Editorial

CAN ARTHROPODS TRANSMIT LEPROSY?

The mode of transmission and spread of leprosy has still not been defined. Clearly it is of the greatest importance for the control of leprosy to discover the answer to this question. The huge load of *Myco. leprae* in the tissues of patients with borderline and lepromatous leprosy provides an ample source of bacilli for directly infecting contacts, or for infecting the environment and thereby indirectly infecting contacts. It is on this basis that the spread of leprosy has dogmatically been said to arise from skin-to-skin contact during prolonged and intimate contact. However, histological studies on the skin of bacilliferous patients show how rarely organisms are shed from the epidermis. On the other hand large numbers of bacilli are shed from the nasal mucosa and upper respiratory tract, a source of infection that has been particularly stressed by Dr Pedley in his series of excellent papers in *Leprosy Review* (1970, **41**, 31) during the last few years. *Myco. leprae* from this source could enter contacts *via* the upper respiratory tract and lungs in a manner comparable with the transmission of tuberculosis, but as yet there is no direct proof. Because natural infections with *Myco. leprae* have been found in no other animal species than man we can safely assume that the source of infection is man. On this basis it is theoretically possible that *Myco. leprae* could be carried from man to man *via* a temporary host in which the bacilli survive for a limited period, and any insect which bites man could provide such a host. Hence the hypothesis that arthropods—mosquitoes, bedbugs, lice or scabies mites—may play a rôle in the transmission of leprosy. This is not a new hypothesis, but hitherto it has not been tackled scientifically, and only within the last ten years have laboratory methods been available to test the hypothesis. In the following pages of this issue of *Leprosy Review* Dr Balasubrahmanyan and his colleagues in Pondicherry, with the collaboration of Dr Kirchheimer from the U.S.A. Public Health Services Laboratory at Carville, present their preliminary results of studies undertaken in India since 1969 on the possible rôle of arthropods in the transmission of leprosy.

Since the skin of patients with active and untreated borderline and lepromatous leprosy is heavily infected with viable *Myco. leprae,* arthropods at the time of feeding on such patients could pick up bacilli from the dermal tissues, or take up bacilli in the blood feed. Therefore the investigators first confirmed that untreated patients with borderline or lepromatous leprosy had acid-fast bacilli in their peripheral blood. They showed that all such patients had a significant bacteraemia of between 5000 and 500,000 acid-fast bacilli per ml of blood, quantitatively comparable with the bacteraemia observed by Drutz *et al.* [*New Engl. J. Med.*, (1972) **287**, 159] in patients with lepromatous leprosy. These figures are sufficient for the blood feed of an arthropod to contain several hundred *Myco. leprae.* Still more significantly the Pondicherry group applied the mouse-footpad technique to confirm that the acid-fast bacilli present in the blood

from these patients were viable and their pattern of multiplication resembled that of *Myco. leprae.*

The next sequence in their systematic studies was to see whether mosquitoes (*Culex fatigans*) and bedbugs (*Cimex hemipterus*), allowed to feed on patients with untreated lepromatous leprosy, contained acid-fast bacilli. For these experiments, laboratory-bred strains of mosquitoes and bedbugs, which they showed were free of acid-fast bacilli, were allowed to feed freely on lepromatous patients and were then collected, homogenized, and the homogenates stained for acid-fast bacilli. They showed that, after feeding
mosquitoes and bedbugs contained small numbers of acid-fast bacilli and these bacilli failed to grow on medium suitable for the cultivation of mycobacteria. They have also inoculated a series of these homogenates from mosquitoes and bedbugs into the footpads of mice and to date have obtained from two groups of mosquitoes, growth patterns of mycobacteria consistent with those characteristic of *Myco. leprae.* In one group of mosquitoes the bacilli were isolated immediately after feeding, but in the other group not until 48 h after feeding, thereby demonstrating that *Myco. leprae* can survive in mosquitoes for the period of time which could elapse before an infected mosquito again fed on man.

Their final series of studies was undertaken on collections of the same species of arthropods obtained from two sources—"patient collections", that is, arthropods from houses in which there was an open case of lepromatous leprosy, and "random collections", i.e., from houses in which there were no patients with leprosy. Groups of arthropods of each species from these collections were homogenized, stained for acid-fast bacilli, inoculated on to medium for the isolation of mycobacteria, and a proportion inoculated into the footpads of mice. From these studies less consistent results have been obtained, since acid-fast bacilli were seen at least as frequently in homogenates of arthropods from random collections as from patient collections. Moreover, from both collections a very small proportion of the homogenates revealed colonies of mycobacteria on culture media. At the time of writing the authors' studies in mice had not been maintained long enough to identify any of the isolates as *Myco. leprae.* Their findings here are eagerly awaited.

The importance of these studies in Pondicherry are that they have established beyond doubt the ability of arthropods to take up acid-fast bacilli at the time of feeding on skin-positive patients with leprosy. Moreover, the investigators have applied the mouse footpad technique to identify the acid-fast bacilli as *Myco. leprae* on the basis of their growth pattern in this experimental model. This is a very considerable achievement, although they still need to demonstrate that the isolates of acid-fast bacilli do invade the dermal and peripheral nerves of the inoculated mice. These same extended and strict criteria must also be applied to the acid-fast bacilli which they have obtained from the arthropod collections from houses with known patients as compared with random samples from non-patient houses. Allowing for these essential further confirmations their studies will show that arthropods can be one mode by which leprosy can be transmitted. However, the very significant observations on the nose in leprosy by Dr Pedley, referred to above, would seem to be a still more likely route of transmission and therefore must be investigated with the same expertise that is currently being applied by the Pondicherry investigators to the rôle of arthropods.

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