are affected in strictly anatomical order—for in some few instances the paralysis begins in the hand and thence descends to the lower limbs, and in all cases the hands and feet are implicated before the parts most nearly connected with the spinal cord. Rarely a case occurs in which the medulla is first attacked, with the characteristic respiratory and circulatory disturbances resulting. According to Landry, the order in which the paralysis extends in the muscular system is the following: the toes and feet with the muscles acting on them; then the thigh and pelvic muscles, posteriorly, and, after these, the muscles in the front part of the thigh. A similar order is pursued in the upper extremity: first are affected the muscles acting on the fingers and hand; next those which move the arm on the scapula, and then those moving the forearm on the arm. Entirely after the muscles of the extremities, the trunk muscles are paralyzed; then come the muscles engaged in the respiratory movements, and after these, and in the order named, the muscles of the tongue, pharynx, and œsophagus. Attention to the mode in which the paralytic phenomena are developed will facilitate the diagnosis.

Sensibility is somewhat affected in many cases. There are numbness, tingling, formication, and impaired tactile and pain-sense, usually in the inferior extremities, but elsewhere the æsthesiometer discloses no changes. The reflexes are, as a rule, finally abolished, although at first there may be no change. The "knee-jerk" ceases. The bladder and rectum are not affected.

Whether the medulla oblongata be early or late affected, in every fatal case it is invaded by the morbid process, and its injury is the cause of death by asphyxia. The disease is of short duration for the most part, death occurring in a few days, or in a few weeks certainly, the average being ten days. It is not always fatal. The progress of the disease in favorable cases is arrested before the medulla oblongata is reached, although some cases presenting evidences of the functional derangement of this organ have, nevertheless, terminated in recovery. When improvement does take place, the change is early manifested by a cessation of morbid activity, by a return of function to the parts last paralyzed—the hands coming into use, then the arms, muscles of the chest, and abdomen, and finally of the lower extremities.

The rapid progress made by this affection, the preservation of the electric excitability of the muscles and of the functions of the rectum and bladder, the absence of bed-sores, and the prompt extension from below to the medulla oblongata, separate acute ascending paralysis from other acute affections of the cord, and render its diagnosis comparatively easy after the full development of the symptoms.

The prognosis, although grave, is not necessarily fatal. About one half of the cases, apparently, get well.

Treatment.—As some kind of toxic agency is supposed to underlie the morbid process, remedies should be addressed to the elimination of the poison. Syphilis, the minerals, will require large doses of the iodides. The rheumatic diathesis will need the remedies appropriate to that state. When the disease succeeds to some infection, as variola or typhoid, only the general condition can be taken into account. Galvanization of the cord has been apparently of benefit in a few instances. It is probable that the subcutaneous injection of strychnine would do good. It should be tried cautiously, and, if it act favorably, should be pushed, for, in the absence of specific lesions, a loss of power to functionate seems to be the essential condition of the spinal cord.

SOME DISEASES AFFECTING THE BRAIN AND SPINAL CORD.

MULTIPLE SCLEROSIS OF THE BRAIN AND CORD.

Definition.—By the term *multiple sclerosis of the brain and cord* is meant a disease characterized by the formation of isolated patches or nodules of sclerotic tissue in the brain, pons, medulla, cerebellum, and spinal cord. It is sometimes treated of as *cerebral sclerosis* and *spinal sclerosis*, but it becomes more and more apparent that neither organ is separately affected. By Charcot* it is entitled "disseminated sclerosis."

Causes.—In this disease both sexes are about equally affected, and it occurs from youth to middle age, becoming very rare after forty-five and before ten. The most powerful predisposing cause is heredity. Exposure to cold and fatigue, living in damp habitations, and sudden exposure of the body to cold and dampness when in a warm and perspiring state, are alleged to be causes, but doubts may well exist as to their influence unless a predisposition exist. Powerful and prolonged moral emotion, chagrin, anxiety, and other depressing moral causes, may favor the development of this affection. It occurs in the convalescence from acute infectious diseases.

Pathological Anatomy.—The disease in the brain and cord, to the naked eye, appear as glistening nodules underneath the pia. They are distinctly circumscribed, grayish patches, raised a little above the

* "Diseases of the Nervous System," "Sydenham Society Translation," lecture vi, p. 157.

level of the cord sometimes, or depressed below, or on a level with the general surface, but always perfectly defined from the adjacent tissue. The patches are somewhat gelatinous and translucent, and marked by fine white lines, round or elliptical or irregular in shape, somewhat closely arranged, often confluent; dense, tough, almost cartilaginous in hardness; on section, rather glistening. The nodules vary greatly in size, from minute, microscopic objects up to the size of a walnut; in the brain they enlarge laterally; in the cord, in its long diameter. They vary greatly in number as in size, and are distributed widely through the brain and cord. In the brain they are found not in the gray but the white matter—in the white matter of the hemispheres, ventricles, optic thalamus, corpus striatum, peduncles, pons, cerebellum; in the cord, the nodules are found both in the gray and white matter and in the columns. The deposits occur in the nerve-roots and the nerve-trunks just as in the nerve-centers. The nodules themselves are composed of the neuroglia, much hypertrophied, a newly formed fibrillated connective tissue, remains of the nerve-elements, fat- and granule-cells, and corpora amylacea. In the nerve-fibers, the medullary sheath is first encroached on by the hyperplasia of the neuroglia, disappears by absorption, leaving the axis-cylinder, which in turn undergoes the sclerotic change, then disappears, so that ultimately nothing remains but the newly formed fibrous tissue containing numbers of so-called "spider-cells," free nuclei, corpora amylacea, and fat. Similar changes occur in the walls of the vessels, beginning in the adventitia and in the perivascular lymph-spaces. Ultimately the adventitia is closely united to the surrounding connective tissue, the other tunics are invaded by the hypertrophied connective tissue, nuclei form in great numbers, fatty degeneration occurs, the fat-elements crowding the perivascular lymph-spaces, and encroaching on the lumen of the vessels.

Symptoms.—There are three forms usually described: the cerebral, the spinal, and the cerebro-spinal. But the description of this disease was purposely postponed to this point, as the spinal and cerebral forms rarely, if ever, exist separately, but the disease is cerebro-spinal sclerosis, in which, it is true, there may be a predominance of the cerebral or of the spinal symptoms in different cases, but in all the traces of both are discernible.

There are two modes of onset—a gradual and insidious mode, and a sudden and severe mode. When it begins slowly the symptoms may be chiefly cerebral or chiefly spinal: in the former, headache, vertigo, convulsions, or an attack of an apoplectiform variety, disordered and staggering gait, tremors in certain limbs or groups of muscles, impairment of special senses—of sight, of taste, of hearing, double vision, etc.; imperfect speech, and mental disorders of various kinds; in the latter (spinal form) there will be weakness and uncertainty of gait, ataxic disorders, numbness, tingling and pains in the extremities, incoördinate movements in writing, trembling, and severe attacks of gastralgia. This disease, as Charcot happily said, "is, in fact, an eminently polymorphic affection."* In the sphere of the sensory nervous system there are pains of various kinds, according to the position of the sclerotic nodules; pains in the face in the distribution of the fifth nerve, in the arms, and in the lower limbs, of an acute, lancinating character, with more diffused pains with a sense of pressure, constricting or girdle pain around the abdomen at different heights, with pains in the back and hips. Instead of pain, there is at a more advanced stage loss of sensation in various parts, or anæsthesia and analgesia. The sense of the position of members and of weight and resistance is also disordered or lost. There may be an entire absence of these sensations, and the appreciation of touch and pain continue normal. The disturbances in the motor sphere are more constant; first, motor weakness or paresis, which attacks one leg, then the other, and after a time the arms, or the order may be reversed; difficulty of locomotion, due not only to paralysis but to tonic contraction—the contraction of extension—which imparts to the gait a shuffling, dog-trot, or titubating character. The tonic contraction of extension passes into permanent contractures and rigidity. In many cases in which sclerosed nodules are largely deposited in the posterior columns the gait is incoördinate, and the usual phenomena of ataxia (reeling with the eyes closed, the peculiar gait) are present. Similar changes occur in the upper extremity, but the contractures and paralyses are usually hardly so pronounced as in the lower extremities. A very characteristic symptom is tremor, a *shaking tremor*, which occurs only during voluntary movement, and ceases when the parts are at rest. In the words of M. Charcot, "*the tremor manifests itself on the occasion of intentional movements of some extent; it ceases to exist when the muscles are abandoned to complete repose.*" Exceptional cases are encountered in which tremor is not present. It may have been present and then disappeared; it ceases when permanent contractions occur, so that the case can not be regarded as exceptional if the tremor is found on inquiry to have been present at some previous time and is now absent. The more powerfully the will is directed to the act, the more considerable and extensive the trembling. In conveying a glass of water to the mouth, the water is spilled and the glass rattles against the teeth. In any muscular act to which the attention is strongly attracted, not only the member acting, but the head, neck, and body are thrown into violent trembling. The reflexes are variously affected, and may be diminished or absent, but are often greatly increased, especially the tendon reflexes. Vesical, sexual, and rectal

* *Supra*, p. 183.

disturbances only appear toward the end, when incontinence, impotence, and constipation will come on. While these symptoms from the spinal lesions are developing, characteristic cerebral phenomena also are occurring. The psychical functions are disordered. At first, changes of disposition are noticed, the emotional centers becoming easily excited, and laughing and weeping occurring with equal readiness; irritability of temper and unexpected gusts of anger are common. Memory is early impaired, and reason, judgment, and the power to acquire knowledge are much weakened. Presently distinct forms of mental derangement make their appearance, as melancholia, mania with exaltation, and finally dementia. During the course of development of the psychical symptoms, vertigo, severe headache, and attacks of obstinate wakefulness appear, and there are also now and then apoplectiform attacks, followed by hemiplegia. Peculiar alterations occur in the speech and voice. The speech has the slow, jerking movement as in scanning, and becomes less and less distinct. The tongue and lips and the muscles of the palate and pharynx become paretic, and hence mastication and swallowing are difficult. The ocular muscles being similarly affected, there are diplopia, or double vision, nystagmus, and amblyopia, proceeding ultimately to amaurosis.

Course, Duration, and Termination.—Not all cases pursue the typical course just described. The cerebral symptoms may be in excess, and the spinal less pronounced (cerebral sclerosis) and *vice versa* (spinal sclerosis). As Erb has well said, "the correctness of this division has not, however, been demonstrated with satisfactory clearness." Charcot has divided the disease into three parts (p. 210): the first extending from the inception to the permanent contractures—a period of very variable duration, but lasting from two to six years; the second period, in which the motor functions are almost abolished, the mind disordered, but the nutrition continues good, in which the individual is reduced to a merely vegetative existence, continues not less than four and often more than six years; the third period is comparatively brief, in which nutrition fails, digestion becomes disordered, swallowing increasingly difficult, cystitis arises from paralysis of the bladder, bed-sores form, respiration and circulation become irregular and disordered, by reason of extension of the sclerosis to the medulla, apoplectic attacks occur, and not unfrequently some intercurrent disease appears. The whole duration of the disease varies from one or two years to twenty, but the average is five to ten years. The termination may be by exhaustion or by apoplexy, but usually some pulmonary disease ends life. The termination by death is the only one known. Sometimes remissions occur that are very illusory.

Diagnosis.—The fully developed disease is so remarkable, by reason of the multiplicity of the symptoms, that a diagnosis is made without difficulty. But in the partial cases there may be much difficulty. Cerebro-spinal sclerosis is often confounded with paralysis agitans. The former occurs in youth and early manhood, the latter in old age; the former is accompanied by tremors that do not occur when the patient is at rest, and increase by volitional effort; the latter by tremors that continue during rest, and that are lessened by an effort of the will. In the former, paresis or paralysis precedes tremor; in the latter, succeeds, and long after. In the former, peculiar defects of speech, of vision, of motility, etc., occur; in the latter not. Cerebro-spinal sclerosis may be confounded with locomotor ataxia, as in both there are ataxic disorders. In the former, there are mental disorders, paralysis, contractures, tremor, troubles of speech, and preserved and increased tendon reflexes; in the latter, none of these, and ataxia without paralyses or contractures, pains, peculiar sexual disorders, and no tendon reflexes.

Treatment.—Several remedies have appeared to act beneficially, although no cures have occurred. "Marked improvement set in under the use of subcutaneous injections of arsenic," says Erb, in one case. The galvanic current has appeared to benefit in a few instances. In other cases good results, if temporary, have been produced by nitrate of silver. Hammond thinks the chloride of barium does good. The most promising treatment is the combined use of galvanism, cold hydrotherapeutic applications, carefully made, cod-liver oil and nitrate of silver; but still more useful, according to the author's experience, is the chloride of gold and sodium, and with this may be advantageously given, for a time, corrosive sublimate in minute doses.

DEMENTIA PARALYTICA—PROGRESSIVE GENERAL PARALYSIS.

Definition.—By *dementia paralytica* is meant an atrophic change in the brain characterized by a peculiar form of mental derangement, associated with general paralysis.

Causes.—The cases largely preponderate in the male sex, the disproportion being nearly four to one. The most active and vigorous period in life—from twenty-five to forty-five—is the period for the appearance of this disease. Heredity seems to be an important cause, but the data do not exist for an exact statement. Excesses—the combined effect of overwork, alcoholic abuse, and venereal indulgence—are the most influential of all factors operating to produce the disease.

Pathological Anatomy.—A diminution in the weight and volume of the brain, due to an atrophy of its gray and white substance, is the characteristic alteration in this disease. The pia mater is œdematous, generally, or in the sulci, and a good deal of water is found between the parietal and occipital lobes; the ventricles, especially the cornua, are dilated, the ependyma thickened and roughened by granular deposition; the convolutions are shrunken, particularly those of the poste-

rior lobes, and the white and gray matter thinned and atrophic. The pia mater is greatly changed in structure, especially in the neighborhood of the vessels, and thickened by spots and patches of exudation of a yellowish color, and is readily stripped from the brain-substance. The dura mater is also much altered, closely united to the skull, thickened by exudations, and sometimes covered by a sanguineous extravasation. A peculiar change takes place in the vessels, of which the initial alteration is an increase of the nuclei in their tunics, and filling of the perivascular lymph-spaces with white and red corpuscles. The walls of the vessels become fatty or undergo the colloid degeneration. The ganglion-cells of the gray matter pass through atrophic changes, resulting in their final destruction. The membranes of the spinal cord undergo similar changes to the cerebral, but less frequently. Important alterations take place in the spinal cord ; gelatiniform degeneration, with entire disappearance of the proper anatomical elements, is the final result. The posterior columns are altered throughout their whole extent in the dorsal and lumbar portion, but in the cervical the change is chiefly in Goll's columns. Another kind of change which takes place in the postero-lateral columns is a granular myelitis, followed by hyperplasia of the connective tissue. Both kinds of change may exist together. The granular myelitis is not limited to the cord proper, but extends to the medulla, pons, and crura cerebri. The posterior roots are affected with the posterior columns, but the peripheral nerves are seldom diseased.

Symptoms.—The symptoms of this disease are naturally divisible into two groups—mental and motor derangements. A correct appreciation of the mental phenomena in these cases is of the highest importance, owing to the serious complications often arising out of the conduct of these subjects. The motor disturbances may precede, but they more usually follow, the first evidences of mental aberration. Changes in the character, disposition, and habits, and irritability and a quarrelsome disposition, quite at variance with the previous character, become manifest. Headache, transient vertigo, and inequality of the pupils, are among the early symptoms. It is observed that they fail in memory, especially of recent events ; they are absent-minded and talk to themselves. Some trembling of the lips may be seen, as well as of the muscles of the face and of the tongue. The speech becomes thick and rather guttural and is hesitating, and at the same time the voice is changed : it is nasal, and has assumed a different quality, the tenor voice becoming bass. Owing to the paresis and fibrillary trembling of the muscles of the tongue, and paresis of the muscles of the lips, the labials are pronounced with difficulty or slurred over. They early have expansive ideas and most deluded notions of what they can accomplish. Before their mental unsoundness is patent, they make purchases, or engage in ruinous enterprises, always on a large scale, and

they often exhibit a marvelous ingenuity in accounting for their acts. Hence the frequent litigation growing out of the acts of such paralytics before their real condition is known. After a time their ideas become so extravagant that the least informed can understand their state. Such a man has written an immortal work, or made a great invention, will build a house many miles high, will run a railroad to the moon, possesses countless wealth, is a king, has astonishing personal prowess, has the strength of a thousand men, etc. So quick is he to forget his statements that, if exposed in an absurdity, he immediately reaffirms it in a still stronger form. He is therefore perfectly happy in the midst of his delusions of personal importance. Meanwhile he has become indifferent to all the obligations and duties of life, ceases to have any affection for the members of his family, or cares for one only, pays no attention to his affairs, and steals, without a thought of the offense. Not all cases present the evidence of exaltation of ideas and happiness from a false conception of personal importance and well-being. Some are dejected and melancholy, but the ideas of depression have corresponding vastness, and their misfortunes are the greatest the world has ever seen. During the course of development of the mental symptoms, some of these subjects are given to paroxysms of rage as blind and ungovernable as those of an epileptic. Enraged by the least opposition, or excited by some trivial incident, they will commit a murderous assault on their best friends, and this, too, stealthily and without warning. During this state there is wild excitement like acute mania. This condition of excitement may persist until death by maniacal exhaustion, or it may pass into the condition of dementia. As these attacks of excitement are accompanied by elevated temperature, it is probable they are induced by chronic meningitis, traces of which are always seen in the anatomical changes. The ideas of exaltation and of melancholy often are present in the same case, and alternate, the patient passing quickly from one to the other. Delusions are not always present. There may be a gradual and progressive failure of intelligence to dementia, without there being any delusion, unless the expansive notions, which are apt to appear some time, are so regarded. A very characteristic mental state is the unconsciousness of weakness and of disease exhibited by these subjects, unless, as may happen during a remission, the patient recovers sufficient memory and judgment to appreciate his changed state. During the height of the symptoms, although paralyzed, he has the strength of a giant, and, though suffering from ailments which in the ordinary state of the mind cause great distress, he experiences nothing but an extravagant sense of well-being. In the motor sphere very important symptoms arise. Disorders of coördination begin in the inferior extremities—an ataxic gait, reeling on closing the eyes, etc., and after a time extend to the superior extremities. Early the handwriting assumes an irregu-