

April 7, 1864.

Major-General SABINE, President, in the Chair.

The Rev. Dr. Salmon was admitted into the Society.

The following communications were read :—

- I. "On the Functions of the Cerebellum." By WILLIAM HOWSHIP DICKINSON, M.D. Cantab., Curator of the Pathological Museum, St. George's Hospital, Assistant Physician to the Hospital for Sick Children. Communicated by Dr. BENICE JONES. Received March 8, 1864.

(Abstract.)

The paper is divided into two Parts; the first gives the results of experiments on animals; the second, of observations upon the human being.

PART I.

Assuming that the great divisions of the brain preserve each the same function through the vertebrate kingdom, it is maintained that experiments which can be performed only on such of the lower animals as are very tenacious of life, will afford deductions of universal application.

The method of proceeding with regard to each species was to remove, first, the whole encephalon, with the exception of the medulla oblongata; then in a similar animal only the cerebrum was taken away. The only difference between the two cases was in the fact that one animal had a cerebellum, and the other had not. A comparison was believed to show, in the powers which one had more than the other, the function of the organ the possession of which constituted the only difference.

Finally it was ascertained in each species what is the effect of taking away the cerebellum alone.

The use of the organ was thus estimated in two ways—by the effect of its addition to the medulla, and of its subtraction from the rest of the nervous system.

The species so treated are arranged in an ascending scale, according to the comparative weight of the cerebellum. The field-snake, frog, salamander, toad, land-tortoise, eel, water-tortoise, pike, perch, tench, dace, carp, gold-fish, rudd, loach, and gudgeon were subjected to these operations; besides which, many experiments of a less systematic character were made upon birds and mammalia.

The results are these :—

In Reptiles, with the exception of the snake, the cord, together with the medulla oblongata, is sufficient to give the power of voluntary or spontaneous motion—limited, but usually enough to allow of feeble locomotion.

With the addition of the cerebellum, all actions dependent on the will appear to be naturally performed.

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The removal of the cerebellum shows that the cerebrum by itself is unable to give more than a limited amount of voluntary motion, and that of a kind deficient in balance and adjustment.

It is therefore inferred that the cord, together with the medulla oblongata, is a great source of spontaneous motor power, in which function both the cerebrum and the cerebellum take part, the cerebellum to the greater extent; it also appears that a certain harmony in the use of the muscles depends on the possession of the latter organ.

Regarding *Fishes*, the cord and medulla oblongata seem unequal to the performance of voluntary motion.

When the cerebellum is added, the powers become so far extended that movements are made in obedience to external stimuli. Generally speaking, a determined position is maintained and locomotion accomplished, without the use, however, of the pectoral fins.

If the cerebellum only be taken away, there is a loss of the proper adjustment between the right and left sides; so that oscillation or rotation takes place. All the limbs are used, but apparently with a deficiency of sustained activity.

It is therefore concluded that with *Fishes*, as with *Reptiles*, the power of intentional movement is shared by both cerebrum and cerebellum; the former in this case has the larger influence.

Such movements as depend on the cerebrum are destitute of lateral balance, are sudden in being affected by any external cause, and are emotional in their character. Such as depend on the cerebellum are mutually adjusted, of a continuous kind, and less directly under the influence of consciousness.

The same facts were supported by experiments on the higher orders of animals: in these it seemed that the cord and medulla are insufficient to excite voluntary movements. The muscles, as with fishes and reptiles, acknowledge a double rule, from the cerebrum and from the cerebellum. The anterior limbs are most subservient to the cerebrum; the posterior to the cerebellum. The limbs on one side are in connexion chiefly with the lobe of the opposite side. The absence of the cerebellum destroys the power of lateral balance.

From the negative results of the experiments, it is inferred that the cerebellum has nothing to do with common sensation, with the sexual propensity, with the action of the involuntary muscles, with the maintenance of animal heat, or with secretion.

The only function which the experiments assigned to the cerebellum is such as concerns the voluntary muscles, which receive therefrom a regulated supply of motor influence. Each lateral half of the cerebellum affects both sides, but the one opposite to itself most.

The cerebellum has a property distinct from its true voluntary power, which harmonizes the action of the voluntary muscles, and has been described as "coordination."

The voluntary muscles are under a double influence—from the cerebrum and from the cerebellum. The anterior limbs are chiefly under the influence of the cerebrum; the posterior, of the cerebellum. Cerebellar movements are apt to be habitual, while cerebral are impulsive. The cerebellum acts when the cerebrum is removed, though when both organs exist it is under its control.

PART II.

From an analysis of one case of congenital absence of the cerebellum, one of disease of the whole organ, and 46 of disease of a portion of it, the following deductions are stated:—

The only faculty which constantly suffers in consequence of changes in the cerebellum, is the power of voluntary movement.

When the organ is absent or defective congenitally, we have want of action in the muscles of the lower extremities.

When the entire structure is changed by disease, we have loss of voluntary power, either general throughout the trunk, or limited to the lower limbs—which results are about equally frequent.

From the manner in which the paralysis was distributed in cases of disease of a part of the organ, it is inferred that each lobe is in connexion as a source of voluntary movement with all the four limbs, but in the greatest degree with the limbs of the opposite side, and with the lower more than with the upper extremities.

The occasional occurrence of loss of visual power, and alterations of the sexual propensity, is referred to the conveyance of irritation to the corpora quadrigemina in one case, and the spinal cord in the other.

From both sources of knowledge it is concluded that the cerebellum has distinct offices.

It is a source of voluntary motor power to the muscles supplied by the spinal nerves. It influences the lower more than the upper limbs, and produces habitual rather than impulsive movements. Each lobe affects both sides of the body, but most that opposite to itself.

Secondly, the cerebellum has a power which has been described as that of “coordination,” which is similarly distributed.

Finally, it is suggested that the outer portion of the organ may be the source of its voluntary motor power, while its inner layer is the means of regulating its distribution.

II. “An Inquiry into Newton's Rule for the Discovery of Imaginary Roots.” By J. J. SYLVESTER, F.R.S., Correspondent of the Institute of France. Received April 6, 1864.

(Abstract.)

In the ‘*Arithmetica Universalis*,’ in the chapter “*De Resolutione Equationum*,” Newton has laid down a rule, admirable for its simplicity and generality, for the discovery of imaginary roots in algebraical equations, and