Bull. Org. mond. Santé / *Bull. Wld Hlth Org.* 1972. 47, 719-726

The epidemiology of human sleeping sickness in the Lambwe Valley, South Nyanza, Kenya

H. J. C. WATSON [1]

Human infection with Trypanosoma rhodesiense *in the Lambwe Valley area of South Nyanza, Kenya, was first reported in 1959 although* T. gambiense *sleeping sickness had been the present there since the turn of the century. The two forms of the disease are associated with the presence of the tsetse* Glossina fuscipes, *which is plentiful and widespread throughout the hinterland, including part of the study area, and* G. fuscipes *in the thickets near the shores of Lake Victoria and along some of the river systems. Fairly successful attempts have been made to eliminate tsetse by control operations around the lake shore and by aerial spraying of insecticide in the Lambwe Valley. The incidence and geographical distribution of cases of* T. rhodesiense *sleeping sickness in the Lambwe Valley are described in this report. Eight survey areas were studied between June 1968 and August 1970. Three types of survey procedure were adopted and blood samples were taken for examination. The most reliable method of demonstrating trypanosomes was by direct microscopy of stained blood films. Cases were treated with either suramin or melarsoprol, the latter being preferred for long-standing infections, but a course of suramin was given first. Although there were localized foci of infection in the study area, cases occurred sporadically, usually in April, i.e., in the early part of the long rainy season. It is suggested that, for diagnosis, survey teams should be replaced by a few fixed diagnostic microscopy centres.*

Willett (1965), in a historical review of sleeping sickness in the Nyanza region of Kenya, quoted Dr C. Christy, of the Sleeping Sickness Commission of the Royal Society, as having concluded in 1903 that the Gambian form of the disease spread from the great epidemic in Uganda, reaching Kasigunga and the offshore islands of South Nyanza in 1902. From there it spread throughout the lake-shore and riverine habitats of *Glossina fuscipes* in South Nyanza, including the Kuja–Migori river system. *Trypanosoma gambiense* infection remained endemic in the area, with sporadic epidemic outbreaks, until the eradication of *G. fuscipes* from the Kuja–Migori river system and the lake shore in 1954–57. The return of *G. fuscipes* to the lake shore and the Kuja–Migori river system necessitated re-spraying operations in 1967–68 and 1970, respectively.

The first case of *T. rhodesiense* infection in South Nyanza appears to have been that reported in 1959 (Willett, 1965). Since then the number of cases each year has risen to as many as 100, but there was a marked fall in the number of cases during the period 1968–70 (Fig. 1). This probably resulted partly from natural events and partly from tsetse control operations carried out by the Government of Kenya around the shore of Lake Victoria and aerial insecticide-spraying trials conducted in the Lambwe Valley.

This report briefly describes the incidence and geographical distribution of cases of Rhodesian sleeping sickness in the Lambwe Valley area of South Nyanza District, Kenya, between 1968 and 1970.

SURVEY METHODS

The endemic zone of the Lambwe Valley was arbitrarily divided into 8 contiguous survey areas (Fig. 2). Surveys of the 8 areas were made during the periods shown in the following tabulation.

Area	*Survey*
Obaluanda	17 June 1968–5 Sept. 1968
Kaksingiri	11 Sept. 1968–20 Jan. 1969
West Ruma	17 March 1969–29 April 1969
Otuok	16 April 1970–7 May 1970
Wiga	18 Aug. 1969–1 Oct. 1969
Magunga	6 March 1970–16 June 1970
Masangala	22 July 1969–28 July 1969
Escarpment	5 Aug. 1970–7 Aug. 1970

[1] Project Medical Officer (Epidemiology). Present address: WHO, Post Office Box 9292, Dar es Salaam, Tanzania.

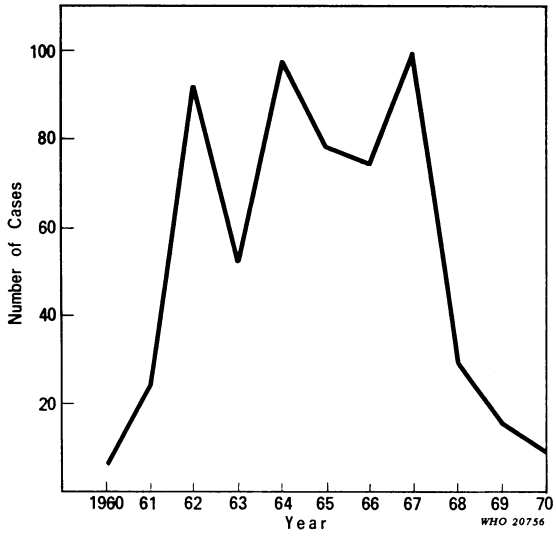

Fig. 1. Annual incidence of sleeping sickness in the Lambwe Valley area, 1960–70.

In order that the greatest possible number of people could be seen, it was decided that all surveys should be carried out on a homestead-to-homestead basis. In this way every homestead in each survey area would be visited by a survey team and attempts would be made to see all the residents of each homestead. Three types of survey procedure—" initial ", " intensive ", and " case area "—were adopted.

Initial surveys were simple surveys in which each person was seen in turn, observed as he approached, and palpated for enlarged lymph glands. A finger was pricked to obtain blood for the preparation of stained thick blood films and filter-paper blots for estimating serum IgM levels by the single-diffusion technique of Cunningham et al. (1967).

Intensive surveys differed from the initial surveys in that blood was obtained by venepuncture. The blood was used to make thick blood films and filter-paper blots; samples were treated with anticoagulant for Westergren and capillary erythrocyte sedimentation

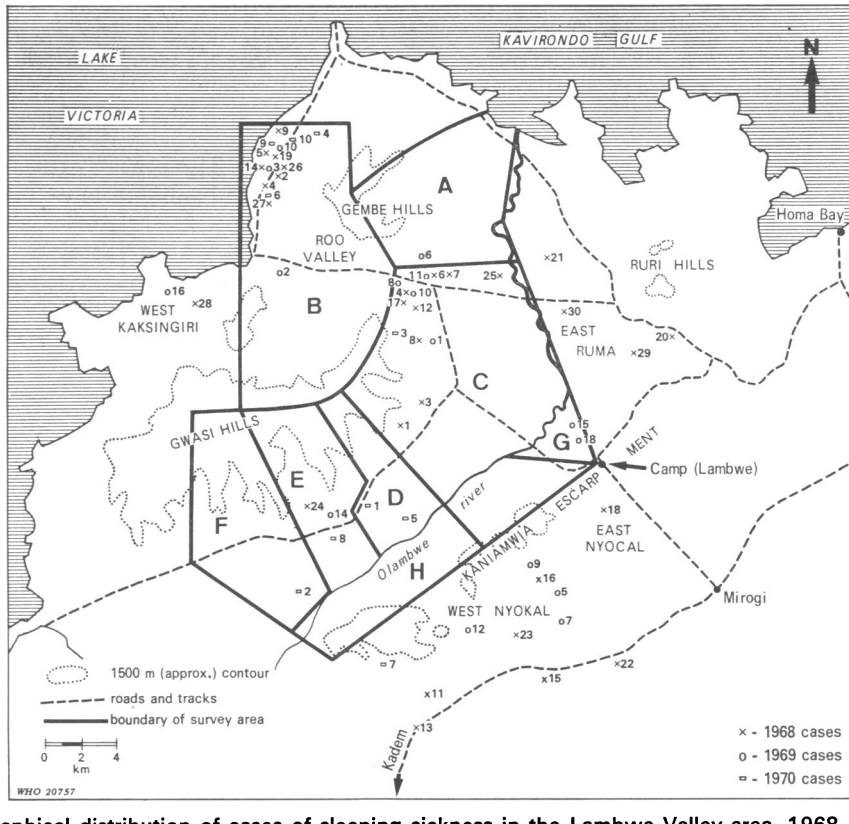

Fig. 2. Geographical distribution of cases of sleeping sickness in the Lambwe Valley area, 1968–70. A. Obaluanda; B, Kaksingiri,C. Western Ruma; D, Otuok, E. Wiga; F. Magunga; G, Masangala; H, Escarpment.

rate estimations; serum separations were carried out, and mouse inoculation tests were made.

Venepuncture proved to be very unpopular with the people in the survey areas and had to be discontinued after the first part of the Kaksingiri survey. It was reintroduced at Otuok, where a human case of sleeping sickness had been diagnosed shortly before the survey took place. The large samples were required so that animal inoculation tests could be carried out in the area where there was a high degree of man–tsetse–game contact, and where further cases were expected to occur. It was accepted fairly well by a small community that was aware that a case had been found in its midst and that feared the disease.

Case area surveys were small-scale initial surveys, carried out in the environs of homesteads where new cases had been diagnosed, the objective being to find other cases.

RESULTS

Cases of sleeping sickness diagnosed during surveys

Details of cases of sleeping sickness diagnosed during initial and intensive surveys in the 8 survey areas are given in Table 1, from which it is seen that only 2 cases (0.03%) were found amongst 5 850 people examined.

During case area surveys carried out between early 1969 and late 1970, a total of 1 851 people were examined (390 adult males, 476 male children, 528 adult females, 457 female children) and only 1 case (0.05%) of sleeping sickness was found. Of the people examined, 137 (7.4%) had raised serum IgM levels.

Volunteer sleeping sickness patients

The term " volunteers " refers to those people who went to a fixed centre for examination and treatment when they felt unwell. Fixed centres included survey teams operating away from the volunteers' settlement area, the Lambwe Valley field station, and the nearby Homa Bay hospital. The centres to which the patients reported, and the method by which sleeping sickness cases were diagnosed, are given in Table 2.

The results show that 76% of all cases were diagnosed by finding trypanosomes in the peripheral blood during the first examination, 15.4% of cases were diagnosed after further examination (7.7% by examinations of blood or glandular fluid, and 7.7% by animal inoculation tests), and 9.6% of cases were diagnosed after a raised serum IgM level indicated the need for further parasitological examination.

The search for trypanosomes during diagnosis

The various methods used to find trypanosomes are given in the following tabulation. The number of examinations carried out by each method is shown, together with the number of times trypanosomes were found by each method.

Table 1. Sleeping sickness cases diagnosed during initial and intensive surveys in the Lambwe Valley, Kenya, 1968–70

Survey area	Persons				Total	Sleeping sickness cases		Persons with raised IgM levels	
	Males		Females						
	Adult	Child	Adult	Child		No.	%	No.	%
Obaluanda	209	296	322	284	1 111	0	0.00	84	7.9
Kaksingiri	193	348	376	322	1 239	1	0.08	67	5.4
West Ruma	150	204	193	227	774	1	0.13	37	4.8
Otuok	57	80	78	81	296	0	0.00	10	3.4
Wiga	186	272	270	277	1 005	0	0.00	58	5.8
Magunga	192	369	286	369	1 215	0	0.00	34	2.8
Masangala	23	52	33	34	142	0	0.00	10	7.0
Escarpment	13	18	17	20	68	0	0.00	9	13.4
totals	1 023	1 639	1 575	1 613	5 850	2	0.03	309	5.3

Table 2. Diagnosis of cases of sleeping sickness in volunteer patients in the Lambwe Valley

Method of diagnosis	Numbers of cases diagnosed at the three examination centres			
	Survey team	Lambwe Field Station	Homa Bay hospital	Total
Peripheral trypanosomes found at first examination	12	11	17	40
Trypanosomes found on further examination made, or initiated, before IgM test results were known:				
(1) further blood film or gland puncture	0	2	2	4
(2) lumbar puncture	0	0	0	0
(3) animal inoculation tests	1	3	0	4
Trypanosomes found after raised IgM level indicated the need for further examination	2	1	2	5
totals	15	17	21	53

Method	*Positive tests*	*Percentage*
Examination of wet blood films	21/42	50
Examination of stained blood films	52/56	92.8
Examination of glandular fluid	18/25	72
Cerebrospinal fluid examination	6/46	13
Animal inoculation tests:		
blood	42/47	89.3
cerebrospinal fluid	10/20	50
glandular fluid	1/4	25

It can be seen from these results that the most reliable method of demonstrating trypanosomes was by direct microscopy of stained blood films, which were positive in 92.8% of cases. Inoculation of blood in animals ranked second, giving positive results in 89.3% of cases.

Age, sex, and ethnic distribution of cases

With the exception of one American patient (No. 4. 1968) and two Maragoli tribesmen (patients No. 1. 1970 and No. 8. 1970), the cases were members of the Luo tribe. The age and sex distribution of cases is shown in Table 3. Details of individual cases are given in Tables 4–6.

Geographical distribution of cases

Altogether, 38 (67.9%) of the cases diagnosed during the period under review came from the areas covered by the field surveys. The remainder, 18 cases (32.1%), came from: West Nyokal, 10 cases (17.8%); West Ruma, 4 cases (7.2%); West Kaksingiri, 2 cases (3.5%); and 1 case each (1.8%) from East Nyokal and Kadem (Fig. 2). Reference to Fig. 2 also shows that there were two main foci of infection, in Kaksingiri and West Ruma, and one subsidiary focus, in West Nyokal.

Table 3. Distribution of sleeping sickness cases by sex and age group

Sex	Adults	Children	Total
males	39 (75%)	1 (25%)	40 (71.4%)
females	13 (25%)	3 (75%)	16 (28.6%)
total	52 (100%)	4 (100%)	56 (100%)

The Kaksingiri focus, where 8 cases occurred in 1968, 2 in 1969, and 2 in 1970, was in the north-western coastal area. In the early part of 1968 the coastline was infested with *G. fuscipes* and some of the cases appeared to be *T. gambiense* infections. *G. pallidipes* was plentiful and widespread throughout the hinterland.

The West Ruma focus was in the north-western corner of the area where it joined the Kaksingiri and Obaluanda areas, and was situated beside a dammed river and a market. Five cases of sleeping sickness

Table 4. Sleeping sickness register of new cases for 1968

Case No.	Ethnic group, sex, and age (years)	Locality	Where diagnosed [a]	How diagnosed [b]	Date diagnosed
first quarter					
1	Luo F 17	West Ruma	VS	A	23 Jan.
2	Luo M 50	Kaksingiri	VS	A	23 Jan.
3	Luo F 42	West Ruma	VH	A	30 Jan.
4	American M 40	Kaksingiri	VH	A	3 March
second quarter					
5	M 78	Kaksingiri	VS	A	6 April
6	M 24	West Ruma	VH	A	17 April
7	F 29	West Ruma	VH	A	18 April
8	F 8	West Ruma	VH	A	22 April
9	M 65	Kaksingiri	VH	A	24 April
10	M 16	West Ruma	VS	A	27 April
11	F 28	West Nyokal	VH	A	7 May
12	Luo M 18	West Ruma	VS	A	10 May
13	M 25	Kadem	VH	A	14 May
14	M 29	Kaksingiri	VH	A	23 May
15	M 33	West Nyokal	VH	A	4 June
16	M 16	West Nyokal	VH	C	10 June
17	M 32	Kaniamwia	VL	A	17 June
18	F 19	East Nyokal	VL	B2	17 June
19	M 78	Kaksingiri	VS	A	21 June
third quarter					
20	F 11	East Ruma	VL	B1	3 July
21	M 60	East Ruma	VL	A	17 July
22	Luo M 16	West Nyokal	VH	A	1 Aug.
23	M 25	West Nyokal	VH	A	9 Aug.
24	M 59	Wiga	VS	B2	15 Aug.
fourth quarter					
25	F 9	West Ruma	VL	C	19 Oct.
26	M ?	Kaksingiri	VS	C	25 Oct.
27	Luo M 60	Kaksingiri	S	A	14 Nov.
28	Luo M 52	Kaksingiri	VH	B1	18 Nov.
29	M 25	East Ruma	VS	A	23 Nov.
30	M 8	East Ruma	VH	A	30 Dec.

[a] VS, Volunteer to survey team; VH, volunteer to hospital; VL, Volunteer to Lambwe Field Station; S, by survey team.

[b] A, Found positive at initial examination for peripheral trypanosomes; B, negative on initial examination, investigations continued on clinical grounds, IgM level not then known, later found to be positive (1, blood positive, 2, animal positive); C, negative on initial examination, investigations continued only on account of raised IgM level.

occurred in 1968 and 4 in 1969 in an area that was heavily infested with *G. pallidipes*.

The subsidiary focus of sleeping sickness in West Nyokal produced 4 cases, 1 diagnosed in 1968 and 3 diagnosed in 1969. On the map (Fig. 2) it appears as if 2 further cases arose from this focus but, although they occurred at about the same time as the others, patients No. 23. 1968 and No. 12. 1969 lived in an area that was separated from the focus by a ridge over which there was no communication.

Associations between sleeping sickness patients

Three patients from the West Nyokal area reported sick over a period of 29 days in March and April 1969. They were not related and had had no contact with one another although all three lived adjacent to a path that ran down the escarpment and across the valley to Wiga; the most distant of their homesteads were about a 20-minute walk apart. No tsetse were found by an entomological team that surveyed the area. The patients all denied that they ever went into the valley,

Table 5. Sleeping sickness register of new cases for 1969

Case No.	Ethnic group, sex, and age (years)	Locality	Where diagnosed [a]	How diagnosed [b]	Date diagnosed
First quarter					
1	M 46	West Ruma	VS	A	14 Jan.
2	M 48	Kaksingiri	VH	A	30 Jan.
3	F 24	Kaksingiri	VH	A	13 Feb.
4 Luo	M 25	West Ruma	VH	B1	3 March
5	F 40	West Nyokal	VL	A	10 March
6	M 35	Obaluanda	VS	A	17 March
7	M 42	West Nyokal	VL	B2	24 March
Second quarter					
8	F 30	Kaksingiri	VH	A	1 April
9	F 45	West Nyokal	VL	C	8 April
10	M 40	Kaksingiri	VS	C	11 April
11 Luo	M 16	West Ruma	S	A	25 April
12	M 49	West Nyokal	VL	B1	5 May
13	F 20	Masangala	VL	A	29 May
14	M 20	Wiga	VL	A	3 June
Third quarter					
15 Luo	F 32	Masangala	VL	A	8 July
Fourth quarter					
16 Luo	M 28	Rowa	VL	A	21 Nov.

[a] VS, volunteer to survey team; VH, volunteer to hospital; VL, volunteer to Lambwe Field Station; S, by survey team.

[b] A, found positive at initial examination for peripheral trypanosomes; B, negative on initial examination, investigations continued on clinical grounds, IgM level not then known, later found to be positive (1, blood positive; 2, animal positive); C, negative on initial examination, investigations continued only as a result of raised IgM levels.

but this seems unlikely to be true since other people in the area said that they frequently crossed the valley to the market at Wiga.

The period of sickness admitted by the patients agrees well with their physical signs and indicates that they all became infected at about the same time. It therefore seems likely that they were all infected at the same source.

In the West Ruma area during an 11-day period in April 1968 4 persons reported sick; another person reported sick 13 days later. At that time the area contained very thick bush that was heavily infested with *G. pallidipes*. Homesteads were located in the thicket clearings and tsetse entered the houses. The source of water for these people was the Ponge dam, just inside the eastern end of the Roo Valley.

In January 1968, 2 cases of sleeping sickness were diagnosed from West Ruma; the patients gave histories of sickness for 6 and 8 weeks. They lived only a few minutes' walk from one another and both drew water from a dam situated between their homesteads in an area that was heavily infested with *G. pallidipes*.

In the Masangala area, 2 cases were diagnosed within 6 weeks; although they knew each other, there was no direct contact at home between the patients. Their homesteads were in a fly-free area but both patients frequently visited the southern end of the Ruma thicket, which was heavily infested with *G. pallidipes*. It is probable that they were both infected in this area.

Seasonal periodicity of sleeping sickness cases

There were two periods of high incidence; the greater in April and the smaller in November. These months are, respectively, in the early part of the long and short rainy seasons, each being preceded by a hot dry period (Fig. 3). It appears, therefore, that there is a correlation between the susceptibility of the tsetse to the trypanosomes and the higher temperature and drier conditions during the pupal period.

It was assumed that with the onset of the rains, the flies dispersed from their breeding sites and came into greater contact with man.

Table 6. Sleeping sickness register of new cases for 1970

Case No.	Ethnic group, sex, and age (years)		Locality	Where diagnosed [a]	How diagnosed [b]	Date diagnosed
First quarter						
none						
Second quarter						
1	Maragoli	M 19	Otuok	VS	A	4 April
2	Luo	M 32	Magunga	VS	A	15 May
3	Luo	M 55	West Ruma	VS	A	15 May
Third quarter						
4	Luo	F 30	Kaksingiri	VH	A	7 July
5	Luo	M adult	Otuok	VH	A	4 Aug.
6	Luo	F 32	Kaksingiri	VL	B2	11 Aug.
7	Luo	M 52	West Nyokal	VL	A	29 Sept.
Fourth quarter						
8	Maragoli	M 38	Wiga	VL	A	27 Oct.
9	Luo	M 24	Kaksingiri	VL	A	28 Oct.
10	Luo	M 70	Kaksingiri	S	A	18 Nov.

[a] VS, volunteer to survey team; VH, volunteer to hospital; VL, volunteer to Lambwe Field Station; S, by survey team.

[b] A, found positive at initial examination for peripheral trypanosomes; B, negative on initial examination, investigations continued on clinical grounds, IgM level not then known, later found to be positive (1, blood positive; 2, animal positive); C, negative on initial examination, investigations continued only as a result of raised IgM level.

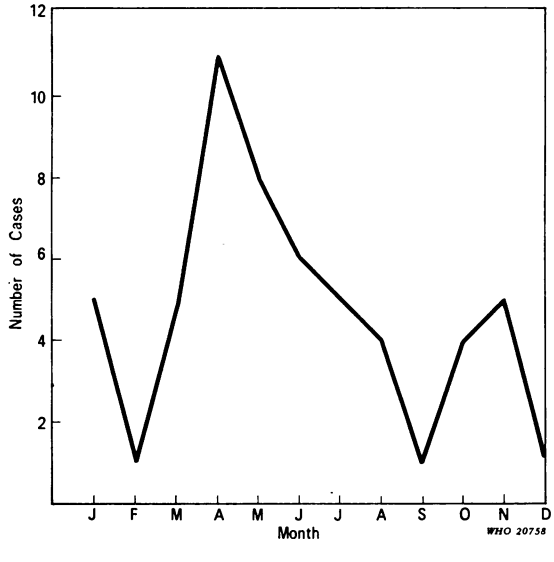

Fig. 3. Seasonal distribution of cases of sleeping sickness in the Lambwe Valley area, consolidated monthly number of cases for the years 1968–70.

The tsetse situation

The use of insecticides in tsetse control operations and in aerial spraying trials undoubtedly altered the tsetse situation in the area during the 3-year study period. In the Obaluanda area and along the coastline deliberate eradication measures were carried out by the Government of Kenya, resulting to a large extent in the elimination of *G. fuscipes* from the coastal areas and in the virtual eradication of fly from the northern part of the Obaluanda area.

In the valley proper the experimental use of insecticides during aerial spraying trials greatly reduced the numbers of tsetse found in most areas previously infested with large numbers of *G. pallidipes* and with small restricted foci of *G. brevipalpis*.

Treatment of cases

Only suramin and melarsoprol were used in the treatment of sleeping sickness. Initially it was found that melarsoprol was being used at too low a dosage for *T. rhodesiense* infections and schedule "A" of Robertson (1963) was later introduced.

Assessment of the stage of the disease was made by a cell count and an estimation of the protein content of cerebrospinal fluid obtained by lumbar puncture. The upper level of normality was taken as 3 cells/mm^3 and 26 mg of protein per 100 ml of cerebrospinal fluid. The choice of drug was made when this information was available. When both the cell count and the protein content of the cerebrospinal fluid were normal, and when the illness was of less than 4 weeks duration, the drug of choice was suramin. When the

cerebrospinal fluid was abnormal in respect of either the cell count or the protein content, or when the illness had lasted longer than 4 weeks, the drug of choice was melarsoprol.

In order to reduce the chances of a severe reaction to melarsoprol, a short course of suramin was given first. This usually consisted of a test dose and 2 injections of the full dose. The first course of melarsoprol started 2 days after the last suramin injection.

The courses of treatment used were as follows.

Suramin. This drug was used at a dosage rate of 20 mg per kg of body weight, the maximum single dose for any patient being 1.0 g:

day 1, test dose of 1/4 of the maximum dose for the patient;
day 3, full dose if no reaction to the test dose has occurred;
day 8, full dose.

This was repeated at intervals of 5 days until 5 injections of the full dose had been given.

Since suramin may cause renal damage, the urine should be examined for albumin before each injection.

Melarsoprol. This drug is given at a dosage rate of 3.6 mg per kg of body weight, the ceiling dose being 180 mg. The drug is dispensed in vials containing 5 ml, representing the dose for a man weighing 50 kg.

day 1,	4/10 of the full dose for the patient
day 2,	1/2 of the full dose
day 3,	6/10 of the full dose
days 4–11,	rest period
day 12,	7/10 of the full dose
day 13,	8/10 of the full dose
day 14,	full dose
days 15–22,	rest period
days 23–25,	full dose

DISCUSSION

Although there were localized foci of infection in the area studied, the cases generally occurred sporadically and were widely separated. Associations by time and place between cases, if they occurred, were usually found in April when the incidence of the disease was highest, and were probably related more to tsetse conditions than to host factors.

It is evident that field survey teams by themselves have little practical value in finding Rhodesian sleeping sickness cases in an area such as the Lambwe Valley, where the disease is of low endemicity; only 3 cases (5.4%) were diagnosed by a survey team during a survey. Such teams should therefore be replaced by a few fixed diagnostic centres and this could possibly be achieved by stationing microscopists at rural health centres.

RÉSUMÉ

EPIDÉMIOLOGIE DE LA TRYPANOSOMIASE HUMAINE DANS LA VALLÉE DE LA LAMBWE, DISTRICT DU NYANZA DU SUD (KENYA)

Des cas d'infection humaine par *Trypanosoma rhodesiense* n'ont été signalés dans la vallée de la Lambwe qu'en 1959, bien que la forme gambienne de la maladie y soit connue depuis le début du siècle. La maladie est endémique dans les régions de fourrés qui abritent *Glossina fuscipes* sur les rives du lac Victoria et le long des cours d'eau. On trouve *G. pallidipes* en abondance dans de vastes zones de l'intérieur.

Durant les trois années de la présente étude, on s'est efforcé, avec succès, d'éliminer les glossines par l'application d'insecticides au sol et par épandage aérien. Les enquêtes intensives menées dans huit régions de la vallée en 1968/70 n'ont fait découvrir que 2 cas (0,03%) d'infections à *T. rhodesiense* sur 5850 personnes examinées. Au cours d'investigations plus limitées effectuées dans les endroits où de nouveaux cas avaient été décelés, on n'a dépisté qu'un seul malade (0,05%) sur 1851 habitants. Enfin, 53 cas ont été diagnostiqués dans des hôpitaux parmi les patients fréquentant la consultation. L'examen microscopique direct d'étalements de sang colorés s'est révélé comme la technique la plus sûre de détection des trypanosomes, donnant des résultats positifs dans 92,8% des infections. Le traitement a consisté en l'administration de suramine ou de mélarsoprol, ce dernier médicament étant préféré en cas d'infections anciennes ou d'anomalies du liquide céphalo-rachidien.

L'auteur estime que dans la vallée de la Lambwe, où l'endémicité de la maladie du sommeil à *T. rhodesiense* est faible, il est préférable d'installer des centres fixes de diagnostic plutôt que d'organiser des équipes itinérantes de dépistage.

REFERENCES

Cunningham, M. P. et al. (1967) *Trans. roy. Soc. trop. Med. Hyg.*, **61**, 688
Robertson, D. H. H. (1963) *Trans. roy. Soc. trop. Med. Hyg.*, **57**, 122, 176
Willett, K. C., (1965) *Trans. roy. Soc. trop. Med. Hyg.*, **59**, 374