An Essay
Upon the vasomotor changes in tabes dorsalis
and on the influence which is exerted by
the sympathetic nervous system in that
disease, being a thesis presented in the
hope of obtaining the degree of the Doctorship
of Medicine of the University of Edinburgh.

by.

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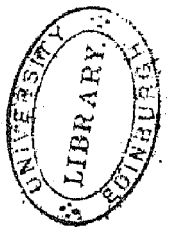

1 Bush Villas
Southsea.
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I The Cerebro Spinal nervous system

There are few diseases which possess a more extensive literature than does tabes dorsalis, and none perhaps, considering the short time since Duchenne first drew attention to it, which has attracted the attention of so many brilliant investigators. The protean nature of its symptoms, its strange and varying course extending over lengthy periods, baffling all treatment and dragging on from one variety of torture to another until the emaciated sufferer hails the death which relieves him of his pain, have excited the interest both of pathologists and of clinical observers. Yet in spite of the researches of such men as Erb, Charcot, Leyden and a host of others, our knowledge of the initial lesion in tabes, and still more of a course of treatment which may cause permanent improvement in the patient, is scanty in the extreme.

It is with diffidence that a young medical man must approach a subject

upon which so many master minds have pondered — more particularly when the views which he entertains differ in many respects from any which he has encountered in his reading. Doubly diffident must he be when enforced residence in a provincial town cuts him off from those pathological and histological aids which might enable him to strengthen his arguments. In the preparation of a thesis upon such a subject the post-mortem room and the microscope are of more value than the writing desk and the library. A workman must however work with such tools as he finds to his hand and this I have endeavoured to do to the best of ~~his~~ my ability.

Among the many varying phases of tabes dorsalis there is one constant pathological fact. That is that in the disease the cerebro spinal system of nerves is prominently affected and that many of the most marked symptoms of the disease are dependant upon this affection. This cerebro-spinal lesion has been considered generally to be the

primary morbid process in the disease. The object of this essay is to endeavour to show that it is secondary to a preceding pathological condition. In any case however the cerebro spinal system plays such an important part that a short discription of it may be a fitting introduction to the subject.

The affection of this system shows itself most prominently in that portion which is set aside for the conduction of sensory impress-ions. It is only as a secondary result, or by concurrent separate morbid processes that the motor tract is invaded. The anatomical lesion is commonly to be found in the cord itself, though in certain rare cases described by Dejerine, Vaillard, Pitres and A Hughes Bennett, the changes have been confined entirely to the peripheral sensory nerve endings. In describing the cerebro-spinal system it may be as well to start with these nerve endings and trace the sensory tract upward, indicating briefly the path taken by impressions in travelling from the periphery to the brain.

Archives de Neurologie. Paris 1883.

Four different forms of sensory nerve endings have been made out. These are the Pacinian corpuscles of Kölliker, the touch corpuscles of Richard Wagner, the end organs of Krause as seen in the conjunctiva, and finally an arrangement peculiar to the cornea in which the axis cylinder ends by sending out fine ramifications among the tissue elements. Through these terminal organs the cerebro spinal nervous system maintains its connection with the outer world, with the exception of those special mechanisms which subserve the functions of hearing, smelling, sight & taste. The remainder of the sensory system has for its object the conveying of impressions so obtained to the central organ where they may be duly registered. The fibres from the end organs coalesce into trunks which pass upward to the spinal cord, and enter it by the posterior nerve roots.

When these sensory nerve fibres have entered the cord they follow two different courses, an external and an internal. The

external fibres pass directly to the grey matter and continue upwards in the substantia gelatinosa of Rolando. Most of the fibres run apparently up and down just where the gelatinous substance joins the true grey substance Some of the fibres pass horizontally into the posterior horns ending probably in the spindle cells there. Others go on to the anterior cornua and end there. Others pass across by the posterior commissure.

Of the internal fibres many pass up and down in the external part of the posterior columns, after which they penetrate the grey matter almost horizontally. Some enter the cells of the posterior horn. Some seem to join lateral cells of the anterior horns. Some pass to the cells in Clarke's column, and some decussate by the anterior commissure.

It is probable that sensory impressions travel to some extent through the grey matter of the cord as well as through the white. The postero-median columns consist of long fibres and are supposed by some to convey sensation

from the legs while in the cervical region similar fibres are found in the postero-lateral columns, in connection no doubt with the arms.

There is reason to believe that various varieties of sensory impressions travel by different routes. For instance heat and pain appear to be conveyed by deeper portions of the cord than ordinary sensations of touch. The fact of the decussation of the sensory fibres shortly after joining the cord is a fact of great clinical importance. The point of decussation varies with the different varieties of sensation.

Without going deeply into the appearance of a section of the healthy cord, which would be superfluous, a few words as to its anatomical divisions are necessary before going further. The posterior column lies between the posterior median fissure or septum, and the posterior nerve roots and cornu of grey matter. It is divided by a small depression and septum into two parts, the postero-median column or column of Goll, and the postero-external column or column of Burdach, or posterior root zones of the French.

anatomists. For convenience sake the portion of the cord chosen for this brief sectional view is in the lower dorsal or upper lumbar region.

The lateral column is the portion of white matter which is situated between the anterior and posterior nerve roots. It has been divided by Flechsig into four areas, the most important of which is the crossed pyramidal tract, composed of the motor fibres which have decussated in the medulla. In addition to this are (a) The limiting layer of grey substance (b) the anterior mixed region of the lateral column (c) The direct cerebellar tract. The last appears in the upper part of the lumbar enlargement, and increases as it ascends to the cerebellum, constituting the restiform bodies in the medulla and entering by the inferior peduncles.

The Anterior column like the posterior is subdivided into two parts. The inner or column of Türck is the direct pyramidal tract, formed by those motor fibres which do not decussate in the medulla. The function of the

remainder of the anterior column has not been made out.

All these columns consist of nerve fibres, connected together by delicate connective tissue or neuroglia, with bloodvessels and lymphatics

The grey matter of each side communicates with that of the other through the posterior commissure. Each half is divided into an anterior cornu, a posterior, and a connecting body. Of the two horns the anterior is the larger and contains many large irregularly stellate cells, which are of great physiological and pathological importance. They are multipolar but have one long unbranched axis cylinder which in favourable sections may be traced into the anterior root fibres. The other poles divide into numerous branches which are supposed to terminate in the nerve fibrils which run through the grey matter. The nerve cells in the grey matter arrange themselves longitudinally into well-marked columns. Of these the chief are (1) The Anterior

columns of which three may be distinguished (2) The intermedio-lateral column behind these and on the outer side (3) Clarke's column on the inner side of the head of the posterior horn, (4) The column of the posterior cornu behind, composed principally of spindle shaped cells.

After this brief sketch of the different tracts seen in a section of the cord it is easier to resume the description of the route traversed by sensory impressions. The columns of Goll and of Burdach pass up into the funiculus ~~cuneatus~~ gracilis and the funiculus cuneatus, which contain nuclei into which the fibres are seen to enter. The posterior horns pass up and are further continued in the formatio reticularis. Fibres pass through the interolivary fibres, formatio reticularis, fillet, tegmentum extremum of crura cerebri, to the red nuclei and so through the posterior third of the internal capsule on to the optic thalami where they radiate towards the cortex

Flechsig's researches show that

the hippocampus major and gyrus hippocampi with the neighbouring inferior tempero-sphenoidal region if destroyed do away with all sensibility of the opposite side. Therefore this must be the site of the tactile centres.

All sensory fibres cannot reach the brain but many must end in centres in the cord where they subserve reflex action.

Having traced out the tract followed by sensory impressions, this short discription of the conducting paths of the cerebro spinal nervous system would be incomplete unless it ran over the course pursued by the motor impulses. The balance of evidence is in favour of their starting from the grey matter of the brain. The fibres converge as they pass down in the corona radiata and form an important part of the internal capsule, after which they pass down the crusta of the crura cerebri. In the medulla the larger portion decussate in order to form the crossed pyramidal tract, while a smaller bundle descends on the same side of the cord as Türck's

columns, as the direct pyramidal tract. This decussates along the whole cord through the anterior commissure with the crossed pyramidal tract of the other side. Türcks column ends by the middle of the dorsal region while the crossed tract descends as far as the third sacral. The fibres of these motor tracts pass into the grey matter and thence out as anterior nerve roots, or become connected with nerve cells in the anterior cornua.

Besides the motor and sensory conducting paths in the spinal cord there are also inhibitory, trophic, and vaso motor strands, as well as numerous centres for reflex action.

The an abeyance of reflex action owing to a break in the reflex arc caused by disease is a prominent symptom in tabes dorsalis a knowledge of the seat of the various reflex centres is of importance

In the lumbar portion of the cord are the reflex centres for the plantar, gluteal

and cremasteric reflexes, also the centres of defaecation, micturition and parturition, with the sexual centre and that for movements of the lower limbs. Somewhat higher in the cord are the centres for the abdominal and epigastric reflex. In the upper dorsal and lower cervical regions are centres for the scapular reflex and the dilator movements of the pupil (cilio spinal region). Within the dorsal region are centres connected with the stomach and intestines. In the cervical region are centres for the movement of the arms and upper part of the trunk.

Within the medulla are the respiratory vaso motor and cardio-inhibitory centres and centres for deglutition and vomiting. There is also the salivary centre and the centres for polyuria and glycosuria.

In writing this short epitome of what is known concerning the conducting paths of the motor and sensory impulses, I must acknowledge my indebtedness to the

anatomical chapters at the commencement of Professor Grainger Stewart's "Introduction to the study of the nervous diseases", as well as to Turner's Anatomy, Foster's Physiology, and Byrom Bramwell's work upon the spinal cord.

There is one other anatomical point about the cord which is of the highest importance in connection with this thesis. That is the origin and nature of its vascular supply. This vascular supply is carried out by slender vessels which come from the vertebral arteries within the cranium. There is one vessel in the front and two in the back of the cord. These vessels are very slender and yet have to run the whole length of the cord. No arteries so small run the same distance in any other part of the body, and pressure falls rapidly in minute arteries as the length of the pipe increases. In order to relieve the strain upon these vessels, some help is given by small reinforcing twigs which run along the nerve roots and so to the cord. Now in the cervical region where the roots are

short this double supply should work well, but in the lower part where the long slender vessels have to climb up the strands of the cauda equina, the amount of blood conveyed is proportionately decreased, and that at the very spot where the supply coming from above is at a minimum.

Hence to quote Dr Moxon in his Croonian lectures of 1881 ("On the influence of the circulation on the nervous system") "The upper parts of the cord have a better sustained supply both from above and below than the lower, and the part corresponding to the lower limbs and sphincters is the most weakly organised of all"

Or in other words, and this is a point upon which too great stress cannot be laid, if the whole circulatory system were subjected to some weakening influence, such as a narrowing of its arterioles or any other change tending to decrease its power of conveying nutrition, the first part to break down under the strain would be that part of the spinal cord which governs the sphincters and lower limbs.