quate, the ejaculation premature, and more or less pain taking the place of the pleasurable sensations, and finally complete impotence results. The first stage, according to the definition of Duchenne, consists of three symptoms: *pains, ocular disorders, anaphrodisia.* As already remarked, the duration of this stage varies within wide limits—from a few months to several years, and then begin the symptoms characteristic of the so-called second stage: numbness; ataxia of the muscular movements of the inferior extremities; cutaneous and muscular anæsthesia. In the bottoms of the feet the numbness includes a sensation as if cotton-wool or a cushion were interposed between the feet and the floor; the constricting girdle sensation of spinal diseases is experienced around the body at different heights; the limbs, thighs especially, feel as if embraced by a tight-fitting cuirass; the severe, lightning-like pains rather increase than diminish; the sense of touch is impaired, so that the points of the æsthesiometer can be felt as two only when they are very far apart; impressions of irritation are slow to reach the centers of consciousness; the sense of pain declines and is entirely abolished, but this latter may be at particular points only; the sense of pressure and the sense of temperature are diminished. As regards the motor functions, we find the following characteristic phenomena: the "knee-jerk" or patellar tendon reflex is found to be absent; at first the limbs are easily fatigued and the movements are uncertain, so that in walking the gait has an unsteadiness like that of slight alcoholic intoxication, and these unfortunates are often suspected of indulging in this vice; a sense of insecurity and often of helplessness, as when a carriage is approaching rapidly, or walking on a marble or tiled floor, or in the obscurity of the evening, is experienced; the ataxic phenomena increase so that they can not stand with the eyes closed, and in walking the feet describe a semicircle, the toes pointing upward and outward, the heels coming down with a stamp. An examination of the muscles now discloses that the disorder of locomotion is an ataxia; the muscles are not weak at first, and very great ataxia may coexist with complete retention of muscular power, but presently some of the muscles become paretic, and ultimately there may be paralysis with wasting. They can not at first walk without the aid of vision; after a time the assistance of a cane is needed besides their eyes, then two canes are found necessary, and finally walking has to be abandoned. In Duchenne's rather arbitrary arrangement the third stage consists in the extension of the sensory and motor disturbances to the upper extremities. The order of phenomena is as follows: pains, numbness, first in the ulnar-nerve region, then extending to all the fingers, troubles of coördination, inability to use the knife and fork, to fasten a button, etc. The reflexes are variously affected —sometimes increased, sometimes lessened, sometimes wanting; but the absence of the patellar tendon reflex is one of the most characteristic signs, so very rarely is it wanting in health, and so constantly is it not found at an early period of this disease. According to Buzzard * it is absent in 96 per cent. of the cases. Electro-contractility is increased or normal, and reduced or lost when muscles degenerate.

During the progress of the case, usually the vegetative functions are well performed. The appetite remains good, and the nutrition does not fail; the patients often having a rosy countenance and a self-satisfied expression, which lends countenance to the theory of secret drinking. The mental functions continue unaffected, and the moral state is one of contentment, although there may be great depression of spirits. There are peculiarities in the symptoms, not included in the preceding description, to which some attention should be paid. The anæsthesia of the soles of the feet is an element in the disorders of movement in walking. Some patients with entire analgesia, so that a pin can be driven into the flesh without any sensation whatever, suffer agony with a gentle touch, as the brushing of a woman's dress against the legs. It is in spots that such sensations exist. The place where a lightning-pain has just been felt often burns for some time after. One of the most disagreeable disorders of sensation is the feeling of "fidgets," a peculiar unrest which impels to movement. The muscular sensibility is much reduced. The muscular sense, the knowledge of the position of the members, and the appreciation of weight and resistance, are all reduced or abolished, and consequently the disorders of muscular action of every kind are enhanced. The ataxia of movement is particularly well exhibited when the patient, lying recumbent, is told to touch objects with his foot. The movements are in jerks, great energy is put into them, but the direction is irregular and apparently purposeless. Ataxia affects the muscles of the eye, as well as of the extremities, producing the effect called nystagmus, disordered accommodation, and changes in the size of the pupils. Friedreich's bilateral nystagmus consists of jactitating movements in a vertical, horizontal, or oblique direction, not when the eye is at rest, but when an attempt is made to fix it. Besides these motor disturbances, vision is affected by gelatiniform degeneration of the optic nerve, in a variety of ways—in respect to the size and sharpness of the field of vision and the appreciation of colors, the ultimate result being white atrophy of the optic disks. Various trophic alterations occur during the course of locomotor ataxia, especially toward the end. The most important, which has already been referred to, are the joint affections, beginning usually in the knee-joint. These changes may indeed begin before the ataxia, during the first stage, and involve the shoulder, elbow, and wrist, as well as the knee and hip. There occurs first, in the joint, swelling due not to any inflammatory process, but

* "Diseases of the Nervous System," p. 138.

the mere accumulation of fluid, without pain or tenderness. The swelling may spontaneously disappear, but usually important and destructive alterations occur in the joint, the cartilages are destroyed, the ends of the bones worn off, and partial and entire luxation results.* The bones of the body of an ataxic manifest an extreme fragility and break easily.

Course, Duration, and Termination.—Beginning obscurely and developing slowly, it may be years before the character of the symptoms will justify the attempt at a diagnosis. The first stage lasts from several months to several years. The ataxic disorders usually begin in the lower extremities, and the pains are most severe in the part or member destined to become ataxic. It occasionally happens that the incoördination begins in the upper extremities. The second stage is even more protracted than the first, and its duration is an affair of years. When extension takes place to the upper extremity, the progress is usually more rapid. The whole duration of the disease is on the average seven years (Topinard), but many continue thirty years. The shortest duration of a well-observed and carefully recorded case is three years. The progress is affected by the seasons, the atmospherical conditions, and by the regimen. Sometimes ameliorations occur without any apparent cause, or the disease remains absolutely stationary for long periods ; then exacerbations are experienced. The final result may be determined by acute congestion or softening of the cord, by cerebral diseases, by extension to the anterior cornua and the evolution of progressive muscular atrophy, by gastro intestinal inflammation, by cystitis and pylonephritis, by bed-sores, and by various intercurrent diseases. The most frequent of the intercurrent maladies is phthisis, for we find that, in a collection of forty-three cases, thirteen were terminated by consumption, four by broncho-pulmonary inflammations, two by enteritis, three by typhoid fever, etc. That a cure of a genuine case, extended to the second stage, is ever affected, seems very doubtful. That the disease may be arrested, after more or less damage has been inflicted, is perfectly true. The author has mentioned a case in which all the symptoms of the second stage were present, and which recovered completely under iodide of potassium, but the patient was a gilder.

Diagnosis.—The recognition of this disease is easy when fully developed. During the first stage, the pains may not be different from those of rheumatism or myalgia, but the occurrence of double vision and of sexual disorders should suggest their real character. At this period the sexual disorders are confounded with "seminal weakness," but the diagnosis ought to be made, by the pains, the double vision, and the time of life at which the nocturnal losses began. From

* "Diseases of the Nervous System," by J. M. Charcot, Syd. Soc. ed., London, 1877, p. 97. See also "Spinal Arthropathies," by Weir Mitchell, "American Journal of the Medical Sciences," April, 1875.

all acute affections of the spinal cord this disease is separated by the exceeding slowness of its development as well as by the character of the attendant phenomena. From chronic myelitis and all other affections of the cord, accompanied by paraplegia, with or without wasting, locomotor ataxia is differentiated by the condition of ataxia. In the one, the muscles are paralyzed ; in the other, they are not paralyzed, but incoördinate. These coarse phenomena seem sufficient without entering into the numerous finer points of difference.

Treatment.—If the disease is recognized early, before important changes have occurred in the spinal cord, the first of all remedies is *rest*, and as nearly absolute rest as possible. The results accomplished in this way are remarkable. The patient should avoid all use of his muscles, and should remain recumbent for weeks. The rest-cure involves the complete severance from all cares, occupations, and movements for a period of two or three months, and subsequently greatly modified occupation and movement for some months longer. The position should be on one side and toward the face as much as possible, and on a firm bed or lounge, without any constricting clothing. The diet must be light and simple, corresponding to the changed necessities of the organism. Coffee, tea, tobacco, and alcoholic stimulants should be given up. Next to rest in importance is the cold-water cure, which may be well conjoined with the rest-cure, and thus serve a double purpose. Erb says the "thermal baths" are hurtful, but that the results of the "cold-water baths are extraordinarily favorable. . . . Of nineteen tabes patients who went through with the cold-water cure, sixteen experienced more or less benefit, two saw no improvement, and only one grew slightly worse." The temperature of the water must not be below 68° Fahr., nor above 88° Fahr., and the application should consist of the rubbing wet pack confined to the spine, the wet cold compress applied along the spine for some minutes, and cold sponging of the spine, all cold douches and full baths being avoided. The treatment may be conducted better at home, if the patients are provided with the means. The springs of our mountain-regions of Virginia, Pennsylvania, New York, etc., may be advised during the summer and fall, the *temperature and not the composition of the water being heeded.* The author has seen a great deal of injury done by the hot springs of Arkansas in this disease. The third remedy is galvanism, direct continuous currents to the spine, labile applications to the extremities for the relief of pain, faradic currents to wasting muscles, and to the bladder if paralyzed. As regards the internal medicines, the use of iodide of potassium is proper in every case for a short time, lest there may be a syphilitic or metallic lesion of the cord. If no results follow in two or three weeks, a continuation of the remedy will not be advantageous. If there be a decided decline of the vital powers, the best results are obtained from lactophosphate of lime and cod-

liver-oil. Nitrate of silver has been serviceable in many cases, and is placed first as a remedy by some great authorities, but the danger of staining the tissues of the body is very great. The author has had excellent results from the persistent use of the chloride of gold and sodium, and when there is reason to suspect a syphilitic taint, he has conjoined with it minute doses of corrosive sublimate. Arrest of the disease has been, apparently, obtained in some instances, no further developments occurring after one and two years of close observation. Phosphorus has produced good effects in the hands of Dujardin-Beaumetz, but has been less useful in the experience of others. Nerve-stretching has now been done in many cases, with much relief. The sciatics are exposed, and stretched by the finger or a hook placed under them. Unfortunately, the first encouraging experiences have not persisted, and the operation of nerve-stretching, as a remedy for tabes, is rapidly declining in professional estimation.

LATERAL SPINAL SCLEROSIS.

Definition.—This term is employed for uniformity to express a disease having similar lesions to those of posterior spinal sclerosis but a different seat. By Charcot this disease is named *spasmodic tabes dorsalis*, and by Erb *spastic spinal paralysis*.

Pathogeny.—Lateral spinal sclerosis develops under the same conditions as posterior spinal sclerosis. The site of the lesions is the lateral white columns, and the changes consist in the gray gelatiniform degeneration. There occurs an interstitial hyperplasia of the connective tissue, and an atrophy of the proper nerve-elements. Although it chiefly affects the posterior part of the lateral column, it may extend forward to the anterior horn (its external angle), posteriorly to the anterior gray matter, and internally to the deepest portion of the lateral columns (Charcot). Secondary degeneration of the lateral columns, which occurs in certain cerebral diseases, is found on one side only. In the disease described by Charcot under the name *amyotrophic lateral sclerosis*, to the sclerosis of the lateral columns are added atrophy and disappearance of the multipolar ganglion-cells of the anterior cornua. This form of spinal sclerosis is situated in the cervical enlargement by preference (Erb). Lateral spinal sclerosis has its seat in the whole length of the cord—from the lumbar region up to the medulla oblongata.

Symptoms.—The symptoms of this disease are peculiarly striking, in that paraplegia exists with motor irritation. Before the motor symptoms there may be present such sensory disturbances as pain in the back, tingling, formication, and "tearing pains," but these are usually transient. The irritation symptoms are motor, and consist of jerking and twitching, cramps, and stiffness of the muscles, felt especially after fatiguing exercise, and at night on lying down. The muscles gradually become very tense, and certain movements difficult in consequence. Because of the continuous tonic contractions of the muscles the knees seem stiff, the step is shortened, and the legs approximated. The gait is a hop, the patient stepping on the toes, and showing a tendency to fall forward. This peculiarity of muscular movement is due, not altogether to the tonic extension state of the muscles, but to paresis. At first there is a feeling of heaviness and weakness, the muscles becoming very tired on slight exertion, and this passes on into paresis, only in very rare cases into paralysis. When the point of the foot rests on the floor, the patient sitting, a tremor of the limb is produced. The tendon reflexes in this disease are much exaggerated. The sensibility is unaffected; there is no atrophy of the muscles; and the functions of the rectum, bladder, and sexual system remain unaltered. The disease, beginning below, extends gradually upward. When the muscles of the trunk become affected, sitting up, or rising from the recumbent to the upright posture becomes difficult, finally impossible. When the arms are involved, the same combined weakness and rigidity, increase of the reflexes, paresis and contractures occur. But there are no symptoms of ataxia, and paralysis only rarely results. Sometimes the disease assumes a hemiplegic form, passing from one lower extremity to the corresponding upper extremity. When the disease completes its development, so to speak, it remains nearly stationary for many years, yet in most cases, ultimately, the contractures increase, and the paralysis becomes complete, and the patient is then entirely disabled. Nevertheless the malady does not prove fatal of itself, the termination being by some intercurrent disease. In that form of anterior spinal sclerosis in which the lesions involve the anterior cornua, and which is accompanied by progressive muscular atrophy, the symptoms present are those of anterior spinal sclerosis and progressive muscular atrophy.* As the anatomical site of the disease is the cervical portion of the cord, the symptoms first produced are those of the upper extremities. The muscles of the arms are occupied by fibrillary contractions, are wasted, paretic, but still retain the electro-contractility. The muscles of the arms, jaws, and neck are also in a state of tonic contraction passing into contractures, which ultimately disappear when the changes in the muscles are complete. In from four months to a year both arms are fully affected, and then extension takes place to the lower extremities. The same phenomena of paresis and rigidity with wasting take place in the lower extremities, but the bladder and rectum are not affected. Then occur also in the lower limbs the fibril-

* "Deux cas d'atrophie musculaire progressive avec lésions de la substance grise et des faisceaux antérolatéraux de la moelle épinière," par MM. J. M. Charcot et A. Joffroy, "Archives de Physiologie," vol. ii, 1869, p. 354, *et. seq.*

lary contractions and clonic spasms, with permanent muscular rigidity, which are characteristic of this disease. In the third stage, the field of morbid activity is transferred to the medulla oblongata. Respiratory and circulatory disturbances then ensue, and death speedily occurs. The whole course of this disease is completed in from two to three years.

Diagnosis.—The main points of difference between *posterior* and *anterolateral* spinal sclerosis have been referred to in passing. The presence of the reflexes, the absence of all symptoms of ataxia, weakness instead of incoördination, the contractures and clonic spasms—all characteristic of lateral, are wanting in the posterior sclerosis.

Treatment.—The principles and methods of treatment are the same as in posterior spinal sclerosis, which have been sufficiently set forth in the preceding chapter.

INFANTILE PARALYSIS—POLIOMYELITIS ANTERIOR ACUTA OF ADULTS.

Definition.—By *infantile paralysis* is meant a peculiar form of spinal paralysis, occurring in children suddenly, and due to an inflammation of the anterior horns of gray matter. It is now known that the same form of disease occurs in adults also, though much less often.

Causes.—Infantile paralysis, as the name implies, is a disease of early life, and occurs most frequently from six months to the fourth year; but precisely the same form of disease occasionally is encountered up to sixty years of age, so that the term proposed by Kussmaul —*poliomyelitis anterior acuta*—is more appropriate. Besides age, little is known as to the causes producing this disease. The influence of summer heat seems established by the observations of Sinkler.* As cases frequently occur during the course of convalescence from the exanthemata, and other acute febrile affections, a causative relation is supposed to exist between them. The important negative fact, that the influence of heredity can not be traced, must be stated.

Pathological Anatomy.—The naked-eye appearances furnish no exact information, and may be entirely negative. On microscopic examination, important changes are found in the anterior horns of gray matter, in the dorso-lumbar and cervical enlargements of the cord. The change consists in an inflammatory softening; the nerve-elements are disassociated by an exudation containing numerous granulation corpuscles and free nuclei; the neuroglia undergoes hyperplasia, and the blood-vessels are abnormally distended; the multipolar ganglion-cells have wasted, and many disappeared, while those remaining are in various stages of atrophic degeneration. The softening occurs in certain areas, from a half-inch to an inch in length, and on both sides, or on one side only, and especially in the dorso-lumbar enlargement. The softening extends a little posteriorly and laterally, and sclerotic degeneration also occurs in the adjacent antero-lateral columns. Similar changes take place in the anterior roots. Extensive wasting, atrophic degeneration, and sclerosis, occur in all cases and after many years. The anterior nerve-roots are thin, atrophied, and translucent, and more or less degeneration takes place in the filaments of the peripheral nerves. The muscles to which the nerves are distributed undergo very serious alterations, which consist in an increase of the connective tissue, the formation of numerous fat cells and granules, and the degeneration and disappearance of the muscular fibers. The bones of the paralyzed members cease to grow, and degenerate more or less, the cancellated structure being relatively increased, and the fatty tissue also. Important changes occur in the joints; the articular surfaces are atrophied and eroded, the ligaments thinned and stretched, the articulations relaxed. By reason of these atrophic changes great deformities, the worst forms of club-foot, are produced.

* "American Journal of the Medical Sciences," vol. lxix, p. 348.

Symptoms.—The usual onset of this disease is a fever, which lasts a day or two, and on recovery from which it is observed, with surprise, that the child is paralyzed. The fever may be accompanied with headache, pain in the back and limbs, with vertigo and delirium, in some cases with convulsions. Dr. Mary Putnam-Jacobi * has analyzed one hundred and sixty-three cases, and finds that there are several modes of onset. In twelve of these cases the paralysis occurred suddenly without any prodromes; in some cases the paralysis appears in the morning after a quiet night, or between morning and evening, without symptoms; in the majority of cases there is an attack of fever lasting two or three days; in some, merely nausea and vomiting, and in still others the paralysis is preceded by convulsions. What symptoms soever may precede the palsy, they subside in a day, or in two or three days, and the health seems restored, but one limb or several are found to be paralyzed; or one leg is limp and motionless, and in an hour or two the other leg is found to be in the same condition; and, in the course of the next twenty-four hours, the arms may also be paralyzed. From the beginning of the symptoms until the paralysis is completed, rarely more than a week is required. The bladder may participate in the paralysis, and the urine be retained, or there may be incontinence, but the bladder is not permanently affected, and these troubles disappear in a few days or weeks. Sensibility is not affected. The paralysis is complete at once, and soon begins to lessen, some restoration of power taking place in from one to three weeks, which may gradually go on until the paralyzed parts are completely restored in the

* "The American Journal of Obstetrics," June, 1874.

course of a few months. During this period the electro-contractility and the nutrition of the muscles are not affected in this group of cases, although the muscles are flabby and soft. Most of the cases behave differently. Improvement begins as in the cases just narrated, but it proceeds to a certain point only; some of the members recover entirely, leaving one or more or a single group of muscles affected. Thus the arms may be restored and the lower limbs continue paralyzed, or one arm or one leg may remain disabled. Rarely is one half of the body (hemiplegia) affected, and, if such be the case, the cause is to be sought within the cranium. When an arm is alone affected, the extensors of the arm and fingers are paralyzed; when the lower limbs are involved, the disability is in the extensors of the thigh (the psoas, Rosenthal), or in the muscles supplied by the peroneal nerve. The muscles remaining paralyzed are affected permanently, and by a rapidly progressive atrophy; the tendon and other reflexes and the electro-contractility to the faradic current are abolished (reactions of degeneration). The temperature of the paralyzed parts falls several degrees; they become cool to the touch, and present a blue, cyanosed appearance. The muscles waste till there is nothing but connective tissue and fat, the joints change in form and structure, the growth of the limb is arrested, and, if one of the lower limbs is affected, assuming often one of the forms of club-foot. Seguin* has given a careful analysis of many of the cases of spinal paralysis (poliomyelitis anterior acuta), which have been published. The following symptoms he regards as characteristic: "Dysæsthesia, and slight temporary anæsthesia, paresis and akinesis, both these symptoms affecting the extremities, and in rare cases the eyes, face, tongue, and throat; not affecting the respiratory muscles, nor those of the back and abdomen, nor the bladder, nor the sphincter ani. Muscular atrophy in the paralyzed parts. Loss of electro-muscular contractility (to faradic current) in the atrophied muscles. A strong tendency to spontaneous retrocession of the palsy, and to spontaneous cure. The important negative characters of this affection are: absence of palsy of the bladder, or of the sphincter ani, or of the respiratory muscles; no bed-sores; no great and extensive anæsthesia; no spinal epilepsy."

Acute Poliomyelitis of the Adult.—Although essentially the same disease in the adult as in children, it presents in the former some special characteristics, owing to the difference in bodily development. It begins with more or less intense headache, backache, nausea and vomiting, hebetude of mind, and even mild delirium. Various disorders of sensibility are noted by the adult when they can not be got from children. These disorders of sensation are numbness, formication, tingling, in the parts subsequently paralyzed. There is usually

* "Spinal Paralysis of the Adult," New York, 1874, p. 27.

considerable fever, the temperature rising to 102°–103° Fahr., but this symptom may be wanting. The paresis or paralysis comes on in a few hours after the beginning of the symptoms, and is widespread as a rule, but may be confined to a few muscular groups. The affected muscles are flaccid, and waste; the reflexes are much less active or disappear entirely; the reactions to the faradic current are feeble or are entirely abolished, the reactions of degeneration appearing. In the adult, however, more frequently than in children, the muscles retain their power of response to faradic stimulation, although in a feeble degree.

When the systemic disturbance subsides, in a few days, the paresis and paralysis manifest a tendency to restoration, which may, indeed, be complete after some weeks or months, but frequently some of the muscles undergo atrophic degeneration, with the characteristic electrical reactions, and deformities result, but never to the same extent as in children. In a majority of the cases, the resulting paralysis involves all of the members, or both of the upper, or both of the lower extremities. Paresis of the sensory nerves may be present at first, but this soon disappears, and thereafter sensibility continues normal. The special senses remain unaffected. Some weakness of the bladder is noted at the outset, but this is a temporary symptom. No change takes place in the sexual functions.

Course, Duration, and Termination.—The course of the disease is very uniform. The mildest cases, in which restoration of power begins in a few days, recover entirely in a few weeks or in a month or two. These cases have been designated "temporary paralysis." Other cases, in which a single member or a group of muscles remains paralyzed after the efforts at restoration have ceased, may regain the lost power in from two to six months. If the restoration does not take place within this time, it becomes less and less likely with the increasing duration of the case. Partial restoration is the rule even in unfavorable cases. Much depends on the treatment. So far as danger to life is concerned, the prognosis is always favorable. So far as ultimate entire restoration is concerned, the prognosis is doubtful. Persistent and rightly conducted electrical treatment may accomplish much even in the worst cases.

Diagnosis.—The first point in diagnosis is the condition of the paralyzed muscles. If wasted, how far do the muscular elements exist? This is ascertained by electrical tests. In these cases the muscles do not respond to a faradic current, but will contract on the application of a weak and slowly interrupted galvanic. Muscular contraction is the proof of the presence of the muscular elements. By the use of the harpoon, some portion of the tissue may be withdrawn and submitted to a microscopic examination. Infantile paralysis may be confounded with *acute myelitis, hæmorrhage into the cord, progressive muscular atrophy, paralysis from cerebral affections* in childhood and *paralysis*