I. Positions, at the level at which the two shadows are found to move in unison. The foreign body will be found at the point of intersection of the two planes.

It may be said that one of the chief virtues of this method is speed, which is important when a large amount of work is in hand. Patients are brought to the X-ray room, the foreign bodies localized, and they are then passed immediately to the operating room adjoining for operation.

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ON TYPHUS FEVER.

By Major Alexander G. R. Foulerton, F.R.C.S.
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The value of statistics as to case-mortality in earlier epidemics of typhus fever was very doubtful. In the past there had been confusion in the diagnosis of typhus, typhoid, and relapsing fevers, and epidemic cerebrospinal meningitis. During the War now in progress, the case-mortality of typhus fever amongst the Serbian army in the field had been fifty per cent, or about the same as the recorded case-mortality amongst French troops in the Crimean War. It had been stated that the case-mortality amongst Serbian prisoners of war, in Austrian and German hands, had been twenty-five per cent in uncomplicated cases, and forty per cent in an apparently large group of cases in which diphtheria and typhus fever had been intercurrent. The Austro-German armies had had a considerable experience of typhus fever during the War, and a noticeable feature had been the frequent association, in the same patient, of typhus fever with some other infective disease— influenza, diphtheria, dysentery, malaria, and typhoid and relapsing fevers. This varied association of infection was doubtless a result of cross-infection in military hospitals by the agency of typhus-infected lice. Similar cross-infection had occurred in one instance, at any rate, in connexion with another louse-carried disease, relapsing fever. The relative frequency of double infection was, in part, an explanation of the variety of parasites described as having been obtained by bacteriological examination of the blood from cases of typhus fever. It was difficult to understand, in view of the results of exact experimental work, and with knowledge of experience that had been gained during the War, how the importance of insect parasites in the transmission of the unknown virus of typhus fever could be questioned. The spirochete of relapsing fever was certainly carried by lice, by ticks, and possibly by other insect parasites; it was equally certain that the louse was a carrier of the virus of typhus fever, and it

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1 Contributed to a Discussion on “Recent Researches into the Étiology of Typhus Fever,” in the Section of Epidemiology and State Medicine of the Royal Society of Medicine, on Friday, May 26, 1917.
was, so far as our knowledge at the present time went, probably the only common carrier. It was impossible to exclude the possibility of other means for the transmission of typhus infection; but the modern teaching was that a patient with typhus fever who had been freed from lice was no longer a cause of danger to others. Nicolle had related recently some details of a criminal experiment as to the transmission of typhus fever by the louse that had come within his knowledge. A warder in a colonial prison had maliciously transferred lice from a prisoner with typhus fever to two healthy prisoners, both of whom became infected. Professor Jürgens had referred, at a joint congress of Austro-German military medical officers which was held at Warsaw in May, 1916, to another experiment carried out in Germany. Twenty healthy men were confined closely with twenty patients suffering from typhus fever who had been freed from lice; there was not any transmission of infection to the healthy. Similar evidence was afforded by the experience of the Russian prisoners of war camps in Germany; when the prisoners had been freed from lice, the previous heavy prevalence of typhus fever disappeared. Again, preventive measures which were directed exclusively to the freeing of certain units from lice had proved completely effective for the prevention of a danger, that threatened at one time, of the introduction of typhus infection amongst allied troops on the Front in France. The seasonal prevalence of typhus fever correlated with the seasonal prevalence of lousiness, as the latter had occurred amongst the troops in the field. In the colder months of the year the men put on more clothing, were generally less inclined to wash themselves thoroughly, and slept closely together in billets. In the summer months, less clothing was worn, personal washing was carried out more thoroughly, and the men were bivouacked out as much as was possible, and lousiness was markedly diminished amongst the troops during the summer months. Doubtless seasonal conditions influenced the prevalence of lousiness amongst civilian populations under somewhat similar conditions, so that in temperate climates typhus fever was essentially a winter disease. The association of typhus fever with times of privation and famine was probably due to widely spread neglect of personal cleanliness, and consequent increased prevalence of lousiness. So far as could be ascertained it appeared that relapsing fever also was most prevalent under the colder climatic conditions. It had been suggested that the fact that a skin eruption occurred rarely amongst monkeys and guinea-pigs that had been infected with supposed typhus virus was evidence that typhus virus had not been conveyed. This line of argument was not of any account; a skin eruption was not by any means a necessary concomitant of typhus infection in man. For the rest, Nicolle and Blaizot had succeeded in keeping two strains of typhus virus alive for more than two years, by passage through the guinea-pig to monkeys, and again through monkeys to the guinea-pig. At the end of two years, the
blood of an infected guinea-pig injected into a healthy guinea-pig produced symptoms exactly similar to those caused either by the injection of the blood of a patient with typhus fever, or by the injection of an emulsion made with lice taken from a case of typhus fever. The same writers had proved that the virus of typhus fever was retained in most of the tissues of an artificially infected guinea-pig after all traces of blood had been removed by prolonged irrigation of the blood-vessels with saline solution. The parasite causing typhus fever had not yet been identified positively. But two suggested parasites had to be considered—one of them seriously. They were the Plotz-Olitsky-Baehr bacillus and *Rickettsia prowazeki*, described by Toepfer and Rocha-Lima. It was not apparent that the Plotz-Olitsky-Baehr bacillus had any causative relationship to typhus infection. The bacillus, when injected into the guinea-pig, did not cause the sequence of symptoms produced by the injection of blood from a case of typhus fever; nor did the injection protect the guinea-pig against a subsequent inoculation with actively virulent blood from a case of typhus fever. Behind all that, it was impossible to accept a strictly anaerobic parasite, such as the Plotz-Olitsky-Baehr bacillus, as the cause of a disease of the nature of typhus fever, in which a continuing blood infection was an obvious feature. On the other hand, there appeared to be a high degree of probability that the organism, described under the name of *R. prowazeki*, which had been identified by Toepfer and Rocha-Lima in the cells of the intestinal epithelium of lice taken from cases of typhus fever, represented a phase in the development of the veritable parasite. Stampell had seen, in the intestinal epithelium of typhus-infected lice, small brownish bodies which might be identical with *Rickettsia* of Rocha-Lima, and which were comparable closely with the organisms found in infected lice by Ricketts and Wilder, and by Prowazek. The "coccobacillus" which Sergent, Foley and Viallette had identified in stained films of blood from cases of typhus fever, and also in films made with the body-juice of lice from cases of typhus fever, but which apparently they had not succeeded in growing on artificial culture media, possibly came within the same category. The evidence as to the causative relationship of the lice bodies to typhus infection was substantial. Somewhat similar bodies had been described as occurring occasionally in the intestinal content of normal lice, but the like had never been found within the intestinal epithelial cells, except in lice taken from cases of typhus fever. According to Rocha-Lima, the parasite appeared in the intestinal epithelium of artificially hatched lice that had been fed on a case of typhus fever on the fourth or fifth day after the infected meal, but only in a small proportion of the number of lice that had been exposed to infection. On the fifth or sixth day after feeding, about fifty per cent of the lice showed the alleged parasite. By the eighth or ninth day the proportion of the number of lice showing the parasite to the number of those that were free from it was about the
Clinical and other Notes

same as that obtaining amongst lice taken freshly from cases of typhus fever. Inoculation of the guinea-pig with an emulsion made from the bodies of normal lice was without any obvious effect. Inoculation with an emulsion of the bodies of lice taken from cases of typhus fever, and containing the alleged parasite, was followed by symptoms identical with those produced by the injection of virulent typhus blood, and the animal was protected afterwards against the effects of injection with blood from a case of typhus fever. If Rickettsia represented a phase in the evolution of the virus of typhus fever, it was probable that the infecting parasite was a protozoon. What was known as to the transmission of the typhus virus accorded, with what was known as to the transmission of certain protozoal infections from man to man through a necessary intermediate insect host. A comparison of the methods for the transmission respectively of the spirochete of relapsing fever and the unknown virus of typhus fever was of interest. In relapsing fever the transmission of the spirochete was direct, the louse was one of several accidental insect carriers. The spirochete was present in the feces of the infected louse, and probably could be transmitted by the bite. The louse after feeding on a patient with relapsing fever could at its next feed infect a healthy man. This was not so with the transmission of typhus virus. According to Nicolle, to whom must be credited most of our knowledge in the matter, the louse cannot transmit the virus until seven days after the infected meal, and does not transmit it after the tenth day. Also the virus is contained in the body juices of the louse and does not occur in the feces. In other words, the virus of typhus fever after it has attained full activity in man must pass through a phase of evolution in the louse before it can be transmitted to a fresh human case. Nicolle's observations are in accordance with the later observations of Rocha-Lima, just mentioned. Rocha-Lima found that Rickettsia first appeared in the intestinal epithelial cells of the louse on the fourth or fifth day after an infected meal, and apparently reached its complete development on the eighth or ninth day. If Nicolle's observations are valid, then the louse must be regarded as a necessary intermediate host in the transmission, under natural conditions, of the virus from man to man, just as some species of Anopheles is necessary as an intermediate host in the transmission of malarial infection. In the guinea-pig and monkey, on the other hand, direct transmission of the virus by means of infected blood occurred under experimental conditions. The question was of importance when preventive measures against the spread of infection were under consideration. It was obvious that a quarantine of at least twenty-one days was necessary when dealing with an infected unit—allowing from six to ten days for the evolution of virus in the louse, and from six to ten days for incubation of the virus in man—after the last man of the unit had been freed from lice. And even twenty-one days' quarantine from the date of the last case of typhus fever did not cover every
possibility. There was the possibility, suggested by a single positive experimental result, of the transmission of the virus from an infected female louse to the ova. The recorded experience in the German army during the War, however, had been that the risk of transmission of the virus to man through a second generation of infected lice was negligible.

FULMINATING CEREBROSPINAL FEVER: PROGNOSIS AND TREATMENT.

By Captains P. W. MacLagan and W. E. Cooke.

Royal Army Medical Corps.

"This is the most malignant form of meningitis. It runs a very acute course and frequently kills the patient in from a few hours to a day."—"Epidemic Cerebrospinal Meningitis," Sophian.

"The fatal termination usually occurs within ten to thirty hours after the onset."—"Meningococcus Meningitis," Heiman and Feldstein.

"The name fulminating or foudroyant has been applied to those cases which begin with startling suddenness and run a uniformly rapid course, terminating in death in twenty-four to thirty-six hours."—"Cerebrospinal Fever," Foster and Gaskell.

"Cerebrospinal meningitis may begin abruptly with unheard-of acuteness during apparently perfect health, and terminate fatally after a course of a few hours. Such is fulminating cerebrospinal fever."—"La Meningite Cerebrospinale," Netter and Debre.

Any form of treatment which can hope to modify favourably the course of this type of cerebrospinal fever is worthy of the most careful consideration. In a recent paper (British Medical Journal and Lancet, December, 1916), we drew attention to the constant association of hemorrhagic adrenalitis with the fulminating type of cerebrospinal fever. In this type we pointed out that death was due, not to the severity of the meningitis, but to a sudden withdrawal from the circulation of the internal secretion of the adrenal gland, on account of interference with its secreting cells. This results in loss of tone of the muscle fibre of the blood vessels and failure of the peripheral circulation, with secondary failure of the cardiac muscle.

Within a very few hours of the onset of the disease the patient is frequently pulseless at the wrist, but the heart continues to beat for some considerable time. In spite of this, the peripheral circulation cannot be maintained because of the dilatation of the blood-vessels, the patient becomes intensely cyanosed, and death takes place because of the cessation of the circulation.

In the same paper we suggested that it might be possible to replace artificially the epinephrin in the circulation and so restore the vascular tone, until such time as the adrenals might recover their function, or