small settled communities arose, and intercourse with Pacific Islanders and Malays increased. The fact, if it be one, seems rather surprising, since some intercourse with islanders and Malays is believed to have existed from far earlier times. The nomadic habits of aborigines may possibly be the explanation.

Some, at least, of the ways in which a high standard of living tends to reduce the malaria rate, can be understood. Modern houses are less attractive to anophelines than hovels; abundance of good food increases the resistance, and accelerates the recovery rate. In Queensland, we have, in addition, the general use of mosquito nets, probably a very important factor in diminishing the number of bites, even though the nets be usually defective, and not universally used. The common use of quinine mixtures in Queensland has also to be remembered.

A factor to which much attention has been given of recent years in other parts of the world is an abundance of live stock preferred by the anophelines to man. It is a factor which probably becomes of greater importance as improvement takes place in the lighting, ventilation, and cleanliness of the human habitations. I do not know how far the habits of *Anopheles annulipes* make it probable that this may be a factor of importance in Australia.

Malaria is certainly still to be found in some parts of Australia, for instance, in some of the stations on the Gulf of Carpentaria. It may possibly prove that the aboriginal camps in these places are the strongholds of the disease, in spite of some reports that aborigines do not suffer from malaria. But probably even in these regions the disease is not very prevalent. The only cases of malaria admitted to Townsville Hospital during the last two years have been from New Guinea.

Our thanks are due to the staff of the Yarrabah Mission Station for their hospitality, courtesy, and the trouble they took to give us every assistance; also to the medical practitioners of Cairns, Port Douglas, and Innisfail for their considerate helpfulness.

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BRENT

Notes on Trypanosoma Lewisi and its Occurrence in Rats from Ships.

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SINCE the finding of the Trypanosome of rats by Lewis (1878) in India, numerous records of occurrence and distribution have been published. Some observers have reported detailed findings of percentage prevalences among different rat species. But so far as the literature at our disposal shows, there is a lack of information regarding the questions of seasonal prevalence and of the occurrence of *T. lewisi* among ship rats. It was, therefore, considered of possible interest to record the results of recent investigations carried out at Townsville, although the number of rats examined was relatively small.

In Australia, Bancroft (1888) and Pound (1905 and 1907) have reported finding *T. lewisi* among wild rats in Brisbane; Cleland (1906), in Perth; and Johnston (1909), in Sydney. Breinl (1911) first recorded percentage incidence figures in Australia; in North Queensland he found 15 per cent. of rats infected. Fielding (1927) found in the same locality that 14 per cent. of all living rats examined were infected, and he also showed that in rats which had been dead for a varying length of time, up to a maximum of eighteen hours, there was a 3.2 per cent. infection. The percentage infection was found to vary in the different species as follows:—

Rattus rattus rattus	25.0 per cent.
Rattus rattus alexandrinus	21.3 per cent
Rattus norvegicus	8.7 per cent.

Varying figures of percentage infection have been recorded for other countries, e.g.:—

Bombay	Vandyke Carter, 1887	12 % of all rats examined
	Lingard, 1895	35 % ,,
	Petrie and Avri, 1909	45 % ,,
Nebraska, U.S.A. (Swingle, 1907)	..	23 % ,,
Manila, P.I. (Musgrave and Clegg, 1903)	..	20 % to 60 % of all rats examined
England	Nuttall and Strickland, 1910 ..	25 % of *R. norvegicus* examined
	Balfour, 1922	19 % ,, ,,
	,, ...	38·2 % of *R. rattus rattus* examined
Bologna, Italy (Bruni, 1926) ..	.. ..	52·4 % of *R. norvegicus* examined

Transmission of T. lewisi.—The fairly constant association of *T. lewisi* and fleas has led to the assumption that fleas are concerned in the transmission of the trypanosome from rat to rat. Experimental transmission by means of fleas has been demonstrated by several workers; successful transmission by lice has been claimed by others. Certain observations made at Townsville provide circumstantial evidence in support of the role of the flea in transmission:—

(1) During a survey for ecto- and endo-parasites of rats carried out by Fielding over a period of thirteen months, fleas were the only ecto-parasites recorded.

(2) During a survey carried out at the Australian Institute of Tropical Medicine at weekly intervals for between nine and twelve months on rabbits, guinea-pigs, and white rats, fleas were the only ecto-parasites present, 3,496 *X. cheopis* and 81 *Ct. felis* being found.

(3) White rats, free from trypanosomes on arrival at the Institute, after a short stay showed a high percentage infected; although the building was supposedly rat-proof, there was evidence of invasion by wild rats, some of which when caught at a later date proved to be infected with *T. lewisi.*

Seasonal Prevalence of infection with T. lewisi.—Several observers have called attention to a seasonal variation of infection with *T. lewisi.* In Bombay, Lingard showed that with *Rattus norvegicus,* during the rainy season from June to October, there was a percentage infection of 42 per cent., but during the dry season, from November to May, the percentage was only 28 per cent. Petrie and Avri demonstrated that, from June to December, the percentage infection rose above the mean for the year, while from January to May the percentage fell below the mean; during March and April the infection rate was *R. norvegicus* 6.5 per cent., and *R. rattus rattus* 16.3 per cent.; in August, the rate rose to 54.5 per cent. in *R. norvegicus,* and 63·8 per cent. in *R. rattus rattus.* The results of examination of rats at Townsville are shown in the following table, in which are also recorded the results of a flea-census of the rats examined.

—	Per cent. infection with *T. Lewisi.*	Fleas per rat.
1925.		
September	16·6	7·8
October	13·3	4·0
November	37·5	3·0
December	28·0	4·2
1926.		
January	23·5	0·65
February	..	0·65
March	..	0·1
April	..	..
April	..	..
May	..	..
June	6·9	2·0
July	..	1·3
August	14·3	2·8
September	36·4	3·0

Of 55 rats examined during the rainy season, from January to April, 4 (or 7.5 per cent.) were infected, while 25 fleas (0.45 per rat) were collected. During the cold season, from May to August, of 73 rats examined 4 (5.5 per cent.) were infected, and 114 fleas (1.56 per rat) were collected. During the warm dry season from September to December, 83 rats were examined, and 19 (22.9 per cent.) were found

infected, while 364 fleas (4.4 per rat) were collected. In addition, in September, 1926, 11 rats were examined, and 4 (36.3 per cent.) were infected, while 32 fleas (or 3 per rat) were collected.

In this series of observations, in view of the relatively small number of rats examined, no distinction has been made between rat species, either in connexion with trypanosome infection or fleas collected. These results, however, vary somewhat from the recorded experiences of Lingard and of Petrie and Avari, and are possibly worthy of record in that connexion. The data given in the table above indicate a maximum occurrence of both trypanosome infection and fleas in the warm dry season in Townsville. The experience in Bombay of Lingard and of Petrie and Avari, quoted above, shows a higher trypanosome infection during the rainy season (June to October). The Plague Research Commission (1908) found that, in Bombay, the highest average of flea prevalence per rat was reached in April, and the lowest average in September. This Indian experience, therefore, is that the flea prevalence is inversely proportional to the trypanosome prevalence.

T. lewisi in Rats from Ships.—So far as could be ascertained from the literature at our disposal, no reference to the occurrence of this parasite in rats from ships has been recorded. Nineteen rats were examined from s.s. *King David,* which arrived at Townsville in May, 1927, from New York, via Panama, Apia, Suva, and Noumea. Thirty-two rats were examined from s.s. *Nirvana,* which arrived at Townsville in June, 1927, from Liverpool, via Port Said, Melbourne, Sydney, and Brisbane. The first batch of rats were all young adult *Rattus rattus rattus,* 11 females and 8 males. All had been dead for some considerable time, and very little blood could be obtained from the heart; reliance had to be placed on examination from liver and spleen. Of these 19 rats, 9 (or 47.4 per cent.) were infected with typanosomes, 8 of the infected rats being females. The second batch of 32 rats were in better condition for examination, and blood was obtained from the heart in each case. Twenty-eight of these rats were *Rattus rattus alexandrinus* (16 females and 12 males); 4 were *Rattus rattus rattus* (2 females and 2 males). Twelve (43 per cent.) of the *Rattus rattus alexandrinus* were found infected, and 1 (25 per cent.) of the *Rattus rattus rattus.* Ten females and 3 males were infected among the 18 females and 14 males examined.

Parasites were found in the blood alone four times, liver alone once, blood and liver together four times, blood and spleen once, liver and spleen twice, and in the blood, liver, and spleen once.

In view of the finding by Fielding in Townsville rats that there was a definite drop from 14 per cent. found infected in the live state to 3.2 per cent. when dead, it is indicated that if rats from ships were examined alive, or immediately after death, the percentage found infected would probably be very much higher than the present records show.