ON THE DISCORDANT ACTION OF THE DOUBLE BRAIN.¹By WILLIAM W. IRELAND, M.D.,
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THE old metaphysicians felt the difficulty of reconciling the persuasion of the unity of the mental operations with the evidence that in its relations to the material world the mind was so closely connected with a double organ. Even in our own day the conjoined functions of the two hemispheres is a question which physiologists are shy of examining. The question arises, Do the two sides of the brain perform the same functions? Have we a double set of sensations, perceptions, apprehensions, and mnemonic images? and how is the simultaneous action of both sides of the body kept up, and the feeling of unity of thought, feelings, and actions sustained?

It is now generally received that the corpus callosum is a real commissure, uniting by its radiating fibres analogous parts of the hemispheres, and uniting heterologous parts of the occipital with the frontal lobes through an underband of longitudinal fibres. This view is confirmed by the experiments on the corpus callosum published by Dr. Mott in the *BRITISH MEDICAL JOURNAL* of May 17th, 1890. It is, however, surprising that the complete absence of this organ has been noted half a dozen times without entailing any apparent functional deficiency, for examination of the literature shows that where there has been imbecility there has always been some other grave defect. On the other hand, the cases of Eichler, Paget, Malinverni, Golly, and the second case of Kaufmann and that of Erb show that where the brain is otherwise well developed there may be no disturbance of mobility, co-ordination, general or special sensibility, reflexes, speech, or intelligence, whether the defect of the corpus callosum be primary or secondary. This view has been also confirmed by observations of destruction of the corpus callosum from disease. We know that the limbs of each side perform simultaneous movements under the direction of the opposite sides of the brain, and that it is easier for them to perform analogous movements than different ones. Nevertheless, we have the power of simultaneously executing different actions which require distinct mental conceptions for their direction—as, for instance, in piano playing.

The power of attending to two or three subjects at once can be increased by cultivation. It is no doubt possessed by some men in greater proportion than by others. Plutarch says that Julius Caesar during his campaigns would go on, sitting on horseback, dictating to two secretaries; and Pliny tells us that Caesar used to read and write at the same time, or to dictate and listen, or that he would keep four clerks employed at once writing to his dictation.² In the debate on this subject at the annual meeting at Leeds, I was surprised to hear a distinguished psychologist question the statement that a man could attend to two mental operations at once; but at the very next meeting my own experience afforded me a proof of the case in point. At the request of the Secretary of the Section I wrote out some remarks which I had made, and at the same time kept on listening to the debate, which I could perfectly recall. In general, when two mental operations are thus transacted at once, the mind gives its main attention to one of them, and the memory runs along a particular train of thought, so that the concomitant ideas are quickly forgotten. Of course, the more powerful the concentration of mind, the more the mind is occupied with one single process. The absent-minded man falls into one train of thought, and loses the parallel observations by which men usually keep up a knowledge of their situation, the when, where, and how of ordinary life.

Most of the sensory fibres from the peripheral organs cross to the opposite side of the brain, a smaller portion going to

the same side. A larger portion of the nerve fibres from each retina crosses to the opposite optic ganglia, but a smaller portion, representing the temporal side of one retina and the nasal side of the other does not cross, but passes to the same side of the brain, so that each visual area of the brain receives impression from both eyes. The innervation of the oculo-motor muscles is arranged on a corresponding plan.³ Dr. Dupuy reported to the Biological Society of Paris (May 25th, 1889) the case of a young woman who had the power of moving her eyes in different directions at the same time. When she did so she saw objects only with one eye, and when she tried to observe with the other at the same time she was seized with giddiness. Dr. Dupuy regarded this as a proof that there were two distinct perceptive centres. He was supported by Brown-Séquard, who took occasion to enforce his view that the two hemispheres are identical in function and can replace each other.

In like manner the fibres which conduct motor impulses from the hemispheres to the muscles do not all cross over to the opposite side of the body. They may be divided into three sets; those which mainly supply the muscles of the same side as those going to the muscles of the neck and trunk, those which go to both sides in almost equal proportion as to the muscles of the jaw, throat, larynx, and diaphragm, and those which mainly cross to supply the other side of the body. Such are those given to the muscles of the arm and leg. In no case does one side of the body derive either its sensory or motor nervous influences from one side of the brain alone, but from both, though in varying proportions. Thus paralysis of sensation from an injury to one side of the brain is never complete, for each side of the brain always represents a certain though minor amount of sensation from the same side of the body. In like manner loss of motor power may be stated as the loss of 95 per cent., or of 50 per cent., as it affects one or other motor centre. In the latter case paresis is not apparent, as the muscle being innervated from both sides of the brain, the loss of one half of its innervation is made up by the increased activity of the other side of the brain. On the other hand, it appears from close observation that in paralysis of one side of the body there is also a loss of power on the opposite side of the body, which derives a certain though smaller amount of innervation from the injured side of the brain.

Though certain areas of the brain seem to have a closer connection with the innervation of definite groups of muscles than other portions of the cortex, it has been found that when these parts have been removed or destroyed the muscles dependent upon them are for the time thrown out of action. After a longer or shorter interval the paresis disappears, and the lost motor function is reassumed. Such experiments have often been repeated on the brains of animals, and have been confirmed by lesions of the cortex observed in man. One good instance was given by Dr. Byrom Bramwell, in which a tumour occupied the middle of the motor zone on one side of the brain, as was well displayed by a photograph, without any paralysis having been observed during life. It has been assumed that in such cases it is the analogous portion of the opposite hemisphere which takes up the lost function of the injured side; and this no doubt holds good in some cases. At the same time, while dealing with this question, it would be unfair to pass over the objection of Goltz, who removed the motor centres in one side of the brain, and then waited for the animal to recover from the injury to the motor powers and from the loss of sensation. On the theory that this recovery was owing to the corresponding part of the opposite hemisphere taking up the functions of both sides, removal of the motor convolutions should have been followed by paralysis on both sides of the body; but the temporary paralysis only affected the muscles of the opposite side. A similar experiment was performed by Luciani and Tamburini.

Some physiologists hold that the lost motor function is in time taken up by another part of the same side of the injured brain; others that the innervation is supplied by the vicarious action of the corpora striata. M. Herzen, of Lausanne, states that if the sigmoid gyrus be extirpated in a dog, there follows temporary paralysis of the opposite limb;

¹ At the Annual Meeting of the British Medical Association held at Leeds I introduced a discussion on "The Discordant Action of the Dual Brain in Insanity," in which some eminent psychologists took part. My address was given orally, not read from a paper, but the following pages contain the substance, with a few additions from original notes and new readings.

² Pliny, lib. vii, cap. 15.

³ See the able paper on Oculo-motor Centres, by Dr. Spitzka, *Journal of Nervous and Mental Diseases*, July, 1888.

but if this operation be performed in a newborn dog before the tenth day, if the pup survive it grows up without any noticeable deficiency save some slowness in the movements of the opposite side, which soon passes away. On the supposition that it is the sigmoid gyrus of the opposite side which has assumed the function of both gyri, extirpation of the uninjured convolution should now cause motor deficiency in both sides; but in an experiment which Herzen made on a young dog, this was found not to be the case. On removal of the second sigmoid gyrus no paralysis whatever followed on either side. On removing the sigmoid gyrus of the same side in a dog of the same litter hitherto uninjured, the usual symptoms of cross paralysis appeared.

Dr. Sherrington has found that destructive lesions of one side of the motor zone of the cortex were followed by bilateral degenerations of the pyramids of the spinal cord; but when the cortical destruction occupied the motor centres for the limbs alone, the bilateral character of the descending degeneration was not so marked.

The well-known relation of the limb centres to the word centres is not invariable. There have been cases of left hemiplegia with aphasia in persons who were not left-handed; there have been cases where destruction of the lower third frontal convolution of the left brain has not induced motor aphasia; and cases where destruction of the left temporo-sphenoidal gyri has not induced sensory aphasia. We may fairly suppose, therefore, that in some brains the speech centres are not on the same side as those of the arm which is most used for fine work. In other cases the functions seemed to be shared between both sides of the brain, just as some men can use both hands equally well or nearly so. Hughlings Jackson thinks that as regards speech the right half of the brain acts automatically along with the other half, and that on the left brain automatic action passes into voluntary action. He regards the short exclamations which often survive in aphasia as the result of the action of the uninjured side of the brain. This, at least in early life, may be educated into speech under the control of the will and intelligence.⁴ It has been observed by Buchwald, Erlenmeyer, and others⁵ that some patients, after losing the power of their right hand from paralysis, in beginning to use their left hand to write, trace the letters from right to left, producing what has been called mirror writing. Left-handed imbeciles are apt to indulge in this style of writing, and sometimes even left-handed children, with no intellectual want, have been observed to do this without noticing the reversed character of their writing. It may be asked, is the image or impression or change in the brain tissue, from which the image is formed in the mind of the mirror writer, reversed like the negative of a photograph; or if a double image be formed in the visual centre, one in the right hemisphere of the brain and the other in the left, do the images lie to each other in opposite directions?

There are a number of observations on record where one hemisphere has been destroyed through disease or injury without any apparent loss of function. This may be considered a proof that both sides of the brain have the same potential function. In some cases the deficiency was not even noticed till after death. It is thus clear that just as we can see with one eye, or hear with one ear, so one side of the brain may suffice for the ordinary exercise of the mental powers, for sensation and motor innervation. In some cases it was the right hemisphere that was found wanting; in others the left. In many cases of destruction of one hemisphere there was more or less paralysis of the arm; in others no paralysis was observed. Much commoner are instances of partial destruction of one side of the brain with a minor amount of injury to the other side, producing paralytic idiocy or paralytic dementia. These cases illustrate in an indirect way the general axiom that it requires injury to both hemispheres to produce complete mental derangement.

In some cases of more or less complete destruction of one hemisphere we find it stated that the power of continued mental exertion was lessened, in others the mental powers did not appear to be weakened, but no severe tests were ap-

plied. The presumption is that there would be a loss of reserve force. On examining the brain of Bichat, who died at the early age of 31, it was found that one of the hemispheres was much larger than the other, and had pushed aside the falx cerebri. This atrophy of one side of his brain did not prevent Bichat becoming one of the greatest anatomists that France ever produced.

From a review of the cases, we should judge that where one side of the brain remains healthy, the integrity of the intellectual, moral and emotional faculties may be preserved, perhaps might be better preserved with a total destruction of one hemisphere than with a diseased hemisphere transmitting irritation to its fellow. I have had opportunities of observing the effect of wounds of one side of the brain. Sometimes the patient is in a state of delirium or stupor, which perhaps is owing to the inflammation extending to the other side through the membranes. At other times the patient seems reasonable and collected, but when he attempts to carry on a conversation, or make some unusual exertion, there is a feeling of fatigue, soon passing into distress, which obliges him to stop. The reason of this, no doubt, is that while at rest the healthy hemisphere is sufficient for the process of spontaneous thought without fatiguing the other, but when, through a severe call, the healthy brain begins to exert itself, it drags the other into play, both acting at once. The result is that the disease of the other hemisphere gets aggravated, which produces the feeling of exhaustion and distress.

In insanity both sides of the brain are generally diseased, but not infrequently one side of the brain is more affected than the other, and here we may expect to find an unequal action. The healthy brain struggles with the insane impulses of the diseased one, tries to correct its hallucinations, or to bridle its strange impulses. Sometimes it succeeds in doing so, and if the disease abates we have one of those cases of abortive insanity which are seen by the consulting physician more often than the superintendent of an asylum.

One-sided hallucinations are not uncommon in insanity. In this country they have been carefully studied by Dr. Alexander Robertson. Sometimes the patient hears threatening words in one ear and soothing and encouraging ones in the other, or he sees with one eye a figure. I know of a patient, a single woman aged 36, who imagined that a large green fish followed her about and bit her between the shoulders. It used to look over her right shoulder at her with its large round eyes. When asked if she heard voices she said: "It seems to come over my shoulder (right); it is like that green fish with big eyes. It does not say anything, but I don't like the look of it." On glancing over her left shoulder she could not see the green fish.

I have been consulted by persons who were haunted by a fixed idea—sometimes profane or disgusting—which they regard with horror. It is probable that this distressing condition is dependent upon some local irritation of one side of the brain.

There are cases of melancholia in which there is an extreme dislike to any exertion, but the patient is found afterwards to have noticed everything and remembered everything. This is to be explained by the extreme distress following any voluntary exertion which would set the diseased side of the brain in action. Then there are patients in every asylum who complain of the intrusion of thoughts and impulses which they refer to another person.

These are symptoms which are readily explained by the assumption of unequal disease of the brain. Then there is a feeling of changed personality. This is no doubt owing to a real change in his feeling and mental tendencies, which, in fact, constitutes the insanity. That it is sometimes accompanied by a lesion of one side of the brain may be seen from the following case, which was reported to me by my valued friend, the late Dr. Grierson of the Roxburgh District Asylum.

J. V., admitted to Roxburgh District Asylum in 1864, suffering from mania. Dr. Grierson got the charge of this asylum three years afterwards, when the acute symptoms had subsided. The man fancied that he was not J. V., but Mr. W., the laird of H. This delusion had led to his being placed in the asylum, and he held to it tenaciously. During the course of his stay his sister came in as a patient, but he refused to recognise her, as he was not J. V. Save the grievance of being kept out of his estate, he seemed satisfied with his

⁴ BRITISH MEDICAL JOURNAL, April 12th, 1890, p. 826.

⁵ See the paper on Mirror Writing in the *Blot on the Brain*. In this book the reader who wishes to pursue the subject will find many references to support and explain the statements made in the present article.

position in the asylum. He was cleanly in his habits, fed himself, and never sought to converse with any one, but would answer questions reasonably enough. He never read anything. Sometimes he would talk away, apparently to no one in particular. In general he was in good humour, but he was easily teased, irritated, and excited. He had been a stone-breaker before becoming insane, and still continued to work at this, in which he was very skillful. Now and then, suddenly throwing down his hammer, he would fly with his fist at some imaginary person, after which he would return to his work. He had the use of all his muscles. This went on for years without variation. His general health was good, but a progressive dementia was observed. After having been twenty-one years in the asylum, he was found one day lying upon his stone heap. The left arm and leg were found to be paralysed. The speech was affected, but there was no aphasia. After a week he died. The viscera of the thorax and abdomen were found healthy. On removing the skull cap the saw penetrated into a cavity. The right hemisphere was found softened down to the lateral ventricle, and quite disintegrated, the cavity occupied by a grumous fluid. Dr. Grierson believed that the destruction of the right hemisphere must have been the work of years; the left hemisphere seemed healthy.

Sometimes a patient seems, as it were, to struggle with two impulses which paralyse his will so that he cannot commence or execute movements. In other cases the lunatic seems to yield alternately to conflicting impulses. Then there are cases of double personality where the patient thinks another being shares his body with him. I had once the charge of an imbecile boy who used often to address himself: "You have been a bad boy to-day, F." Sometimes he would strike himself hard blows on the face, and then roar out.

The natural disparity in the weight of the two hemispheres found in the sane is increased with the insane.⁶ Sometimes it is the right brain which is found heaviest, sometimes the left; in the majority of brains examined the difference was in favour of the right hemisphere. The average disparity, whether on the right or left side, is about 16 grammes. Inequality in weight has been found to be most marked in general paralysis, idiocy, and epilepsy.

Dr. J. Murray Lindsay, of the Derby County Asylum, has kindly furnished me with a detail of the different weights above 1 ounce in 41 brains out of 279 necropsies in which the hemispheres were weighed separately. Of these overweights, 24 were on the right and 17 on the left side. The disparity mostly ranged from 2 ounces to 4 ounces. The greatest overweight was 9 ounces on the left in a case of mania. On Dr. Lindsay's list the inequalities were most marked in mania and epileptic idiocy (one case). I had once under my care a boy of 11 years, an epileptic imbecile, left-handed. He sometimes had fits implicating the right side of the body only, when he retained consciousness and could answer questions. The left hemisphere was smaller than the right. The right side of the encephalon weighed 20½ ounces, the left side 15½ ounces.

In 21 observations taken from the casebooks of the West Riding Asylum, the preponderance was in the right hemisphere in 11 cases, on the left in 9 cases, and in 1 the balance was equal. The inequalities ranged from 5 to 40 grammes; in 1 (general paralysis) it was 60 grammes on the right; in 2, on the left, the overweights were as high as 90 grammes (sclerosis of right) and 400 grammes (cyst on right side of brain). Whether the disparity is owing to the addition of adventitious deposit, or to unequal subtraction through atrophy, or to both, has not yet been made out.

Whether cases of somnambulism or double consciousness such as those of Felida and Léonie are to be explained, as Luys and others have suggested, by the supposition of one hemisphere being alternately active and inactive, is a question for which I cannot venture to claim space at present. It has been objected to this explanation that persons have been recognised to be, not only in two separate states, but in three or four, each having its own memory. I am, however, inclined to think that there are conditions in dreams and trances which depend on an unequal distribution of blood in the two hemispheres or in different parts of the brain.

Doctors Dumontpallier and Bérillon have sought to prove the functional independence of each hemisphere by experiments in the hypnotic state. They claim to be able to inhibit one side of the brain, while the activity of the other side is sustained; to arrest movements of one arm, while the other arm continues to act; to banish sensation from one side of the body while it is sustained on the other side; to introduce ideas of one complexion in one ear, and ideas of another complexion into the other: so that the subject is sad or fearful on one side of his brain, joyful or content on the other. To give an exact appreciation of these most interesting experiments would greatly prolong this article. The reader will find a full account of them in *Hypnotisme Expérimental: La Dualité Cérébrale* (par Edgar Bérillon, Paris, 1884) and a summary in *The Blot on the Brain*, p. 352.

ON POINTS OF AFFINITY BETWEEN RHEUMATOID ARTHRITIS, LOCOMOTOR ATAXY, AND EXOPHTHALMIC GOÏTRE.

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In actual practice we soon discover that Nature does not provide abrupt classifications and symmetric groupings. Thus, the phenomena of locomotor ataxy depend upon distinct internal lesions, and the phenomena of goitre (whether there be exophthalmos or not) are associated with distinct external lesions. Now, some of the same phenomena are also found in a large number of cases of rheumatoid arthritis. The three diseases overlap each other, so to speak, at several points. Does not this go to prove that there is an arthritis which is essentially neural, apart from all diathetic contamination? These curious facts have a wide significance, and are of much interest to workers in the comparatively untilled ground of rheumatoid arthritis. If it be true, as Dr. Todd said, that a knowledge of gout is a passport to all humoral medicine, it is possible that a knowledge of rheumatoid arthritis will provide a key which will open many secret avenues of neural medicine.

PIGMENTATION OF SKIN.

I believe that I may fairly claim priority in observing and recording some *differentiæ* of rheumatoid arthritis during its early stage. These differential symptoms are striking and obtrusive. They belong to no other group of the large family of arthritis. Many rheumatoid people, belonging mostly to an age between 50 and 65, possess neither the distinction nor the energy to display nerve disturbances; but nearly every case of undoubted rheumatoid arthritis in early or middle life shows marks of cerebro-spinal sympathy in one or more ways. Look for pigment; feel the hands for cold sweats; examine the heart for quick beating and often high tension; and ask whether there be severe or paroxysmal neuralgia. The probability is great that you will catch at least one of these connotative signs. Assuming, then, that there is before you a neural arthritis with a yellow or melasmic bronzing of some part of the body usually sheltered from light, the judgment may at first lean to disease of the adrenal glands. Only for a moment need we dwell upon this, or upon the bare possibility of arsenical poisoning. To Dr. David Drummond, of Newcastle-on-Tyne, we are indebted for a record of the fact that a pigmentation, like that which is associated with tuberculous disease of the adrenal glands, is a frequent accompaniment of exophthalmic goitre. The favourite situations of the discoloration are around the prominent eyeballs; on the face generally; neck, armpits, and areola of nipples; abdomen, and inner part of both thighs. The patches are sometimes clearly defined, but often they fade imperceptibly into normally coloured skin. Wherever pigment occurs naturally, there it is found increased; and the colour varies from a pale yellow to a deep brown.

Very like these are those disturbances in the chromatogenous function of the skin which I have described as a common feature of rheumatoid arthritis. The pigment patches are more or less large; their hues are infinitely varied, and they are seen on many parts of the body. Across the forehead there may be a light bronze smear. Beneath

⁶ See Marandon de Montyel, *Annales Médico-Psychologiques*, Tome Sixième, 1887.