REMARKS

ON

LATERAL AND POSTERIOR SCLEROSIS OF THE SPINAL CORD.*

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WHAT is sclerosis? It appears to me that, like tubercle, sclerosis is a pathological term which conveys a definite meaning only as far as appearance and qualities are concerned, but about which the greatest diversity of opinion as yet prevails, as soon as we begin to consider the nature and different phases of the morbid process giving rise to it. Is sclerosis a disease *sui generis*, or does it belong to the large class of inflammations? Does it primarily affect the nervous matter itself, or its cementing tissue, the neuroglia? Does it arise spontaneously, or is it due to other preceding alterations of tissue; and, therefore, a secondary consequence rather than a primary event? To all these questions we can, as yet, not return a thoroughly satisfactory reply; and it would be an easy, though ungrateful, task to range an imposing array of authorities on either side. On the present occasion, I do not intend to argue these various questions in a comprehensive manner, but will only express my own views on this part of the subject in the following propositions.

(a.) Sclerosis may be both primary and secondary.

(b.) Where it is primary, it is, as a rule, bilateral, and only exceptionally confined to one-half of the spinal cord.

(c.) Primary sclerosis, such as we see it in tabes dorsalis and lateral spinal paralysis, consists of an extremely chronic inflammation of the nervous matter, which leads, in course of time, to disintegration and wasting of nerve-cells and fibres, thickening of connective tissue, and formation of amyloid bodies in the meshes of that tissue.

(d.) Secondary sclerosis is a simple degenerative process, arising from failure of nutrition, but leading in the end to the same pathological appearances as the primary or inflammatory variety of the affection.

(e.) Secondary sclerosis is frequently unilateral, more especially where it occurs after hæmorrhage into the brain from rupture of military aneurisms of the cerebral arterioles, and where it affects only that portion of the spinal cord which corresponds physiologically to the diseased hemisphere, *i. e.*, the crossed pyramidal column.

(f.) Secondary sclerosis occurs likewise after hæmorrhage into the substance of the cord, and acute myelitis.

(g.) Disseminated insular sclerosis, or Charcot's disease, is a chronic interstitial myelo-encephalitis, affecting chiefly the neuroglia of the central ganglia and the lateral columns of the cord, and leaving the cylinder-axis more or less intact.

(h.) Lateral amyotrophic sclerosis, the chief symptoms of which are motor debility, atrophy, and rigidity of the muscles, consists anatomically of wasting of the ganglionic cells of the anterior cornua, combined with sclerosis of the crossed pyramidal portion of the lateral column.

It is to some aspects of primary or idiopathic sclerosis, as affecting the posterior and lateral columns of the spinal cord, that I wish to draw attention on the present occasion. It will be my endeavour to show you the close analogy which exists between these two affections, one of which has long been known to us as tabes dorsalis, progressive locomotor ataxy, or posterior sclerosis; while the other one has only been recently introduced into our system of nosology by the name of spasmodic tabes dorsalis (Charcot), gastric spinal paralysis (Erb), and lateral sclerosis (Berger). I hope I may, at least to some extent, succeed in showing that the two diseases are essentially of the same nature, and that the differences in the symptoms which they present during life are rather owing to the different physiological functions of the several portions of the cord which are affected, than to any fundamental diversity which might be thought to exist in the pathological process. I must add, that to Professor Erb of Heidelberg belongs the credit of having first recognised this form of lateral sclerosis as a separate pathological entity.

The most recent microscopic investigations of the anatomical changes in the two diseases have shown that the lesion does not originally affect

the entire extent of the several columns, but only a certain portion thereof. In posterior sclerosis or ataxy, the morbid process begins in that part of the posterior columns which Henle has termed the "Keilstrang", funiculus caudatus, and which the French anatomists call the "rubans" or "bandelettes externes"; that is to say, the external portion of the posterior column, which is in close proximity to the posterior roots of the spinal nerves; while the internal portion of the same, which Burdach has called the funiculus gracilis, but which is now generally known as Goll's column, is not primarily affected, but only suffers later on, when the disease spreads to other portions of the nervous matter, such as the posterior roots, the posterior cornua of the grey matter, etc.

In lateral sclerosis, on the other hand, the affection begins in the posterior portion of the lateral columns, which Flechsig has termed the crossed pyramidal column, and which is composed of fibres derived from the opposite cerebral hemisphere. This is distinct from the lateral column proper, which is situated more anteriorly, and the direct cerebellar column, which lies more to the rear. The pyramidal column is, in this disease, found studded with wedge-shaped grey patches, reaching anteriorly as far as the lateral column proper, exteriorly as far as the pia mater, and interiorly as far as the posterior cornua. This peculiarity in the localisation of the disease distinguishes it anatomically (a) from Tiliak's degeneration, or secondary lateral sclerosis consequent on cerebral hæmorrhage, in which the patches are rounded, not wedge-shaped, and do not spread exteriorly as far as the pia mater; and (b) from secondary sclerosis after myelitis, hæmorrhage into the cord, etc., where the grey patches do not extend posteriorly as far as the posterior cornua, but where a small intermediate layer of healthy white matter remains between them and the sclerosed tissue.

1. In analysing the various symptoms which we meet with in posterior and lateral sclerosis, we find that the most important in the former are referable to sensory disturbance and want of motor co-ordination; while true paralysis, with muscular spasms and rigidity, may be considered characteristic of the latter. I will now endeavour to trace these symptoms to morbid alteration of the normal functions of the affected parts, such as they are known to us from the present teaching of experimental physiology.

That *sensibility*, in its various forms, should suffer in disease of the posterior columns is only what might be expected, inasmuch as these parts have been experimentally shown to contain the chief paths for the conduction of the senses of touch, pressure, temperature, and tickling. In accordance with this, we find such symptoms as the following: a feeling of constriction round the chest, abdomen, and limbs; numbness and tingling in the legs and feet; a sensation in walking as if the patient stepped on bladders or cotton; tardy sensation, so that several seconds are required for appreciating an impression which has been made; loss of the keenness of touch, so that the patient is unable to tell the nature of an object which is given him to touch, without the help of his eyes; diminution or loss of the muscular sense, so that, without looking, the patient is not aware of the position of his limbs, or of any changes which are made in it by others. All these signs, and, in the later stages of the disease, cutaneous anæsthesia, are amongst the commonest symptoms of ataxy, and absent only in the most exceptional cases.

A prominent symptom of tabes dorsalis is a peculiar kind of pain which darts through the limbs like lightning, occurs chiefly at night; selects mostly the lower extremities, but spares no part of the body; is sometimes neuralgic in character, so that there is a paroxysm and afterwards an interval of rest, while, at other times, it is more continuous, and lasts in various degrees of intensity for weeks and months. Now, it has been shown, that the paths for the conduction of the sensation of pain are not situated in the posterior columns, but in the central grey matter; and as the pain to which I have just alluded is one of the most constant earlier symptoms of posterior sclerosis, and occurs at a period when the central grey matter is still unaffected, it must be referred to irritation of the posterior roots in Henle's "Keilstrang", where the disease is located in the first instance.

A far greater difficulty is experienced in physiologically explaining the symptom of *ataxy* or want of co-ordination, which is not only *locomotor*, as usually stated, *i. e.*, perceptible in complex movements, but also *static*, that is to say, that there is a difficulty or impossibility to keep the arms and legs, the body, and, in some cases, even certain muscles supplied by the cranial nerves, for any time fixed in certain positions. The atactic patient has, indeed, not only great difficulty in walking, but cannot stand erect with both feet close together. Where the disease affects the cervical cord, he finds it impossible to write, dress, play musical instruments, etc., and cannot well keep his arm or hand stretched out in a certain direction. This symptom of locomotor and static ataxy is a true motory phenomenon, and not dependent

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upon anaesthesia, as was formerly believed. That such is the case, is shown by the fact that the degree of ataxy is not at all proportionate to the degree of anaesthesia which may be present, inasmuch as the one is occasionally found slight, and the other severe, and *vice versa*. Moreover, complete anaesthesia of the limbs may exist without simultaneous ataxy, which alone renders it evident that this latter is nothing but a symptom of disordered motion.

As both locomotor and static ataxy occur with great regularity in disease of the posterior columns, we would naturally draw the inference that these structures are the centres for the co-ordination of complex movements; yet Goltz's experiments have shown unmistakably that no such centres exist, either in the posterior columns, or anywhere throughout the entire extent of the cord; on the contrary, these are situated in the brain, residing more particularly in the corpora quadrigemina, the optic thalamus, and the cerebellum. If, therefore, the posterior columns are not the actual centres, we might at least expect them to contain the paths by which the co-ordinating impulses travel from the brain to the muscles. But even this supposition is controverted by Woroschiloff's experiments, which tend to show that, at least in the rabbit, these paths are situated in the middle third of the lateral columns of the cord, and do not touch the posterior columns at all. Physiology and pathology seem, therefore, in such a simple case as this, for the present hopelessly at variance with one another; and we must leave to future observations the task of reconciling these apparently discrepant phenomena.

Experimental destruction of the posterior columns in animals does in no way impair the voluntary motion of the parts behind the lesion; and, in accordance with this, we find that, in the first two stages of sclerosis of these columns, there is no loss of voluntary power over the muscles, or paralysis. The patient may be unable to walk or to use his limbs for any useful purpose, but is still in possession of motor power, so that when he is sitting or lying down, he can move his legs, cross one over the other, etc.; and, it is only in the later stages of the disease, when the sclerosis creeps up to other portions of the spinal centre, that true paralysis may be observed.

The functions of the lateral columns of the cord are still to a great extent enveloped in obscurity. There is diversity of opinion amongst physiologists with regard to their being concerned in the conduction of sensations; but it appears highly probable that each lateral column contains sentient fibres for both extremities, and that these fibres cross over from one to the other side of the cord. Pathological observation does not quite tally with these data; for, in a number of cases of lateral sclerosis, symptoms in the sphere of sensibility are entirely wanting, while in some we find pain, tingling, numbness, a feeling of heat or cold in the skin, etc.; but even in these latter cases the sensory disturbance only occurs in the commencement of disease, and is very moderate in degree. On the other hand, the lateral columns are generally acknowledged to contain the principal paths for the voluntary movements for the extremities, for which, however, they are associated throughout with the large ganglionic masses of the grey anterior cornua, and the anterior roots of the spinal nerves. In accordance with this, we find that, in lateral sclerosis, loss of motive power in the extremities constitutes one of the principal symptoms.

This loss of power is at first very slight. The patient feels weak in the legs, and has a difficulty in going up and down stairs; after walking a short distance he is greatly fatigued. There is great difficulty in lifting the feet from off the ground; they are apt to shuffle along it, and the soles of the boots by scraping the ground are sooner worn out at the toes than formerly. The patient soon takes to sticks or crutches. Coincident with the loss of power, there is motor irritation, as shown by twitches, cramps, and convulsions, which are apt to occur after fatigue, but often come on without any apparent exciting cause, and with considerable regularity, nay, periodicity, at certain hours of the day. After a time, the muscles assume a degree of rigidity, which, in its turn, renders voluntary movements more difficult, and causes resistance to passive movements. The patient finds it difficult to stoop. The legs resist flexion, extension, and abduction; they ultimately become fixed in extension and adduction, and the foot assumes the position of *varo-equinus*. This state of things induced Seguin to describe the complaint as "*tetanoid paraplegia*".

In consequence of these differences in the pathological conditions of the lower extremities, the gait of the patient affected with ataxy forms a complete contrast to that which is seen in one suffering from lateral sclerosis. The atactic patient uses his eyes as crutches, and is constantly looking at his feet in order to guide their movements. He walks in a jerky and irregular manner, puts his feet down with force, throws the toes heavily forwards and outwards, staggers in turning round, and has to manœuvre considerably with his arms in order to prevent himself from falling. On closing the eyes, or in the dark, he

is peculiarly unsteady, and liable to fall. The patient with lateral sclerosis, on the other hand, seems to be, as it were, fixed in a vice. While he has no difficulty in standing, the legs appear so stiff that he is almost unable to get the feet from the ground; he walks on tiptoe; the whole body seems to join in a spasmodic effort, and is thrown forwards in order to aid the action of the legs. There is tendency to fall forwards; yet the help of the eyes is not sought in walking, and light or dark makes no difference in it.

2. The faculty of *reflex action* has been shown to reside in the ganglionic cells of the central grey matter of the cord, where sentient impressions are conveyed from the posterior roots of the spinal nerves to motor paths in the anterior roots. Destruction of the grey matter annihilates reflex action; thus, we find that in anterior *polio-myelitis*, where the anterior cornua are disorganised by inflammation, no reflex movements can be elicited, although tickling of the soles and other parts is distinctly perceived, and sensibility is altogether normal. Neither the posterior nor the lateral columns contain any centres for this faculty, and coincidentally with this we find that in posterior as well as lateral sclerosis the reflex function of the skin and mucous membranes is, in a general way, preserved. A singular and important feature of the two diseases which we are now considering, is, however, the behaviour of *tendinous reflexion*, which appears to present a marked contrast in them. Westphal and Erb have shown that reflex movements may be elicited, independently of cutaneous stimulation, by giving a tap or blow with the fingers or a hammer on certain tendons, such as that of the rectus femoris, the tendo Achillis, and that of the triceps muscle of the arm. Such a tap or blow is generally answered by a contraction in the muscle or set of muscles connected with the tendon, and is not owing to mechanical concussion of the muscular substance, as Westphal at first believed, but to true reflex action, the centre of which for the legs appears to be situated in the lower portion of the spinal cord (Schultze and Fürbringer). It is best shown by a patient being made to sit on a table so that the legs dangle about; the tendon of the rectus is now gently struck, when the foot is seen to be jerked forward. That it is stimulation of the nerves of the tendon and not of the skin which produces this phenomenon, is shown by the circumstance that it occurs after the skin has been rendered insensible by the ether-spray, and that it may be present where cutaneous reflexion is diminished or gone, and *vice versa*.

Now, tendinous reflexion appears to be entirely gone in ataxy, as soon as this disease has become fairly developed; while it is, on the contrary, greatly increased in lateral sclerosis. Thus, when a patient suffering from this latter complaint is told to stamp on the floor with his foot, the whole limb is thrown into a state of tremor, which may continue for hours. This tremor may also be excited by suddenly flexing the foot, and can be generally arrested by extending the same. It thus comes to resemble the phenomenon known by the incongruous name of "*spinal epilepsy*". Such reflex movements are, in lateral sclerosis, not only more readily induced in those tendons in which they habitually appear in healthy subjects, but they also occur in other tendons in which they are usually absent, such as those of the tibiales and semitendinous muscles of the lower, and the biceps, deltoid, supinator, and extensor digitorum communis muscles in the upper extremity. In doubtful cases, the opposite behaviour of tendinous reflexion in posterior and lateral sclerosis may, therefore, be utilised for the purpose of diagnosis. The increase of the phenomenon in lateral sclerosis cannot be explained by irritation of the grey matter, as this does not share in the affection; but has to be accounted for by the influence of inhibition. The centre for the inhibition of reflex movements is situated in the corpora quadrigemina, and paths for its conduction are found in the lateral columns. We shall, therefore, be justified in assuming that the increase of tendinous reflexion in lateral sclerosis is owing to the cessation of arrival of inhibitory influence from the brain in the muscles, from interrupted connection.

3. Symptoms on the part of the *vaso-motor nerves* and of those which preside over nutrition, are rare in lateral as well as posterior sclerosis, unless the lesion has invaded other portions of the cord. An exception to this rule is, however, found in some forms of ataxy, where a peculiar affection of the joints, more particularly of the knee, shoulder, elbow, and hip is apt to occur. The joints, as well as the subcutaneous cellular tissue in their neighbourhood, become subject to a non-inflammatory swelling, which is unattended by pain, tenderness, redness, or heat. This lesion is nevertheless of a serious nature, as it leads to atrophy of the epiphyses, dislocation, and consequent deformity and uselessness of the limbs. Excessive fragility of the bones may also be present. These symptoms can only be owing to more or less sudden failure of nutrition in the parts affected; but it has not yet been ascertained which portion of the cord is to be held responsible for this condition.

4. The principal centre for the movements of the bladder, rectum, and male organs of generation has by physiologists been found in the lumbar enlargement of the cord; but the more precise seat of this centre has not yet been ascertained. Judging from pathological observations, I should say that it is not situated in the lateral columns; for in lateral sclerosis there are no symptoms pointing to loss of function in those viscera. It is true, that Dr. Gray, of Long Island College, has quite recently recorded a case in which there was involuntary action of the bladder if the desire to urinate were not quickly gratified; but this is most exceptional, and most likely owing to extension of the disease to other parts. In posterior sclerosis, on the other hand, either irritation or failure in the action of the bladder, bowel, and sexual organs is the rule, and appears at a comparatively early stage of the disease. Total loss of function in these parts is only observed in the later period, when the posterior cornua of the grey matter have presumably become sclerosed. On the other hand, I have found that in inflammation of the anterior cornua of the lumbar enlargement, with consecutive muscular atrophy, the bladder and rectum continue to act normally, while the male sexual function is at once and completely destroyed. It therefore appears to me probable that the posterior columns are not the centre, but only contain the paths for the conduction of motor impulses to the bladder, rectum, and sexual organs; that the true centre for these parts is situated in the grey matter; that the posterior cornua of it are the centre for the bladder and rectum; and that the anterior cornua contain an important centre for the male sexual organs.

5. The mode of development of both lateral and posterior sclerosis is, as a rule, extremely chronic, and protracted over years, nay decennia. In both, the morbid process usually commences in the lumbar enlargement of the cord, owing to which the symptoms appear simultaneously and to an equal or nearly equal extent in both lower extremities. The disease has a tendency to remain limited to this neighbourhood for years, but to spread within it from one set of nerve-cells and fibres to another, so as to gradually disorganise the whole structure. There is, however, no continuous progress of this sort, but it goes on as it were by fits and starts; for a time the morbid process appears arrested, after which, mostly owing to unfavourable external influences, a fresh start in the wrong direction is made, which stops again at a certain point. The course of the complaint is particularly slow where the patients are placed in favourable conditions and are not obliged to expose themselves to cold and wet, or to undergo exertions and privations; and where, in addition to this, they resign themselves to a quiet and uneventful life. In the contrary circumstances, the development of the disease is far more rapid.

After a variable time, the sclerosis spreads upwards through the dorsal portion of the cord to the cervical enlargement, where it assumes the same course of slow disintegration. Even then, however, neither lateral nor posterior sclerosis have the tendency to shorten life, unless the morbid process spreads more transversely through the organ, when cystitis, bed-sores, and blood-poisoning are apt to become developed; or when it creeps up to the medulla oblongata and its motor nuclei, when death takes place from failure in the power of the cardiac and respiratory centres, or through inanition from loss of the power of swallowing. In other cases, the patient succumbs ultimately to certain complications, such as typhoid fever, pulmonary consumption, bronchitis, pneumonia, affections of the heart and liver, and other diseases which have no particular connection with the sclerosis.

There are, however, some peculiarities in the course of both affections to which a short allusion must be made. The participation of the cranial nerves in the first stage of posterior sclerosis is one of them; and we are, therefore, led to think that ataxy has even in the beginning more tendency to generalisation than lateral tabes. In the latter, it is not uncommon that the clinical aspect of the case is at first more like that of hemiplegia than paraplegia, the affection beginning in one leg, and then creeping up to the arm of the same side; or it assumes the form of cervical paraplegia, beginning in both upper extremities, and gradually descending to the lower ones. Anomalies of this description also occur now and then in posterior sclerosis.

6. The chief cause of lateral tabes appears to be cold. Sleeping in a damp bed, getting a thorough wetting during a day's shooting, etc., is generally mentioned by the patients. Whether hereditary tendency, lead-poisoning, sexual excesses, and syphilis play any part in the causation of the disease, remains uncertain. The patients I have seen were all males, between thirty-five and fifty years of age; yet it occurs in women likewise, and also later and earlier in life than the period just mentioned.

The causes of posterior sclerosis are much better known. Some forms of it are clearly hereditary; but more frequently the neurotic constitution is not marked in the parents of the patients. Cold, sexual

excesses, overexertion, and depressing mental emotions are the most frequent amongst them; and the disease is particularly developed where all these different agents act together. Accidents, more especially a fall from horseback, are often mentioned in the history of these cases; yet ataxy is rarely seen after railway accidents; and in those cases where injury was mentioned to me as a cause, the interval between its occurrence and the outbreak of the malady was so long, that it appeared difficult to assume a causal connection between the two.

7. The prognosis in both lateral and posterior sclerosis is, in a general way, unfavourable, as soon as the symptoms have become fully developed; yet every physician who has seen much of these diseases knows of some cases in which complete, or almost complete, recovery has taken place. Mostly, however, we must be satisfied if we succeed in arresting the progress and relieving the symptoms of the complaint. The prognosis depends greatly upon external circumstances and the mode of life adopted by the patient. Those who have to work for their living are worse off in this respect than those born with the silver spoon in their mouths, and the rake dies more quickly than the philosopher. Two of the most marked cases of ataxy which I ever saw occurred, one in a member of the hereditary branch of the legislature, who, being of slight physique and calm and fastidious by temperament, surrounded himself with everything that may adorn life, and found consolation for his infirmity in the arts and literature. He lived to the age of sixty, after having been subject to the complaint for upwards of thirty years, and having hardly ever experienced really severe suffering. The other case was that of a hot-tempered Irishman, who, after having made a fortune in Australia, returned to England to spend his life in the wildest excitement, intrigues, and debauchery of every description. He died within four years from the outbreak of the malady, after having undergone the most frightful tortures which man may be called upon to endure, and having seen an originally Herculean constitution undermined and wasted in a comparatively short time.

8. The treatment of both diseases must be persevered in systematically for a considerable time, if any real success is to be achieved. Rest is of great importance, and we must endeavour to arrange all conditions of life as favourably as possible for the patients. Of specifics we have two, viz., nitrate of silver and ergot of rye. Some great cures have been effected by the use of either of these medicines, more particularly in the earlier stages of the complaint; but in the majority of cases, and at a later period, their effect is disappointing. Nitrate of silver should be given in doses of from one-eighth to one-half of a grain, and must be stopped after one hundred and twenty grains have been given. The urine should be tested frequently, and the remedy omitted if albuminuria be induced by it. Ergot is given either as Bonjean's ergotine in doses from one to five grains, or as the liquid extract in doses from twenty to one hundred and twenty minims. I have completely cured two cases of ataxy with drachm-doses of the latter preparation three times a day; and at no period during its administration, which in one instance extended to six and in another to eight months, were there any symptoms of ergotism. Damiana likewise appears to have a special influence on the cord in these cases; I give it in doses of twenty to sixty minims of the liquid extract. Iodide of potassium, strychnia, and arsenic are generally ineffective. The constant galvanic current is useful for the relief of pain, paralysis of the ocular muscles, anæsthesia, and vesical debility. If used sufficiently early, it appears capable of arresting the disease. It is, however, essential for success that a gentle and perfectly steady current should be used, by large electrodes, for a short time; and that all shocks, voltaic alternatives, or powerful and prolonged applications, be avoided. A judiciously directed hydrotherapeutical treatment, and the thermal brines of Rehme and Nauheim in Germany and Droitwich in this country, are also useful. For the relief of the pain of ataxy, I can strongly recommend the salicylate of soda in twenty-grain doses several times a day. It often acts better than the hypodermic injection of morphia or chloral, but is likewise, as all other remedies, occasionally disappointing. Special attention must be given to the state of the bladder and rectum. For catarrh of the bladder, with ammoniacal decomposition of the urine, the salicylate of soda in the doses just mentioned is useful, while for constipation the Hunyadi János water and allied remedies may be given. Where symptoms of general debility and impaired nutrition are prominent, phosphorus and cod-liver oil, alone or in combination, have proved to me most valuable. For lateral sclerosis, ergot and nitrate of silver likewise deserve a trial. For the relief of the muscular rigidity and twitches, the bromides of sodium, potassium, and ammonium may be given. I have sometimes usefully combined them with extractum physostigmatis in doses from one-eighth to one-half grain, and succus conii. The motor debility is often successfully combated by galvanisation of the cord and suffering nerves, and the use of sulphur-baths at a temperature of 98 or even 100 deg. may prove serviceable.