

of the vessels, acute inflammation, and tumor. Occlusion of the vessels and inflammation occur suddenly with very severe symptoms, often apoplectic, and terminate in a few days. Such is not the behavior of progressive bulbar paralysis. Tumor of the medulla and pons comes on slowly: there are, at first, symptoms of irritation, followed by depression; in progressive paralysis, the onset is slow and obscure, but there are no symptoms of irritation, those of depression occurring at once. In the case of tumor, pressure on the cavernous sinus is exhibited in swelling of the retinal veins and "choked disks," in puffiness of the eyelids and distention of the facial vein—symptoms which do not occur in bulbar paralysis.

Treatment.—Cheadle* reports a cure by the free administration of iodide of potassium, but this must have been a case of gummata. Iodide of potassium has never arrested the progress of, much less cured, a genuine case. Galvanism is the most promising remedy. Stable applications, the electrodes on the mastoid processes, and in the opposite direction, galvanization of the sympathetic, and applications to the lips, tongue, and fauces, should be persistently used. The current should have sufficient tension to cause slight giddiness and faint flashes of light. The *séances* should be short but daily, and, if suspended occasionally, can be kept up for the necessary period. Hydrotherapy is, next to electricity, the most useful remedy. A wet pack can be worn about the neck every night, and a hot douche may be directed to the nucha for five minutes daily, but, better, a sponge dipped in hot water and kept in contact with the back of the neck for a few minutes. The good effects of the water applications are increased by the daily use of a mustard-plaster, in contact long enough to induce a little redness and nothing more. The internal medicines have not effected any improvement in the cases thus far treated. As, under analogous conditions, the chloride of gold and sodium has been of great service, it should be given a fair trial. Bichloride of mercury acts similarly. The utility of these agents probably consists in their power to check the overproduction of connective tissue. As lead and other metals, slowly introduced into the system, will produce analogous symptoms, and as syphilis has the same effect, it is good practice in every case of progressive bulbar paralysis to give iodide of potassium, freely at first—its subsequent administration being governed by the results of the first trial. From the beginning the utmost attention should be given to the diet, so as to postpone the period of decline. Soft solids are more easily swallowed, when the palate is paralyzed, than liquids. Rectal alimentation should be resorted to when the difficulty of swallowing becomes great. The injection of defibrinated blood may be employed with advantage.

* "St. George's Hospital Reports," vol. v, p. 123.

DISEASES OF THE SPINAL MENINGES AND CORD.

HYPERÆMIA.

Definition.—As the vascular supply to the meninges and cord is the same, and as hyperæmia occurs, necessarily in both simultaneously, the term *hyperæmia* must be understood to include the contents of the spinal canal. There may be an *active*, or arterial hyperæmia; and *passive*, or venous hyperæmia.

Causes.—Hyperæmia is the first stage in the inflammatory affections, and is a notable element in variola, typhoid, and intermittent fever. It is caused by over-stimulation of the cord in the performance of its functions: for example, protracted standing or walking, excesses in coitus, etc. Certain spinal poisons cause hyperæmia, as strychnia, picrotoxine, amyl nitrite, and alcoholic excess. The arrest of such an habitual discharge as from bleeding piles, the menses, etc., diverts an excessive quantity of blood to the cord. Probably the most frequent cause is exposure of the body while in a heated and perspiring state to cold and dampness. Congestion is produced by traumatism, concussion, etc. Workmen engaged at labor in compressed air suffer from hyperæmia, due to the solution and setting free of nitrogen in the blood of the spinal canal, as Bert has shown. Venous or passive hyperæmia is caused by obstructive disease of the heart and lungs, by cirrhosis of the liver, and by tumors of the abdomen.

Pathological Anatomy.—In active hyperæmia, vessels come into view that are invisible in health, and those of larger size are enlarged, giving to the meninges and cord a distinctly congested appearance. On section, there are more bloody points than in health; and numerous points of extravasation, due to the rupture of capillary vessels, are to be seen. The spinal fluid is increased in amount, and is more or less reddish from the admixture of blood. Passive congestion is much more distinct, owing to the large size and numerous anastomoses of the vessels, which are greatly distended, more or less tortuous, and cause a bluish discoloration by the increase in size of the numerous small veins. Ecchymoses may also form in passive congestion, and the spinal fluid is somewhat increased in quantity.

Symptoms.—The symptoms are of two kinds; those of irritation and those of depression. The onset is sudden in the active form, somewhat more slow in the passive form. Pain in the back, in the dorsal or lumbar region, or both, radiates downward through hips and thighs, and is increased by movements and by percussion of the skin. The pain

is rather dull and heavy than acute. Pains are felt in the lower limbs, often of an acute character, and with the pain an unpleasant tingling. The skin of the lower limbs is abnormally sensitive, and the reflex excitability of the cord is somewhat augmented. A slight and usually transient sense of constriction of the abdomen is felt, and the abdominal muscles and those of the extremities are abnormally tense and rigid. There is also increased tenderness of the muscles to pressure, and they feel sore and ache a good deal, even when at rest. The electro-contraction is more prompt than in health. These symptoms of irritation occur to both forms of congestion, but they are more acute in the active form. The symptoms of depression immediately succeed those of excitation. Sensation is diminished; the lower limbs feel benumbed and heavy, and the movements are weak.

Course, Duration, and Termination.—The symptoms of irritation exist in the active form but a few hours, when the stage of depression comes on, the two groups of symptoms intermingling. The whole duration of the active form may be a few hours to two or three days. The cause continuing in operation, the symptoms will continue; but congestion can not long exist in the active form without setting up myelitis. The stage of depression coincides with the escape of fluid from the vessels and the occurrence of ecchymoses. Then the cord and the nerve-trunks being impinged on, they are functionally depressed. The termination is in recovery, if the cause is removed, or in myelitis. The onset of the passive form and the development of its symptoms are gradual; the symptoms are not so pronounced as are those of the active form, and the duration is only limited by that of the cause producing it. With various fluctuation the passive form may last an indefinite period.

Diagnosis.—Hyperæmia is distinguished from the more severe affections of the cord by the mildness and transitory character of the symptoms. From myelitis it is differentiated by the absence of fever, severe pains, contractions, paralyses, bed-sores; from meningitis, by fever, the severe symptoms of excitation and of depression; from spinal hæmorrhage, by the suddenness of the latter, and the occurrence of depression without symptoms of excitation; from anæmia, by the symptoms of general and local depression characteristic of the latter.

Treatment.—Lying on the back should be avoided. Cups or leeches to the spine, if the patient is plethoric, should be applied. If the attack has succeeded to sudden arrest of the perspiration, pilocarpine should be used to reëxcite the sweat. If the congestion is active, the spinal ice-bag may be applied. The blood-pressure should be reduced by an active purgative. A descending stable galvanic current should be used once daily if the symptoms persist. A hot douche to the spine, every four hours, the author has found remark-

ably beneficial. The internal remedies most useful are, for the active form, tincture of aconite-root (two drops every two hours), and infusion of digitalis (a half-ounce every four hours), unless the symptoms of depression increase. In the active form, the author has had excellent results from the fluid extract of gelsemium (five drops every four hours); in the passive form, digitalis and ergot (j—ij ʒ fluid extract of ergot every four hours) are the most efficient means. In all cases the cause must, if possible, be removed.

SPINAL MENINGEAL HÆMORRHAGE.

Pathogeny.—Injuries and diseases of the vertebræ, penetrating wounds, rupture of a vessel from strong muscular effort, as in convulsions, tetanus, lifting a heavy weight, and the spontaneous bleeding occurring in hæmorrhagic and infectious diseases, as hæmophilia, scurvy, purpura, variola, typhoid, etc., are regarded as the causes. The most frequent position of the hæmorrhage is in the extra-meningeal connective tissue. It may form a clot entirely enveloping the dura, or occur at isolated spots, or extend over a part of the membrane. The dura itself may contain numerous ecchymoses. The coagulum may also coat the nerve-trunks up to their point of emergence. In the subarachnoid space there may be a quantity of blood, partly fluid and partly coagulated, usually quite widely distributed. In the meshes of the pia mater, or rather in the subarachnoid cellular tissue, there are layers of dark blood, partly fluid, surrounding the cord, and extending longitudinally the distance of two or three vertebræ. The cord will be compressed if the hæmorrhage is large, the part next the blood stained red and softened by imbibition. If the nerve-roots are long in contact with blood-clot, they will become stained and softened. The spinal fluid will be red, and contain particles of clot floating in it. Hyperplasia of the connective tissue, adhesions between the membranes, and extensive pigment deposits, are the results of the final changes wrought by hæmorrhage. Spinal hæmorrhage is not unfrequently associated with, or rather results from, cerebral hæmorrhage, the blood flowing down into the spinal canal.

Symptoms.—The usual onset is sudden: intense pains in the back and down the limbs are experienced, and the patient falls powerless. The other and much less common mode of onset is slower: there are pains, strange sensations, headache, and gradual failure of the lower limbs. In rare cases cerebral and spinal hæmorrhage occur simultaneously; there are then sudden loss of consciousness, defects of speech, and syncope, in addition to the spinal symptoms. When the immediate effects of the hæmorrhage subside—the phenomena of shock, or apoplexy—then are seen the symptoms of excitation due to the presence of the blood. Intense pain in the spine about the site

of the clot—the whole length, one division, or one or two vertebræ of the spine—and radiating along the peripheral tracks of the nerves impinged on in the canal. In the lower extremities will be felt the referred sensations produced by pressure on the cord—tingling, burning pain, mixed with numbness. Pressure on the motor nerves produces the signs of irritation in the muscles, chiefly contraction, rigidity, and cramp; but there may be trembling, local convulsive movements, etc. The muscles of the spine are rigid, and motions of bending or turning the body are painful. The symptoms of irritation soon yield to those of depression. Numbness, formication, diminished tactile, and painful sensations, succeed to the pain and burning; the muscles become weak, and a sense of exhaustion is experienced. Paresis of the bladder and rectum is observed when the position of the hæmorrhage is low down. In the symptomatology it has thus far been assumed that the hæmorrhage was not higher than the dorsal region. Special symptoms are produced by hæmorrhage in the cilio-spinal region, and the more if high enough to affect the origin of the phrenic. The occiput, the shoulders, and arms, are attacked by pain, spasm, and paralysis, the pupil is dilated (irritation), the respiration embarrassed (dyspnœa), there is difficulty in swallowing, and the pulse is slow and weak.

Course, Duration, and Termination.—The course of the disease varies with the site and extent of the hæmorrhage and the complications. The first stage (apoplectic) is but a few hours in duration, the stage of irritation a few days, and of depression two or three weeks. If the hæmorrhage be large, cervical, and cranial, death may ensue in the apoplectic coma; if cervical, death may be caused at once, or in a day or two, by the disturbance in the respiration and heart. Most of the cases in the dorsal and lumbar part get well, the clot being gradually absorbed. During the stage of irritation there is more or less reactive inflammation, and the products of this help to increase the after-depression. The whole course of a case of spinal hæmorrhage may be completed in one or two months, and health restored after a convalescence requiring two months. The prognosis will be influenced by the violence of the initial symptoms, by the extent of the hæmorrhage, the number and severity of the signs of irritation, and by the extent of the symptoms of depression.

Diagnosis.—Spinal hæmorrhage is to be differentiated from hyperæmia, spinal meningitis, hæmorrhage into the cord, and myelitis. It is distinguished from hyperæmia by the suddenness, the violence, and the range of the symptoms; from meningitis and myelitis, by the absence of fever, and by the suddenness of onset and more manageable character; from hæmorrhage into the cord, by the fact that in the latter there are sudden paralysis without excitation, and extensive anæsthesia.

Treatment.—Absolute quiet, the decubitus on the side or face, are the first measures. Severe pain must be combated by the hypodermatic injection of morphine, which is furthermore very useful to remove restlessness. If the hæmorrhage is going on, ergotin should be freely used hypodermatically, and general bleeding practiced if the subject is plethoric. Bloodletting is improper if the hæmorrhage has stopped. To promote absorption, the best measures are purgatives, infusion of digitalis, and the occasional administration of pilocarpine. Good results are obtained by the persistent use of ammonia—ten grains of the carbonate in a tablespoonful of the liquor ammonii acetatis three times a day. The products of inflammation (reactive) are best removed by the galvanic current to the spine daily, by the hot spinal douche, and by the spinal pack worn for a few hours at a time.

INFLAMMATION OF THE SPINAL DURA MATER—PACHYMEMENINGITIS SPINALIS—PACHYMEMENINGITIS SPINALIS INTERNA.

Definition.—*Inflammation of the spinal dura mater* corresponds to the same process of the cerebral dura mater, and the same nomenclature is used. *Pachymeningitis spinalis* means inflammation of the spinal dura mater, and it may be *external* or *internal*, the former associated with external diseases and injuries—the latter arising from ordinary causes. As the latter possesses the greater interest and importance, it is alone considered here. There are two forms of pachymeningitis spinalis interna: the hypertrophic, and the pseudo-membranous.

Pathogeny and Symptoms.—Exposure to cold and dampness combined and living in damp habitations are said to be the chief causes of the variety known as the hypertrophic. The hæmorrhagic form is precisely the same as the hæmatoma of the cerebral dura mater, and is usually found in the subjects of dementia paralytica and of alcoholic excess. In the *hypertrophic* form a great quantity of exudation is poured out on the inner surface, which solidifies into a compact connective tissue, arranged in concentric layers. This ring of indurated tissue more or less tightly embraces the cord and sets up a secondary myelitis, and, equally compressing the nerve-roots, causes them to undergo an atrophy, and the muscles to which the nerves are distributed also waste in the usual way of muscular atrophy. In the *hæmorrhagic* form a membranous exudation also takes place, developed from the sub-epithelial layer (Rindfleisch). This neo-membrane is abundantly supplied with large, thin-walled vessels, which yielding a large hæmorrhagic extravasation, in the interstices of the membrane, a cyst is thus formed, as has been described in connection with cerebral pachymeningitis. The *cervical hypertrophic pachymeningitis* is one of the numerous contributions to knowledge made by Professor Charcot, who has shown that the neck is a favorite seat of the hypertro-

phic form. He has shown that the first stage is that of irritation, and it coincides doubtless with the stage of membranous exudation. This first stage is characterized by violent pains in the head, neck, shoulders, and arms—pains that are continuous, and also subject to exacerbations—and are associated with a painful sense of constriction around the upper thorax. This stage of irritation continues two or three months, and is succeeded by depression. Then ensue paralysis with contraction of the upper limbs, and atrophic degeneration of the muscles, which lose their electro-tractility as regards the faradic current. Subsequently the lower limbs may become similarly affected, but to a much less extent. After remaining stationary for a long time, a change for the better may take place and a cure ultimately result.

SPINAL MENINGITIS—LEPTOMENINGITIS SPINALIS.

Definition.—When the term *spinal meningitis* is used it is intended to express inflammation of the arachnoid and pia mater, for no distinction between the two is possible either in respect to the pathological or clinical standpoint. There may be an *acute* or *chronic* form.

Causes.—It is a disease of the male sex, and occurs in youth and adult manhood. All depressing influences and the evils of bad hygiene tend to develop it, and it attacks by preference the subjects of the serofulous cachexia. Exposure to cold and dampness, while the body is warm and perspiring, is an influential factor. Penetrating wounds and injuries and diseases of the vertebræ have a direct effect which is unquestionable. Neighboring diseases affect the spinal meninges by contiguity; those of the brain have the most immediate connection. It occurs also during the course of acute infectious diseases, as puerperal fever.

Pathological Anatomy.—After an intense hyperæmia of the membranes, punctuated by ecchymoses, much fluid is exuded, and the tissues are swollen and infiltrated with serum. A quantity of exudation partly purulent and partly fibrinous is poured out; the spinal fluid becomes reddish and muddy from the presence of cells, flakes of fibrin and pus; the membranes are infiltrated with pus-cells, and are coated more or less extensively with patches of fibrin, the whole length of the cord nearly being covered with exudation. The roots of the spinal nerves are also thickly covered with exudation and bathed with a pathological fluid—the result is, they are swollen, softened, and more or less injured by imbibition. The cord itself never escapes entirely; it may be only sodden; it may be softened, congested, and œdematous. In the chronic form there may be adhesions of the membranes, pigmentation, large accumulation of fluid, atrophic and sclerotic degeneration of the cord, etc.

Symptoms.—There may or may not be a chill to mark the onset of the disease, but a rise of temperature, general *malaise*, headache, nausea, and constipation, with the urine acid and high-colored, indicate the beginning of an inflammatory affection. Then occur the local pains, which attract attention to the spine—pain, of a severe, deep, boring character, in the loins, back, or neck, usually in the dorso-lumbar region, rigidity of the spine, a constriction or girdle of severe pain around the body, and pains radiating downward into the limbs. The motor nerves excited by the exudation cause the muscles to which they are distributed to assume a state of spasmodic contraction, limited to the lower limbs, to the rectum and bladder (retention of urine and constipation), when the lesions do not extend above the last dorsal; extending to the muscles of the trunk and the superior extremities, to the respiratory and posterior cervical muscles, if the cervical portion of the meninges is invaded. When this portion of the spinal canal is occupied by the inflammation, there occur dysphagia, dyspnœa, slowing of the pulse, and feebleness of the heart. Striking on the spinal processes does not necessarily awaken pain, but much soreness is felt when the spine is bent in the movement of the body. It is important to note that the muscular contractions are excited and increased by all attempts at movement, whereas irritation of the skin does not have this effect—a point of differentiation between meningitis and tetanus (Jaccoud). With this condition of the motor functions, there are also hyperæsthesia and hyperalgesia of the integument in the area of motor derangement. When the respiratory muscles are affected, at this stage death occurs early, the pulse becomes very rapid, the dyspnœa increases and asphyxia results. Otherwise, the acute symptoms subside, and the remission may be the beginning of convalescence. More often this diminution of the acuity of the symptoms and the moderation of the excitation denote the onset of the paralytic—the stage of depression. The paraplegia is not complete; partial contractions remain in the paralyzed members, and more or less hyperæsthesia persists. Constipation from paresis and urinary retention are replaced by incontinence, but this is not invariable. Reflex movements are not abolished. Anæsthesia will more or less, but not entirely, replace hyperæsthesia. The electro-tractility (faradic current) is not impaired in some muscles, but is weakened and lost in others. The extensors are more often affected by atrophy and loss of electro-tractility (Rosenthal*). The cases may now follow two courses: In one the symptoms of paralysis will invade the respiratory muscles, and death will occur in coma (carbonic-acid poisoning), the temperature sometimes rising to an extraordinary height. In the other case, the course will be more protracted; there will be periods of apparent improvement, but the paraly-

* "Klinik der Nervenkrankheiten," Stuttgart, 1875, p. 286.

sis will extend, bed-sores will form, urine will dribble away, and death occur finally by exhaustion. If the disease extend to the medulla, there will be produced, besides the disturbances of respiration and of the heart which occur when the cervical meninges are inflamed, affections of speech, vomiting, ocular derangements, delirium, etc. There is no characteristic thermal line; the fever is high at the outset, but the temperature declines during the stage of depression, to rise sometimes to an extraordinary height during the death-agony. The appetite is lost, the body wastes rapidly, and emaciation, in the cases with bed-sores and death by exhaustion, proceeds to a remarkable extent. The *chronic form of spinal meningitis* succeeds to the acute cases of moderate severity, or originates spontaneously—the latter more frequently. It presents the same form and order of symptoms—those of excitation, those of depression. These effects are due to effusions and membranous exudations in the spinal canal. The membranes are thickened, pigmented, and adherent to each other and to the cord. The pressure of the contracting sclerotic connective tissue induces atrophy of the nerve-roots, and if the posterior roots are impinged on degeneration may occur in the posterior columns (Rosenthal). The cord itself is ultimately damaged by a parenchymatous myelitis. The symptoms of irritation are chiefly expressed in disorders of sensibility, muscular rigidity and spasm being partial and fugitive. The pain is felt in the lumbar region and through the lower limbs, and has a rheumatismal character. The pain is accompanied by hyperæsthesia, which, however, is never so considerable as in the acute form. Paraplegia develops slowly: at the first there is a strong sense of fatigue, then of increasing weakness; numbness, tingling, and slowly marching plantar anæsthesia, come on in the order named. The weakness extends to all the muscles of the inferior extremity, and to the rectum and bladder, and may ultimately invade the upper extremities, always in its march attacking the two sides of the body equally. This form of paraplegia is irregular in its progress—now advancing, now receding.

Course, Duration, and Termination.—The fulminant form terminates in a few hours or a few days, its course being characterized by the extent and diffusion of the symptoms, the early implication of the cervical portion, and consequent failure of the lungs and heart. The ordinary severe form lasts two or three weeks, and terminates in either of two modes: in from one to two weeks by the embarrassment of respiration and weakness of the heart, coma developing in consequence of carbonic-acid poisoning; in from two to four weeks, by gradual failure, death being due to exhaustion. The severe form may terminate in recovery. At the end of the excitation period a remission in the symptoms occurs, the stage of depression does not develop into paraplegia, and convalescence proceeds slowly, the health being re-established not until two or three months have elapsed. In the most

favorable cases a change for the better may take place in the excitation period in a few days, and convalescence be established, or the symptoms be resumed in a milder form, convalescence being then established. Not unfrequently some critical evacuation, such as a profuse sweat or urinary discharge, an epistaxis, or menstrual or hæmorrhoidal discharge, marks the cessation of the morbid process, and a rapid recovery then takes place. More frequently the recovery is slow, owing to extensive exudations, and there is a long period of lameness or paralysis. Again, recovery may ensue with permanent disability of a member, or group of muscles. In any case, the prognosis is serious.

Diagnosis.—The distinction between tetanus and spinal meningitis rests on these points: trismus is among the first symptoms of tetanus, and rarely occurs, and then later in spinal meningitis; risus sardonius is peculiar to tetanus; the spasms are rhythmical in tetanus, are more severe, and are excited by reflex causes—similar spasms do not occur in meningitis, are much less severe, and are only excited by movements. In tetanus, no oculo-pupillary phenomena, no changes in the cranial nerves, no delirium, no fever—all occur in meningitis. The history of the case, especially the presence of a wound, will often decide. From myelitis, meningitis is differentiated by the pain in the back, the hyperæsthesia, the muscular rigidity, and on the part of myelitis by the early paraplegia and anæsthesia. Rosenthal places much stress on the electrical state of the muscles—the electro-contraction and sensibility (faradism) of the nerves are much lessened, or disappear entirely in spinal meningitis. From typhoid fever, by the thermal line, by the absence of the irritation symptoms, by the diarrhœa, by the stupor—in fact, the least attention ought to decide promptly.

Treatment.—Absolute repose in a darkened room, the decubitus lateral or on the face, must be insisted on. Leeches or cups to the spine during the period of excitation—the amount of blood drawn being dependent on the vigor of the subject. The application of the spinal ice-bag may be proper, but caution is necessary. The author has a strong conviction that hardly any topical application is to be compared with the hot douche to the spine, or, instead, a large sponge dipped in hot water and passed frequently over the spine. The most efficient internal medicines are opium, aconite, and ergot—two drops of the tincture of aconite-root, five to ten drops of the tincture of opium (deodorized), and fifteen to thirty minims of the fluid extract of ergot every two hours during the stage of excitation. If the pain is very severe, the hypodermatic injection of morphine may be necessary at the outset. As opium is a remedy of the greatest importance, its effects should be steadily maintained during the excitation stage. When the symptoms of depression come on, quinine (three grains) and belladonna