AN ACCOUNT OF A CASE
IN WHICH THE
CORPUS CALLOSUM, FORNIX, AND
SEPTUM LUCIDUM,
WERE IMPERFECTLY FORMED.

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THE Brain, of which the description is now offered to the Society, was found by Dr. Ormerod, in a girl 21 years old, who died in St. Bartholomew's Hospital with pericarditis, and who had presented, while under observation there, nothing remarkable in the condition of her mind. I am indebted to Dr. Ormerod, both for the opportunity of publishing the case and for much assistance in collecting the evidence relating to it.

At the first examination of the head, nothing peculiar was observed in the form or texture of the skull. The dura mater was rather more than usually adherent to the upper surface of the brain, the Pacchionian glands were numerous, and the anterior part of the falx was deficient. The inner surfaces of the cerebral hemispheres were connected by pia mater in every part but one, where, in the middle line, and just above the great transverse fissure, there appeared a round aperture about one-fifth of an inch in diameter, through which the cavity of the ventricles was seen.

In the suspicion of some unusual formation, the brain, as soon as this aperture was discovered, was carefully removed

from the skull, and the following report of its condition was drawn up:—

The general proportions of the brain appear normal. The antero-posterior diameter of the cerebrum is 7 inches; its width about $5\frac{1}{2}$ inches; the width of each hemisphere, measured across the anterior lobe in front of the corpus callosum, is $2\frac{1}{2}$ inches. The antero-posterior diameter of each hemisphere of the cerebellum is $2\frac{1}{2}$ inches; its whole width $3\frac{7}{8}$ inches. The convolutions of both cerebrum and cerebellum have the usual size, form, and arrangement.

On separating the remains of the cerebral hemispheres (the upper parts of which have been removed), there is visible in the ordinary position of the corpus callosum only a rudiment or a remnant of that organ.* This consists of a transverse band, measuring in the median line 1·4 inch from before backwards, having its anterior margin 1·9 inch distant from the anterior margin of the cerebral hemispheres, and the middle of its posterior margin 3·7 inches from their posterior margin.

The anterior margin of this imperfect commissure is just two lines in thickness, smoothly rounded. It is formed by a nearly cylindrical bar or cord of white nervous matter, extended from one hemisphere to the other, in a semicircular horizontal arch, with its concavity forwards. The pillars of this arch, which represents the *knee* of the corpus callosum, penetrate on each side into the substance of the cerebral hemispheres; its anterior and upper surfaces are free in the space between the hemispheres; and from its lower surface, near its posterior margin, a thin layer of grey nervous matter, the lamina cinerea, extends to the upper surface of the chiasma of the optic nerves. The posterior surface of the same arch is, on the right side, united with the rest of the corpus callosum; but, on the left side, is separated from it by a fissure from one-fourth to three-fourths of a line in width, one thin and short fasciculus alone connecting them.

The rest, i. e. the body, of the corpus callosum, forms a thin

* See Plate V. 1, 1.

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fasciculated layer of white nervous substance, measuring a little more than an inch in the middle line, and gradually increasing in length as it thence proceeds towards each side and passes into the substance of the cerebral hemispheres. Its posterior margin is thicker than the rest of it, and forms a defined border, like a hem, a line and a half wide, and from half a line to a line in thickness. This border forms an arch, wider but thinner than that of the anterior border, with its concavity directed backwards, and having its pillars continued far back, thickening as they proceed towards the upper part of the convolution of the hippocampus.

In the space enclosed within, behind, and beneath the arch formed by the posterior border of the corpus callosum, there appear, after the removal of the velum, nearly the whole of the optic thalami, the middle and posterior commissures, the pineal gland and its commissure, the corpora quadrigemina, and the extremity of the superior vermiform process of the cerebellum.

After hardening the brain in alcohol, I examined some other parts of it, and, tracing as far as possible the course of the fibres in its corpus callosum, found them admitting of this description:—

The fibres, or margins of the lamellæ, in the front and upper surfaces of the anterior border of the corpus callosum, radiate, prolonging the pillars of its arch, downwards, forwards, and some downwards and backwards, into the anterior lobes of the hemispheres, in which the majority of them may be traced to the cortical substance. It appears, also, as if the whole of the fibres of this anterior border were thus continued into the lower part of the anterior lobes.

The middle, thin, and fasciculated portion, or body, of the corpus callosum is composed of flat bands of fibres, a few of which extend transversely from one hemisphere to the other; but the greater part pass with various and unsymmetrical obliquity, decussating with the transverse bands and with each other. Most of these oblique bands pass from left to right; the whole of the left side of this part of the corpus callosum being thicker than the right.

On the right side, (on which alone they were left perfect,) all the fibres of this part of the corpus callosum pass outwards, radiating, and forming the roof of the lateral ventricle. On their way, none of them pass upwards to the convolutions of the inner part of the hemisphere; but they all, opposite the outer margin of the corpus striatum, rise, and then again descend, so as to form a ridge like that formed by the fibres of a natural corpus callosum, but only half as high and half as wide, and not reaching further back than the middle of the margin of the optic thalamus. Outside the ridge, the superficial fibres which are engaged in forming its anterior half, appear to continue their course, radiating still outwards, and shortly turning upwards into the upper and outer part of the anterior lobe of the hemisphere, the part which is directly above the *island* of Reil. The fibres which are engaged in the posterior half of the ridge, and some yet further back, become entangled at its outer margin; they appear to turn rather abruptly downwards, decussating with bundles of fibres, which are proceeding from below upwards and from within outwards.

The fibres of the most posterior part of this body of the corpus callosum proceeding far backwards, are confused with those of the posterior thickened hem-like border, and perhaps with those also of the fornix; and the fibres of the three, thus mingled, divide into two portions, which completely enclose and form the walls of the posterior horn of the lateral ventricle, and which do not appear to pass further into the substance of the hemisphere; and a third portion, which proceeds in the ordinary way over and along with the convolution and *tænia* of the hippocampus.

On the under surface of the corpus callosum there is not, in their usual position, a trace of either the septum lucidum, or the middle part of the fornix. The side portions of the latter organ are closely attached to the whole length of the body of the corpus callosum, and are natural in size and arrangement. The anterior and posterior commissures, and the pillars of the fornix, present no deviation from what is

usual; but the middle, or soft commissure, is very large. It measures six-tenths of an inch from before backwards, and at its posterior border coalesces with the nates below the orifice of the aquæductus Sylvii. It appears also rather thicker than is usual.*

In no other part of the brain could I discern anything uncommon in either size or structure.

In the hope of obtaining some guidance in the obscure physiology of the corpus callosum, I made careful inquiries into all that concerned this patient's mind. I procured evidence from her father, step-mother, master, and near neighbour, who all agreed on all essential points.

Her father is a workman in a colour manufactory, and has the best testimonial of the good condition of his mind, in that he has been twenty-five years in the same service. Her mother, who has been dead eleven years, presented nothing remarkable in the state of her mind, till about twelve years before her death, and two years before the birth of this girl, when, without any known cause, she became melancholy, fearful, and insane on matters connected with religion. Her insanity was aggravated while she was pregnant with her third child; and during her pregnancy she twice attempted to commit suicide by jumping from a window. Her melancholy was again aggravated in each of three following preg-

* The middle commissure is peculiarly liable to variations of size, but its dimensions in this case were so great that they must excite a suspicion whether, notwithstanding the difference of their apparent structure, it may not have compensated in a small degree for the deficiency of the corpus callosum. Duplicity of the middle commissure is, I believe, so rare, that I may be allowed to take this opportunity of mentioning a case which has been lately observed by my brother, Dr. Paget, in an unusually intelligent agricultural labourer, 22 years old, who died under his care, with ulceration of the cervical vertebræ, in Addenbrooke's Hospital, at Cambridge. The two commissures lay one above the other, a space intervening of sufficient size to admit a large probe between them. "Both consisted of thin sheets of grey cerebral substance, and presented lunated edges before and behind. The lower one was above half an inch long; the upper one less than a quarter of an inch. The latter was situated exactly above the middle of the former." All the rest of the brain was naturally formed.

nancies ; and her husband clearly remembers that it was so while she was pregnant with this girl. She made no more attempts to commit suicide, but it was at this time necessary to have nurses constantly watching her.

The girl herself was not remarkable for any excellence or great defect of mind. She was light-hearted, happy-tempered, heedless, and very girlish in her manners. Her moral character was unimpeached, even by her step-mother, who certainly did not err by judging too kindly of her ; and her master, a respectable master-printer, thought her so trustworthy, that for two years he daily left his house in her sole charge. She habitually attended church, and had no indications of the insanity under which her mother laboured.

She was educated for six or seven years in the Islington School of Industry, where she learned to read very well ; but after she left the school, she always read in a headlong way, very fast, sometimes missing words, and not staying to correct herself. She showed great facility in learning by rote ; she could thus learn twenty verses of the Bible in about half an hour. She had a good verbal memory, and as long as she was in health, used to be constantly singing hymns and scraps of songs which she had learned in childhood. She was taught in writing, but she acquired the art so imperfectly, that she could scarcely do more than write her own name. She had not a much better knowledge of arithmetic, and would make mistakes in reckoning her wages, or in receiving change of money. She was dexterous, but not accomplished, in all household work.

Her heedlessness was remarkable in her dress ; she was almost indifferent to what she wore, and in her own person was of uncleanly habits. She showed almost as little regard for money, and would make bad bargains many times in the same kind of transactions. She had a singular way of speaking, addressing and answering her equals always, and her superiors sometimes, in a sharp, abrupt, off-hand manner, with seeming, though not intended, rudeness ; and in this she persisted, though often reproved for it.

But, from all that I could hear, I could not find otherwise than that this girl's mind was one of the least remarkable kind. Her only peculiarity was vivacity, and a want of caution, showing themselves in an habitual rapidity of action and want of forethought, deliberation and attention. Certainly she could not be regarded as unusually deficient in either moral goodness or intellectual power; for if we consider her scanty school instruction, the neglect of teaching which she must have suffered in her early years, while her mother was insane, and her natural heedlessness, we must admit that she acquired at least as much knowledge as the average of persons in the like case would.

Before discussing the many questions which this case suggests, I will state the chief facts of the other recorded instances in which the corpus callosum was defective, without any other serious wrong condition of the brain.* These instances are very few; and when it is sometimes said that they are not a few, I suspect it is because one of them, that

* The cases which are excluded on the ground of their being complicated, and therefore uninformative on the questions here considered, are comparatively numerous. Such are the cases recorded by G. Battista, (*Storia del Mostro di due Corpi*. Campana: 1748. 8vo.) of a child, quite senseless and motionless, which had no corpus callosum, and, it is said, scarcely a trace of pons, or medulla oblongata; that by Sandifort, (*Museum Anatomicum Acad. Lugduno-Batavæ*, t. iv. p. 86, tab. cxc, xcxi, Lugd.-Batav. 1835. folio,) of an idiot, 20 years old, who had an exceedingly small and anteriorly narrow brain, with a corpus callosum like that of this girl; the case of James Cardinal, recorded by Dr. Bright, (*Reports of Medical Cases*, vol. ii. p. 431,) and by Dr. Spurzheim, in his "*Anatomy of the Brain*," and other works, in whom the corpus callosum, after exceeding distension in chronic hydrocephalus, gave way, but it is not known when or with what result. Notices of other cases of deficiency of these commissures, associated with still greater malformations of the rest of the brain, such as hydrocephalic hernia of the hemispheres, cyclopia, anencephalia, &c., may be found in the works of Isidore Geoffroy St. Hilaire (*Histoire des Anomalies*, t. ii. Paris: 1836), Vrolik (*Handboek der Ziektekundige Ontleedkunde*, D. i. p. 528, &c. Amsterdam: 1840), and Rokitsansky (*Handb. der Pathologischen Anatomie*, B. ii. p. 760, &c. Wien, 1844). Treviranus (*Biologie*, B. vi. p. 155), and Tiedemann (*Anatomie der kopflösen Missgeburten*), may also be referred to. Since this paper was read, a case has been published by Dr. Ogier Ward, in the *Medical Gazette*, March 27, 1846.

by Reil, has been so often quoted, that it has seemed to be many different cases.

The first case that I can find is recorded by Reil.* A woman about 30 years old, who was otherwise healthy, but was of dull intellect, yet could go on errands from the village where she lived, to the town, and carry common messages, suddenly fell, and died apoplectic. On opening the head, it was found that the ventricles were moderately full of water, and that the corpus callosum was divided longitudinally in the middle, or, rather, that its middle and free part was in its whole length deficient. The optic thalami lay exposed, and the two halves of the cerebrum were held together only by the commissure of the optic nerves, the anterior commissure, the isthmus of the crura cerebri in front of the pons, and the corpora quadrigemina. Anteriorly, the whole of the knee and of the crura of the corpus callosum, as well as the septum which lies within the knee, were wanting. The inner surfaces of the anterior cerebral lobes were completely separate down to the anterior and middle commissures; and the parts of them in which the knee and the beak of the corpus callosum should have been inserted, were covered with such convolutions as commonly the surface of the brain is covered with. The middle and posterior part of the corpus callosum, and its appended posterior border, were also absent.

The fornix arose as usual from the optic thalami, formed the corpora mammillaria, ascended from them behind the anterior commissure, coalesced on both sides with that part of the roof of the cerebral ventricles which runs just under the longitudinal convolutions, and formed with it a smooth and rounded edge. It then curved round the posterior part of the optic thalamus, entered the descending horn of the lateral ventricle, and adapted itself therein in the usual manner.

A second case is recorded by Mr. Solly;† and the speci-

* Reil and Autenrieth's *Archiv für die Physiologie*, 1812. Vol. xi. p. 341.

† *The Human Brain*, p. 433. London: 1826. 8vo.

men which he describes is preserved in the Museum of St. Thomas's Hospital, where I was favoured with permission to examine it and the account of the patient which is inserted in the Case-book.

The patient was 17 years old, but did not appear more than 15. He died seven days after a fall, in which the base of his skull was fractured; and it is unfortunate that we have not the advantage of Mr. Solly's own observations concerning the state of his mind, since he was almost totally insensible from the time of the injury to that of death. The account given by his mother, who was not an intelligent person, was that she considered he was never right from his birth, and that, in consequence of a difficult labour, as she supposed, he had always been of weak intellect. It had always appeared difficult to him to maintain the erect posture, and he used to stumble and roll about. He had been from infancy unable to hold up his head, and generally appeared drowsy. He was fond of reading, and religious books were his greatest favourites. He was childish in his amusements, very good-tempered, and willing to do all that was required of him. He sometimes talked pretty rationally, but generally, to use his mother's expression, he "was boobyfied." It is said that he had no power of reviving or comparing impressions on his mind; but this is sufficiently disproved by the fact that he could read, and was fond of a particular class of books.

On separating the cerebral hemispheres, parts of which were deeply injured by the fracture of the skull, there was seen in the place of the corpus callosum, a pale semitransparent membranous cyst attached to the left hemisphere, forming part of the roof of the left lateral ventricle, and protruding into the space between the hemispheres. The cyst was formed of thin membrane, and had numerous small vessels ramifying on its inner surface: it measured two inches in length, and one inch in width, and contained about an ounce of limpid fluid.

The corpus callosum is wholly absent; and the third ven-

tricle, which is exposed in the preparation, was covered by only a thin membrane, probably the velum. The middle part of the fornix is also absent. Its right pillars and lateral portion appear to be perfect; the outer thin free border lying in its usual position, over the optic thalamus: its inner border is united to the inner wall of the lateral ventricle, so that there could have been, I think, no opening into the right ventricle above the fornix. A part of the left posterior pillar of the fornix also appears, but is diminutive; it is similarly attached to the inner wall of the left ventricle: the anterior and chief part of this wall is occupied by the cyst, which conceals, and, possibly, has destroyed some of, the rest of the fornix.

Both the lateral ventricles are very much enlarged, and each contained about four ounces of fluid. The third ventricle also is large, and the middle commissure appears both wide and thick.

The patient in a third case related by Mr. Chatto,* was a child who died when a year old. During the last nine months of its life, it was subject to violent convulsive fits, recurring several times daily; but so little interfering with its general health, that, till within a few weeks of its death, it grew and appeared quite well. In all its life it "manifested no sign whatever of recognising persons or objects."

In examining the brain after death, a considerable quantity of fluid escaped when the dura mater was cut through, flowing, apparently, from between the hemispheres. On separating the hemispheres, the cavities of the lateral ventricles were at once exposed, the corpus callosum, septum, and middle part of the fornix being absent, with the exception of two narrow slips of the corpus callosum, a few lines in breadth, which were extended between the anterior portions of the hemispheres. Just anterior to the corpora quadrigemina, lying in a cavity large enough to contain the tip of the little finger, was "an hydatid, about the size of a small hazel-nut, having much smaller ones adhering to it, and filled with a

* London Medical Gazette, Jan. 10, 1845.

gelatinous fluid." The optic nerves, and the tubercula quadrigemina, were remarkably small. A small quantity of fluid was found in the ventricles. The cerebral substance was very firm.

I can find no cases besides these in which the history of persons suffering from almost uncomplicated deficiency of the corpus callosum is recorded. And of examples without histories, two only appear; namely, one mentioned by Meckel,* in an adult woman, the rest of whose brain was in a natural state, except in that the lateral ventricles were rather large: and another referred to by M. Longet,† as seen by M. Förg, in an adult male epileptic.

But, though these cases be few, they afford good evidence on some questions in the anatomy, the development, and the functions of the corpus callosum. And first, respecting its anatomy. In the brain which I have described, and of which an accurate drawing, by Mr. Delamotte, the Librarian of St. Bartholomew's Hospital, accompanies this paper (see Plate V.), the thinness of the corpus callosum, and its fasciculate character, afford a rare opportunity of perceiving the arrangement of its fibres. Of these fibres, a considerable proportion pass across the space between the hemispheres, with a degree of obliquity which is not implied either in the name of "great transverse commissure," or in the description which is usually given of this organ. For, of all the writers to whose works I have referred, Burdach‡ alone speaks of any of the fibres passing otherwise than transversely in the free part of the corpus callosum, and he says, only, that "many fibres from an anterior part of one hemi-

* Pathologische Anatomie, B. i. p. 301.

† Anatomie et Physiologie du Système Nerveux, t. i. p. 536. M. Longet, probably quoting from Meckel (Handb. der menschl. Anatomie, B. iii. p. 302), refers to what he supposes to be a similar case in Wenzel. But the only case to which he can allude is one of a three months' fœtus (De penitiori structura cerebri, fol., p. 302), in which the corpus callosum was, perhaps, not yet formed, or in which it may have been broken in the examination.

‡ Vom Baue und Leben des Gehirns, B. ii. p. 143.

sphere go to a somewhat more posteriorly situated part of the other." But in this specimen, many fasciculi of fibres proceed from the anterior quite to the posterior part of the body of the corpus callosum ; and if these be, as I believe, representatives of similar fibres in the healthy corpus callosum (for the deficiency here existing is not of a kind to generate an unnatural obliquity of fibres), they exhibit a fact of no small importance ; for, according to the usual descriptions of this and the other commissures, there is an ample commissural connection between several parts of each hemisphere, and between the corresponding similar parts of the two hemispheres, but none between the anterior parts of one hemisphere and the posterior parts of the other. Such a connection may be formed by fibres like those which are here shown ; although I have often failed in attempts to trace fibres as oblique as these in the healthy corpus callosum. In such attempts, as one separates the vertical lamellæ in transverse cleavings of the organ, proceeding from its outer side towards the median line, comparatively few fibres are broken ; but at the median line there is such an interlacement of the fibres of the successive lamellæ, that the cleavage cannot be continued till many of them are torn across. I have been unable to trace, for even a short distance, the further course of the fibres which are thus broken ; but it is not improbable that here, in or near the median line, a small proportion of the fibres of the corpus callosum deviate from the transverse into an oblique or longitudinal course. Something of the kind is indicated in this specimen, in which some of the largest fasciculi go transversely from the outer side to the middle of the corpus callosum, and then assume the oblique direction. These are all in the body of the corpus callosum : the fibres, in its anterior and posterior borders, appear all to pass transversely, as if uniting corresponding parts in the opposite hemispheres.

Secondly,—With regard to the normal development of the parts which are in these cases defective, there does not in them appear any help towards the decision of the question

how, and from what parts, the corpus callosum is first formed.* Yet some conclusions may be drawn from these cases.

1. In the first case, the fibres of a corpus callosum, of which the development was probably arrested (according to the description by Tiedemann†) in or before the sixth month of foetal life, are traceable to all the regions into which those of the perfect corpus callosum extend. Defective as they are in number, they appear normal in their plan. We may, therefore, believe that in the early foetus, the corpus callosum, though it bears a less proportion to the size of the cerebral hemispheres than it does in after-life, yet from the first gathers its fibres from all its usual sources.

2. The examination of these defects confirms what we might deduce also from comparative anatomy, namely, that the corpus callosum is that part of the brain, the development of which is last of all attained. For the corpus callosum has been often absent or imperfect in cases of defect of the cerebral hemispheres: but it has also sometimes been absent when nearly every other part of the brain was perfect. The former cases confirm the rule derived from comparative anatomy, that, in the brains of placental mammalia, the development of the corpus callosum is commensurate with that of the extra-ventricular masses of the cerebral hemispheres. The latter cases show that there is no part of the brain, the development of which is dependent on that of the corpus callosum. Probably not even the middle part of the fornix is thus dependent, for we may explain its coincident absence in every recorded case of abnormal absence of the corpus callosum, on the supposition that the same diseases hindered at once the development of both: while in favour of its independence, are the facts discovered by Professor Owen,‡ that,

* See on this question Bischoff's *Entwicklungsgeschichte*; in v. Soemmering, *Vom Baue des menschl. Körpers*; Leipzig, 1842, B. vii. p. 176.

† *Anatomie und Bildungsgeschichte des Gehirns im Fœtus*. Nürnberg, 1816, 4to. p. 155.

‡ On the Structure of the Brain in Marsupial Animals; in the *Philosophical Transactions*, 1837, p. 87.

in the marsupialia, the middle transverse portion of the fornix exists without a corpus callosum, and that, in the whole mammalian series, the corpus callosum and fornix are developed commensurately with two distinct parts, namely, the corpus callosum with the extra-ventricular masses of the cerebral hemispheres, and the fornix with the hippocampi and their tæniæ. Even the septum lucidum, though its position and apparent extent in man may be determined by the relative positions of the corpus callosum and fornix, yet probably is dependent for its development on the latter alone. For the analogues of the septum lucidum are found in the marsupialia, and in birds, without any corpus callosum, in the laminæ of medullary substance which extend from the superior and internal border of each hippocampus to the overlapping inferior and internal border of the hemisphere: and in Reil's and Solly's cases, the bond of connection between each of the lateral halves of the fornix and the hemisphere, by which bond the internal and superior wall of the lateral ventricle is completed, must be regarded as the analogue of one layer of the septum lucidum; the two layers, which should have between them only the narrow cavity of the fifth ventricle, being, in all instances of complete absence of the corpus callosum, placed wide apart, and attached directly to the hemispheres themselves. In the case which I have here described, the analogues of the septum lucidum are in an intermediate position, corresponding to the imperfection, but not total absence, of the corpus callosum; for they connect the lateral halves of the fornix, not to the margins of the hemispheres, but to the under surface of the corpus callosum; yet they are very far asunder.

Thirdly,—I beg to offer some considerations on these cases, in the relation which they bear to questions concerning the physiology of the corpus callosum.

They prove, as the facts of comparative anatomy also do, that a corpus callosum is not necessary for the mental reception of sensations, or for the ordinary exercise of the will upon the muscles, or for the natural movements of any inter-

nal organs, or for due nutrition or secretion in any part. On these points, the cases recorded by Reil and myself afford unexceptionable evidence, and the defective voluntary movements in Mr. Solly's case may be fairly ascribed to the existence of the large cyst in the left cerebral hemisphere, and to other adjacent morbid conditions, probably coincident with it. The apparent opposition of Mr. Chatto's case may be similarly explained. The cases, therefore, prove that, in regard to sensation and voluntary motion, that is true in the instance of man, which has been proved for lower animals, by the experiments of many physiologists, from Lorry* to Valentin,† and Longet,‡ who have found that neither pain nor convulsion is excited by irritation of the corpus callosum, and that, after its complete longitudinal division, sensation and voluntary motion are retained. And, certainly, the plain negative results of these cases prove more than such experiments can; for experiments on animals cannot prove that any part of the human brain is not, in direct proportion to its greater development, placed in a more close connection with the lower functions of the nervous centres. They are also better adapted than such experiments are, to disprove the contrary conclusion, drawn from certain instances of disease;§ in which instances we may be sure that the insensibility, convulsions, and other like symptoms, supposed to be dependent on the disease of the corpus callosum, were really due to the coincident disturbance of some other part of the brain.

Again, these cases are opposed to the apparent results of those experiments of Valentin|| which led him to believe that division of the corpus callosum in rabbits produces an acceleration of the heart's action, and an increased secretion of bile, and of the fluid of the small intestines, together with

* Mem. des savants étrangers, t. iii.; quoted by Longet, l. c., t. i. p. 534.

† Ueber die Thätigkeit des Balkens; in his Repertorium für Anatomie und Physiologie, B. vi. 1841, p. 361.

‡ Anat. et Phys. du Système Nerveux, t. i. p. 534.

§ The best collection of such cases may be found by referring to Burdach, Vom Baue und Leben des Gehirns, B. iii. p. 485.

|| L. c. p. 359, c. s.

apathy and an obstinate and vicious temper. No condition like any of these has been observed when the corpus callosum was absent: probably, therefore, if these were really the consequences of his experiments, they depended on the damage of some other part.

We are thus compelled to seek for the office of the corpus callosum among the higher and more internal functions of the brain. But we search in intense obscurity, for the facts do not even show that its existence is necessary to the possession and average development of any of the admitted faculties of the mind. ^a

We might hope to obtain a clue to its function in some characteristic mental distinction between the placental mammalia, in whom the corpus callosum exists, and all the other vertebrata, in whom it is totally absent. But I believe that if we take these mammalia as a class, we are not yet acquainted with any such superiority, either in the kind or number of their mental faculties, or in the apparent power of any of them, or in their mode of manifesting them, as we can ascribe to their being sole possessors of this organ.

These cases of morbid anatomy are hardly more instructive. One-sixth, or a less portion, of the corpus callosum, in the girl whose history I have related, sufficed for all the ordinary operations of the educated mind. I am aware that, in certain cases* of destruction of nervous matter, the loss of power

* Those to which I here especially allude, and which probably are most nearly analogous to deficiency of the corpus callosum, are the examples, such as are mentioned by Ollivier and others, of the spinal chord retaining an apparently unimpaired power of transmitting impressions through a small remnant of its substance. These examples occurring in diseases are confirmed by some of the experiments of Van Deen (*Nadere Ontdekkingen over de Eigenschappen van het Ruggemerg*. Leiden, 1839), and Volkmann (*Wagner's Handwörterbuch; Art. Nervenphysiologie*). And an experiment which I have often made on the hearts of turtles shows something of the same. If a portion of the heart, while still irritable, be so nearly divided into two, that the halves remain connected by only a very narrow isthmus of muscular substance, and one half be mechanically irritated, the subsequent contraction, after extending through this half, will

appears to be less than that of structure: yet if the corpus callosum were really necessary to the operations of a human mind of average power and capacity, its great imperfection should, in this instance, have been marked by some evident sign.

In Mr. Solly's case of complete absence of the corpus callosum, the boy's intellect was weak, but not so weak as on the first reading of his history it may appear. For it must be considered that, in spite of bodily infirmities, which had existed from birth, and were of a kind apt to bring ridicule and neglect—with little education—and with a mother who (Mr. Solly tells me) appeared less intelligent than most hospital patients,—this boy had learned to read, and had acquired a fondness for books, and especially for religious books. In a person in his social and bodily condition, such attainment indicates, I think, the possession of nearly an average amount of mental power. Moreover, whatever mental deficiency there was in him, it cannot be, certainly, all ascribed to the absence of the corpus callosum: his brain had other defects. The permanent distension of the ventricles by fluid might not be attended by weakness of the mind;* but the large cyst over the ventricle, existing, as it probably did, from birth or infancy, and involving the middle of one half of the fornix, may have had a more evil influence. Reil's case, if it stood alone, would afford as much evidence as one case can, that the corpus cal-

extend also across the isthmus, and thence over the whole of the other portion; the few nerve-fibres in the isthmus thus serving to convey the irritation to the many in that half of the portion of heart which was not directly irritated. Such a transmission will not take place through a portion of tendon connecting two pieces of the heart.

* In the Museum of St. Bartholomew's Hospital (Series 6, No. 64), is the brain of a young man who was remarkable for cleverness and for excellence in his work as an ornamental room-painter. He was said to have had hydrocephalus in infancy, and the shape of his head confirmed this account. He died of some disease not connected with the brain, and the lateral ventricles were found each containing about three ounces of fluid, with their lining membrane thickened and granular, and adhesions of the fornix and choroid plexuses to the optic thalami.

losum is necessary to the possession of the average power of the human mind. Yet caution is necessary in concluding from it, because, though the mental defect seems to have been greater than in Mr. Solly's case, yet the apparent cerebral defect was less : some, therefore, of the greater defect must be ascribed to a structural error in the brain which was not discerned, and if a part of it was certainly due to this, more may have been. And, indeed, so long as we are unable to tell whether the structure of a brain is absolutely healthy or not, we shall have no right to ascribe to the absence of a corpus callosum a greater amount of mental deficiency than existed in Mr. Solly's case: rather, we may expect, that if a brain should be found, having really no defect, except the total absence of the corpus callosum, it will be in a person who had more mental power than the boy had, whose history Mr. Solly has recorded.

On the whole, these cases force us to think that the corpus callosum has its office as an organ for the highest operations of the mind. But of what part of the mind it is one of the ministers, and how its function is discharged, we have no evidence whatever. Its structure indicates that it is not a nervous centre, neither a source of nervous power, nor a first recipient of the influence of the mind : for it is composed wholly of nervous filaments, such as, elsewhere, have no higher office than that of conducting impressions, and are incapable of either originating, controlling, or diverting them. If, therefore, as a reasonable hypothesis, we adopt the general expression of the office of this and other commissures, that "they serve to ensure unity or harmony of action between those parts of the brain between which they are placed," we must use it as meaning, for the corpus callosum, not that it is a centre of action from which similar, and, therefore, harmonious influences proceed to each side ; but that it is formed of conductors, by which a part on one side of the brain is informed (as it were) of the state of some part on the other side, and, probably, is induced into the same state. But, whatever may be meant by this and any similar forms of ex-

pression, they must be held as only hypothetical ; there is no substantial evidence for their truth.

It is not a valid objection against the opinion that the corpus callosum is necessary to only the highest operations of the human mind, that a similar organ exists in nearly all mammalia, although their minds are incapable of such acts as are performed by even the poorest human intellects ; for what is assumed is, that the corpus callosum is necessary to the highest offices of which the cerebral hemispheres are capable, and it may be equally necessary to those which are, relatively, the highest offices in any animal, although, absolutely, the dignity of these offices may be very different in different instances.

Many of the facts here adduced afford support to that doctrine of the brain being a double organ, to which, though often assumed or discussed, the admirable Essay of Dr. Holland* has first given clearness and determination, and to which, perhaps, more attention than his essay received, has been attracted by the vigorous writings of Dr. Wigan ;† for, if it is not necessary that the two halves of the cerebrum should be connected, in order that the mind may exercise all but its highest powers, it is certainly very probable, that for all but these, each half is, by itself, a sufficient organ. But as it is not my purpose to consider the physiology of the cerebral hemispheres, I shall not dwell on this subject, already so well discussed in the works to which reference has just been made.

* On the Brain as a double organ : in his *Medical Notes and Reflections*, p. 151. London, 1839.

† The Duality of the Mind. London, 1844 ; and in the *Lancet*, 1843-4-5.

EXPLANATION OF PLATE V.

- 1, 1.—The anterior and posterior borders of the corpus callosum.
- 2.—The fibres of the anterior, and (3) the fibres of the posterior, part of the corpus callosum, radiating into the right cerebral hemisphere.
- 4.—Fibres of the corpus callosum joining those of the hippocampus.
- 5.—The cavity of the posterior horn of the right lateral ventricle.
- 6.—The soft, or middle, commissure.
- 7.—The left margin of the fornix exposed by opening the left lateral ventricle.
- 8.—The cut margin of the corpus callosum, turned aside to expose the cavity of the left lateral ventricle.