SCRUB TYPHUS IN HONG KONG

BY

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Cases of scrub typhus have been recognized by local medical authorities in Hong Kong for a number of years, but no account can be traced of the evidence on which the diagnosis has been based. The purpose of this paper is to present the results of serological investigations in cases of scrub typhus and to review briefly the epidemiology of the disease in Hong Kong.

INTRODUCTION

Scrub typhus is a disease caused by Rickettsia orientalis and is transmitted from reservoirs in rodents to man by the larvae of the mites Trombicula akamushi and Trombicula deliensis. This disease is widespread throughout the Far East. Textbooks on tropical medicine include Northern China among the areas where scrub typhus is found, but make no mention of Hong Kong. Simmons et al. (1944) in their review of epidemic diseases in the Far East give Wuchang, Hupeh and other sections of the lower Yangtze valley as the provinces of China where scrub typhus has been reported and note only epidemic and endemic typhus in Hong Kong. Audy (1951) referred to the occurrence of scrub typhus in Hong Kong when discussing the epidemiology of this disease.

YEARS UP TO 1941

Many of the records relating to the years before the Japanese occupation of Hong Kong have been destroyed, but Gray (1952) saw eight cases, six military and two European civilians, in the year 1941 in which the diagnosis of scrub typhus was made. The results of the Weil-Felix reaction are available in four cases only, of which three showed a tenfold rise in titre against OXK, the highest titre observed being 1 in 250, 1 in 1,250 and 1 in 2,500 respectively. One of these cases was fatal, but all post-mortem material was lost during the occupation.

1945-1950: CIVILIAN CASES

It is understood that since the end of the last war sporadic cases of scrub typhus have been notified in Hong Kong, but little information is available. As the annual reports by the Director of Medical Services, Hong Kong, show only the total number of cases of typhus fever notified, it is not possible to determine from these reports alone what proportion were scrub typhus. The annual report for 1950, however, shows one death from mite-borne typhus, but gives no details (Report, 1951). Duck (1949), working in the Government laboratory,
examined sera from cases thought to be typhus fever and during 1946-1949 found five which gave a titre of 1 in 400 or over, and two a titre of 1 in 200, with Proteus OXK.

1945-1949: MILITARY CASES

The records of the laboratory at the Military Hospital, Hong Kong, reveal that six sera from six different patients, five military and one civilian (nationality not stated), examined during 1947 gave titres of over 1 in 320 against OXK and low or negative titres against OX19 and OX2. Only one Weil-Felix test appears to have been performed in each case, and as no relevant clinical details are available it cannot be stated, with any certainty, that these were cases of scrub typhus.

In 1949, Captain G. A. K. Missen, R.A.M.C., examined sera from five military cases which were clinical scrub typhus and demonstrated a considerable rise in titre against OXK during the course of their illness (see Table I).

TABLE I.—MILITARY CASES, 1949

<table>
<thead>
<tr>
<th>Case</th>
<th>Onset</th>
<th>Titre against OXK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Initial</td>
</tr>
<tr>
<td>A</td>
<td>May</td>
<td>1 in 250</td>
</tr>
<tr>
<td>B</td>
<td>August</td>
<td>1 in 50</td>
</tr>
<tr>
<td>C</td>
<td>August</td>
<td>1 in 50</td>
</tr>
<tr>
<td>D</td>
<td>October</td>
<td>1 in 125</td>
</tr>
<tr>
<td>E</td>
<td>October</td>
<td>1 in 125</td>
</tr>
</tbody>
</table>

1950-1951: MILITARY CASES

During 1950 and 1951 ten cases were diagnosed as scrub typhus on clinical and serological grounds. A few cases where the clinical picture or the serological evidence was unconvincing have been omitted from the series. All cases were in British troops.

Laboratory Investigations

As the majority of the cases were admitted to hospital with a diagnosis of P.U.O., certain laboratory investigations were carried out—e.g., white blood counts, thick films for malarial parasites, etc.—but the only significant positive findings were those of the Weil-Felix reactions. The Weil-Felix reactions were carried out by the method described by Felix (1944) using suspensions as fresh as possible. Serum was obtained on several occasions from each patient during his stay in hospital and when possible after his discharge. The results of the Weil-Felix reactions are shown in Table II. The titres against OXK only are given in this table as the titres against OX19 and OX2 were not significant.

It is regretted that it was impossible to carry out any animal inoculation experiments.

Treatment

Chloromycetin was given if the clinical condition warranted this. All cases recovered.
TABLE II.—MILITARY CASES, 1950-51

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Onset</th>
<th>Titre against OXK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Initial</td>
</tr>
<tr>
<td>1</td>
<td>January, 1950</td>
<td>1 in 80</td>
</tr>
<tr>
<td>2</td>
<td>September, 1950</td>
<td>1 in 40</td>
</tr>
<tr>
<td>3</td>
<td>September, 1950</td>
<td>1 in 40</td>
</tr>
<tr>
<td>4</td>
<td>September, 1950</td>
<td>1 in 2,560</td>
</tr>
<tr>
<td>5</td>
<td>September, 1950</td>
<td>1 in 320</td>
</tr>
<tr>
<td>6</td>
<td>October, 1950</td>
<td>1 in 80</td>
</tr>
<tr>
<td>7</td>
<td>June, 1951</td>
<td>1 in 20</td>
</tr>
<tr>
<td>8</td>
<td>June, 1951</td>
<td>1 in 20</td>
</tr>
<tr>
<td>9</td>
<td>August, 1951</td>
<td>1 in 10,240</td>
</tr>
<tr>
<td>10</td>
<td>October, 1951</td>
<td>1 in 320</td>
</tr>
</tbody>
</table>

Illustrative Case History

Sgt. O'S., aged 26. His illness commenced on 3rd January, 1950, when he developed severe headache, general malaise and shivering. He was admitted to a Field Ambulance on 5th January and transferred to the General Hospital on 10th January with a diagnosis of P.U.O. Cervical gland enlargement had been noted on 8th January.

On admission his temperature was 101.2° F., pulse 86 and respiration 20. A rather faint roseolar rash was present on the chest, abdomen, lumbar region and shoulders, but not on the arms or legs. There was an oval, crusted eschar just below the umbilicus. Rubbery discrete glands were palpable in the neck, axilla and groins; they were not tender. The spleen was just palpable. On 10th January the W.B. count was 10,200 per c.mm. with polymorphs 60 per cent., lymphocytes 28 per cent. and monocytes 12 per cent. The rash had faded by 13th January. The Paul-Bunnell test carried out on serum obtained on 14th January was negative. The temperature fell by lysis and remained normal after 15th January. Recovery was uninterrupted.

TABLE III.—CASE No. 1

<table>
<thead>
<tr>
<th>Days after onset</th>
<th>Reading of OXK Titres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hong Kong</td>
</tr>
<tr>
<td>7</td>
<td>1 in 80</td>
</tr>
<tr>
<td>10</td>
<td>1 in 160</td>
</tr>
<tr>
<td>13</td>
<td>1 in 640</td>
</tr>
<tr>
<td>16</td>
<td>1 in 1,280</td>
</tr>
<tr>
<td>21</td>
<td>1 in 640</td>
</tr>
<tr>
<td>35</td>
<td>1 in 320</td>
</tr>
<tr>
<td>76</td>
<td>*</td>
</tr>
</tbody>
</table>

*Not examined.

Serum for Weil-Felix reaction was obtained at three-day intervals for 9 days and further specimens were taken 21, 35 and 76 days after the onset. Each sample of serum was divided in two; one was examined in Hong Kong and the other sent to Dr. Felix, who repeated the tests in London. The results obtained are shown in Table III. The titres against OX19 and OX2 were not significant. Dr. Felix considered that this was undoubtedly a case of scrub typhus (Felix, 1950).
Weil-Felix Reaction in other Febrile Diseases

During the period in question Weil-Felix reactions were carried out on a number of sera from patients suffering from various febrile diseases finally diagnosed as other than scrub typhus. The titre of agglutinins for OXK was usually in the range 1 in 20 to 1 in 80. Titres of 1 in 160 and 1 in 320 were recorded on a few occasions.

Topography

The British Crown Colony of Hong Kong comprises the island of Hong Kong, the Kowloon peninsula and the New Territories which include a part of the mainland leased to Britain, together with a number of islands. The total area of the Colony is about 400 square miles. A large port has been developed in the enclosed waters between Hong Kong island and the mainland.

The island of Hong Kong is some eleven miles long and from two to five miles broad. It consists of an irregular range of hills. The Kowloon peninsula and the New Territories are mainly hilly, although there are extensive areas of flat ground in the north-west of the New Territories.

At the western end of the harbour is a small island known as Stonecutter's Island. This island is about one mile long by one-third of a mile broad and only a few hundred feet in height at its highest point.

Afforestation has been carried out, particularly on Hong Kong island, with considerable success. The lower slopes of the hills are well covered with vegetation. Scrub is common. In one area on Stonecutter's Island the vegetation had been cleared some years ago to make a football pitch, but secondary growth had taken place around the edges by 1949.

Climate

Hong Kong has a subtropical climate of a monsoon type. During summer the relative humidity is high and the temperature around 80° F.; in winter the relative humidity is lower and the temperature around 60° F. The annual rainfall is 85 inches, of which two-thirds falls from June to September.

Epidemiology

The eight cases seen by Gray in 1941 occurred among personnel stationed on Hong Kong and in the New Territories (Gray, 1952). From the information available it would appear that of the five military cases recorded in 1949, two were infected on Hong Kong and three on Stonecutter's Island, and that most of the cases recorded in 1950-1 (Table II) were infected in the New Territories.

Audy (1951, 1952) examined the ears of rats trapped during 1949-1950 on Stonecutter's and Hong Kong Islands and found T. deliensis, a known vector of scrub typhus, in specimens collected in the hot wet period, but species of Eushongastia in those collected in the cool dry season. From this information he concluded that the scrub typhus season in Hong Kong was probably distinct, occurring roughly between May and October. Fourteen of the fifteen cases enumerated in Tables I and II occurred within this period, as did seven of the
eight cases seen by Gray in 1940-1. This evidence supports Audy's contention that the "typhus season" in Hong Kong is between May and October.

In an attempt to discover evidence of infection in the likely reservoir, the rat, blood was obtained by Mr. J. D. Romer, the Government Rodent Control Officer, from rats trapped on Stonecutter's Island between September and November, 1949, and the serum titrated against OXK suspensions. Six sera gave a titre of only 1 in 25. The remainder showed no demonstrable antibody.

**DISCUSSION**

It has long been recognized that suspensions of *Proteus* OXK are more susceptible to non-specific agglutination by sera of man than are suspensions of OX2 and OX19. Further, OXK suspensions are unstable and may consequently be agglutinated by relatively high dilutions of serum from patients who are suffering from diseases other than scrub typhus.

There is a divergence of opinion as to what titre may be regarded as diagnostic of an active infection in scrub typhus. Felix (1944) states that when a patient's serum is examined for the first time, complete agglutination with OXK at 1 in 160 or 1 in 200 may be taken as diagnostic of an active infection and that a rise of titre of at least 100 per cent. may be considered a significant reaction provided that a properly checked suspension is used. Lewthwaite and Savoor (1940) consider that a titre of 1 in 125 against OXK may be regarded as evidence of infection if the clinical condition is that of scrub typhus, but point out that titres as high as 1 in 480 may be found in leptospirosis. Giles and Symington (1950), however, found titres of as high as 1 in 400 occurring regularly as the result of non-specific stimulation. In the series studied by the author and reported in this paper (Table II) the highest titre recorded varied considerably from case to case, although in every instance it was 1 in 160 or more. The majority of cases showed a twofold or greater rise in agglutinin titre against OXK during the course of the disease, and in many it was possible by repeated examination to demonstrate the waxing and waning titre which Lewthwaite and Savoor (1940) regard as almost certain proof of active infection.

The agglutinin titre usually rises late in the course of scrub typhus and thus the Weil-Felix reaction is of limited value in early diagnosis. This late rise of agglutinin titre was noted in many of the cases reported in this paper, e.g., Case 1 (Table III).

**CONCLUSIONS**

The results of the Weil-Felix reactions in cases of scrub typhus in Hong Kong during 1950-51 are recorded.

The available findings of previous workers are noted.

The occurrence of scrub typhus in Hong Kong has been confirmed by serological methods.

Over 90 per cent. of the cases occurred between May and October.

A brief description of the topography of Hong Kong and a few facts relating to the epidemiology of scrub typhus in the Colony are given.
Foot Ailments in Infantry Recruits

ACKNOWLEDGMENTS

My thanks are due to Dr. Felix for repeating certain of the Weil-Felix tests and for his advice; to Dr. Gray for the information on the pre-war years; to Dr. Audy for making available the results of his entomological researches; to the laboratory staff of 33 General Hospital for technical assistance; and to my colleagues, especially Captain G. A. K. Missen, for their co-operation. I am indebted to the Director of Pathology for permission to publish this article.

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AN INVESTIGATION OF FOOT AILMENTS IN INFANTRY RECRUITS

BY

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The foot troubles of the soldier have become proverbial and, in war-time conditions particularly, they present an appreciable military problem. Melville (1909), for example, stated that thirty thousand German soldiers were incapacitated by foot ailments during the Franco-German war, whilst reports by Bingham (1944), Burkitt (1941), Burnham (1944), and Schmier (1946) emphasized that the problem was still one of considerable magnitude during the 1939-1945 war. Recent surveys of troops in home stations by Matthews (1946), Hopkins et al. (1947), and Davies (1952), who studied fungus infections of the feet, and by Kark (1944) and Berkman (1944), who studied forefoot pain and foot strain in patients attending surgical and orthopedic clinics, demonstrated that a large number of these soldiers suffered from foot complaints. In tropical climates, of
Scrub Typhus in Hong Kong

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