extract (one fourth of a grain), every four hours, are the most useful remedies. The paralysis of muscles during the period of convalescence is best treated by faradization, or galvanism slowly interrupted, if the former fails to induce responses. The galvanic current should be applied to the spine and to the nerve-trunks. After the acute symptoms have subsided, strychnine may be injected into the paralyzed muscles. Massage to the paralyzed members or muscular groups is an expedient of great utility. During the excitation period, and after cups or leeches have been applied, mustard-plasters to produce slight rubefaction are highly useful. Twice a day, a mustard-plaster four inches broad should be put on from the occiput to the sacrum, and removed as soon as slight redness is caused. During the stage of depression, *flying*-blisters to the spine are highly serviceable. Great circumspection is necessary, since all severe counter-irritation may help to form bed-sores. To remove deposits from the spinal canal, especially in the treatment of the chronic form of spinal meningitis, and the pachymeningitis interna of the cervical region, there is no remedy so efficient as the iodide of potassium, especially when its actions are aided by the occasional administration of pilocarpine.

ACUTE MYELITIS.

Forms.—*Myelitis* implies an inflammation of all the tissues of the cord. There are several forms, determined by the seat and range of the inflammation. It is sometimes designated *diffused* myelitis, and it may be *acute* or *chronic*. It is further distinguished into *central myelitis*, when the inflammation occurs chiefly in the central gray matter; into *transverse myelitis*, when all the tissues of the cord at certain levels are involved, as, for example, *dorso-lumbar*, *dorsal*, and *cervical* transverse myelitis; into *hemilateral*, when a longitudinal half of the cord is affected, and *disseminated*, when there are spots of inflammation scattered along the cord at various points through its whole length.

Causes.—Myelitis is more common in males than in females; in youth and early manhood than in advanced life. One form occurs in childhood. Contusions, blows, fractures of the vertebra, severe and prolonged functional activity of the cord, as in protracted standing, excesses in coitus, self-abuse, exposure to cold and dampness combined, are the most common causes. Inflammation of the cord may be excited by neighboring inflammations, transmitted by contiguity: meningitis, traumatic inflammation of the dura, and carcinoma, are the representatives of this group of causes. It is one of the complications of typhus, the exanthemata, puerperal fever, and acute rheumatism. The so-called reflex paraplegias are often, probably, examples of myelitis.

Pathological Anatomy.—The first step in the process is hyperæmia,

which is usually very intense, the affected area being deeply red. Extravasations also occur, and hence the tissues may have a reddish-brown or chocolate tint. With the hyperæmia occur serous transudations, so that the inflamed district is moist and juicy, and softened. A change in coloration next takes place to yellow, and ultimately to white, the nerve-elements are disassociated, become fatty, and finally an emulsioned mass remains, of creamy appearance and consistence. The meninges of this part of the cord take part in the inflammation, become thickened, opaque, and infiltrated with pus-cells, and contract adhesions. Such are the macroscopic or naked-eye appearances. On microscopic examination the changes consist in dilatation of the capillaries, arterioles, and veins; in the migration of the white and diapedesis of the red corpuscles; in fatty and granular infiltration of the walls of the vessels; in the exudation of a colloidal hyaline substance about the vessels; in swelling and proliferation of the neuroglia-cells, and a hyperplasia of the reticulum; in the exudation in great numbers of granule-cells in the interstices; in the granular disintegration of the nerve-fibers, the axis-cylinders forming ampullary dilatations: and in swelling, proliferation and granular atrophy of the ganglion-cells. The continued development of these morbid processes results in the almost entire disappearance of the proper elements, the remaining mass being composed of fat-granules, hypertrophied neuroglia, dilated and thickened vessels. Cysts are sometimes seen, composed of a dense connective-tissue envelope, and a reticulum of the same, containing serum and detritus. Without proceeding so far as the complete destruction of the nerve-elements (cells and fibers), which is the ultimate step in the acute process, a transition to the chronic forms is effected, in which there is an hyperplasia of the neuroglia, the spider-cells enlarge and increase in number, the vessels undergo thickening, numerous amylaceous corpuscles or bodies appear, while the nerve-elements atrophy. The central gray matter is the chief seat of this disease, but it extends so as to involve all parts. It may be most severe in the gray matter; it may have an hæmorrhagic character, and it may consist chiefly in a hyperplasia of the neuroglia.

Symptoms.—The usual course is the onset by a chill, fever, and general *malaise*. Or the spinal symptoms begin without any preliminary. There are experienced intense pain in the back, with a band of pain and constriction around the body, soreness developed by percussion of the spine, pains and muscular soreness of the limbs, tingling, formication, a feeling of weight and dragging in the rectum and bladder, and priapism. There may be, but not invariably, corresponding symptoms of irritation in the motor sphere, such as tremors, spasmodic contractions, clonic convulsions partial, even general. But paralytic symptoms appear in a few hours, and soon complete paralysis, and disappearance of the electro-contractility (reactions of degeneration). Pa-

ralysis of the sensory nerves also takes place in a short time, and sensation is lost more or less completely in all the affected region up to the upper line, often terminating quite abruptly about the middle of the body. The analgetic parts may also be the seat of violent pains (*anæsthesia dolorosa*). Paralysis of the sphincters may follow very soon the paralysis of the muscles, but it may be delayed for some time, and in other cases it may not occur at all. The condition of the reflex function varies greatly. All reflex activity may be abolished ; it may be diminished ; it may be unchanged ; it may be greatly exaggerated—the variations being due to the position and extent of the lesion in the cord. Sometimes the paralysis reaches its highest at once and is afterward stationary ; sometimes it ascends the cord and rapidly involves the parts above ; sometimes the extension is transversely, all parts of the cord in turn being affected. When the inflammation extends horizontally and affects the anterior cornua, the paralyzed muscles waste rapidly, and bed-sores form quickly and spread widely. These *trophic* lesions also excite disease of the mucous membrane of the genito-urinary tract, the urine becomes alkaline, and a violent and destructive pyelonephritis and cystitis are set up, the paralyzed limbs become œdematous, and effusion takes place into the joints. If the myelitis is of the ascending variety, when the cilio-spinal region is reached, pupillary phenomena are observed—enlarged pupil, if the sympathetic centers are merely irritated ; contracted pupil, if these centers are destroyed. When the cervical portion of the cord is reached, the muscles of respiration becoming paralyzed—the intercostals and trunk-muscles—breathing can be carried on only with the diaphragm, and finally, this muscle being paralyzed, there are most intense dyspnœa, rapid filling of the lungs, and death. The fever with which many cases are inaugurated pursues no defined plan. In some cases fever persists throughout, in many it is paroxysmal, but without regularity, in others it does not appear at all. In some instances intense fever precedes death, and is higher than ever immediately after death. The pulse is frequent usually, very frequent and irregular when the cervical portion of the cord is invaded. The nutrition in some cases fails rapidly, in others is preserved fairly well. There are obstinate constipation and meteorism produced by paralysis of the muscular layer of the bowel.

Course, Duration, and Termination.—There are numerous variations in the course of the disease, due to the position and tendency of the lesions. If the paralysis is of the ascending variety, the respiratory muscles soon become involved, and death takes place in a few days by asphyxia. In other cases, the trophic center being invaded, there occur extensive bed-sores, intense pyelonephritis and cystitis, changes in the joints, and death by exhaustion in three or four weeks, or as many months. It occasionally happens that the morbid process is arrested at a certain stage, and the health is restored ; but, permanent

damage having been inflicted, permanent deformity remains, such as wasted and paralyzed muscles, contractions, and deformities of joints. In still other cases, the acute passes into the chronic form of the disease. Rarely, complete recovery ensues. When this result takes place, a remission occurs at an early period, the paralysis is not complete, and slow absorption of exudations is effected. The myelitis from traumatic causes is usually situated above the dorso-lumbar enlargement, and is of the variety known as *myelitis transversa*. The symptoms present are the constricting band around the body, spinal pain, paraplegia, anæsthesia, no atrophy of the muscles, paralysis of the bladder, and reflex contraction of the muscles more active than normal. The electro-contractility of the leg-muscles is preserved. Central myelitis affects the gray matter, including the anterior horn. This form begins abruptly, proceeds rapidly, and involves sensation and motion and the trophic functions. The reflex excitability and the electro-contractility (faradism) are quickly extinguished (reactions of degeneration), the muscles waste rapidly, the muscles of respiration are quickly paralyzed by extension upward of the disease, and death occurs early by asphyxia. The hæmorrhagic form differs from the purely central myelitis by the still more abrupt appearance of the paralysis.

Diagnosis.—Myelitis may be readily confounded with meningitis : they differ especially in respect to the stage of irritation, which is pronounced in meningitis, but hardly recognizable in myelitis. In meningitis, there are rigidity, spasms and contractions of muscles, pain and hyperæsthesia ; in myelitis, paralysis appears in a short time, involves the rectum and bladder, and anæsthesia follows. The electro-contractility is preserved in meningitis, but often lost in myelitis. Hæmorrhage in the spinal canal is distinguished by its abruptness, the irritative symptoms (absent in myelitis), the slight paralysis and preservation of electro-contractility, as against the severe paralysis, wasting of muscles, loss of reflex and electric excitability, and trophic disorders characteristic of myelitis. Hæmorrhage into the cord is recognized by the abruptness of the symptoms, sudden paralysis without fever or other constitutional disturbance, the loss of power being stationary.

Treatment.—Absolute rest and the avoidance of all excitement, decubitus on the side or face, and careful and nutritious alimentation, are the first measures. The frequent application of hot water to the spine—preferably the hot douche—is very serviceable ; in some interval between these applications, a mustard-plaster the length of the spine and four inches broad should be put on, and retained no longer than beginning rubefaction, and repeated twice a day. Internally, the best results are obtained from the infusion of digitalis (a tablespoonful four times a day), for this remedy is preferable to ergot in the acute inflammatory affections of the spine, owing to the peculiar arrangement of the spinal veins. Local bloodletting and purgatives

are useful in plethoric subjects. As the stage of congestion passes into the stage of exudation, ammonia (the carbonate) should be given freely (five grains every three hours). Any specific infection must be regarded in the plan of treatment adopted. As the stage of depression develops, quinine in small doses, and belladonna extract, may be very useful. Scruple to half-drachm doses of quinine may have a good effect at the very beginning of the congestion stage.

CHRONIC MYELITIS.

Forms.—Under the term *chronic myelitis* are included various changes in the cord, of induration or sclerosis, and gray or gelatiniform degeneration, and, less often, of softening. The several forms of chronic myelitis, named according to their seat and character, are *central*, *transverse*, *progressive*, and *disseminated myelitis*. Each form has its distinctive symptomatology, because of the functions of the different parts of the cord.

Causes.—The causes of chronic are much the same as those of acute myelitis. It may arise from the acute form ; may be due to injuries, concussions, blows on the spine ; may result from sexual excess, from exposure to cold and dampness, or from the arrest of some habitual discharge. The so-called reflex paraplegias are probably nothing more than chronic myelitis, arising from reflex disturbances.

Pathological Anatomy.—The changes are of several kinds. Macroscopically there may be no alteration, or the consistence and color may be visibly changed. As to consistence, there may be sclerosis or softening, the latter much less frequently, and in color the change is to a grayish or yellowish-gray discoloration—an evidence of the existence of gray degeneration. The patches of sclerosis may be localized, or diffused, or disseminated. The changes may be limited to the central gray matter, and especially to that part surrounding the central canal, or to the gray matter of the anterior cornu, or to the lateral columns or to the posterior columns. Again, the peripheral part of the cord may be affected in conjunction with the pia.* The nerve-roots may be more or less advanced in the gray or gelatiniform degeneration, the nerve-trunks atrophied, and the muscles to which they are distributed equally affected by an atrophic degeneration, partly fatty. Various trophic changes occur in the joints and mucous membrane of the genito-urinary tract, and bed-sores form. The microscopic changes consist in an hyperplasia of the neuroglia—the fibers increase in number and size, and the cells undergo a nuclear proliferation. Various changes occur in the nerve-fibers : they may be swollen, disintegrating, fatty ; the axis-cylinder equally atrophied or indurated. The ganglion-cells are shrunken, pigmented, indurated, lose their processes, and their

* Vulpian, "Archives de Physiologie," tome ii, p. 279, "Note sur un cas de méningite spinal et de sclérose corticale annulaire de la moelle épinière."

nucleus and nucleolus alike disappear. The vessels also undergo important changes : the adventitia is indurated, and is the seat of nuclear proliferations and formation of fat-cells, and is thickened as well as indurated. Numerous fat granules and cells and corpora amylacea are distributed through the sclerosed patches.

Symptoms.—The symptoms are at first without much significance. Disorders of sensation usually precede the motor disturbances. There are pains in the limbs that have the character of and are usually confounded with muscular rheumatism, tingling, mixed with numbness, and some burning ; pain in the back, and a sense of constriction around the body—the girdle or band feeling ; sometimes the integument over the spine is highly sensitive. Motor disturbances next appear. Muscular fatigue is felt without exercise, and becomes severe when any effort, as in walking, is made. The feet and legs feel heavy, and their movements are awkward. With the progress of the case, sensory depression, after a time, supersedes all the symptoms of excitation. Numbness is felt in the fingers in the distribution of the ulnar nerve, in the toes, and in the bottoms of the feet, which feel as if a cushion were interposed between them and the floor. The various endowments of the sensory nerves disappear in turn—first the impression of tickling, then touch, pressure, temperature, and finally pain (Rosenthal). The anæsthetic area is the front part of the thighs, the hips and loins, the inferior portion of the body upward to either side of the abdomen. There are parts below the girdle-line in which sensation is only lessened, and parts that still retain their normal sensibility. Strange aberrations of sensations are observed in the anæsthetic regions—the application of heat may cause a sensation of coldness, of cold, a hot or burning feeling. Furthermore, an impression made at any spot may be referred by the patient to some distant point, or indeed to the other side of the body. The rate at which impressions are transmitted from the periphery to the centers of consciousness is much lessened in this disease owing to the obstacles in the paths of conduction—seconds even being occupied in the passage of an impression from the great-toe to the sensorium. The paresis or paralysis extends from below upward, very rarely in the opposite direction. The position of the paralysis depends on the part of the cord invaded. If the cervical portion, the upper extremities will be the seat of motor and sensory disorders, the pupils will be unequal, there will be embarrassment of respiration in consequence of paralysis of the intercostals and muscles of the chest above, the action of the heart will be rapid and weak, there will be suffocative attacks, and difficulty in swallowing. If the dorso-lumbar enlargement be involved, there will be the paralysis of the lower limbs (paraplegia), of the bladder and rectum, the electro-contractility (reactions of degeneration) and the reflex excitability will be both abolished ; but, if above the dorso-lumbar enlargement, the reflex and electro-contractility will be rather heightened. The para-

lyzed muscles waste and lose their electric reaction—the anodal disappearing before the cathodal reaction. The sexual functions decline correspondingly. At first there is priapism, but the erections presently cease altogether; yet nocturnal pollutions occur from time to time until absolute impotence results. The urine is at first frequently discharged with difficulty; there may be incontinence and dribbling, or retention and a catheter needed. Constipation and meteorism are present, because the muscular layer of the bowel is either paretic or paralyzed. The general nutrition often continues in a satisfactory state throughout, but, in the severe cases and toward the end of most cases, much suffering is experienced from the wakefulness, bed-sores, the incontinence of urine, and the inflammatory reaction from cystitis and pyelonephritis.

Course, Duration, and Termination.—The development of the disease is slow, whether the chronic succeeds to the acute or originates *de novo*. Its progress is slow, and, although varied by periods of apparent improvement followed by exacerbations, its tendency is downward. Nevertheless, there are in many cases long periods of a perfectly unchanging state in which the damage done continues, and no change for the worse takes place for many years. Even in those cases which seem stationary, there should be not too confident hopes of an arrest, since relapses may occur. In any case there can be no true recovery; only an arrest of the morbid action, for the damage done is permanent. There are various modes of termination: by cystitis, pyelonephritis, and bed-sores, by some intercurrent malady, as pneumonia or pleuritis, or by the extension upward into the cervical region.

Diagnosis.—We have first to distinguish the several forms of myelitis, as regards the seat of the lesions and the mode of their progression. When the cervical portion of the cord is affected, the symptoms of irritation and depression are seen in the hands and arms, in the disturbances of respiration and circulation, in the oculo-pupillary phenomena, the lower extremities and the sphincters becoming affected subsequently. If the dorsal portion is affected, above the dorso-lumbar enlargement, the respiration will be affected by paralysis of the intercostals, the constricting girdle will be high up about the nipples, there will be paraplegia and paralysis of the sphincters, but reflex and electro-contractility will not be affected, rather heightened than diminished. If the lumbar region is affected in addition to the symptoms of the dorsal, there will be loss of reflex and electro-contractility and usually the trophic disorders. When the disease invades the multipolar cells of the anterior horns, it is called *poliomyelitis anterior chronica*, the paralytic symptoms occur as in the disease of the other parts of the cord, but in this region lesions produce trophic changes in the paralyzed parts, rapid wasting of the muscles, changes in the joints, bed-sores, cystitis, etc., and loss of reflex and electro-contractility. Chronic myelitis is distinguished from hæmorrhage into the cord by the suddenness of the onset, and the prompt development of paralysis characteristic of the latter. From spinal meningitis, by the excitation symptoms, and the preservation of the reflexes and the electro-contractility, and the presence of febrile excitement, all wanting in chronic myelitis.

Treatment.—If the disease is recent and advancing, rest takes the first rank as a remedial agent. The rest must be as nearly absolute as possible, and should be kept up for two to three months to be of any service. Erb regards the hydropathic method as the most successful; the local application of cold water by compresses to the spine, removed when they get warm; the "rubbing wet pack," the application restricted to the back and body, hip-baths, and the half-bath, with douches to the spine.* The temperature of the water should not exceed 80° Fahr., and should not fall below 55°, and the treatment should not be continued too long. If patients do not react well and remain chilly, the treatment does no good. The author has had remarkably good results from the application of the hot douche in cases of myelitis. Next to hydrotherapy, galvanism is the most useful agent. The important point, too little understood, is the use of a large volume and low tension. From forty to sixty elements of Siemens and Halske and large sponge electrodes well moistened are the principal needs. The individual applications should be about two to five minutes' duration, and should be made daily. The duration of the treatment will be influenced by many considerations, by the benefit or injury especially. Even if it do good, the current should not be used daily for months at a time, but a few days' intermission every month are necessary. The direction of the current seems a matter of indifference, but the author believes, if the blood-supply is to be increased and the nutrition improved, that the descending current is better. Nitrate of silver has been beneficial in many cases. The author has seen good results from the chloride of gold and sodium, alone, and in combination with minute doses ($\frac{1}{30}$ gr.) of corrosive sublimate. Of all the agents for the period of depression, the author regards the lactophosphate of lime as the most permanently beneficial. It may be given with arsenic and contemporaneously with cod-liver oil. The diet must be light and easily digested, especially so in those cases undergoing the rest-cure. Spirits must be forbidden. One of the most unpleasant complications of myelitis—incontinence of urine—may often be relieved by faradization of the bladder, which is best accomplished by introducing a button electrode into the rectum, and applying a sponge electrode to the hypogastric region.

POSTERIOR SPINAL SCLEROSIS—PROGRESSIVE LOCOMOTOR ATAXIA.

Definition.—*Posterior spinal sclerosis* is a form of myelitis, which does not extend transversely but longitudinally, and is limited to the

* See the author's "Materia Medica and Therapeutics," sixth ed., art. "Hydrotherapy."

posterior columns. The term *progressive locomotor ataxia* was applied by Duchenne to designate the special characteristics of the malady. This disease has long been known in Germany under the term *tabes dorsalis*.

Causes.—Probably the chief cause of posterior spinal sclerosis is inherited tendency. Some striking examples of this disease appearing in collateral family lines have been reported by Friedreich.* It is sometimes directly transmitted; thus, Carré has reported an instance of one family, among whom there were eighteen cases in three generations.† It is a disease of the most active period of life, occurring from twenty to sixty, but the cases are most numerous between thirty-five and fifty. It attacks males twice as often as females. Occupations involving exposure to cold and dampness, to fatigue, and depressing moral emotions, favor the development of the disease. It is alleged that railroad-engine drivers, stokers, conductors, and brakemen, suffer from this and other spinal diseases by reason of the concussion. There are no statistics or exact observations thus far published on this point. Sexual excesses are generally held to be influential in causing this disease, but, as an unusual salacity is one of the first manifestations of the changes taking place in the cord, there is danger of confounding cause and effect. There seems to be no doubt that there is a relation between rheumatism and locomotor ataxia.‡ The author has seen a well-marked case, produced in a gilder by his occupation, the symptoms ultimately disappearing under iodide of potassium. It is probable that the slow absorption of the metals used in the arts is often responsible for the production of symptoms similar to those of posterior spinal sclerosis. That the syphilitic cachexia stands in an intimate causal relation to this disease seems well established by modern researches. By this statement, it is not intended to express the notion of an ataxic condition due to syphiloma of the spinal cord, but rather that the disease arises in the posterior columns in consequence of the development of a peculiar cachexia, the product of syphilitic infection and of the remedies used for its cure.

Pathological Anatomy.—The meninges may be unaffected, but in a majority of cases the pia mater presents the appearances of increased vascularity along the region of the posterior columns. The form, color, and consistence of the cord are altered. The change consists in an atrophy of the posterior columns, and hence there is a shortening of the antero-posterior diameter; in a gray, semi-transparent, rather vitreous, amber, rose or reddish-yellow color, which contrast strongly with the adjacent whitish nervous matter, and in an increase of the consistence of the affected area, although it may also be softer than normal. The extent of the degeneration varies in different cases,

* "Ueber Ataxie mit besonderer Berücksichtigung der hereditären Formen," von Professor Dr. N. Friedreich in Heidelberg, Virchow's "Archiv," Band lxviii und lxx.

† Erb, *op. cit.*

‡ Topinard, "De l'Ataxie Locomotrice," etc., Paris, 1864, p. 363.

but in general it occupies the parts between the posterior roots, and is most considerable in the dorsal and upper lumbar portion of the cord, but it may extend from the filum terminale to the calamus scriptorius. The changes, microscopically studied, consist in a hyperplasia of the connective tissues, a granular degeneration, atrophy, and disappearance of the proper nerve-elements, the accumulation of fat-cells, pigment, and corpora amylacea. The posterior roots are also affected by a fibroid change—the connective tissue undergoing development, the nerve-fibers wasting. Not all parts of the posterior columns are equally affected: in the lumbar region the external division, in the cervical the inner and middle division or the columns of Goll are chiefly diseased. Similar alterations take place in the gray posterior horns, and extension of the morbid process ultimately is effected to the lateral columns. The spinal ganglia and anterior nerve-roots escape degeneration, as also the ganglia of the sympathetic system. The gray degeneration often attacks the optic nerves, sometimes the oculo-motor and the abducens. The joints undergo remarkable changes: the articular cartilages disappear by absorption, the head of the bone and the articular cavity gradually flatten, atrophy, and are greatly changed from their normal appearance.

Symptoms.—In a man of the middle period of life, apparently in good health, there appear from time to time severe pains in the body, hips, thigh, and leg. These are usually of two kinds—sharp, quick, lightning-like pains flying through the limb, and a feeling of muscular pain, which leaves a sensation of soreness. These pains at first are occasional but after a while they become paroxysmal and somewhat more frequent, and may, by the time the other symptoms are defined, be present more or less every day, although they may disappear for weeks at a time. The pains are increased by cold, especially by cold and dampness combined, and are worse in winter. At or before the onset of the pains there is a marked increase in the sexual appetite, and men are driven to commit excesses to which they had previously been strangers. The period of pains, with or without increased sexual inclination, lasts a variable period, from a few weeks to several years, and is very often diagnosticated and treated as rheumatism. These pains are most severe in those parts destined to become ataxic first, usually the lower limbs. The next symptom is *diplopia*, which appears unexpectedly and after a variable period of a few weeks or a few months, disappears as unaccountably, although the change is very often attributed to the remedies of some oculist consulted by the patient. Besides the visual disorder from this cause, the eyesight gradually becomes dim (amblyopia), and further on, the gelatiniform degeneration attacking the optic nerve, vision is lost (amaurosis). During this period the salacity, which was at first active, begins to decline and nocturnal seminal losses occur. There is also less and less ability to satisfy the desire, the sexual congress becoming unsatisfactory, the erections inade-