

self-disinfection is not to be recommended to young people, but that we must impress only chastity upon them as the best means of protection. We wish to handle this matter if possible in such a way that these prescriptions can only be given by doctors and the "Beratungsstellen." I do not consider it right to have the advertisements of these methods of self-disinfection in any of our exhibitions or public advertisements.

At the most we should agree that printed circulars could be obtained by request at our exhibitions concerning these means of self-disinfection, and that attention should be drawn to these circulars in some way.

But this must be so arranged that no young people, for example, can obtain them.

On the other hand, I believe that in our consulting hours we doctors should and must give information to all who have been ill or who wish to have these means of self-protection, as to what they should do to protect themselves.

I also hold the view that the State, as such, should not be allowed to handle the question of self-disinfection but that this must be done privately, and as I have indicated above, in the most confidential and decency-observing manner possible.

I believe that here in Germany, we are, on the whole, fully in accord with the National Council for Combating Venereal Diseases, and I should be very pleased to hear from you that you agree with my views. At the same time let me thank you for your *Health and Empire* journal, which has interested me very much. I hope shortly to send you a small contribution from my pen on the new laws we are drawing up on the combating of sexual diseases.

Believe me, yours sincerely,

Dresden, Jan. 13th, 1922. (Signed) E. GALEWSKY.

KALA-AZAR AND THE BED BUG.

To the Editor of THE LANCET.

SIR,—The announcement in the *Indian Journal of Medical Research* for January, 1922, of a telegram, received from Mrs. Adie, stating that she has found a swarming infection of Leishman-Donovan bodies in the salivary glands and ducts of *Cimex rotundatus* caught in the bed of a suspected kala-azar case, and that this discovery positively proves that the bed bug is capable of transmitting the disease through biting, raises once again the whole question of the transmission of this disease. In the light of the announcement it may be well to review the various investigations which led to the bed bug being accused of transmitting kala-azar, and to weigh the evidence which has been adduced in favour of this hypothesis, for, however probable it may be, it must always remain a hypothesis till the actual transmission experiments have been carried out. The announcement, to which you drew attention in an annotation in THE LANCET of Feb. 11th, may lead to the hasty conclusion that the method of transmission of the disease by the bed bug has at last been solved.

When kala-azar first became known as a distinct disease in India, after the investigations of Leishman, Donovan, Rogers, and others, attention was turned to the discovery of a vector. It was realised that kala-azar was a house disease and Rogers and many others considered the bed bug as a possible agent. This elusive insect is admirably suited to play a part in the spread of infections. It does not live on its host but sucks his blood at night, returning in the daytime to any shelter it may find. It ingests a large quantity of blood on which it may survive for long periods without further feeding. Every time it feeds, it may do so on a different individual, while it is easily transported from place to place in bedding or furniture. In spite of these facts, though the bug has been accused of carrying many diseases, it has never been proved to carry any one of them.

That the bug was suspected as being the carrier of kala-azar was only natural, but against this view is the very strong argument that the disease in India is peculiarly limited in distribution, while the bed bug occurs everywhere. In order to obtain more definite evidence Patton turned his attention to the behaviour of the Leishman-Donovan body in the bug. He demonstrated the presence of Leishman-Donovan bodies in the peripheral blood of cases of kala-azar

and proved that bed bugs fed on these cases ingested parasites with the blood they imbibed. Your notice in last week's LANCET suggests that the scantiness of parasites in the peripheral blood argues against any invertebrate vector acquiring infections from this source. It has been demonstrated that cultures, which ultimately contain thousands of flagellates, can be obtained from a few drops of finger-blood, and we have no reason to suppose that the invertebrate vector, whatever it may be, may not obtain from the blood a sufficient number of parasites to lead to its infection. Patton was able to prove that the organism ingested from the peripheral blood of cases of kala-azar developed into a fully formed flagellate in the stomach of the bug, as Rogers had shown it did in the culture tube. This fact was regarded as proof that the bug was the carrier of kala-azar. It was, however, discovered by the writer that other flagellates, such as the rat trypanosome, were also able to undergo a development in the bug, and furthermore, that the parasite of oriental sore of Bagdad, a disease which is certainly not carried by the bug, also developed into flagellate stages in this insect. It was concluded, with ample justification as subsequent investigations prove, that the stomach of the bug could act merely as a culture tube on account of the large quantity of slowly digesting blood it contained and that the mere fact that the Leishman-Donovan body became a flagellate in the stomach of the bug was in itself no proof that this insect was its natural host. This conclusion has received support from experiments conducted subsequently by Patton himself. He has investigated the length of time the flagellates can persist in the bug and has proved that those developed from the Leishman-Donovan body may still be present 41 days after the parasites were first taken up. He has, however, shown that other flagellates, of which the bed bug cannot possibly be a host, such as those of the flea and house-fly, can survive in the bug for even a longer period. The mere persistence of the Leishman-Donovan body in the bug has thus taken us no further towards arriving at a final verdict.

The next step was the announcement by Mrs. Adie last year that the Leishman-Donovan body, after being taken up by the bug, actually entered the cells of the stomach and there underwent a development comparable with that which is known to take place in the case of the rat trypanosome during its development in the flea. It is unfortunate that this process was only observed in dead bugs in which the cells of the stomach must evidently be in an unnatural condition and subject to invasion by organisms in a manner which would not occur in life. Patton states that he has confirmed these observations, but here again it is not clear that the intracellular stages were observed in living bugs. Nevertheless, he claims that "this is the final proof that *Cimex* is the true invertebrate host of *Herpetomonas donovani*." It is maintained that the flagellate enters the cell of the stomach and there becomes the "thick-tailed" form, which was first described by Cornwall, and that this proceeds to multiply within the cell. No details of Patton's technique are known, but in the case of those made by Mrs. Adie it is far from clear from the illustrations that all the forms depicted are really Leishman-Donovan bodies, or developmental stages of these. Some of them have the appearance of parasites of a different nature entirely—possibly sporozoa—and that other parasites may be present is proved by the fact that nematode larvæ occurred in these bugs. It is useless to speculate as to how the latter gained entrance to the bugs, but it is clear that observations made on bugs which have been dead some days and which have other concurrent infections cannot be employed or must be employed with the utmost caution in making deductions as to what happens to the Leishman-Donovan body under natural conditions. From Mrs. Adie's results and his own confirmations of these, together with the fact that he has never found the least evidence of a salivary gland infection during the many years he has investigated the subject, Patton comes to the con-

clusion that the parasite is transferred to man by the bug being crushed on the skin and not by the bite of the bug.

It is difficult to judge of the significance of the intracellular stages in the bug, but one must be cautious in concluding that what occurs in dead cells is an indication of what will occur in life. Neither Mrs. Adie nor Patton has obtained evidence of the intracellular stage in living bugs, and it seems not improbable that just as the flagellates of the flea and house-fly were shown to persist in the bug as long as, or even longer than, the parasite of kala-azar, so intracellular stages would occur in the case of dead or dying cells. The observations of Mrs. Adie and Patton were made on crushed material examined fresh and in smears, a method which gives very erroneous ideas of the true relation of parasites to cells. It is highly significant that in the same number of the *Indian Journal of Medical Research*, Cornwall describes experiments he has made with bugs with the object of confirming Mrs. Adie's observations. Cornwall employed live bugs fed on cultures and the stomachs were fixed entire and sectioned without disturbing the cells. Though heavy infections of the stomach occurred, he could not obtain the slightest evidence of any intracellular stage. Furthermore, he concludes that the "thick-tailed" form first described by him and upon which Mrs. Adie and Patton lay so much stress, is merely an abnormal form and has no place in the true life-cycle of the parasite. It is clear, therefore, that there is no real evidence that an intracellular stage occurs during the development of the Leishman-Donovan body in the living bed bug and that the stages which have been found in the dead bugs may be merely a culture of the flagellate in dead or dying cells, and, as already remarked, it is not improbable that other flagellates may behave in a similar manner under like conditions. Patton's statement, therefore, that "the final proof" has been obtained seems premature.

We now come to the last stage—namely, the announcement contained in Mrs. Adie's telegram that Leishman-Donovan bodies have been found in the salivary glands of the bug. If this is correct, then Patton's carefully argued conclusion expressed in the same number of the *Journal* that infection is spread by the crushing of the bug on the skin will hardly be necessary. On Mrs. Adie's observation itself it is difficult to form an opinion from the few details which the telegram contains. In the first place, it is evident that the bug came from the bed, not of a case of kala-azar but only a suspected case, and there is no proof that the bug had even fed on this particular individual. Furthermore, it is quite clear that the statement that the parasites in the salivary glands were actually Leishman-Donovan bodies requires proof. It is notoriously difficult to identify flagellates of this kind. Those which produce kala-azar and oriental sore are often indistinguishable from purely insect flagellates which give rise to no disease and are never parasitic in vertebrates. However closely the salivary-gland forms seen by Mrs. Adie resembled the parasites of kala-azar, it is impossible that she can have obtained proof, from the single observation, that she was actually dealing with what she supposes the organism to be. It is quite possible that the bed bug may occasionally harbour a flagellate of its own, though, if this be so, Mrs. Adie is the first to discover such an infection. Flagellates resembling the Leishman-Donovan body occur in many arthropods. They are mostly parasites of the intestine but occasionally invade the body cavity, salivary glands, and other organs, while in one case a development in the cells of the stomach has been described. It is possible that Mrs. Adie was dealing with a rare infection of this kind. As an illustration of the confusion to which such an organism may give rise, we have only to remember the natural flagellate of the tsetse-fly which was frequently mistaken for developmental stages of pathogenic trypanosomes in Africa. The fact that the flea harbours a flagellate very similar to that of kala-azar has often led to the latter

being regarded as the kala-azar parasite itself and to the view that Mediterranean kala-azar is transmitted by the flea.

The fact that thousands of bugs have been dissected during kala-azar investigations without a single instance of a natural flagellate of the bug being discovered may suggest that Mrs. Adie was actually observing the parasite of kala-azar. On the other hand, thousands of bugs which have taken up the parasite of kala-azar, or have had opportunity of doing so, have also been examined without evidence of salivary gland infection by the parasite being found. The single instance brought to light by Mrs. Adie is capable of either interpretation. Whether she was dealing with a harmless flagellate of the bug or a developmental stage of the Leishman-Donovan body it is evident that a salivary-gland infection is of very rare occurrence. The observation is undoubtedly a valuable one and may be very suggestive in view of the fact that the bug, as far as we know, rarely feeds on anything except human blood, but unfortunately the final proof of the nature of the flagellate is lacking and cannot be obtained till many more similar instances have been seen. If it could be demonstrated that laboratory-bred bugs which ingest Leishman-Donovan bodies from the peripheral blood of cases of kala-azar show developmental stages in the stomach and within the cells of this organ and that this is followed by an infection of the salivary gland, then there would be great presumptive evidence in favour of regarding the bug as the vector, though the final proof could only be obtained by the actual transmission of the disease. Up to the present this has not been done. That opinion in India is still undecided is borne out by the fact that in this one number of the *Indian Journal of Medical Research* we find that, as a result of the discovery of the so-called intracellular stages, Patton considers that the final proof that *Cimex* is the invertebrate host has been obtained, and that infection occurs through the crushing of the bug on the skin. Mrs. Adie wires that her discovery positively proves that the bed bug is capable of transmitting the disease through biting, while Cornwall suggests that it would be well to give the bed bug a rest in connexion with leishmaniasis and that some other possible vector be carefully investigated. From an epidemiological point of view there is something to be said in favour of the bed-bug hypothesis, but the wide distribution of the bug compared with that of kala-azar is against it. Patton believes that the fact that only a small percentage of bugs are able to become infected and remain so explains why the distribution of the bug does not correspond with that of kala-azar—presumably because there is only a remote chance of infected bugs being transferred from place to place. This argument seems to ignore the fact that disease is rarely spread by the transportation of infected insects, but by the movements of already infected human beings. Cases of kala-azar have constantly moved from the endemic centres in India to other places where it does not exist, and though in these bed bugs abound, the disease has never become established. This is one of the most puzzling features of kala-azar, and if the ubiquitous bug should prove to be the vector, it will be very difficult to explain why the disease is limited to special endemic foci.

We may conclude, therefore, that the bed bug, though a suspected agent, still awaits the final verdict, and that unless more tangible and convincing evidence is forthcoming the jury will certainly disagree. Every credit is due to the prosecution for their most careful and exhaustive inquiries which have extended over many years, and which have been stimulated by a desire to rid the world of a harmful parasite, but the elusive bug, which has been acquitted of so many charges, has so far escaped sentence in the case of kala-azar also.

I am, Sir, yours faithfully,

C. M. WENYON,

Feb. 12th, 1922. Wellcome Bureau of Scientific Research.