

Infectivity of Glossina morsitans in Nyasaland.

By Surgeon-General Sir DAVID BRUCE, C.B., F.R.S., A.M.S.; Majors DAVID HARVEY and A. E. HAMERTON, D.S.O., R.A.M.C.; and Lady BRUCE, R.R.C.

(Scientific Commission of the Royal Society, Nyasaland, 1912.)

(Received February 24,—Read April 10, 1913.)

Introduction.

The object of this paper is to put on record the proportion of tsetse flies found in this district of Nyasaland to be infected with disease-producing trypanosomes, and, further, to identify the species of trypanosomes with which the flies are infected.

It must be understood that this paper only deals with the district lying near the camp at Kasu and not to every part of Nyasaland. The geographical position and other features of this district have already been described in a previous paper.* It is known as the "Sleeping Sickness Area" or "Proclaimed Area," and in it almost all the cases of the Human Trypanosome Disease of Nyasaland have occurred. This disease is caused by *Trypanosoma rhodesiense*, and the natives give it the name of "Kaodzera," but there is a good deal of evidence accumulating that *T. rhodesiense* is in reality *T. brucei*, in which case the disease would be known as "Nagana."

Definitions.

In this paper an *infective* fly is one which contains trypanosomes which have reached the final stage of their development and are capable of giving rise to disease. An *infected* fly is one in which the development of the trypanosomes may not have reached this final stage, and where, therefore, it may not as yet be disease-producing. An infective fly must be infected, whereas an infected fly need not be infective.

"Fly" means the tsetse fly, and in this paper the species dealt with is *Glossina morsitans*.

Methods Employed.

The method employed in studying the infectivity of the flies was simple. Native boys were employed in catching the flies, which were brought up to Kasu in small cages by a native cyclist. Each cage of flies was fed on three healthy animals—the first day on a monkey, the second on a dog, and the

* *Supra*, p. 269.

third on a goat. To ensure, as far as possible, that each animal was fed on by every fly, the flies were fed nine times—three times on each animal.

The number of flies brought up each day would probably average about 60, and as each animal was fed on by three cagefuls, then each monkey, dog, and goat ran the gauntlet of some 180 flies. It is therefore impossible to arrive at any very precise knowledge of the proportion of infective flies in each cage.

Infectivity of the Flies.

As will be seen from Table I, every experiment, with the exception of one, was positive, and on two occasions a goat was infected by all the four species of pathogenic trypanosomes occurring in this neighbourhood.

The Commission showed in a previous paper* that one in three of the wild game found in this district is infected with trypanosomes, and recommended that the animals should be destroyed. If this were done and a year allowed to elapse, the proportion of infective flies then found would be an index of the usefulness or futility of such operations.

The Commission is of opinion that the wild game is the principal factor in the spread of trypanosome disease, and that, for practical purposes, the smaller mammals, birds, and reptiles need not be taken into account.

The following table gives, in the first column, the date the first cageful of flies was fed on the monkey, the second column the number of flies fed; the signs *plus* and *minus* show the result of feeding the flies on the monkey, dog, and goat.

The four species of trypanosomes carried by the "fly" in this district are *T. brucei* vel *rhodesiense*, *T. pecorum*, *T. simia*, and *T. caprae*. The first and second of these attack all three animals, the third the monkey and goat, being harmless to the dog, whereas the fourth only produces disease in the goat.

Where no *plus* or *minus* sign occurs it means that an animal was not available. For example, the experiment beginning on January 20 shows that the monkey was infected by *T. simia*, the goat by *T. brucei*, and that no dog was available. The experiment on February 21 shows that neither the dog nor goat became infected by the bites of 170 flies, and that no monkey was available.

* *Supra*, p. 277.

Table I.—The Result of Feeding 10,081 Tsetse Flies (*G. morsitans*), caught in the "Proclaimed Area," Nyasaland, on Monkeys, Dogs, and Goats.

1912.	Number of flies fed.	Monkey.				Dog.				Goat.			
		<i>T. brucei</i> vel <i>T. rhodesiense</i> .	<i>T. pecorum</i> .	<i>T. simiae</i> .	<i>T. capre</i> .	<i>T. brucei</i> vel <i>T. rhodesiense</i> .	<i>T. pecorum</i> .	<i>T. simiae</i> .	<i>T. capre</i> .	<i>T. brucei</i> vel <i>T. rhodesiense</i> .	<i>T. pecorum</i> .	<i>T. simiae</i> .	<i>T. capre</i> .
Jan. 20	296	—	—	+	—					+	—	—	—
" 24	370	—	—	+	—					—	+	—	—
" 29	280	—	—	+	—					—	+	+	—
Feb. 2	295	—	—	+	—					—	+	+	+
" 8	220	—	—	+	—					—	+	+	+
" 13	200	—	+	+	—					—	+	—	+
" 16	195					+	—	—	—	+	—	—	—
" 21	170					—	—	—	—	—	—	—	—
" 26	170					—	—	—	—	—	—	+	—
Mar. 2	140					—	—	—	—	—	—	—	+
" 9	165					—	+	—	—	—	—	—	+
" 14	100					—	—	—	—	—	—	—	+
" 17	160					—	+	—	—	—	+	—	—
" 22	205					—	+	—	—	+	+	+	—
Apr. 3	135					—	+	—	—	—	+	—	—
" 10	275	+	—	+	—	+	+	—	—	—	—	—	+
" 15	330	—	—	+	—	—	+	—	—	—	+	+	+
" 18	200	—	—	+	—	—	+	—	—	—	+	—	+
" 18	180	—	—	+	—	—	+	—	—	—	—	+	—
" 23	230	—	—	+	—	—	+	—	—	—	+	—	+
" 23	140	—	+	—	—	—	+	—	—	—	+	—	+
" 26	100	—	—	+	—	—	+	—	—	+	+	+	—
" 27	260	—	—	+	—	—	+	—	—	—	+	—	+
May 3	155	+	+	+	—	—	+	—	—	—	—	—	+
" 3	96	—	—	—	—	—	+	—	—	—	+	—	—
" 8	330	+	—	+	—	+	—	—	—	—	+	—	+
" 9	120	—	—	+	—	—	+	—	—	—	+	—	+
" 13	50	—	—	—	—	+	—	—	—	—	—	+	+
" 14	250	—	—	+	—	—	+	—	—	+	+	+	+
" 17	190					+	+	—	—	—	+	+	+
" 24	113					—	+	—	—	—	+	+	+
" 29	120	—	—	—	—	—	+	—	—	—	+	—	—
" 29	230	—	—	—	—	—	+	—	—	—	+	—	—
" 29	320					+	+	—	—	—	+	—	+
" 29	240	—	+	—	—	—	+	—	—	—	+	+	+
" 29	100	—	—	—	—	—	+	—	—	—	+	+	+
" 31	175	+	—	+	—	+	+	—	—	—	+	+	—
June 2	300					—	+	—	—	—	—	+	+
" 6	210	—	+	—	—	—	+	—	—	—	+	—	+
" 7	230	+	—	—	—	+	+	—	—	+	+	—	—
" 11	160	—	—	+	—	—	+	—	—	—	+	—	+
" 18	135	—	—	—	—	—	+	—	—	—	+	—	—
" 25	90	+	—	—	—	+	—	—	—	—	+	—	+
July 3	95					—	+	—	—	—	+	—	—
Sept. 25	70	—	+	—	—								
" 27	25	+	—	—	—								
Oct. 29	87	+	—	—	—	+	—	—	—	+	+	—	+
Nov. 5	145					—	—	—	—	—	—	—	+
" 11	150	—	—	+	—	—	+	—	—	—	+	—	+
" 18	157	—	—	—	—	—	—	—	—	—	—	+	—
" 21	95	—	—	—	—	+	—	—	—	+	—	—	—
" 25	180	—	—	+	—	+	—	—	—	+	+	—	—
Dec. 3	180	—	+	+	—	—	+	—	—	—	+	—	+
" 6	198	+	+	+	—	+	—	—	—	+	—	—	+
" 11	156	—	—	+	—	+	—	—	—	+	+	—	—
" 16	113	—	+	+	—	—	+	—	—	—	+	—	+
Total.....	10,081	9	9	26		14	34			11	35	17	35

Table II.—The Number of Times a Monkey, Dog, and Goat became infected with *Trypanosoma brucei* vel *rhodesiense*, *T. pecorum*, *T. simia*, and *T. capræ* in a Series of 56 Experiments, averaging 180 Tsetse Flies each.

<i>T. brucei</i> vel <i>rhodesiense</i> .			<i>T. pecorum</i> .			<i>T. simia</i> .			<i>T. capræ</i> .		
Monkey.	Dog.	Goat.	Monkey.	Dog.	Goat.	Monkey.	Dog.	Goat.	Monkey.	Dog.	Goat.
9	14	11	9	34	35	26	0	17	0	0	35

This shows that the monkey is less susceptible to *T. brucei* and *T. pecorum* than the dog, whereas it is remarkably so to *T. simia*. The dog is not susceptible to *T. simia*, and neither the monkey nor dog to *T. capræ*.

Table III.—The Proportion per 1000 Tsetse Flies, caught in the "Sleeping-Sickness" Area of Nyasaland, found to be Infective with Pathogenic Trypanosomes.

<i>T. brucei</i> vel <i>rhodesiense</i> .	<i>T. pecorum</i> .	<i>T. simia</i> .	<i>T. capræ</i> .
Per 1000. 2·0	Per 1000. 4·6	Per 1000. 3·4	Per 1000. 3·5

This is only allowing one infective fly to each series of flies fed on the experimental animals, and is therefore the irreducible minimum. The average number of flies fed on each animal was 180, and it might well be that there were present in the same batch several flies infective with the same species of trypanosome. Ten thousand flies gave rise to 135 infections, and taking it for granted that no fly was infective with more than one species of trypanosome, then 13·5 per 1000 flies are infective with one or other of the disease-producing trypanosomes of this district.

Table IV.—Number of Times the Species of Trypanosomes under consideration were found in 56 Experiments.

<i>T. brucei</i> vel <i>rhodesiense</i> .	<i>T. pecorum</i> .	<i>T. simia</i> .	<i>T. capræ</i> .
20	46	34	35
35·7 per cent.	82·1 per cent.	60·7 per cent.	62·5 per cent.

This means that in experiments carried out in the manner described *T. brucei* may be expected to turn up once in every three series, *T. pecorum* eight times in ten, and *T. simiae* and *T. caprae* six times in ten.

Months and Seasons.

On examining Table I it will be seen that these infective flies occur all the year round, and are just as numerous during one season as another. It will also be seen that no experiments on the infectivity of the flies were carried out during July and August. This was due to the fact that all the energy of the Commission was devoted during these two months to the study of the wild game.

Conclusions.

1. The tsetse flies (*Glossina morsitans*) caught in the "fly-country" near Kasu are infected with four species of disease-producing trypanosomes—*T. brucei* vel *rhodesiense*, *T. pecorum*, *T. simiae*, and *T. caprae*.

2. The proportion of infective flies is 13·5 per 1000.

3. The proportion of flies infective with *T. brucei* vel *rhodesiense*, the cause of the Human Trypanosome Disease of Nyasaland, is 2 per 1000.

4. The flies are found infective all the year round.

5. To prevent the infection of tsetse flies it is proposed that the experiment should be tried of destroying all the wild game in the "Proclaimed Area" of Nyasaland.
