

*Trypanosome Diseases of Domestic Animals in Nyasaland.*II.—*Trypanosoma capræ* (Kleine).

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[PLATE 5.]

INTRODUCTION.

This species belongs to the *vivax* group, which consists of three species:—*Trypanosoma uniforme*, *T. vivax*, and *T. capræ*. They are all characterised by their extreme motility; clear cell contents; large, round, terminal micro-nucleus; and lastly, by the fact that the *vivax* group only infects cattle, goats, and sheep, and is harmless to the smaller laboratory animals. All three develop in the proboscis of the tsetse flies and not in the alimentary tract, as do other pathogenic trypanosomes.

T. vivax is stated to be pathogenic to horses, mules, and donkeys, but there has been no opportunity of testing these animals at Kasu with *T. capræ*.

It is curious that *T. uniforme* and *T. vivax* have not been met with by the Commission in Nyasaland. This may be due to the absence of *Glossina palpalis*, which is their carrier, while *T. capræ* is carried by *G. morsitans*.

MORPHOLOGY OF *T. CAPRÆ*.A. *Living, Unstained.*

The description given of *T. vivax* can be equally applied to this species. It is just as active in its movements and dashes across the field of the microscope with the same impetuosity.

B. *Fixed and Stained.*

The blood films were fixed, stained, and measured as previously described in the 'Proceedings.'†

* Dr. Davey resigned his membership of the Commission in October, before the completion of the work here recorded.

† 'Roy. Soc. Proc.,' 1909, B, vol. 81, pp. 16 and 17.

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Length.—The following table gives the length of this trypanosome as found in the waterbuck, ox, goat, and sheep—500 trypanosomes in all.

Table I.—Measurements of the Length of *Trypanosoma capræ*, Nyasaland.

Date.	No. of expt.	Animal.	Method of fixing.	Method of staining.	In microns.		
					Average length.	Maximum length.	Minimum length.
1912.							
Sept. 18...	1388	Waterbuck ...	Osmic acid	Giemsa	26·8	29·0	25·0
" 4...	349	Ox	"	"	25·9	32·0	22·0
" 9...	350	"	"	"	25·5	30·0	18·0
March 4...	175	Goat	"	"	23·3	28·0	20·0
" 11...	263	"	"	"	26·1	29·0	21·0
" 14...	263	"	"	"	27·5	30·0	24·0
" 18...	200	"	"	"	26·2	30·0	22·0
" 20...	263	"	"	"	26·9	30·0	22·0
" 21...	247	"	"	"	23·7	26·0	20·0
" 21...	263	"	"	"	24·4	29·0	21·0
April 4...	339	"	"	"	25·1	28·0	23·0
" 22...	272	"	"	"	23·4	27·0	21·0
" 22...	339	"	"	"	24·6	27·0	21·0
" 29...	339	"	"	"	27·6	31·0	25·0
May 13...	339	"	"	"	25·5	29·0	23·0
" 16...	339	"	"	"	24·4	27·0	23·0
April 8...	348	Sheep	"	"	26·6	30·0	24·0
" 11...	346	"	"	"	24·6	28·0	21·0
" 11...	348	"	"	"	26·7	29·0	24·0
" 25...	348	"	"	"	23·9	27·0	22·0
May 9...	348	"	"	"	26·2	29·0	24·0
" 13...	348	"	"	"	24·4	27·0	22·0
" 23...	347	"	"	"	24·7	27·0	22·0
June 13...	548	"	"	"	25·6	29·0	23·0
July 25...	907	"	"	"	27·5	32·0	24·0
					25·5	32·0	18·0

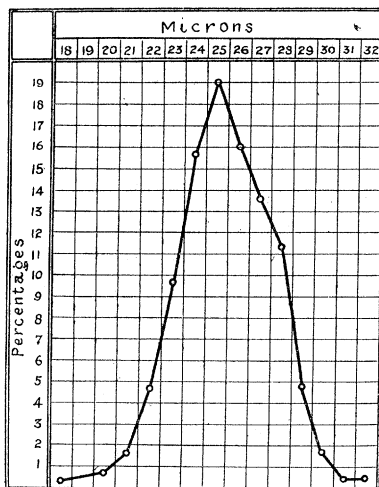
The average length of *T. capræ*, Nyasaland, in different species of animals, taken from Table I, is as follows:—

Table II.

Species of animal.	Number of trypanosomes measured.	In microns.		
		Average length.	Maximum length.	Minimum length.
Waterbuck	20	26·8	29·0	25·0
Ox	40	25·7	32·0	28·0
Goat	260	25·3	31·0	20·0
Sheep	180	25·6	32·0	21·0

Table III.—Distribution in respect to Length of 500 Individuals of *T. capræ*, Nyasaland.

Animal.	In microns.																Average length.
	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.		
Waterbuck	—	—	—	—	—	—	—	1	9	4	4	2	—	—	—	26·8	
Ox	—	—	—	—	1	2	3	2	3	6	2	—	—	—	1	25·9	
Goat	1	—	—	—	1	—	4	3	4	2	4	—	1	—	—	25·5	
Goat	—	—	2	—	6	4	1	5	1	—	1	—	—	—	—	23·3	
Goat	—	—	—	1	—	3	1	2	2	5	4	2	—	—	—	26·1	
Goat	—	—	—	—	—	—	1	—	3	6	6	2	2	—	—	27·5	
Goat	—	—	—	—	1	1	3	4	2	1	5	2	1	—	—	26·2	
Goat	—	—	—	—	1	—	—	4	2	5	3	4	1	—	—	26·9	
Goat	—	—	1	2	—	6	4	3	4	—	—	—	—	—	—	23·7	
Goat	—	—	—	1	—	4	6	6	1	1	—	1	—	—	—	24·4	
Goat	—	—	—	—	—	4	5	4	2	2	3	—	—	—	—	25·1	
Goat	—	—	—	2	3	6	4	4	—	1	—	—	—	—	—	23·4	
Goat	—	—	—	1	—	2	7	4	5	1	—	—	—	—	—	24·6	
Goat	—	—	—	—	—	—	—	2	4	3	4	5	1	1	—	27·6	
Goat	—	—	—	—	—	2	2	7	5	2	1	1	—	—	—	25·5	
Goat	—	—	—	—	—	3	9	5	2	1	—	—	—	—	—	24·4	
Sheep	—	—	—	—	—	—	3	4	1	6	3	1	2	—	—	26·6	
Sheep	—	—	—	1	2	2	4	4	5	1	1	—	—	—	—	24·6	
Sheep	—	—	—	—	—	—	1	2	7	3	6	1	—	—	—	26·7	
Sheep	—	—	—	—	4	4	5	5	1	1	—	—	—	—	—	23·9	
Sheep	—	—	—	—	—	—	1	4	8	4	2	1	—	—	—	26·2	
Sheep	—	—	—	—	2	1	6	9	1	1	—	—	—	—	—	24·4	
Sheep	—	—	—	—	2	2	3	8	3	2	—	—	—	—	—	24·7	
Sheep	—	—	—	—	—	3	5	—	4	5	2	1	—	—	—	25·6	
Sheep	—	—	—	—	—	—	1	3	1	5	6	1	1	1	1	27·5	
Total	1	—	3	8	23	49	79	95	80	68	57	24	9	2	2		
Percentages ...	0·2	—	0·6	1·6	4·6	9·8	15·8	19·0	16·0	13·6	11·4	4·8	1·8	0·4	0·4		

CHART giving Curve representing the Distribution by Percentages in respect to Length of 500 Individuals of *Trypanosoma capræ*, Nyasaland.

This curve is made up of measurements from 20 specimens of trypanosomes taken from the waterbuck, 40 from the ox, 260 from the goat, and 180 from the sheep.

From it will be seen that *T. capræ* is a monomorphic species, varying from 18 to 32 microns in length, the greatest number of individuals (19 per cent.) being 25 microns long.

Breadth.—Measured across the broadest part *T. capræ* averages 3 microns in breadth (maximum 4·25, minimum 1·75).

Shape.—*T. capræ* differs from *T. vivax* in that it is heavier built and altogether has a larger and clumsier appearance. The posterior half is swollen, and its end is bluntly angular or rounded. The anterior extremity is narrower and pointed (Plate 5).

Contents of Cell.—Clear, with a delicate alveolar structure, and free from vacuoles or granules.

Nucleus.—Oval, compact, lying about the middle of the body.

Micronucleus.—Large and round, situated, as a rule, close to the posterior extremity, but sometimes removed to a short distance.

Undulating membrane.—Much more developed than in *T. vivax*, and thrown into bolder folds and undulations.

Flagellum.—There is a well-marked free flagellum which averages 6·5 microns in length (maximum 9·5, minimum 4). No specimens have been seen without a free flagellum as stated by Kleine.

Disease set up in Cattle by T. capræ.—Only two oxen were inoculated from goats suffering from this disease. These animals showed the trypanosomes in their blood in small numbers for two months after inoculation. The trypanosomes then disappeared and have never reappeared. The two oxen at the present time are in good health and have evidently recovered. This strain of *T. capræ* cannot, therefore, be considered of much pathological importance as far as oxen are concerned, but more cases are wanted. Kleine states that cattle are immune.

Disease set up in Goats and Sheep by T. capræ.—In goats and sheep, on the other hand, *T. capræ* runs a fairly fatal course. In the list of animal experiments 36 goats and 4 sheep are given. Of the 36 goats, 15 had been infected by wild *G. morsitans* and died, on an average of, from 53 to 59 days. As the flies were fed on a goat, a monkey, and a dog, and, as a rule, three times on each animal, to ensure that all the flies fed, it is not possible to tell the exact day of infection.

Four others were inoculated with blood from infected goats or antelope, and these died, on an average, in 57 days. The remaining 17 goats are still alive after intervals of from 61 to 262 days. Of the four sheep, one died in

36 days, another lived 89 days, the third 221 days, while the fourth is still alive after 245 days.

Table IV.—Animals Susceptible to *T. capræ*.

Date.	No. of expt.	Source of virus.	Period of incubation, in days.	Duration, in days.	Remarks.
Cattle.					
1912.					
Mar. 20...	349	From Goat 263	20	—	Alive and well after 245 days.
" 20...	350	" 263	10	—	These animals appear to have recovered.
Goat.					
Feb. 6...	273	Wild flies	0-12	41-53	Died of <i>T. capræ</i> .
" 14...	200	"	20-26	128-134	" "
" 22...	281	"	2-17	51-66	" "
Mar. 3...	272	"	21-29	—	Alive after 262 days.
" 11...	263	Natural infection	?	?	Died March 22.
" 14...	334	Wild flies	7 ?	—	Alive after 251 days.
" 16...	335	From Goat 263	5	—	" 249 "
" 16...	339	" 263	9	63	Died of <i>T. capræ</i> .
" 16...	340	" 263	16	—	Alive after 249 days.
" 20...	346	" 263	5	—	" 245 "
" 20...	347	" 263	12	—	" 245 "
" 20...	348	" 263	5	89	Died of <i>T. capræ</i> .
Apr. 1...	398	Wild flies	10-21	101-112	" "
" 11...	410	"	6-11	46-51	" "
" 12...	412	"	0-13	0-20	" "
" 16...	414	"	7-13	33-39	" "
" 19...	422	"	4-10	—	Alive after 215 days.
" 24...	415	"	13-19	46-52	Died of <i>T. capræ</i> .
" 24...	420	"	13-19	43-49	" "
May 2...	433	"	10	63	" "
" 4...	435	"	13-19	55-61	" "
" 9...	266	"	6-11	69-74	" "
" 9...	269	"	10-18	18-26	" "
" 18...	553	"	6-16	—	Alive after 186 days.
" 23...	565	"	3-10	52-59	Died of <i>T. capræ</i> .
June 5...	622	"	15	34	" "
July 25...	979	From Reedbuck 988 ...	11	—	Alive after 118 days.
Aug. 18...	1039	From Bushbuck 1087	8	33	Died of <i>T. capræ</i> .
" 22...	1111	From Reedbuck 1153	11	43	" "
" 22...	1114	" 1156	11	—	Alive after 90 days.
" 22...	1118	" 1150	11	—	" 90 "
" 22...	1120	" 1162	7	—	" 90 "
Sept. 13...	1342	From Waterbuck 1339	20	—	" 68 "
" 14...	1366	From Reedbuck 1363	9	—	" 67 "
" 18...	1391	From Waterbuck 1388	8	—	" 63 "
" 20...	1409	" 1406	17	—	" 61 "
Sheep.					
July 17...	907	From Goat 653	5	36	Died of <i>T. capræ</i> .
Mar. 20...	346	" 263	5	—	Alive after 245 days.
" 20...	347	" 263	12	221	Died of <i>T. capræ</i> .
" 20...	348	" 263	5	89	" "

Table IV—continued.

Date.	No. of expt.	Source of virus.	Period of incubation, in days.	Duration, in days.	Remarks.
Monkey.					
1912.					
Feb. 2...	49	Wild flies	—	—	Only showed <i>T. simia</i> .
Mar. 9...	326	From Goat 175	—	—	Never showed trypanosomes.
Apr. 15...	405	Wild flies	—	—	Only showed <i>T. simia</i> .
" 23...	465	"	—	—	" "
" 23...	467	"	—	—	Only showed <i>T. pecorum</i> .
July 25...	989	From Reedbuck 988 ...	—	—	Never showed trypanosomes.
Aug. 22...	1154	" 1153...	—	—	" "
" 22...	1157	" 1156...	—	—	" "
Sept. 13...	1340	From Waterbuck 1339	—	—	" "
" 14...	1364	From Reedbuck 1363...	—	—	" "
" 18...	1389	From Waterbuck 1388	—	—	" "
" 20...	1407	" 1406	—	—	" "
Dog.					
Mar. 9...	319	From Goat 175	—	—	Never showed trypanosomes.
" 9...	320	" 175	—	—	Only showed <i>T. brucei</i> .
" 9...	321	" 125	—	—	Only showed <i>T. pecorum</i> .
" 9...	322	" 125	—	—	" "
" 9...	344	" 263	—	—	Never showed trypanosomes.
" 9...	345	" 263	—	—	" "
July 25...	990	From Reedbuck 988...	—	—	" "
Aug. 22...	1155	" 1153...	—	—	" "
" 22...	1158	" 1156...	—	—	" "
Sept. 13...	1341	From Waterbuck 1339	—	—	" "
" 14...	1365	From Reedbuck 1363...	—	—	" "
" 18...	1390	From Waterbuck 1388	—	—	" "
Guinea-pig.					
Mar. 20...	351	From Goat 263	—	—	Never showed trypanosomes.
" 20...	352	" 263	—	—	" "
Rat.					
Mar. 20...	351	From Goat 263	—	—	Never showed trypanosomes.
" 20...	352	" 263	—	—	" "

THE CARRIER OF *T. CAPRÆ*.

The carrier of *T. capræ* in Nyasaland is *G. morsitans*. These tsetse flies in the neighbourhood of Kasu are heavily infected with this trypanosome.

In the experiments made to ascertain with what trypanosomes the wild flies are naturally infected, *T. capræ* was found in 61 per cent.

The development of this trypanosome in *G. morsitans* will be dealt with in a future paper; suffice it to say here that it is restricted to the proboscis and runs a course of from 16 to 20 days.

THE HOST OR RESERVOIR OF *T. CAPRÆ*.

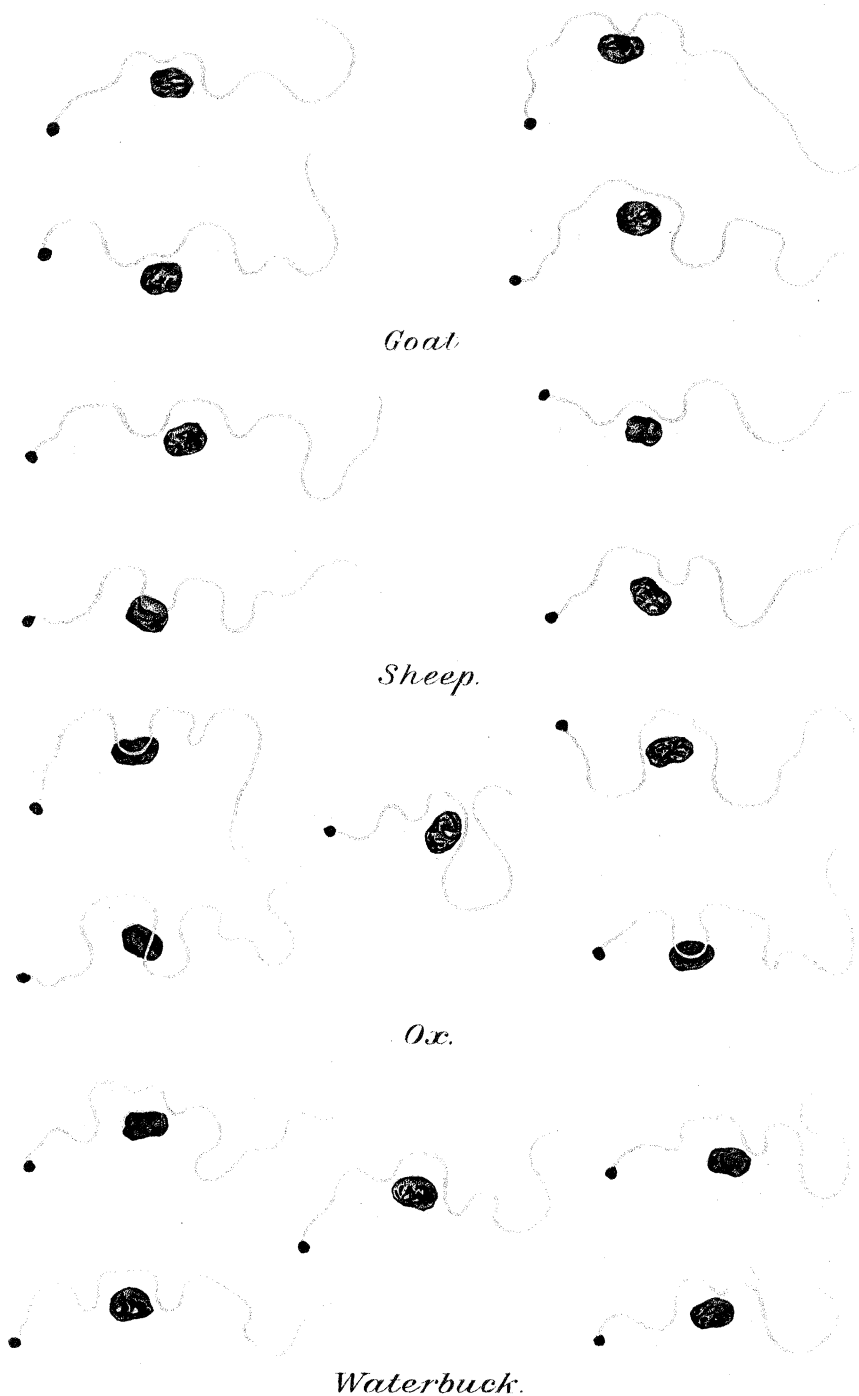
Up to the present 180 specimens of wild game living in the Nyasaland Sleeping-Sickness Area have been examined. Of these 19, or 10·5 per cent., harboured *T. capræ*. The animals were reedbuck, waterbuck, eland, and bushbuck.

CONCLUSIONS.

1. *T. capræ* belongs to the same group as *T. vivax* and *T. uniforme*, and affects the same animals—cattle, goats, and sheep. Monkeys, dogs, and the smaller laboratory animals are immune.
2. The carrier is *G. morsitans*.
3. The reservoir of the virus is the wild game living in the “fly-country.”

DESCRIPTION OF PLATE.

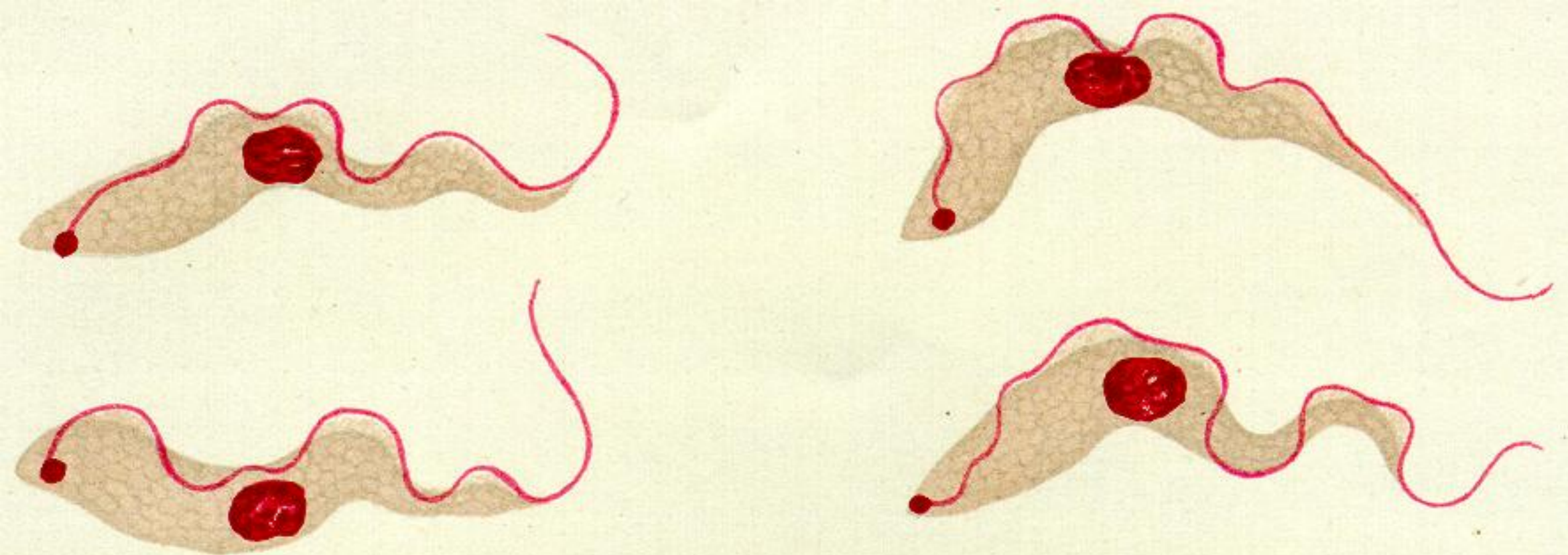
Trypanosoma capræ (Kleine).—Large, heavily built body ; posterior extremity swollen, bluntly angular, or rounded ; anterior extremity pointed ; nucleus oval, compact ; micronucleus large, round, situated, as a rule, close to posterior extremity ; undulating membrane marked, thrown into bold folds ; flagellum well marked, free, average 6·5 microns in length. × 2000.



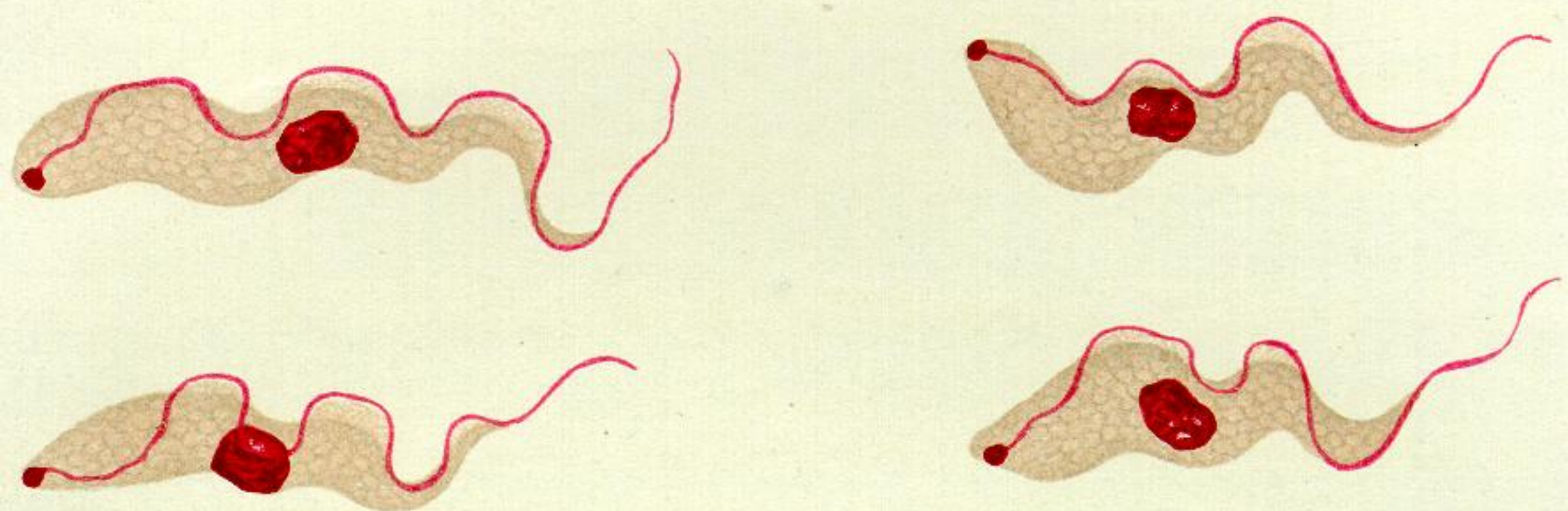
Trypanosoma capræ (Kleine).

M. E. Bruce, del.

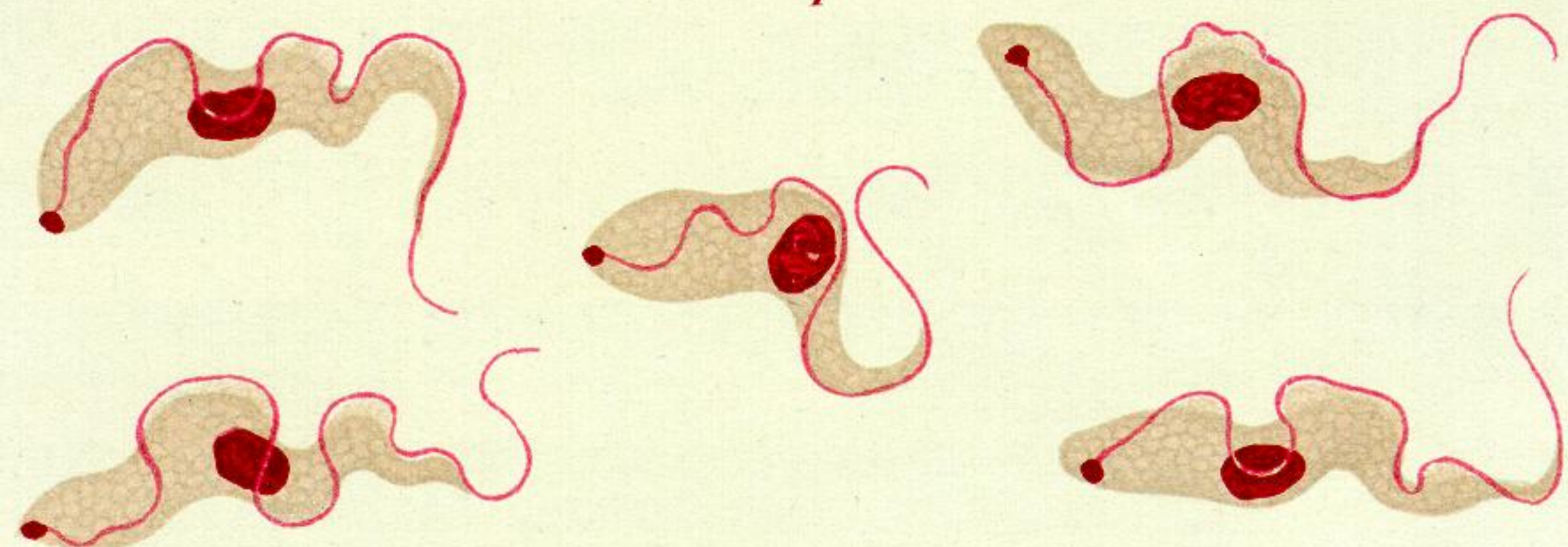
1. *Journal of the American Medical Association*, 1997; 277: 1001-1005.



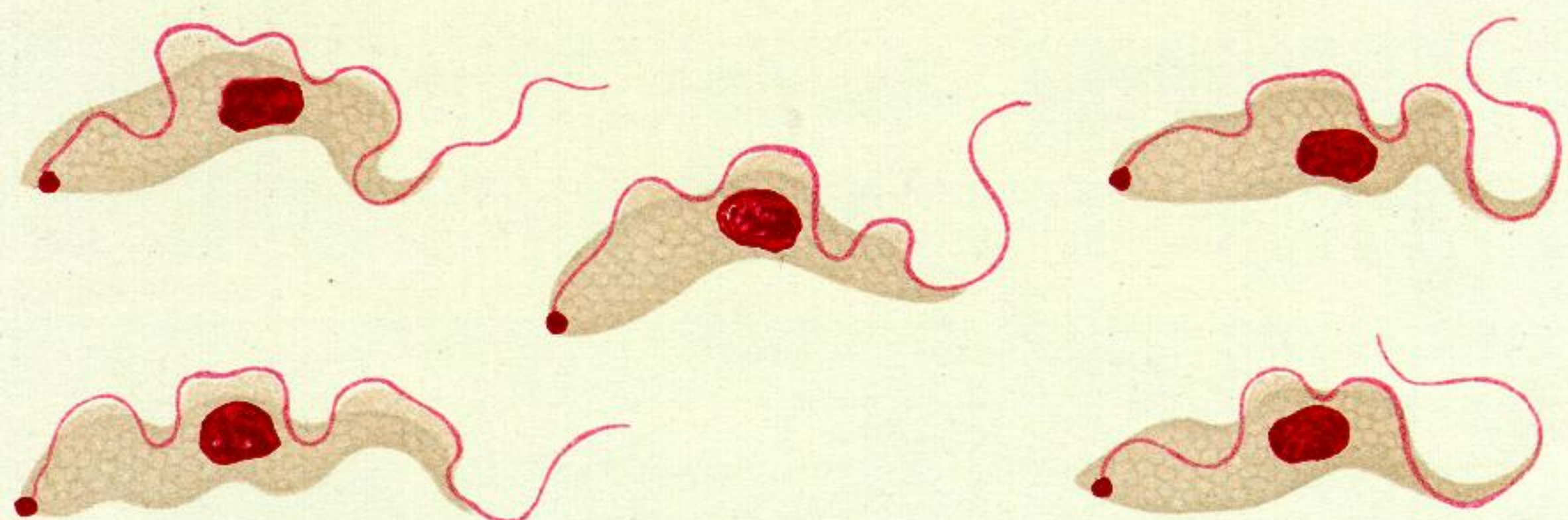
Goat



Sheep.



Ox.



Waterbuck.

Trypanosoma capræ (Kleine).