A CASE
OF
ASYMMETRY OF THE BRAIN
PRESENTING PECULIARITIES WHICH BEAR UPON THE
QUESTION OF THE
CONNECTION BETWEEN THE OPTIC NERVES AND CERTAIN
DEFINITE AREÆ OF THE CEREBRAL CORTEX.¹

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E. A—, æt. 25, was admitted into St. Thomas's Hospital under the care of Mr. Mason, owing to injuries received by the fall of a house. She died of the results of the accident in a manner which need not be related now, as it has no bearing upon the condition of the brain found after death, which is the subject of the present communication. The condition referred to was evidently a congenital abnormality, and was accompanied by a certain diminution in size of the right arm and leg, and by rigidity of the former.

I never saw the patient until I performed the post-mortem examination upon her, and no account was obtained

¹ The specimen is now in the Museum of St. Thomas's Hospital.

during her lifetime of the origin of the abnormality in the right arm and leg, nor of the state of her mind and special senses. The scraps of information which have since been received can pretend therefore to no scientific accuracy. But even so, the brain presents peculiarities which make it an anatomical specimen of very unusual interest, and which may contribute to the elucidation of certain points in the physiology of the cerebral hemispheres.

After her death the patient's father informed me that his daughter had always been healthy up to the time of the accident, which proved fatal in a few weeks; that she had never suffered from fits or other nervous affections; that from her very birth she had had a small and stiff right arm; and that she had always been left-handed and a little lame. He said that he had never noticed any mental deficiency, and that she had never complained of her sight, hearing, or other senses.

No peculiarity in her eyes, speech, or aspect, was noticed during her stay in the hospital, but the sister of the ward says that she struck her as being intellectually dull, even for a person in her position of life.

With these few remarks I shall pass on to the results of the post-mortem examination.

Both the right arm and leg were evidently smaller than their fellows though they were otherwise normally formed, and the muscles examined presented the rich brown colour of health. The right wrist measured $4\frac{3}{4}$ inches, the left $5\frac{3}{8}$ inches; the right forearm $6\frac{1}{2}$ inches, the left 8 inches. The circumference of the left leg round the calf exceeded that of the right by one inch. The heart and lungs and other viscera were healthy, with the exception of the kidneys and the bladder, which were in a state of acute inflammation. The skull and the membranes of the brain were normal, as were the intracranial blood-vessels, nor was there any marked inequality of the latter on the two sides.

On examining the brain it was seen at once that the

left hemisphere was smaller than the right, but that the difference in length was less than the difference in breadth and general bulk. One of the characters which specially struck the observer's eye was that laterally the most prominent part of the right hemisphere corresponded with the region of the supra-marginal and angular convolutions, whereas in the left the brain was quite flat in this position. The measurement of the hemispheres from the tip of the frontal lobe along the margin of the great longitudinal fissure to the tip of the posterior lobe was on the right $8\frac{1}{2}$ inches, on the left 8 inches. The circumference, from the edge of the great longitudinal fissure over the parietal lobe to the internal border of the temporo-sphenoidal lobe on the under surface of the brain, was on the right $6\frac{7}{8}$ inches, on the left $5\frac{7}{8}$ inches.

On closer examination it became evident that most of the convolutions of the right hemisphere had their representations on the left, though the latter were smaller than the former. There was, however, one very striking exception. The angular and superior temporo-sphenoidal convolutions on the left appeared to be absent, and the supra-marginal convolution was represented by two thin strips of brain substance, which ran vertically upwards from the edge of the fissure of Sylvius, and lay between the posterior extremity of the latter and the base of the ascending parietal convolution. In the right hemisphere the angular and superior temporo-sphenoidal convolutions were well developed. The second annectent convolution on the right joined an offset from the angular gyrus and so formed a convolution which became continuous with the middle temporo-sphenoidal. But on the left the convolution which ran into the upper temporo-sphenoidal convolution was formed by an offset from the second annectent and another direct from the superior parietal lobule, the lower border of the latter owing to the absence of the angular gyrus coming to within one sixteenth of an inch of the upper extremity of the fissure of Sylvius, while on the right it was separated from this fissure by

about one inch and a quarter, a space occupied by the highly developed angular gyrus.

The anatomical relations, therefore, of the upper temporo-sphenoidal convolution on the left were the same as those of the middle temporo-sphenoidal on the right, with the exception that owing to the absence of the angular gyrus the offset from the superior parietal lobule was directly continuous with the temporo-sphenoidal convolution, instead of joining the angular gyrus as it did in the opposite hemisphere. On both sides the uncinate convolution, together with its terminal hook, were well developed, but they were somewhat larger on the left than on the right. On the right the portion of the temporo-sphenoidal lobe lying between the uncinate convolution on the under surface and the superior temporo-sphenoidal on the outer surface of the brain, was divided more or less clearly into the three convolutions ordinarily described, namely, the middle and inferior temporo-sphenoidal, and the inferior occipito-temporal, which is continuous with the latter. On the left the uncinate and inferior occipito-temporal were clearly defined, but the middle and inferior temporo-sphenoidal were fused into one convolution, which was smaller than those which it represented on the opposite side. In fact, the tip of the temporo-sphenoidal lobe on the right projected one inch in advance of its fellow on the left, and was formed by the middle temporo-sphenoidal convolution, which wound round the curved and prominent extremity of the inferior occipito-temporal and projected three quarters of an inch beyond the anterior extremity of the uncinate gyrus. On the left the tip of this lobe was formed by the uncinate convolution and by the extremity of the middle temporo-sphenoidal. The latter, however, did not project, as it did on the right, but was level with the uncinate gyrus. The fissure of Sylvius gaped much more on the left than it did on the right, so that there the island of Reil lay somewhat exposed to view.

The absence of the parts mentioned, viz. the angular

gyrus and superior temporo-sphenoidal convolution, was also indicated by measurements. Thus the fissure of Rolando on each side met the great longitudinal fissure very nearly at the same point, but the right slanted forward much more than the left, the difference being most observable in its lower half. On measuring the distance of the inferior extremity of the fissure of Rolando, where it approached the fissure of Sylvius, from the tip of the frontal lobe, it was found to be on the right three and a half inches, on the left four inches. And the distance of the same point from the tip of the occipital lobe was on the right four and a half inches, on the left four inches. In other words, the lower extremity of the fissure of Rolando was half an inch further back on the left than on the right. This was due to the absence of the angular convolution.

The measurement from the great longitudinal fissure over the angular gyrus and temporo-sphenoidal lobe to the crus cerebri was on the right six and a quarter inches, on the left five and a quarter inches, being a difference of one inch in girth and lateral prominence in favour of the right hemisphere. This was mainly due to the absence of the angular and superior temporo-sphenoidal convolutions on the left.

Thus the measurements bore out the conclusions drawn from a comparison of the anatomical details of the two hemispheres, viz. that the left hemisphere was generally smaller than the right, and that this inequality was due to the reduced size of the individual convolutions, which were otherwise similar on the two sides; but that there was one exception, and that was that the angular and superior temporo-sphenoidal convolutions were absent in the left. Moreover, the middle and inferior temporo-sphenoidal convolutions were fused together on the left, and their place occupied by a single convolution, which was considerably smaller than those which it represented on the opposite hemisphere. Of the other cerebral lobes on the left the parietal appeared to be the most markedly

reduced in size, and to be comparatively smaller than either the frontal or occipital.

When looked at in connection with the condition of the several convolutions already described, the other parts of the brain presented peculiarities, which were very striking and of unusual interest.

The left optic thalamus was hardly more than one half the size of the right, and though on a level with the latter anteriorly it stopped short of it by at least one quarter of an inch posteriorly.

The corpora geniculata, which were well developed on the right, were exceedingly small on the left; and the left optic tract was not much more than one quarter the size of its fellow of the opposite side. The left optic nerve was decidedly larger than the right, but the disproportion between them was not nearly so great as between the two optic tracts, but was about as five to four.

The corpora quadrigemina were well developed and equal on the two sides, but the brachia on the left were much smaller than on the right.

The left corpus albicans was, if anything, slightly larger than the right. The two olfactory nerves presented no difference in size, nor was there any marked inequality between any of the other cranial nerves on the two sides, though those on the left appeared to be a little smaller than those on the right. The anterior and the soft commissure were present, and perhaps a little small. The pineal gland and pituitary body were normal.

The corpus striatum on the left was smaller than that on the right, but the disproportion was not nearly so marked as between the two optic thalami.

The left crus cerebri was decidedly smaller than its fellow, and the left side of the pons Varolii was a little smaller than the right. The disproportion between the two sides of the medulla oblongata was extreme. This appeared to be almost entirely due to the great diminution in size of the left anterior pyramid, which was so small that the olivary body stood boldly out and came to within

one sixteenth of an inch of the anterior median fissure; while the right olivary body was separated from the latter by at least one quarter of an inch. In other words, the left anterior pyramid was about one fourth of the size of the right. The two halves of the cerebellum and their crura appeared to be quite equal in size and similar in every respect.

Both the history of the patient and the anatomical peculiarities of the brain show that we must consider the case as one of malformation of one portion of the left hemisphere and arrest of development of the remainder.

The most striking characteristics of the specimen are :

(1) The general arrest of development of the left hemisphere.

(2) The small size of the corresponding crus cerebri and anterior pyramid.

(3) The absence of the angular gyrus and superior temporo-sphenoidal convolution, together with the fusion of some of the other convolutions of the left temporo-sphenoidal lobe.

(4) The small size of the optic tract, optic thalamus, and corpora geniculata on the same side.

Considering the knowledge we now possess from observations conducted both ante-mortem and post-mortem, it can hardly be doubted that the condition of the anterior pyramids or motor strands must be looked at in connection with the arrest of development of the central convolutions, viz. the two ascending convolutions and their expansions near the great longitudinal fissure. It must be accepted as proved not only that the latter are in some special way connected with the motor impulses transmitted from the cortex to the various voluntary muscles of the body, but also that when their influence is wholly or partially abolished by disease, the motor strands passing along the anterior pyramids gradually undergo atrophy and degeneration, and stiffness and contraction of the limbs result. But more than this it has been shown by several recorded cases that the same atrophic condition of the motor strands

is present, and the same condition of limbs, when the cortical motor areas are congenitally malformed. Hence it seems to us that we are justified in saying that the arrested development of the ascending central convolutions explains that of the motor tract.

With regard to the frontal lobes no observations drawn either from experiment or disease have succeeded in definitely localising any specific functions in them; nor have we any knowledge of such intimate connection of any of the cerebral nerves with them as would lead us to expect that marked atrophy or degeneration of these nerves would result from their deficiency.

Some physiologists have concluded from their experiments that the occipital lobe contains visual centres, and of late Ferrier himself has inclined to this view. The present specimen tells neither for nor against such a theory. For the slight reduction in the size of this lobe cannot be made responsible for the extreme atrophy of the optic tract; though it is possible that the remnant of the latter which still exists may owe its survival to the presence of the occipital lobe.

The case is different, however, with the angular gyrus and temporo-sphenoidal lobe. Ferrier's experiments have raised a very strong presumption in favour of the theory that the angular gyrus has some special function in relation with sight, some intimate connection with the optic tract. And we hold that the specimen under consideration affords anatomical confirmation of this view. Setting aside the central convolutions and the degenerate motor strands in relation with them, the rest of the left hemisphere, with the striking exception already mentioned, presents only such general slight diminution in size as will explain any inequality which may exist between the nerves proceeding from the two sides. But the angular gyrus and temporo-sphenoidal lobe on the one hand, and the optic tract, optic thalamus, and corpora geniculata on the other, are so exceptionally malformed and deficient, that some interdependence between them is at once

suggested. And although from a consideration of this single anatomical specimen we are hardly justified in making any more precise assertion, still we can scarcely avoid looking upon it as confirmative of those physiological experiments which point to the angular gyrus as in some way bound up with the function of vision.

The opinions of physiologists are still far from unanimous respecting the functions of the optic thalami, nor is it universally allowed that they have any special relation to vision. The great reduction in size of the left optic thalamus in this case, when looked at in conjunction with the still greater diminution of the optic tract must, we think, be taken as striking evidence in support of the doctrine that this large basal ganglion is directly concerned in sight, although this may be far from its only function. The same may be said with regard to the corpora geniculata, about the connection of which with the optic tract there is much less difference of opinion.

The fact that the corpora quadrigemina are well developed and equal on the two sides is of considerable importance, as it indicates that these bodies are not in the direct line of fire, so to say, between the retina and the cerebral cortex. It does not, however, prove that they have no connection with sight. On the contrary, as is widely believed, they may be in some way related to the co-ordination of the ocular muscles, which is necessary for normal vision. And in this patient's case every observer has asserted that the eyes appeared to be healthy and similar in their movements, a fact which would be in accordance with this view of the function of the corpora quadrigemina.

Another point of interest in the case is that it supports the opinion now generally held, that a complete decussation of the optic nerves does not take place in the chiasma, for the left optic tract is very much smaller than the right, whereas the right optic nerve is only slightly smaller than the left. This could not have been the case had complete decussation occurred in the chiasma, for then

the same relative proportion should hold between the two optic tracts and the two optic nerves. But this is not so, and the actual condition of things can only be accounted for on the supposition that to the fibres of the right optic nerve, which come from the left or atrophied optic tract, are added some of the fibres of the right optic tract, which consequently do not decussate.

With reference to the question of the localisation of other functions, such as hearing, smell, and taste, in the temporo-sphenoidal lobe, this case gives a dubious answer. For although, in spite of the abnormal condition of this lobe, there is no marked inequality between the nerves connected with these senses on the two sides, still it is uncertain how far the normal temporo-sphenoidal convolutions are represented in this malformed specimen. Hence it is not legitimate to conclude from the fact the nerves of special sense in question are not reduced in size in the same proportion as the temporo-sphenoidal lobe, that this part of the hemisphere is not in direct functional connection with them. The brain, which has been described, yields no decisive information on this point, but we hold that it does give strong support to the views held by Ferrier as to the localisation of at least a part of the visual centres in the angular gyrus.

DESCRIPTION OF PLATES X AND XI.

Asymmetry of the Brain (SEYMOUR J. SHARKEY, M.B.).

PLATE X.

- FIG. 1. Base of Brain.
2. Vertex.

PLATE XI.

- FIG. 1. Right Hemisphere (normal).
2. Left Hemisphere.
A. Ascending frontal convolution.
B. Ascending parietal convolution.
C. Supra-marginal convolution.
D. Inferior border of the parietal lobule.
E. Third annectent convolution.
F. Middle temporo-sphenoidal convolution.
G. Convolution formed by offsets of the parietal lobule and second annectent gyrus on the left, and by these together with a branch from the angular gyrus on the right, and running into the middle temporo-sphenoidal convolution.
H. Island of Reil.
K. Angular gyrus.
L. Superior temporo-sphenoidal convolution.

Fig. 1.

Fig. 2.