Psychologie und Neurologie. 1905—1906.

Physics. — "*The currents arising in n -coupled circuits when the primary current is suddenly broken or completed.*" By BALTH. VAN DER POL Jr. (Communicated by Prof. W. H. JULIUS.)

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Suppose we have two circuits with given resistance and self-induction and coupled magnetically. If the electromotive force in one of the circuits suddenly stops, the current in it will asymptotically fall to a zero value, whereas the current in the other circuit rises from zero to a maximum value, then gradually falling again to zero.

This paper will treat on the following extension of this problem:

1. The change in time of the currents excited in n equal circuits coupled magnetically, in such a way that the first is coupled with the second, the second with the third, etc., the $n-1^{\text{th}}$ with the n^{th} .