picric acid and 50 grm. sodium carbonate in 1 litre of water; after draining the paper, it is hung from a pin to dry until it is only just perceptibly moist; it is then cut up into $\frac{3}{4}$-inch lengths and stored in a closed tube. It is well to keep a piece of the paper in each of the stock of tubes carried, so as to make sure that hydrogen cyanide has not been stored up in the cork.

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Antelope Infected with Trypanosoma gambiense.

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(Communicated by Sir John Bradford, Sec. R.S. Received December 2, 1911,—Read January 25, 1912.)

The Sleeping Sickness Commission of the Royal Society, Uganda, 1908–10, showed that waterbuck, bushbuck and reedbuck could be readily infected with a human strain of *Trypanosoma gambiense*, and that clean laboratory-bred *Glossina palpalis* were capable of transmitting the virus from the infected antelope to susceptible animals.

In the present paper, observations which were made upon these antelope during the eight months subsequent to the Commission's departure from Uganda are recorded. Experiments are also described which show that the duiker—another species of antelope common in most parts of Uganda—can also be similarly infected with a human strain of *T. gambiense*. As regards the antelope employed by the Commission, six of the nine remained in apparently excellent health in April, 1911—roughly, a year after they were infected.

Until Bushbuck 2428 escaped from the kraal, and Bushbuck 2372 died 338 days after its infection as the result of an accident, they had also been healthy. A *post-mortem* examination was made immediately after death in the case of Bushbuck 2372, but no evidence of trypanosomiasis was found.

Reedbuck 2427 appeared to be perfectly healthy for 200 days after it had been infected. It then died suddenly. At the *post-mortem* examination performed immediately after death the prescapular glands were found to be the size of a hazel-nut. On section they were hæmorrhagic. There were numerous petechiæ on the mucous membrane of the mesentery. The

mucous membrane of the fourth stomach also showed many petechiæ. Microscopical examination of smears made from the various organs was negative. It is, therefore, impossible to say what the cause of death was in the case of this buck.

With the view of ascertaining how long the antelope remained infected, investigations were carried out on the following lines:—

1. Feeding laboratory-bred *Glossina palpalis* for several days on the antelope and subsequently endeavouring to infect a healthy susceptible animal.

2. Dissecting these flies and examining them for flagellates.

3. Injecting blood of the buck into animals susceptible to *T. gambiense* infection.

Table I gives the detailed results obtained by the first of these methods The number of days which elapsed from the date on which the buck was infected until the commencement of the experiment is given.

"Hereditary transmission" flies indicates that the flies before being put upon the antelope had been fed for 30 days upon healthy monkeys to ascertain if laboratory-bred flies which had never fed upon an infected animal could give rise to an infection. As it has been suggested that flies were most readily infected when their first feed was upon an infected animal, these flies were used with the view of obtaining evidence on this point, control experiments being at the same time made with laboratory-bred flies which had not fed before they were put upon the antelope. Although it will be noted that no infection occurred among the "hereditary transmission" flies, whereas the control flies sometimes became infected, the numbers of the flies used are too small to allow of any conclusions being arrived at.

It will be noted that flies which were fed on Bushbuck 2372, 315 days after it had been infected with a human strain of *T. gambiense*, became infected and successfully transmitted the disease to a healthy monkey.

Table II gives the results of the dissections of laboratory-bred *Glossina palpalis* which had fed on the infected antelope.

The experiments recorded in Tables I and II are summarised and grouped according to the length of time the antelope had been infected in Table III.

Table I.—Giving the Results of Feeding Laboratory-bred *Glossina palpalis* on Antelope infected with *T. gambiense*.

Experiment No.	No. of flies. On 1st day.	No. of flies. On 30th day.	No. of days after original infection of antelope.	No. of days flies fed on antelope.	No. of days before flies became infective.	Result. Positive.	Result. Negative.	Length of experiment, in days.	Remarks.
				Bushbuck, Expt. 2328.					
7	?	?	134	5	25	+		32	Experiment carried out by Dr. van Someren.
215	115	79	202	10			—	79	
402	53	18	264	11			—	64	"Hereditary transmission" flies.
403	49	29	264	11			—	64	Control to Expt. 402.
538	21	16	306	7			—	48	"Hereditary transmission" flies.
539	39	31	306	7			—	62	Control to Expt. 538.
647	52	46	342	6			—	41	
				Bushbuck, Expt. 2371.					
89	?	?	126	3	50	+		59	Experiment carried out by Dr. van Someren.
216	90	64	173	10			—	78	
404	50	21	235	11			—	63	"Hereditary transmission" flies.
405	43	31	235	11	38	+		51	Control to Expt. 404.
543	33	17	279	9			—	60	"Hereditary transmission" flies.
544	71	44	279	9			—	60	Control to Expt. 543.
643	73	49	311	5			—	42	
				Bushbuck, Expt. 2372.					
88	?	?	123	3	39	+		48	Experiment carried out by Dr. van Someren.
218	72	59	171	9	34	+		47	
480	79	47	253	7			—	64	
607	85	61	298	8	25	+		33	
658	64	48	315	9	38	+		38	
				Bushbuck, Expt. 2428.					
106	?	?	116	2			—	67	Experiment carried out by Dr. van Someren.
222	20	20	164	9	40	+		49	

				Reedbuck, Expt. 2357.					
51	92	18	131	7			–	77	
189	101	62	173	11	44	+		59	
469	83	34	263	9	31	+		43	
528	41	20	288	8			–	57	"Hereditary transmission" flies.
529	70	55	288	8	34	+		43	Control to Expt. 528.
631	97	56	322	6			–	41	
669	119	63	336	12			–	35	
				Reedbuck, Expt. 2359.					
52	170	64	113	7	38	+		55	
190	89	76	155	11	32	+		44	
398	50	34	231	12	36	+		49	Control to Expt. 400.
400	49	13	231	12			–	63	"Hereditary transmission" flies.
530	54	19	270	8			–	61	
642	33	29	306	5			–	40	
				Reedbuck, Expt. 2427.					
97	60	53	117	8	34	+		46	
254	72	52	177	11	29	+		49	
				Reedbuck, Expt. 2431.					
98	81	41	119	7	32	+		43	
268	60	51	184	10	36	+		50	
399	43	29	224	12			–	63	Control to Expt. 401.
401	25	4	224	12			–	63	"Hereditary transmission" flies.
598	88	44	288	9			–	50	
656	66	30	306	11			–	40	
				Waterbuck, Expt. 2378.					
6	?	?	105	5	25	+		32	Experiment carried out by Dr. van Someren.
217	168	53	173	10			–	68	
406	54	0	237	9			–	19	
471	96	9	251	7			–	62	
488	45	28	259	8			–	59	
523	36	24	270	7			–	62	
622	62	15	306	7			–	42	

Table II.—Giving the Results of the Dissection of Laboratory-bred *Glossina palpalis* which had Fed on Antelope infected with *T. gambiense*.

Experiment No.	No. of flies used in experiment.	No. of flies dissected.	No. of infected flies found.	Percentage of infected flies.	Result of experiment.	Remarks.
			Bushbuck, Expt. 2328.			
7	?	0	0		+	Flies not dissected.
215	115	79	0		—	
402	53	42	0		—	
403	49	42	0		—	
538	21	21	0		—	
539	39	33	0		—	
647	52	51	0		—	
			Bushbuck, Expt. 2371.			
89	?	27	0		+	
216	90	61	0		—	
404	50	33	0		—	
405	43	41	0		+	
543	33	26	0		—	
544	71	66	0		—	
643	73	51	0		—	
			Bushbuck, Expt. 2372.			
88	?	29	1	3·45	+	
218	72	37	1	2·7	+	
480	79	44	0		—	
607	84	70	1	1·4	+	
658	64	59	2	3·4	+	
356	36	36	0		—	Experiment lasted 12 days.
357	38	38	0		—	„ „ 14 „
			Bushbuck, Expt. 2428.			
106	?	14	0		—	
222	20	20	2	10	+	
			Reedbuck, Expt. 2357.			
51	92	30	0		—	
189	101	46	4	8·6	+	
469	83	53	5	9·4	+	
528	41	31	0		—	
529	70	64	3	4·7	+	
631	97	77	0		—	
669	119	65	0		—	
			Reedbuck, Expt. 2359.			
52	170	122	0		+	
190	89	61	5	8·1	+	
398	50	49	3	6·1	+	
400	49	40	0		—	
530	54	23	0		—	
642	33	30	0		—	
			Reedbuck, Expt. 2427.			
97	60	27	1	3·7	+	
254	72	49	1	2·0	+	
322	28	28	0		—	Experiment lasted 9 days.
323	30	30	1	3·3	—	„ „ 13 „

Table II—*continued.*

Experiment No.	No. of flies used in experiment.	No. of flies dissected.	No. of infected flies found.	Percentage of infected flies.	Result of experiment.	Remarks.
			Reedbuck, Expt. 2431.			
98	81	8	0		+	
268	60	53	2	3·7	+	
399	43	36	0		—	
401	25	14	0		—	
598	88	45	0		—	
656	66	35	0		—	
			Waterbuck, Expt. 2378.			
6	?	0	0		+	
217	168	53	2	3·8	—	
406	54	36	0		—	
471	96	18	0		—	
488	45	44	0		—	
523	36	31	0		—	
622	62	20	0		—	

Table III.—Summarising Experiments of Tables I and II and grouping them according to Length of Time the Antelope had been infected.

Species of antelope.	Days after original infection of antelope.	No. of experiments.	No. of positive experiments.	No. of flies.		No. of flies dissected.	No. of infected flies found.
				On 1st day.	On 30th day.		
Bushbuck 2328 ...	100—200	1	1	?	?	0	0
,, 2371 ...	,,	2	1	?	?	88	0
,, 2372 ...	,,	2	2	?	?	66	2
,, 2428 ...	,,	2	1	?	?	34	2
Reedbuck 2357 ...	,,	2	1	193	80	76	4
,, 2359 ...	,,	2	2	259	140	183	5
,, 2427 ...	,,	4	2	190	105	134	3
,, 2431 ...	,,	4	2	209	125	111	2
Waterbuck 2378...	,,	2	1	?	?	53	2
Bushbuck 2328 ...	200—300	3	0	217	126	163	0
,, 2371 ...	,,	4	1	197	113	166	0
,, 2372 ...	,,	4	1	238	108	188	1
Reedbuck 2357 ...	,,	3	2	194	118	148	8
,, 2359 ...	,,	3	1	151	66	112	3
,, 2431 ...	,,	2	0	154	74	80	0
Waterbuck 2378...	,,	4	0	231	61	129	0
Bushbuck 2328 ...	300—342	3	0	112	93	105	0
,, 2371 ...	,,	1	0	73	49	51	0
,, 2372 ...	,,	1	1	64	48	59	2
Reedbuck 2357 ...	,,	2	0	216	119	142	0
,, 2359 ...	,,	1	0	33	29	30	0
Waterbuck 2378...	,,	1	0	62	15	20	0

It will be seen that positive experiments were obtained from all the buck (nine examined) when the flies were fed upon them before 200 days had elapsed from the date of the antelope's infection. When more than 200 days had elapsed four of the seven buck examined yielded positive results.

The results of all experiments are shown in Table IV.

Table IV.—Giving Results of Experiments from all Antelopes.

Interval in days after infection of antelope.	No. of experiments.	No. of positive experiments.	No. of flies dissected.	No. of flies found infected.	Percentage of infected flies.
100—200	21	13	745	20	2·7
200—300	23	5	986	12	1·2
300—342	9	1	407	2	0·5
Totals	53	19	2138	34	1·6

It appears from the above table that as the interval after the infection of the antelope increases, the percentage of positive transmission experiments and of flies which become infected with flagellates after having fed on the buck diminishes. This diminution becomes still more striking when these results are compared with those recorded by the Commission of experiments carried out soon after the antelope were infected. (Of the 24 experiments carried out by the Commission 17 were positive, 1722 flies were dissected, and 6·9 per cent. were found to be infected.)

The results of injecting blood of these antelope into susceptible animals are shown in Table V (p. 491).

It is seen that the injection of a small quantity of the blood of Bush-buck 2372, 327 days after it had been infected with *T. gambiense*, produced an infection in a white rat. This, however, was the only positive result which was obtained. Three injections were carried out from Waterbuck Experiment 2378—on one occasion 5 c.c. of blood was injected—and all were negative. It will be remembered that the Commission found it easy to produce infections in susceptible animals by injecting the blood taken from these antelope soon after they were infected.

Table V.—Giving Results of injecting the Blood of Antelope infected with *T. gambiense* into susceptible Animals.

Antelope.	No. of days after infection of antelope.	Animal used.	Quantity of blood injected in c.c.	Result.	Remarks.
Reedbuck 2427 ...	200	Monkey	2	Inconclusive	Monkey died. Negative for 9 days.
Waterbuck 2378...	306	White rat	1	—	
,, ,, ...	316	Monkey	5	—	
,, ,, ...	316	White rat	1	—	
Bushbuck 2328 ...	355	,,	1½	—	
,, 2371 ...	330	,,	1	—	
,, 2372 ...	327	,,	1	+	Trypanosomes appeared in rat on the 12th day.
Reedbuck 2357 ...	345	,,	1	—	
,, 2359.....	327	,,	1	—	
,, 2431.....	320	,,	1	—	
Bushbuck 2372 ...	338	Monkey	5	Inconclusive	Monkey died before trypanosomes could have appeared.

Can a Duiker be Infected with a Human Strain of T. gambiense ?

Experiment 99, *Duiker.*—On August 30, 1910, 3 c.c. of this buck's blood were injected subcutaneously into a normal monkey to ascertain if the antelope naturally harboured trypanosomes. The monkey's blood was examined regularly for a month. No trypanosomes appeared in its blood, the monkey remaining healthy.

For nine days (January 25 to February 2, 1911, inclusive) laboratory-bred *G. palpalis* known to be infected with a human strain of *T. gambiense* were fed upon the buck.

On February 4, the tenth day after the infected flies first fed upon the antelope, *T. gambiense* appeared in fair numbers in its blood.

On February 10 and 11, 1911, 119 clean laboratory-bred *G. palpalis* were fed upon the duiker. These flies were subsequently fed on a normal monkey, which they infected after 28 days had elapsed from the date of their first feed on the buck. Of 42 flies which were dissected, two were found to be infected with flagellates.

Remarks.—The duiker was free from trypanosomes inoculable into a monkey on its arrival at the laboratory.

T. gambiense appeared in the buck's blood on the tenth day after infected flies had fed upon it, and clean laboratory-bred flies successfully transmitted the infection to a healthy susceptible monkey.

Conclusions.

1. Antelope may remain in apparently perfect health for a year after having been infected with a human strain of *T. gambiense.*

2. One antelope was still capable of infecting clean laboratory-bred *G. palpalis* 315 days after it had been infected.

3. A small quantity of blood taken from one antelope 327 days after its infection was proved by inoculation into a white rat to be infective.

4. As the interval after the infection of the antelope increases their infectivity, as tested by "cycle" transmission experiments, dissection of flies which have fed upon them, and by the injection of the buck's blood into susceptible animals, appears to diminish.

5. A duiker was infected with a human strain of *T. gambiense* by feeding infected *G. palpalis* upon it.

The Bacterial Production of Acetylmethylcarbinol and 2.3-Butylene Glycol from Various Substances.

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(From the Biochemical Department, Lister Institute.)

In working out the action of *B. lactis aërogenes* on glucose quantitatively, Harden and Walpole (1) found that, in addition to the products already noted in the action of *B. coli communis* on glucose (2), a small quantity of acetylmethylcarbinol, $CH_3{\cdot}CH(OH){\cdot}CO{\cdot}CH_3$, and a considerable proportion of 2.3-butylene glycol, $CH_3{\cdot}CH(OH){\cdot}CH(OH){\cdot}CH_3$, were formed, the latter corresponding to about 33 per cent. of the carbon of the sugar fermented. The production of acetylmethylcarbinol by the action of *Tyrothrix tenuis*, *B. subtilis* and *B. mesentericus vulgatus*, and similar organisms on glucose, had been previously noted by Grimbert (3) and by Desmots (4).

The presence of acetylmethylcarbinol is of especial interest, as it has been shown to be the substance responsible for the Voges and Proskauer reaction (5). In view of this fact, and of the interest attaching to this mode of decomposition of glucose, it becomes a matter of some importance to discover what substances will give rise to acetylmethylcarbinol and butylene glycol during fermentation, and also which bacteria are capable of producing these two compounds. *B. lactis aërogenes* and *B. cloacæ* have been shown to