

but one of which subsequently developed relapsing fever and showed spirochaetes in the blood.

The results of the experiments are summarized in Table I. It is clear that under a pressure of 5 to 10 lb. to the square inch, a number of spirochaetes in some form pass through Berkefeld filters "V", "N", and "W". Spirochaetes were easily found in all the "V" filtrates, but only occasionally in one of the "N" filtrates. The "W" filtrates showed no spirochaetes under the darkfield microscope, but the filtrate caused relapsing fever when inoculated into a squirrel.

The fact that the "W" filtrates and most of the "N" filtrates failed to show spirochaetes under the darkfield microscope does not necessarily mean that these filtrates actually contained absolutely no spirochaetes in their normal form, for it remains possible that the spirochaetes present were so scanty that they were missed when looked for under the microscope. Hence, the fact that such a filtrate caused relapsing fever when inoculated into a splenectomized squirrel does not prove that the spirochaetes were present in an invisible or granular form. Further, since spirochaetes in their usual form have been shown to pass through Berkefeld filters, more direct evidence than has been offered is needed to establish the existence of an invisible or granular form.

Conclusion. The Chinese strain of *Sp. recurrentis* passes through Berkefeld filters "V", "N", and "W" under a pressure of 5 to 10 lb. to the square inch.

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Susceptibility of Rodents (*Myospalax fontanieri*) to Experimental Infection with Rickettsiae of Chinese Typhus.

SAMUEL H. ZIA AND C. H. HU.

From the Departments of Bacteriology and Pathology, Peiping Union Medical College, Peiping, China.

In general, guinea pigs have served satisfactorily as the experimental animal in the study of rickettsial diseases. However, when dealing with the European type of typhus fever, which occurs locally, these animals presented certain disadvantages. The only clinical manifestation of this disease in guinea pigs is a more or less typical period of fever following an average interval of incuba-

tion. With the possible exception of the finding of Durand,¹ who used a special technique, their blood serum has not been found to agglutinate proteus X₁₉. So unless one uses the rarely obtainable rickettsial emulsion as the antigen, there can be no positive serological evidence of this infection. The study of histological lesions would necessitate the sacrifice of the animals which is often undesirable. Rabbits have been used to obtain a positive Weil-Felix reaction, but even then, the titre is usually low and is, therefore, often inconclusive. Rats give only an inapparent infection. Recently the ground squirrel or "Zieselmaus" has been independently^{2, 3} found to be extremely susceptible to the European type of typhus. As many as 70% of the animals infected die from this disease. However, the blood serum of this animal also failed to give a positive Weil-Felix reaction. It was for the purpose of finding another laboratory animal in which these difficulties might be circumvented that led us to make a study of a local species of rodent (*Myospalax fontanieri*), Milne-Edwards; the following is a brief report of our results.

Adult animals, weighing 200 to 300 gm., were used. A preliminary observation period of 7 to 10 days was made before actual use in order to note the effect of confinement on these untamed animals. At the end of this period, each animal received either subcutaneous, or more often, intraperitoneal injections of one-fifteenth of the brain of a guinea pig infected with a passage strain of typhus. The body temperature was taken daily and recorded. It may be mentioned that the normal body temperature of these rodents varies from 36.6°-37.5°C.; in the present study any temperature reading above 38°C. was taken to indicate fever. Animals were bled for blood culture and for the Weil-Felix reaction a few days after they showed fever. It is to be noted that normal animals gave consistently negative Weil-Felix reactions. Some of them were also sacrificed for pathological examination and for reinoculation into guinea pigs.

Altogether 28 animals were used for inoculation with rickettsial material from guinea pigs. Among these, 5 died of secondary infection within one week after inoculation, and these were, therefore, discarded. Among the remaining 23 animals, 16 showed varying periods of fever, preceded by an incubation of 5-12 days,

¹ Durand, R., *Compt. rend. Soc. de biol.*, 1934, **116**, 360.

² Jelin, W., and Grossmann, J., *Arch. f. Schiff. u. Trop. Hyg.*, 1933, **87**, 346.

³ Serebrennaji, A. I., Grünfeld, A. A., and Neumann, M. W., *Zentralb. f. Bakt.*, 1933, **1**, Orig. 129, 254.

with an average of 7 days (7 animals). The Weil-Felix reaction was done on 19 of these animals with 12 positive and 7 negative results. The titre ranged from 1:20 or 1:40 (2 animals) to 1:160 or above (7 animals). The highest titre was 1:640 taken on the fifth day of fever. Ten died during the febrile attack; in some of these animals the serological reaction was positive. Typhus nodules appeared irregularly in the brains of these animals. Of 8 examined, only 2 gave positive findings, one with an extensive distribution, the other with few lesions. A small amount of the brain was reinoculated into guinea pigs and in every case examined, a typical typhus reaction occurred. Of special interest is one animal which showed no fever for a period of 16 days, but gave a positive Weil-Felix reaction with a titre of 1:80; a small amount of an emulsion of its brain produced a typical typhus reaction after inoculation into guinea pigs. Serial passages in the rodents were attempted but owing to the lack of further supply of the animals at that time, only 2 passages were made. Animals in both generations showed regular fever, and a small amount of the brain of one of the third generation produced a typical typhus reaction in guinea pigs.

Rodents found locally and of convenient size were shown to be susceptible to infection with local typhus rickettsiae. They showed not only fever after an incubation period of about 7 to 11 days, but the sera of the majority also gave positive Weil-Felix reactions in titres ranging from 1:20 to 1:160 and above which are considered to be significant. Typhus nodules, however, were found only in 2 of the 8 brains examined. On reinoculation to guinea pigs, the brain of these animals, which included one animal that did not show febrile reaction, invariably gave rise to a typical typhus reaction. It, therefore, appears clear that we have an animal which may prove more advantageous than the guinea pig for the experimental study of typhus.