

FIG. 1

Location of camps of tsetse control workers.  
 The figures are the numbers of families living in each camp.

(2) Among families using permanent swamps the women and girls go to the swamps daily to collect water or wash clothes, and all members of these families may go there for activities such as bathing and the collection of useful plants. (3) Members of families using seasonal swamps go there frequently during those months of the year when the swamps contain water, but infrequently during the dry season.

In February 1970 each camp was visited, and all the men and their families were interviewed and examined for signs of new or healed Buruli lesions. When a person was found who had been treated for the disease between 1 January 1969 and the time

of the survey, case records were checked at whichever of the three government hospitals or mission hospital surgical treatment was given. From March 1970 onwards special clinics for Buruli disease were held in the area each month until July 1972. On each monthly pay-day clerks at the headquarters asked the men about the occurrence of any new cases in their families, and recorded the names of those patients who did not attend the special clinic but went directly to hospital.

In this way the name, age, sex, address and clinical details were recorded for all new cases of Buruli disease occurring among the tsetse control staff or their families during the period 1 January

# Mycobacterium Ulcerans Infection Among Tsetse Control Workers in Uganda

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Barker, D. J. P. (Dept. Community Medicine, University of Southampton, England), and Carswell, J. W. *Mycobacterium ulcerans* infection among tsetse control workers in Uganda. *Int. J. Epid.* 1973, 2: 161-165.

Forty-five cases of *Mycobacterium ulcerans* infection were recorded among 170 Ugandan tsetse control workers and their families during a period of forty-three months. There was a higher incidence of the disease in families using swamps as a domestic water source than in families using boreholes. In those using permanent swamps the incidence was higher than in those using seasonal swamps. These findings may be interpreted as showing an association between the frequency of the disease and the frequency with which people go to swamps; and they accord with the hypothesis that the disease is transmitted to man by contact with vegetation in and around swamps.

Infection with *Mycobacterium ulcerans* causes chronic necrotizing skin ulcers commonly known as Buruli ulcers. The method of transmission of the infection is unknown, but there is strong evidence that it is not usually from one person to another (1). Recent epidemiological findings have led to the suggestion that *Myco. ulcerans* occurs on vegetation growing in poorly drained soil and is transmitted to man through contact with the vegetation (2). This hypothesis postulates that the organism penetrates the skin by way of small scratches or other lesions resulting from the contact with vegetation, and that the Buruli lesion occurs at the site of penetration.

According to the hypothesis the main source of infection is vegetation growing in permanent swamps, but seasonal swamps and other areas with wet soil would contribute during the rainy seasons (3). It may be predicted, therefore, that within an area where Buruli disease occurs, the frequency of the disease among different sub-groups of the population will be related to the frequency with which people go to the swamps. In rural Uganda swamps are widely used as a source of domestic water. This prediction has been tested by a study of the occurrence of Buruli disease among a group of workers employed by the Uganda Tsetse Control Division.

## METHOD

In the north-east part of Bunyoro District, Uganda, the Tsetse Control Division employs 170 men, who work in a sparsely populated area of approximately 25 by 20 miles, situated on the west bank of the Victoria Nile. The men live in camps scattered throughout the area. Many of them bring their relatives to live in the camps, and the population observed in this survey comprises 170 families, whose composition ranges from a single tsetse control worker living alone to a worker with several wives, many children and other relatives. The location of the camps and the number of families living in each are shown in Fig. 1. Each camp contains between one and eight families, with the exception of the headquarters camp where there are twenty-eight.

Each camp obtains water for domestic use from one of three sources: (1) boreholes, (2) permanent swamps at the edge of the Nile, (3) a combination of seasonal swamps, which form during the rainy season, and borehole water which is brought by tractor from the headquarters during the dry season. Although each camp is mainly dependent on one of these sources either of the other two may be used on occasion. For example, after heavy rains a camp which usually uses a permanent swamp may temporarily use a pool which forms close to their house. However, classification of the camps according to their main source of domestic water divides the families into three groups, with varying frequency of contact with swamp vegetation. (1) Among families using boreholes visits to permanent or seasonal swamps are infrequent.

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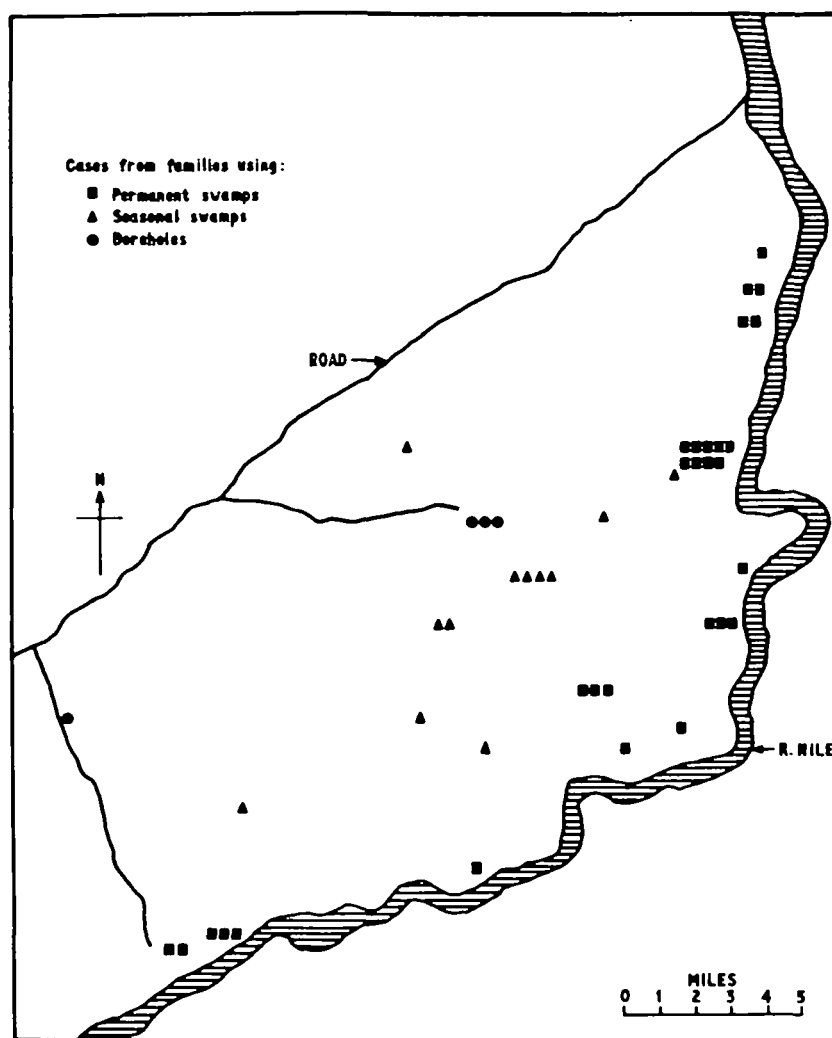


FIG. 2  
Location of cases of mycobacterial skin ulcer.

1969 to 30 July 1972. A patient was accepted as having Buruli disease if a definite clinical diagnosis was made by a doctor familiar with the disease. Whenever possible a biopsy was taken to confirm the diagnosis.

#### RESULTS

Forty-seven cases of Buruli disease were recorded during the forty-three month period of the study. Two had lived outside the Tsetse Control area during the presumed time of infection with *Myco. ulcerans*, which is from one to three months before the first appearance of the lesion (1). These two cases were excluded from the study leaving forty-

five. For thirty-five of these the clinical diagnosis of Buruli disease was confirmed by biopsy.

Table I and Fig. 2 show the distribution of the cases according to their families' source of domestic water. There were 29 cases among 55 families using permanent swamps; 12 cases among 48 families using seasonal swamps; and 4 cases among 67 families using boreholes. Relating the numbers of cases to the numbers of families gives incidence rates of 53 per cent for families using permanent swamps, 25 per cent for those using seasonal swamps and 6 per cent for those using boreholes.

Table II shows the age and sex distribution of the cases. Thirty-one of them were children under fifteen years, and there were thirty females com-

TABLE I  
*Distribution of cases according to families' source of domestic water*

Source of water	No. cases (a)	No. families (b)	Percentage (a)/(b)
Permanent swamps	29	55	53
Seasonal swamps	12	48	25
Boreholes	4	67	6
Totals	45	170	26

pared with fifteen males. This distribution agrees with that of the disease in Uganda as a whole, where there is a higher incidence among children than adults, and a higher incidence among adult females than adult males (4). There was no marked difference between the distribution of cases from families using the three different water sources.

Thirty-six of the 45 patients were able to recall the month of onset of their lesion. The distribution of months of onset is shown in Table III. Of the nine patients from families using seasonal swamps only two developed lesions in the first half of the year. Among the 23 patients from families using permanent swamps the distribution was more even, with 11 lesions developing from January to June and 12 lesions developing from July to December. The onset of lesions in four patients from families using boreholes was equally distribu-

ted between the two halves of the year. For all patients combined, the second quarter, April-June, had a lower frequency of onset of lesions than any other quarter.

#### DISCUSSION

This study shows that among a group of families living in an area where Buruli disease occurs, the incidence of the disease is lower in families who obtain domestic water from boreholes than in those using swamps. There is a higher incidence among

families using permanent swamps than among those using seasonal swamps.

Precise data on family size and structure were not obtained because members of many families spent only part of each year in the tsetse control area, returning at other times to their home districts. For this reason the denominator used in calculating incidence rates was the number of families rather than the number of individuals (Table I). This method of expressing incidence would bias the results if there were marked differences in family size according to the source of domestic water. General observation in the area suggests that the camps which depend on boreholes or permanent swamps may be more congenial than those using seasonal swamps. The camps using boreholes are close to roads, with resulting ease of communication, and those using permanent swamps

TABLE II  
*Age and sex distribution of cases according to source of domestic water*

Source of water	Males				Females				Totals
	0-4	5-9	10-14	15+	0-4	5-9	10-14	15+	
Permanent swamps	6	3	0	1	3	5	2	9	29
Seasonal swamps	2	0	0	2	1	4	1	2	12
Boreholes	1	0	0	0	0	3	0	0	4
Totals	9	3	0	3	4	12	3	11	45

TABLE III  
*Month of onset of lesions according to source of domestic water*

Source of water	J	F	M	A	M	J	J	A	S	O	N	D	Totals
Permanent swamps	6	1	1	2	0	1	2	4	1	5	0	0	23
Seasonal swamps	0	1	0	1	0	0	0	3	2	1	0	1	9
Boreholes	0	0	2	0	0	0	0	1	0	1	0	0	4
Totals	6	2	3	3	0	1	2	8	3	7	0	1	36*

\* Data on month of onset not obtained from 9 of the 45 patients.

are beside the Nile with plentiful fish and fertile soil. Many of the camps using seasonal swamps are isolated, since the local people either live close to the roads or to the river.

When each camp was visited in February 1970, a count was made of the number of individuals resident at that time. Average family sizes (including the heads of family) were 2.0 (105/53) for families using boreholes, 2.4 (131/54) for families using permanent swamps, and 2.0 (61/31) for families using seasonal swamps. Therefore, although disease incidence expressed in relation to numbers of families may exaggerate the difference between families using permanent swamps (incidence 53 per cent) and seasonal swamps (incidence 25 per cent), it seems unlikely that it could account for more than a small part of the difference between families using either type of swamp and those using boreholes (incidence 6 per cent).

Since the camps using permanent swamps are located close to the Nile, it may be suggested that the association between disease incidence and permanent swamps is secondary to some other influence related to the Nile. However, if the families using seasonal swamps and boreholes are distributed according to their distance from the Nile, the combined incidences are 11 per cent (4/36) for camps from 0 to 3 miles distance, 23 per cent (5/22) for camps 4 to 6 miles distance, and 12 per cent (7/57) for camps 7 or more miles distance. This provides no evidence of an association between disease incidence and proximity to the river.

The reduced frequency of onset of lesions in the April-June quarter (Table III) agrees with the known seasonal pattern of Buruli disease in this area of Uganda (3). These seasonal variations in disease incidence have been related to changes in rainfall and consequent changes in the vegetation. From November to March there is a long period of low rainfall, during which the seasonal swamps dry up and the camps using them come to depend on water delivered from the headquarters camp. The seasonal swamps fill up again when the rains come in April, but it is at least a month before the surrounding vegetation, which has withered and died down, regains its height of up to 3 metres or more. If tsetse control families using seasonal swamps for water contract Buruli disease by contact with vegetation in the vicinity of the

swamps, it may be predicted that transmission will be reduced from November to April. Since, as already stated, the incubation period of the infection is thought to be around two months this reduction in transmission will result in a reduced frequency of lesions whose onset is from January to June. Although the numbers are too small to permit any firm conclusions, the data in Table III suggest that families using seasonal swamps may be less liable to develop Buruli lesions during the January-June period.

This study has shown that in families who use swamps as a source of domestic water there is a higher incidence of Buruli disease than in families who use boreholes, and who therefore go to swamps less frequently. In families who use permanent swamps, which contain water throughout the year, the incidence is higher than in families using seasonal swamps, which can only serve as a water source for part of the year. Therefore the study may be interpreted as showing an association between the incidence of Buruli disease and the frequency with which people go to swamps. This interpretation accords with the hypothesis that the disease is contracted by contact with vegetation growing in swampy areas.

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