

tween death and the autopsy. Leyden reports a case of this kind in which Recklinghausen made the examination.

On opening the skull the membranes of the brain are revealed in a state of intense hyperæmia. The sinus longitudinalis is distended to tension of its walls, and all visible vessels are filled to their utmost capacity. In fulminant cases there may be no trace of exudation, but the pia mater is already opaque and lustreless, sometimes ecchymotic, from infiltration into its texture. The substance of the brain and cord is cedematous and softened in the most superficial layers.

In cases of longer duration the dura mater is stretched tense by the effusion beneath it, punctate hemorrhages are diffused over its surface, and the hyperæmia involves the porous substance of the bones of the spinal column, whose spongy structure appears saturated with blood. The pia mater is reddened with distended vessels, is opaque in some places, ecchymotic in others, and is softened in spots or more extensive surfaces. The first exudation is a light, clear or amber-colored serum, which soon becomes an opaque milky fluid of semi-gelatinous or mucilaginous consistence, sticky, "drawing to a thread," which later becomes greenish, "leek-green," or yellowish with pus. The viscosity of the exudate is due to the presence of mucin (Klebs). The effusion occurs first in the subarachnoid spaces and along the course of the vessels of the pia mater at the base and sides of the cerebrum, in the fissure of Sylvius and between the cerebrum and cerebellum, or extends over the whole surface of the brain to form a veritable cap. Or the exudation, more limited to the base, surrounds the emerging nerves, dissecting up their investing sheaths and following them out in their course. Both Tourdes and Netter have observed purulent flocculi in the fluid that is usually found in small quantities in the cavity of the arachnoid. In the spinal column the exudation is deposited first along the posterior aspect of the cord, as determined by gravity, but soon extends to its lateral surface and to affect or follow out the spinal nerves in the same manner as in the brain. However, Tourdes and Netter have each reported a case in which the false membrane was confined to the anterior surface of the cord. The thickest masses of exudation are found in the cervical and lumbar regions of the cord, though effusion in spots, bands, or islands occurs irregularly throughout its course. In its advance the suppurative process invades the sheath of the optic nerve to travel along its course, infiltrate the orbital fat, to account in life for an iritis, choroiditis, or an all-destructive panophthalmitis. So, also, implication of and transit along the facial and auditory nerves lead to destructive changes in the ear.

As a rule there is no change in the arachnoid. Even the visceral layer of the arachnoid is not adherent to the false membrane beneath it but may be readily separated from the underlying purulent effusion by simple inflation. Sometimes parts of the arachnoid appear whitish or opaque, especially in old cases.

But the ravages of cerebro-spinal meningitis do not remain confined to the membranes of the brain. Mention has been made already of œdema of the substance of the brain and cord in rapid cases, and more profound lesions are to be observed in cases of longer duration. Strümpell (*Deutsch. Arch. für klin. Med.*, xxx., 5 and 6, p. 505, 1882) described in detail these conditions. His autopsies revealed in nearly all the cases such participation of the brain and cord as to justify him in naming the disease a meningo-encephalitis and meningo-myelitis rather than meningitis alone. Beneath the inflamed membranes lies a border zone of hyperæmia and infiltration, composed of distended vessels, perivascular accumulations of round cells which dip deep into the substance of the brain, or more especially the spinal cord, with occasional punctate hemorrhages up to the size of a millet seed. Disseminated depots of pus of various size, with even larger abscesses, more especially in the substance of the brain (four cases), were noticed as a rule. But, aside from the effects of direct mechanical disturbance, there were few visible

histological changes in the ganglion cells and fibres of issuing nerves.

Although these exudative changes belong more especially to the average or more protracted cases, they have been noticed also in the cases of short duration. Thus Fronmüller reports the case of a girl, aged fourteen, who died in four days, when the central canal of the cord was found dilated and "filled with pure pus"; and Gordon speaks of a case in which "purulent effusion was found, although the whole duration of the attack was under five hours" (Hartshorne's "Reynolds," p. 306.) More credible is the report by Ziemssen, of an "exquisite case," in which the cord was wholly embedded in pus at the end of eleven days.

The changes in the ear have been studied especially by Heller, who found the tympanum, vestibule, and the semicircular canals of both sides containing pus, which bathed the facial and optic nerves. The purulent fluid may be confined to either the middle or the internal ear, but usually is present in both. Acute otitis has been frequently observed preceding an attack of cerebro-spinal meningitis. In such cases the affection of the ear would seem to be primary and the meningitis due to an extension of the inflammation. Heller, on the other hand, would attribute the affection of the ear to the propagation of the inflammation from the meninges along the nerves to the ear; and Moos believes that the inflammation of the ear and meninges occurs simultaneously.

A microscopic examination reveals the fact that the inflammation affects the tissues through the blood-vessels. Numberless round cells infiltrate the intima and adventitia to collect on the external surface and form the lines and layers of pus cells along their course. In the substance of the brain and cord beneath and about the vessels "proliferation of the nuclei in the neuroglia takes place, with swelling of the ganglion cells and granulo-fatty degeneration of the nerve fibres" (Eichhorst). Examination of the blood reveals the presence of hyperleucocytosis varying from 12,000 to 32,000 per cubic millimetre (Flexner and Barker). The polynuclear and neutrophile cells are the ones most increased; the number of eosinophile cells remains practically normal. Netter calls attention to the resemblance between the leucocytosis of cerebro-spinal meningitis and that of pneumonia, and suggests that the fact that the leucocytosis in cerebro-spinal meningitis is without prognostic value, such as it has in pneumonia, is probably to be explained by the fatal issue in cerebro-spinal meningitis being due to the organic changes in the nerve centres rather than to the infection itself. The presence of micrococci in the exudation has been mentioned already.

SYMPTOMATOLOGY.—The symptoms of cerebro-spinal meningitis naturally fall into two groups, those belonging to the general infection, and those belonging to the local lesion.

The period of incubation lasts from eight to ten days (Latimer). The period of invasion is very short. The onset of the disease is in the majority of cases sudden, with the impress of profound toxæmia. Prodromal symptoms exist in but five per cent. of cases (Ziemssen), and the symptoms of this period are too vague, in the absence of an epidemic, to establish a diagnosis. Malaise, headache, anorexia, nausea, chilliness, wandering pains precede the outbreak of the disease in a few cases. These are symptoms which may mean nothing or may serve as forerunners of any one of the acute infections. The disease dates from the initial chill or chilliness, and subsequent fever, with vomiting, headache, and stiffness of the neck. This chill may repeat itself several times in the course of the disease, more especially in the intermittent forms, and it signifies always a new invasion or advance of the disease. During and subsequent to the chill the temperature begins to rise, reaching 100° to 102° F., as a rule, by the second or third day of the disease. In foudroyant cases it may run up rapidly from the beginning of the disease, reaching a pre-agonal acme at even 108° F. (Wunderlich). Post-mortem elevations are not uncommon in bad cases. But even excessive elevation of temperature in cerebro-spinal

meningitis may be followed by recovery. A remarkable case is reported by Christian (*Medical Record*, vol. lvi., No. 10), in which the temperature reached 118° F. on successive days. The patient recovered. On the other hand, some of the worst cases show little or no elevation of temperature at all (Hirsch and Ziemssen). In one case reported by Stokes the highest temperature recorded was 98.8° F. The characteristic of the temperature in this disease is irregularity. Cerebro-spinal meningitis shows an atypical temperature curve, a fact which distinguishes it at once from typhoid fever. Exacerbations and remissions occur so frequently in the course of the disease, even in the same day, as to baffle the most patient investigators. Ziemssen declares that few of the curves resemble each other, and Bäumlér confirms this statement from his own observations. Wunderlich attempts to account for this irregularity by the successive complications on the part of the bronchi, lungs, intestines, serous membranes, etc., and Emminghaus appeals in explanation of it to the influence of œdema of the brain, basal lesions, affections of the cord, perhaps of a heat-regulating centre.

The pulse is increased in frequency as a rule. It is usually more full and strong at the beginning of the disease, and may number not more than 80 to 100 beats to the minute throughout its course. But the pulse is subject to the same deviations as the temperature, to which at times it seems to bear no relation. Tourdes and Ziemssen mention variations of 30 to 40 beats between observations at different times of the day, and every practitioner of experience has noticed fluctuations in the course of the same observation. In foudroyant cases the pulse may be increased to from 140 to 160 per minute, to become thready and imperceptible before the end of the disease. Abnormal slowness, it may be stated here, is much less frequent than in basilar meningitis. The irritation of the pulse-regulating centres in the brain, the changes in the substance of the heart, the poisoning of the blood, as well as the various complications of the disease, have all been invoked to account for the varying conditions of the pulse.

The respiration is affected in the same way. Many cases show no especial disturbance in frequency or rhythm, while others are characterized by extreme irregularity. Sighing respiration is very frequent in childhood, and arrhythmia with dyspnoea is not uncommon at all ages. Leyden accounts for the Cheyne-Stokes respiration, sometimes observed in the later stages of the disease, by pressure on the medulla occasioned by œdema. This explanation is based upon the observation of this symptom in animals by Schiff, after the artificial induction of hemorrhage in the vicinity of the medulla. Reference has already been made to a preparatory nasal catarrh in this disease, and in this connection may be mentioned the arrest of the nasal secretion, catarrhus sicca, noticed among the prodromal manifestations by Summerell and Schuchardt.

The symptoms on the part of the digestive system belong among the cardinal manifestations of the disease, as vomiting ranks in significance along with the chill, headache, and opisthotonos. It is only the mildest cases which show no disturbance of the stomach. It ceases frequently in a few days, to reappear in bad cases, and to remain, at times, a more or less constant attendant of the disease. It is especially provoked by the ingestion of food, sometimes even of water (Schilizzi), or by rising in bed. The contents of the stomach, then mucus in quantity, are rejected, and later a yellowish-green fluid is regurgitated from the duodenum through an incontinent pylorus. Hart says of his cases (St. Barthol. Hosp. Rep., xii., p. 105, 1876) that vomiting occurred without retching, was constant in bad cases, in which it was always an ominous manifestation. As a rule, however, it is preceded or attended by great effort, with such energetic contraction of the abdominal muscles at times as to eject worms from the intestinal canal. Loss of appetite is characteristic of the disease, even in the absence of fever, when it is dependent probably upon irritation of

the vagus (Eulenberg). Yet the very opposite condition, boulimia, has been noticed. Reich speaks of a case of progressive emaciation, notwithstanding a "voracious appetite" throughout, and Stillé observes that "in no other disease is the return of a good appetite and digestion so prompt and complete." Constipation is the rule in this disease, from inhibition of peristalsis through the influence of the sympathetic, and is obstinate to the action of laxatives; yet diarrhœa from gastric catarrh, or dysentery from catarrh of the colon, occurs exceptionally in the later course of the disease. In the worst cases stools are voided continuously from a paralyzed sphincter, while the abdomen loses its sunken shape to become tympanitic.

Ordinarily the urine is passed freely, and in normal quantity and character; exceptionally there is difficulty in its discharge and alteration in its composition. Thus, pain may be experienced in evacuating the bladder, or there may be anesthesia to such degree as to permit great distention of this organ. Emminghaus speaks of pear-shaped tumors above the symphysis, and Reeve mentions the case of a woman who passed her urine "by time," having lost all sensation in the bladder. Any neglect on the part of the practitioner may lead thus to a troublesome cystitis. In the last stages of the disease there may be incontinence of urine as well as of feces. With any reduction in the quantity, the color and specific gravity are naturally increased, but the most curious anomaly of the urine in this disease is an increased quantity in the face of fever. This paradoxical condition is accounted for by the pressure and destruction, from the exudation, of parts of the medulla. Resorption of these products during the stage of resolution may lead to irritation of the medulla, with polyuria or glycosuria. Albumin, usually in small quantity, is present in about one-third of the cases. As a rule the albuminuria is febrile in origin; acute nephritis was found by Friis in only three out of ninety-seven cases.

The skin shows the greatest variety of eruption of any one of the acute infections, with nothing peculiar or pathognomonic in any. A scarlatinous blush, more especially of the face, is very frequent in the first days of the disease, and a roseolar exanthem, more especially upon the trunk and extremities, frequently follows later. Hirsch speaks of spots resembling measles, Ziemssen mentions urticaria, Kamph erysipelatous macule, Grimshaw pemphigus, and Jenks bullæ, in individual cases. As to the petechiæ which have falsely named the disease, they are most frequently distinguished by their absence. Davis states that they were present in but one-third of the cases seen by him; Tourdes saw only three cases in the epidemic at Strasburg, and Stillé observed no eruption whatever in thirty-seven out of ninety-eight cases, in the epidemic at Philadelphia. "Neither Burdon Sanderson nor Wunderlich mentions petechiæ or vibices as occurring during life; and Hirsch, after noting their occasional presence, is obliged to draw upon American authors for an account of them" (Stillé). Yet bloody eruptions or extravasations do occur in this disease as frequently, but not more so, as in any acute infectious malady of equal gravity. Thus, in the first New England epidemic, and later in the outbreaks at Geneva, Dublin, and Naples, they were frequently present. Stokes and Banas speak of spots which coalesced over some portions of the body, "so as to cover a large extent of the skin, and render it completely black, as though it were wrapped in some dark shroud" (Stillé). Not infrequently the petechiæ or ecchymoses appear only post mortem (Day).

The only eruption which has any real significance in this disease is herpes. It begins usually as early as the third day of the disease, and may continue in renewed eruption throughout its course, or, as Hirsch remarks, weeks after full recovery. It shows itself first, as a rule, about the face, on the lips, nose, forehead, and neck, or may extend to the chest, abdomen, back, nates, and even the extremities. Pneumonia is, perhaps, the only disease which shows herpes in equal frequency, but the herpes

of meningitis differs from that of pneumonia in having no prognostic value. In fact, Hirsch claims that a renewed outbreak rather signifies an exacerbation of the disease. Ziemssen is inclined to regard it as of trophoneurotic origin.

As in all the grave acute infections or septic maladies, cerebro-spinal meningitis is sometimes associated with affection of the joints. Jackson likens the articular swellings to attacks of gout, and Collins speaks of the swollen, red, and tender state of various joints, especially the knee, elbow, and wrist, and often also the smaller joints of the fingers and toes. Rinecker and Wunderlich observed this complication early in the disease, Salomon and Litten during its course, and Pfeiffer in the period of convalescence. While articular affections are rather rare in this disease, some epidemics, notably that in Greece, 1869, have been distinguished by their frequency.

Of the symptoms produced by the local lesions, pain in the head is among the most prominent. Headache, crushing as if produced by a vice, or boring as from the penetration of nails or screws, is, as has been stated, one of the initial signs, and it constitutes always one of the most obstinate and distressing features of the disease. Strong men cry aloud in the agony of headache, and young children show, on account of it, the peculiar wild, strange look attending excruciating pain, which finds utterance at times in the *cri hydrocephalique*. But the localization of the pain does not of necessity localize the seat of the disease, nor does its intensity bespeak its gravity, signs which prove it to be partly due to the septicelement. Fortunately, it is subject to intermissions or remissions in the course of the disease, and not infrequently it disappears altogether. The other signs of the disease may then still remain in force, though cessation of headache may be usually regarded as one of the most favorable signs in prognosis. Warning should be entered here, however, against that ominous arrest of headache, along with a general euphoria, which sometimes immediately precedes the end. Vertigo may be associated with the headache, to greatly aggravate the sufferings of the patient by compelling the continued observance of the recumbent posture. Tourdes speaks of cases in which the giddiness was so intense as to cause patients to whirl and fall, unable to rise again. Such cases excite suspicion of implication of the semicircular canals.

Pain of a similar character, indescribable in its intensity, is also felt in other parts of the body, in the spinal column (rachialgia), in the extremities, or anywhere upon the surface in the course of the spinal nerves. Usually such pain is paroxysmal, stabbing, fulgurant, agonizing. It shoots out from the posterior nerve roots of the spinal cord, where the local lesion, as determined by gravity, is most intense, and carries with it sickening sensations of præcordial depression.

A more characteristic, though less frequent, sign of cerebro-spinal meningitis is hyperæsthesia of the surface. It is commonly absent altogether in the lighter or abortive forms, and may not show itself throughout the short course of the foudroyant forms, but it is quite constant, at least in the earlier days of the disease, in cases of average intensity. It is first seen, as a rule, in the lower extremities, to which it may remain confined; next in the upper extremities, and lastly in the face and head. Like the pain described it may undergo remissions and exacerbations, may disappear to recur later, or may last over, in regions, to the period of convalescence. When present it adds a peculiar poignancy to the suffering of the patient, who watches with anxious eyes every movement about the room. In aggravated cases it is manifest also during sleep, and even the stupor of coma does not entirely annul it. In such cases it interferes with, or even entirely prevents, an examination of the patient, which, however, may be unnecessary, as with the history and superficial inspection it frequently declares the disease. Hirsch, Fraentzel, and Ziemssen unite in saying that it is often absent throughout the whole course of the malady.

Opisthotonos stands in the foreground in the semeiology

of this disease. It is rare that some degree of rigidity in the back of the neck is not present, though Burdon Sanderson declares that in the Prussian epidemic, 1864-65, there were many cases in which there was no stiffness or retraction of the muscles. In the lightest cases there is simply a sense of increased resistance on attempts at flexion of the head upon the chest—a valuable point in differential diagnosis—or a slight degree of tenderness to pressure upon the cervical vertebrae. In most severe cases rigidity is marked, with retraction of the entire head, to such degree at times as to give rise to extreme mechanical dysphagia. Leyden speaks of cases in which the head was bent back at a right angle to the spine, and Gordon mentions an instance in which, in addition to this deformity, the spine presented “a most wonderful uniform curve concave backward.” The most striking illustration of the degree to which this extension may occur was reported by Neville Hart (St. Barthol. Hosp. Reports, xii., p. 105, 1876), in a case in which the pressure of the occiput caused a slough between the scapulae. In the experience of this author the degree of opisthotonos corresponded with the gravity of the disease. Not infrequently the rigidity extends lower in the vertebral column, as in Gordon's case just mentioned. Thus Jansen mentions an instance where the whole body could be lifted rigid with the hand behind the occiput, and Ziemssen and Merkel report cases of “orthotonos” in which attempts to flex the head pushed the body like a statue to the foot of the bed. With the other symptoms mentioned this condition may disappear, to reappear in greater or less degree, undergo fluctuations throughout the disease, continue to the fatal end—as long in one case as forty-nine days,—or remain in some degree until full recovery. Ziemssen speaks of convalescents going about with rigid spines, and cases are reported in which the condition lasted throughout life. Usually the retraction is symmetrical, as pleurosthotonos is very rare. The rigidity is due to tonic contraction of the deep muscles of the neck, the splenii; the superficial muscles, the trapezii, remaining unaffected. It is easy to understand it in the presence of the abundant exudation about the medulla oblongata, but the absence of it in the presence of the same conditions remains as yet inexplicable.

Besides these tonic, clonic spasms may occur in the muscles of the face, trunk, or extremities, as mere fibrillar twitchings or veritable convulsions. Children are much more frequently affected in this way than adults, and the spasms occur more often in the graver than in the lighter cases. Sometimes the case begins with a well-marked epileptiform convulsion, and cases, as in the epidemic at Dublin, have been characterized by their persistence throughout the disease. The convulsions may be limited to one side of the body, and Netter reports a case in which the convulsive paroxysms were confined to one side of the face. Attempts at changing the posture, or agitation of the patient in any way, as by sounds or the approach of light, are often the exciting causes. Yet grave as is this complication in adults, it is by no means fatal of necessity. Thus Stillé records a case, cited from Vienna, in which “convulsions occurred repeatedly during the first two days, and less frequently during the two following days, but the patient ultimately recovered.” In the case of a young lady under the observation of Whittaker, clonic convulsions of the upper extremities existed continuously for three days and nights, and were only stilled finally by narcotic doses of opium. This patient escaped with life, but with lesions that left it of little value. As a sub-variety of convulsions may be mentioned tremor, which occurs exceptionally, more especially in children, and jactitation, which may occur at any time, more especially in the graver cases, and more frequently toward the end. The tonic and clonic spasms, expressions of the stage of irritation, give place in time to paralytic as evidence of destructive change. Ptosis, paralytic strabismus, and paralysis of the facial nerve may be thus manifestations of the later period of the disease, or may be associated with hemiplegia as evidence of central lesion. Emminghaus quotes

in this connection from Leyden, who saw in several cases paralysis supervene in the contracted muscles of the neck. Thus also hyperæsthesia may eventuate in anæsthesia to such degree as to permit the penetration of a pin. Aphasia has been observed by Leyden and Netter.

Of the special senses, besides that of touch, the senses of vision and hearing suffer most. Corresponding to the hyperæsthesia or hyperalgesia of the surface of the body is photophobia, to such degree, as a rule, as to necessitate the darkening of the chamber and the avoidance of artificial light. Graver lesions than this functional disturbance, conjunctivitis, iritis, irido-choroiditis, neuritis, atrophy of the optic nerve, even panophthalmitis, may occur in the course of the disease. The same exaltation of sensibility affects the ear with even greater distress, because offence in this regard is less preventable. Tinnitus aurium is frequent. Suppurative processes in the middle and internal ear, perforation of the membranes, atrophic changes, are among the graver affections of this organ, to be mentioned later among the complications and sequelæ. Loss of the sense of smell on one side was first observed by Ames. Alteration of the sense of taste has been reported by Corbin.

Delirium is quite uniformly present at some stage of this disease. It sets in, as a rule, on the second or third day, to vary in degree, coinciding often with the fever or the headache, or to be replaced by stupor, apathy, or coma at various periods of the disease. Low forms of delirium are constantly associated with sleeplessness, or incessant mutterings, the so-called coma vigil, alternate with outbreaks of maniacal excitement. Illusions and hallucinations are, though rare, sometimes encountered, and permanent impairment of the intellect may result. Yet long-continued stupor is quite exceptional in meningitis, though complete oblivion of every incident of the attack has been noticed not infrequently, even when the symptoms on the part of the nervous system have been of light degree.

COMPLICATIONS AND SEQUELÆ.—With the elements of a general inflammation of the membranes of the brain and spinal cord, and the implication of the nerves irradiating thence over the body, together with affection also of the substance of these organs, superadded to a general poisoning of the blood, it is not to be wondered at that complications and sequelæ of various kinds occur in this disease. Among the most frequent and serious of these complications are *catarrhal pneumonia* and *croupous pneumonia*. Of these affections catarrhal pneumonia, or broncho-pneumonia, is most frequently encountered in children, and, if developed as a secondary affection, readily undergoes, according to Ziemssen, favorable resolution. But croupous pneumonia has a much more serious prognosis. It occurs more frequently in certain epidemics—fifteen times in the Erlangen epidemic of 1866 to 1872—and develops by predilection in the later periods of the outbreak of the disease. But Jürgensen reports of his cases that the relation of the two diseases was in three cases just the reverse, as the meningitis supervened upon or followed the pneumonia. This author calls attention to the great difficulty of diagnosis in these cases when opisthotonos happens to be absent. In this connection Maurer points to the arching of the fontanel in young infants as indicative of increased intracranial pressure, a sign of great value in a doubtful case. Schilizzi at Aignes-Mortes, Tourdes at Strasburg, Levy at Paris, and Laveran at Metz, have all found serous and sero-purulent exudations in the pleural cavity as complications of this disease. Eichhorst emphasizes the frequency with which affections of the throat occur as not sufficiently remarked hitherto, and Pfeiffer found parotitis present in a number of his cases at Thüringen.

Peripheral or multiple neuritis has been observed in some cases (C. K. Mills, *Medical News*, March 3d, 1888). In the retrogressive changes which occur during and after the period of resolution, various thickenings, thrombotic occlusions, or permanent hyperæmias may be left behind. Thus it is not surprising to learn that headaches sometimes remain for years, or for life, or that paralysis

of various muscles, especially those supplied by cranial nerves, the abducens, oculomotor, and facial, develop during the disease or after it has run its course. Perhaps the most deplorable, if not the most dangerous, damage is done in this way to the organs of sight and hearing. Hyperæmia of the conjunctivæ, “redness of the eyes,” with irregularity of the pupils, and photophobia are to be noticed, as a rule, at the onset of the disease, and affections of the cornea, synechia, opacities of the lens, iriditis, etc., have been mentioned in its course. Fish spoke of cases announced by blindness, to be followed later by symptoms on the part of the spine, and though the amaurosis was in his cases always temporary, examples of permanent loss of sight are abundantly recorded. Rudnew claims that a microscopic examination reveals suppurative inflammation of the uveal tract, as a rule, in this disease. The affection begins in the capillaries of the choroid and proceeds to invade its entire structure.

The ear is affected, as stated, in both its middle and internal parts. In a case reported by Ziemssen the pain of an otitis media began as late as the twenty-fifth day of the disease, and perforation with the discharge of pus did not occur until the thirty-sixth day. Heller and Lucae and Moos describe cases in which the trunk of the auditory nerve was embedded in pus, with hyperæmia of the neurilemma, suppurative inflammation of the cavity of the drum, hemorrhage and pus in the membranous labyrinth. Per contra, Ziemssen has seen cases in which the floor of the fourth ventricle was “macerated by pus, and the auditory nerve, together with the facial nerves, completely surrounded by the purulent exudation, without the occurrence of deafness during life.” But cerebro-spinal meningitis is one of the most common causes of deafness, perhaps the most common cause of all diseases affecting the internal ear. For in the vast majority of cases the affection is bilateral and permanent. Knapp states that in every one of thirty-nine cases the deafness was bilateral, and, “with the exception of two cases of faint perception of sound, complete.” Should this complication occur in the earliest years of life the patient is not only deaf but also dumb. The Bamberg Deaf and Dumb Asylum contained, April, 1874, forty-two pupils—deaf-mutes, without exception, from cerebro-spinal meningitis; and of the thirty-two inmates of a similar institution at Nuremberg, twenty-two were victims of this disease. Moos mentions further that one-half of his cases that recovered from the disease with some impairment of hearing showed also disorder in maintaining their equilibrium.

That processes of cicatricial contraction, by thickening and shrivelling the pia and obliterating its plexuses of vessels, may lead eventually to chronic hydrocephalus, or that these accidents with the deeper lesions in the substance of the brain and cord may beget aphasia, anarthria, impairment of memory or other faculties of the intellect up to complete imbecility, may readily be inferred. One case illustrative of the extent of damage that may be inflicted by this disease upon a patient who barely escaped with life may be cited from the graphic descriptions of Gordon. This was a case in which the patient recovered from all the acute symptoms, but gradually, in fifty-eight days after the invasion of the disease, passed into a state of almost organic life. “He ate, drank, and slept well; he passed solid feces and urine without giving any notice; yet evidently not unconsciously; he was excessively emaciated, and there was a peculiar mouse-like smell from him; he seemed to understand what was said to him, but he could not answer; he never called for anything; his breathing was rather slow; his pulse 120; his heart acting with a peculiar strong jerking motion; his eye was quite well as also his knee (he had suffered from ulceration of the right cornea and immense effusion into the right knee-joint); he could draw his legs and arms up to him; but he could not use his hands at all.”

DURATION.—Cerebro-spinal meningitis has no definite duration. Hirsch says of it that it may last from a few hours to several months. The first period applies to the