

*Trypanosome Diseases of Domestic Animals in Uganda.**
V.—*Trypanosoma nanum* (Laveran).

By Colonel Sir DAVID BRUCE, C.B., F.R.S., A.M.S.; Captains A. E. HAMERTON, D.S.O., and H. R. BATEMAN, R.A.M.C.; and Captain F. P. MACKIE, I.M.S. (Sleeping Sickness Commission of the Royal Society, Uganda, 1908-10).

(Received October 1,—Read December 8, 1910.)

[PLATES 13 AND 14.]

INTRODUCTION.

Only two cattle (Experiments 503 and 1118) examined by the Commission at Mpumu were found to harbour this trypanosome in their blood. Both came from the Uganda Company's estate at Namukekera, some fifty miles from Lake Victoria, and both had become infected on the estate.

This species differed from *Trypanosoma pecorum*, in that it did not affect the smaller laboratory animals, such as monkeys, dogs, rats, or mice. Guinea-pigs were also refractory to the disease. Horses, mules, donkeys, and rabbits were not available at Mpumu, so that it is impossible to say what would have been the effect of inoculation in them. Oxen and goats were inoculable, but the only sheep experimented on failed to become infected, although inoculated with the same blood which infected a goat.

It seems rash to recognise *T. nanum* as a Uganda species on the insufficient evidence at our disposal; but yet the fact remains that this trypanosome in every case failed to infect the smaller animals, and, moreover, by placing these cases on record it will draw the attention of future workers to its possible presence.

MORPHOLOGY OF *TRYPANOSOMA NANUM*.

A. *Living, Unstained.*

T. nanum is indistinguishable from *T. pecorum* in the fresh and living condition.

B. *Fixed and Stained.*

Length.—The following table gives the average length of this trypanosome in the ox and goat. Twenty trypanosomes are drawn and measured from each preparation, the average length reckoned, and the length of the longest and shortest given :—

* Continued from preceding paper.

Trypanosome Diseases of Domestic Animals in Uganda. 181Table I.—*Trypanosoma nanum*.

No. of expt.	Animal.	Method of fixing.	Method of staining.	In microns.		
				Average length.	Maximum length.	Minimum length.
503	Ox	Osmic acid	Giemsa	13·3	15·0	11·0
983	"	"	"	13·1	14·0	12·0
698	Goat	"	"	13·9	16·0	13·0
698	"	"	"	15·2	16·0	12·0
882	"	"	"	12·9	15·0	11·0
883	"	"	"	13·3	15·0	11·0
1691	"	"	"	13·7	16·0	12·0
				13·6	16·0	11·0

The average length of *T. nanum* corresponds closely with that of *T. pecorum*, which was 13·3 microns. The question arises as to whether it would not be better for the sake of simplicity to include, for the present at least, this species in that of *T. pecorum*. If the morphology is the same, if the important domestic animals are susceptible to both, if the geographical distribution is the same, and if the carrier is found to be the same, there seems little need of separating the two under different names.

Breadth.—At the widest part from 1·5 to 2·5 microns.

Shape.—Much the same as *T. pecorum*, but perhaps slightly narrower, due to the less development of the undulating membrane (Plate 14).

Contents of Cell.—As a rule homogeneous.

Nucleus.—Oval and situated about the middle of the body.

Micronucleus.—Small and rounded, and situated near the posterior extremity.

Undulating Membrane.—Perhaps a little narrower and simpler than in *T. pecorum*. It was thought to be applied more closely to the body and less thrown into folds than in that species.

Flagellum.—There is no free flagellum.

From a comparison of Tables II and III, Chart 1, and the coloured figures of the two species, it is evident that *T. pecorum* and *T. nanum* resemble each other very closely morphologically.

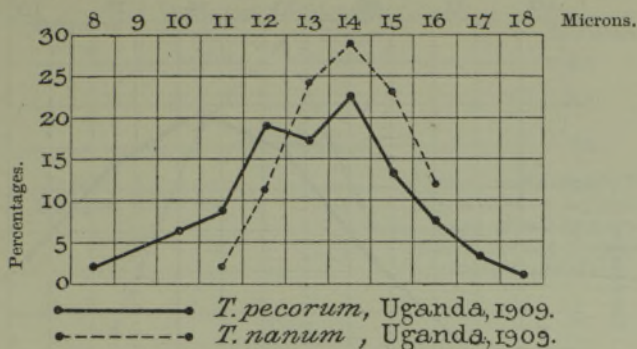
Table II.—Showing the Distribution in respect to Length of 100 Individuals of *T. nanum*, Uganda, 1909.

No. of expt.	Microns.						Average, in microns.
	11.	12.	13.	14.	15.	16.	
689	—	—	7	8	4	1	13·9
698	—	1	—	2	7	10	15·2
882	1	5	10	3	1	—	12·9
883	1	4	5	7	3	—	13·3
1691	—	1	2	8	8	1	13·7
Totals.....	2	11	24	28	23	12	
Percentages	2·0	11·0	24·0	28·0	23·0	12·0	

Table III.—Showing the Distribution in respect to Length of 260 Individuals of *T. pecorum*, Uganda, 1909.

No. of expt.	Microns.											Average, in microns.
	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	
82	—	—	2	6	8	3	1	—	—	—	—	11·7
505	—	—	2	2	9	4	1	2	—	—	—	12·3
—	—	—	—	2	3	6	6	3	—	—	—	13·2
593	—	—	1	—	2	1	3	7	5	1	—	14·5
44	—	—	4	2	5	3	6	—	—	—	—	12·2
559	—	—	—	2	9	4	4	—	1	—	—	12·7
461	—	—	—	—	—	5	4	1	2	6	2	15·3
543	—	—	—	2	—	2	6	6	4	—	—	14·3
1406	—	—	—	1	5	2	5	5	2	—	—	13·7
551	1	—	3	3	3	3	3	2	1	—	1	12·6
626	—	—	3	2	3	2	7	3	—	—	—	12·8
398	—	—	—	—	—	1	9	6	4	—	—	14·6
398	—	—	1	1	3	9	4	—	1	1	—	13·1
Totals ...	1	—	16	23	50	45	59	35	20	8	3	
Percentages	0·4	—	6·1	8·8	19·2	17·3	22·7	13·5	7·7	3·1	1·2	

CHART 1.—Giving Curves representing the Distribution, by Percentages, in respect to Length of *T. pecorum*, Uganda, 1909, and *T. nanum*, Uganda, 1909.



COMPARISON OF *T. NANUM*, UGANDA, 1909, WITH *T. NANUM*, SUDAN, 1904.

Thanks to Dr. Andrew Balfour, the Director of the Wellcome Research Laboratories, Khartoum, the Commission is enabled to compare the Uganda strain with the original Sudan strain.

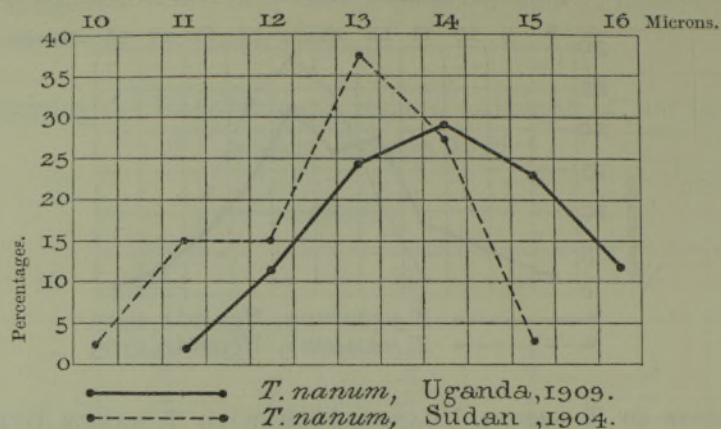
Table IV.—Measurements of Dr. Balfour's Sudan Strain of *T. nanum*, 1904.

Animal.	Method of fixing and staining.	In microns.		
		Average length.	Maximum length.	Minimum length.
Ox	?	12.9	15.0	11.0
„	?	12.7	14.0	10.0

Table V.—Showing the Distribution in respect to Length of 40 Individuals of *T. nanum*, Sudan, 1904.

Animal.	Microns.						Average, in microns.
	10.	11.	12.	13.	14.	15.	
Ox	—	3	4	6	6	1	12.9
Ox	1	3	2	9	5	—	12.7
Totals	1	6	6	15	11	1	
Percentages	2.5	15.0	15.0	37.5	27.5	2.5	

CHART 2.—Giving Curves representing the Distribution, by Percentages, in respect to Length of *T. nanum*, Uganda, 1909, and Dr. Balfour's *T. nanum*, Sudan, 1904.



From a comparison of these tables and the figures in Plate 13 there can be little doubt as to the identity as regards morphology of *T. nanum*, Uganda, 1909, and Dr. Balfour's *T. nanum*, discovered in the Sudan in 1904:—

ANIMALS SUSCEPTIBLE TO *T. NANUM*, UGANDA, 1909.

Date.	No. of expt.	Source of virus.	Period of incubation, in days.	Duration of disease, in days.*	Remarks.
Cattle.					
1909.					
Feb. 5	503	Nat. infec.	?	245	From Namukekera. Died of <i>T. nanum</i> .
June 25	1118	"	?	3	From Namukekera. Died of <i>T. nanum</i> .
Sept. 29	780	Ox 983	—	—	Never showed trypanosomes; still alive after 47 days.
June 11	982	Ox 503	—	—	Never showed trypanosomes; still alive after 141 days.
" 11	983	"	20	141	Killed.
Goat.					
Apr. 12	698	Ox 503	25	137	Died of <i>T. nanum</i> .
May 21	882	"	26	91	" "
" 21	883	"	6	46	" "
Sept. 16	1691	Oxen 503 & 982	8	12	" "
		Average ...	16	71	
Sheep.					
May 21	880	Ox 503	—	—	Never showed trypanosomes; still alive after 82 days.

* Duration includes the days of incubation; it dates from the day of infection.

ANIMALS SUSCEPTIBLE TO T. NANUM, UGANDA, 1909—*continued.*

Date.	No. of expt.	Source of virus.	Period of incubation, in days.	Duration of disease, in days.*	Remarks.
Monkey.					
Apr. 10	687	Ox 503	—	—	Died; under observation 23 days.
June 26	1168	Ox 1118	—	—	Never showed trypanosomes; still alive after 141 days.
" 26	1169	"	—	—	Never showed trypanosomes; still alive after 97 days.
Dog.					
May 21	884	Ox 503	—	—	Died; under observation 66 days.
June 30	1194	Goat 883	—	—	" " " " 42 "
" 30	1195	"	—	—	Never showed trypanosomes; still alive after 43 days.
" 30	1196	"	—	—	Died; under observation 26 days.
Guinea-pig.					
Apr. 10	689	Ox 503	—	—	Never showed trypanosomes; still alive after 59 days.
June 26	1162	Ox 1118	—	—	Never showed trypanosomes; still alive after 36 days.
" 26	1163	"	—	—	Never showed trypanosomes; still alive after 36 days.
" 26	1164	"	—	—	Never showed trypanosomes; still alive after 36 days.
Rat.					
1909.					
Feb. 9	529	Ox 503	—	—	Experiment stopped; alive after 44 days.
" 9	530	"	—	—	Experiment stopped; alive after 44 days.
Apr. 10	688	"	—	—	Experiment stopped; alive after 59 days.
" 12	717	"	—	—	Experiment stopped; alive after 57 days.
June 26	1165	Ox 1118	—	—	Experiment stopped; alive after 57 days.
" 26	1166	"	—	—	Experiment stopped; alive after 57 days.
" 26	1167	"	—	—	Experiment stopped; alive after 57 days.
May 21	885	Goat 698	—	—	Experiment stopped; alive after 80 days.
Mouse.					
Apr. 10	690	Ox 503	—	—	Experiment stopped; alive after 59 days.

* Duration includes the days of incubation; it dates from the day of infection.

186 *Trypanosome Diseases of Domestic Animals in Uganda.*

CULTIVATION OF *T. NANUM*.

No attempt was made at Mpumu to cultivate *T. nanum*.

THE CARRIER OF *T. NANUM*.

Of the two experiments made at Mpumu with *T. nanum* and *Glossina palpalis*, one was unsatisfactory and the other negative. Since the two oxen supposed to be suffering from *T. nanum* disease came from Namukekera, where it is stated there are no tsetse flies, it is probable that *T. nanum*, like *T. pecorum*, is carried by some species of biting fly other than *Glossina*.

CONCLUSIONS.

1. *T. nanum* is indistinguishable from *T. pecorum* either in the living condition or when fixed and stained.
2. It differs from *T. pecorum* in not being pathogenic to the smaller laboratory animals.
3. The carrier of *T. nanum* is probably the same as that of *T. pecorum*, as both diseases occur under the same conditions, but there is no evidence available as to what the carrier is.

DESCRIPTION OF PLATES.

PLATE 13.

Figures in black and white for the comparison of *Trypanosoma nanum*, Uganda, 1909, and *T. nanum*, Sudan, 1904. × 2000.

PLATE 14.

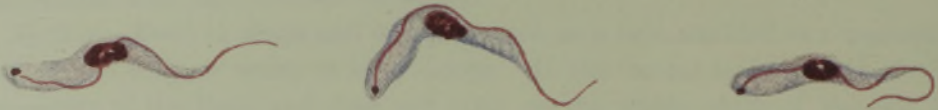
T. nanum, Uganda, 1909, in the goat. Fixed osmic acid, stained Giesma. × 2000.



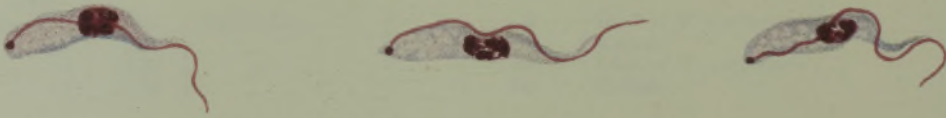
T. Nanum, Uganda, 1909.



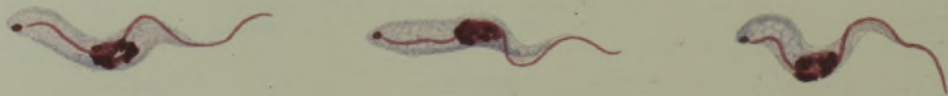
T. Nanum, Sudan, 1904.



Oxen.



Goats.



Sheep.