he went from bad to worse. I had to tap him on May 7th, 1911, drawing off twenty-two pints from his abdomen. This, one thought, was the beginning of the end. He in a few weeks again had to be tapped; this time sixteen pints were removed.

Since June 12th, 1911, he has taken 5 oz. of sugar a day, hardly missing a single day and almost always taking the full quantity. Only twice since he commenced the sugar has he taken any cardiac drugs, and then only for a few days. Further, he has never again required tapping.

I attribute his remarkably improved condition (his condition at one time appeared absolutely hopeless) solely to the cane sugar. His urine was examined on various occasions and only contained an excess of urates. Whether in time he will sufficiently improve to allow of light work remains to be seen, but I certainly think it well worth while continuing the sugar treatment. Dr. Wood, who saw the patient twice with me before I commenced the sugar treatment, agreed with me that there was little to be done, as it seemed quite a hopeless case. I may add that the patient experienced no inconvenience in taking such a large quantity of sugar, except at the very first, when he occasionally had a feeling of nausea. Before commencing the sugar he had to be almost constantly taking aperients, now he hardly ever takes any.

I am indebted to Dr. Goulston, of Exeter, for the idea of the cane sugar treatment.

A CASE OF OBSCURE FEVER WITH PRONOUNCED NERVOUS SYMPTOMS,

APPARENTLY DUE TO INFECTION BY A
LEPTOTHRIX BACILLUS.

BY

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This was a case of continued fever of obscure origin, running a course of a little over three weeks, with marked symptoms of disturbance of the nervous and also of the urinary systems. It appears to have been due to a leptothrix bacillus not previously described as a pathogenic organism except in a case recorded by Professor J. Ritchie and Dr. Stuart McDonald,¹ and in five other cases met with by the latter during an epidemic of cerebro-spinal meningitis. These cases were all fatal.

The leptothrix described by Professor Ritchie and Dr. Stuart McDonald occurred in a case of pyaemia and meningitis, and had the same characteristics, except as regards motility. The patient was a child, aged 1½ years. The symptoms were:

1. Diffuse inflammation of the left leg, with a small abscess outside the knee-joint.
2. An abscess in each elbow-joint and suppuration in the right middle ear.
3. Signs of meningitis and hypostatic pneumonia; death.

A leptothrix was recovered from the blood, cerebro-spinal fluid, and from the suppurating joints; its characters and cultural characteristics will be given below. In this case there was also a terminal pneumococcal infection. *Post mortem* there was a purulent subdural meningitis over the left cerebral hemisphere, pia-arachnoiditis in patches over the brain, and spinal meningitis. They found the organism to be pathogenic to monkeys and mice, very slightly to guinea-pigs, and not at all to rabbits. By intra-spinal injection in monkeys it produced acute meningitis. It appeared to break down the resistance of the body to other pathogenic organisms.

Dr. Stuart McDonald² had previously described 5 cases of meningitis during prevalence of epidemic cerebro-spinal meningitis, in which micro-organisms with the same microscopic characters as this leptothrix bacillus were found in the cerebro-spinal fluid. In none of these

cases was the typical meningococcus isolated. In two cases there was a mixed infection with the *Diplococcus crassus*. In one case in which there was a *post-mortem* examination—the patient dying after eight days' illness with typical clinical symptoms of cerebro-spinal meningitis—a fibrino-purulent lepto-meningitis was found on the sides and vertex of the brain. In this case there was a growth on blood-agar after three days like a pneumococcus, with next day a leptothrix formation.

Our patient, Rowland W., aged 23, was a shop assistant. When very young he had a severe attack of chorea, and early in 1911 he had rheumatism, which laid him up for three weeks. These were the only previous illnesses, and he had never had gonorrhoea or any previous difficulty in micturition.

Five weeks previous to admission he was given double work to do, owing to the illness of his manager, and this work involved the keeping of accounts, with which he was unfamiliar. He began to suffer from severe headaches, chiefly frontal, and felt weak and overdone. There was no complaint of sore throat. The headache grew much worse on September 11th, and he gave up work on September 15th. He saw Dr. Stevens on September 19th, who found he had fever, and sent him to bed. The fever continued, with headache, dullness and drowsiness, and slight abdominal swelling. There was no delirium, no diarrhoea, no cough, no pains in or swelling of the joints, and no abdominal pain except a little over the pubes; he had some difficulty in passing water; there was no discharge from the urethra and no history of gonorrhoea.

He was admitted on October 3rd. He had a heavy expression, was dull and listless, and complained of headache; his aspect strongly suggested enteric fever. He was quite clear in all statements, but had little memory of his illness.

Condition on Admission.

Cheeks flushed; pulse regular, not dicrotic, varying in rate from 96 to 110 per minute; respirations 28 to 30; bowels constipated; appetite fair; tongue dry, furred in centre. On examination, chest well formed, lungs normal.

Heart.—Apex beat and area of dullness normal; the sounds showed evidence of affection of heart muscle (toxaemia), in that there was a triple sound at the apex, and the pulmonary second was accentuated.

Abdomen.—Not distended, resonant everywhere; no abdominal pain or tenderness; no ascites. The lower edge of the liver was felt just below the ribs; it was not tender. The splenic dullness was increased, beginning above the seventh rib, and extending forwards to the anterior margin of the ribs, its tip being just felt. There were three or four doubtful pink spots on the abdomen.

The urine contained a trace of albumen, a few pus cells, and a deposit of urates. It had a very peculiar mouse-like odour.

Nervous System.—Pupils small, equal, acted well to light and accommodation. Optic discs normal. Knee-jerks exaggerated; superficial reflexes all normal. There was a marked fine muscular tremor with slight twitchings of the muscles. Widal's test, taken once before and once after admission, was negative. During the next few days he lay in a very drowsy state with low muttering delirium, especially at night. Slight retraction of head and stiffness of limbs. He answered questions slowly and complained chiefly of headache and of pains over the bladder. He had great difficulty in micturition. The urine contained a trace of albumen and was somewhat turbid. On October 6th Widal's test was again negative.

Within a few days after his admission to hospital cultures were made from the blood on two occasions from three different veins. Each sample yielded a pure growth of the leptothrix. The same organism had been first recovered in pure culture from the cerebro-spinal fluid. The latter was clear and contained a very large number of lymphocytes; few polymorphs; a differential count gave small lymphocytes 60 per cent., large lymphocytes 33 per cent., polymorphonuclears and endothelial cells 7 per cent.

A specimen of urine removed by catheter with antiseptic precautions gave a similar growth to that found in the blood and cerebro-spinal fluid.

From October 8th to 14th the patient was at his worst; he lay in a drowsy, stuporous condition, with low muttering delirium, with an occasional loud cry, like a patient with meningitis. During the nights the delirium became more violent, and he shouted out and tried to get out of bed. At this time he could not be sufficiently roused to answer questions, and appeared to be somewhat deaf; he lay down in the bed on his back; restlessness was not a marked feature of the illness. The tremor increased, and there was marked subcutaneous tendinum. At the same time there was some retraction of the

head and neck, slight rigidity of the limbs, no optic neuritis, and no alteration in reflexes except for exaggeration of the knee-jerks and deep reflexes generally. At times he perspired profusely. The urine had to be withdrawn by catheter at first, then for three to four days—October 10th to 14th—there was incontinence of both urine and faeces. There was no diarrhoea, and the stools were pale in colour. The tongue remained very dry, with a brown fur over the dorsum. There was no abdominal distension, and no further enlargement of the spleen or liver. The pulse varied from 100 to 112; it was soft, regular, and atherotic. A blood examination on October 11th gave red cells 6,420,000, haemoglobin 128 per cent., index about 1.3, leucocytes 8,000.

Differential count of leucocytes:

Polymorphonuclears	...	...	47 per cent.
Small lymphocytes	...	...	29 "
Large lymphocytes	...	...	16 "
Transitionals	...	...	7 "
Eosinophiles	...	...	0 "
Myelocytes	...	...	1 "

There was a fairly rapid fall of temperature on October 12th and 13th, which, except for a small subsequent rise on the 17th, then remained at or about normal (see Chart). The general

A, admitted to hospital.

symptoms showed a remarkably rapid improvement; he became brighter, the delirium and tremor ceased, and he gradually gained strength. He recovered control over the rectal sphincter almost at once, but not over the bladder for some days longer—the use of the catheter not being required after the 19th. His recovery occurred before the vaccine which was being prepared was available.

On October 21st he was quite convalescent, and left the hospital on November 2nd, somewhat weak, but otherwise quite well. The urine was then of normal specific gravity, clear, with no deposit, and free from albumen.

There was no haemorrhage, no petechial rash, and no herpes throughout.

The cultural characteristics of this leptothrix bacillus are as follows: Recovered from the blood on two occasions, and from three different veins, from the cerebro-spinal fluid, and from the urine. Each sample yielded a pure growth of the leptothrix. Growth was slow, and only occurred on the surface of the agar and not at all in broth primarily. The first visible colony appeared on the third day of incubation; smears made prior to this contained the leptothrix. The colonies appeared as moist, flat, dull, discrete growths with defined, even edges and no wrinkling on the surface. They were transparent, with a milky haze in their substance; they did not cling to the surface of the media, nor were they tough to the touch. In smears the appearance was that of a long, non-septate, non-branching filament; no bacillary forms occurred. They did not stain by Gram's method; no motility observed, except that a wave-like motion often traversed the length of the filament. Growth in gelatine occurred without liquefaction, and the colonies were similar to those on agar. No growth in anaërobic culture. Acid was produced in litmus milk and in litmus glucose, levulose, galactose, maltose, glycerine, and mannite broths. Lactose, saccharose, dextrine, dulcitol, and sorbit litmus broths remained unchanged, no acid being found. Indol was not formed, and neutral red broth was not changed. There was no gas formation in any medium.

There is a striking resemblance to the *Bacillus typhosus* in the ferment reactions and indol test. It did not agglutinate with serum from a case of enteric fever. Agglutination occurred in contact with the patient's own serum up to a dilution of 1 in 350.

Subcultures were difficult to carry on, probably through

a sensitiveness to drying. The strain was lost at both the subcultures. Lastly, the patient's serum did not agglutinate *B. typhosus*, *B. paratyphosus*, or the dysentery group of bacilli (Shiga and Flexner) 1 and 2.

Briefly stated, the characteristics given by Ritchie and McDonald³ of the leptothrix in their case are that the bacillus was Gram-negative, motile, grew on all media, in some cases in long forms, did not liquefy gelatine, gave slight acid in milk and glucose, not in lactose, with no gas formation in any medium; agglutination observations were incomplete. Except with regard to motility, the characteristics of the organism in each case therefore correspond. The close correspondence in the reactions of this leptothrix to the *Bacillus typhosus* is interesting in view of the possibility of a mouth leptothrix being in some way the precursor of the latter organism.

With regard to the mode of invasion of the body, McDonald points out that such leptothrix forms are most usually found in infections about the mouth, pharynx, or lungs. One of us (Scott-Williamson), in attempting to

make aerobic from anaërobic subcultures of *Bacillus fusiformis* in cases of Vincent's angina, has on three occasions found a leptothrix bacillus, which in subculture had all the appearances of the leptothrix above described, and was in all probability the same organism. He also found it in association with *Diplococcus crassus*. As McDonald has suggested in his cases, it seems probable that in our case the infection of the blood took place through the bucco-pharyngeal mucous membrane. As in two of his cases of epidemic cerebro-spinal meningitis, this leptothrix was associated with *D. crassus*, the presence of the

two organisms together in the buccal cavity supports this route of infection.

Clinically the symptoms during the greater part of the illness bore a marked resemblance to an irregular case of enteric fever; to that group of cases of this disease in which the nervous manifestations predominate. The very slight signs of abdominal disturbance, the absence of spots, and of Widal's reaction, etc., of course practically negated enteric fever; but, in spite of all this, it was at one time strongly suggested.

The blood count is, perhaps, worthy of special note; there was no leucopenia, the leucocytes being 8,000, but there was a relative increase of lymphocytes, the numbers per cubic centimetre being: Polymorphs 3,760, small lymphocytes 2,320, large lymphocytes 1,280, transitionals 560, myelocytes 80. Eosinophiles were absent in the count. This increase of lymphocytes in the blood may be connoted with that in the cerebro-spinal fluid.

Lastly, the case is another example of the value of lumbar puncture in a case of febrile illness with marked nervous phenomena. The discovery of the bacillus in the cerebro-spinal fluid led in this instance directly to the elucidation of the cause of what was at the time a very obscure illness, and at that period so severe that it seemed likely to prove fatal. As another instance in which a lumbar puncture was of similar value may be mentioned the case of a youth aged 20 with continued fever and symptoms suggesting diffuse meningitis. Lumbar puncture was done and a paratyphoid bacillus removed from the cerebro-spinal fluid.

REFERENCES.

- ¹ Case of Pyaemia and Meningitis associated with a Pathogenic Leptothrix Bacillus, *Journal of Path. and Bact.*, vol. xiii, 1909, p. 119.
- ² Observations on Epidemic Cerebro-spinal Meningitis, *Journal of Path. and Bact.*, vol. xii, 1908, p. 447.
- ³ Loc. cit.

THE foundation stone of a new building which is to take the place of the temporary quarters hitherto used for the Children's Sanatorium at Holt, Norfolk, was laid on December 19th. All building expenditure has been met by Mr. Otto Beit, but the maintenance fund will have to be increased as the new building provides more accommodation than formerly. Donations may be sent to the Honorary Secretary of the Children's Sanatorium, Mr. T. H. Wyatt, M.V.O., 68, Dehison House, Vauxhall Bridge Road, S.W.