FOCAL EPILEPSY: TREPHINING AND REMOVAL OF SMALL HÆMORRHAGIC FOCUS: NO IMPROVEMENT; REMOVAL OF PART OF LEG CENTRE AFTER ELECTRICAL STIMULATION: IMPROVEMENT.

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WITH REMARKS BY

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THE following case is of a similar nature to that published by Mr. Rushton Parker in the *BRITISH MEDICAL JOURNAL* of May 27th last, but I have delayed bringing it forward until the result of the operation was more definite. The success, from a surgical point of view, was most satisfactory although the child still has fits, which, however, are modified in character.

A boy, aged 15, was admitted into the West London Hospital on March 9th, 1892, under the joint care of Dr. Herringham and myself:

History.—In 1888 the patient began to suffer from sudden muscular contractions of the right leg; at first these occurred about every quarter of an hour both day and night, but gradually became less frequent, and ceased entirely six months later. He was free from these attacks for two years, but the fits returned in 1890, and did not leave him for eighteen months. He was free from fits from the summer of 1891 until Christmas, since when he has been having from four to fifteen attacks daily. There is no definite history of injury, but the mother thinks that he had a fall on his head two years previously.

State on Admission.—A bright healthy-looking lad, quite intelligent, good at school work and anxious to get some employment. General health good; lungs, heart, and kidneys healthy. The patient described the fit as starting with a tickling sensation in the sole of the right foot; this was followed by a contraction of the great toe, extension of the ankle, and flexion of the knee; there was occasionally slight flexion of the fingers of the right hand; if standing he fell down but did not lose consciousness. A stinging pain in the thigh followed. Each contraction lasted about two seconds. The knee-jerks were normal and there was no wasting or alteration of sensation of the right limb. The attacks occurred more frequently on certain days, and he had a peculiar sensation in the right foot by which he knew when he was likely to be attacked by the fits. There was nothing abnormal in the foot. The head was perfectly symmetrical and there was no depression or tender spot in the neighbourhood of the left motor area. He never had headaches. Mr. Percy Dunn kindly examined the eyes and reported that the optic discs were quite normal.

Symptoms Observed before Operation.—He had six to twelve small fits daily, and on March 12th one of these developed into a true epileptic fit, lasting ten minutes, ending in unconsciousness, with involuntary escape of urine and feces. March 23rd: Had had two epileptic fits since the last note, and about eight contractions of the right leg daily. On this day a fit was produced by tickling the sole of the foot. It began with flexion of the knee, extension of ankle, and inversion of foot. The question of operation was discussed between Dr. Herringham and myself, and I agreed to explore the motor area if no improvement took place within a month.

First Operation.—April 23: The lad continued to have the same number of spasms daily in spite of large doses of bromide, so the operation was performed. The head was shaved, scrubbed, and washed with ether, and in 20 carbolic acid. The position of the fissure of Rolando was marked out with a blue pencil, having been determined as suggested by Makins. Two hours before the operation the patient had a severe general epileptic fit, followed by unconsciousness; after the fit the right foot perspired freely. A fifth of a grain of morphine was injected hypodermically, and chloroform was given by Mr. Lloyd. A large square flap about 3 inches wide, having its anterior edge just behind the coronal suture, was dissected up, and reflected downwards. A trephine with an inch crown was applied just behind the line of the fissure of Rolando; and, again, more anteriorly, and the intervening bone removed with bone forceps. There was no abnormal appearance in the bone or dura mater, which was opened along the anterior edge of the trephine holes, and reflected down. The fissure of Rolando was exposed with a large vein lying in it. The cerebral substance at the lower part of the exposed area looked discoloured, so the opening was enlarged downwards by removing a further disc of bone with the trephine. The whole of the discoloured area of cortex thus exposed was about the size of a fourpenny piece, and was freely excised with a knife to the depth of three-quarters of an inch. There was some bleeding from the brain substance, which was controlled by a stream of 1 in 20 carbolic acid solution, after a vein in the pia mater had been ligatured with fine silk. The dura mater was sutured with silk, and the bone replaced in small pieces. The wound was closely sutured up, without a drainage tube, and dressed with cyanide gauze.

After-treatment.—The boy had some troublesome vomiting for the first three days, but made a rapid recovery, not suffering once from headache. He had no fit for three days, but then commenced his old attacks. The wound healed completely in a week, and there was no loss of power in the foot or leg. The fits having rather increased in frequency since the operation, Dr. Herringham recommended that the motor area should be again exposed, and that portion excised which produced the increment of the fit when stimulated electrically.

Second Operation.—On May 14th chloroform was again given by Mr.

Lloyd after a preliminary injection of $\frac{1}{2}$ grain of morphine. The head having been prepared and marked out as before, a large square flap, extending further backwards than the former one, was reflected. The pericranium was closely adherent to the replaced bone, the pieces of which were again removed and placed in warm boracic solution. The opening was enlarged by removing two further discs of bone, one above and the other posterior to the old opening, the intermediate bone being removed with bone forceps. The dura mater, which was adherent to the pia mater at the site of the old suture, was divided and reflected downwards. Dr. Sherrington, who had kindly lent the electrical apparatus, was good enough to superintend the stimulation of the cortex. The patient, having been allowed to come round partly from the chloroform, the electrodes were applied to the cortex. No response was produced on stimulating the lateral and posterior part of the exposed surface; but, on applying a strong current just above the part previously removed, movements of the foot and knee similar to the epileptic spasms were produced. After one or two stimulations a typical clonic spasm was produced, which lasted after the withdrawal of the electrodes. The area by stimulation of which these increments were produced was about the size of a sixpence, and was situated just above the discoloured area previously removed. It was freely excised to the depth of $\frac{1}{2}$ inch with a knife, and bleeding stopped by 1 in 20 carbolic lotion. Before and during the electrical stimulation no antiseptic lotion was used. The dura mater was stitched up with silk, and the wound filled with small pieces of bone. The wound was closed with a continuous suture without a drainage tube, and dressed with cyanide gauze. The operation lasted an hour.

After-history.—The patient again had some troublesome vomiting for the first twenty-four hours, during which time he was given nothing by the mouth except hot water. The wound was healed at the end of a week. There was absolutely no loss of power in the right leg or foot, and no impairment of any movement; there was no loss of sensation or fall in temperature of the limb; the knee-jerks were natural, and there was no ankle clonus.

Some slight attacks of clonic spasm reappeared two days after the operation, and on May 25th one of these was seen by the house physician, Mr. Lakin Paget, who reported that the fits lasted one or two minutes, and appeared to begin without any contraction of the foot or leg. The right arm was flexed, and underwent a series of clonic spasms. The chin was depressed upon the right shoulder, and the right side of the face was contorted, the jaw open and fixed, and the angle of the mouth drawn down; there was also some slight lateral flexion of the body. There was no spasm of the leg, but during the fit voluntary movements were possible. After the fit there was marked paresis of the right arm and the right side of the face, but none of the right leg. He did not lose consciousness.

He continued to have four to six attacks daily, and left the hospital on June 8th, 1892. Since then I have kept him under my observation till the present time. At first nearly every day he had two or three attacks of clonic contraction of the right arm occurring usually between 5 and 7 A.M., but he never had any of the old attacks of spasm of the leg and foot. In August, 1892, during the attacks, an involuntary cry escaped him, and the fits appeared to be more severe but less frequent, but did not stop altogether for more than a few days at a time. The duration of the fit gradually got shorter; at the beginning of this year he began to have attacks of "pins and needles" over the right side of the body and limbs, which lasted some hours, and occurred about once every ten days. These gradually passed off, but during the past two months he has during the early hours of the morning one or two slight attacks of contractions of the muscles of the right thigh and hip-joint which often do not awaken him. Before these attacks he had an aura in the back of the thigh and the fit began with flexion of the knee followed by flexion of the hip, the right hand then became strongly pronated and there was some lateral flexion of the body. The fit lasts about five to ten seconds. Since the operation he has never had an aura in the sole of the foot, nor have the fits affected the ankle or foot. He never loses consciousness during these attacks. The boy is well nourished, and his general health has improved; there is a very firm cicatrix over the trephine holes and only at one point is there any pulsation to be felt. For the first nine months after the operation the patient took large doses of bromide of potassium; he has had none since April, and he appears to have made more progress without that drug.

The state of the right leg at the present time (eighteen months after operation) is as follows: There is no wasting nor lowered temperature of the right limb or foot nor is there any hyperæsthesia or loss of sensation. The boy is able to perform every voluntary movement of the leg and foot, even

moving the great toe by itself, and adduction and abduction of the other toes. If anything, the muscles of the right leg appear slightly stronger than those of the left, and careful measurements of the girth of the calves and thighs at corresponding distances from the knees showed that the right calf measures a quarter of an inch more than the left, the thighs having the same girth on both sides. The muscles of the right leg and foot reacted well to the galvanic current. The knee-jerk was very brisk, and there was well-marked patella clonus on both sides. The patient has never had any muscular pains in the leg, and walks without the slightest trace of a limp.

On the whole I think that he has benefited greatly by the operations, as when first seen he was having, daily, about fifteen spasms of the leg, which made it quite impossible for him to go about alone; he also had occasional true epileptic fits, which have not returned since the operation. The absence of any alteration in voluntary power or in sensation of the leg after the removal of a considerable piece of the motor area is interesting; so, too, is the shifting of the site of the spasms and the consequent freedom of the ankle and foot.

The portion of the cerebrum excised at the first operation was examined microscopically, and the discoloration found to be due to altered blood, but nothing abnormal was found in the part removed at the second operation. I have reported this case, in spite of the child not being quite cured, because in the present state of our knowledge every such case is of interest.

NOTE.—Since writing the above I have more carefully tested the sensation of the right leg, and can find absolutely no difference as compared with its fellow. On testing it with a pair of compasses, I found that the extent to which it was necessary to separate the points before two distinct sensations were perceived was exactly the same when the compasses were applied to the right or to the left leg at corresponding points. When blindfolded the patient could indicate with a finger the exact spot where he had been touched on either leg. The sensation of heat and cold was quite normal.

REMARKS BY PROFESSOR SHERRINGTON.

Mr. Bidwell has kindly invited me to append a few remarks regarding the excitation of the cortex in the above case.

For excitation was used an ordinary sliding inductorium (Elliott Brothers) of the Du Bois-Reymond pattern, as generally employed in the physiological laboratory. In the primary circuit were a pair of 1-pint Daniell cells coupled for intensity. A steel reed (Hawksley), vibrating 100 per second, was introduced as an automatic interrupter; a side-wire shunt (Helmholtz) "equalised" the intensities of the make and break currents. Platinum electrodes were used in the form of two short wires curled into springs, but sheathed except at the tips; these can be pressed against the cortex with little risk of injuring its surface, and I have found them very useful in the laboratory. The tips of the electrodes were a quarter of a centimetre apart.

The currents were first applied at the lowest part of the cerebral surface exposed, just in front of the central fissure. The currents were of moderate intensity, the secondary coil being on the scale at 15 centimetres from the primary. No effect being obtained, the secondary coil was brought nearer the primary until within 10 centimetres. Each application of the current lasted about five seconds. The anaesthetisation, which was not deep at this moment, was then further relaxed. I hesitated to resort to more violent stimulation. I was not at the time aware of the observations by Keen,² Nancrede,³ and Horsley⁴ regarding the very great intensity of the currents found requisite for obtaining responses from the human cortex. The electrodes were shifted forward and toward the median line, about a centimetre from the place previously tried. The secondary coil was kept within 10 centimetres of the primary. The faradisation still elicited no movement, and this although no fluids that could have been harmful to the cortex had been applied.

The intensity of the currents was now increased, and by successive shifts the secondary coil pushed up to 4 centi-

metres from the primary. A movement then followed the application of the electrodes. The movement was simply dorsal flexion at the right ankle-joint. The electrodes were then shifted again to the place at which they were applied first of all, and again to a place behind the central fissure. No movement was elicited from this, although the applications lasted full five seconds each. The electrodes were then placed a little lateral to and in front of the point whence the movement at the ankle had been produced. A movement followed. Again dorsal flexion at the ankle; this time followed by flexion at hip and knee, the latter two movements appearing simultaneously, I think. The application was then made a little further laterally; there resulted dorsal flexion at the ankle with drawing up of the outer edge of the foot, followed by flexion at hip and knee. The movement was more vigorous than the previous ones; it persisted after withdrawal of the electrodes and terminated with some clonic contractions.

The excitation was not repeated further.

The surface of the cortex, which did not respond even to the, physiologically speaking, very intense currents found necessary⁵ in this exploration (currents quite unbearable on the tip of the tongue), was normal in appearance; its vascular condition at the time was hyperæmic rather than anæmic. The degree to which the patient was under the influence of the anæsthetic was, especially at the time of the second repetition of the application, quite trifling. I think, therefore, this surface must have been, in part at least, one of the inexcitable blanks first observed to exist in the "motor" cortex of man by Lloyd and Deaver,⁶ and in the orang by Beevor and Horsley.

A point incidentally noticed in the exploration was the absence of any sign of sensitiveness in the dura mater.

A point in the case not connected with experimental excitation of the cortex, but yet of some physiological interest, concerns the topographical relation between the sensory aura and the primary movement of the convulsion in the fit. The primary movement in the convulsion was dorso-flexion at the ankle. In slighter fits this was the only movement; in severer fits it was the earliest movement, or as early as any. As to the aura, the patient stated that the fit commenced with a tickling in the right sole. On one occasion the fit was induced by tickling the right sole. Between the skin of the sole and the muscles of the front of the leg there may not at first thought seem any close connection. Experimental work on the lumbo-sacral plexus of the monkey shows, however, that the one is supplied with sensory, the other with motor, nerves from the same lumbar segments of the spinal cord. In the above case, therefore, the aura seems to have been referred to the same spinal segments in which are represented the muscles which were earliest convulsed, and on one occasion the cortical discharge was induced by irritation applied to and through those very spinal segments.

THE NATURE OF VACCINE IMMUNITY.¹

Presented to the Section of Pathology at the Annual Meeting of the British Medical Association held in Newcastle, August, 1893.

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AND

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THE following is a preliminary report of an investigation on the nature of vaccine immunity. The experiments detailed in this account are limited to the calf, but we are engaged in extending them to other animals:

It has been demonstrated by some observers that when immunity to infectious disease has been experimentally produced in animals, the serum of the blood of such animals possesses immunising and even curative properties in the case of the disease in question, when injected into other animals. It therefore seemed very desirable to us to apply

⁵ Cf. Parker and Gotch, *BRITISH MEDICAL JOURNAL*, May 27th, 1893.

⁶ *International Journal of Medical Science*, 1888.

¹ The authors desire to express their very great obligations to Dr. Robert Cory for the interest, valuable help, and criticism which he was ever good enough to give them:

² *International Journal of Medical Science*, 1888.

³ *Medical News*, Philadelphia, 1888.

⁴ Beevor and Horsley, *Excitation of the Motor Cortex in an Orang*, 1890.