thrombosis and sclerosis, followed by syphilitic meningitis, but in the absence of a *post-mortem* examination I admit it is at least as likely that the terminal infection was tuberculous.

The second case is under my care in the hospital at the present moment.

Z., a boy aged 6. His mother is under treatment at the Royal Infirmary for tertiary syphilis of the nose. On August 6th, 1913, he dropped his cup and bread from his left hand at breakfast, and within the next few hours weakness was noticed in the left side of his face and dragging of the left leg on walking, while speech was distinctly affected. (Here we have the "silent onset.")

On admission, pulse, temperature, and respiration are normal. Intelligence poor; lies quietly, takes no notice, wets bed, cannot read letters nor answer questions intelligibly, and speech is indistinct. Can stand, but is weak on left leg and drags it after him. Left upper extremity also weak, but degree hard to estimate owing to his lack of intelligence. Left face, including the eyelid, parietic. Tendon reflexes increased on affected side, superficial normal. No wasting. Pupils equal and dilated, react sluggishly. Fundus: Right, normal; left, extensive patch of choroidal atrophy with interspersed pigment; disc = white atrophy. Vision nil.

Under treatment with mercury and iodide he improved rapidly, so that by September 1st, when he was discharged, he was running about the ward, with intelligence normal and no paralysis left, except in the face. On November 10th, in out-patient's department, I noted that there was only the slightest facial weakness left, but on December 31st he was readmitted on account of a recurrence of hemiplegia on the same side, preceded this time by severe headaches. The second attack is accompanied by much spasticity of the extremities—clasp-knife rigidity of the knee, adduction of the thumb, flexion at the hip, knee, wrist, and elbow, etc., but there is no fresh involvement of the face, nor is his mentality again impaired. He has recovered up to a certain point, but splints are now being used to prevent spastic contractures.

With evidence of such extensive and acute cerebral syphilis there is great risk of a catastrophic local reaction were he treated with salvarsan, and so far he has not had it. But I intend to administer either that or neo-salvarsan after a thorough course of mercury and iodide, and hope thereby to stop the disease at its present stage, and before it reaches that illustrated in the following case. I think this patient should be included here as an example of the pathetic termination of cerebral syphilis, though some might say it was juvenile general paralysis.

A boy, aged 11, sent to me by Dr. Sheridan, and admitted to the Liverpool Infirmary for Children on February 7th, 1911. Father admitted syphilis. Mother died with phthisis two years after the boy's birth. The child is said to have been quite well and bright up to 7 years of age. He then had some sort of left hemiplegic attack, without convulsions, upon which progressive weakness ensued. For the last twelve months he has been quite helpless, having lost the power of active movement and control over his bladder and rectum. The power of speech has been lost for about four months, and of late he has been going into "swoons," lasting as long as twelve hours, in which "the face twitches and the eyes roll."

Upon admission, temperature and respiration are normal; pulse accelerated, about 120. Upper central incisors notched. There is general rigidity, and the patient lies huddled up in bed and is unable to sit up. Expression usually vacant. Intelligence grossly impaired. He will sometimes answer "yes" and "no" to simple questions; generally no answer is obtained. When asked his name he tries to say some word, but it is quite unintelligible; there seems to be difficulty in articulation. Faeces and urine passed into the bed. There is convergent strabismus. Pupils unequal, dilated and inactive; but Mr. Shears reported the fundus practically normal and the squint alternating and due to hypermetropia. His neuro-muscular condition may be summed up by saying that he was diplegic, with extreme spasticity and exaggeration of reflexes.

A week after admission the patient had a convulsive seizure during the night, lasting an hour; movements general, but more severe on the left side of the body. This was succeeded by a state of general tremor with clammy skin, frequent pulse and shallow respiration, becoming Cheyne-Stokes before he died towards the close of the third day after the epileptiform attack. No *post-mortem* examination could be obtained.

In his condition, when I first saw the boy, the diagnosis between cerebral syphilis and general paralysis was unimportant, for recovery was impossible; but in the early stages it is momentous. For whereas the former may be more or less amenable to treatment, dementia paralytica is, or used to be considered, parasymphilitic, and is, at any rate as yet, upon the list of incurable and progressively fatal diseases.

Similarly, locomotor ataxy, though much rarer than general paralysis in children, is incurable, though sometimes subject to arrest. Remak,¹⁸ in 1885, first called attention to this disorder, and a fair number of cases is now on record. Many of them are brought to light by the

oculist,¹⁹ for optic atrophy is unusually frequent, while the ataxy is not marked. It has occurred at any age between 3 and adult life, but the majority seem to develop the disease at about 15. Enuresis is usually the first symptom. Unlike general paralysis, tabes is more frequent in females—in the proportion of 63 per cent. to 37 per cent.²⁰—though, as the known cases are comparatively few, this disproportion may be only coincidence. It is to be noted that locomotor ataxy in children has followed syphilis which has been accidentally acquired, not inherited, with a much greater frequency than is proportionate to the incidence of the two varieties. I have never recognized a case myself.

The discovery of the spirochaete and of the Wassermann and other diagnostic tests has thrown the whole subject of syphilis into the melting-pot, from which new conceptions of the disease are emerging. These are still malleable, and fresh investigations are daily entailing their remodelling. For instance, as was indicated above, it is more than likely that the term "parasymphilitic" may have to be dropped, the discovery of the spirochaete in the cerebral tissues of general paralytics compelling the inference that this disease and those related to it will now fall into place as pure syphilitic infections of the nervous system. Mott²¹ suggests the term "parenchymatous syphilis."

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THE CLINICAL IMPORTANCE OF THE CEREBRO-SPINAL FLUID.*

BY

WILLIAM BOYD, M.D., M.R.C.P.E., DIPL. PSYCH.,
PATHOLOGIST TO THE GENERAL HOSPITAL, WOLVERHAMPTON.

THE cerebro-spinal fluid, when withdrawn, is clear, colourless, and limpid, with a faintly alkaline reaction, and a specific gravity of 1006 to 1008. It contains a trace of globulin, and a substance which reduces Fehling's solution, probably glucose. It contains no polymorphs, and only an occasional lymphocyte.

NAKED-EYE CHANGES.

The fluid may be turbid instead of clear. Excluding contamination by blood at the time of puncture, turbidity indicates the presence of polymorphs, which are never present in the normal fluid; their presence as a rule indicates acute inflammation of the meninges. Enormous numbers of lymphocytes, on the other hand, may be present without producing any turbidity. This is a point of practical importance, for in tuberculous meningitis, where the cells are mainly mononuclears, the clearness of the fluid might lead to the conclusion that there was no meningitis, but this microscopic examination would at once prove to be erroneous. The fluid may also contain large numbers of micro-organisms, and yet appear perfectly clear. Turbidity, then, is an indication of acute meningitis. A cerebral abscess, unless it involves the meninges or drains into the ventricles, produces no change in the fluid. Thus, if a patient shows signs of acute cerebral trouble accompanied by a high leucocytosis in the blood but a normal cerebro-spinal fluid, the probability is that he is suffering from abscess of the brain.

CYTOLOGY.

The number and nature of the cells present are of great importance. Using Widal's centrifuge method and a

* Abstract of a paper read at the Staffordshire Branch of the British Medical Association.

magnification of 450 diameters, in normal fluid not more than two or three lymphocytes will be seen in each field, and not a single polymorph.

In certain morbid affections of the central nervous system and its meninges there is a great increase in the cell count. In acute inflammatory conditions, such as meningococcal or streptococcal meningitis, polymorphs are present in enormous numbers, producing turbidity as a rule. It must be remembered, however, that a considerable number of polymorphs may be present with a perfectly clear fluid.

The lymphocytes are increased in the more chronic infections of the central nervous system, notably syphilis—including so-called parasyphilis—and tuberculosis. It used to be considered that these were the only conditions which gave a cerebro-spinal lymphocytosis, but it is now recognized that in certain mental diseases an increase in the lymphocytes may occur. I have encountered nine cases of dementia praecox in which a marked lymphocytosis was present, and in one case of pituitary tumour accompanied by marked dementia there were over 1,000 cells per field. I examined this tumour microscopically, and it proved to be of a sarcomatous and not of a syphilitic nature. With such rare exceptions, however, lymphocytosis in the cerebro-spinal fluid indicates tuberculous meningitis, general paralysis, tabes dorsalis, or cerebro-spinal syphilis. It also occurs in the meningitis which sometimes accompanies mumps.

In tuberculous meningitis lymphocytosis is the rule, but in some cases a considerable proportion of the cells present may be polymorphs. Demonstration of tubercle bacilli in the coagulum, which usually forms when the fluid is allowed to stand, will settle the diagnosis.

It is now generally admitted that the earliest, the most easily recognized, and the most certain of all the physical signs of general paralysis and tabes dorsalis is lymphocytosis in the cerebro-spinal fluid. Further, the earlier the case the more marked is the lymphocytosis, so that in those cases which are most difficult to diagnose this sign is the most marked. We all know how puzzling and how worrying a doubtful early case of general paralysis may be. The question of prognosis is so grave and the physical and mental signs often so indeterminate, that any assistance in clearing up the diagnosis is welcome. I have no hesitation in saying that the presence of a lymphocytosis, together with a positive Wassermann reaction in the cerebro-spinal fluid, is worth all the other physical signs put together. Although it is the lymphocytes which are increased polymorphs may also be present, especially after a seizure. They are rarely met with in tabes.

In tertiary syphilis of the central nervous system lymphocytosis usually occurs. This, as a rule, is not nearly so marked as in general paralysis and tabes. Moreover, it tends to disappear under antisyphilitic remedies, which is not the case in the parasyphilitic conditions. Finally, the Wassermann reaction, although present in the blood, is very often absent from the cerebro-spinal fluid in cerebro-spinal syphilis, whereas in general paralysis it is present in about 95 per cent. of cases. In the earlier stages of syphilis, even before the end of the first year, involvement of the central nervous system is by no means uncommon. Indeed, at the recent International Congress, Neisser stated that no one should be passed as cured of syphilis until the cerebro-spinal fluid had been reduced to a fully normal condition.

The fact that eosinophilia occurs in the blood of patients infected with intestinal and other parasites is well known, but hitherto eosinophiles have never been found in the cerebro-spinal fluid. Quite recently, however, two cases of *Cysticercus cellulosae* in the brain were reported, in each of which there was eosinophilia both in the blood and the cerebro-spinal fluid. Cerebro-spinal eosinophilia is probably pathognomonic of this condition, but it is little more than a pathological curiosity.

PROTEIN CONTENT.

In the normal fluid there is no albumin and only a trace of globulin; the protein content, therefore, is extremely low. In general paralysis and tabes dorsalis, and to a lesser extent in cerebral syphilis, it is greatly increased.

A multitude of tests have been devised to show this increase, but I shall only mention one, the ammonium sulphate ring test, which consists in running the cerebro-spinal fluid on to the top of a saturated solution of pure

neutral ammonium sulphate. A white ring at the junction of the two fluids indicates that the protein is increased. As regards quantitative estimation, I have found that by using this test, and by diluting the cerebro-spinal fluid till a ring is just obtained, and noting the dilution used, a very good indication of the amount of protein present is obtained.

BACTERIOLOGY.

Various micro-organisms have been described as occurring in the cerebro-spinal fluid. Those most often found in acute meningitis are the meningococcus, the pneumococcus, and the streptococcus. In tuberculous meningitis the tubercle bacillus can usually be demonstrated in the cerebro-spinal fluid if special methods be used. Many other organisms have been found, such as the *Bacillus coli*, typhoid bacillus, influenza bacillus, etc., but all these are of rare occurrence. Sometimes a vaccine may be prepared from the infecting organism. A small girl was recently admitted to the Wolverhampton General Hospital under the care of Dr. Codd, to whom I am indebted for permission to publish the notes. The patient was supposed to be suffering from some indefinite form of meningitis, and from the cerebro-spinal fluid, which was perfectly clear, an actively motile bacillus was isolated on two occasions; it was clumped by the patient's serum, even when diluted 120 times. On admission the patient was in a stuporose condition, with severe headache and frequent attacks of vomiting. Vidal's test was negative. An autogenous vaccine was prepared and given with most gratifying results, for the child speedily became bright, lost all headache, and ceased to vomit. After six weeks the vaccine was stopped, and the child relapsed into her former state—torpor, headache, and vomiting. The vaccine treatment was resumed, and the symptoms speedily disappeared. The spinal fluid became free from organisms, but there remained some weakness of the right arm and unsteadiness in walking.

THERAPEUTICS.

The operation of lumbar puncture may be performed as a therapeutic measure. In cases of meningitis, whether purulent or tuberculous, great good has sometimes resulted from the withdrawal of large quantities of cerebro-spinal fluid and the injection of such an antiseptic as a 1 per cent. solution of lysol.

Lumbar puncture may take the place of a decompressive operation for lowering the intracranial pressure in cerebral tumour, but in these cases the operation is not unattended by danger. Uraemic coma and convulsions, and cases of puerperal eclampsia, are sometimes relieved by lumbar puncture in a remarkable way, and the coma which follows cerebral haemorrhage is sometimes amenable to the same treatment.

One of the greatest therapeutic uses of an examination of the cerebro-spinal fluid is the determination of the causal organism in meningitis. If the case is proved by the discovery of the meningococcus to be one of cerebro-spinal meningitis, the patient must be isolated, and large doses of Flexner's antimeningococcal serum injected directly into the spinal canal. As the mortality of this disease has been reduced to less than a third by the serum treatment, the great importance of an accurate bacteriological diagnosis is evident.

MENINGITIS IN CHILDREN.*

BY

W. MITCHELL SMITH, M.D. ABERD.,

TEAN, STAFFORDSHIRE.

MENINGITIS is one of the most hopeless diseases with which we have to deal, and it is also one in which an early diagnosis is difficult and which is liable to be confused with other conditions.

Modern diagnosis and treatment of meningitis in children include as to diagnosis lumbar puncture followed by the examination of the fluid obtained from it by cytological and bacteriological methods, and as to treatment the intraspinal injection of a suitable serum.

In the adult the spinal cord terminates at the lower border of the first lumbar vertebra; in children it extends a little further down. The spinal cord is supported in the

* A paper read at a meeting of the Staffordshire Branch.