Measles is a dangerous childhood disease often with serious complications and its impact on undernourished and malnourished children is even more disastrous.

There has been some hesitancy regarding its use in mass campaigns in the Republic at present, but we have been informed that a pilot study is under way in the Cape in order to assess the efficacy and side-effects of the vaccine. Although the side-effects elsewhere have been reported to be mild and of a transient nature, such as a mild febrile condition 6 - 10 days after vaccination and the development of a rash in certain cases 10 - 12 days later, we could predict that such effects might well be more severe among poorly nourished children whose resistance is suspect. However, results from Nigeria have indicated that the vaccine is both safe and effective.[2]

It is hoped that the results of this pilot study will be satisfactory and may lead to mass immunization campaigns.

Antibody studies[2] have indicated that so large a proportion of children are naturally immune to measles by three years of age that mass vaccination after this age would prove to be both redundant and uneconomic.

Important considerations in any such campaign would be the choice of vaccine with particular reference to its immunizing properties, its reactogenecity, the ease of administration and its cost. It is essential that before launching on any such campaign we should be certain that the reactions to the vaccine are not severe as this would certainly have an adverse effect on the public's acceptance of immunization and vaccination procedures which have been so successful in eliminating other serious preventable diseases. Such acceptance has not been won easily and we can appreciate the caution that should be adopted in order to maintain and not undo the value of such promotive measures.

Measles and its complications can be childhood killers and with an effective vaccine they may be relegated to the past in the company of other formidable viral or bacterial infections. This remains a challenge and an opportunity for all those concerned with the health of the community.

The public would be well rid of the notion that 'measles is simply a part of growing up'.

1. Editorial (1967): Amer. J. Publ. Hlth., **57**, 729.
2. Hendrickse, R. G., Montefiore, D., Peradze, T., Sherman, P. and Powell, M. (1966): J. Trop. Med. Hyg., **69**, 112.

BILHARZIA SURVEY IN THE EASTERN CAPRIVI, NORTHERN BECHUANALAND AND NORTHERN SOUTH WEST AFRICA

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Before this survey was undertaken very little was known about bilharzia in the area. As far as could be ascertained there had been no systematic survey apart from random ones in the Ngamiland district of Bechuanaland by the local health authorities (urines), by De Meillon and Gear (urines) in 1949 and by Pitchford (rectal snips) in 1956. These surveys had all been negative. Except for the presence of snails and of a few cases diagnosed in Katimo Mulilo Hospital, which were traced to endemic areas in Zambia or Eastern Bechuanaland, and reports of bilharzia from mission hospitals in the Okavango, nothing was known.

Snail intermediate hosts—*Biomphalaria sp.* and *Bulinus (Physopsis) sp.*—had been reported almost throughout the area and this survey was undertaken to determine their exact distribution and to investigate the prevalence of the disease and also to determine as far as possible the factors influencing its absence.

The area surveyed is bounded in the north by the southern border of Angola and the south-west corner of Zambia. It includes the northern portion of Ovamboland and the Kaokoveld, the area along the west/east-flowing Okavango River, the Eastern Caprivi strip and the area surrounding the Okavango swamps. The area lies between 14° 0′ and 24° 45′ east and 16° 45′ and 19° 30′ south in the west and 21° south in the area surrounding the Okavango swamps in the east.

METHODS

Snails were collected using routine methods with Barlow scoops, or any other method available, in as many waters as possible. Provisional identifications were made in the

TABLE I. NORTHERN KALAHARI BILHARZIA SURVEY—WATER ANALYSES

Name of water-body	*Date*	*Colour*	*Turb.*	*Cond.*	*Alkal.*	*Ca+Mg*	*Ca*	*Mg*	*Cl*	*SO_4*	*SiO_2*	*Na*	*F*
Chobe 27/6/65	7/9/65			240	108·0	107·8	78·2	29·6	1·0	18·8	18		0·49
Okavango at Shakawe .. 30/7/65	7/9/65			37	20·5	15·5	10·2	5·3	0	2·0			0·10
Okavango 55m W of Rumbu Musese 11/8/65	7/9/65			40	20·0	15·0	9·6	5·4	0	0·9			0·11
Botletle River 60m NW of Maun .. 10/7/65	7/9/65	Brownish		110	50·0	45·4	30·4	15·0	0	3·0			0·42
Lake Ngami .. 18/7/65	7/9/65	Brownish		280	104·0	68·6	44·0	24·6	9·0	0·4	20		1·70
Water hole at Onesi	7/9/65			320	144·0	60·0	31·6	28·4	18·0	0		56·4	0·45
Kunene at Epupa..	7/9/65			44	25·0	16·5	10·4	6·1	0·5	1·2	15		0·12
Lake Oponono ±30m S of Oshakati ..	7/9/65	Very dark	Very turbid	750	130·0	60·0	30·0	30·0	190·0				0·90
Oshana at Oshakati	7/9/65			140	64·0	32·6	19·6	13·0	2·5	0·6			0·40
Kaoko Otavi Spring 25/8/65	7/9/65			810	480·0	516·0	240·0	276·0	7·5	10·8	16		0·07
Warmquelle .. 27/8/65	7/9/65			660	304·0	348·0	138·4	209·6	16·0	18·6			0·36

field on which the maps are based. Intermediate hosts were tested for cercariae, but unfortunately rodents exposed to those cercariae died before schistosomes could be identified.

Urine and stool samples were collected individually in honey jars after exercise between 10.30 a.m. and noon. Urines were allowed to sediment for at least 20 minutes in the original containers when the supernatant was decanted and the sediment examined in a petri dish under a wide field stereoscopic microscope. Stools were washed with saline through petrol gauze no. 100 (·00099) mesh, allowed to sediment for at least 20 minutes, the supernatant decanted and the process repeated as often as necessary and eventual sediment examined in the same manner as the urine. If the stools could not be examined on the same day as collected, they were preserved in 10% formol saline and examined later in the same manner.

Schoolmasters or the parents of children were questioned about birth-place, migration and swimming habits of children. Water samples from rivers and pools were collected (for chemical analysis) in 1 litre bottles and preserved in formalin (see Table I for results).

For convenience the area has been divided into geographical areas and political boundaries have been disregarded.

Map 1 EASTERN CAPRIVI AREA

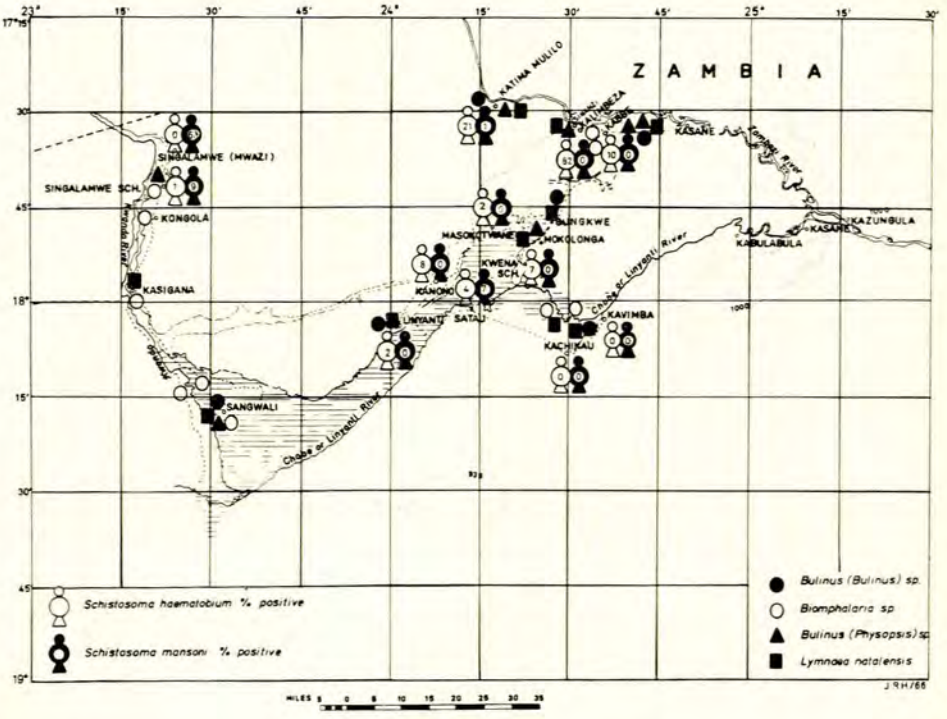

Fig. 1. Eastern Caprivi area.

THE EASTERN CAPRIVI AREA (FIG. 1)

Except in the central north, which is uninhabited, the area is surrounded by permanent swamps formed by the Kwando, Chobe, Linyanti and Zambesi Rivers which unite in the east. The country is flat with heavy sandy soil and devoid of stones and rocks. Vegetation is semi-tropical

TABLE II. RAINFALL FIGURES

Month	Eastern Caprivi area: Katimo Mulilo (1961) mm.	Eastern Caprivi area: Katimo Mulilo (1962) mm.	Okavango swamps: Maun (1963) mm.	Okavango River: Shakawe (1963) mm.	Katimo Mulilo Yearly rainfall mm.
July–September	—	—	—	—	1935/36–715·0
					1936/37–582·5
October	8·7	—	29·2	12·6	1937/38–365·0
November	72·4	94·0	116·9	147·9	1938/39–822·5
December	68·8	286·7	215·9	109·8	1939/40–995·0
	1962	*1963*	*1964*	*1964*	
January	242·4	196·6	76·5	56·4	
February	104·7	233·2	69·7	11·4	
March	15·4	44·7	27·3	37·8	
April	28·7	—	—	4·1	
May	—	—	—	—	
June	—	7·5	0·3	—	
	541·1	862·7	535·8	380·0	

TABLE III. RESULTS OF EXAMINATIONS IN THE EASTERN CAPRIVI AREA

Village	Urine: No. exam.	Urine: No. pos.	Stool: No. exam.	Stool: No. pos.	Water: Type in vicinity	Water: Distance from village	Water: Habits of people	Water: Dry season supply	Water: Snails
Kwena	45	3	41	0	Large flowing river	Close in floods. Over 2 miles when dry	—	Well	*Physopsis* in Linyanti River
Masokotwane ..	44	1	44	0	,, ,, ,,	,, ,, ,,	—	Well	
Linyanti	107	2	107	0	,, ,, ,,	,, ,, ,,	—		*Physopsis*
Konono	97	8	80	0	,, ,, ,,	,, ,, ,,	—	Well	
Sangwali	65	0	63	0	Large pool	Less than ½ mile	—		*Biomphalaria*
Kavimba	30	0	19	0					
Kachikau	45	0	30	0	Permanent swamps			Water holes	*Biomphalaria*
Satau	25	1	15	1	Swamp pools				*Biomphalaria*
Mwazi	18	0	18	11	Stagnant river pools	Less than 100 yds.	Wading, defaecate on river banks	Well	*Biomphalaria* and *Physopsis*
Singalamwe ..	79	1	79	68	Large permanent pool	,, ,, ,,	,, ,, ,,	Well	*Biomphalaria*
Katimo Mulilo ..	90	19	88	1	Very large permanent	On Zambesi	Swimming, defaecation not near river		*Physopsis*
Kabbe	98	10	92	0	Numerous permanent pools	Zambesi 3 miles	,, ,, ,,		*Physopsis*
Kalimbeze	45	37	40	0	Side pool	Less than ¼ mile Zambesi 1 mile	,, ,, ,,		*Physopsis*

bushveld with open grasslands which are flooded during the rainy season from about November to March (Table II).

The population consists of two Bantu tribes living in villages along the river banks and swamps above the flood level. The interior is uninhabited. The people hunt and fish, cultivate maize, millet and beans, and raise cattle except in the west where tsetse fly is endemic and there are no cattle.

There is very little migration from the villages, although recently some people have been attracted by construction work in Katimo Mulilo.

Results

Results of urine and stool examinations are shown in Table III.

In the south and east of the area where people depend on wells in the dry season and river water during the flood time, no *Schistosoma mansoni* and few *S. haematobium* were found. *B.* (*Physopsis*) *sp.* was found in the river in the northern group of these villages and *Biomphalaria sp.* in the swamps in the south.

On the Kwando River in the north west, high *S. mansoni* infection rates were found in two villages, in the immediate vicinity of which stagnant pools contained *Biomphalaria sp.* These pools were the main water supply although wells were also used by one of the villages.

The three north-eastern villages which were dependent on water from large flood pools away from the river, had high to low *S. haematobium* infection rates with no or little *S. mansoni*. *Bulinus* (*Physopsis*) *sp.* was found in the pools.

OKAVANGO RIVER AREA (FIG. 2)

The headwaters of the Okavango River lie in Angola in an area of heavy rainfall from October to March and marked drought for the rest of the year. The river terminates in the great Okavango swamps in northern Bechuanaland. Occasionally its waters flow through the swamps to reach the Zambesi. In the upper reaches the river is generally broad and shallow with a slow flow and only a few feet below the general surface of the surrounding plateau. During the rains the surrounding countryside is flooded, but the villages are not inundated. The river flows through alluvium although bedrock outcrops occur at a few places. Heavily vegetated large pools remain in the river bed after the floodwaters have receded.

The country is heavily populated with primitive pastoral tribesmen who use the water for domestic purposes and for watering their stock. They spend a great deal of time in the water, often knee deep, tending cattle, trapping fish and paddling canoes.

In the lower 60 - 100 miles until it reaches the Okavango swamps, the river is swift with occasional side pools.

Results

Results of urine and stool examinations are shown in Table IV.

Although snails were found throughout the whole length of the river, high *S. haematobium* or low *S. mansoni* rates were only found in those villages in the upper reaches.

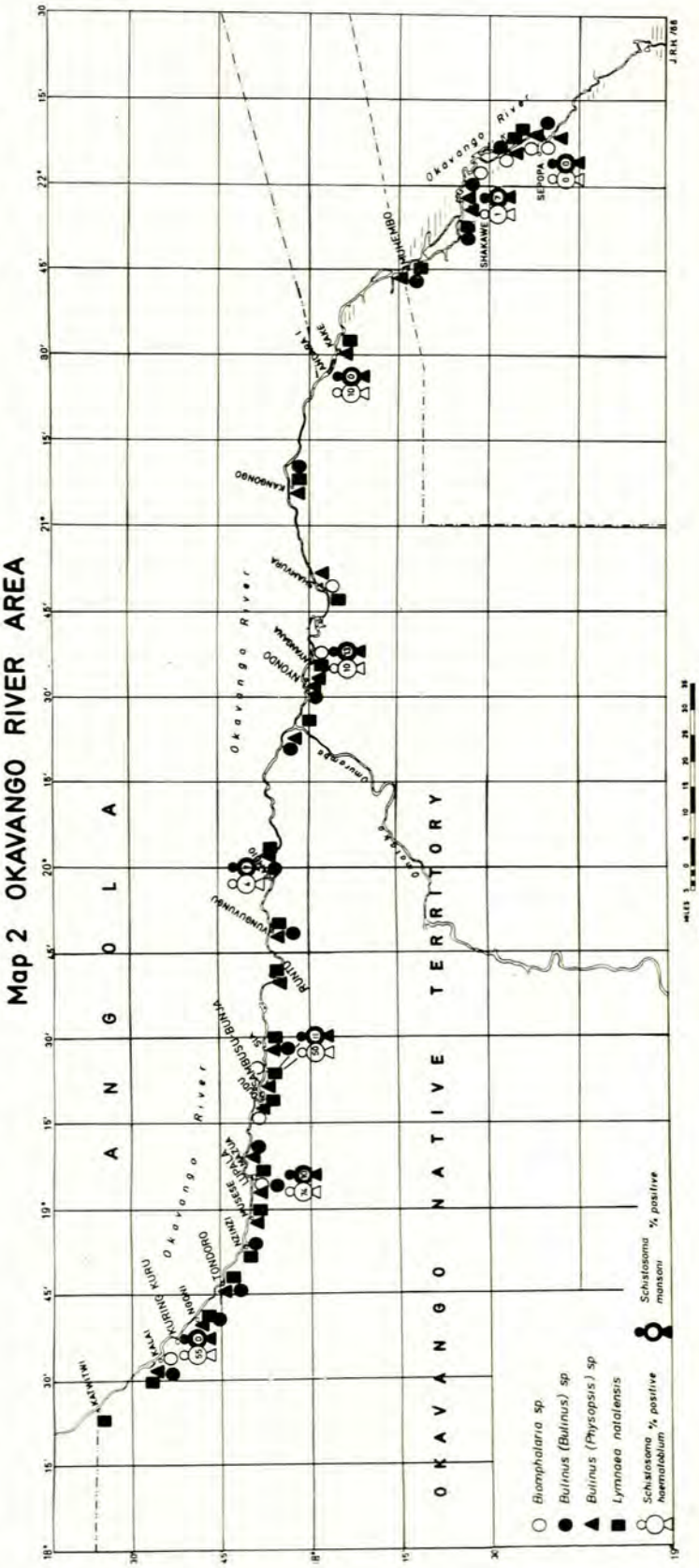

Fig. 2. Okavango River area.

TABLE IV. RESULTS OF EXAMINATIONS IN THE OKAVANGO RIVER AREA

	Urine		*Stool*	
	No. exam.	*No. +ve*	*No. exam.*	*No. +ve*
Sepopa	58	0	57	0
Shakawe	102	1	86	6
Andara	106	1	107	0
Nyangana	105	1	104	13
Sambio	103	4	100	7
Sambusa-Bunja	109	55	97	11
Lupala	107	79	105	11
Kuring-Kuru	101	56	101	0

OKAVANGO SWAMP AREA (FIG. 3)

The Okavango swamps are permanent large swamps populated by Bantu living in villages sometimes spaced at great distances from each other. The swamp receives water from the Okavango River and occasionally from the Zambesi. Kalahari bushveld with occasional grassland in the flood plains surrounds the swamps.

Results

Results of urine and stool examinations are shown in Table V.

Biomphalaria and *Bulinus* (*Physopsis*) snail species were found only at Maun in this area. All the other villages used wells or water holes during the dry season when the swamp water had receded.

AREA SOUTH EAST AND NORTH EAST OF OKAVANGO SWAMP (FIG. 3)

This is typical dry bushveld country with occasional water holes and few rivers. Water for human use is obtained from water holes in river beds except at Makalamabedi which relied on the permanent river.

No autochthonous infections were found in the four villages visited in this area (Table VI) although *Biomphalaria sp.* was found in the river near Makalamabedi. Unfortunately there was poor cooperation from the population of this village and only 7 stools could be collected.

OVAMBOLAND (FIG. 4)

Ovamboland is a wide stretch of country with its northern boundary between the Okavango and Kunene Rivers; the plateau slopes very gently southward as a vast plain from southern Angola to the lower-lying Etosha Pan. Much of this plain is inundated seasonally by regional flooding, caused by the run-off water from the uplands of Angola. Some of the shallow watercourses (*oshanas*) which carry the floodwaters do not

TABLE V. RESULTS OF EXAMINATIONS IN OKAVANGO SWAMP AREA

	Urine		*Stools*		
Locality	*No. exam.*	*No. +ve*	*No. exam.*	*No. +ve*	*Water supply*
Shorobe	70	0	68	1	Well in middle of village
Maun	93	1*	69	9	Swamp river
Sehitwa	56	1*	37	0*	Well in village and Lake Ngami 3 miles to east
Tsau	80	0	78	1†	Wells
Nokaneng	99	0	96	1	Water holes and wells
Gomare	104	0	95	0	Water holes and river 3–5 miles away

*Children from endemic areas in Eastern Bechuanaland.
†Child from Maun.

TABLE VI. RESULTS OF EXAMINATIONS IN AREA SOUTH EAST AND NORTH EAST OF OKAVANGO SWAMPS

	Urines		*Stools*	
Locality	*No. exam.*	*No. +ve*	*No. exam.*	*No. +ve*
Rakops	93	2*	38	0
Makalamabedi	25	0	7	0
Mababe	32	0	27	0
Kanjai	12	0	9	0

*Children from Eastern Bechuanaland endemic area.

Map 3 OKAVANGO SWAMP AREA

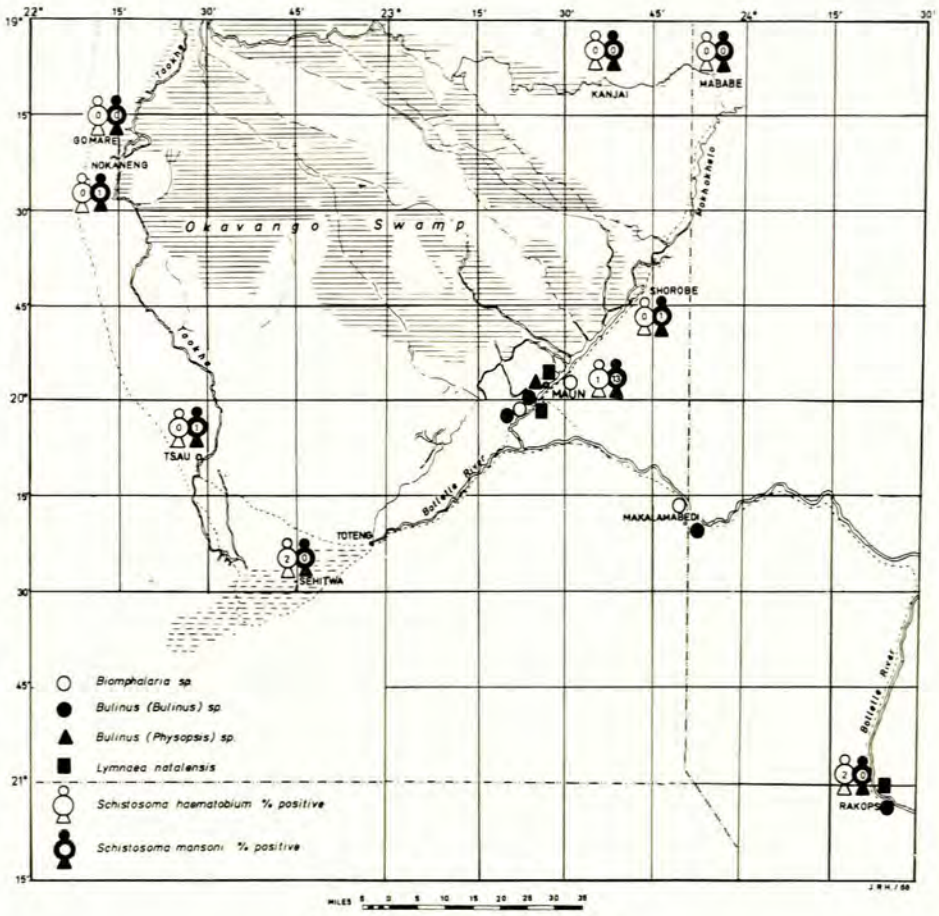

Fig. 3. Okavango Swamp area.

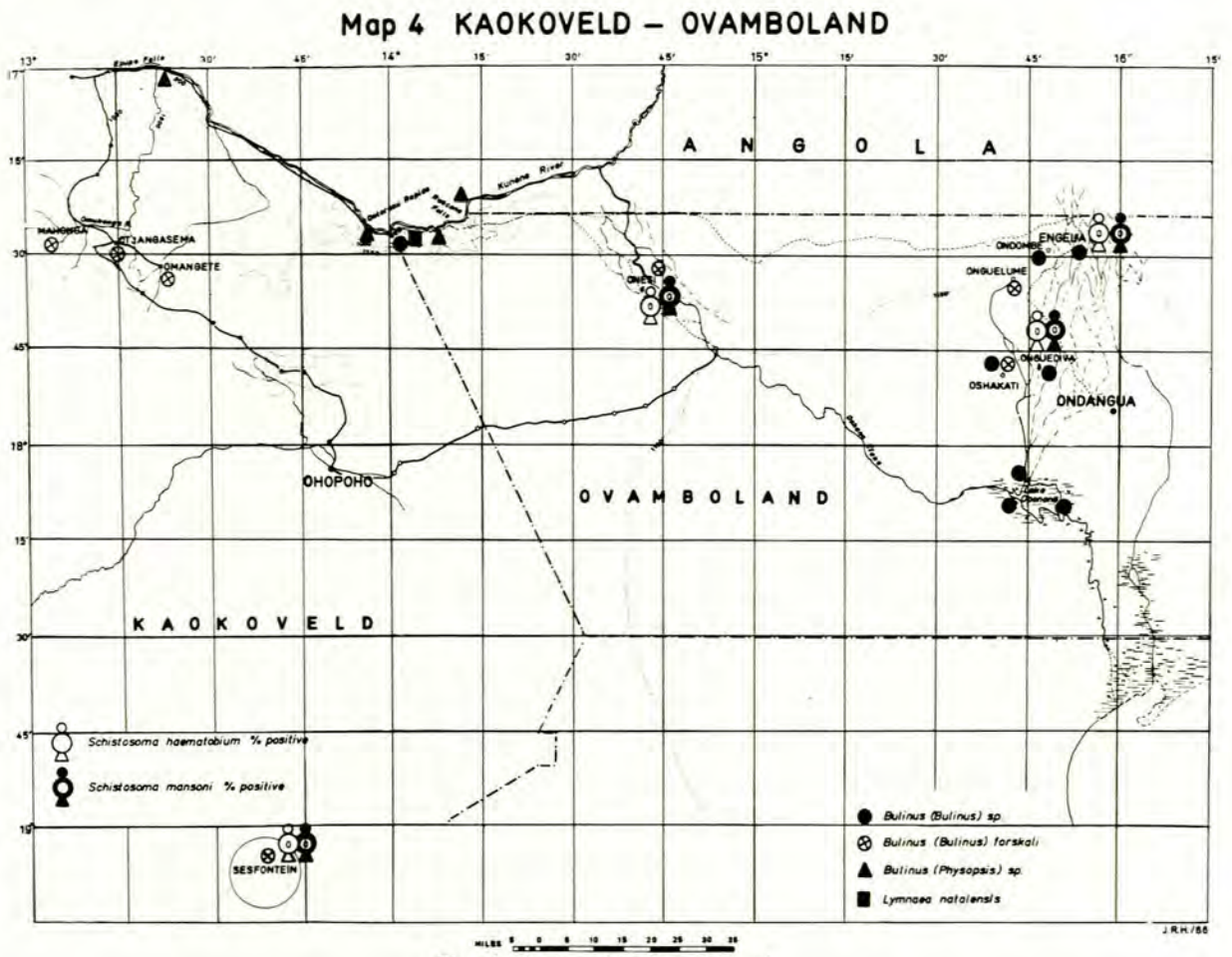

Fig. 4. Kaokoveld—Ovamboland.

always dry up completely during the long dry season.

A major water diversion scheme is under construction whereby Kunene River water in Angola will be conveyed through canals into Ovamboland, for water supplies and possible irrigation of this densely populated area.

No bilharzia was found in Ovamboland among 60 urine and 56 faecal samples from Engela, 102 urine and 91 faecal samples from Onguediva and 79 urine and 53 faecal samples from Onesi 45 miles east of the Ruacana falls.

KAOKOVELD (FIG. 4)

Bulinus forskali was found in all permanent waters in the Kaokoveld, except at Kaoko-Otavi where no snails were found in the spring.

B. (Physopsis) sp. was collected below the Ruacana falls and along the Kunene River into the Kaokoveld to the Epupa falls. The presence of both bilharzia intermediate hosts in the Kunene River is of great significance as they may now be introduced into Ovamboland, a bilharzia-free area, with the future water development scheme. With the exception of Sesfontein, no human survey could be carried out in the Kaokoveld owing to the poor cooperation of the tribesmen. At Sesfontein 48 urines and 33 faecal samples were all negative.

SUMMARY

A survey undertaken to determine the distribution of bilharzia intermediate hosts and the prevalence of the disease in the Eastern Caprivi, northern Bechuanaland and northern South West Africa is described. For convenience the area surveyed is divided into four areas and a brief description of the geography of these areas and habits of the people is given.

The results of the survey show that bilharzia intermediate hosts are more widely distributed than formerly believed, being found in the Eastern Caprivi, Okavango swamp area and along the Okavango and Kunene Rivers. High infection rates of both *S. haematobium* and *S. mansoni* were found in certain areas of the Eastern Caprivi and along the west region of the Okavango River. The disease was also found in the Okavango swamp area at Maun where previous surveys had all been negative. This is thought to be the first recorded geographic spread of bilharzia (*S. mansoni*) in Southern Africa.

No bilharzia was found in Ovamboland or the Kaokoveld, but the planned irrigation scheme in Ovamboland may introduce the intermediate host snails to that area.

This survey was possible only through the cooperation of the territorial authorities concerned and the personal assistance of many individuals. In particular we wish to thank the Bantu Affairs Commissioner in the Eastern Caprivi for his interest and cooperation; Field Officer W. Drotsky and his co-workers of the Bechuanaland Health Department, whose practical knowledge of the Bechuanaland terrain was extremely useful; members of the South West Africa Administration Health Department, in particular Dr. A. H. Hitzeroth and Mr. A. Albertyn. We should also like to record our thanks to Dr. R. Logan, Professor of Geography at the University of California, who accompanied the survey team in South West Africa.

Finally, we wish to thank Dr. R. J. Pitchford for his assistance in preparing this paper for publication from the original report, Mr. A. H. Meyling for the chemical analysis of the waters and Miss J. R. Harding for the maps.

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