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LECTURE II.

DUAL CHARACTER OF THE BRAIN.

BY

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JOSEPH HENRY,

Secretary Smithsonian Institution.

SMITHSONIAN INSTITUTION,

Washington, January, 1877.

LECTURE II.

Delivered April 22, 1874.

DUAL CHARACTER OF THE BRAIN.

BY C. E. BROWN-SÉQUARD, M.D.

GENTLEMEN: I have to-day to put forward views which, if they have the value that I attach to them, deserve all your attention. I confess, however, that although I have come to a conviction myself (and I am, perhaps, rather difficult to satisfy in this respect), I do not accept as proved all that is drawn from facts. I confess, also, that I feel great embarrassment, since not only are the facts I have to present new, and not, perhaps, easily to be accepted, but besides, they require for their full understanding a knowledge of medicine, which probably does not exist among many of my hearers. I will, however, try my best to render the subject as clear as possible, even to persons who know nothing of medicine.

As you perhaps know, the subject is this, putting it in an interrogative form, Have we two brains or one? And if we have two brains, why not educate both of them?

As you will see by these questions, if the first is decided negatively, of course there is no reason for discussing the second. The very fact, therefore, that I am in your presence to speak about an hour on this subject, implies that I have come to the conclusion that we have two brains, perfectly distinct the one from the other. There are, however, views held in science on this subject different from mine. They consist in considering the left side of the brain as the exclusive organ serving to the movement and feeling of the right side of the body, and

vice versa, the right side of the brain being the only organ serving for volition and sensation for the left side of the body. This view I will have first to disprove.

Beginning, however, with what relates to the noblest functions of the brain—that is, its capability to serve in mental phenomena—I shall say at once that I am not the first to put forward the view that we have two brains. Long ago Sir Henry Holland, and Dr. Wigan,¹ and a few others, insisted on the fact that each side of the brain is perfectly sufficient for the full performance of the mental functions. But they stopped there, and they have, therefore, left to others to go further. In regard to this I may say, if we adopt the view, that we have two brains, a conclusion will follow, which—although I shall have to speak of it more at length by and by—I must now allude to. It is quite certain that if we make use of only one brain for most of our actions, we leave inactive one-half of the total mass of brain matter, and, therefore, we leave quite useless one-half of the most important of our organs as regards manifestations of intelligence, will, and perception or sensation. If this conclusion is correct, you will easily understand how important it is to come to the point which I have in view in this lecture; that is, that we ought to give education to the two sides of the brain, or, rather, to the two brains.

As regards intelligence, it is hardly necessary to insist, after what has been said by the physiologists, Sir Henry Holland and Dr. Wigan. They both show that there are a great many facts which would seem to prove that either half of the brain may equally perform intellectual functions. It may be, however, that their proofs were not sufficient.

Dr. Wigan has insisted upon a feature of great interest, which is that in cases of insanity sometimes, and I may say

¹ The Duality of the Mind Proved by the Structure, Functions, and Diseases of the Brain, by A. L. Wigan, 8vo., London, 1844.

very frequently without any insanity, we have two different views on the same subject. There are a great many people who labor through life under the difficulty of being unable to make up their minds. It is because they have, unfortunately, two minds. Better would it be for them to have only one: but I hope you will not conclude from this that I intend to teach here, that to educate our two brains is a fallacy, on account of the danger of leading men to have two minds, and to be all the time hesitating between two views, two opinions, or two decisions. On the contrary, I shall attempt to prove that the fault in those individuals who cannot make up their mind is dependent in a measure on the fact that they have not developed sufficiently the power of their two brains.

Dr. Wigan especially insisted upon the facts which we observe in insanity: that a patient knows he is insane; that he knows that he has insane ideas; that he will put them forward, and immediately afterwards will say, "I know they are insane." He is perfectly rational, while at the same time he is completely insane. Dr. Wigan has concluded, without any positive demonstration, that in these cases one-half of the brain is normal and the other half is diseased; one-half is employed with the mental faculties in a normal way, the other is employed as regards the same faculties in an abnormal way. But there are cases which are, perhaps, more interesting, and which, I think, more clearly support the view, that there are two brains. I saw a boy, for instance, at Notting Hill, in London, who had two mental lives. In the course of the day, generally at the same hour, but not constantly, his head was seen to fall suddenly forward. He remained erect, however, if he was standing, or if sitting he retained this position; if talking, he stopped for a while; if making a movement, he stopped moving. After continuing one or two minutes in this state of falling or drooping of the head, appearing as if asleep with his eyes closed, he would suddenly raise his head, open his eyes, being

quite awake, and then ask if there was anybody in the room whom he had not previously seen, who the person was, and why he was not introduced to him; being all the time in a state quite different from that of wakefulness. He had seen me many times, and knew me very well. Being with him once when one of these attacks occurred, he lifted his head and asked his mother, "Who is that gentleman?" Why don't you introduce him to me?" His mother introduced me. He did not know me at all. He shook hands with me, and then I had a conversation with him, such as a physician may have with a patient. In another instance, when with him again, while he had the same kind of an attack, I found that he recognized me fully, and talked of what we had spoken of in our first interview. I ascertained from what I witnessed myself, and from what I obtained from his mother, a very intelligent woman, that he had in reality two lives, two mental lives, one in his ordinary state, and another occurring after those attacks of a kind of sleep for about a minute or two, when he knew nothing of what existed in his other state—in his ordinary life; that was all a blank. He knew nothing during that second state but what had occurred in previous periods of that same condition, but he knew full well all that had occurred then; and his recollection of everything was as perfect then as it was during his ordinary life concerning the customary acts of that state. He had, therefore, as I have said already, two absolutely distinct lives, in each of which he knew everything that belonged to its wakeful period; and in neither of which did he know anything of what had occurred in the other. He remained in his abnormal state for a time, which was extremely variable, between one and three or four hours, and after that he fell asleep, and passed out of that state of mind pretty much in the same way that he had gone into it. I have seen three other cases of this kind, and as so many have fallen under the observation of a single medical practitioner, such cases cannot be extremely rare.

As regards the faculty of speech, the fact that we have two brains perfectly distinct, one from the other, is not, perhaps, so easily proved as it may be in reference to the mind. We well know, however, that a lesion in the left side of the brain will produce loss of the faculty of speech; which belongs almost exclusively to the left side of the brain; but the very fact that the loss of speech depends on a disease in the left side of the brain is itself an evidence that the left side of the brain is quite distinct from the right side; that it is in fact a brain in itself as regards that particular function of the organ which we call the brain. Therefore, the well-known fact, that out of one hundred cases in which the loss of the faculty of speech had occurred, there is only one in which the disease was to be found in the right side of the brain, is extremely important in showing that the two sides of the brain may act independently of each other. I shall have to return to this again, as much of my argument depends on this point.

As regards sight, a theory has been advanced by a celebrated philosopher, Dr. Wollaston, of London, which has been adopted by a great many physiologists, although by no one without some hesitation. But as there was no better theory proposed, it was received as being at least probable if not demonstrated. Wollaston held the opinion that the right side of the base of the brain is the centre for sight in the right half of each eye. The right half of the right eye is, of course, the half farthest from the nose, and the right half of the left eye is the one nearest the nose. The inner half of the left eye and the outer half of the right eye have for their centre, according to this view, the right side of the brain, and, *vice versa*, the left side of the brain would be the centre for sight in the left or outer half of the left eye and the inner half of the right eye. There is, therefore, according to that view, a condition which is quite peculiar. If we admit it for a moment, then we ought to find that a disease in the left of the brain at the base must destroy

only one-half of the power of sight, and objects then if seen are seen in half. Suppose a man to be looked at, there would be visible, if it is the left side of the brain which is affected, only the right half of the body. Wollaston himself had this trouble. One day, trying to read the name of an instrument, the barometer, he read "meter" only; the other part of the word, "baro," he could not see. Another eminent friend, while living in France, Professor Agassiz, had the same affection. He saw one-half of all objects. And a good many patients who are affected especially with certain disorders of movement and with diabetes have also this trouble; they see but half of objects. There are, therefore, cases which seem to be in favor of the view. But, continuing to consider what ought to take place, we find that, if the disease exists only in a small part of the left side of the brain, in that portion which serves for sight, we ought to find that then only one-half of one eye will be affected. There are such cases. If it is the other part of that same half of the base of the brain which is affected, then it is one-half of vision in both eyes which should be affected. There are also facts of this kind.

There are, therefore, three kinds of facts which seem to support the view of Wollaston. But what of that? Philosophers do not accept conclusions because there are some facts which support them. We accept conclusions when all the known facts are either in perfect harmony or clearly prove the conclusion; and also when there is no fact that seems to be in opposition. It is requisite, therefore, either that all the facts are in favor of the theory, or that while there are a number in favor there are none in opposition. Such is not the case here. There are a great many facts which show that a disease in one-half of the brain will produce complete loss of sight of one eye, either on the same or on the opposite side, or the two halves of both eyes. Therefore there are three series of facts, while

one only would be enough, which demonstrate that the theory ought to be rejected.

But as regards sight we find this, and it is a point of importance, that a disease anywhere in one-half of the brain can exist without any alteration of sight whatever. A disease existing in that part where the optic nerve enters the brain, destroying that part altogether, may not be a cause of loss of sight; so that one optic fibre alone may be perfectly sufficient for the functions of the two eyes. Therefore I conclude that it is quite enough to have one brain to have our power of sight; and as it is so for each half of the brain, I can also conclude, and this is a point of importance, that each half of the brain is independent of the other, and that each of them possesses the powers of serving to the sensations of sight. You will ask how is it that a disease in certain cases in the brain will produce loss of sight, and that in other cases a disease in the same part will not produce loss of sight. As regards this, I cannot develop at length what I would have to say; but if any of you were present at my lecture in this city last year, or at the Academy of Sciences to-day, you know that an alteration in any part of the nervous system, whether in the brain or elsewhere, can, by producing an irritation, act on other parts, so as to produce the loss of a function of those other parts; and so it is especially with sight. In many experiments I have ascertained that injuring a small part of the spinal cord produces a loss of sight in the eye on the same side. An injury to the *medulla oblongata*, a little higher than the part of the spinal cord which produces loss of sight on the same side, will produce a loss of sight, but in the opposite eye. There is, therefore, a power of producing a loss of sight by irritation; and indeed there is nothing more common in children having worms than a diminution in the power of seeing. It is in the same way that an irritation existing in certain parts of the brain will produce, at a distance from the place where it exists, a loss of the func-

tion of sight. The cases that can serve as proof are, therefore, not those alone in which we find that the disease exists, since the loss of sight exists when there is a disease. The cases that can serve positively must clearly bring us to a conclusion; as those, on the contrary, which establish that an injury in any part or one-half of the brain—even in that part which receives the optic track—can exist without producing any loss of sight; and that fact has been observed—more than five or six times to my knowledge—and in those cases in the most decisive manner. Therefore the conclusion I have drawn is established. Either half of the brain may serve for the function of sight.

Now, as regards the volitional movements, the voluntary movements, if you like to call them so. Those movements, as you well know, have been considered as depending on each half of the brain for one-half of the body. Still, many physiologists have ascertained that there are muscles in our system in the neck, in the eye, in the throat, and in the back also, which escape paralysis when there is disease in one-half of the brain; and for these cases a theory has been imagined to explain how it was that the left half of the brain, for instance, is not the regulator of the movements in the right side of the body. I shall pass over that theory, and come to the point of importance in the object which I have in view.

As regards volitional movements, there are cases on record which leave no doubt that either the anterior lobe of the brain, the middle lobe, or the posterior lobe, the three essential parts of the organ, can be destroyed and voluntary movements not be interfered with at all. There are many cases—perhaps the word “many” is too strong, but there are at least seven or eight to my knowledge—of the destruction of the whole half of the brain without any interference with the voluntary movement. Therefore we are not to look upon one-half of the brain as being necessarily the organ serving to the movement of the body on the opposite side. And also another inference; we are to look

upon one-half of the brain, in some individuals at least, as being able to control voluntary movements in the two sides of the body. If so, certainly the point I have in view—that is, to show that we have two brains—is established as regards voluntary movements. We have certainly two brains as regards voluntary movements; and if it is found in most cases that even a slight injury limited to a small part of the brain will produce a paralysis on the opposite side, or sometimes on the corresponding side—if that is found, it is on account of the principle which I mentioned a moment ago; that is, that an irritation in any part of the brain can affect functions in other parts through transmitted irritation. And I can say in regard to voluntary movements what may be said as to worms in the bowels, as well as an irritation in a tooth, in the stomach, in the lungs, in the heart, or an irritation in the skin; in other words, an irritation wherever there is a nerve subject to be irritated, all can produce a paralysis as well as an irritation in a part of the brain. And therefore, when we see a slight alteration in a very limited part of the brain cause a complete paralysis on the opposite side of the body, we are not to conclude that it is owing to the loss of function of voluntary power where the disease exists, but that it depends upon an irritation starting from the place where we see the disease, and acting upon remote parts so as to produce the loss of the function. The mere fact, that a disease exceedingly limited in extent can produce a complete paralysis in the opposite side of the body, is sufficient to show that it does not depend on the loss of the function of will; for the cause of motion of one-half of the body cannot be located in a very limited part of the brain. If it were the other side of the brain which produced that complete paralysis, if we found that paralysis is more or less extensive, more or less durable according to the extent of the disease in one-half of the brain, then we might conclude that the disease has destroyed the power of will in that half of the brain, and thereby produced

the loss of voluntary movement on the opposite side. But that is not what we find. We see that the lesion which has destroyed one-half of the brain may allow voluntary movement, while a lesion which is not larger than a pea in any one part of the brain can produce a loss of voluntary movement. Therefore we are to admit that when the paralysis of movement comes in connection with disease of one-half of the brain, it depends on an influence starting from the place where the disease is acting upon remote parts so as to produce a cessation of activity there, or in other words a paralysis.

The same reasoning may be applied in regard to perception of sensation. Here also we find the same thing. I shall, therefore, not dwell on that point. We know a thousand cases of disease occupying one-half of the brain that has not produced the slightest alteration in the power of feeling. But, if it is so, it remains to be explained how it is, that the two halves of the brain come to be in some respects different, and that the physiological and pathological study of the two halves of the brain indicates great differences in this respect. If we pass in review what is known, we find very great differences indeed. These differences depend on the fact that, through the fault of our fathers and mothers, the faults that weigh upon us, and have led us to make use of only one-half of our body for certain acts, and one-half of our brain for certain other acts also—we find that it is owing to that defect in our education that one-half of our brain is developed for certain things, while the other half of the brain is developed for other things. As regards what belongs to the left side of the brain compared with the right side of the brain, allow me to say the most important feature in its physiology or pathology is what a French physician has discovered. It is, as I have said already, that to that side of the brain belongs the faculty of expressing ideas by speech. Besides that mental faculty of speech, the left side of the brain possesses, in a much more marked degree than the right, the power of moving the

tongue and larynx and muscles of the chest to produce the sounds of articulate voice. Articulation of sounds in speech in a great measure depends on the left side of the brain. I mean by the words "in a great measure" that it is chiefly the left side of the brain which has the power of acting upon the organs. So that more frequently in cases of disease of the left side of the brain do we find the difficulty in the mechanical part of the speech than in cases of disease of the right side of the brain. But that, although speech is, when defective, mechanical, and is something like a gesture, there is a mental sign in it, and I cannot but consider it as representing some mental trouble.

My pupil and assistant in London, who has become a very eminent man since, Dr. J. Hughlings Jackson, has also insisted on the point, that it is the memory for direction of movements of the muscles which serve to articulate, which is lost, and not the mere power of moving the muscles of the tongue, larynx, or chest. I have had proof of this in a great many instances, that, when told to do so, the patient could move the tongue in any direction, could move the larynx and utter sounds very well, but could not articulate, so that it was the mental part of that mechanical act—the mental part of which was altered, and not purely a mechanical action lost. The left side of the brain is also the one that leads in gestures, and that by a very simple reason, which is, that it is the left side of the brain which mainly directs the movement of the right arm, and it is chiefly with the right arm that we make our gestures. Still, it is likely, as pathological facts show, or at least appear to show, that even the motion of the left arm depends on the left side of the brain as regards gestures, as we find that in patients who have a disease of the right side of the brain the faculty is lost of making gestures with either the right or the left arm. That of course shows, or at any rate seems to show, that the left side of the brain is the organ for gestures chiefly. In a few cases, however, of disease of the right side of the

brain, the power of making gestures has been lost as well as in case of disease of the left side of that organ.

As regards the power of writing, there is a difficulty which you will easily understand. Still there are many facts which show that the power of writing can be lost more easily, and is lost more frequently in cases of disease of the left side of the brain than in cases of disease of the right side of the brain—a difficulty which many of you have understood without my mentioning it. We conclude that the right arm is not rarely paralyzed in diseases of the left side of the brain, and as we write with the right arm, it is very natural that, on being paralyzed, we cannot write; but very few patients have lost altogether the movements of the fingers, and cannot form the least sign, though many of them cannot at all form a letter. They will be able, however, if they have a letter written by some one whose handwriting is not very much different from theirs (and sometimes when it is different), they will be able to imitate what is under their eye, but they cannot from memory write anything; at all events, they cannot express ideas by writing. They are attacked with what is called *agraphia*—that is, a loss of the faculty of expressing ideas by writing. In many of these cases of patients attacked with *agraphia* there is a perfect power of moving the right arm. The arm is not paralyzed in all cases where the left side of the brain is paralyzed; there is often no paralysis on the right side of the body or the left; no paralysis anywhere. In these cases, it has occurred sometimes that the patient could not write at all; so that it is clear that the loss of the faculty of expressing ideas by writing does not depend on the paralysis which in these cases had no existence.

Another thing depends on disease of the left side of the brain more than the right side of the brain, and that is intelligence. Alterations of the mind manifesting themselves in the various forms of insanity depend more frequently, I should

say, on diseases of the left side of the brain than on diseases of the right side. This is all I know now which belongs to the left side of the brain. The right side of the brain is quite different. From all that I have stated about the left side, as you will see, that organ is chiefly the organ serving the mental faculties, either in speech, or in intelligence, or in gesture, or in writing. That organ, therefore, is the important organ in our system adapted to the life of communication between ourselves and our brethren in a mental way. But the other organ—the right side of the brain, in some individuals, as you will see, has the power of the left side, and in all, perhaps, it might have had it if the proper development had taken place; but this right side has also additional functions. The right side of the brain serves chiefly the emotional manifestations, hysterical manifestations included, and to the needs of the nutrition of the body in various parts. There is, therefore, taking a large view of the differences between the two brains, this difference, that one of them—the left—serves to what we call the life of relation, while the right serves to what we call the organic life. This view, which I put forward five or six years ago, has begun now to receive demonstration from several physicians, and I am, therefore, the more emboldened in maintaining its correctness. The right side of the brain is remarkable in producing alterations of nutrition either in limbs that are paralyzed, or in the back. It is perfectly well known that a number of patients die every month in every large city, of ulcerations taking place on the *nates* or on the *sacrum* originating from an irritation of the brain. These patients are more numerous among those attacked by disease in the right side of the brain than among those attacked with disease in the left side of the brain. Either œdema or bed-sores, either one or the other of those two kinds of lesions is more frequent in cases of disease of the right side of the brain than in cases of the left side. The proportion is considerable. It is as two-thirds for the right side of the brain

and one-third for the left. There are many other points which show the same thing. An ulceration in the lungs, an ulceration in the liver, a hemorrhage, for instance, and sudden inflammation—all these disturbances can take place from an irritation of the brain, as I have shown; but in these cases it is chiefly the right side of the brain that has the power.

I have already said that hysterical and emotional symptoms are more common in cases of disease of the right side of the brain. This has been established already by a good many physicians—Drs. Briquet and De Fleury, and a good many others, besides myself. We have collected cases of paralysis in one-half of the body, caused by hysteria, and this proportion has been found; out of 121 cases of paralysis caused by hysteria (a paralysis which is usually merely transient, and very rarely lasts long)—in 121 of these cases there was disease of the brain on the right side 97 times, and disease on the left 24 times; so that the right side predominates in this class of affections. That paralysis exists on the left side of the body more frequently than on the right side you well know, and, as it affects chiefly the right side of the brain, it affects chiefly the left side of the body.

Now as regards other points, my pupil, Dr. Jackson, has ascertained that an inflammation of the retina produces amaurosis more frequently in both eyes from disease of the right side of the brain than the left side. Convulsions of the eye take place very frequently in cases of disease of the brain. I have ascertained, from a study of the cases published by Dr. Prevost, Dr. Charmel, and many others besides my own, that out of 69 cases in which these convulsions of the eye occurred there were 47 due to the disease in the right side of the brain, and 22 due to disease in the left side of the brain. Therefore there is a great difference between the two sides of the brain, as you will see. It is also so as regards general convulsions. Callender and myself have shown that general convulsions will

occur much more frequently in cases of disease of the right side of the brain than in cases of disease of the left side. I have ascertained that both will occur far more frequently in cases of disease of the right side of the brain than in cases of disease of the same extent and the same location in the left side of the brain. Not only disease in the right side of the brain will have the greatest power in this respect, but it will also, if the patient does not die, produce a more marked paralysis; a more extensive and more permanent one. So that, as regards degree, as regards extent, as regards duration of the paralysis, the right side of the brain is by far worse than the left, showing again that that side has the greater power of nutrition. There are a good many other points showing a difference of the same kind. I pass them over, as time presses. There is, therefore, as you will see, a radical difference between the two sides of the brain. But now this depends, as I have said already, not upon the fact that the two sides of the brain are very different originally, but it depends on development. Every organ which is put in use for a certain function becomes developed, and more efficient in performing that function. Indeed, the organ shows it in size. The left side of the brain, which is used most in our system, is larger than the right side of the brain. The left side besides receives a great deal more blood than the right side of the brain, because it has a preponderance in our system, and every organ that acts much, receives more blood. As regards the influence of action on the brain, there is a fact which hatters know very well. If a person is accustomed for many, many years from adult life—say from 20 up to 40 or more—to go to the same hatter, the hatter will find after a time that he has to enlarge the hat of his customer; and, indeed, a person advanced in life, even having passed, as your lecturer has, 56, has a chance to observe such a change. There is no period of six months that has passed that I have not found that my hat, if neglected and put aside, became too small. The head, therefore, growing, is a

very strong proof that the brain also grows. Action, therefore, is a means of increasing size, is a means of development; and I have no doubt that a good many among you have observed that, after they have paid great attention to a subject, they have not only acquired knowledge on that subject, but become much more able to solve questions relating to that subject—that they have developed the part of the brain which has been used for the acts in which they have been engaged, and that part has become far more able to perform its functions. This is perfectly well shown by everything in our system. We well know what a power a pianist can have, if he continues to exercise his fingers and brain on the piano. But such a pianist neglecting to perform the acts that he was accustomed to perform before, it is very soon found that there is a defect. We must go on, therefore, exercising the organs in which we desire to have the great activity of life. There is no doubt, therefore, that the left side of the brain, as is shown by its great enlargement compared with the right side, and as is shown also by the quantity of blood that it receives, that that organ is the one which is predominant in our system. But our being right-handed shows this also.

It is quite certain that right-handedness depends something on nature. As you well know, the wildest populations in the world are right-handed, as we are. There is no people anywhere in the world that has not been found right-handed. There is therefore in man a cause which makes the right side of the body to be selected as the one to be used the most, and together with that right side of the body the left side of the brain, which usually moves that right side, is increased considerably in power and in size. There is, therefore, primitively, a development given through some natural cause to the left side. We find that individuals who are left-handed make use of the right side of the brain, and when they become confused—when they lose the faculty of expressing ideas by speech—it is

the right side of the brain that is affected, showing the connection between the development of one-half of the brain in the use of one arm, and the development of that same half of the brain in the faculty of expressing ideas by speech. There is, therefore, a connection between these two things, and on this point I shall dwell a little more in a moment. There is primitively a difference between the two brains, and Professor Gratiolet has discovered in children that the second convolution—the convolution of the left side of the brain—is developed quicker than the convolution of the right side. This may be in a measure owing to hereditary traits; but at any rate, as there is an evidence that there is a natural tendency to make use of the right arm, it is certain that a part of that ability of development on the left side is due to something natural—that something natural will be found, if it is examined, in the greater supply of blood to that part. Even parrots and birds show something very interesting as regards right-handedness. Parrots perch only on the right leg, or mostly only on the right leg. Very few parrots out of twenty taken at random, perch on the left leg, according to what Dr. William Ogle ascertained after having examined a great number of them. Parrots, of course, are known to have something like speech—a parrot's speech, of course. It is perfectly well known that the mechanical parts of speech belong to them, and it is remarkable that their left brain receives also more blood by far than their right brain. There is therefore a relation between all these things in the development of the right side of the limbs and the amount of blood received by the left side of the brain. There is another point of importance. Prof. Broadbent and others have found that in the left side of the brain the mass of gray matter is greater, and there are more convolutions than in the right side of the brain.

Now we come to four points of great importance in this lecture. They are the vital points, I may say, in the argument

I have presented here. The first of these points I have already spoken of. It is, that we find that *agraphia* is connected with the left side of the brain in persons who are right-handed, and with the right side of the brain in persons who are left-handed. This, certainly, is a very strong argument to show that the side of the brain which serves the motion of one side of the body, that side—if the side of the body be the one which leads, is the most important of the two—that side of the brain then is the one that serves chiefly to the mental life in our system. The mental life of our system, therefore, seems to be developed considerably in the organ which itself seems to be developed in a great measure owing to the action of will in one-half of the body. There is certainly a connection between these things, but that will come out more by and by.

The second point is, that in children who have not yet learned to talk, or who have already learned only a little, if disease comes in the left side of the brain, the one, I repeat, which is, usually, the most rapid in its development if disease comes to produce atrophy, so that the left side of the brain becomes useless, those children then learn to talk just as well, or nearly as well, as if they had no such affection, and they learn it with the right side of the brain, which is the only one acting. They were not born (the most of them, if not all of them, if there is any exception I don't know it) of parents who were left-handed, and there was no reason for their being left-handed. They had the misfortune of losing the half of the brain which served usually to the mental faculties, and other mental faculties became developed—the power of speech and action—and they make use of the left arm then just as well as any one of the right-handed people makes use of the right arm. There is in these facts clear proof that the right side of the brain can be educated to become a leader in mental faculties as well as the left side of the brain. There is a clear proof that the right side of the brain can lead movements and obtain exe-

cution with the left arm, just as most people who are right-handed obtain execution of movement with their right arm. These facts, therefore, are decisive in favor of the view that I have for my object in this lecture.

The third point of importance is that with a given number of individuals, out of 100 examined by Dr. Wm. Ogle, who were left-handed, four only had learned to write with the left arm. They had been taught by their parents, although they were left-handed, to make use of the right hand to write, and their writing with the left arm, the author states, was very clumsy. In one of the cases he had to learn the facts from what the patient had to say; the patient being paralyzed in the left hand, he could not write; but in the others he had the proof, and could see. Therefore, the left side of the brain, even in persons who are left-handed naturally—even in persons who make use chiefly of the right side of the brain—can be educated so as to produce a very good handwriting instead, and better than the writing by the left arm.

The fourth point of importance is one on which I shall not dwell, as it implies a knowledge of medicine that you have not, but I shall state it in only a few words. It is exceedingly rare that the leg is affected to the same degree by paralysis as the arm, and the leg, as you well know, is not a part which we develop as much in its movements as we do the right arm. If a patient is struck with paralysis, for instance, on the right side of the body, owing to a disease of the left side of the brain, he will lose more, if he does lose movement at all—he will lose more of it in the right arm which he has been accustomed to train than in the right leg. But, I repeat, that this argument cannot be understood well except by medical men. I pass it over therefore.

There is no reason whatever to object to our teaching children to make use of the two sides of the body. If you have been convinced by the arguments I have given that we have two

brains, it is clear that we ought to develop both of them, and I can say, at any rate, as much as this, there is a chance—I would not say more, but at least I can say there is a chance—that, if we develop the movements of the two sides of the body, the two arms and the two legs, one just as much as the other, there is a probability that the two sides of the brain then will be developed, as regards the mental faculties, one as much as the other.

The facts that I have brought forward, the last especially—what I have called the four points of importance, and particularly the first three, show that there is a connection between the development of the brain as regards the mental faculties, and the development of the brain as regards leading movements in one side of the body. There is a great probability, therefore, that, if we give a good deal of attention, or, better, as much attention to the left side of our body as we give to the right, there is a great chance that we would have two brains, as regards mental functions, instead of one, as we have now. There is no doubt that we can improve the two sides of the body constantly. The facts I have mentioned as regards those children having atrophy on the left side of the body, do not leave room to doubt. It is clear we can develop the left side so as to make it exercise all the functions which exist in most of us in the left side of the brain, and, if so in cases of atrophy on one side of the brain, why not so in cases in which we have two brains? I think, therefore, the important point should be to try to make every child, as early as possible, exercise the two sides of the body equally—to make use of them alternately. One day or one week it would be one arm which would be employed for certain things, such as writing, cutting meat, or putting a fork or spoon in the mouth, or in any of the other various duties in which both the hands and the feet are employed. In this way it would be very easy indeed to obtain a great deal, if not all the undeveloped power possible to the individual. We know

that even adults can come to make use of their left arm. A person who has lost his right arm can learn to write (with difficulty, it is true, because in adult life it is much more difficult to produce these effects than in childhood), and the left arm can be used in a great variety of ways by persons who wish to make use of it. It is perfectly well known that the left arm is employed in playing on the piano or on certain other instruments almost as well as the right arm. Therefore there is no difficulty in training children to make use of both sides of the body equally.

There is also another fact as regards the influence of training. Even in adults, who have lost the power of speech from disease of the left side of the brain, it is possible to train the patient to speak, and most likely then, by the use of the right side of the brain, the left side of those patients, with great difficulty, will come to learn. They always have more difficulty than do children, but they learn if they are taught in the same way. It is the same kind of teaching that we employ for a child when we try to make it speak; it is the same way that should be employed to teach an adult who has lost the power of speech. It is so, also, as regards gesture, and the rest. I have trained some patients to make gestures with the left arm, who had lost the power of gesture with the right, and who were quite uncomfortable because their left arm, when they tried to move it, at times moved in quite an irregular way, and without any harmony. There is an aptness acquired by training, therefore, even in adults, and, if so, that capacity exists in children, and as we well know that we can make a child naturally left-handed to become right-handed, in the same way we can make a child who is naturally right-handed to be left-handed also. But the great point should be to equally develop the two sides. To point out this has been the principal object of this lecture; and I have now to thank you for having listened to these long and tedious details.