

earliest to appear, and the most usual paralysis, is that of the palatal muscles, causing the voice to assume a nasal tone, and impairing the power of deglutition, especially for liquids, which are regurgitated largely by the nose. Ocular troubles, consisting of dimness of vision, double vision, divergent and convergent strabismus, dilated pupil, disorders of accommodation, etc., are produced by paresis of the third, fourth, and sixth nerves. Shortly after these visual disorders have appeared, numbness, tingling, and pain are felt in the extremities, notably the inferior. These perverted sensations are followed by paresis of the muscles and awkward gait, and ultimately paralysis. The same conditions obtain in the upper extremities—they become paretic, then paralytic. The muscles are apt to waste, and they lose their irritability first to the faradic and finally to the galvanic current, and there is more or less anæsthesia of the plantar surface. Remarkable variations in the extent of the muscular weakness are observed from day to day—a group of muscles not paralyzed to-day may be so to-morrow, and *vice versa*. The muscles of the larynx are attacked not usually at the same time with those of the pharynx, as might be expected, but when there is a wider diffusion of the paralytic symptoms. It may be partial, affecting only one vocal cord, or general, affecting both cords. There may be coincident anæsthesia of the mucous membrane. The voice is hoarse, husky, or wanting; the breathing is troubled if special effort is necessary; and the anæsthesia may permit foreign bodies to enter the glottis, with fatal consequences. Paralysis of the neck-muscles and of the thorax is apt to occur simultaneously, an example of which is reported by Sir William Gull.* When this form of paralysis occurs, the head can not be supported, the respiration is shallow, and the least effort induces dyspnoea. If not soon relieved, the consequences are very serious: the blood is not decarbonized, hypostatic congestion occurs, mucus accumulates, and death happens in asphyxia. The sphincters of the rectum and bladder are usually paralyzed with the lower extremities, and anaphrodisia also is produced. Fortunately, diphtheritic paralysis is very amenable to treatment, and only from five to ten per cent. of the cases prove fatal. A cure is usually effected in a few weeks, but a case of general paralysis may last a number of months. A fatal result is caused by suffocation—the dropping of food into the glottis; by pneumonia, set up by the entrance of some foreign body into the lungs; by failure of respiration; by paralysis of the heart; or by some intercurrent disease.

Diagnosis.—The catarrhal variety of diphtheria may be confounded with acute follicular ulceration of the tonsils, and this mistake is doubtless frequently made. The systemic condition may be much the same in the two diseases, but the local appearances are very different. In the tonsillar affection, there are usually several ulcers at the orifices of

* *Supra*.

as many follicles, depressed below the surface and containing a grayish, cheesy secretion. Pain is limited to the affected tonsil, and the lymphatics under the angle of the jaw are a little swollen and somewhat tender. Both tonsils may be affected when the same conditions obtain on the other side. In diphtheria the exudation is on the surface of the membrane, is not limited to the tonsil, and is accompanied by swelling of the deep cervical lymphatics. The identity or non-identity of croup and diphtheria is still *sub judice*.* It seems, however, definitely established that there are cases in which a false membrane is limited to the larynx and trachea, occurring idiopathically and in the proportion of about one to thirty during an epidemic of diphtheria. That a membranous laryngitis can exist quite irrespective of diphtheria is rendered probable by analogy: there are a membranous bronchitis and a membranous enteritis. The fact of its actual occurrence is admitted by Bretonneau, except that he regards it as diphtheria of the larynx. Judged from the clinical standpoint, croup differs from diphtheria in being a local affection, not contagious; the exudation non-specific and formed on the surface of the mucous membrane; in that it does not cause systemic infection, and is not accompanied by albuminuria. The author for these reasons adheres to the non-identity of croup and diphtheria. Between scarlatinal sore-throat and diphtheria close analogies exist, but they may be differentiated by reference to these points: in scarlatina there is an intense and diffused redness of the whole mucous membrane—in diphtheria the redness is merely about the infected area; in scarlatina the exudation is on the surface of both tonsils and usually also on the palate, and is soft like curds—in diphtheria the exudation commences at one or more spots, is attached to the epithelium and is of a grayish-yellow or brownish color; in scarlatina, the symptoms are violent—convulsions, delirium, vomiting, intense fever, inaugurating the disease—in diphtheria the symptoms are not so severe—there are no convulsions, delirium, etc., and only moderate fever; in scarlatina the peculiar rash appears at the end of the first and beginning of the second day, and which desquamates—in diphtheria there is no proper eruption, only transient rashes which are very irregular and accidental.

Treatment.—If the theory of a local infection followed by systemic poisoning be adopted, the early detection and destruction of the first patch of false membrane is of the highest importance. Bretonneau acted up vigorously to the requirements of his theory, and applied muriatic acid to the patches as they appeared. This practice is still pursued by many—by the majority of physicians, probably, but in a modified form. Strong solutions of nitrate of silver; the tincture of

* The facts collected by the committee of the Medico-Chirurgical Society for their "Report on the Relations of Membranous Croup and Diphtheria" are very strong and very ably presented. ("Medico-Chirurgical Transactions," vol. lxii, 1879.)

the chloride of iron; solution of equal parts of perchloride and glycerine; solutions of salicylic acid, of chloral, of chlorate of potassa, of borax, etc., are those most usually employed. The objections to the use of strong caustic applications seem insurmountable. Experience has shown that the morbid process can not be arrested by the most prompt and efficient applications, for it is impossible to penetrate to all the parts where germs may be deposited; injury done to the healthy mucous membrane invites the spread of the false membrane; the destruction of one layer of false membrane does not prevent the reproduction of successive layers, and it is probable systemic infection takes place during the period of incubation. Those who employ the most powerful applications do not present better results. Cleanliness of the parts, frequent removal of decomposing materials, and disinfection of the discharges, are of great importance for the prevention of septicaemia. These observations are especially true of diphtheria of the nose, the mortality from this being largely due to neglect of cleanliness and disinfection. Oertel* has abandoned and condemns all the strong applications above mentioned, and relies on the vapor of hot water containing a little salt, or chlorate of potassa, as the means for securing cleanliness, disengagement of the false membrane, and for inducing suppuration. The nares should be carefully syringed out every three or four hours with a weak solution of chlorine, chlorate of potassa, carbolic acid, salicylic acid and Borax, etc. The solutions must be very weak, and used freely and frequently. With the spray douche a stream of vapor can be nearly constantly kept playing on the parts. Various disinfectant solutions may be used in this way. The author has seen excellent results from the frequent application of a solution of lactic acid—strong enough to taste sour—by means of a mop. A quantity of this may be applied by a large mop to the fauces, and by a syringe to the nares. By what means soever the result is accomplished, careful washing of the affected parts is necessary. Afterward there should be thoroughly dusted over the affected region washed sulphur, which is best accomplished by an insufflator. The good effects of this practice are undoubted, and the explanation is not far to seek. A portion of the sulphur is oxidized, and sulphurous acid produced. The application of lime-water by a method originating in domestic practice is deserving of high commendation. It consists essentially in the inhalation of the vapor, as it arises from the slaking of lime. Some pieces of *freshly burned* lime are put into water, and the vapor is directed to the throat and nose, and inhaled. Above all other topical applications, according to some good authorities, is the atomization of a maximum solution of muriate of quinine, used as often as possible, the spray directed into the fauces. In the case of laryngeal

* Ziemssen's "Clycopædia," article "Diphtheria," *op. cit.*

implication, an attempt should be made to dissolve the false membrane by very frequent inhalation of atomized lime-water and lactic acid. Emetics are also used, to effect the mechanical displacement of the membrane. Those acting promptly and producing no after-depression are the most suitable for this purpose, as alum, subsulphate of mercury, sulphate of zinc, ipecac, but not tartar emetic.

The treatment of the systemic condition is equally important with the local. There are two principal indications—to limit the spread of the local disease, and to prevent systemic infection. The author has employed, with apparently great advantage, for the first object, bromide of ammonium (two to fifteen grains every three hours). The bromides are eliminated in large part by the mucous surfaces, especially of the mouth and throat, and thus act locally on the very source of mischief. Acting similarly, and in a high degree efficient, is iodine. In the normal state very decided irritation of the fauces is produced by the iodides. In diphtheria the author prescribes the iodide of ammonium with the bromide for the purpose of effecting a modification of the morbid process in the fauces. To prevent systemic infection it is preferable to administer *liquor iodi compositus*—one to five drops every four hours. Carbolic acid may be given with iodine (℞ Liq. iodi comp. ʒij, acid. carbol. ʒj. M. Sig. One fourth of a drop to two drops in water every four hours). The most efficient of the agents to prevent systemic infection, and at the same time act as a food, is alcohol. There are those who maintain that alcohol is of itself sufficient, if only a large enough quantity can be given. From half an ounce to an ounce every three hours is sometimes administered to infants by the advocates of an exclusively alcoholic treatment. It is certainly good practice to commence with moderate doses of whisky or brandy at the onset of the disorder, and increase them as circumstances demand, as the case progresses. It is certainly surprising to observe the large amount which can be taken by even the tenderest subject. That it is proving beneficial is shown by an improvement in the force, rhythm, and frequency of the pulse, by rise in the temperature if below, by a fall in the temperature if much above normal, and by a change for the better in the general state. Quinine is often given with alcohol for the purpose of support, and as an antipyretic when the temperature is high. The use of quinine by atomization has been briefly referred to. It is questionable whether the good effects apparently produced by this mode of application were due to the systemic or local action of the quinine, for much of that reaching the fauces is swallowed. Not only stimulants and quinine, but nourishing aliments, are required in this disease from the beginning. Milk, beef-essence, egg-nogg, etc., must be given systematically, and when collapse is threatened the intervals between the feedings must be short. Those who have personal charge of a diphtheritic patient, and the physician, need to exercise great cir-

cumspection to avoid infection. Several physicians have lost their lives by catching matter from the throat in inspecting the parts, by clearing the canula used in a tracheal fistula, and by making autopsies. Whenever a case occurs in a family, it should be at once isolated. All the dejections, expectorated matters, and utensils used about the patient should be immediately disinfected; clothing and linens used during the illness should be destroyed; and the furniture and floors should be washed with chloride-of-zinc solution, papering removed and destroyed, carpets disinfected by heat, etc. The author was personally cognizant of the following facts: A family consisting of father, mother, two children, and a nurse, were put into rooms of a great hotel in Saratoga that had just been vacated by a family returning home, of whom several were ill with some affection of the throat; in a week the little boy became affected with severe diphtheria, was removed to another and a larger room, where he died; and into this room some new-comers were put the day following the removal of the dead body, without any change in the bed or furniture! How many more victims we do not know. The paralytic affections of diphtheria require iron and quinine, the phosphates, a generous diet, and a change of air. If they do not yield and get well under these measures, special stimulants of the nervous system are then necessary. Strychnine should be given—hypodermatically if the case is obstinate—and the muscles should be first exercised with the galvanic current, slowly interrupted, and with the faradic current when the contractility of the muscle to the latter has been recovered. When paralysis of the muscles of respiration has occurred, prompt application of these remedies becomes necessary. The pneumogastric, the phrenic, and the intercostal nerves must be galvanized in turn by currents of considerable strength, and the diaphragm should be brought directly within the circuit by poles placed on opposite sides. The question of tracheotomy in laryngeal diphtheria is still *sub judice*. The mortality is so large after this operation, as performed in this country, only as a *dernier ressort*, that there is a growing disinclination to its performance. In France it is performed earlier, with better results. Nevertheless, the successful issue of some apparently desperate cases, such as those of Mr. Lawson and Mr. Pugin Thornton, encourages further efforts in this direction.*

CEREBRO-SPINAL MENINGITIS—CEREBRO-SPINAL FEVER.

Definition.—*Cerebro-spinal fever* is an acute, infectious disease, which prevails as an epidemic, and occurs also in the sporadic form,

* "Transactions of the Clinical Society," vol. xii, pp. 117, 122, "Cases of Tracheotomy in the Last Stage of Diphtheria—Recovery." For an elaborate discussion of the subject, see Dr. J. Solis Cohen's work on the throat; also, "British Medical Journal," April 10, 1880.

and is characterized by symptoms of excitation, followed by symptoms of depression of the cerebro-spinal functions, by various forms of eruptions on the skin and by fever of moderate grade—the symptoms being dependent on an inflammation of the membranes of the brain and spinal cord. It has received various designations—as *spotted fever*, *epidemic meningitis* (Stillé), *petechial fever* (G. B. Wood). *Cerebro-spinal meningitis* is the term most generally used, and cerebro-spinal fever is that proposed in the "Nomenclature of Diseases."

Causes.—Cerebro-spinal meningitis prevails under the most opposite conditions of climate and soil, and at all seasons; but certain parts of the globe have not as yet been visited—Asia, Australia, and Africa, except Algiers, having escaped.* Epidemics appear simultaneously in districts widely separated, under circumstances, as to soil, climate, and hygienical surroundings, the most diverse. While these facts are true, it is also evident that season has some slight influence, not directly, but indirectly, through the changes in habits and modes of life imposed by climate. The disease prevails more during the winter and spring, a fact which is true of the epidemics in this country and other places. Local conditions, good or bad hygiene, or station in life, are without influence in its causation. The disease selects by preference the young, especially young men, but no age and neither sex are exempt. Young recruits, the boys of a boarding-school, children, male and female, under fifteen, are favorite victims, while the disease becomes rapidly less and less frequent after twenty-five. There is probably much truth in Hunt's † observation that this disease "has its favored habitat in cold, damp, and overcrowded tenements, preferring prisons and barracks," as respects its appearance among troops. The author witnessed an epidemic among the boy inmates of a military school, most favorably situated as respects the known hygienic conditions, and there was no extension of the disease in the surrounding rather thickly populated neighborhood. "In April, 1863, four cases occurred in a single tent of the Twenty-second North Carolina: three of these cases died, all being from one family of conscripts, while the fourth tent-mate, an old soldier, recovered. It is difficult to define any special circumstances affecting this tent in preference to the others," says Dr. Robinson, who reports the incident. A great many examples have now been collected of outbreaks within very limited areas, as in jails, prisons, individual houses, confined to such areas, while simultaneously similar outbreaks are occurring at distant points. It is supposed that the places visited are in a bad hygienic state, but there must be some other element present, for the nurture and development of which evil hygienic influences are necessary. There must be a peculiar miasm, *materies*

* Lombard, "Traité de Climatologie Médicale," *op. cit.*, vol. iv.

† "United States Sanitary Commission Memoirs," edited by Flint, chap. II, on "Cerebro-spinal Meningitis," by Dr. Sanford B. Hunt, p. 383.

morbi, or germ present. The nature of this unknown principle has not as yet been ascertained. The etiological facts thus far presented demonstrate that the disease is not contagious in the proper meaning of the term. That it is infectious there can be no reasonable doubt. Dr. Burdon-Sanderson* concludes that it is not contagious; that there were no instances of spread from the family first attacked; that the disease appeared simultaneously in the two districts, which were thirty miles apart; that in no instance were two persons attacked in one house. Dr. Lidell † says that "no relation by contact whatever can be traced between them," in the cases occurring in Stanton Hospital. The general experience of American physicians, as collected by Stillé, ‡ is against contagion, in the sense that small-pox is contagious.

Pathological Anatomy.—The changes wrought by this disease are almost as distinctive as those of typhoid fever. They are chiefly in the cerebro-spinal axis. The skin after death presents traces of the herpetic eruptions which are usually seen during life. There are extensive suggillations, not confined to the dependent parts only, and large patches of ecchymoses, the body in some instances being almost black (Stillé). The *post-mortem* rigidity is strongly marked, the muscles, in cases that have continued for many weeks, being much emaciated. Besides emaciation the muscles are found to have undergone granular degeneration to a greater or less extent. The dura mater and arachnoid may be but little altered, but usually present traces of hyperæmia, the arachnoid rough and opaque also. The pia mater is always congested, often intensely punctated with capillary hæmorrhages, and thick and opaque by reason of interstitial exudations. After the initial hyperæmia, wandering leucocytes in great numbers are found in the neighborhood of the vessels, and these are the only changes seen in the fulminant form, because there has not been sufficient time to develop others. After a day or two, the subarachnoid spaces contain more or less cloudy serum, sometimes reddish from the presence of red blood-corpuscles. Next, the membrane is infiltrated by an exudation composed for the most part of purulent elements having a greenish or yellowish color; the exudation may be more consistent, firmer, and of a gelatinous character. Dr. Burdon-Sanderson found that the gelatinous material consisted of cells having many points of resemblance to but still differing from pus-corpuscles, and that the interstitial substance was crowded with granules. The exudation may be several lines in thickness, and it is found in greatest abundance along the great vessels in the fissure of Sylvius, about the optic chiasm, infun-

* "Official Report on the Epidemic of Cerebro-spinal Meningitis of Northern Germany," London, 1865.

† "American Journal of the Medical Sciences," January, 1865, p. 1, vol. xlix.

‡ "Epidemic Meningitis; or, Cerebro-spinal Meningitis," by Alfred Stillé, M. D., Philadelphia, Lindsay & Blakiston, 1867, p. 178.

dibulum, pons, and cerebellum. The whole convexity of the hemispheres may be covered, but usually here the exudation is most abundant in the sulci between the convolutions. As regards the visceral arachnoid, which is usually more or less thickened and opaque, Klebs* has found that this change is due to purulent infiltration. Similar structural alterations are found in the membranes of the spinal canal. The dura mater sometimes presents the same character of changes as in recent pachymeningitis (Klebs, s. 333), at least the hæmorrhagic extravasation; the arachnoid is more or less cloudy from infiltration with pus-cells; but the most important of the alterations are those in the pia, which is strongly adherent to the cord at all points. As in the brain, the first morbid appearance consists in hyperæmia, and then serum, pus, gelatinous exudation of greater or less thickness, the nerve-roots entirely covered with a thick layer of exudation, follow in order according to the time given to them. It follows, then, that in the fulminant form, death occurring in a few hours, there may be but little evidence in the spinal canal of the severity of the malady. The ravages of this disease are not limited to the membranes. The ventricles contain more or less turbid serum, the ependyma and the choroid plexus are hyperæmic, and there may be more or less of the purulent exudation. Those portions of the brain and spinal substance adjacent to the pia mater are, in advanced cases, altered by hyperæmia and by the imbibition of fluids, so that the nerve-elements are more or less disassociated (Klebs). In cases of long standing, the effusion may be so great as to cause flattening of the convolutions and œdema of the brain. In one case the central canal of the cord was filled with pure pus (Ziemssen). Besides these *post-mortem* appearances which are necessary to constitute the disease, various alterations have been found, and some of them so constantly as to justify the opinion that they are parts of the morbid complexus. The heart-muscle, as it is in other fevers, is soft, friable, and granular in the cases of some weeks' duration, but unaltered in the fulminant form. The blood is dark, fluid, wanting in coagulability, and the walls of the vessels are stained by it. The lungs frequently present evidences of bronchitis, catarrhal pneumonia, atelectasis, etc. The hepatic cells and the tubular epithelium are cloudy and more or less granular by deposit of fat-granules (Klebs), a change which is likened to that which takes place in phosphorus-poisoning.

Symptoms.—There are marked differences in the behavior of cases of cerebro-spinal meningitis, but they may be comprehended in four groups: the ordinary or common form; the fulminant; the petechial; and the abortive.

The Common Form.—Almost always the disease begins abruptly,

* "Zur Pathologie der epidemischen Meningitis," von Dr. Klebs in Berlin, Virchow's "Archiv," xxxiv, s. 327, et seq.

and if prodromes exist they are headache, muscular pains, vertigo, and fatigue, which disappear just as the disease is about to manifest itself.* A chill, or a decided sense of chilliness, an intolerable headache, nausea, vomiting, vertigo, and an overwhelming sense of weakness and illness, are the formidable symptoms with which the disease opens. The pain in the head may be like a constricting band, especially about the forehead, or a boring or lancinating pain shooting in all directions, or the whole head is the seat of an intense but indescribable anguish. With every attempt to rise up, vertigo comes on and vomiting is induced, but when recumbent the vertigo often persists, the patient seizing hold of the bed to keep steady. The vomiting is causeless so far as the stomach is concerned; at first food and afterward some mucus and bilious matter come up. In a few hours the muscles of the neck become somewhat stiff, and pain is experienced with every attempt to turn the head. An extension of this state of the cervical muscles takes place to the muscles of the spinal column, which become stiff, rigid, and painful with all attempts to move the body. The muscles of both upper and lower extremities are affected in the same way, and the motions of flexion and extension are both painful and awkwardly performed. At the same time symptoms of irritation of sensory nerves are experienced. The surface of the body generally is highly sensitive, but the skin of the temples, neck and face is especially so, a light pinch causing expression of suffering even when insensibility is profound. Headache is, however, the source of greatest suffering, which is manifest by restlessness and groaning during the existence of more or less complete insensibility. At the outset high mental excitement introduces delirium; in children, convulsions may occur; the delirium may be active, maniacal, the patient difficult of restraint, or it may assume a busy, trembling character. The symptoms of excitation in the mental sphere do not continue long, for effusion which occurs in the course of the first day causes depression of this function, and the excitement or delirium gives place to somnolence or stupor. The rigidity of the neck increases, and the spinal muscles also contracting, the head is drawn back and the spine curved; the forearms are partly flexed on the arms, the legs on the thighs. In the milder cases there is a condition of somnolence, from which the patient may be aroused and will answer correctly in part, but he at once falls into stupor, or the state of somnolence is interspersed with paroxysms of active delirium. Besides the condition of rigidity of the muscles generally, attacks of cramp and transient spasms occur. Convulsions at the outset in the case of children have already been referred to, but the cramps and spasms here intended

* Githens says that "there is a week of prodromata," "American Journal of Medical Sciences," July, 1867, "Notes of Ninety-eight Cases of Epidemic Cerebro-spinal Meningitis," etc., by W. H. H. Githens, M. D.

occur in groups of muscles—cramps in the muscles of the legs chiefly, and spasmodic twitchings in the muscles of the lips, eyelids, etc. The face is usually pale and sunken, the features fixed, sometimes retracted (*risus sardonius*), and always expressive of suffering, manifested in the deepest stupor. The special senses are more or less disordered. Intolerance of light is succeeded by double vision, amblyopia, and, in some cases, amaurosis; tinnitus aurium, vertigo, and intolerance of sounds, are succeeded by impaired hearing, in many cases by permanent deafness. Taste is lost, appetite is absent, and vomiting is frequent. Constipation exists at the first part of the disease, but toward the close diarrhoea and involuntary evacuations occur. The tongue becomes very dry and cracked; sordes accumulate about the teeth, some blood exudes from the gums and nares, and the hardened clots block up the anterior nares and collect about the teeth. It not unfrequently happens that lumbrici are thrown up in vomiting. It is remarkable how little the circulatory system participates in the inflammatory disturbance of the nervous system. The pulse is usually a little quickened, but it does not exceed 100 as a rule within the first four or five days; but very distinctive features are the irregularity of the pulse, the unaccountable quickening, the equally unaccountable slowing, and the variations in tension. The respiration is equally irregular—at first quickened, and afterward becoming variable in respect to the depth and rhythm. When sufficient effusion occurs to compress the medulla—in from three to five days—the respiration assumes the well-known Cheyne-Stokes type—is sighing and irregular. Various kinds of eruption appear on the body, but these are not observed in every epidemic, although it is our observation that some form of eruption will be found if careful search be made. Herpetic eruptions are most frequent, next roseola and urticaria—all eruptions belonging to the group of trophic affections, and petechiæ, those due to disintegration of the blood. The most frequent site of the herpes is on the face, but it may occur on any part, while the others are distributed over the body irregularly. Having attained its maximum in from three to six days, the case may take either of two directions—to a fatal termination; to recovery. In the fatal cases the stupor deepens into profound coma; the symptoms of motor and sensory excitation yield to those of depression; the rigidity and contraction relax; the extremities become limp and paralyzed; the paralysis may be general or limited to one side; the pupils are dilated and motionless, the eyes deeply sunken and surrounded by a dark ring; no noise awakens a response; deglutition is slowly and at last not at all performed; the evacuations are involuntary; the temperature rises in some cases to 105°, 106°, even 108°, and the pulse beats too rapidly to be counted. In the cases taking the other direction, the symptoms of depression are necessarily slight and transient, for any considerable depression indi-