of the peroneus tertius, almost completely frayed through, was found crossing the wound. This tendon was retracted inwards, and it was then found that the astragalus was completely free from all its attachments, the posterior surface pointing directly outwards and the head inwards. By forcing the foot into an exaggerated varus position and turning the bone it was possible to replace it so that it occupied its normal position. The foot was then everted, and the torn dorsal ligaments repaired and the peroneus tertius tendon sutured. The fibula fracture was positioned and the wound closed by interrupted sutures, and splinted on a metal shoe with a rectangular foot-piece.

Gentle effleurage was commenced a fortnight later with active flexion and extension of the ankle under supervision to ensure that no inversion of the foot should occur. In the intervals of treatment the foot was retained in the splint. At the end of this time (six weeks after operation) there was very useful movement. Weight bearing was not permitted until three months had elapsed from the date of the injury. Since that time the man has walked comfortably on the foot.

Fig. 3 shows the lateral view after reduction of the dislocation. Figs. 4 and 5 show the range of ankle movement. This case has been very instructive, particularly because it shows that removal of the completely detached astragalus is not essential, and that excellent function with no shortening—a result much superior to that obtained after astragalectomy—may be obtained by this more conservative method.

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¹ Stimson, *A Treatise on Fractures and Dislocations*, 1908. ² Barwell, *Med.-Chir. Transactions*, vol. lxxi.

ON THE PROBABLE IDENTITY OF RICKETTSIA PEDICULI WITH RICKETTSIA QUINTANA.

BY

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MUNK and da Rocha-Lima (1917)¹ and Brumpt (1918)² found rickettsia bodies in lice taken from "healthy persons"; the two former writers named this supposed distinct species found by them *Rickettsia pediculi*, although they stated that it was indistinguishable morphologically and in its distribution in the louse from *R. quintana*, which they found associated with lice that had fed on trench fever patients. They infer that there is a form of rickettsia, infecting the gut of lice, which has no relation to trench or typhus fever. If this is correct, the discovery of these organisms in the lumen of the gut has no necessary significance. My colleague, Dr. Arkwright, and myself have, however, examined numbers of lice taken from civilian clothing in London and have never seen rickettsia bodies except when the insects have fed upon patients who have suffered from trench fever, and it is accordingly conceivable that this disease may have existed unrecognized among the population from which Munk and da Rocha-Lima and Brumpt obtained their lice.

The following account of a case of trench fever occurring in a region where the disease was supposed to be non-existent, in which the rickettsia bodies appeared in lice shortly after the insects were fed upon the patient, is of interest in this respect.

In April, 1920, I experienced while in Warsaw a febrile attack which exhibited the clinical signs of trench fever. The clinical evidence was, moreover, supported by the development of rickettsia bodies in the lice which I took to Poland with me. All the details of the case were under the observation of Professor Wolbach of Harvard, and Professor J. L. Todd³ of McGill, who agreed (1920) that the symptoms were those of trench fever.

On February 18th I joined Professors Wolbach and Todd in Paris in the capacity of Entomologist to the Typhus Research Commission to Poland of the League of Red Cross Societies. I carried with me stocks of *Pediculus humanus (capitis et corporis)* which have been under observation and fed only upon myself since November, 1915. Lice from these stocks were used for experimental work in connexion with trench fever by Sundell and Nankivell, the War Office Trench Fever Committee, and the American Red Cross Trench Fever Committee. Since the com-

mencement of the use of these stocks for trench fever research (more than two years ago) lice from them have been frequently tested for the presence of rickettsia bodies, but the insects have remained free; and prior to my visit to Warsaw I had never experienced any febrile attack which displayed the clinical signs of this disease.

We arrived at Warsaw on February 25th, but owing to unavoidable delays were unable to commence laboratory work until the latter end of March, when, as a preliminary step to the use of our stocks of lice for typhus research, a series of control smears were made from the guts and excreta of lice taken from the boxes. Both the American and English stocks were found free of rickettsia bodies. Steps were next taken to obtain a supply of normal Polish lice for comparison. These we were able to obtain by the courtesy of the officials at one of the municipal bath houses where uncleanly and frequently verminous, but not sick, persons were sent for cleansing, their clothing being subjected to hot-air treatment while they bathed. We were informed that lice from this source would be free from suspicion with regard to typhus.

I searched underclothing for lice in this establishment on March 31st and obtained a small supply, larger numbers being forwarded to us a day or two later by the officials in charge of the bath house. The dissection and making of smear preparations of these Polish lice occupied a portion of my time daily up to April 5th, when the few remaining alive were killed and fixed for sectioning. Of course no attempt was made to feed them. Of 151 of these lice 11 (about 7 per cent.) were found to be infected with rickettsia bodies indistinguishable from *R. quintana*. In sections these were seen only in the lumen of the gut; with smears it is not possible to decide definitely whether the cells lining the gut are or are not infected.

History of Author's Illness.

On April 17th I experienced a sharp febrile attack. Feeling very unwell when I awoke at 6.30 a.m., I took my temperature and found it to be only 97° F., but by 2 p.m. it had risen to 101.7° F. I had a severe frontal headache, and by 9 p.m. my temperature was 103.6° F. I passed a restless night with broken slumber. On April 18th at 8 a.m. the temperature was 101.6° F., and at 10 a.m. 102.3° F., and arrangements were made for me to go to the American Red Cross hospital at Praga. When I arrived there at 3 p.m. my temperature was 101.4° F., at 6 p.m. 101.3°, and at 8 p.m. 101° F. That night I had but little sleep as I suffered from continuous pains in my bones and joints, from ankles to hips and wrists to elbows, accompanied by heavy sweating. These pains, though of low intensity, were, no doubt on account of their wide area of distribution, peculiarly discomforting. On April 19th my temperature remained at or below normal all day. I felt better, but was somewhat depressed and the sweating continued. At night the pains in my limbs were very acute and continued until about 2 a.m., when they gradually subsided and were replaced by a dull confused sensation in the head accompanied by visual hallucinations whenever I closed my eyes. I sweated heavily and got no sleep until after daybreak. I recognized shin pains as more intense than the general aching of my limbs on this occasion. On April 20th I was better in all respects but very weak. My temperature remained down, and at night the limb pains were slight and discontinuous; the shin pains were, however, more intense by comparison. I slept much better.

In view of the possibility of the attack being typhus (I had been dissecting typhus-infected lice twelve days previously), I refrained from feeding my large stocks of lice at the commencement of the attack, but recommenced to do so when my temperature fell to normal on April 19th as I was convinced that I had not suffered from typhus.

I was very much better on April 21st, and was told that I might leave the hospital on the morrow, but actually left the same afternoon at my own request, as I was very anxious to get back to my quarters in proximity to the laboratory. I suspected that the attack was trench fever and it was important, in order to settle this point, to keep my stocks of lice in the incubator, and make smears of the lice and their excreta from day to day.

That same night (April 21st) I had a renewal of the attack: temperature up to 101° F., with some increase in the intensity of the pains in limbs, but not sufficient to disturb my sleep. The shin pains were again more intense than those in the other bones, and with each recurrence this feature became more apparent. A noticeable feature in connexion with these pains was that, whereas in the primary attack they did not commence until the fever was subsiding and were still acute after it had left me, they now accompanied the febrile wave. Later they commenced prior to a rise in temperature however slight, and on at least one occasion they occurred without any perceptible rise in temperature. Following this renewal of the attack, my temperature rose each night and fell by day for about ten days, and subsequently slight rises occurred at about five-day intervals, some being barely perceptible. Weakness, lethargy and depression tended to increase as the febrile waves became less pronounced. Slight shivering, alternating with flushing and followed by sweating, frequently accompanied the slightest rise

indicates opportunities afforded for the lice to feed. + + + + + indicates the presence of rickettsia bodies in the excreta of the lice and the extent of the infection.

of temperature above normal. Shin and bone pains (chiefly in the knees) were often intense, sometimes accompanied by nausea and headache, causing restlessness and preventing sleep for a portion of the night.

These symptoms occurred for the last time on May 12th, and by May 15th I felt quite fit save for a certain amount of lassitude. This gradually subsided.

No signs of rickettsia bodies were visible in the smears made from the excreta of the lice in my boxes, until the eighth day after I recommenced feeding them; then a smear of the excreta from the only box that I was able to keep warm, in the pocket of my pyjamas, until the incubator at the laboratory was available, showed a few rickettsia bodies in several of the fields examined. This box (a) was two days ahead of the remaining five boxes in the matter of incubation, though the chances of infection in all the boxes dated from the same time.

The details of incubation after the first infecting meal are as follows: Box (a), two days at an estimated temperature of 85° to 90° F. The other five boxes, except during feeding times, remained during this period at about 60° to 65° F. After this all the boxes were kept in an incubator except when the lice were being fed. The temperature of the incubator varied occasionally between the limits of 90° and 100° F., but usually it remained at 93° F. Smears of excreta from box (a) showed a quite convincing rickettsia infection on the ninth day, while on the tenth and eleventh days these bodies were present in great abundance in the excreta from box (a), and were present in small numbers in most of the smears made from the excreta out of the other boxes. From the twelfth day onwards all the boxes were heavily infected. Smears of guts dissected out of adult lice taken from the boxes showed about 60 per cent. of easily recognizable infections. Out of some fifty sectioned lice taken from the boxes the percentage showing a general infection of the gut was somewhat lower than in the case of the smears, but a prolonged examination of the apparent negative instances often revealed a slight local infection where folds in the gut wall are of most frequent occurrence.

In no case was any evidence of intracellular infection discovered although careful search was made for it. The gut walls, which seem to be so favourable a situation for the development of *Rickettsia quintana*, were, however, generally more or less lined with them, in some cases so uniformly as to give the appearance of palisading.

My blood remained infective for lice after all the symptoms had completely disappeared. Ova from my stocks were washed on May 17th for several minutes in 4 per cent. lysol and then in running tap water for thirty minutes, they were then dried, put into a clean box, and the lice after hatching were fed upon myself; excreta from this box showed the presence of rickettsia bodies on June 11th and 21st.

Ova from my boxes were washed in the same manner on June 11th and placed in two clean boxes to hatch, the lice in one of the boxes being fed by Dr. Arkwright and those in the other by myself. Smears made of the excreta from these boxes showed that the insects fed by Dr. Arkwright were free from rickettsia bodies on June 28th and July 5th, whereas those fed by myself gave positive results when

tested on June 28th, July 29th, and August 2nd and 6th. Lice were taken from Dr. Arkwright's box on July 20th, placed in a new box and fed upon myself; excreta from this box remained free from rickettsia bodies for ten days but showed them on the fourteenth and eighteenth days.

Ova of *Pediculus capitis* taken from one of my boxes on August 6th and washed in the manner already described were placed in a new box; the lice which hatched were fed on myself, and the excreta from this box showed a slight infection with rickettsia bodies on September 8th, but subsequent tests of excreta from this box, and also from the one containing lice from Dr. Arkwright's stock, have shown no trace of rickettsia bodies up to mid-October. That is to say, lice fed upon my blood four months after an attack of the disease and three months after the disappearance of all symptoms developed the organisms in their guts, so that it would not seem improbable that the occurrence of rickettsia bodies in the lice from healthy persons was due to the lice having fed on a convalescent from trench fever.

CONCLUSIONS.

1. Trench fever patients may remain capable of infecting lice with *Rickettsia quintana* for at least three months after the cessation of febrile attacks or other obvious symptoms.
2. Persons in apparently good health may therefore infect lice with *Rickettsia quintana*.
3. Lice infected with rickettsia bodies indistinguishable from *R. quintana* were present in Warsaw in 1920, and were associated there with a case of trench fever.

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RECENTLY the French Minister of War asked the Académie de Médecine several questions with regard to the best age and most suitable time of the year for calling young men to the colours. He asked whether it would be better to call them up at the age of 19, 20, or 21. The Académie, in its reply, while pointing out that growth in man does not cease until 25, stated that the age for incorporation in the army might be 20, but that the medical examination at that date should be very strict. The end of April was considered the best time for calling up the class of that year, but if a second call was necessary it was thought that it should be made during September. The best barracks available should be used for housing young soldiers, who should be supplied with a complete change of clothes, to be used when they come in tired and wet. The food, it was stated, should be abundant, varied, and prepared by trained cooks.