

Rule 8.—This would require the sanction of Government which might be applied for beforehand and adopted when the local authority thought necessary.

TRANSMISSION OF PLAGUE IN THE ABSENCE OF RATS AND RAT FLEAS.

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ON July 25th, 1909, plague broke out in the villages of Kyaukpin and Ywatha, Meiktila district. One case occurred on that date and two further cases occurred on the 26th and 29th July respectively. Dead rats were found in the villages (Kyaukpin and Ywatha are practically one) and in these rats *B. Pestis* was found. The disease had been imported by a case from Yamethin. I visited the village for the first time on August 1st, and gave orders for evacuation, which was completed by August 3rd, the villagers, some 900 in number, removing to mat shelters in the surrounding fields.

It was reasonably hoped that the only further cases, if any, would be amongst persons who were already infected on the date of evacuation.

The further sequence of events was as follows:—

On the 5th, 7th, 8th and 12th August one case occurred each day amongst these villagers segregated in the fields. On the 16th there was one case, on the 17th two cases, on the 24th two cases. These results were considered very disappointing, and not as good as those generally obtained by the complete evacuation of infected villages, a measure, which has been very successful in this division.

I had then to consider whether the evacuation was not thoroughly done, or whether some other factor was at work of whose existence we were ignorant.

Accordingly on the 15th August every mat shelter and also the people's clothing, bedding and property of every sort was thoroughly searched by coolies to see if any rats had accompanied the people from the village, or if any dead rats had been removed inadvertently along with their property. This search was very thoroughly carried out, but not a single rat was found, dead or alive.

The fact then appeared that plague cases were occurring in the absence of rats.

Somewhat puzzled by this, although I had by now suspicions of what was happening, on the 18th August I again removed all the villagers to new sites in the fields varying in distance from 400 yards to 1½ miles from the village. In spite of this, two more cases occurred amongst these people on the 24th August. Of the nine cases which occurred after evacuation seven occurred in families in which there had already been a

previous case, while in two cases no direct connection could be made out.

All the nine cases were bubonic in type, seven were fatal, none showed any pneumonic symptoms; putting infection by sputum out of court. On the other hand, the factor of *direct contact* with a previous case was evidently an important one, it was present in 77 per cent. of the cases.

The infection then might have taken place either by means of (a) infected discharges or (b) some parasite. As regards (a), the report of the last plague commission states that even in a septicæmic case the infectivity of urine or fæces is small.

Further pneumonic plague was not present. As regards (b), I was aware of the researches of Yerjbitski, who had proved that plague can be transmitted by other parasite than the rat-flea.*

On August 15th I started collecting bed-bugs obtained from the bedding, clothing, mats, etc., of the segregated villagers. The blood contained in the alimentary canal of these parasites was examined for plague bacilli.

All the bugs were of the *Cimex Rotundatus* variety.

The results of the examination may be classified into two sets.

Series I.—Consists of bugs collected indiscriminately from infected and non-infected huts.

Number of bugs examined	... 24.
Number containing <i>B. Pestis</i>	... 1.
Percentage of infected bugs	... 4·14%.

Series II.—Consists of bugs collected from infected huts only.

Number of bugs examined	... 27.
Number containing <i>B. Pestis</i>	... 6.
Percentage of infected bugs	... 22·2%.

These results are open to a very valid objection *i.e.*, the presence of *B. Pestis* in the contents of the alimentary canal of the bed-bug is vouched for merely by its recognition under the microscope. I was not able to make cultures owing to want of facilities, but I am myself perfectly satisfied that the bodies observed were plague bacilli.

I have examined some 800 slides of human and rat's blood for plague bacilli since January.

The bacilli showed in all cases polar staining, in two slides they were absolutely typical and in others, they showed considerable divergence from the normal type; they were enlarged, vacuolated, and some took up the stain badly. I presume that this is due to the action of the alimentary juices of the bacilli.

In order to obtain further proof, the following experiment was conducted. A number of bed-bugs were obtained from Meiktila jail where there has never been a case of plague, and a healthy rat was also obtained from Meiktila town. On August 21st I took five bed bugs out

* *Journal of Tropical Medicine and Hygiene*, May 1908.

to Kyaukpin and allowed them to bite the leg of the case which occurred on the 16th and was still alive. This case had a well marked bubo and a temperature of 102°.

The bugs were allowed to bite for ten minutes and were not removed until it was seen that they actually contained blood. They were then brought back to Meiktila. On August 22nd they were applied to the shaved abdomen of a rat but all refused to bite, owing, I fancy, to the soap used in cleaning the rat. On August 23rd they were again applied to the rat's abdomen and bit freely. The rat was carefully fed and watered, but on the night of the 26th-27th it died. Smears made from this rat's spleen showed plague bacilli in very large numbers, and of most typical appearance, showing well-marked bi-polar staining. It may be noted here that an interval of 48 hours elapsed between the time when the bed-bugs bit the plague patient and the time when they bit the rat, and that after the rat was bitten only some 60 hours elapsed before it died of plague.

Following out Verjbitski's methods, I collected bed-bugs from the clothing and bedding of infected cases and crushed them into agar tubes in order to get a culture of *B. Pestis*. This was tried on three occasions, but each time the growth of non-pyogenic organism, moulds, etc., was so vigorous that no growth of *B. Pestis* was detected. There was no proper laboratory available, and it was difficult to carry out this part of the investigation with any hope of success. As regards the epidemic, single cases kept on occurring up to September 16th. The Civil Surgeon, Meiktila, and myself decided to allow the people to return to the village on 18th September. No further cases occurred after this which is curious, as between 10th and 16th September, seven cases occurred. With the return to the village the epidemic ceased absolutely, and there have been no cases since December 3rd. Verjbitski used very large numbers of bed-bugs in his series of 18 experiments, and amply proved that the bed-bug can transmit plague from guinea-pig to guinea-pig. He also explains how infected bugs might convey the disease to man either by "directly introducing bacilli adherent to its proboscis, or owing to the irritation it produces it may be crushed and the infective contents rubbed into the slight puncture occasioned by its bite." This point is proved in his experiment No. XLII in which the hind legs of six guinea-pigs were slightly scratched and the contents of crushed infected bugs spread over the place. All six guinea-pigs died of plague.*

Verjbitski's experiments were conducted in 1902-1903 and first published in English in 1908.† His work proves absolutely the transmission of plague in guinea-pigs by bed-bugs,

* *Journal of Tropical Medicine and Hygiene*, May 1908.

† *Ibid.*

but no one so far seems to have considered these results as having a more than theoretical value, or to have reported transmission of plague during all epidemic by such means. In view of the conclusion of the Plague Commission that plague is transmitted by the rat-flea and by it alone, and the great amount of evidence that has been recorded in proof of this statement, one feels a certain amount of diffidence in offering a contrary opinion. Still, transmission of plague by bed-bugs has been amply proved under elaborate conditions. It is possible in natural surroundings, and if it can be proved to occur in nature it is a factor of some importance in plague prevention. I trust that I have made my position on this point quite clear, I have seen the chain of events involved in rat-flea transmission only too often; it is only the unique and lonely position accorded to the rat-flea to which I object, and I have recorded my experiences above to show that it is possible for another parasite to transmit plague, and to transmit it directly, without infected rats being present.

I am fully aware that these observations are very incomplete, but I hope that other observers who have material available may be able to investigate this question further and settle whether the rat-flea is the only transmitter of bubonic plague, or whether there are not other possible channels of transmission.

I am indebted to Captain J. Good, I.M.S., for valuable assistance and advice.

A Mirror of Hospital Practice.

A CASE OF HYPERTROPHIC PULMONARY OSTEO-ARTHROPATHY.

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THE following case of a disease which is very rare was admitted into the Mayo Hospital recently. The man had a very small cranium, but the facial development was not abnormal, though his face looked large from in front, owing to the poor development of the frontal part of his skull.

His hands and arms below the elbows, and his feet, ankles, legs and knee-joints, were all markedly hypertrophied. He was suffering from longstanding cough and had a cavity of fairly large size in his right apex. A complete and detailed description of the case is appended,