TRENCH FEVER: A RELAPSING FEVER OCCURRING AMONG THE BRITISH TROOPS IN FRANCE AND SALONICA.

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After all examples of the well-defined acute fevers had been separated from the cases of fever occurring in the British Armies in France and in Salonica, a considerable number remained in which the diagnosis was doubtful. A few were probably due to infection with the Bacillus paratyphosus or even the B. typhosus, although all bacteriological examinations had proved negative, but I do not think that these should amount to more than 5 per cent of the cases in which bacteriological confirmation is obtained. The cases left over are most frequently diagnosed as "pyrexia of unknown origin," influenza and rheumatic fever, the first of these being the only diagnosis which is indisputably correct. A small number of cases of true influenza with the characteristic catarrhal and general symptoms undoubtedly occur, although an attempt is rarely made to confirm the diagnosis bacteriologically. Rheumatic fever is rare; Herringham only saw five cases in France between October, 1914, and October, 1915, though it subsequently became rather more common, and I only saw a single definite case in Salonica; in the few cases so diagnosed, in which the pain is really localized in the joints, the arthritis is almost always gonococcal and not rheumatic. We are thus left with a number of cases of pyrexia of unknown origin; in this paper two varieties of a well-defined febrile disease are described which account for a considerable proportion of these cases.

In the early summer of 1915 Major J. H. P. Graham drew attention to a type of fever occurring in the British Army in France, in which two periods of pyrexia were separated by a normal interval. Similar cases were recognized with increasing frequency, and the disease soon became widely known as "trench fever." In November, 1915, Captain G. H. Hunt and Major A. C. Rankin described thirty cases of the same kind of trench fever, and a still fuller account was published in February, 1916, by Captain J. W. McNee, Lieutenant A. Renshaw and Captain E. H. Brunt, in which for the first time two distinct clinical types of the disease were distinguished.
The disease was only observed among officers and men living near the trenches and in the personnel of hospitals, especially among orderlies of wards in which there were patients suffering from the disease. No cases occurred among ammunition columns, ordnance and headquarters troops. It was for this reason that the name trench fever was adopted, though actual residence in the trenches themselves was certainly not an essential factor, and Hunt and McNe in their most recent communication state that cases have recently been met with further from the front.

According to Colonel Sir Wilmot Herringham, literally thousands of cases of the first type occurred among the troops in France and Flanders between the end of April and October, 1915; it was comparatively rare in the following winter, but increased again in the spring of 1916. It did not occur in Gallipoli and was not definitely recognized in Salonica until April, 1916. The second type, which was rare in France and Flanders until November, 1915, when it became more common than the first, has been very prevalent in Salonica since December, 1915. At first cases had to be recorded as "P.U.O." (pyrexia of unknown origin), or under the head of influenza, or some other equally incorrect name, even when their nature had been recognized. For this reason it became customary to call the disease "pyrexia of unknown origin (A)," or shortly P.U.O. (A), as this designation did not introduce into the official records an unauthorized name, such as "periodic one-day fever" or "Salonica fever," which had been used by some medical officers. The term trench fever was not used, as besides being an unauthorized name the disease was common in Salonica at a time when no men were living in the trenches, and cases occurred in ammunition columns several miles from the trenches as well as in front line troops and in hospital attendants. When, however, in March, 1916, I recognized that the disease was identical with the long form of trench fever described by McNe, Renshaw, and Brunt, and when a month later, the common short form of trench fever seen in France and Flanders became prevalent in Salonica, it seemed wise to adopt this name.

A few cases with symptoms intermediate between the two types of trench fever have been observed in France and in Salonica, and the initial symptoms are very similar, but the temperature chart is so different in typical cases and the second class occurred in such large numbers without the first in the winter months, although it was very rare in comparison with the first during the summer of 1915 in France, that it cannot yet be regarded as definitely
proved that the two diseases are really due to the same infection, as is generally believed by British observers in France.

My attention was first drawn to the disease in Salonica at the beginning of January, 1916, by Lieutenant Colonel McGavin, Major Wylie and Major Acland of No. 1 New Zealand Stationary Hospital. At first it was not widely recognized, but as medical officers became more familiar with its characteristics, it became clear that it was extremely common, especially in certain units.

With the exception of one man, who contracted the disease whilst in hospital from another case, all of the cases observed in Salonica up to March, 1916, belonged to men who had been several months in France, having come to Salonica from Marseilles in November and December, 1915. None had been in Gallipoli or Serbia. The short form of trench fever had occurred in several of the affected units whilst they were in France. They went to France from India at the end of 1914, and included many old soldiers, a large proportion of whom had had malaria. It is highly probable that these men brought the infection with them from France. In March, 1916, the long form of trench fever began to occur in a division which had been in Serbia, but not in France; some of the men had been in Gallipoli, but most had come straight to Salonica from England. In April, groups of cases of both forms of trench fever appeared in units belonging to other divisions, which had been free from the disease since their arrival at the end of 1915. The later cases probably became infected by men coming in drafts from France. The disease also developed among the personnel of some of the hospitals to which the patients were sent.

Early in 1916, Schrotter described in a Vienna journal cases of the first variety, which he had observed in Austrian troops in the Tyrol, and Werner, in a Munich journal, cases of the second variety, which he had observed in a German field hospital on the eastern front.

Pathology.—Before trench fever could be accepted as a clinical entity it was necessary to prove that it was not an aberrant form of some other condition, such as paratyphoid fever, which it may closely simulate during the first pyrexial period, true relapsing fever, which it resembles in so far as the fever is of a characteristic relapsing type, and malaria, which is sometimes simulated by the shorter and sharper pyrexial attacks. But the blood taken at the height of both the initial and the latter febrile periods has always been sterile on cultivation, the Widal reaction has been consistently negative at every stage of the illness, and no spirochæte nor
malarial plasmodium has been found in spite of repeated examinations of blood films taken both during febrile and afebrile periods.

McNee and Renshaw found that trench fever could be transmitted to healthy soldiers by the intramuscular or intravenous injection of the blood of men suffering from the disease. Injection of the washed red corpuscles had the same effect, but the plasma and serum were not infective.

One attack does not seem to protect against re-infection. I saw a man with the long type of trench fever in April, 1916, in Salonica; he had been seen by Captain McNee in a typical attack in September, 1915, while in France, and had been quite well in the interval. It is possible, however, that there was no re-infection, the original infection having remained latent between the two attacks.

As all attempts to discover the infective organisms have failed, and as no fatal case has occurred, the nature of the disease remains unknown. The striking periodic character of the fever in the long type of case, the considerable increase in the proportion of large mononuclear leucocytes, which has been found on several occasions, and the evidence pointing to an intracorpuscular infection suggest a protozoal rather than a bacterial origin.

Method of Propagation.—There is no nasal-pharyngeal or bronchial catarrh and, except for constipation, gastro-intestinal symptoms, though occasionally well marked, are generally completely absent. It is probable, therefore, that the disease is not conveyed by the respiratory secreta or by the faeces, but through the intermediation of some insect. The occurrence of the long form of the disease during the winter months shows that the infection can be conveyed in the absence of mosquitoes and other flying insects; though Herringham found mosquitoes in France throughout the winter, there were certainly none in Salonica. Fleas have been scarce in both countries and the men themselves rarely complain of them. Almost all patients admitted that they were lice-infested up to the time of their entry into hospital, so that it is quite possible that the disease is conveyed by lice. A hospital orderly, who had been free from lice since his arrival in Salonica, had to carry the kit of a number of new patients suffering from trench fever on May 2, 1916. The clothes were swarming with lice and the same evening he found some in his own clothes. He got rid of them in the course of a few days, and on May 20 an attack of trench fever began. He was not employed in the wards
and he never came in contact with any patient suffering from the disease. He was the first case of trench fever in the personnel of the hospital to which he was attached. The incidence of trench fever is least in the cleanest battalions and in the divisions which have the best facilities for bathing. In some units a successful campaign against lice has been immediately followed by a great diminution in the incidence of trench fever. Captain Urquhart developed the short form of trench fever after allowing the lice from a patient with this form of the disease to bite him, and Captain McNee tells me that his observations in France have led him to agree with the conclusion I came to in Salonica—that the disease is spread by lice.

Cold, wet, and fatigue appear to be exciting causes in a man who has become infected, but has so far had no symptoms; thus Captain Hay noticed that almost all cases in his regiment in Salonica began two or three days after they had been wet through. In several instances a group of men sleeping in the same tent have been affected.

Some patients appear to be carriers, who do not lose the infection completely for several months, but have recurrences from time to time, during each of which they may infect an additional number of men. A serjeant, who had been in good health whilst in France between December, 1914, and November, 1915, developed the long form of trench fever early in December, 1915, directly after he left France for Salonica; in the following four months he was in hospital five times for a week or more, though he was perfectly well in the intervals. Every time he returned to his unit he became lice-infested again, and appeared to infect some of the men with whom he came in contact, about thirty men of his company, including six serjeants, having been taken ill with trench fever between January and March; one of the serjeants had wrestled with him, another had danced with him, a corporal slept next to him, and a private sat next to him for some lectures.

Incubation Period.—As a result of observations in Salonica on cases arising in hospital when a patient had been admitted for some other condition, I came to the conclusion that the incubation period is between fifteen and twenty-five days; in the case of the hospital orderly already described it was probably eighteen days. Quite independently Hunt and McNee in France concluded that it was between fourteen and twenty-four days. The following three cases are typical of those which led to my estimate of the incubation period. (1) Serjt. B., R.E., was admitted for rhinitis on
December 27, 1915, into a ward in which there were at the time two patients suffering from the long form of trench fever, no other cases of which have yet been observed in his unit. On January 1, 1916, he was moved into another ward, in which there were, and have since been, no such cases. When convalescent from the rhinitis, which had been accompanied by no pyrexia or pains in the head, back or legs, he suddenly became ill on the evening of January 24; his temperature in the morning was normal, but at 6 p.m. it was 104°F. This proved to be the first pyrexial period of a typical attack of the long form of trench fever. It was probable that the infection was contracted from the other cases in the ward between December 27 and January 1, between twenty-three and twenty-seven days before the onset of symptoms.

(2) Pte. W. went to France at the beginning of the War with the 1st —— Regiment. He was wounded in January, 1915, and was in England until the end of 1915, when he came to Salonica, joining the 2nd —— Regiment, which had come there from France in November or January 13, 1916. A few days after he arrived he became lice-infested. On January 21 he went to a field ambulance, and then to a casualty clearing station with a hydrocele; he was transferred to a stationary hospital on February 6. On February 12 his temperature rose, and a typical attack of the long form of trench fever began. His clothes were disinfected when he entered the casualty clearing station, and he had no more trouble with lice after his admission there. It is probable that he contracted the disease whilst with his regiment, i.e., between twenty-four and sixteen days before the onset; as he was not lice-infested until he had been with his regiment some days, the period was probably about twenty days.

(3) A third patient was admitted into hospital for quinsy. He was in a ward in which there were no other cases of trench fever, but developed the disease fourteen days after admission. He had probably contracted it whilst still with his regiment, in which at least one case had already occurred, so that the incubation period was over a fortnight.

Symptoms.—The disease generally begins suddenly without any premonitory symptoms, but a feeling of malaise occasionally precedes the attack for a day or two. The patient complains of severe headache, especially frontal and behind the eyes, and this is rapidly followed by pain in the lower part of the back and on the second or third day in the legs. Pain in the neck is occasionally observed; in two cases mentioned by Hunt and McNeely pain and
stiffness in this region was so severe that a lumbar puncture was performed in order to exclude meningitis, and I also saw two cases in Salonica in which this was done. The patient generally shivers, but there is never a definite rigor; he is occasionally flushed, and often sweats profusely. The bowels are regular or constipated, and there is no nasal or bronchial catarrh; the appetite is lost, the tongue is moist, and often slightly furred, and occasionally mild pharyngitis is present. Herpes labialis has occurred in a few cases, but less frequently in the long than in the short form of the disease. There is no rash.

The onset is sometimes extremely abrupt; the patient suddenly feels giddy with a burning head, he shivers and may be very short of breath, and complains of a pain in his left side. He has to fall out if on parade or marching, and has often great difficulty in returning to camp without assistance.

In a few cases, in which constipation is generally present there is some abdominal pain with slight distension and tenderness, and there may be nausea and some vomiting at the onset. Four out of my first fifty cases of the long type were sent to hospital diagnosed as appendicitis; in one a normal appendix was removed, and a second would have been operated upon had he not refused. The abdominal symptoms rapidly disappeared and in the relapses they were less prominent than the other symptoms.

When the pain in the legs is severe, there may be some cutaneous hyperesthesia over the shins. In several cases the periosteum of the tibia has seemed to me to be rough and thickened, as it pits slightly on pressure, although no pitting of the subcutaneous tissue was present. The tenderness is most marked over the lower half of the shins and may be very severe, a comparatively slight pressure causing the patient to cry out, and the pain produced may last for hours. A less degree of tenderness is often present in the tendons behind the knee, and occasionally in the ligamentum patellae and along the course of the femur. The shins are always tender, even if the patient complains of no pain in the legs, but tenderness appears most marked in groups of cases and at certain times. Graham did not mention it, and it was not observed in the earliest cases in Salonica. There is little or no tenderness of the calves or other muscles. The knee and ankle jerks are normal.

In the first attack the spleen is sometimes palpable or is found to be enlarged on percussion, and there may be some tenderness in the left hypochondrium. Although this was certainly the case in
Salonica, Herringham and Hunt and McNee never found any splenic enlargement in the cases they observed in France.

Leucocytosis is often, but not always, present during the pyrexial attacks; the count varied between 4,700 and 22,000 per cubic millimetre in 35 cases, mostly of the short type, examined in France (Hunt and Rankin, McNee, Renshaw and Brunt); in many of the cases examined both in France and in Salonica there was a relative increase in the large mononuclear cells (Elworthy, Urquhart). Polychromatophil cells above the normal size with well-marked punctate basophilia were observed by McNee, Renshaw and Brunt in France, but Elworthy, working in Salonica, came to the conclusion that they only occurred in the later stages of the more severe cases. The percentage of haemoglobin is generally about eighty, though the number of red corpuscles is undiminished.

In the short form of trench fever the temperature rises rapidly to between 102° F. and 104° F., but the pulse rate is only slightly increased. On the third or fourth day the temperature suddenly falls—generally to normal or subnormal, but there is no corresponding improvement in the symptoms. After an interval of a few hours it rises again and then after another two to five days it falls to normal; on this occasion there is immediate relief to all of the symptoms. In some cases the remission on the third or fourth day does not occur, the temperature remaining raised for about a week. There is often a single relapse after an interval varying from a few hours to ten days, but generally less than four days; the temperature rises to 100° F. or 101° F. for twenty-four or forty-eight hours, during which the symptoms return, with diminished severity. The patient is generally fit for duty almost immediately after the temperature falls again. Many cases have subsequently been kept under observation by Hunt and McNee for weeks or months without any return of fever or other symptoms, so that there could be no question of additional relapses occurring after the patient had been discharged from hospital.

In the long or periodic type of trench fever the temperature rises to between 101° F. and 104° F. on the first evening. The initial attack is variable in duration; the temperature may be normal the first morning, high in the evening, normal the second morning, and rather less high the second evening than the first, after which it remains down. In other cases the first attack may last as long as four or five days, the temperature being always lower in the morning than the preceding and following evening, the highest temperature being reached on the second or
third day; in one case it reached 105.8°F. on the third evening, though it was normal the previous and following mornings. The pulse is generally accelerated in proportion with the temperature, but at first it may be considerably faster. With the fall of temperature at the end of the initial attack all the symptoms disappear and the patient is often sent back to duty.

After being well for two to ten days he complains of a return of headache and pain in the legs, which culminate at night; the temperature rises in the evening to a point which is generally a little lower than the highest temperature in the first attack. The temperature falls to normal or nearly normal the next morning, and either remains down or rises to a less extent the second evening, thereafter to remain normal. The general symptoms are much less severe than in the first attack and the acceleration of the pulse is less marked, but the pain in the legs and tenderness of the shins are generally greater, and they may not disappear completely in the interval between the second and third attacks, though the headache, which generally remains the most prominent symptom during the attack, is never present in the apyrexial periods. The pain in the legs is sometimes extreme and may prevent sleep; in other cases it is comparatively slight and the patient looks and feels remarkably well, considering that he has a temperature of 101°F. or more.

Recurrences follow periodically, the maximum temperature being always reached in the evening. The intervals between the height of the attacks is fairly constant in each case, but it varies in different cases between four and eight days, five being the most common interval. Each succeeding attack is generally milder than its predecessor and the temperature is rather lower, but in severe cases the patient feels weaker in the later intervals, and the pain and tenderness of the legs are more persistent. The later attacks may be of such short duration that the rise in temperature is not recorded at all if it is only taken twice a day. On the afternoon and evening of the day on which the attack is expected the temperature should therefore be taken every two hours, especially if there is any pain in the head or legs, as in most cases the patient knows from his sensations there is going to be a relapse, even before the temperature rises. The temperature is sometimes only raised for three or four hours: in one case, for example, the morning temperature was 98°F., at 5.30 p.m. it was 99°F., 6.30 p.m. 100°F., 8 p.m. 101°F., and at both 9 and 10 p.m. and at 8 a.m. the following morning.
In another case it was 97.6°F. at 5 p.m., though the patient had had a headache since the morning, but 101.4°F. at 8 p.m., 102.4°F. at 10 p.m., 101.4°F. at 2 a.m., 100.2°F. at 6 a.m. and 98°F. at 8 a.m., so the chart showed no rise, as the temperature in the ward was taken at 8 a.m. and 5 p.m. This liability to miss the rise in temperature accounts for the fact that it may appear from the chart that an attack has been missed, the interval between two of the later attacks being double that between the earlier ones; a headache may have been felt and a rise in the pulse rate recorded half way between the attack. In some cases the temperature is subnormal between the last two attacks, in which it rises to normal but no higher.

In a few cases the temperature remains raised for three or even four days in each attack, the evening temperature being always higher than the morning temperature, which may be normal on the first and last days; the highest point is generally reached the second evening.

Diagnosis.—The diagnosis can only be made with certainty from a study of the temperature chart, but the association of pyrexia with tender shins is very suggestive of trench fever already in the first attack. Painful and tender shins have, however, sometimes been observed in the Salonica Army in the absence of fever and the unsatisfactory name of “trench shin” has sometimes been used to describe such cases. Some of the cases regarded as examples of the short form of trench fever are probably really periodic cases, as there is no doubt that the later bouts of pyrexia are often entirely missed owing to the short time they last, the patient having meanwhile gone back to duty, or if in hospital the evening temperature may have been taken at 5 p.m., although the rise only began at 7 p.m., or later. Several medical officers, who were very familiar with the early stages of the disease, only recognized the periodic rise of temperature after their attention had been specially drawn to its occurrence, as their patients had returned to duty after the first or second attack, and had not “gone sick” for the later and, comparatively slight recurrences.

The majority of cases were at first diagnosed as influenza, though it was generally recognized by medical officers that they were not identical with the familiar forms of influenza. Thus there is never any nasal or bronchial catarrh, the patient rarely appears or feels seriously ill, except sometimes during the first two days of the first attack, and cardiac, respiratory and nervous complications never occur. The periodic return of pain and pyrexia and
pain and tenderness of the shins are quite characteristic and prevent confusion with influenza except at the onset.

The possibility of *malaria* must always be considered, and a blood film should be examined for the malarial plasmodium before making a definite diagnosis in cases of doubt, especially when malaria is prevalent or if the patient has previously had malaria. The differential leucocyte count is of no assistance, as there is a relative increase in large mononuclear cells in both diseases. The longer intervals between the attacks, their invariable occurrence in the evening instead of at various times of the day, the absence of true rigors and the failure of quinine to modify the course of the illness are distinguishing features of trench fever. Several old soldiers at first thought that they were suffering from malaria, but they subsequently realized that the disease must be different, as they never before had had severe pain and tenderness in their shins.

A few cases of true *relapsing fever* occurred in British as well as Indian troops at Gallipoli, but only eight Indian and no British soldiers had been attacked by the disease in Salonica up to the end of April. The disease was, however, common in the Serbian Army in 1915, and was actually first described by Hippocrates in the Greek Island of Thasos, so it is necessary to be on the look out for it among British as well as Indian soldiers at Salonica, and at least one case occurred in June, 1916. In six cases I saw with Captain Struthers Smith, I.M.S., the pyrexial period was generally longer, varying between two and a half and six days, and the fever was higher than in trench fever, the maximum temperature in each attack being between 104° F. and 105° F., successive relapses did not diminish in severity unless they were cut short by injecting salvarsan, the effect of which was almost instantaneous; the patients were extremely ill and often delirious during the pyrexial periods, and the delirium occasionally continued after the temperature fell; bronchitis was common, and there was no pain in the legs nor tenderness of the shins; the apyrexial periods varied between two and eight days, six days being the most common, but the periodicity was less regular than in the periodic type of trench fever. The *spirochaete* was found without difficulty in the blood during the pyrexial period in every case. The disease may, however, be less severe when it occurs among Europeans.

*Prognosis.*—There have been no fatal cases, and the patient never appears seriously ill, except occasionally for a very short time in the first attack.
Until the commencement of the hot weather in Salonica at the end of May, no complications had been observed with the exception of phlebitis of the femoral vein in one case, and slight jaundice in two cases, but the latter at any rate was probably accidental. With the onset of the hot weather it was found that trench fever was often accompanied by a moderate degree of cardiac dilatation, which resulted in the development of "soldier's heart" if the patient returned to full duty too soon. Endocarditis has never occurred. Hunt and McNee have not observed albuminuria, but Herringham found a trace of albumin which soon disappeared in a few cases. I know of no case in which albuminuria occurred in Salonica.

The total duration of the periodic type of trench fever from the onset to the end of the last attack is generally between four and six weeks, but some cases appear to abort and in a few others attacks may recur for several months, the patient remaining quite well in the intervals. I saw a sergeant with the periodic form of trench fever in January, 1916, in Salonica; he had had similar attacks at intervals since August, 1915, when he first became ill in France. In most cases the patient rapidly gets strong again after an attack, and is generally fit for duty after the second period of pyrexia, though he may have to rest for a few hours when the later attacks occur. Sometimes, however, great exhaustion follows, and convalescence is slow.

Prophylaxis.—As the disease is probably conveyed by lice, which become infected by biting a patient during an attack, every effort should be made to keep troops free from them. All cases of trench fever should either be sent to hospital or isolated, and the patient's clothes and bedding should be specially disinfected as well as that of all men who have recently slept near him. After the initial or the second attack a man is often able to return to duty; it is very important that he should be kept under observation, and if he again becomes verminous his clothes and bedding should again be disinfected; men who are still having attacks or have recently recovered should sleep together isolated from the other men in their unit, but there is no reason why they should not work with them.

Treatment.—No treatment has yet been found which prevents the periodic return of attacks or which is really effective in overcoming the pain. It is generally agreed that in the first attack considerable relief occurs if the tendency to constipation is prevented by aperients. Acetyl-salicylic acid is the most effective
analgesic drug. Quinine has been repeatedly tried without success, both by mouth and subcutaneous injection, and salvarsan and antimony have proved useless. In one severe case Hunt and McNee tried intravenous injections of eusol without success, and in two others twenty cubic centimetres of the serum of a convalescent patient was injected intravenously without influencing the course of the illness.

Numerous local applications, both hot and cold, have been used for the painful shins; some of them have appeared to do good in certain cases, but the most frequently successful seems to have been a cold compress of saturated magnesium sulphate solution, which was first recommended by Captain D. S. Harvey. In slight cases gentle massage has given temporary relief. In a few cases in Salonica the periosteum was incised, but when this was done on one side only, improvement occurred with equal rapidity on the opposite side. Even if the results had been more promising I should regard the operation as quite unjustifiable, as the pain always disappears spontaneously in the course of a few weeks and often quite rapidly even when it is exceptionally severe.

REFERENCES.