III. ACUTE AFFECTIONS OF THE SPINAL CORD.

(1) Acute Diffuse Myelitis.

Etiology.—Acute myelitis results from many causes, and may affect the cord in a limited or extended portion—the gray matter chiefly, or the gray and white matter together. It is met with: (*a*) As an independent affection following exposure to cold, or exertion, and leading to rapid loss of power with the symptoms of an acute ascending paralysis. (*b*) As a sequel of the infectious diseases, such as small-pox, typhus, and measles. (*c*) As a result of traumatism, either fracture of the spine or very severe muscular effort. Concussion without fracture may produce it, but this is rare. Acute myelitis, for instance, scarcely ever follows railway accidents. (*d*) In disease of the bones of the spine, either caries or cancer. This is a more common cause of localized acute transverse myelitis than of the diffuse affection. (*e*) In disease of the cord itself, such as tumors and syphilis; in the latter, either in association with gummata, in which case it is usually a late manifestation, or it may follow within a year or eighteen months of the primary affection.*

Morbid Anatomy.—In localized acute myelitis affecting white and gray matter, as met with after accident or an acute compression, the cord is swollen, the pia injected, the consistence greatly reduced, and on incising the membrane an almost diffluent fluid may escape. In less intense grades, on section at the affected area, all trace of distinction between the gray and white matter is lost, or extremely indistinct. The tissue may be injected, or, as is often the case, hæmorrhagic. It is particularly in these forms, due to extension of disease from without or to acute compression, that we find definite involvement of the white matter. In other instances the gray matter is chiefly affected. There may be localized areas throughout the cord in which the gray matter is reduced in consistence and hæmorrhagic, the so-called red softening. There may be definite cavity formations in these foci. In some cases of disseminated or focal myelitis the meninges also are involved and there is a myelo-meningitis. And, lastly, there are instances in which, throughout a long section of the cord, sometimes through the lumbar and the greater part of the dorsal, or in the dorsal and cervical regions, there is a diffuse myelitis of the gray substance.

Histologically the nerve fibres are much swollen and irregularly distorted, the axis cylinders are beaded, the myelin droplets are abundant, and the laminated bodies known as corpora amylacea may be seen. The granular fatty cells are also numerous and there may be leucocytes and red blood-corpuscles. Changes in the blood-vessels are striking; the smaller veins are distended and may show varicosities. The perivascular

* Breteau, Des Maladies Syphilitiques Précoces, Paris Thesis, 1889.

lymph spaces contain numerous leucocytes, and the smaller arteries themselves are frequently the seat of hyaline thrombi. The ganglion cells are swollen and irregular in outline, the protoplasm is extremely granular and vacuolated, and the nuclei, though usually invisible, may show signs of division, and the processes of the cells are not seen.

In cases which persist for some time we have an opportunity of seeing the later stages of acute myelitis. The acute, inflammatory, hyperæmic or red softening is succeeded by stages in which the affected area becomes more yellow from gradual alteration of the blood-pigment, and finally white in color from the advancing fatty degeneration. In cases of compression myelitis, a sclerosis may gradually be produced with the anatomical picture of a chronic diffuse myelitis.

Symptoms.—(*a*) *Acute Central Myelitis.*—It is this form which comes on spontaneously after cold, or in connection with syphilis or one of the infectious diseases, or is seen in a typical manner in the extension from injuries or from tumor. The onset, though scarcely so abrupt as in hæmorrhage, may be sudden; a person may be attacked on the street and have difficulty in getting home. In some instances, the onset is preceded by pains in the legs or back, or a girdle sensation is present. It may be marked by chills, occasionally by convulsions; fever is usually present from the beginning—at first slight, but subsequently it may become high.

The *motor* functions are rapidly lost, sometimes as quickly as in Landry's ascending paralysis. The paraplegia may be complete, and, if the myelitis extends to the cervical region, there may be impairment of motion, and ultimately complete loss of power of the upper extremities as well. The sensation is lost, but there may at first be hyperæsthesia. The reflexes in the initial stage are increased, but in acute central myelitis, unless limited in extent to the dorsal and cervical regions, the reflexes are usually abolished. The rectum and bladder are paralyzed. Trophic disturbances are marked; the muscles waste rapidly; the skin is often congested, and there may be localized sweating. The temperature of the affected limbs may be lowered. Acute bed-sores may develop over the sacrum or on the heels, and sometimes a multiple arthritis is present. In these acute cases the general symptoms become greatly aggravated, the pulse is rapid, the tongue becomes dry; there is delirium, the fever increases, and may reach 107° or 108°.

The course of the disease is variable. In very acute cases death follows in from five to ten days. The cases following the infectious diseases particularly the fevers and sometimes syphilis, may run a milder course.

The diagnosis of this variety of acute myelitis is rarely difficult. In common with the acute ascending paralysis of Landry, and with certain cases of multiple neuritis, it presents a rapid and progressive motor paralysis. From the former it is distinguished by the more marked involvement of sensation, the trophic disturbances, the paralysis of bladder and rectum,

the rapid wasting, the electrical changes, and the fever. From acute cases of multiple neuritis it may be more difficult to distinguish, as the sensory features in these cases may be marked, though there is rarely, if ever, in multiple neuritis complete anæsthesia; the wasting, moreover, is more rapid in myelitis. The bladder and rectum are rarely involved—though in exceptional cases they may be—and, most important of all, the trophic changes, the development of bullæ, bed-sores, etc., are not seen in multiple neuritis.

(*b*) *Acute Transverse Myelitis.*—The symptoms naturally differ with the situation of the lesion.

(1) Acute transverse myelitis in the *dorsal region*, the most common situation, produces a very characteristic picture. The symptoms of onset are variable. There may be initial pains or numbness and tingling in the legs. The paralysis may set in quickly and become complete within a few days; but more commonly it is preceded for a day or two by sensations of pain, heaviness, and dragging in the legs. The paralysis of the lower limbs is usually complete, and if at the level, say, of the sixth dorsal vertebra, the abdominal muscles are involved. Sensation may be partially or completely lost. At the onset there may be numbness, tingling, or even hyperæsthesia in the legs. At the level of the lesion there is often a zone of hyperæsthesia, which is discovered by passing a test-tube containing hot water along the spine, when the sensation of warmth changes to one of actual pain. A girdle sensation may occur early, and when the lesion is in this situation it is usually felt between the ensiform and umbilical regions. The reflex functions are variable. There may at first be abolition of the reflexes; subsequently, the reflexes, passing through the segments lower than the one affected, may be exaggerated and the limbs may pass into a condition of spastic rigidity. It does not always happen, however, that the reflexes are increased in a total transverse lesion of the cord. They may be entirely lost, as pointed out some years ago by Bastian, and insisted upon by him in a recent memoir.* F. T. Miles has also called attention to this fact and reported five cases in which the reflexes were lost in total transverse lesion of the cord. That this is not due to the preliminary shock is shown by the fact that the abolition of the reflexes may continue for four or more months. The trophic changes are not marked. The muscles become extremely flabby, but not wasted in an extreme degree; subsequently rigidity develops. If the gray matter of the lumbar cord is involved, the flaccidity persists and the wasting may be considerable. The reaction of degeneration is not present. The temperature of the paralyzed limbs is variable. It may at first rise, then fall and become subnormal. Lesions of the skin are not uncommon, and bed-sores are apt to form. There is at first retention of urine and subsequent incontinence. If the lumbar centres are involved, there are from the outset vesical symptoms. The urine is alkaline in reaction and may rapidly become ammoniacal. The bowels are constipated and there is usually incontinence of the fæces. Some writers attribute the cystitis associated with transverse myelitis to disturbed trophic influence.

* Medico-Chirurgical Transactions, vol. lxxiii.

The course of complete transverse myelitis depends a good deal upon its cause. Death may result from extension. Segments of the cord may be completely and permanently destroyed, in which case there is persistent paraplegia. The pyramidal fibres below the lesion undergo the secondary degeneration, and there is an ascending degeneration of the posterior median columns. If the lower segments of the cord are involved the legs may remain flaccid. In some instances a transverse myelitis of the dorsal region involves the anterior horns above and below the lesion, producing flaccidity of the muscles, with wasting, fibrillar contractions, and the reaction of degeneration. More commonly, however, in the cases which last many months there is more or less rigidity of the muscles with spasm or persistent contraction of the flexors of the knee.

(2) *Transverse Myelitis of the Cervical Region.*—If at the level of the sixth or seventh cervical nerves, there is paralysis of the upper extremities, more or less complete, sometimes sparing the muscles of the shoulder. Gradually there is loss of sensation. The paralysis is usually complete below the point of lesion, but there are rare instances in which the arms only are affected, the so-called cervical paraplegia. In addition to the symptoms already mentioned there are several which are more characteristic of transverse myelitis in the cervical region, such as the occurrence of vomiting, hiccough, and slow pulse, which may sink to twenty or thirty, pupillary changes—myosis—sometimes attacks of dysphagia, dyspnœa, or syncope.

II. Myelitis of the Anterior Horns

(*Polio-myelitis Anterior; Atrophic Spinal Paralysis*).

Definition.—An affection occurring most commonly within the first three years of life, characterized by fever, loss of power in certain muscles, and rapid atrophy.

Etiology.—The cause of the disease is unknown. It has been attributed to cold, to the irritation from dentition, or to overexertion. Since the days of Mephibosheth, parents have been inclined to attribute this form of paralysis to the carelessness of nurses in letting the children fall, but very rarely is the disease induced by traumatism, and in perhaps a majority of the cases the child is attacked while in full health. As Sinkler has pointed out, the cases are more common in the warm months. Boys are more liable to be affected than girls. Several instances of the occurrence of numerous cases together in epidemic form have been described. Medin reports from Stockholm an epidemic in which from the 9th of August to the 23d of September 29 cases came under observation. In two instances two children in the same family were attacked within a few days.

Although most frequent in children, it develops occasionally in young adults, or even in middle-aged persons.

Morbid Anatomy.—The disease is oftenest seen in either the cervical or lumbar enlargements. In very early cases, such as those described by David Drummond and Charlewood Turner, the lesion has been that of an acute hæmorrhagic myelitis with degeneration and rapid destruction of the large ganglion cells. The condition may be strictly confined to the anterior cornua; in some instances there is slight meningeal involvement. In cases in which the examination is not made for some months or years the changes are very characteristic. The anterior cornu in the affected region is greatly atrophied and the large motor cells are either entirely absent or only a few remain. The affected half of the cord may be considerably smaller than the other. The antero-lateral column may show slight sclerotic changes, chiefly in the pyramidal tract. The corresponding anterior nerve roots are atrophied, and the muscles are wasted and gradually undergo a fatty and sclerotic change.

Symptoms.—In a majority of the cases, after slight indisposition and feverishness, the child is noticed to have lost the use of one limb. Convulsions at the outset are rare, not constant as in the acute cerebral palsies of children. Fever is usually present, the temperature rising to 101°, sometimes to 103°. Pain is rarely complained of; there may occasionally be slight aching in the joints. The paralysis is abrupt in its onset and, as a rule, is not progressive, but reaches its maximum in a very short time, even within twenty-four hours. It is rarely generalized. The suddenness of onset is remarkable and suggests a primary affection of the blood-vessels, a view which the hæmorrhagic character of the early lesion supports. The distribution of the paralysis is very variable. One or both arms may be affected, one arm and one leg, or both legs; or it may be crossed paralysis, the right leg with the left arm. In the upper extremities the paralysis is rarely complete and groups of muscles may be affected. As Remak has pointed out, there is an upper-arm and a lower-arm type of palsy. The deltoid, the biceps, brachialis anticus, and supinator longus may be affected in the former, and in the latter the extensors or flexors of the fingers and wrists. This distribution is due to the fact that the groups of nerve-cells are attacked which preside over certain muscles acting functionally together.

In the legs the tibialis anticus and extensor groups of muscles are more affected than the hamstrings and glutei. The muscles of the face are never, the sphincters rarely, involved. While the rule is for the paralysis to be abrupt and sudden, there are cases in which it comes on slowly and takes from three to five days for its development. At first the affected limb looks natural, and as children between two and three are usually fat, very little change may be noticed for some time; but the atrophy proceeds rapidly, and the limb becomes flaccid and feels soft and flabby. Usually as early as the end of the first week the reaction of degeneration

is present. The nerves are found to have lost their irritability. The muscles do not react to the induced current, but to the constant current they respond by a sluggish contraction, usually to a weaker current than is normal, and more to the positive pole than to the negative. The paralysis remains stationary for a time, and then there is gradual improvement. Complete recovery is rare, and, when the anatomical condition is considered, is scarcely to be expected. The large motor cells of the cornua, when thoroughly disintegrated, cannot be restored. In too many cases the improvement is only slight and permanent paralysis remains in certain groups. Sensation is unaffected; the skin reflexes are absent, and the deep reflexes are usually lost.

When the paralysis persists the wasting is extreme, the growth of the bones of the affected limb is arrested, or at any rate retarded, and the joints may be very relaxed; as, for instance, when the deltoid is affected the head of the humerus is no longer kept in contact with the glenoid cavity. In the later stages very serious deformities are produced by the contracture of the muscles.

Diagnosis.—The condition is only too evident in the majority of cases. There is a flaccid, flabby paralysis of one or more limbs which has set in abruptly. The rapid wasting, the lax state of the muscles, the electrical reactions, and the absence of reflexes distinguish it from the cerebral palsies. The pseudo-paresis of rickets is a condition to be carefully distinguished. In this the loss of power is in the legs, rapid atrophy is not present, certain movements are possible but painful. The general hyperæsthesia of the skin, the characteristic changes in the bones, and the diffuse sweats are present. Disease of the hip or knee may produce a pseudo-paralysis which can with care be readily distinguished.

Prognosis.—The outlook in any case for complete recovery is bad. The natural course of the disease must be borne in mind; the sudden onset, the rapid but not progressive loss of power, a stationary period, then marked improvement in certain muscle groups, and finally in many cases contractures and deformities. There is no other disease in which the physician is so often subject to unjust criticism, and the friends should be told at the outset that in the severe and extensive paralysis complete recovery should not be expected. The best to be hoped for is a gradual restoration of power in certain muscle groups. In estimating the probable grade of permanent paralysis, the electrical examination is of great value.

Treatment of Acute Myelitis.—In the rapidly developing form due either to a diffuse inflammation in the gray matter or to transverse myelitis, the important measures are: Scrupulous cleanliness, care and watchfulness in guarding against bed-sores, the avoidance of cystitis, either by systematic catheterization or, if there is incontinence, by a carefully adjusted bed urinal, or the use of antiseptic cotton-wool repeatedly changed. In an acute onset in a healthy subject the spine may be cupped. Counter-irritation is of doubtful advantage. Chapman's ice-bag is some-