they may become much more general and finally may extend over the entire body. As a rule, it is found that the convulsion spreads in a definite manner from one group of muscles to another, and that the mode of progression remains the same in subsequent attacks. Consciousness is often retained throughout the seizure, though it is generally lost when the convulsion extends to both sides of the body. After each attack slight paralysis may develop temporarily in the affected parts. It grows most pronounced after repeated attacks and finally may remain permanent. The convulsions sometimes recur with such frequency that the status epilepticus develops. In not a few cases this condition is the immediate forerunner of death.

Like other cerebral symptoms of syphilis, cortical epilepsy and paralysis may disappear suddenly and may remain absent for many months, even without antisyphilitic treatment.

The monoplegias due to meningitis of the convexity sometimes develop prior to the epileptic attacks. Furthermore, the monoplegia may be converted suddenly into hemiplegia on account of extension of softening downward into the white matter of the hemispheres.

The symptoms described above are due to localization of the lesion in the motor zone. Meningitis of other parts of the cortex will produce symptoms corresponding to the functions of those parts. The most frequent symptoms are aphasia and hemianopsia. The aphasia is often ephemeral in character and may even last only a few minutes at a time. It is apt to be attended or preceded by convulsive twitchings on the right side of the body, starting usually from the muscles of the face and tongue. After a variable period the aphasia usually becomes permanent.

Hemianopsia, due to an affection of the occipital lobes, is not very rare. This symptom is apt to be attended by visual hallucinations, which are referred to the blind side of the field of vision. When the meningitis is more diffuse and extends over a considerable part of the convexity of one or both sides, mental disturbances may be the chief feature in the clinical history. In such cases the first symptom noticeable may be a change in the character of the patient, who becomes morose, peevish, irritable, loses judgment in business affairs and exhibits decided lapses of memory. There may be a pronounced melancholy tinge at an early stage. In rarer cases, maniacal attacks, sometimes attended with destructiveness, are observed very early. Ideas of grandeur may be noticed at times, but, as a rule, they are not very persistent or well defined, and they do not last as long as in general paresis. Headache may be a prominent symptom and usually exhibits the well-known syphilitic characteristics. Speech sometimes becomes slow and labored, and there may even be tremor of the tongue and twitchings of the lower facial muscles. The dominant symptom, however, is the mental failure, which usually progresses more or less rapidly, but sometimes shows very pronounced remissions. Paralysis of various cerebral nerves is quite common, likewise sudden attacks of temporary aphasia. Convulsive or apoplectiform seizures are also frequently observed and serve to increase the resemblance to general paralysis of the insane. Indeed, the latter disease is found in such an immense proportion of cases among syphilitic subjects that it may be difficult or even impossible to distinguish it from cerebral syphilis.

Gummy tumors, when solitary and uncomplicated with other lesions of the brain or vessels, present the same clinical history as do other varieties of tumor, except that exacerbations and remissions of the symptoms are much more frequent in the former (*vide Brain, Tumors of*, in the present volume). In addition, choked disc is comparatively rare in gummata, while it is a frequent attendant of other varieties of tumor.

Diagnosis.—Of course, the first element in diagnosis is the recognition of previous infection with syphilis. In many cases this is a very simple matter, but in numerous instances the symptoms at the time of the original infection were so slight, and such a long interval has elapsed before the outbreak of cerebral symptoms, that it may be extremely difficult to make a positive diagnosis. Moreover, in negative cases we must not forget that many patients attempt to deceive the physician in regard to the contraction of venereal disease. In doubtful cases careful search must be made throughout the entire body for any traces which may have been left over by the original disease.

Headache is an important sign at the beginning of cerebral syphilis, in whatever part of the brain tissues the lesion may be located. The pain exhibits the characteristics described in the previous section, but it must be remembered that the nocturnal exacerbations are sometimes absent.

The occurrence of cortical epilepsy in a syphilitic subject is also very significant. It must not be forgotten that this may start with either convulsions or paralysis, although the former are a much more frequent initial symptom. Unlike ordinary epileptic attacks, these seizures are often unattended with unconsciousness.

Another important sign of cerebral syphilis is the heterogeneous character of the symptoms (paralysis of the cranial nerves, hemiplegia, aphasia, convulsions, etc.), a fact which is naturally due to the varied character of the lesions present in the brain. In many cases the secondary manifestations of the constitutional disease are very slightly marked, so that they may have been unnoticed by the patient, and, as the initial lesion is often disregarded, he may be unaware of his infection with the specific virus. But so significant are the heterogeneity and anomalous distribution of the symptoms that the existence of syphilis should be suspected in every case of nervous disease in which the symptoms appear to be due to an organic affection but are grouped in an irregular and anomalous manner. Buzzard says: "I should not take much account of this absence [of syphilitic symptoms], if there were other reasons for strongly suspecting syphilis, for we are continually meeting with cases in which the symptoms caused by lesion of some part of the nervous system constitute of themselves the only testimony to the specific nature of the disorder, and experience shows these to be quite as pathognomonic as affections of the skin." The brilliant results which are often obtained by vigorous antisyphilitic treatment may also prove a valuable aid in diagnosis. It is true that, in rare cases, very favorable results are also obtained by such treatment in non-specific cases, but we can hardly expect such pronounced changes as are seen in syphilitic affections.

Another very important characteristic of the symptoms of cerebral syphilis is their remarkable changeableness. For example, an attack of aphasia may last only a few minutes or hours, or an attack of hemiplegia may disappear within a day or two. In no other disease, with the exception of hysteria, is this ebb and flow of the symptoms noticed in such a marked degree.

In making a diagnosis of syphilis of the cerebral vessels, as distinguished from other syphilitic lesions of the brain, special stress should be laid upon the absence of irritative symptoms. The localization of the lesion in the individual arteries will depend upon the same factors as in ordinary cerebral embolism and thrombosis. The problem is frequently complicated, however, by the coincident affection of several vessels, and perhaps by the existence of other syphilitic lesions.

The diagnosis of gummy basilar meningitis is based chiefly on the prominence of paralyses of various cerebral nerves, in addition to the other evidences of cerebral syphilis. It should be borne in mind, however, that in rare cases the syphilitic lesion appears to be confined to the cerebral nerves themselves (multiple neuritis). In basilar meningitis, however, the cerebral-nerve paralyses are complicated sooner or later by other symptoms, such as hemiplegia, hemianæsthesia, etc.

The most significant symptom of meningitis of the convexity is the development of cortical epilepsy. Hemianopsia, attended by visual hallucinations, is also a very characteristic symptom. The occurrence of temporary aphasia is also apt to be the result of syphilitic lesions of the convexity. In addition to these special focal symptoms, we usually find the general symptoms which have been described in the section on Symptomatology.

When the syphilitic changes in the brain are very diffuse, especially when they involve a large part of the convexity of one or both hemispheres, mental symptoms are often prominent, and it may be difficult to distinguish the condition from dementia paralytica. The latter affection runs a progressive course and ends fatally in a few years. In cases of cerebral syphilis proper treatment may result in very marked improvement and occasionally in recovery. Inequality of the pupils is much more common in dementia paralytica, but in rare cases of cerebral syphilis pupillary changes are found for years before the outbreak of other symptoms. In cerebral syphilis the focal symptoms are prominent and the dementia, while it is more stable in character, does not lead gradually to complete dementia. True ideas of grandeur are comparatively rare in syphilitic dementia, and are frequent in dementia paralytica. On the whole the evidences of an organic disease of the brain are much more decided in cases of cerebral syphilis than in dementia paralytica.

Prognosis.—However mild the symptoms of cerebral syphilis may be at the outset of the disease, the prognosis is always serious. It is true that a considerable proportion of cases recover, but the danger of relapse is always to be kept in mind. There seems to be some ground for believing that when the original syphilitic infection runs a mild course, subsequent cerebral manifestations are apt to be severe in character. This may be owing to the fact that antisyphilitic treatment is not carried out very vigorously or persistently unless the symptoms are severe. Nungazzini, on the other hand, claims that malignity of the morbid process and early death are characteristic of many cases of early syphilis of the brain.

Contrary to the opinion of many writers, we have not found that the general condition of the patient has much effect upon the course of the disease, except in those cases in which there is excessive indulgence in alcoholic stimulants.

Among the various forms of cerebral syphilis the most unfavorable prognosis is presented by lesions of the blood-vessels. Even a lesion which is very slight in actual dimensions may be sufficient to interfere very seriously with the circulation in the brain. When a vessel is occluded entirely, softening in its area of distribution develops very rapidly and the function of such parts is never restored. The most serious results are observed when the basilar artery is the site of disease.

The most favorable results are seen in gummy tumors and gummy meningitis of the convexity. Symptoms which point very conclusively to gummy tumors may disappear completely under treatment. Gummy meningitis of the convexity also promises a more favorable prognosis than other localizations, but in these cases recovery is usually incomplete. This is particularly true of cases in which mental disturbances have been prominent.

Gummy meningitis at the base of the brain presents almost as unfavorable a prognosis as syphilis of the vessels, and indeed the two conditions are very apt to be associated. In many cases, however, the extent and rapidity of the improvement secured by antisyphilitic treatment are little less than marvellous.

Treatment.—The treatment consists practically of the administration of antisyphilitic remedies, and the earlier we resort to these remedies the more assured is a successful result. Hence the extreme importance of an early diagnosis and the advisability of specific treatment in all doubtful cases.

In our hands more benefit has been derived from the use of potassium iodide than from the preparations of mercury; but this opinion is not held by all writers. German authorities in particular usually lay more stress upon the exhibition of mercurial preparations.

Unless the patient manifests an idiosyncrasy with regard to one or the other of these drugs, the mixed treatment should always be adopted. The dosage should depend solely upon the tolerance of the patient. In some cases the effect desired is not secured until enormous doses (an ounce or even more) of potassium iodide are given in the course of twenty-four hours. The notion is quite prevalent that such large doses are dangerous to the general condition of the patient, but this opinion is not justified by our own observation. For internal administration we usually rely upon bichloride of mercury, beginning with one-thirty-second of a grain, and increasing rapidly until the desired effect is obtained. The mercury is given in solution with potassium iodide, the initial dose of the latter being usually fifteen grains, unless the symptoms are very urgent, when much larger doses may be given at once. This mixture is best given about two hours after meals and should always be largely diluted (one-half to one tumblerful of water, Vichy water, or milk). If we wish to increase the dose of the two drugs at varying rates, it is preferable to give the mercury in the shape of tablets. Sometimes it is necessary to give daily as much as one-eighth of a grain or even more, according to the indications in the individual case. It is a good plan to keep on increasing the dose until the gums become a little tender, and then an amount slightly smaller than that necessary to produce such an effect may be continued for a long time. In grave cases, when we wish to overwhelm the patient with the drug, it is better to use inunctions of mercurial ointment regardless of its effect upon the gums. If the patient is unconscious, my plan has been to administer the mercury by inunction and the iodide of potassium by rectal injections. As much as from 4 to 6 gm. of the iodide (diluted with water or milk) may be injected every four hours. When the patient recovers consciousness, the drug may again be administered in the usual way.

During the entire period of treatment, the patient should devote extreme attention to the care of the teeth and mouth. The teeth should be very carefully brushed after each meal, and the mouth rinsed several times a day with a weak solution of listerine or some other mild antiseptic.

After serious symptoms have subsided, the dose of the antisyphilitic is gradually diminished to a certain extent, but should be continued persistently (if possible, without intermission) for at least one or two years after the disappearance of all evidences of the disease.

I cannot express myself too strongly concerning the extreme importance of protracted treatment and the necessity of administering the remedies in sufficiently large doses. The dose is to be regulated solely by the amount requisite to control the symptoms in each individual case.

Apart from the use of the strictly antisyphilitic remedies, very little can be done in the way of treatment. When the pains do not yield to these drugs, opium must be resorted to, and perhaps the repeated application of blisters to the back of the neck will prove useful. Repeated convulsions are sometimes controlled by the addition of bromide of potassium to the iodide mixture. The patients should be strictly warned against the use of alcoholic stimulants in any shape, and also against indulgence in sexual intercourse. They should be kept as free as possible from excitement and overwork, and regular, easy evacuations of the bowels should be secured daily.

Leopold Putzel.

BRAIN: TRAUMATIC AFFECTIONS. See *Skull, Diseases and Injuries of*.

BRAIN: TUBERCULOUS MENINGITIS.—(Synonyms: Acute Hydrocephalus, Granular Meningitis, Basilar Meningitis, Dropsy of the Brain.)

Definition.—Tuberculous meningitis is an acute inflammation of the pia mater of the brain, due to infection by tubercle bacilli, and characterized by the deposit of miliary tubercles and an effusion of pus and lymph.

General Observations.—In 1768 the attention of the profession was first particularly called to this disease by Dr. Robert Whytt, of Edinburgh. His remarkable monograph, entitled "Observations on the Dropsy of the Brain," ranks to-day among the medical classics, and is highly commended by all recent writers for its accuracy of description and fulness of detail.

Dr. Whytt, and the observers immediately succeeding him, framing their opinion as to the nature of the affection from the very prominent anatomical lesion—the ventricular effusion—unavoidably included, under the term *dropsy of the brain*, several other diseases besides tuberculous inflammation of the meninges. No correct idea of its pathology could be attained until Gölis, in 1815, pointed out that acute ventricular dropsy was not a primary condition, but was always dependent upon some antecedent affection of the cerebral vessels or nerves.

Although the granular condition of the meninges had been previously noted by Guersant, it was reserved for Papavoine, in 1830, to establish the tuberculous nature of these granules, and to point out their pathological relation to the meningeal inflammation.

The name of tuberculous meningitis, which has won its way to universal acceptance, was suggested by Bricheteau. Dr. Gerhard, of Philadelphia, was the first to call attention to the disease in this country. His most valuable paper, published in the *American Journal of the Medical Sciences* (1833-34), was based upon the reports of thirty-two cases, with autopsies (Minot).

Tuberculous meningitis is not an independent affection, but is one of the most important phases of that protean malady, acute miliary tuberculosis. It rarely, if ever, occurs as the sole tuberculous lesion in the body.

Two forms of the disease are recognized, a primary and a secondary form. In the former, although other organs besides the pia may be the seat of tubercles, the symptoms first noticed are those arising from the cerebral lesion, and these retain their prominence throughout the attack. In the secondary form, on the other hand, the brain symptoms are preceded by those arising from inflammatory affections of other viscera, also dependent upon the diathetic influence, and are only manifested toward the close of the illness.

Tuberculous meningitis is one of the most important and most fatal organic diseases of the cerebro-spinal system. The primary form is essentially a disease of early life, and occurs with special frequency between the ages of two and ten years. Infancy and adolescence do not confer entire immunity, but at these periods of life the disease is almost always secondary to advanced pulmonary tuberculosis. Statistics indicate that males are more susceptible to the disease than females; according to Huguenin, this preponderance is much oftener observed in children under fifteen years of age than in adults.

Etiology.—The essential factor in the causation of tuberculous meningitis is the infection of the pia mater with tubercle bacilli. They may reach the brain through the lymphatics or blood-vessels. Foremost among the predisposing causes must be placed the hereditary diathesis. The badly nourished and physically ill-developed children of consumptive parents are the most susceptible, but the apparently rugged and robust are not exempt; in the latter, however, a careful search will almost certainly disclose a taint in some collateral branch of the family, if not in the direct line of descent.

That the disease is with rare exceptions dependent upon foci of caseous degeneration in some remote gland or viscus, a suppurating joint, or tuberculous inflammation of bone, is now generally recognized by modern pathologists. Seitz found such lesions in more than ninety-three per cent. of the cases tabulated by him. Holt states that "although it is not infrequent to see meningitis without symptoms of tuberculosis elsewhere, I have never failed at autopsy to find other tuberculous lesions in the body."

The exciting causes are obscure. Unpropitious external conditions of all kinds, such as impure air, unwholesome food, exposure, bad drainage, may kindle into activity a slumbering predisposition.

Blows upon the head, emotional excitement, exposure to the direct rays of the sun, and like causes exert a doubtful influence. Climate and seasons have no place among the etiological factors, although the disease is more prevalent in the changeable weather of winter and spring.

It is not improbable that, in older children, excessive study and worry, or the high-pressure system of modern schools, may promote the disease in those predisposed by inheritance to tuberculous affections; and, in this connection, it may be stated that such children are, as a rule, precocious and ambitious to excel in their studies.

Morbid Anatomy.—The distinctive anatomical feature of tuberculous meningitis is a deposit of miliary tubercles in the pia mater of the brain. These granules are always found on the inner surface of the membrane, are grayish white, semi-transparent, and vary in size from an object just visible to the naked eye to that of a millet or hemp seed. "These are really the seats of activity of the bacilli" (Lloyd). The coalescence of several nodules may form tubercular masses as large as, or larger than, a pea. They are usually more numerous at the base, especially about the fissure of Sylvius and the optic chiasm, but in rare instances are formed in greater numbers on the convexity. The distribution is generally symmetrical in the two hemispheres, but may be limited to any particular portion, even to the narrow area fed by the branches of a single artery. They are always developed within the perivascular canals, and adhere to the coats of the arteries, giving somewhat the appearance of a string of beads. They may be few in number or so abundant as to impair the integrity of the coats of the vessels and completely obstruct the circulation.

Hektoen found tubercles in the intima, accompanied by extensive endarteritis. His investigations showed the intravascular lesion to be primary, due to the implantation upon the intima of bacilli from the blood. The number of the nodules does not determine the intensity of the inflammation, which may be slight in the presence of a large deposit, or severe with a few widely scattered granules.

The pia mater is thickened, opaque in appearance, more or less adherent to the surface of the brain, and often is studded with tubercles.

Other changes may be noted which are to a certain extent common to all forms of meningeal inflammation. A sero-purulent exudation covers the pia, especially at the base, and extends along the course of the arteries. It may be so copious as to embed the cranial nerves and fill up the natural depressions at the base of the brain.

The ventricles are almost invariably distended with fluid. The effusion into the ventricles, which was considered by the early authors to be the essential anatomical lesion, furnishes the most common name for the disease. It varies largely in quantity, but is generally sufficient to distend the ventricles, flatten the convolutions, and render them dry and anæmic. There is often bulging of the fontanel and sometimes even separation of the sutures when they are not completely ossified. The fluid has a specific gravity of about 1.010, is usually turbid from the admixture of epithelium and leucocytes, and is sometimes, though rarely, tinged with blood. The portions of the brain adjacent to the ventricles are softened. The fornix and septum lucidum may be almost diffluent, and the basal ganglia so altered in consistence as to fall into a shapeless pulp on being removed from the skull (Fagge).

The choroid plexuses are hyperæmic, and sometimes covered with purulent exudation. The convolutions are œdematous and injected when the ventricular effusion is small or wanting, but are dry, bloodless, and flattened when the effusion is large. Occasionally patches of red softening, punctiform hemorrhages, and, very rarely, large extravasations of blood are met with in the substance of the brain.

Changes similar in kind to those above described, but less in degree, are sometimes found in the spinal cord and its membranes.

In tuberculous meningitis the lesions are very rarely limited to the intracranial viscera. Tuberculous deposits almost invariably occur in other organs of the body, most frequently in the lungs; or there are remote depots of caseating material or other evidences of the cachexia. Tubercles can often be demonstrated by means of the ophthalmoscope in the choroid coat of the eye. Dr. Money found the choroid affected in fourteen out of forty-two cases of tuberculous meningitis. In one instance tubercles were observed in the eye, but not in the brain or its membranes; in another, the meninges were free, but there was a mass of crude tubercles in the cerebellum (London *Lancet*, 1883). According to Oliver tuberculous meningitis is more prone than other forms of meningitis to cause changes in the optic nerves.

Symptoms.—Tuberculous meningitis is nearly always preceded by premonitory symptoms which, if rightly interpreted, are of the highest value. In twenty-six cases collected by Dr. Gee there were only two in which prodromes were absent. These symptoms are usually so indefinite in character as to excite little attention at the time, and are rarely thoroughly appreciated until the developed disease leads the parents carefully to review the past weeks of the child's life.

This period probably corresponds with the deposit of miliary tubercles in the pia mater before serious structural changes have taken place.

The symptoms met with during the prodromal stage relate chiefly to the nutritive and digestive processes. The appetite is capricious, the breath offensive, and the tongue furred. Vomiting is not common. The bowels are slightly constipated, or diarrhœa and constipation alternate. The child tires easily and will often be found asleep on the floor surrounded by his playmates and toys. At night, sleep is restless and disturbed by dreams. Headache is not a prominent symptom, but is rarely wholly absent. Frequent complaints of dizziness are made. Very rarely double vision is observed. Along with these symptoms will be noted an alteration in the child's character. This is one of the most important of the prodromes, and should never be overlooked in endeavoring to make a diagnosis in a doubtful case. The patient, before precocious and vivacious, becomes dull and listless, indifferent to his books or plays, moody, and petulant. Many grow very emotional, bursting into tears on the slightest provocation, or dispensing their caresses with annoying lavishness. Before the close of the prodromal period the effect of imperfect nutrition is apparent. The patient grows thinner and paler. The muscles become soft and flabby, and he is day by day less inclined to exertion of any kind. The prodromal stage may last for from one week to three months.

It is customary, for convenience of description, to divide the disease into distinct stages, based upon the predominance of certain symptoms at different periods in its course, viz., a stage of *invasion*, one of *pressure*, and one of *paralysis*. This arrangement is purely arbitrary, and is rarely fully justified by clinical observation.

There are few diseases more irregular in the development or sequence of symptoms than tuberculous meningitis, and he who seeks at the bedside only the typical case of the books may long search in vain.

Since the age of the patient impresses some minor differences upon its course, we will first describe the disease as seen in children.

Stage of Invasion.—The onset is rarely announced by any sudden perturbation, like a chill or convulsion, but usually the symptoms of the prodromal stage are increased in severity and gradually reinforced by others characteristic of cerebral lesions.

Headache, vomiting, and fever are the common initial symptoms. Of these, vomiting is perhaps the most constant. It varies greatly in frequency, is not usually troublesome after the first few days, though it may continue during the entire illness, and seldom returns, after it has once ceased for twenty-four hours. It is especially provoked by the ingestion of food or drink, and by rising in bed, and, as a rule, is not preceded by nausea or accompanied with severe retching.

The headache is intense, and constitutes one of the most distressing features of the disease. It is usually referred to the frontal region. The pain is aggravated by sudden movement, bright light, or loud noises, and is subject to exacerbations without apparent cause. It at times compels the child to make outcries, hold his head with his hands, or bury his face in the pillow. Fortunately, remissions of variable duration are not infrequent. Vertigo is occasionally present, manifested by unsteadiness of gait, or a sensation of falling, even when lying in bed. The complaint of headache in a child, especially when associated with vomiting, should always awaken the gravest apprehensions.

There is no distinctive temperature curve. The fever is moderate in intensity, irregularly remittent in type, and rarely measures more than 103° F. in the evening, and 100° F. or 99° F. in the morning. Constipation is very constant. It is usually marked from the beginning of the illness, and is rebellious to the action of laxatives; yet cases are recorded in which persistent diarrhœa has occurred without tuberculous or other disease of the gastro-intestinal mucous membrane (Huguenin). Anorexia and moderate thirst are present. The tongue may be clean, but is generally heavily coated.

The pulse for the first few days is rapid and regular, but soon becomes slow, irregular, and variable. The variability is marked; the slightest exertion or excitement will cause an increase of twenty or more beats per minute, and a like effect may be often produced without known cause.

The respiration is changed in like manner, and after three or four days becomes irregular and sighing. These alterations in the pulse and breathing are by no means constant in the early stages. They may be marked at one, and absent at several subsequent visits; in fact, fluctuations may be noted in the course of the same observation. Repeated and lengthy examinations must therefore be made before they are declared absent. It is important to make the examination of the pulse when the child is at rest, since a pulse which is slow and irregular during repose may be rapid and regular under excitement or after movement.

Sleep is fitful and disturbed. Mild delirium is observed at some period of the day or night. The pupils are contracted, and light is painful to the eyes.

During the early part of this stage, both special and general sensibility are increased, so that the child often receives with dread even the gentle ministrations of its mother. Later on, he becomes more passive, and will without a murmur submit to the protracted examination of the physician.

If the cranial bones are unossified, the anterior fontanel is distended.

Strabismus, double vision, and ptosis sometimes appear toward the end of the stage of invasion. Convulsions are not common, but muscular twitchings and rigidity of the muscles of the spine are occasionally noted.

The child is dull, apathetic, and drowsy from the beginning. At first he can be easily aroused, and although his mental operations are sluggish, he notices his surroundings and may at times amuse himself with his playthings. The somnolence gradually increases until, toward the close of this period, he will, if undisturbed, lie for hours in a deep sleep, with eyelids half-open, grinding his teeth, and at times uttering a sharp, piercing shriek—*the hydrencephalic cry* of Coindet. Some authors place great stress upon this cry, but Rilliet, Gee, and others hold that it is not special to nor frequent in tuberculous meningitis.

The duration of this stage is from seven to fourteen days.

Stage of Pressure.—The signs of irritation now give place to those of pressure or exudation upon the surface of the pia and into the ventricles of the brain. The transition takes place gradually; in fact, there is usually

a period of uncertain duration, which has been not inaptly named the *mixed stage*, in which the "symptoms of irritation still linger and the symptoms of depression are just manifesting themselves" (Bartholow).

Paroxysms of pain, great restlessness, irritability, and delirium are succeeded by periods of extreme drowsiness or even of profound stupor, out of which the child is aroused with difficulty, perhaps replies in monosyllables, or stares vacantly at the questioner through half-open lids, and again lapses into his former condition.

The most characteristic feature of this stage when fully developed is loss of consciousness. The patient remains in a state of complete insensibility, and at times moans or shrieks out wildly. He commonly lies on one side, with the knees drawn close to the abdomen, one hand pressing his head and the other grasping the genitals.

The head is often retracted, and the muscles of the nape of the neck are rigid. The pulse becomes slow—from 40 to 80 beats in the minute. The irregularity of the pulse and respiration are more pronounced and more constant than before. Typical Cheyne-Stokes respiration is often observed. The temperature falls a degree or more and often becomes subnormal. Vomiting ceases, if it has not already done so, but constipation persists. The abdomen is deeply hollowed. The common term "boat-shaped" very accurately describes the sunken belly bounded by the unduly prominent symphysis, iliac crests, and ensiform cartilage.

The pupils are dilated, often unequally, and sometimes waver under light. The globe rolls from side to side, the sclerotic is suffused, a puriform secretion collects in the angles of the eyes or glues together the edges of the lids. The ophthalmoscope shows ischæmia of the optic discs or beginning neuro-retinitis. In rare instances, miliary tubercles are seen in the choroid. Dr. Allbutt found retinal lesions in twenty-nine out of thirty-eight cases of tuberculous meningitis.

The skin presents peculiar vaso-motor disturbances. Small patches or spots of congestion appear on the cheeks, forehead, or ears, and quickly fade away, their bright color making a vivid contrast with the general pallor. If the finger-nail be lightly drawn across the abdomen or inner surface of the thigh, a bright-red line comes out slowly, persists for a few moments, and then gradually fades—the *tâche cérébrale* of Trousseau.

Paralyses, both local and general, are commonly met with at this period; as are also rigidity or pendulum-like movements of one or more of the extremities.

The contents of the bladder and rectum are usually discharged involuntarily.

Stage of Paralysis.—From twenty-four to forty-eight hours before death, some of the characteristic symptoms undergo a remarkable alteration. The period covered by these changes is known as the stage of paralysis. The child now lies completely comatose and irresponsive to external irritations. Only reflex movements can be excited, and these imperfectly.

The constipation which has marked the whole progress of the illness is now often replaced by copious, involuntary, liquid stools; the sunken abdomen becomes distended with gas; the slow pulse becomes rapid and feeble, numbering 160 to 180 beats per minute, and the mercury registers a temperature of 104° to 107° F. This second rise in pulse and temperature is a certain forerunner of speedy dissolution.

The capillary circulation is more and more interfered with, the respirations become less distinct, and death may occur quietly in deep coma or be ushered in by a convulsion. Death by coma is the more common mode.

Sometimes the death agony is prolonged for several days, to the great grief of the parents. Death occurs in from sixteen to twenty-one days after the appearance of the initial symptoms.

Tuberculous Meningitis in the Adult.—The course of tuberculous meningitis in adults varies sufficiently from that observed in children to deserve brief mention.

The disease is more common in men than in women, and occurs at all ages, but especially between the years of seventeen and thirty. It is almost invariably secondary to advanced tuberculous disease in some remote part, the symptoms of which to a certain extent mask those of the meningeal affection. The primary form of the disease is rarely met with in adult life.

Premonitory symptoms are usually absent, and when present never obtain the same prominence as in early life. Persistent vomiting and convulsions rarely usher in the attack, but local paralyses, hemiplegia, and aphasia—very seldom seen in childhood—are not infrequently the first symptoms to direct attention to the cerebral complication.

The disease ordinarily runs a much shorter course than in children. Death may occur within forty-eight hours after the appearance of brain symptoms, and is seldom delayed longer than fourteen days.

Diagnosis.—The diagnosis of typical, fully developed tuberculous meningitis can scarcely give serious trouble, but in the prodromal period, or in those cases which pursue an irregular course or in which some of the prominent symptoms are absent altogether, it is proverbially difficult.

Since the disease is almost invariably engrafted upon a tuberculous diathesis, a careful investigation of the family record and personal history should be at once instituted. It is, however, only by the exercise of the most painstaking care, by closely observing the physiognomy and actions of the child, and by noting the hourly variations in the symptoms, that an early diagnosis can be reached in doubtful cases. Ill-defined ailing in a scrofulous child which resists ordinary treatment, especially if accompanied with headache and causeless vomiting, should always awaken suspicion.

The diseases for which tuberculous meningitis is most liable to be mistaken are acute simple meningitis, hydrencephaloid disease, gastro-intestinal disturbances, and typhoid fever.

Simple meningitis is ordinarily recognized by the sharper onset (without prodromes), more severe headache, more furious delirium, higher temperature—in short, the greater intensity of all the symptoms and its rapid course. The comparative rarity of the simple over the tuberculous form of the disease should be remembered. In exceptional cases the differentiation cannot be made.

False hydrocephalus is usually readily known by the history of antecedent diarrhœa or other exhausting malady, the prostration when the cerebral symptoms began, the rapid and feeble pulse, the depressed fontanel, the pallor, and the normal or even subnormal temperature. All authors speak of the resemblance which certain cases of typhoid fever bear to the disease under discussion. The infrequency of typhoid fever in patients of the age most prone to tuberculous meningitis, the regular temperature curve, the diarrhœa, the iliac gurgling, the rose-colored spots, and the splenic tumor will generally easily establish the nature of the disease.

The subacute gastro-intestinal disturbances to which children, especially cachectic children, are so liable may lead to error. Feverishness, anorexia, vomiting, irritability, and headache are common to each, and in many cases the development of the symptoms must be awaited to clear up the diagnosis.

The more intense headache, the irregular pulse, the sighing respiration, the alterations in the pupils, and the graver aspect of the illness will generally speedily indicate its cerebral nature.

The lumbar puncture of Quincke sometimes gives valuable information. It is especially valuable in the differentiation of meningitis from other diseases accompanied by marked brain symptoms.

The discovery of tubercle bacilli in the spinal fluid is positive evidence of the nature of the disease. They are, however, difficult of demonstration, and are not always present in undoubted cases of meningeal tuberculosis.

Fürbringer found bacilli in thirty out of thirty-seven examinations.

The changes which take place in the fundus of the eye are often among the early signs of meningeal inflammation, and hence are valuable in diagnosis. However, too much reliance must not be put upon the ophthalmoscopic examination. Dr. Pagge remarks: "The clinical value of ophthalmoscopic changes in the optic discs is still somewhat doubtful. It is certain that a normal state of the retinæ is no proof of the absence of tuberculous meningitis, but I believe the time has not yet arrived for a dogmatic expression of opinion as to the positive significance of ischæmia (or even of retinitis) as between that disease and some less severe affection of the brain, such as might be attended with great vascular congestion of its tissue. One appearance indeed is conclusive, namely, the presence of tubercles in the choroid. It is true that they belong not to the meningeal affection itself, but rather to a general acute tuberculosis, but this fact in no degree diminishes their diagnostic importance" ("Practice of Medicine"). Dr. Minot says on this point that "choroidal tubercles are so rarely seen as to be of little avail in diagnosis. In fact, they are less frequent in this disease than in general tuberculosis without meningitis. In twenty-six cases of tuberculous meningitis examined by Garlick at the London Hospital for Sick Children they were found only once" (Pepper's "System of Medicine").

Dr. Bastian (Quain's "Dictionary of Medicine") places great reliance upon the microscopic examination of the blood in the diagnosis of tuberculous meningitis. He mentions the following alterations in the blood as peculiar to this affection: an increase in the number and exalted amœboid activity of the white corpuscles; groups of protoplasmic particles of various sizes interspersed among the blood corpuscles, as well as here and there small pigment granules. The red corpuscles tend to run together into irregular masses rather than into definite rouleaux, but present no distinctive changes.

Prognosis.—The prognosis is absolutely bad. When fully developed, tuberculous meningitis almost invariably marches steadily on to a fatal termination. Delusive lulls not infrequently occur, however, even in the advanced stages, when an unwary practitioner may doubt his diagnosis and raise hopes in the parents which are doomed to bitter disappointment.

The possibility of recovery from the early stages of the disease cannot now be successfully denied, although it is not, perhaps, uncharitable to doubt the correctness of the diagnosis in many of the recorded recoveries. Rilliet, Rousseau, and other equally eminent clinicians report cases in which death occurred from a relapse some time after recovery from the first attack; and at the autopsy, old and recent tubercles of the pia could be clearly distinguished. Huguenin does not even accept the revelations of the post-mortem examination as conclusive, and remarks that "pathological anatomy furnishes no information the correctness of which it would not be possible to doubt."

The isolated exceptions who do survive an attack of tuberculous meningitis are nearly always left with impaired mental or physical powers, and sooner or later succumb to a recurrence of the disease.

The writer has seen recovery in one case which was well advanced in the second stage, and in which there could scarcely be a doubt as to the tuberculous nature of the disease; but the patient never fully regained his mental faculties, and died in convulsions eighteen months afterward.

Treatment.—Tuberculous meningitis is so universally fatal that but little benefit can be hoped for from the administration of remedies. There are no drugs that can control or retard the specific action of the tubercle bacilli on the membranes of the brain. The treatment is wholly symptomatic and palliative. Treatment should not, however, be abandoned too soon, as a positive diagnosis between the simple and the tuberculous form of meningitis is not always possible in the early stages.

In the present stage of our knowledge, the greatest good must come from the adoption of measures to prevent the development of the cachexia in those so predisposed. It is not necessary for us to detail here the special means to be employed; they are set forth at length in other chapters of this Handbook.

In general terms, however, we may say that, in the presence of the diathesis every influence which tends to develop the nervous system at the expense of the digestive and muscular systems will increase the liability to the disease.

The violent antiphlogistic measures formerly employed in the treatment are now properly discarded. As soon as the nature of the disease is known or strongly suspected, the patient should be placed in a darkened room and all sources of cerebral excitement excluded. An active calomel purge should be at once administered. An ice-cap must be applied to the head and upper portion of the spine and warm applications to the extremities.

Special symptoms must be met as they arise by the use of the customary remedies, but our chief reliance in arresting the disease lies in the use of the bromide and iodide of potash. The bromide may be omitted during the pressure stage, unless convulsions ensue, but the iodide must be given until treatment is abandoned.

Sometimes, during the stage of excitement, opium may be advantageously combined with the bromide. Flattering reports have been published from the use of iodoform inunctions, and a Swedish physician, Dr. Warfvinge, reports five successful cases. The method followed by Dr. Warfvinge consists in shaving the head and anointing it with an ointment consisting of iodoform, 1 gm., in vaseline, 5 gm. This is applied twice daily, the head being afterward covered with an impermeable cap. This method has still a few advocates, but it never gained the confidence of the profession and is practically abandoned. Lumbar puncture has been recently practised in a large number of cases, both as a curative and as a diagnostic measure, but the later reports are not such as to commend the practice. Rotch and Wentworth report alarming symptoms following its use in a two-year-old child.

W. J. Conklin.

BRAIN, TUMORS OF THE.—The symptoms caused by tumors of the brain are due, first, to irritation or destruction of the portions of the nerve tissue in which they are embedded, or near to which they lie; second, to pressure exercised upon the entire contents of the cranium—nerve tissue, blood-vessels, and lymphatics. The first class of symptoms are common to tumor, and to all other circumscribed lesions of the same locality, thus especially patches of chronic softening. The second class are common to all conditions in which the intracranial space is encroached upon; such are extra- as well as intra-cerebral tumors, morbid products within the brain, which differ considerably from neoplasms proper, and finally, abscesses and aneurisms. Thus, the investigation of the case of any patient exhibiting cerebral symptoms demands that we decide: first, whether these are caused by a new growth of any kind, which is encroaching upon the cranial cavity; second, this being admitted, what is the nature of the growth; third, what is its precise locality.

The prognosis must then be framed according to the fact, the nature, and the seat of the growth; and, finally, the (very limited) indications for treatment must be considered.

Symptoms Indicating the Existence of an Intracranial Growth.—These are of two kinds: those belonging to the perversion or abolition of cerebral function, and those indicating a rise of intracranial pressure. The first are the focal, the second the diffused symptoms (Griesinger). It is this second class of symptoms which are of the most importance in distinguishing between tumor and other cerebral lesions, and they may therefore be considered first.

Diffused Symptoms.—These are headache, vertigo, vomiting, general epileptiform convulsions, apoplectiform attacks, psychic disturbances, and choked disc.

Headache is one of the earliest and most constant symptoms of intracranial tumor. The intensity of the pain