(3) The strain is infective to the rat but this animal apparently does not show heavy infection.

(4) The spironema is best studied by suspending blood from a heavily infected guinea-pig in human citrated serum and then examining by dark field illumination. Under these conditions the spironema remains alive and actively motile \textit{in vitro} for at least forty-eight hours. It can readily be observed in the clear serum apart from the clumps of agglutinated corpuscles.

(5) The living spironema of Cyprian relapsing fever has a wave-length of about 2 \( \mu \). It is extremely constant in wave-length which is shorter and very much more regular than that observed in fixed films. Its amplitude is only slightly shorter than its wave-length. It has between 3 and 11 coils.

(6) The living spironema of relapsing fever is very different in structure from that of Vincent’s angina. The latter when examined alive by the same technique has open irregular waves like those seen in fixed preparations and with about three times the wave-length of the living spironema of relapsing fever.

(7) Wheel-like annular forms are frequently encountered in these serum preparations of the spironema of Cyprian relapsing fever. In these the spironema forms a complete highly motile circle. A fine thread is seen to join the two ends of the spironema so that it seems likely that the annular forms are produced by entanglement of the terminal flagell\ae of one organism. These annular forms revolve, spinning to and fro.

I am very grateful to Colonel J. S. K. Boyd for suggesting that inoculation of guinea-pigs should be attempted and for his continued advice and encouragement. I also wish to thank Major B. J. Doran, I.M.S., for his kind co-operation in sending blood from an infected patient and for providing me with his case notes; and Corporal R. Nicholson, R.A.M.C., and Private W. Fuller, R.A.M.C., for valuable assistance.

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A CASE OF PNEUMOCOCCAL MENINGITIS WITH RECOVERY FOLLOWING CHEMOTHERAPY.

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AND

EFFIE F. A. ELIAS, L.R.C.P., M.R.C.S., D.P.H.

Bombardier W., a previously healthy man aged 32, was admitted to hospital on the evening of August 21, 1942, with a provisional diagnosis of sandfly fever. For two days he had suffered from slight frontal headache, generalized muscular pains and sensations of heat and cold. He had, however, carried out his usual duties up to the afternoon of the day of admission to hospital.
On admission he complained of moderately severe frontal headache and general malaise. The face was flushed and the skin hot and dry. Temperature 102°F. Pulse 92/min. Physical examination revealed no abnormality and he was bright and alert mentally. There was no history or other evidence of sinusitis or otitis media. A blood film showed no malarial parasites. After a restless night he was examined at 0930 hours on August 22 when his condition was unchanged. Temperature 102°F. Pulse 90/min. Thereafter the progress of the case was extremely rapid and is summarized in the following notes.

**August 22.**—1130 hours: Headache much more intense. Nuchal rigidity pronounced. Kernig's sign negative. Right plantar reflex extensor. No other abnormality detected on physical examination. Perfectly clear mentality. W.B.C. 30,600 c.mm.; P. 88 per cent, L. 8 per cent, M. 4 per cent.

1215 hours: Lumbar puncture. Cerebrospinal fluid under slightly increased pressure, clear to the naked eye but microscopically there were 359 cells per c.mm., of which 90 per cent were polymorphs; and an organism with the morphological character of the pneumococcus was present. The nature of the organism was confirmed on culture but its type was not determined.

1400 hours: Given M & B 693. 2 g., by mouth.
1500 hours: Vomited. The general condition was now poor; he lay apathetically in bed in a light stupor and answered questions slowly and dully. Headache intense. Nuchal rigidity pronounced.
1600 hours: Dagenan (M & B Sol.), 1 g. intravenously and 1 g. intramuscularly.
1800 hours: Condition unchanged. Dagenan 2 g. intravenously.
1900 hours: Rigor temperature 105°F.
2200 hours: Catheterized, urine normal. Dagenan 2 g. intramuscularly. His condition was now rather better, his mental state was clearer. M & B 1 g. by mouth was given four hourly, no vomiting occurred.

**August 23.**—0900 hours: Following a fairly quiet night his general condition was much better and he was mentally clear. Headache much less severe. Nuchal rigidity present but much diminished. He complained of some dimness of vision and was examined by an oculist who reported that the fundi were normal but that there was a degree of myopia.
1145 hours: Lumbar puncture. Cerebrospinal fluid under normal pressure, hazy but sterile.
1900 hours: Sulfadiazine 3 g. intravenously begun and continued four-hourly for four doses.

**August 24.**—0900 hours: No headache. Nuchal rigidity almost gone. Perfectly clear mentally. Right plantar reflex flexor. W.B.C. 13,000 c.mm. P. 74 per cent, L. 20 per cent, M. 6 per cent.
1130 hours: Lumbar puncture. Cerebrospinal fluid under very low pressure was slightly hazy; only a very small quantity was obtained, all of which was used for chemical analysis. Sulfadiazine was continued in doses of 3 g. by mouth, at first at eight hourly intervals but, on August 26 there was a scanty growth of pneumococcus from the cerebrospinal fluid and the dose was increased to 3 g. every four hours for eleven doses up to August 28, on which date three further doses were given and then discontinued. The general condition, which was already good by August 24, became even better and, on August 28, he appeared perfectly well. The cerebrospinal fluid was normal on August 27 and the last lumbar puncture, done on September 1, yielded a perfectly normal fluid under normal pressure. On September 1 W.B.C were 7,200 c.mm. He was allowed to go on leave on September 17.
When last seen on October 11 he was perfectly fit and there were no sequelæ.

<table>
<thead>
<tr>
<th>Date</th>
<th>Cells</th>
<th>P. %</th>
<th>L. %</th>
<th>Protein mg.%</th>
<th>Chlorides mg.%</th>
<th>Culture</th>
<th>Sulfa-diazine given grammes</th>
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<th>Conc. Blood</th>
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<td>10</td>
<td>80</td>
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<tr>
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<td>90</td>
<td>10</td>
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<td>—</td>
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<td>—</td>
<td>—</td>
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<tr>
<td>24.8.42</td>
<td>—</td>
<td>—</td>
<td>10</td>
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<td>—</td>
<td>15</td>
<td>10·3</td>
<td>16·4</td>
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<tr>
<td>25.8.42</td>
<td>102</td>
<td>+</td>
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<td>—</td>
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<td>9</td>
<td>—</td>
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<td>5</td>
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</table>

Note on Chemotherapy Employed.

Between 1400 hours on August 22 and 2300 hours on August 28, this patient received M & B 693 by mouth, 6 g.; Dagenan intravenously 3 g. and intramuscularly 3 g. Thereafter he was given sulfadiazine, intravenously, 12 g. and, by mouth, 60 g.

In the first twenty-four hours he received M & B 693 and Dagenan combined 12 g. In the second twenty-four hours sulfadiazine 15 g. In the third twenty-four hours sulfadiazine 21 g., in the fourth twenty-four hours sulfadiazine 18 g. and in the fifth twenty-four hours sulfadiazine 18 g.

The concentration of sulfadiazine in the cerebrospinal fluid and the blood was 10·5 mg. per cent and 16·4 mg. per cent respectively at the end of forty-eight hours and 13·6 mg. per cent and 21·84 mg. per cent respectively at the end of ninety-six hours.

Comment.

The chief features of interest in this case are:—

1. The extremely sudden onset of symptoms of which mental phenomena were a striking feature; (2) the very rapid deterioration in the mental and physical state; (3) the dramatic response to chemotherapy.

Two other examples of pneumococcal meningitis, seen recently, are of interest in relation to the present case. Detailed notes are not available but the histories are briefly as follows:—

Both men went to bed apparently in average health; during the early hours of the morning both became suddenly delirious, then very rapidly stuporose and finally comatose. Lumbar puncture, performed in both cases approximately five hours after the onset of symptoms, yielded a turbid fluid from which a pneumococcus was cultured. Dagenan 2 g. was given intravenously in each case but both men died within nine hours of the onset of the symptoms. The two cases were quite unrelated both in time and place.

Acknowledgment.

Our thanks are due to Colonel R. R. G. Atkins, O.B.E., M.C., for permission to forward this case for publication and to Lieutenant-Colonel W. L. Lamb, R.A.M.C., for his helpful advice.