

Original Articles.

THE ROLE OF CATTLE IN THE EPIDEMIOLOGY OF MALARIA.

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THE editorial note in the September number of the *Indian Medical Gazette* on the rôle played by cattle in the prevention of malaria refers to a subject which is of the greatest importance in India, where cattle are commonly housed in close association with human dwellings. The observations of Drs. Rouband and Leger have frequently been noted by observers in other parts of the world.

Drs. Edmond and Etienne Sargent (*Annales de l'Institut Pasteur*) reported from Algeria:

"Le jour, l'endroit où il est le plus facile de capturer des anophèles adultes est la porcherie: sur un espace d'un metre carré environ, nous avons vu des centaines d'anophèles comme piqués sur le fond blanc des toiles d'araignée. Une des causes de la predilection des anophèles pour les porcheries nous parait tenir à la chaleur considerable que dégage le porc dans l'espace restreint ou il est tenu enfermé."

Also—

"Nous insistons sur la predilection des anophèles maculipennis adultes pour les coins sombres des écuries. Ces anophelines piquent d'ailleurs les animaux domestiques."

[The following is a free translation of the above passages:—

"In daytime the place where it is easiest to catch adult anopheles mosquitoes is the pig sty: on a surface of about a square yard we have seen hundreds of anopheles which looked like thorns against the white background of spiders' webs.

One of the causes of the preference shown by the anopheles for pig styes appears to us to be the heat engendered by the pig in the narrow space in which he is enclosed."

"We emphasized the preference of anopheles maculipennis for dark corners of stables. These anopheles are in the habit of biting domestic animals."—Ed.]

In the report of the Malaria Expedition to West Africa in 1899, Ross and Annet state that the barracks at Wilberforce swarmed with female anophelines and, out of 109 insects examined, parasites were detected in 27. They further make a note that there were absolutely no vertebrates other than human beings within or in proximity to the barracks. Cattle, dogs, cats, bats, and monkeys were absent while, owing to the buildings having been newly erected, there were even no sparrows or lizards.

The Royal Society's Commission to Lagos reports¹ that the sporozoite rate in mosquitoes in the railway camps was 25 per cent. at Aro and over 50 per cent. at Loko Meji. These anophelines were all caught in native dwelling

huts and Major Christophers tells me that cattle were not a common feature in West African villages nor in these camps.

In comparison with these figures the parasite infection rate in Bengal, which I estimated by the dissection of many hundred anophelines to be about 0.2 per cent. was extraordinarily low, and I formed a theory then that the vast majority of anophelines never fed on human beings at all.

In my second report² I wrote that "The daytime resting place of anophelines in Bengal is the cowshed and the low mosquito infection rate which we found in Bengal may be explained by the fact that most of the mosquitoes which were dissected by us were not caught in sleeping rooms, where it was always very difficult to find specimens. Cowhouses are packed with animals at night, and the number of anophelines found in them increases in direct proportion to warmth and darkness. The sleeping apartments of houses in Bengal are generally very clean and well kept. Though the cowhouses in the same compound may swarm with anophelines, it is exceptional to find a single specimen in a cookhouse or sleeping apartment. As the cattle are penned in these houses at sunset, it is natural to suppose that the majority of anophelines have no desire to go abroad but feed chiefly on the cattle. It is only those wishing to lay eggs that need go outside, and it is probably these insects and those newly hatched that feed on human beings."

Ross' mathematical treatment of the epidemiology of malaria is well known.³ He has published a formula including all the known factors influencing rise and fall of epidemic malaria which includes one factor b , the proportion of mosquitoes which succeed in biting human beings.

He has shown that, making certain assumptions the truth of which has not been questioned, $b^2 s a i (1-m) m p$ will be the number of new infection in a unit of time and that if r be the recovery rate, the condition for static malaria is $b^2 s a i (1-m) = r$. In these expressions a is the rate of anophelines per person, b the proportion which succeed in biting, s the proportion which succeed in maturing and becoming infective, i the proportion of humans which are gamete carriers, m the malaria rate in human subjects and p the population.

m , The malaria rate in human beings, is influenced by all the factors s , a , i and b , but variations in the biting factor b are of more importance than variations in s , a or i , since the square of the former and only the first power of the latter are involved in the equation.

The presence of cattle must certainly influence the factor b . Major Christophers in a letter has kindly pointed out that close association with cattle does not always prevent a human epidemic. In the Punjab epidemic of 1908 the cattle zone of Amritsar city was one of the worst epidemic areas. I do not consider that this destroys my theory. It is quite understandable that the presence of cattle may act as a two-

edged weapon. Cattle and their warm shelters would certainly attract mosquitoes. The Amritsar epidemic was due to the abnormal number of mosquitoes, that is, the factor *a* in Ross' equation, and one may argue that though those human beings in the cattle area suffered by the presence of cattle, the rest of the town was largely protected from the abnormal mosquito population, which were attracted to, and remained in, the cattle area.

Major Christophers has kindly sent me a paper read by Dr. Schuffner at the recent Batavia Congress. Schuffner states that he has found that certain species of anopheles actually prefer to feed on bullocks rather than on man and suggests as a prophylactic measure the regular placing of animals between dwelling houses.

Many of the villages in the endemic areas of Bengal are built on high ground surrounded by swamps. If the cowsheds were arranged in a ring on the outskirts of the village with dwelling houses in the centre instead of indiscriminately as is usual, I am sure that the dwelling houses and their inhabitants would be even more free from infestation by mosquitoes than they are at present.

REFERENCES.

¹ Reports to Malaria Committee of the Royal Society. Third Series, 1900. Stephens and Christophers.

² Second Report on Malaria in Bengal, by Major A. B. Fry, 1914. Bengal Secretariat Book Depot, Calcutta.

³ Prevention of Malaria, by Ross. First Edition, Section 28.

A CHOLEROID EPIDEMIC IN THE UNITED PROVINCES.

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With Pathological Account.

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DURING the period April 1st to July 11th, 1921, the number of cholera cases admitted to King George's Hospital, Lucknow, was about the average.

During these 3½ months, 39 cases were admitted, of whom ten died, giving a mortality of 25.6 per cent. Bacteriological reports showed six of these cases positive to the cholera vibrio; the rest were negative.

The numbers of cases and deaths, respectively, during this period that were reported to the Director of Public Health, United Provinces, as occurring (a) in Lucknow City, (b) in the whole United Provinces area, are shown in Charts I and II.

It is the usual experience here, as elsewhere, that the incidence of cholera increases in the hot weather, falls suddenly shortly after the onset of the monsoon and rises again somewhat as the monsoon fades away. This normal prevalence is shown graphically in Chart

III, which is based on the figures given in Rogers' book on cholera for a twenty years period in the United Provinces. It is seen at once that the curves in Charts I and II are entirely different from that of the normal Chart III. A comparison of these graphs shows that there was an unusual increase of cholera or of disease resembling it at a time when it might be expected to diminish. This increase was evident both in Lucknow and in the whole United Provinces area. This abnormality in the epidemiology of the disease did not by itself lead to doubt of the diagnosis; but there were other points that did so.

Certain differences in the clinical aspect of the disease began to be remarked when a number of cases had been treated: and at the same time the clinicians noted that the bacteriological reports on the cases of the fresh epidemic were persistently negative.

