THE GOULSTONIAN LECTURES ON THE LOCALISATION OF CEREBRAL DISEASE.

Delivered at the Royal College of Physicians of London.

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LECTURE I (concluded).—March 15th.

MM. FRANCK and PITRES* have shown that a distinct interval elapses between the excitation and the movement: an interval which, after deducting the latent periods of nervous and muscular stimulation, and the rate of transmission of neural impulse in the cord and nerves, leaves a residue of nine-two-hundredths of a second of retardation in the grey matter. If, however, the grey matter be removed, and the stimulus applied to the medullary fibres, the period of retardation diminishes to six-two-hundredths of a second. This proves, in accordance with the laws of stimulation of nerve-centres, that the grey matter intervenes, not as a conductor, but as a centre. It has likewise been proved by the experiments of Putnam, Carville and Duret, etc., and verified by Franck and Pitres, that, in order to excite movements after removal of the cortex, a stronger stimulation is necessary than that required for the cortex itself. This, on the physical conduction theory, would be, the less the resistance, the less the effect: a proposition manifestly absurd. It is, however, the property of the nerve-centres to reinforce an excitation; and such is the case with the cortical grey matter. Still more important, perhaps, than these results, is the fact that certain modifications occur in the excitability of the medullary fibres after removal of the cortex, which conclusively demonstrate that we have to deal with neurility, and not with mere electrical conductivity, as Mr. Lewes supposes.

We know from Waller's researches that, when a motor nerve is divided, the excitability gradually diminishes and ultimately disappears: phenomena which proceed *pari passu* with progressive degeneration of the nerve from the centre towards the periphery. In a similar manner, it has been found by Albertoni and Micheli,† confirmed by Dupuy,‡ and by MM. Franck and Pitres, that, after a certain period, excitation of the medullary fibres no longer gives rise to the movements which can be caused by stimulation immediately after removal of the grey matter of the cortex. In dogs, as a rule, as Franck and Pitres have shown, the excitability totally disappears about the fourth day; and this coincides with the period at which, in consequence of the degeneration described, the motor nerves of the dog lose their excitability. By such facts, the only plausible arguments in favour of mere physical conduction of the electrical currents are shown to be absolutely without foundation; and, all other evidence apart, the direct relation of the cortical grey matter to movements is established beyond all doubt.

I have purposely excluded until now the consideration of the effects of localised destruction of the cortex. These, as I hope to be able to show you, are, in the case of man at least, clear and decisive in the same direction. But, it must be admitted, there is a considerable want of unanimity among the conclusions which physiologists have considered themselves entitled to draw from their several experiments. Many of these differences seem to me in a great measure due to narrowness of view, and to the entire disregard of the facts relating to man himself.

We should think it a very misleading research if a pharmacologist were to set himself to determine the mode of action of a drug on the human economy by experiment on an animal, before he had first ascertained whether the animal on which he proposed to experiment exhibited symptoms of being similarly affected by the drug as man himself. Before his researches could be allowed to have any bearing on therapeutics, this would have to be established; for we know that drugs may act differently on different animals. It is even more necessary, in regard to the physiology of the brain, that a similar caution should be exercised. Anatomical homologies must not be pushed too far in support of identity of function.

* Soc. de Biologie, December 23rd, 1877.

† Sui Centri Cerebrali di Movimento. *Lo Sperimentale*, February 1876.

‡ *Physiology of the Brain*, p. 9.

A frog deprived of its cerebral hemispheres still remains capable of a number of the most complicated and adaptive reactions, so little differing from those normally manifested by this animal that, except for the defect of spontaneity, they might be regarded as identical. But no one will say that the symptoms presented by the brainless frog at all resemble the clinical picture of a case of disorganisation of the cerebral lobes in man. The same may be said of pigeons, the favourite subjects of Flourens' experiments, and the origin of many misleading conclusions in human physiology and pathology. Nor are the phenomena in the case of the much-experimented-on rabbit at all comparable to those observed in cerebral disease in man. We might be led, from the effects of ablation of the cerebral hemispheres in this animal, to regard the cerebral hemispheres as having special functional relation to the upper extremities, as these are more particularly paralysed; and this conclusion has a germ of truth in it, when looked at in the proper light, but is a grave error if applied without qualification to human physiology.

The destruction of the cerebral hemispheres in the dog approaches more nearly in its results to the universal powerlessness caused by a similar lesion in man, but not so complete or enduring. The destruction of the cortex only, however, though at first producing a greater or less degree of paralysis of the opposite limbs, does not render the animal quite powerless; and within a few days or weeks the motor powers are regained to such an extent that, except on hurried movements, a superficial observer might come to the conclusion that the animal had not suffered by the lesion.

Some, who do not extend their view beyond dogs, at once jump to the conclusion that facts like these justify them in asserting that not only in dogs, but in man also, the cortex of the brain has no real relation to motility; and that the phenomena which ensue from cortical lesions are merely transitory disturbances of the functions of other parts. Others, if they do admit any direct relation between the two, assume, from the apparent recovery, that there is no exclusive localisation of function, and formulate a law of functional substitution of one part by another to explain the difficulties, chiefly of their own creation.

When, however, we ascend higher, and come to experiments on animals which in conformation, habits (and shall we say kinship?), most closely approach man, and to the experiments of disease on man himself, we meet with results little in harmony with the conclusions drawn by some from their researches on the lower animals. In monkeys, destruction of those regions, excitation of which gives rise to definite movements of the limbs, causes paralysis of voluntary motion complete and enduring, and restricted to those very movements the centres of which are specially destroyed. It will be my endeavour to show you that what is true of the monkey is strictly true also of man.

Taking these facts as established—the proofs of which will be given subsequently—may we not, instead of trying to contradict one set of facts by the other, find some generalisation which will admit of all these apparently discordant results being harmonised with each other and with the great law of evolution? This, I think, can be arrived at, if we recognise the fact towards which all these experiments on different animals point; viz., that the same movements have a plurality of causes, and are represented, though with different significations, in different centres, higher and lower. Those which involve conscious discrimination, and which we term volitional in the strict sense of the term, are those alone which are necessarily paralysed by destruction of the cortex; while those which are variously described as automatic, instinctive, or responsive, including all the motor adjustments concerned in equilibration, locomotor co-ordination, and instinctive emotional expression, are more or less completely and independently organised in the centres situated below the cortex. Though there is a general solidarity of the whole cerebro-spinal system, yet there exist in different animals great differences in the degree of organisation of such movements in the lower ganglia, and in their relative independence of the higher centres. This is greatest in the frog and pigeon, and lowest in the monkey and man. Hence the marked differences which we observe in different animals in the results of destruction of the cerebral hemispheres.

If we clearly distinguish, therefore, between the different kinds of movement and their respective centres, and regard paralysis of truly volitional movements, or those involving conscious discrimination, as the only essential feature of cortical lesions, we shall be in harmony with the results of comparative experimental physiology, and shall not need a hypothesis of functional substitution, which cannot, I think, be maintained consistently by those who accept the doctrine of specific localisation.

In accordance with this generalisation, I ventured to predict that, even in the case of animals whose motor powers did not seem permanently to suffer from destructive lesions of the cortical motor centres,

those movements must be paralysed which involved conscious discrimination, and were not automatically organised. This has been amply verified by Goltz's experiments on dogs.* Goltz found that, though a dog's paw is not permanently paralysed as an organ of locomotion by destruction of the cortex, yet it remains permanently paralysed for all those actions in which it is employed as a hand.

The conclusion, therefore, which I would provisionally draw from the results of experimental physiology, and proceed to justify by a consideration of the facts of human pathology, is, that there are certain regions in the cortex to which definite functions can be assigned; and that the phenomena of cortical lesions will vary according to their seat, and also according to their character—viz., whether irritative or destructive, two classes into which they may all be theoretically reduced. And, as the experiments of physiology necessitate the strictest topographical accuracy in the position and limits of individual centres, it is of vital importance that the same accuracy should be observed in respect to the situation of lesions in the human brain. For this reason we are, however unwillingly, obliged to discard most of the older records of cerebral disease, unless where supplemented by drawings, or by description of the position of the lesion with reference to certain fixed points; for, although we can now read these cases in the light which laws otherwise arrived at throw upon them, they cannot be used to establish these laws. In the older records, we, as a rule, meet with nothing more exact in the topography of a lesion than that it was situated "on the convexity" of one or other hemisphere, or in the anterior, middle, or posterior lobe—terms which admit of considerable looseness of interpretation. Anatomically, the frontal lobe was generally considered as marked off from the middle lobe by the antero-parietal (Huxley) or præcentral sulcus (Ecker); but we find Bouillaud extending the frontal lobe so as to include as much as the half of the hemisphere: an extension of this lobe which may serve to explain his theory as to the seat of the faculty of speech. In the question of localisation of cerebral function, we must follow Bacon's dictum: "*Frustra magnum expectatur augmentum in scientiis ex superinductione et insitione novorum super vetera, sed instauratio facienda est ab imis fundamentis.*"

It is in the observations of the last few years, in which only the necessity of strict accuracy in cerebral topography has been duly recognised, that we must look for our chief material, and of this the largest share has been contributed by Charcot and the French school of pathology. As to the kind of evidence on which we must base our conclusions, I cannot do better than quote and emphasise the injunction given by Charcot and Pitres in their recent valuable papers on the localisation of cerebral disease.† "It is necessary rigidly to exclude as valueless in this relation all observations in which the topography of the lesion is not indicated with rigorous exactitude; and, among those which, in a topographical point of view, leave nothing to be desired, it is necessary to make a selection and reject the majority of the cases of multiple lesions, and all those in which the lesion was diffuse. It is necessary also to accept with extreme caution cases of tumour compressing without destroying the cerebral convolutions; for the effects of pressure may be felt at a distance from the seat of lesion, and complicate the results. In making these estimations, in our opinion absolutely indispensable, the number of ancient observations really available is extremely small; and it is by the aid of new observations, made with all the requisite precautions, that we must approach the study of cerebral localisation." The lesions which are of special value are cases of wounds, laceration, or loss of substance, and various forms of chronic degeneration, such as atrophy, necrosis, etc., and the results of hæmorrhage, inflammation, and the like, which, though at first complex, subside into local lesions, such as softenings, cysts, and abscesses; or, in general, all lesions which exclude diffuse meningo-encephalitis, mechanical compression, or general cerebral disturbance.

From the standpoint of regional diagnosis, the exact nature of the lesion is unimportant, except in so far as it is likely to cause irritation or destruction of the cerebral substance. The diagnosis of the nature of the lesion will depend on other characters, such as its mode of onset, general symptoms, and the various recognised features by which we are enabled, with more or less accuracy, to arrive at it. To discuss

these, however, would be foreign to the subject more immediately in hand. I would likewise remark at the outset that, notwithstanding the large and daily increasing body of evidence from the pathological side, for the present at least, physiological experiment is considerably in advance of pathology as regards precision and exactitude; and that, but for the aid of physiological experiment, pathology would not even yet have succeeded in arriving at much beyond general indications as to localisation.

For my part, I should consider it hasty and not to the advantage of "la belle doctrine" of cerebral localisation to make pathological evidence carry more than it can legitimately bear at present, or to found on it measures of treatment, not well considered, the only effect of which will be to make cerebral localisation pray earnestly to be saved from its friends.

Lesions of the Frontal Lobes.—I will first direct your attention to lesions of the frontal lobes. The frontal lobe includes the superior, middle, and inferior frontal convolutions, and the ascending frontal or præcentral convolution, together with the orbital and internal aspect of the corresponding region (see figs. 1 and 2, with description).

Though anatomically all this region may be included in the frontal

Fig. 1.—Lateral View of the Human Brain.—F. Frontal Lobe. P. Parietal Lobe. O. Occipital Lobe. T. Temporo-sphenoidal Lobe. S. Fissure of Sylvius. S'. Horizontal. S''. Ascending Ramus of the same. c. Sulcus Centralis, or Fissure of Rolando. A. Anterior Central Convolution, or Ascending Frontal. B. Posterior Central Convolution, or Ascending Parietal. F₁. Superior; F₂. Middle; F₃. Inferior Frontal Convolution. f₁. Superior; f₂. Inferior Frontal Sulcus; f₃. Sulcus Præcentralis. P₁. Superior Parietal Lobe, or Postero-Parietal Lobule. P₂. Inferior Parietal Lobule—viz., P₂. Gyrus Supramarginalis. P₃. Gyrus Angularis. p.o. Sulcus Intraparietalis. c.m. Termination of the Callosal-Marginal Fissure. O₁. First, O₂. Second, O₃. Third Occipital Convolution. p.o. Parieto-Occipital Fissure. o. Sulcus Occipitalis Transversus. o₁. Sulcus Occipitalis Longitudinalis Inferior. T₁. First, T₂. Second, T₃. Third Temporo-Sphenoidal Convolution. t₁. First, t₂. Second Temporo-Sphenoidal Fissures.

lobe, it is necessary for physiological and pathological purposes to subdivide it, and to term that part which, in its relation to the skull, is roughly bounded by the coronal suture, the *prefrontal lobe* or antero-frontal region (fig. 3). In the monkey, electrical irritation of this region causes no motor reaction; and destruction of these lobes causes no paralysis of motion or sensation. If the positive results, which will be alluded to subsequently, are not altogether definite, the negative results are clear and decided.

There are multitudes of cases on record in which these regions have been the seat of extensive disease on one or both sides with a like negative results as regards sensation or motion; and recovery has taken

* Pflüger's *Archiv für Physiologie*, Band xiii, Heft i, 1876.

† *Revue Mensuelle*, 1877, No. 1, p. 6.

place after the most frightful lacerations and loss of substance. One of the most remarkable of these is that known as the "American Crowbar Case"; and as this case, in addition to its importance otherwise, has lately been appealed to by Dr. Dupuy,* as showing that

Fig. 2.—Lateral View of the Monkey's Brain.—A. The Fissure of Sylvius. B. The Fissure of Rolando. C. The Parieto-Occipital Fissure. F.L. Frontal Lobe. O.L. Occipital Lobe. T.S.L. Temporo-Sphenoidal Lobe. F₁, F₂, F₃, Superior, Middle, and Inferior Frontal Convolutions. s.f. Supero-Frontal Sulcus. i.f. Infero-Frontal Sulcus. a.p. Antero-Parietal or Precentral Sulcus. A.F. Ascending Frontal; A.P. Ascending Parietal Convolutions; P.P.L. Postero-Parietal Lobule. A.G. Angular Gyrus. i.p. Intraparietal Sulcus. T₁, T₂, T₃. Superior, Middle, and Inferior Temporo-Sphenoidal Convolutions. t₁, t₂. Superior and Inferior Temporo-Sphenoidal Sulci. o₁, o₂, o₃. Superior, Middle, and Inferior Occipital Convolutions. o₁, o₂. First and Second Occipital Fissures.

lesions of the so-called motor region may occur without paralysis, I have thought it necessary to obtain exact particulars in reference to it. And I am enabled, by the kindness of my friend Professor Bowditch of Harvard, to place before you photographic delineations of the skull in

Fig. 3.—Relations of Skull and Brain (Turner).

this case, which was at one time regarded incredulously as a mere "Yankee invention". The skull is preserved in the Medical Museum of Harvard University. There is no doubt about its authenticity. An account of the case was published by Dr. Bigelow,[†] and another

and later, after the man's death, by Dr. Harlow,* under whose care he came immediately after the accident, and through whose interest in the man till death we owe the preservation of this unique specimen. (See figs. 4, 5, 6.)

The subject of the lesion was a young man, Phineas P. Gage, aged twenty-five. While he was engaged tamping a blasting charge in a rock with a pointed iron bar, 3 feet 7 inches in length, 1¼ inches in diameter, and weighing 13¼ lbs., the charge suddenly exploded. The iron bar, propelled with its pointed end first, entered at the left angle of the

Fig. 5

patient's jaw, and passed clean through the top of his head, near the sagittal suture in the frontal region, and was picked up at some distance covered with "blood and brains". The patient was for the moment stunned, but, within an hour after the accident, he was able to walk up a long flight of stairs and give the surgeon an intelligible account of the injury he had sustained. His life was naturally for a long time despaired of; but he ultimately recovered, and lived twelve and a half years afterwards. Unfortunately, he died (of epileptic convul-

Fig. 4

Fig. 6

Figs. 4, 5, 6 (Harlow).—Illustrations of Dr. Harlow's Case of the Passage of an Iron Bar through the Head.

sions) at a distance from medical supervision, and no *post mortem* examination of the brain was made; but, through the exertions of Dr. Harlow, the skull was exhumed and preserved. Upon this the exact seat of the lesion can be determined. The union of the cicatrices of entrance and exit, however, allowed a pretty accurate estimation of the track of the bar during life, and Dr. Bigelow made experiments on a skull to determine this, and, as the photographs, when compared with figures before you, show,† with very considerable accuracy. Dr. Bigelow, who examined the man two years after the accident, thus describes the appearances presented. "A linear cicatrix of an inch in

* *Medical Times and Gazette*, 1877.

† *American Journal for Medical Sciences* for July 1850.

* "Recovery from the Passage of an Iron Bar through the Head." Read before the Massachusetts Medical Society, June 3rd, 1868; Boston, 1869.

† The lectures were illustrated by numerous diagrams, to which reference was constantly being made.

length occupies the left ramus of the jaw near its angle...The eyelid of this side is shut, and the patient unable to open it; the eye considerably more prominent than the other. [Vision lost (Harlow).]...Upon the head, and covered by the hair, is a large unequal depression and elevation...A piece of the cranium of about the size of the palm of the hand, its posterior border lying near the coronal suture, its anterior edge low on the forehead, was raised upon the latter as a hinge, to allow the egress of the bar; still remains raised and prominent."

From his examination of the skull itself, Dr. Harlow thus describes the track of the bar. "The missile entered, as previously stated, immediately anterior and external to the angle of the inferior maxillary bone, proceeding obliquely upwards in the line of its axis, passed under the junction of the superior maxillary and malar bones, comminuting the posterior wall of the antrum, entered the base of the skull at a point the centre of which is an inch and a quarter to the left of the median line, in the junction of the lesser wing of the sphenoid with the orbital process of the frontal bone—comminuting and removing the entire lesser wing with one half of the greater wing of the sphenoid bone—also fracturing and carrying away a large portion of the orbital process of the frontal bone, leaving an opening in the base of the cranium, after the natural effects at repair by the deposit of new bone, of one inch in its lateral, by two inches in its antero-posterior, diameters." (P. 17.) Dr. Harlow does not describe the further track of the bar through the frontal bone, but you will clearly see, from the figures, that the whole lesion is situated anterior to the coronal suture. If, now, you will compare the track of the bar through the skull and brain with the diagram before you (fig. 3), showing the relations between the skull and the brain, you will, I think, have no doubt in convincing yourselves that the whole track is included within that region of the brain which I have described as the prefrontal region, and that, therefore, the absence of paralysis in this case is quite in harmony with the results of experimental physiology. The only other region which the bar could have injured is the tip of the temporo-sphenoidal lobe and the outer root of the olfactory bulb. Respecting the condition as to smell, nothing is, however, said, by either Bigelow or Harlow. This case is generally quoted as one in which the man suffered no damage bodily or mental. But hear what Dr. Harlow says as to his mental condition. "His contractors, who regarded him as the most efficient and capable foreman in their employ previous to his injury, considered the change in his mind so marked that they could not give him his place again. The equilibrium or balance, so to speak, between his intellectual faculties and animal propensities seems to have been destroyed. He is fitful, irreverent, indulging at times in the grossest profanity (which was not previously his custom), manifesting but little deference for his fellows, impatient of restraint or advice when it conflicts with his desires, at times pertinaciously obstinate, yet capricious and vacillating, devising many plans of future operation, which are no sooner arranged than they are abandoned in turn for others appearing more feasible. A child in his intellectual capacity and manifestations, he has the animal passions of a strong man. Previous to his injury, though untrained in the schools, he possessed a well-balanced mind, and was looked upon by those who knew him as a shrewd, smart business man, very energetic and persistent in executing all his plans of operation. In this regard, his mind was radically changed, so decidedly, that his friends and acquaintances said he was 'no longer Gage'." (P. 13.)

After these facts, I do not think it can be said with justice that the man suffered no damage either bodily or mentally, or that the "American Crowbar Case" is in opposition to the experimental facts which I have adduced as to the effect of lesions of the frontal lobes.

A similar case of wound of the frontal lobe, also without motor or sensory paralysis, is related by Bouillaud.* The wound was caused by a bullet which traversed the upper lip and right nostril, and, passing through the roof of the orbit, emerged at the upper part of the frontal bone, near the sagittal suture.

Trousseau gives a frequently quoted case of an officer who, in a duel, received a bullet, which passed through the head in the middle of the frontal lobes. The man could speak freely, and showed no signs of paralysis of any kind. Death occurred from encephalitis.†

An interesting case of wound of the frontal lobe has been recorded by Congreve Selwyn.‡ A boy aged 4, while at dinner, accidentally fell on a cheese-knife, four inches and a half long in the blade, which penetrated the orbit above the right eye to the depth of three inches and a quarter. After removal of the knife, some brain-matter escaped, and more was discharged on the eighth day. The accident occurred in September 1821. At the date of writing (1838), the only symptoms

observable were blindness of the right eye, dilated pupil, and ptosis. "As regards the present state of his mind, all the senses are perfect, excepting the vision of the injured eye. The memory is very defective. He is incapable of applying to any pursuit requiring mental activity. His disposition is irritable, especially after indulging in liquor, or after any unusual stimulus. He has occasional pain on the injured side of the forehead, and has once had typhus fever since. His bodily health is now good, and he has the free use of the superior and inferior extremities."**

But cases of injury of one or other frontal lobe, without sensory or motor affection, are very numerous. Many are given by M. Pitres, in his recent work,† to which reference may be made for exact citations; a case, by Morgagni, of perforation of the right anterior lobe by a pointed iron; a case, by Morrin, of recovery from a bullet-wound of the left frontal lobe; a case, by Padeau, of recovery after a bayonet-wound of the same region; a case, by Tavignot, of fracture of the frontal bone, and death, without affection of sensation or motion, in which the right anterior lobe was disorganised; a case of wound of the left frontal lobe by the ferrule of an umbrella which penetrated the orbit, related in the *Dublin Journal of Medicine*, 1851; a case of a bullet-wound above one of the orbits, the bullet lodging and causing no symptoms; recorded by Quesnay.

A case has been recently reported by Marot‡ of fracture of the frontal, followed by pyæmia and death, in which it was found that there was effusion into, and laceration of, the first frontal convolution, on the right side. No cerebral symptoms were observed.

The same observer brought another similar case before the Société Anatomique.§ In this, there was depressed fracture of the frontal bone and laceration of the frontal region by a piece of bone. There was no affection of sensation or motion. Death occurred a month afterwards. The laceration occupied the middle frontal convolution of the right side, at the junction of the anterior with the posterior two-thirds. The superior frontal was injured at the same level. There was loss of substance, and an irregular cavity filled with detritus and blood replacing it. There was also slight extravasation over the left frontal lobe. In the discussion which followed, M. Renault quoted a similar case, also without symptoms; and M. Petit two like instances.

I might multiply instances all demonstrating the same fact, that sudden and extensive lacerations may be made in the prefrontal region, and large portions of the brain-substance may be lost, without causing impairment either of sensation or of motion; and, indeed, without very evident disturbance of any kind, bodily or mental, especially if the lesion be unilateral. And if it be true that sudden lesions may be thus latent, *à fortiori*, it might be expected that the slowly progressive lesions of disease would be free from objective symptoms; for it is frequently said that the absence of symptoms may be accounted for by the compensation and functional substitution of other centres: a hypothesis which the negative character of sudden lesions renders altogether inadmissible.

Of cases of softening or abscess, etc., in these regions many are on record. Charcot and Pitres,‖ and Pitres in his before mentioned memoir,¶ have collected numerous cases in which one or both frontal lobes have been the seat of disease without any objective symptoms. Time will not permit me to describe these cases in detail, and I will content myself with merely giving the headings: a case of hæmorrhage into the substance of the second right frontal convolution; a case, by Andral, of softening of the orbital lobule of the left hemisphere; a case, by Bergeron, of abscess of the left frontal lobe following a blow; a case, by Hertz, of abscess of the left frontal lobe; a case, by Reed, of fracture of the frontal bone followed by abscess occupying the whole of the right frontal lobe; a case, by Begbie, of abscess of the whole of the left anterior lobe in connection with an abscess of the ethmoid; a case, by Cholmeley, of abscess of the anterior part of the left hemisphere; a case, by Evans, of abscess of the left frontal lobe following a blow; a case, by Prescott Hewett, of abscess of the left anterior lobe; and a similar case by Bouilly. To these, quoted by Charcot and Pitres, may be added a recent case, reported by Lepine,** of abscess of the right frontal lobe, connected with disease of the nasal fossæ.

In all these cases, there was an entire absence of sensory or motor paralysis; and in many, there was nothing recorded or nothing calling for special attention as regards the mental condition. In some of these, however, and in one or two others to be referred to, the psychological

* *Loc. cit.*, p. 16.

† *Lesions du Centre Ovale*. Paris, 1877.

‡ *Prog. Méd.*, February 26th, 1876.

§ Meeting of February 11th, 1876; *Le Progrès Méd.*, June 3rd, 1876, p. 437.

¶ *Revue Mensuelle*, 1877.

** *Lesions du Centre Ovale*.

*** *Revue Mensuelle*, November 1877, p. 862.

* *Traité de l'Encéphalite*, p. 331.

Peter, "De l'Aphasie." *Gaz. Hebdomadaire*, 1864, p. 433.

Lancet, February 28th, 1838.

condition seems to have attracted notice. Lepine says of his case of abscess of the right frontal lobe: "He was in a state of hebétude. He seemed to comprehend what was said, but could scarcely be got to utter a word. He would sit down when he was told to do so, and when taken up could walk a few steps with assistance."

A very interesting case is reported by Baraduc,* in which there was atrophy of the frontal convolutions in both hemispheres. The patient was an inmate of the Hospice de Ménages for six years. His muscular powers and sensation were unimpaired. He was, however, in a state of complete dementia, marching about restlessly the whole day, picking up what came in his way, mute, and quite oblivious of all the wants of nature, and requiring to be tended like a child. The lesion in this case was purely cortical, atrophic, and dependent on partial obliteration of the arterial supply. The lesion occupied the two anterior lobes, that is to say, the first, second, and third frontal convolutions, and also the internal aspect of the frontal lobes. The ascending frontal, ascending parietal, and paracentral convolutions were intact. The rest of the brain was normal, except in the region of the inferior parietal lobule of the right hemisphere (supramarginal and angular gyrus).

Another case, presenting several interesting features, has been put on record by Dr. Davidson.† A labourer received a severe blow on the head with an iron hook, which smashed and carried away a considerable portion of the frontal bone, exposing and injuring the brain as far back as the coronal suture. The injured portion of the brain, as determined *post mortem*, included, on the right side, the greater part of the superior and middle frontal convolutions; and on the left side, a piece of bone was found firmly adherent to the superior frontal convolution at its middle part, this part being disintegrated to the depth of an inch or so. With the exception of a spasmodic extension of the right arm occasionally, the only symptoms of the cerebral lesion in this case were of a psychical nature. Though the man seemed to understand what was said to him and did what he was told, "every action he performed left the impression on the mind of the observer that it was purely automatic" or machine-like.

Marked mental deficiency has been frequently noted in connection with arrested development, or atrophy, of the frontal lobes, without any objective symptoms as regards motility or sensibility. One good instance of this has been described and figured by Cruveilhier. This was a case of a girl aged 15, who had remained in a complete state of idiocy from birth. The prefrontal regions or anterior two-thirds of the frontal lobes in this case were completely wanting. But, indeed, the frequent association of idiocy with such defect of the frontal lobes is a generally recognised fact.

Whatever opinion we may form as to the positive indications of disease of the prefrontal lobes, I think it is abundantly manifest, from the cases I have cited from among many, that, in the total absence of affections of motility or sensibility, whether in connection with sudden or slowly progressive lesions of these regions, we cannot attach objective motor or sensory functions to them. With such evidence before us, to say nothing of the facts of experimental physiology, we cannot regard cases in which, with lesions in the prefrontal lobes, sensation or motion has been affected, as other than cases of co-existence or multiple lesions, whether organic or functional. Between lesions of the prefrontal lobes and such symptoms, we have no grounds for assuming even indirect causal relationship, unless they can be shown to be of very frequent, if not constant, occurrence. Such relationship we all admit in the case of tumours, which, as we know, influence regions at a distance from the actual seat of disease; or in the case of diseases spreading backwards, such as encephalitis or meningitis.

It is chiefly on the indirect or accessory symptoms that we at present rely for our diagnosis of lesions in the frontal regions. We may obtain indications from the history of some traumatic lesion, or from the proximity of some such affection as disease of the nasal fossæ; or we may have uncertain signs of pain localised in the frontal region; or there may be disturbances of the sense of smell. But, in the absence of all these—and they may be absent—the question is: whether there are any symptoms directly indicating disease of the prefrontal lobes? Even if we have to admit that such symptoms cannot be definitely specified, yet it will not have been in vain if experimental physiology has succeeded in bringing into prominence certain facts to which attention should be more particularly paid in future.

Touching the effects of removal of the prefrontal lobes in monkeys, I may be allowed to quote from myself: "Removal or destruction by the cautery of the antero-frontal lobes is not followed by any definite physiological results. The animals retain their appetites and instincts, and are capable of exhibiting emotional feeling. The sensory faculties,

sight, hearing, touch, taste, and smell, remain unimpaired. The powers of voluntary motion are retained in their integrity, and there is little to indicate the presence of such an extensive lesion, or a removal of so large a part of the brain. And yet, notwithstanding this apparent absence of physiological symptoms, I could perceive a very decided alteration in the animals' character and behaviour, though it is difficult to state in precise terms the nature of the change. The animals operated on were selected on account of their intelligent character. After the operation, though they might seem to one who had not compared their present with their past fairly up to the average of monkey intelligence, they had undergone a considerable psychological alteration. Instead of, as before, being actively interested in their surroundings, and curiously prying into all that came within the field of their observation, they remained apathetic or dull, or dozed off to sleep, responding only to the sensations or impressions of the moment, or varying their listlessness with restless and purposeless wanderings to and fro. While not actually deprived of intelligence, they had lost, to all appearance, the faculty of attentive and intelligent observation."

I have elsewhere attempted some explanation of the faculty of attention—the basis of the higher intellectual operations—and its relation to the anatomical substrata of the prefrontal lobes; but I will not enter further on these speculations at present. I would, however, call your attention to the psychical characters in some of the cases of disease and injury of the frontal lobes to which I have referred (*e.g.*, the American "Crowbar" case, Baraduc's, Selwyn's, Lepine's, Davidson's), as, in many respects, similar to those seen in monkeys after removal of the prefrontal lobes. I may also adduce the observation of Dr. Crichton Browne on General Paralysis of the Insane,† tending to show that the earlier symptoms, *inter alia* "general restlessness and unsteadiness of mind, with impairment of attention, alternating with apathy and drowsiness" (page 223), coincide with the morbid changes occurring at this stage, more particularly in the frontal regions.

ON SOME POINTS IN THE CLINICAL HISTORY OF CHOREA.‡

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THE object of the following paper is to call attention to, and illustrate by cases, some points in the common or occasional clinical history of Chorea, which have hitherto received little notice. The points specially considered are four: the electrical condition of nerve and muscle in chorea; the proportion between the choreiform movements in their relation to the will; the distribution of hemichorea; and the relation, occasionally to be observed, between chorea and certain convulsive disorders. The patients whose cases are narrated, except when it is stated otherwise, were under my care at the National Hospital for the Paralysed and Epileptic.

I.—THE IRRITABILITY OF NERVE AND MUSCLE IN CHOREA.

Observation on this point can only be made, with accuracy, on patients with hemichorea, in whom the irritability of the unaffected side can be taken as a standard for comparison. An examination of such cases shows that, a few weeks after the onset of the affection, there is to be observed, in most, though not in all, cases, a distinct increase in the irritability of both nerve and muscle on the affected side, the increase existing to both faradisation and to the voltaic current. The difference varied in the cases examined, from one to three centimètres of the secondary coil of Stöhrer's larger induction apparatus, and from two to five cells of the Stöhrer or Leclanché voltaic battery. The change was always in the same direction to both faradisation and the voltaic current. The increase in irritability was found to subside with the subsidence of the chorea. The following cases illustrate the alteration.

CASE I. *Hemichorea: Increased Irritability of the Muscles of the affected Arm.*—A healthy-looking lad, aged 14, noticed slight unsteadiness of the right arm the day after some severe rowing, he having had an attack of severe general chorea two years previously. A fortnight after the onset of this second attack, there were slight occasional choreic movements of the right arm, varied by an occasional sudden start, and there was also slight inco-ordination on movement. There was no cardiac murmur. The electrical irritability of the muscles of the two arms was carefully compared, and was found to be greater in the right

* Soc. Anat., March 1876; *Le Progrès Méd.*, Aug. 19th, 1876, p. 598.

† *Lancet*, March 19th, 1877, p. 342.

* *Functions of the Brain*, p. 230.

† *West Riding Reports*, vol vi, p. 170.

‡ Read in the Section of Medicine at the Annual Meeting of the British Medical Association in Manchester, August 1877.