

two were sacrificed after 271 days of such isolation and were both found to be negative.

Giant hamster series. A total of ten tested negative giant hamsters were kept in pots with lousy positive giant hamsters. In two cases the animals died and carcasses were decomposed. The other eight at autopsy after 22, 23, 52, 63, 116, 125, 231 and 286 days were found to be negative. The giant hamsters withstood the conditions of the pots much less successfully than the striped hamsters due in large part to their extreme lousiness, which hastened their death.

A tested negative giant hamster received 15 to 20 giant-hamster lice, a few of which had fed on a heavily positive striped hamster. This giant hamster was kept by itself in a pot and at autopsy after 229 days was found to be negative.

Discussion. It is thus seen that there was no demonstrable transmission of kala-azar from lousy positive to negative hamsters kept in close proximity over relatively long periods of time.

Summary. (1) No development of *Leishmania donovani* in the two species of hamster lice studied was demonstrated, but these organisms occasionally survive for a short period in the striped-hamster louse.

(2) Attempts to transmit kala-azar from hamster to hamster by means of hamster lice were completely unsuccessful.

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Attempts to transmit kala azar by means of bedbugs (cimex sp.).

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Since Patton in 1907 demonstrated that *Leishmania donovani* would develop into the flagellate stage and multiply in the intestine of the bedbug, a number of investigators have studied the bedbug as possible vector of both kala azar and oriental sore.

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(For critical review of the literature and bibliography see Wenyon, Tropical Diseases Bulletin, 1922, xix, 1-18.) Although the organisms of both kala azar and oriental sore are able to produce abundant growths of flagellates in both *Cimex lectularius* and *C. rotundatus*, every effort to transmit these diseases to experimental animals and even to man by means of the bites of bedbugs has failed, and attempts to produce leishmaniasis by inoculating such infected bugs into animals has failed with a single exception. Shortt and Swaminath¹ fed bedbugs on patients and then injected these into mice. Cultures of *Leishmania* were obtained from one of five mice after 123 days. Furthermore, flagellates have not been found in hundreds of bugs taken from the bedding of kala azar patients (Mackie,³ Shortt and Swaminath²). In spite of the many failures to transmit, several investigators, notably Patton,⁴ have maintained the bedbug to be the vector of kala azar.

Although there are grave objections to the bedbug as vector on epidemiological grounds, and the many uniformly negative transmission experiments fail to incriminate the bedbug as vector, we have thought it desirable to attempt to transmit kala azar, using the highly susceptible striped hamster. The lack of such suitable experimental animal has been a serious handicap to previous workers. The present paper is a report of transmission experiments made with *Cimex lectularius*, the common bedbug of North China, and with the closely related *Cimex pipistrelli* parasitic on bats. The work on the latter was undertaken along with the investigation of rodents and other animals and their ectoparasites as possible reservoirs and vectors of kala azar. The bat *Cimex*, living with the bats in the walls of houses, is frequently found in large numbers inside the house and occasionally feeds on man. One of us was bitten while collecting them. The investigation of the bat *Cimex* was especially desirable on account of its association with man and the ready development of *Leishmania* in other species of *Cimex*.

Material and Methods. Abundant *Cimex lectularius* material was obtained from various sources in Peking and Hsüchowfu, Kiangsu, not associated with kala azar patients or infected animals. Specimens of *Cimex pipistrelli* were found in small num-

¹ Shortt, H. E., and Swaminath, C. S., *Indian J. Med. Res.*, 1924, xi, 965.

² Shortt, H. E., and Swaminath, C. S., *Indian J. Med. Res.*, 1925, xiii, 143.

³ Mackie, F. P., *Indian J. Med. Res.*, 1915, ii, 942.

⁴ Patton, W. S., *Indian J. Med. Res.*, 1922, ix, 496.

bers on bats in Hsüchowfu, but most of our material was obtained from a certain room in a foreign house in Hsüchowfu, the outer wall of which harbored many bats. Of three adult bat bugs examined soon after being brought to the laboratory, all three were infected with trypanosomes or crithidiform flagellates. The few "wild" nymphs examined were negative for flagellates. No trypanosomes were found in the bats from which some of these bugs were taken.

The method followed was that used in experiments with hamster lice described in another paper.⁵ A pair of striped hamsters consisting of a tested positive and a tested negative were kept in a partitioned cage in an earthen pot covered with muslin and made insect-proof by means of a vaseline seal between the muslin and the edge of the pot. Both species of *Cimex* thrive in such pots. They feed readily on the hamsters and use as breeding and hiding places either pieces of corrugated cardboard wired to the cage, or the dry bean hulls in the bottom of the pot.

TRANSMISSION EXPERIMENTS.

Cimex lectularius Series. A total of eleven tested negative striped hamsters have been kept in pots with positives and bedbugs. Of these six at autopsy after 112, 166, 261, 286, 286 and 286 days respectively were negative. The remaining five are still in the experimental pots, but were all negative on liver puncture after 176, 183, 194, 194 and 194 days respectively of contact with positive hamsters and bedbugs.

Cimex pipistrelli Series. A total of ten tested negative striped hamsters have been kept in the pots with tested positives and bat bugs. Four of these were autopsied after 89, 114, 161 and 162 days respectively and were found to be negative. The other six are still in the pots but were negative on liver puncture after 112, 112, 158, 158, 158 and 158 days respectively.

Discussion. In these two series of experiments, in the presence of abundant insects and with close contact of heavily positive and negative hamsters known to be highly susceptible to kala azar, no transmission has been demonstrated. This is in accord with the results of previous investigators. It may be noted that comparable "experiments" with man as subject are taking place

⁵ Young, C. W., and Hertig, M., PROC. SOC. EXP. BIOL. AND MED., 1925-6, xxiii, 395.

constantly in most of the kala azar houses in China. The majority of kala azar cases in China are solitary, *i. e.*, there is only one infected person per household, with no obvious special relationship to other cases in the vicinity. Adults and children frequently sleep crowded together, the patient among them, and bedbugs are usually plentiful. If bedbugs were the vectors of the disease a succession of cases among the members of a kala azar household would be expected. Our observations indicate that this, in general, is not the case in China.

These transmission experiments are still in progress and will be extended. In addition the survival of the parasites in both species of *Cimex* is being studied. Bugs are fed on positive hamsters and after various intervals are injected into tested negative hamsters. In the few cases thus far in which the time since inoculation has made conclusive results possible, these have been entirely negative.

Summary. Attempts to transmit kala azar from heavily infected hamsters to highly susceptible negative hamsters by means of *Cimex lectularius* and *Cimex pipistrelli* have been unsuccessful.