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Population Movements and Problems of Malaria Eradication in Africa *

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Population movements of various kinds are among the outstanding demographic features of the African continent and entail serious difficulties for malaria eradication. The majority of these movements are free and uncontrolled and are frequently inter-territorial in nature, hampering nation-wide or more limited malaria eradication projects and resulting in much reinfection.

The author examines in some detail the types of population movements and their relationship to malaria problems in the Republic of Sudan, Ethiopia, Somalia, East Africa, Zanzibar, the Federation of Rhodesia and Nyasaland, Nigeria and Ghana. He concludes that these movements cannot be stopped and must be taken into account in planning malaria eradication programmes. More information on them and on the complex relationships between parasites, vectors and human beings is required, and inter-territorial co-operation is essential in obtaining this information and in planning.

" It is well known that mass movements within or through a malarious country in the malaria season are likely to cause an exacerbation of the disease to the extent of often precipitating a severe epidemic."

This statement by the WHO Expert Committee on Malaria (1957) illustrates the considerable awareness among malariologists of relationships between movements of population and other geographical and socio-economic factors and problems of malaria eradication. Even if they do not cause epidemics, population movements may be responsible for increased malaria morbidity. They need not necessarily occur on a large scale; relatively small-scale shifts of population over short distances may be significant.

No method has yet been devised for measuring the extent of population-instability, so as to make comparisons possible between countries and areas in different parts of the world, but there is no doubt of the very high degree of instability in Africa. Population movements of various kinds are among the most outstanding demographic features of the continent.

In all African countries, at least among certain groups of the population, there are movements of population between permanent villages and farms. The patterns of these vary a great deal but they generally involve a period of residence in the farming areas and the erection of temporary shelters for this period. They take place mostly during the early months of the wet season (for cultivation, planting and weeding), when there is usually a marked rise, if not an explosive increase, in the vector population, and the temporary shelters may become favoured resting places for mosquitos. Without detailed studies it is impossible to assess the numbers of people involved in this type of seasonal movement.

The large-scale migration of labour in Africa is a feature of major social and economic as well as of demographic importance (Fig. 1). Over much of Africa, agricultural labour for harvesting (e.g., to the ground-nut-growing areas of Senegal, to the cocoa-growing areas of Ghana and Western Nigeria or for cotton picking in Sudan) is moving to work *after* the peak of the malaria season, and returns before the onset of the next wet season. Migrant labour movements to mining, industrial and commercial

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* This paper has been prepared from a report submitted to the World Health Organization following the author's tenure, in January-July 1960, of a WHO consultantship.

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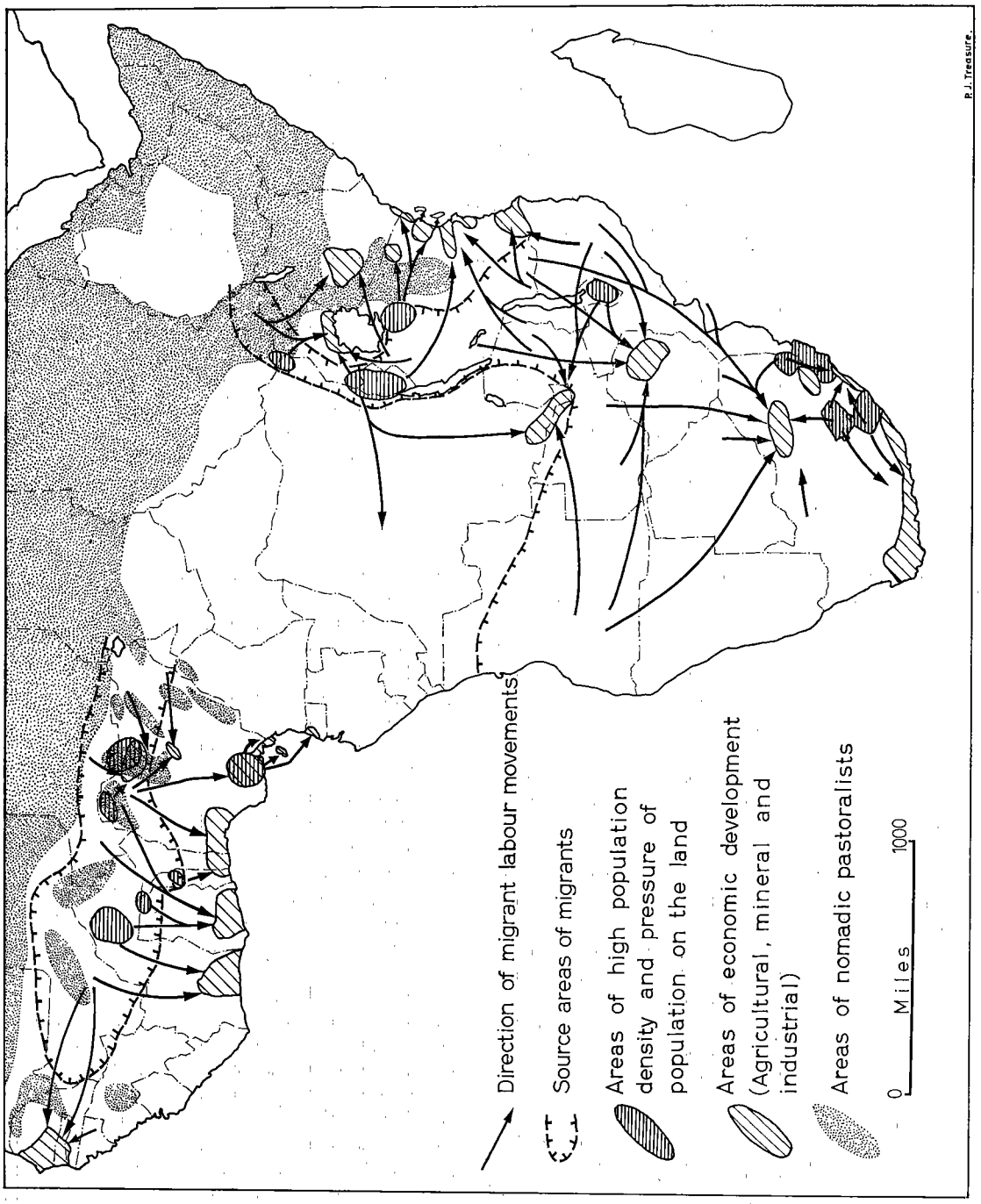


FIG. 1 MIGRANT LABOUR MOVEMENTS AND AREAS OCCUPIED BY NOMADIC PASTORALISTS IN AFRICA SOUTH OF THE SAHARA

enterprises do not conform to a seasonal pattern and are taking place at all times of the year. Whether the movements of labour are seasonal in nature or not, there is the fact that malaria transmission is perennial, or nearly perennial, over much of tropical Africa.

Movements of pastoral nomads, on a larger scale than other types of population movements, occur only in certain parts of Africa, such as the Northern Sudan and Somalia (Fig. 1). Patterns of nomadism vary, and it is inaccurate to state that they follow " a fixed circuit each year ". It is difficult for workers in malaria eradication to make contacts with nomads, who are generally conservative and reserved in character; nomadic dwellings are difficult to spray with residual insecticide and the efficiency of the insecticide is retained for only a short time.

Movements of population made for religious reasons are relatively unimportant in Africa, as compared with those observed in other parts of the world, and as compared with other types of movements in Africa itself. The only one of any real significance is that made from the Islamic areas of West Africa north-eastwards towards Mecca. This results in a convergence of peoples on Sudan, but the numbers concerned are far less than those involved in movements within that country.

It is important to emphasize the very free nature of population movements in Africa. With the exception of most of those made for farming, they are often of an inter-territorial nature, and are not limited by political boundaries. These boundaries have had little meaning for Africans from the time when they were defined by the European powers; the position may change, however, with the emergence of independent African States. All the malaria eradication pilot projects now in operation in Africa are being hampered by the problem of population instability with constant reinfection taking place as a result. So far it has not been possible to start a malaria eradication programme for a whole country in Africa, but there is not one country in which the movements of population are contained within its own boundaries. International co-operation in malaria eradication is essential, but it is difficult to achieve. Even if full co-operation between countries were achieved, it would go only part of the way towards an alleviation of the difficulties and certainly it would not solve all problems.

Population movements are closely related to the unified physical-human complex of ways of life in Africa. Some are traditional (pastoral nomadism); others have developed more recently (migrant labour). Whether they date from the past or not, they are phenomena which can neither be stopped nor easily controlled. They, and other aspects of the peoples' ways of life, must be accepted, and if they create problems in malaria eradication, then ways and means will have to be found of adjusting techniques and programmes to fit in with them.

REPUBLIC OF SUDAN

The total population of Sudan is about 11 000 000, of whom about 10 250 000 are assumed to live under malaria risk. Ways of life are summarized in Table 1, which has been compiled from the results of the first census, held in 1955-56 (Krotki, 1958).

Only 8% of the population live in towns; the main concern is with the 92% that are rural. Of the latter, according to the definitions used in the census, 78% are sedentary and 14% are nomadic. This is certainly an underestimate of the nomadic population; indeed, the Chief Census Officer stated that, depending on definition, not less than 15%, and perhaps even up to 40%, of the rural population might be classed as nomadic.

The ways of life and movements of the Nilotic tribes, south of latitude 12°N., are controlled to a very large extent by the regime of the White Nile (Sudan Government, 1954a, 1954b). Permanent villages are sited on high ground (*gok*), and are occupied during the wet season when much of the low-lying land is flooded (Fig. 2). During this time crops are harvested and cultivated and the cattle are grazed close to the villages. In December, when the rains cease, the cattle are taken further afield for grazing, but they are still brought back to the villages each evening. As the dry season continues in January-February the pasture and water become scarce on the higher ground, and the cattle are moved to the edges of permanent swamps or the banks of large rivers (*toich*). The whole of the tribes move with the cattle, except the old people and some children who are left in the villages. The distances covered in these movements may be as great as those covered by true nomads in Northern Sudan; and yet these Nilotic peoples were classed in the census as "sedentary ". The patterns of these movements are highly variable; the cycles of movements and the concentrations of population may change from year to year, depending on the local conditions.

TABLE 1
POPULATION COMPOSITION OF THE REPUBLIC OF SUDAN

Province	Population totals (in thousands)								
	Total	Urban settlements				Rural			
		Large		Small		Sedentary		Nomadic	
		No.	%	No.	%	No.	%	No.	%
Bahr el Ghazal	999	—	—	17	2	974	98	—	—
Blue Nile	2 070	48	2	96	5	1 781	86	145	7
Darfur	1 329	—	4	54	4	1 010	76	265	20
Equatoria	903	—	—	22	2	881	98	—	—
Kassala	941	48	5	101	11	290	31	502	53
Khartoum	505	246	49	9	2	197	39	53	10
Kordofan	1 762	52	3	63	4	1 293	73	354	20
Northern	873	36	4	52	6	718	82	67	8
Upper Nile	889	—	—	10	1	879	99	—	—
Sudan	10 263	430	4	424	4	8 023	78	1 386	14

The movements of Arab nomads further north are exemplified by the Humr of Kordofan, who also practise some cultivation (Cunnison, 1954). These people migrate through four main zones during each year:

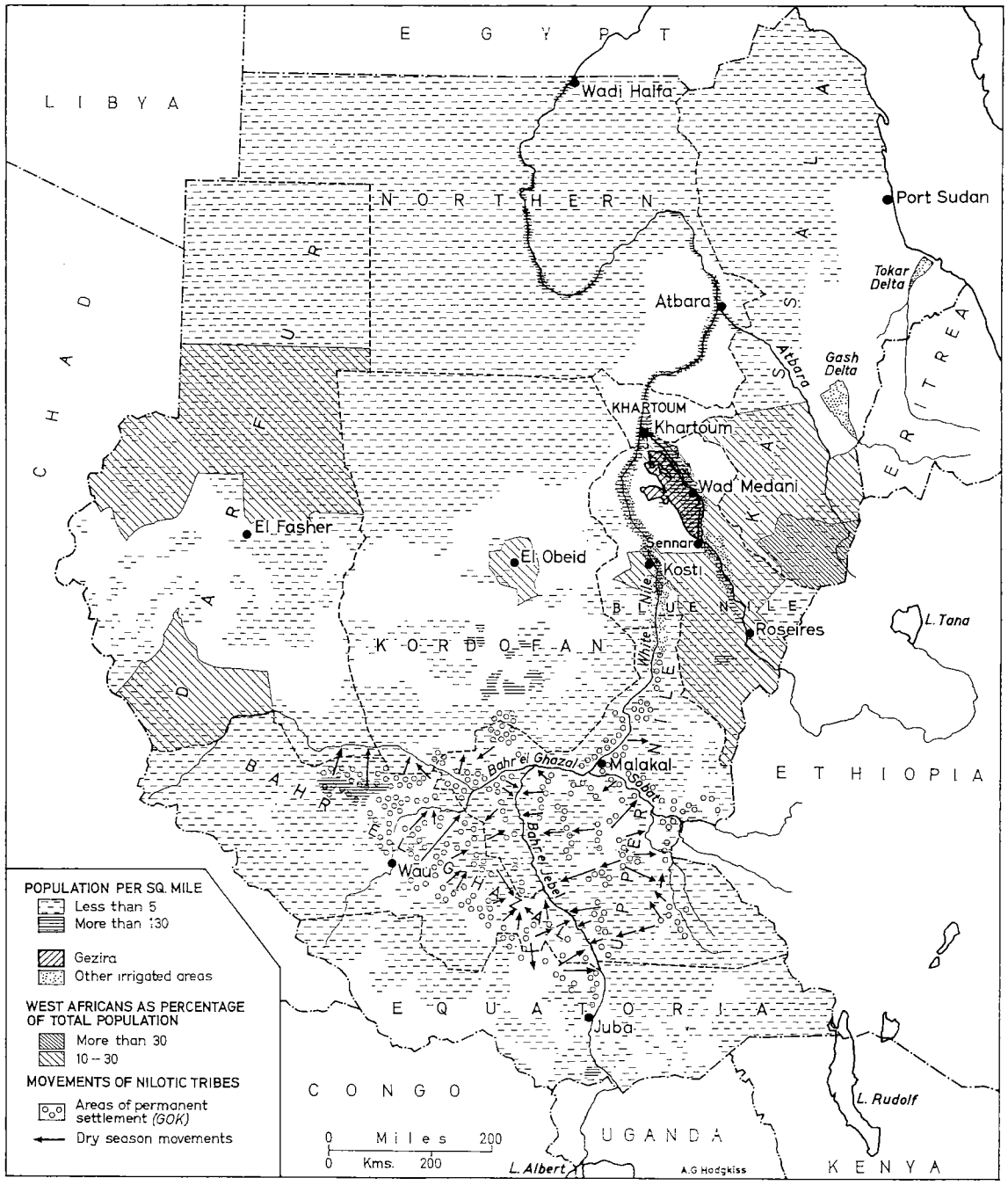
1. *babanusa* . . wet season pasture,
2. *muglad* . . . cultivated land,
3. *bahr* . . . . dry season grazing,
4. *qos* . . . . the transition zone, through which they pass between 1, 2 and 3 above.

At the height of the dry season some of them move even as far south as into Upper Nile Province. In the course of these movements there is a considerable amount of breaking-up and coming-together of groups, with a tendency towards concentration in the *babanusa* (wet season pasture), and dispersal in the *bahr* (dry season grazing). Nothing is regular; various factors will change the pattern from year to year. In the *bahr* such disparate factors as the availability of grass and water, the outbreak of quarrels between groups, the desire or not to hunt giraffe, the siting of other camps, and the possession or not of cotton gardens (near which a group may wish to camp) may change the pattern. Houses can be dismantled and packed for transport within an hour and re-erected in about two hours. A camp may be moved 20 miles (30 km) in a day. The system of values of these peoples is related entirely to their nomadic way of life and to their cattle, which make nomadism necessary. Examples of similar movements and attitudes are plentiful among groups in Darfur, Kordofan, Blue Nile and Kassala Provinces.

There is a third type of movement, associated with a long-established drift of people, mainly from west to east, through the savannah and *sahel* lands of Africa between 10°N. and 16°N. Since the coming of Islam to Africa south of the Sahara, pilgrims have passed in this direction towards Mecca; but social, economic and political motives have also been responsible for similar movements. The Gezira and other cotton-growing schemes have attracted labourers from outside the country. Over 200 000 West Africans were recorded in the 1955-56 census as being employed in these schemes. In Kassala, Blue Nile, Kordofan and Darfur Provinces the West Africans account for between 10% and 30% of the total population (Fig. 2). Those who possess the required travel documents enter Sudan by several recognized routes; but for those without documents there is a vast network of roads and tracks which can be taken along 1600 miles (2600 km) of frontier, and over which complete control is impossible.

FIG. 2

ASPECTS OF POPULATION MOVEMENTS IN THE REPUBLIC OF SUDAN [a]



[a] Based on maps by K. M. Barbour, H. R. J. Davies, G. M. Davies and J. H. G. Lebon.

There is a seasonal movement of labourers to the cotton-growing areas from January to April; this is the slack period in the grain-growing areas of Central Sudan (Fig. 2). The number of labourers is supplemented by an influx of nomadic groups, who move in ostensibly to work in the cotton-fields but are probably even more attracted by the available water and pasture for their herds and flocks.

All these different movements are liable to cross and recross one another, thus producing an intricate and confusing pattern which can be identified only by detailed work in the field applied specifically to this task.

In the malaria eradication pilot project area in Blue Nile Province nomadic groups represent between 15% and 20% of the total population. An efficient way of protecting them is essential for successful eradication, for they maintain a reservoir of transmission, and may even transport malaria vectors to dry areas where they would otherwise be absent. Making contact with them is difficult, but this may be possible during the following times when they tend to be less dispersed:

(*a*) during the wet season, when they congregate in the vicinity of the hilly areas of the Jebels Dali, Moya and Mazum and cultivate a little corn;

(*b*) at the time of the *hakra* (tribal meetings) in December, when taxes are collected;

(*c*) when some groups come to pick cotton along the Blue Nile.

An understanding of the contacts that are made between the nomadic and settled populations is also necessary. There is evidence of a tendency on the part of some nomadic groups to lead a more settled life than in the past; but this is a very slow process of change and is unlikely to be relevant to any timetable for malaria eradication in Sudan. Seasonal labour for cotton-picking merits some particular attention, in order to determine whence it comes and its relationship with the settled population. The temporary dwellings of cotton-pickers, which have straw roofs and walls built on a framework of poles, serve as resting places for *A. gambiae*, and are difficult to spray effectively.

In the south of the malaria project area, where the boundary runs with that of Upper Nile Province and Ethiopia, movements of people to and from these areas, in which no malaria eradication work is being undertaken, constitute a serious problem. This is " wild " and sparsely populated country in which it would be impossible to control movements; the only real solution to the problems which these create appears to lie in the undertaking of comparable eradication work in Upper Nile Province and Ethiopia. In relation to Addis Ababa, this part of Ethiopia is difficult of access, and communications are reported to be poor. It would probably be difficult to mount a malaria eradication scheme there.

Sudan has the greatest variety of types of population movements to be found in any one country in Africa; this includes both those that occur internally and those that involve the crossing of international frontiers. They occur within a greater range of conditions of physical environment than elsewhere in the continent, for the malarious areas of Sudan extend from about 4°N. to at least 16°N. These variations in the physical environment are important influencing factors in the development and form of population movements.

ETHIOPIA, EXCLUDING OGADEN

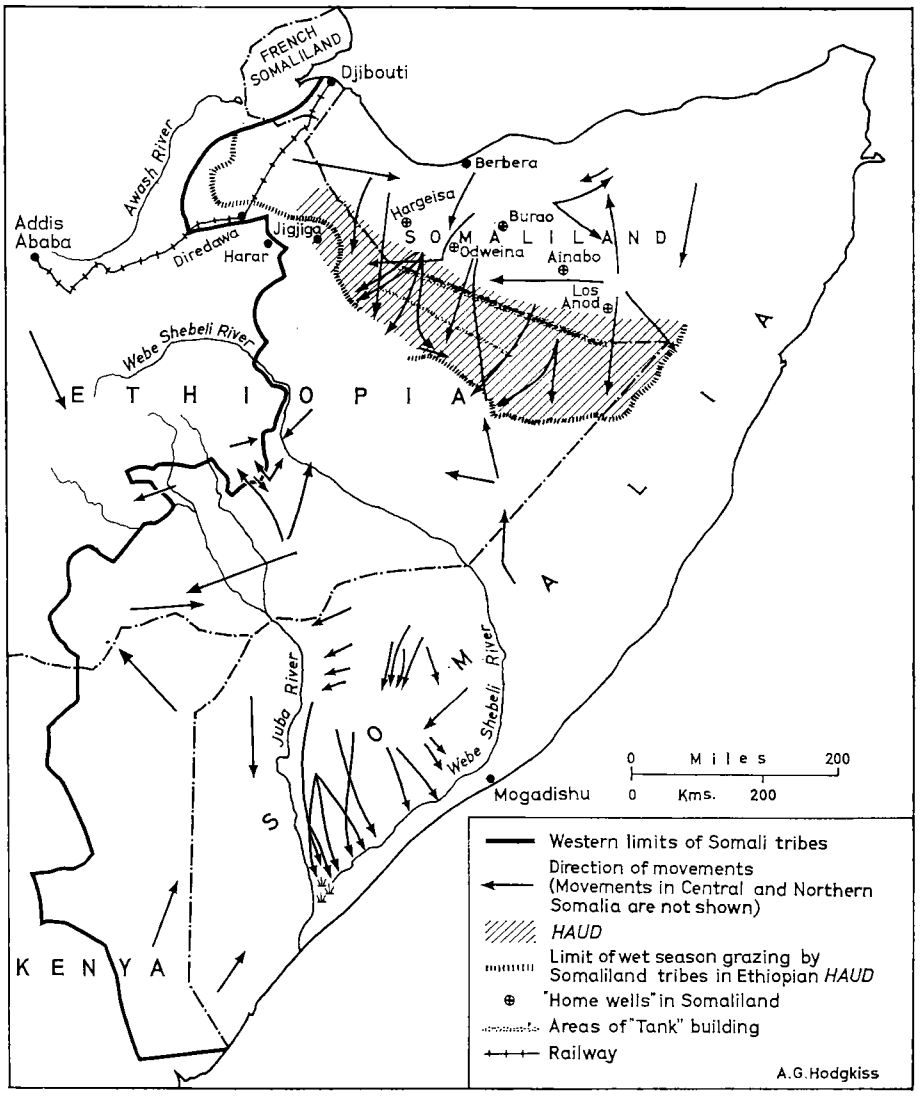
There is probably very little information existing on movements of population in Ethiopia. A WHO malariologist formerly in Ethiopia has made a general review of the situation, illustrated with an excellent map on which Fig. 3 of the present article is partly based.[1] He deals in turn with the movements associated with the three main ethnic groups in Ethiopia—Galla, Somali and Danakil—which are related to both their economic and social activities. The Somali movements are the most significant and difficult from the point of view of malaria eradication; they are considered in the next section.

On the Ethiopian plateau there are some seasonal movements of a fairly regular transhumant nature, and others which are irregular in place and time. The former result in malaria transmission being carried from valleys up to an altitude of 7000 feet (2100 m) above sea level. In the south-west of the country there are many small tribes, each with a way of life and pattern of movements peculiar to itself. It is only in these very general terms that the situation can be outlined. Detailed information, such as is required for planning malaria eradication, is not available.

On the Ethiopian plateau itself it might be possible to phase malaria eradication to accord with zones of population movement. On the eastern side

[1] Zaphiropoulos, M. A., *Nomadism in Ethiopia* (unpublished document presented at the Second Regional Conference on Malaria Eradication, Addis Ababa, 1959; WHO Regional Office for the Eastern Mediterranean).

FIG. 3
MOVEMENTS OF SOMALI PEOPLE IN NORTH-EASTERN AFRICA [a]



[a] Based on maps by W. H. Zaphiropoulos and J. A. Hunt.

of the plateau there is a natural barrier (the rift valley scarp); and there is also an ethnic (Galla-Danakil) barrier. In a pilot malaria eradication project in the Awash Valley difficulties in organization have been encountered owing to the paucity of geographical information and the lack of adequate maps, the scattered pattern of dwellings and lack of community life, the poor communications and inadequate water supplies.

The type of basic study which might prove very useful in such conditions may be illustrated by a survey carried out by an ICA geographical adviser to the Imperial Ethiopian Mapping and Geographical Institute. This survey was of the Yerer-

Kereyu-Awraja area, covering the greater part of the western half of the Awash Valley malaria eradication project area. With limited resources a wide variety of data were collected and plotted to produce maps of features such as land forms, population density, types of agriculture, distribution of fertile land, people-language groups and markets, all of which would be relevant factors in planning malaria eradication. In order to make the most of the resources available, similar surveys might well be adjusted to meet the needs not only of health but also of economic development and social welfare.

SOMALIA, AND OGADEN REGION OF ETHIOPIA

In July 1960 Somaliland (British Protectorate) and Somalia (United Nations Trusteeship Territory, formerly Italian Somaliland) became independent and united with one another to form the Republic of Somalia. Even if this union had not taken place, it would be logical to consider these two territories together and to include also the Ogaden region of Ethiopia. The need to do this is based fundamentally not on political considerations, though these are of the greatest importance, but on the fact that this great area of north-eastern Africa is inhabited for the most part by one ethnic group, the Somali, who are also found in French Somaliland and in the northern parts of Kenya (Fig. 3). The Somalis are nomadic pastoralists who move for large parts of the year with their flocks and herds. About 85% and 65% of the populations of Somaliland and Somalia respectively are nomadic. In other parts of Africa the movements of population across international boundaries have important implications, but nowhere else do such movements have a greater significance for malaria eradication. The international boundaries have little or no meaning for the ordinary Somalis in their way of life; they cross and recross them freely in the course of their nomadic movements. These movements are uncontrolled and probably uncontrollable.

Movements within Somaliland and between it and the Ogaden are determined by a number of factors, of which the need to find grazing and water for animals is the most important. It is impossible to forecast in precise detail where the people will move; in general terms it is from north to south and back again, related to the alternation of dry and wet seasons. At the height of the dry season the people and their stock are concentrated in the vicinity of the permanent " home wells " at Hargeisa, Odweina, Burao, Ainabo and Los Anod (Fig. 3). In April, when the main rains (*Gu*) start (in 1960 very heavy rain was falling over most of Somaliland in the middle of March), grazing becomes available in the *Haud*. The *Haud* occupies the southern part of Somaliland (about 14 000 square miles or 36 000 km^2) and the adjacent part of Ethiopia, extending far down into the Ogaden region (about 50 000 square miles or 130 000 km^2). It is a great undulating plateau, sloping gently to the east-south-east from over 4000 feet (1200 m) down to about 2000 feet (600 m). In the dry season the *Haud* is waterless, a semi-desert of thick thorn-bush with open areas of rolling grass plains (*bans*). Rainfall is 5-8 inches (about 125-200 mm) per annum, and beside the main rains in April-June there are secondary rains (*Dhair*) in September-October. For the most part the pattern of fall is a scattered one, the rain coming in heavy storms which affect only restricted areas. There is obviously no way of forecasting where the rain will fall. The different tribes send out scouts to find out where rain has fallen, and where grazing will be available. On the basis of their information a decision is taken which may involve the movement of a considerable number of people for a distance of even 100 miles (160 km) in 60 hours. The moving groups frequently change in size and composition, and, though a tribe may move within an area that can be generally defined, it has been shown that the area may vary considerably from year to year. Fig. 4 shows the considerable variations in the areas grazed by four Somali tribes in the years 1944-46.

The international boundary, which is an artificial one, cuts through the *Haud* grazing area (Fig. 3). The Somali tribes move far into Ethiopian territory; over-grazing in Somaliland and the development of water supplies in the *Haud* have accentuated this. People and stock are able to penetrate further and remain for longer than was possible in the past. There are no reasonable supplies of ground-water at depths which can be exploited by bore-holes, but various ways of conserving rain water have been developed. " Tanks " which hold between 20 000 and 100 000 gallons (90-450 m^3) have been constructed on either side of the international boundary and more recently in the Ethiopian section of the *Haud* (Fig. 3). These " tanks " provide excellent breeding-grounds for mosquitos in areas where breeding would otherwise be restricted for much of the year. On the Somaliland side of the boundary the " tanks " have been kept under surveillance and treated if necessary to prevent mosquito breeding. But there

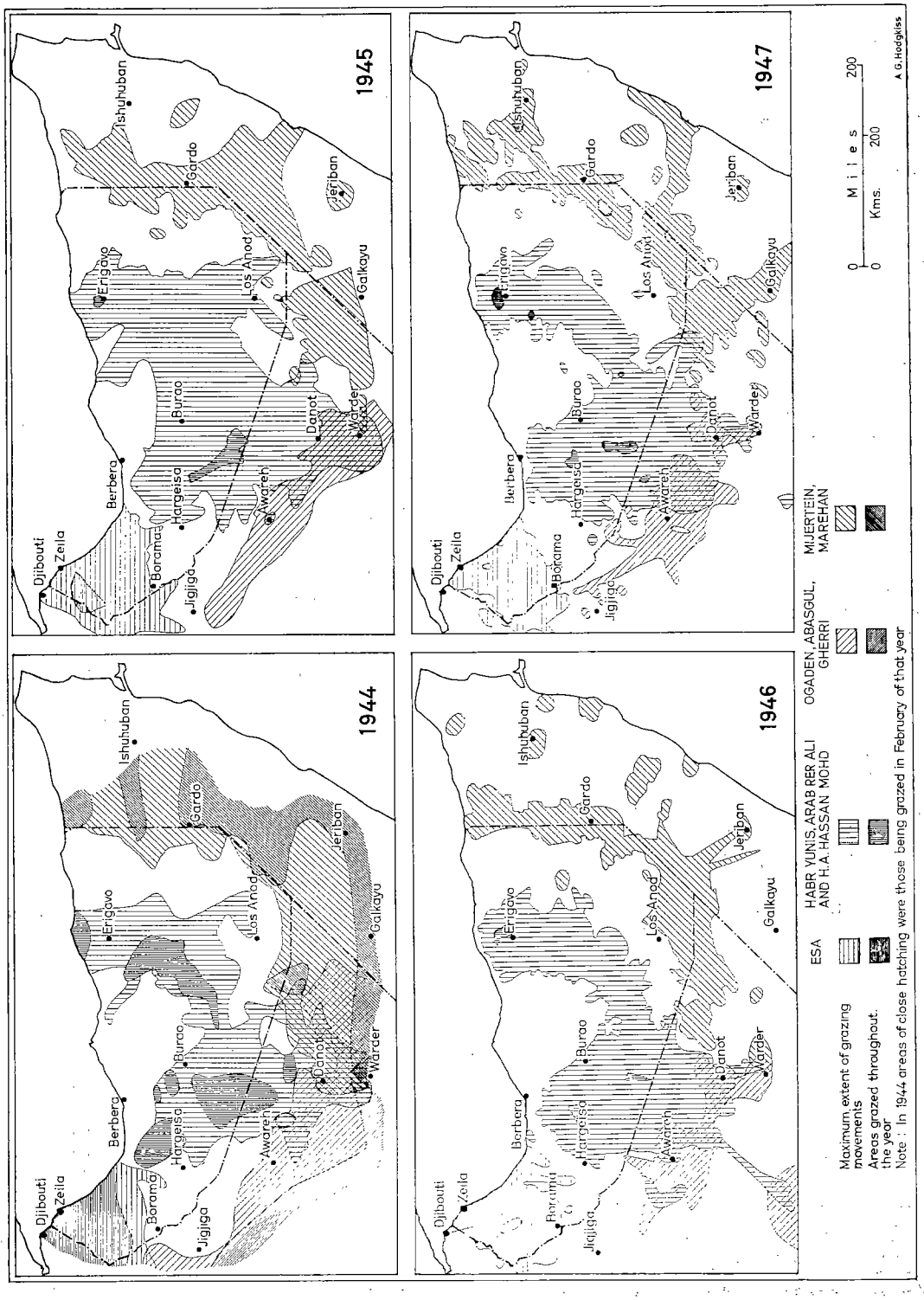


FIG. 4 RANGE OF MOVEMENTS OF SOMALI TRIBES DURING THE YEARS 1944-47 [a]

[a] Based on maps by J. A. Hunt.

has been no similar complementary work going on in Ethiopia; thus mosquitos may be breeding in " tanks " only 50 or 100 metres away from others which are being treated.

The circumstances of nomadic movements in Somalia are closely similar to those in Somaliland. They have been discussed in an excellent paper by a WHO entomologist working there.[1] There is a contrast between Northern Somalia, where the population is very largely nomadic, and the south, where nomadism is replaced by transhumance and sedentary agriculture. Either the cultivators have their own stock or else they have pastoralists attached to them as clients. Each group has a defined area of grazing, and movement takes place to this area and back again (e.g., towards and away from the Shebeli and Juba rivers) with the alternation of dry and wet seasons (Fig. 3). In the north there are movements to and from Ethiopia, and from Somaliland into Somalia. In the south there are 15 tribal police posts between Belet Uen, Oddur and Dolo, which are intended to control movements to and from Ethiopia. There are also movements across into Kenya. The nomads are themselves affected by malaria, and they probably play a part in transmitting it to and maintaining it in the settled communities. They may also assist in transporting malaria vectors.

Like all nomadic peoples the Somali are conservative and reserved, with a reserve frequently amounting to suspicion. Thus there is a very real problem in making contact with them and obtaining their co-operation. Success has, however, been achieved in Somaliland in anti-tuberculosis work, and also with a scheme of " tribal aides ", selected from nomadic groups; the latter undergo a short training in administering simple drugs and dressings and are able to recommend attendance at hospital. The prospects of settling nomadic peoples in north-east Africa in the foreseeable future are very remote.

Recent political developments complicate the problems associated with Somali movements over international boundaries and the need for international co-operation in malaria eradication work. The boundary between Ethiopia and Somaliland was originally defined in 1897, taking little account of the Somali movements that have been described; the boundary between Ethiopia and Somalia has never been clearly defined. For more than a decade from 1941 Somaliland, Somalia and the Ogaden region were under military administration; then the Ogaden was handed back to Ethiopia. Under an agreement signed in 1954 between Ethiopia and the United Kingdom tribes from Somaliland were allowed to graze in the Ethiopian section of the *Haud*. When the new Republic of Somalia came into being this agreement was terminated by Ethiopia and has not yet been renewed. Without such agreement the prospect for eradicating malaria in any part of north-eastern Africa and of finding solutions to the problems created by the nomadic way of life of the Somali are very remote.

[1] Khattat, F. H., *A preliminary report on the nomads of Somalia* (unpublished document presented at the Second Regional Conference on Malaria Eradication, Addis Ababa, 1959; WHO Regional Office for the Eastern Mediterranean).

EAST AND CENTRAL AFRICA

In north-eastern Uganda (Karamajong and Sebei), Northern Kenya (Somali, Rendille, Turkana, Suk, Samburu, Kamasia and Masai) and Tanganyika (Masai) there are nomadic and semi-nomadic pastoralists. Their numbers in proportion to the total population of these territories are small, but the areas occupied by them are vast—about three-quarters of Kenya, and one-quarter of the whole of East Africa. Their ways of life are similar to those of peoples further north in Sudan, Ethiopia and Somalia, to whom they are ethnically related, and would similarly be of significance if malaria eradication were to be undertaken in the areas in which they live.

Population movements in East and Central Africa may, however, be considered primarily from the point of view of those associated with migrant labour. They are both internal and inter-territorial, and may take place over great distances. Their magnitude and importance have been insufficiently appreciated, and it may be thought incorrectly that they are of a type that can be easily checked and controlled. This is not so. They are already a factor to be taken into consideration in malaria control and eradication. A WHO malariologist in Southern Rhodesia states (in a personal communication):

" Approximately 120 000 migrants from neighbouring territories (Northern Rhodesia, Nyasaland, Portuguese East Africa) are entering the territory annually. In these territories no malaria control is at present being done . . . According to our latest investigations approximately 20%-30% of these labourers are malaria parasite carriers. The epidemiological importance of such a highly infected labour force infiltrating into controlled or malaria-free areas of Southern Rhodesia needs no further comments . . . "

Migrant labour has developed for the most part during the present century in response to labour demands for economic developments associated with European enterprise. This is a part of the economic evolution of Africa. The reasons for labour migration are highly complicated and may involve economic, social, psychological and political factors (Mitchell, 1959; Soper, 1959; Elkan, 1959). It is difficult to obtain reliable statistics of the volume of migrant labour in Africa south of the Sahara, except in the Union of South Africa, where it is strictly controlled. It has been estimated that there are about 5 000 000 persons who might be classed as migrant labourers. This is only a rough estimate, probably under rather than over the actual figure, and it would be impossible to obtain an accurate one. A review of migrant labour in Africa by the International Labour Office gave the figures shown in Table 2 for East and Central Africa and adjacent territories (International Labour Office, 1957). These do not include all movements.

These figures take no account of the movements of migrant labour which occur within countries, and which may be very considerable. Different tribes vary in their tendency to move away from their home areas. As compared with the Kikuyu, who migrate to a large extent, the Karamojong in north-east Uganda are almost completely untouched by factors influencing modern population movements. The Wanyamwezi in Tanganyika leave their home area in large numbers, while their neighbours the Wasukuma do not. The Wanyamwezi have been astride lines of movement since the nineteenth century, when the early trade routes inland from the coast passed through their country; the Wasukuma have no such traditional contacts with other areas. At the same time the agricultural possibilities in Sukumaland for both cultivation and pastoral activities are better than in Nyamwezi country, so that there is not the same economic incentive for the Sukuma people to leave home (Southall, 1961).

TABLE 2
MIGRANT LABOUR IN CENTRAL AND SOUTH AFRICA

From	To	Number of migrants *per annum*
Ruanda-Urundi, Tanganyika, Kenya, Belgian Congo, Sudan	Uganda	74 000
Tanganyika	N. Rhodesia	5 768
	Union of S. Africa	15 000
N. Rhodesia	S. Rhodesia	100 000
	Union of S. Africa	42 000
	Other territories	8 000
Mozambique	Union of S. Africa	163 964
	S. Rhodesia	156 735
Bechuanaland	Union of S. Africa	21 000
Swaziland	Union of S. Africa	9 000
Ruanda-Urundi, Mozambique, N. Rhodesia, Kenya, Nyasaland	Tanganyika	49 470

Notes:

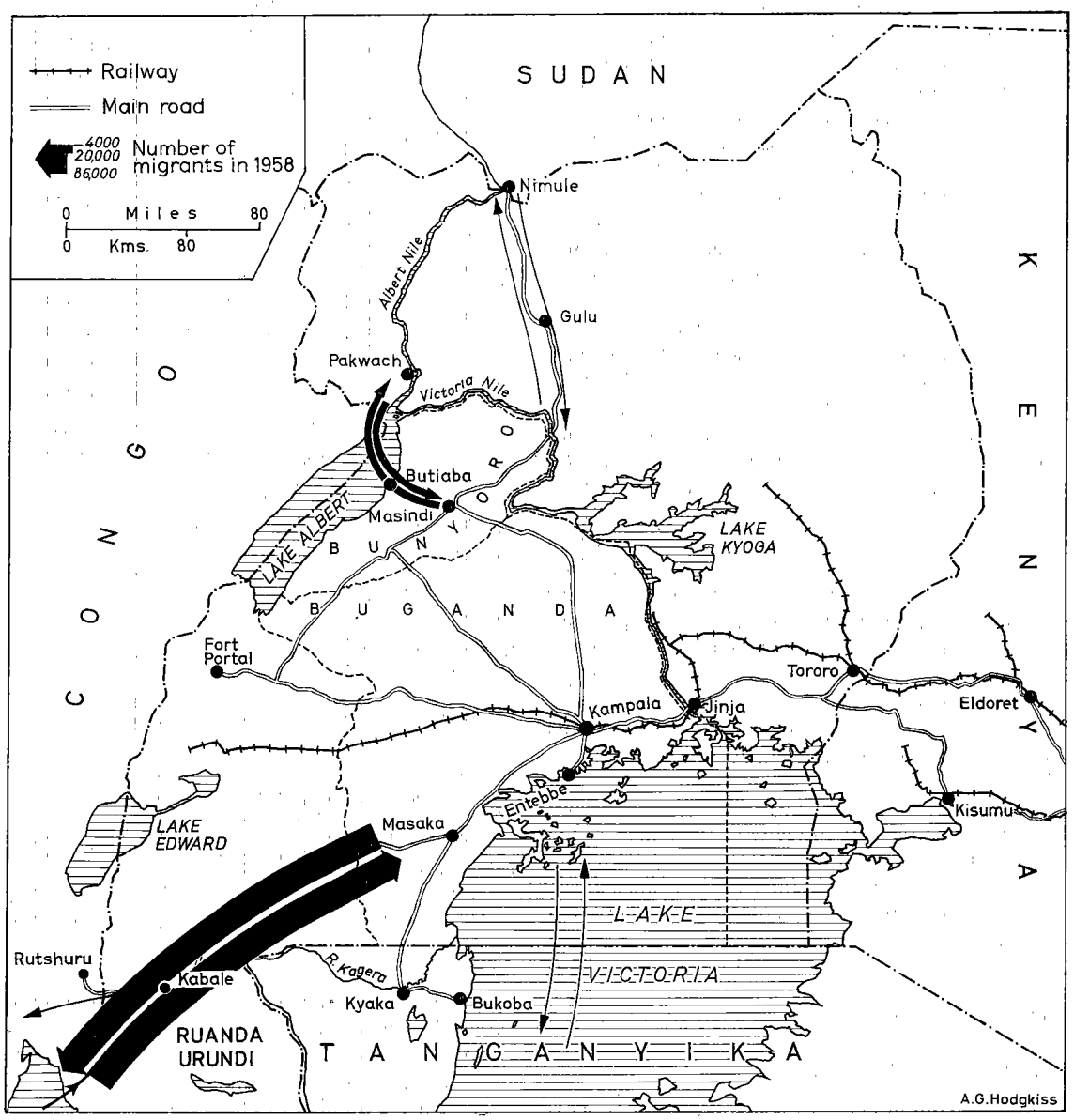
1. There were an estimated 14 498 migrant labourers to Kenya from countries unspecified.
2. All the figures above are as they were given; they could be rounded to the nearest thousand and would still give the nearest indication to what is likely to be correct.
3. The figures are roughly for the middle of the decade 1950-60. They may vary considerably from year to year; e.g., in 1946, the peak year, 140 000 migrants went from Ruanda-Urundi alone into Uganda.

Uganda (Richards, 1954)

Malaria continues to be the main cause of sickness among the employed population in Uganda, particularly those engaged in agriculture. Closer malaria control among mine workers has been responsible for a lowering of sickness rates in that group. Migrant labourers form the greater proportion of the malaria cases among agricultural workers. They are particularly prone to the disease during their first few weeks in Uganda, since the majority of them come either from malaria-free areas or from areas with a low incidence of malaria such as Ruanda-Urundi (Fig. 5). They have therefore had little opportunity to acquire immunity.

There are a number of check-points for migrants coming into Uganda, but there is not a complete control. Migrant labourers from outside the country and from some parts of Uganda (Kigezi, West Nile, Toro, Acholi and Ankole) concentrate for the most part in the provinces of Buganda and Bunyoro, which are the most economically advanced parts of the country. Some are employed in large-scale enterprises like the sugar plantations at Lugazi or

FIG. 5
MAIN MOVEMENTS OF POPULATION TO AND FROM UGANDA



the plantations of the Uganda Company; both these concerns recruit their labour at or near its source and then transport it by bus and lorry to the places of work and back again. The majority of migrants, however, are employed on relatively small-scale African farms and it would be difficult to make any checks on the movement of this labour and to control it.

Kenya

There is much less information on migrant labour in Kenya than in the other East African countries.

This is probably due to the fact that such labour movements as there are take place almost entirely within the country, with comparatively little movement either into or out of it. Migrants come from the Kikuyu, Embu and Meru areas, from Central Nyanza and from the coastal strip to the urban areas, European farms (Rift Valley Province) and tea and sisal plantations. Government policy is directed towards the stabilization of population in the urban areas, but at the present time the rate of turnover is very high. In a sample tuberculosis survey in Nairobi it was found that only about a half of the sample could be traced after a year (Kenya, Medical Department, 1959).

Events in Kenya during the last decade have resulted in movements of population. During the Mau Mau emergency Kikuyu were moved from the European farming areas to the reserves, and there has been a reverse of this movement with a return to settled conditions. In the Kikuyu reserves the settlement pattern has been changed from a traditional one of scattered homesteads to one of compact villages. This change was initially unpopular, but the benefits from it have been recognized subsequently, particularly the greater ease with which it is possible to provide social services. Other movements of population have taken place in connexion with schemes for land consolidation in the reserves (particularly in Central and Nyanza Provinces), where in the past the fragmentation of holdings and the insecurity of tenure have seriously hindered the development of sound agricultural practices (Swynnerton, 1958).

Tanganyika (Hurst, 1959)

Labour migration takes place into, within and out of Tanganyika. Migrants come for short periods of employment, and the turnover of the labour force is approximately 300 000 per annum. Much of the country is highly malarious, and migrants coming from malaria-free areas, or areas with a low incidence of the disease, are readily infected (Fig. 6). Comparatively little check on or control of migrant labour is possible. There are two main organizations which recruit labour for work in Tanganyika, but they deal with only a small proportion of those employed. The Sisal Growers' Association Labour Bureau recruits only about one-third of the labour force employed in the sisal industry. Transit centres and rest-camps which are run by the Labour Department do result in some channelling of the labour movements along certain routes (Fig. 6).

From the Southern and Southern Highlands Provinces labour is recruited by the Witwatersrand Native Labour Association for work in the mines of the Union of South Africa. This procedure is very carefully controlled; recruits are medically examined and attested at a transit centre at Tukuyu and then sent by air and rail to the Union. The labourers are repatriated when their contracts expire. Efforts are being made by the Tanganyika Government and by non-government agencies to exercise a closer control on the movements of migrants across the international boundaries of the country, not only with a view to preventing hardship to the migrants, but also with the aim of protecting the interests of the communities from which they originate, in which they work, and through which they pass on their way to and from employment. The importance of this control for public health purposes is obvious.

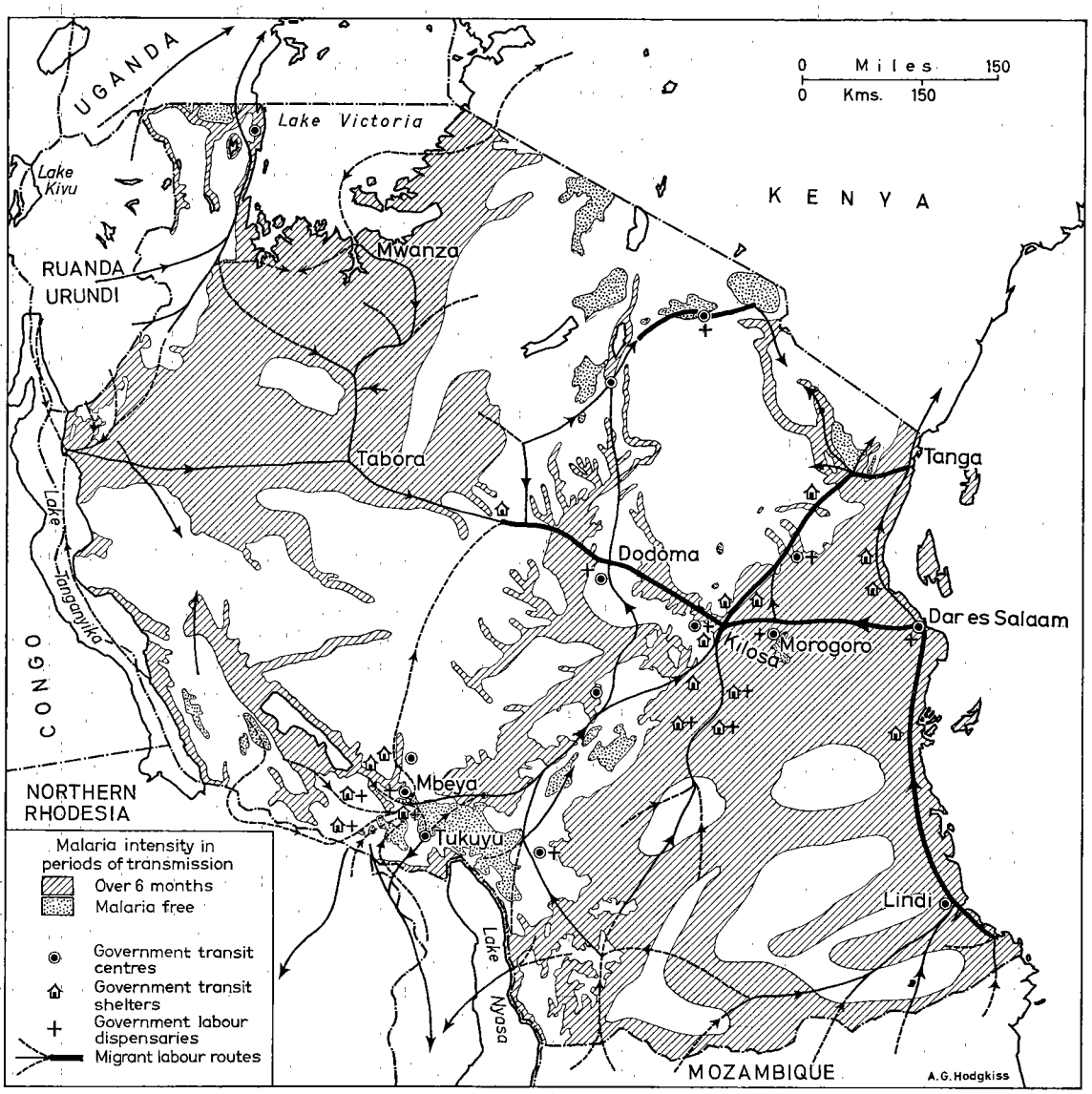
Zanzibar

In most of Africa it is difficult, if not impossible, to insulate either parts or the whole of territories from movements of population to or from adjacent areas, because of the absence of effective barriers and control points. In the case of Zanzibar Protectorate, which includes the islands of Zanzibar and Pemba, one would expect that there would be no problem and that insulation would be complete in both the literal and metaphorical senses of the term. This is not so. The Protectorate produces 75% of the world's supply of cloves (four-fifths from the island of Pemba) and for the harvest there is an influx of large numbers of migrant labourers from the East African mainland. It is thought that this influx is one of the factors in the problem of eradicating malaria from the islands. Whether these labourers come from the mainland of Tanganyika immediately adjacent to Zanzibar and Pemba or from more remote areas, they either come from or pass through areas which are highly malarious, and thus provide a reservoir of infection.

There is no accurate figure of the numbers involved. These vary from year to year, depending on the size of the clove harvest and the number of pickers required. No close check is kept on persons entering and leaving and no figure can be given for the amount of unchecked entry that may take place; no one knows, however, whether in fact very much unchecked entry does take place in relation to the total number of persons who come to the islands. A study of the movements that take place would necessitate investigations not only on the islands

FIG. 6

MIGRANT LABOUR MOVEMENTS AND DISTRIBUTION OF MALARIA IN TANGANYIKA [a]



[a] Based on the Atlas of Tanganyika.

but also on the mainland at those points from which migrant labourers leave (Dar es Salaam, Bagamoyo and Tanga). There would also be a need, certainly in Pemba, to study the movements of labour on the islands during the harvest season.

Federation of Rhodesia and Nyasaland (Scott, 1954)

Nyasaland is the Federation's main exporter of labour, and Southern Rhodesia is the main destination for migrants. Labour recruiting takes place, but where free movement is allowed (it is not permitted

in the case of labour going to the Union of South Africa), only a small proportion of labourers passes through the recruiting organizations and is therefore subject to some control.

The " Copper Belt " is the biggest employer of labour in Northern Rhodesia; just over a quarter of its labour force consists of Africans who have come from outside the territory, mainly from Nyasaland and Tanganyika (Mitchell, 1954). The urban and mining areas are subject to malaria control, though no chemoprophylaxis is given to mine labour. Recently a large migrant labour force was dispersed with the completion of the Kariba Dam. At the peak period of work 7000 Africans were employed, and these were drawn from various parts of Northern and Southern Rhodesia. On arrival at the scheme the labourers were given chemotherapy, followed by regular chemoprophylaxis against malaria. The latter was given weekly to labourers before they received their meat ration. Prophylactics were also supplied to labourers' families (12% - 15% of the labourers had their families with them), but no check was made on whether the drugs were taken by this group, and most of the malaria cases treated were in fact among wives and children. No follow-up was made of this labour force when it dispersed. This would, in fact, have been difficult, but it would have afforded an opportunity to find out what happened to the labourers when they were fully exposed again to malaria infection without any protection by drugs.

Labour which has to cross the Zambesi river to enter Southern Rhodesia could be controlled and chemotherapy administered, but this would be more difficult with migrants coming in from the east. Besides the migrant labour entering the country, there is also the movement of Southern Rhodesian Africans from the reserves to mining, urban and European farming areas; in most areas these form the major element in the labour force. The Land Husbandry Act (1951) has been aimed at stabilizing conditions in the African farming areas by land apportionment and the introduction of individual freehold tenure. Through these adjustments the population is becoming much more accessible for medical services, both preventative and curative. Land apportionment has been preceded by surveys of the population and the land they occupy (Floyd, 1959). These are now completed for all reserves in Southern Rhodesia and the records would provide some of the essential information required for planning malaria eradication.

WEST AFRICA

Evidence, which is only gradually becoming available, suggests that the total volume of population movement in this part of Africa is very much greater than was previously realized. The majority of people in West Africa cultivate crops as their main means of livelihood, and there are movements of many different kinds associated with agricultural practices. Throughout the northern parts of West Africa, from about 10°N. to the semi-desert fringes of the Sahara, there are nomadic or semi-nomadic Fulani who are cattle pastoralists, engaging in various patterns of movement throughout the year in search of pasture and water for their stock. Both of these main categories of movement are traditional. Several studies of the Fulani have been made, and there are references to agricultural movements, but no over-all study of these on a comparative basis has yet been attempted.

Developments during the present century have resulted in the movement of people from rural areas to towns. Some of this movement is permanent but much of it is still based on comparatively short absences from home villages. At the beginning of each dry season hundreds of thousands of adult males leave their home areas to seek work, and it is probable that the majority of them are away for about six months and then return to their farms for the next wet season (Labouret, 1941).

In the central and southern parts of Africa movements of migrant labourers to areas of economic development have been known and studied for a long time. In West Africa migrant labour movements involving large numbers of people are similar, but it is probable that in their evolution they are several stages behind those in other parts of Africa. Some of this labour is employed in large-scale enterprises, but the greater part works on small African farms and businesses. The latter employers keep no records of the labour they employ, not even of the numbers, let alone of where it comes from. Moreover, the movements of migrant labour are almost entirely free (there are no recruiting organizations). Thus the amount of information and data available on the movements is very small. Up to the present time, to build up a picture of what goes on has meant bringing together information from a wide variety of sources, few of which contribute any specific data. In recent years, however, there have been several developments which will go some way to filling the gaps in information on labour migra-

tion in West Africa. The most important of these was the setting up of a West African Migrations Study Committee by the Council for Technical Co-operation in Africa South of the Sahara (CCTA). This Committee has organized studies of the labour migration that takes place from the Republics of Mali, Senegal, Upper Volta and Niger southwards to Ghana and the Ivory Coast.

These studies are a further development of investigations which were carried out in the early 1950's, for the most part in Ghana, on migrant routes, places and duration of stay, migrant economy and the relationships of migrants with one another and with the people of Ghana (Rouch, 1957). At this time there were between 300 000 and 400 000 French African migrants employed in Ghana —200 000 as manual labourers, 120 000 as agricultural labourers, and another 60 000 as traders. These migrations are of economic significance; the migrants provide the labour on which the Ghana economy depends, and return with money and goods to their home areas. The more recent studies which have been in progress for nearly four years include a survey of migrant movements at Bouaké in the Ivory Coast and at the ferries over the Volta River in Ghana and in Togoland; further studies of migrants have been made in Kumasi, Ghana. These surveys are both quantitative (by sampling) and qualitative (CCTA/CSA, 1959).

Nigeria

There has been little progress in the study of population movements in Nigeria during the last five years. References to movements are for the most part vague and unsupported by any specific evidence, let alone by any quantitative data. One important exception to this is in respect of the movement of labour from the Eastern Region of Nigeria across to the island of Fernando Poo (Nigeria, Federal Government, 1957).

The population of Fernando Poo is made up of 12 000 indigenous inhabitants and 30 000 other Africans, mainly Nigerians, the majority of whom are recruited for work on the coffee and cocoa plantations on the island. Recruiting of labour from Eastern Nigeria has gone on since 1931; the first agreement on recruitment was signed in 1942, and a new agreement was made in 1954 and revised in 1957. Under its terms 800 adult males of over 18 years of age may be recruited each month by authorized agents. Each worker enters into a contract which covers transport to the island, living and working conditions there, and repatriation. In 1957 the total number of recruited labourers (including a few to Rio Muni) was 23 747; of these 15 050 were on first contract and 8697 on second contract. It is probably correct to say that movements from Eastern Nigeria to Fernando Poo and back are checked and controlled, though there is some illicit movement associated with smuggling.

The last published Annual Report of the Federal Department of Labour (1956-57) stated that the most interesting movement in Nigeria from the sociological point of view is that of peoples from the Eastern Region (clerks, artisans and labourers) into the Western and Northern Regions. Little is known of the numbers involved in this, but they are probably not great. In any case, recent measures have been introduced by the Government of the Northern Region to replace southerners in their employ by northerners, wherever this is possible.

The report also refers to the migration during the dry season of adult males, particularly from Sokoto Province, but also from other parts of the Northern Region north of latitude 12°N. Of the size of this migration nothing further is known beyond the results of the check census of migrant labour in Sokoto Province, which was organized by the Department of Statistics in 1952-53 and subsequently analysed by the present writer (Prothero, 1957, 1959). This census was of a pilot nature and no similar censuses have been taken in other parts of the Northern Region. The next general census of Nigeria is due to take place in 1961 or 1962. The last census, held in 1952-53, provided no data on the extent of population movements within the country; but it may be hoped that this deficiency will be made good. The 1960 census in Ghana has pointed the way in this respect. In the general census, information has been collected on birthplace, country of origin and tribe and on duration of stay in place of enumeration in the sample post-enumeration survey.

All malaria eradication projects in Africa are hampered, at least to some extent, by problems of population movement. In Western Sokoto Province, Northern Nigeria, an effort is being made, in connexion with the malaria eradication pilot project, to determine quantitatively the extent and nature of population instability. One of the main types of population movement is seasonal migration (Hausa, *cin rani*; lit. " eating away the dry season "); this was studied during the dry season 1959-60. Data were collected by junior members of the project

staff on a specially devised form. The survey is based on a random sample of approximately 10% of the villages in the project area. It has the advantage that it can be carried out without upsetting the other activities of the project. The analysis of the data from the survey has not yet been completed, but from an examination of the completed forms for a large number of villages it was interesting to see how they showed the known dual pattern of movement over long and short distances, the one carried out almost exclusively by adult males, the other more varied, but with what appeared to be a surprising number of independent adult males. The long-distance movements are to the usual places—the Western Region of Nigeria (Ibadan and Lagos), Ghana, Dahomey and Togo. Much of this movement is now taking place by lorry, and shows a rapid change from the previous means of transport, which was mostly on foot. Many of those who travel only short distances go to carry on dry-season farming on the large river flood plain adjacent to the project area. The presence of this type of land may appreciably affect the pattern of seasonal migration; further north in Sokoto Province, where it is not found, the percentages of people away and travelling over long distances in search of work are greater. The project area in Western Sokoto has been expanded several times in an attempt to lessen this problem of movement, but with the very long distances that are covered by migrants moving outside the project area it is obvious that this enlargement will not solve the problem (Fig. 7).

The other unstable element in the population of the project area is the Fulani, who number about 18 000 and represent just under 4% of the total population affected by the scheme. Numerically they are not important, but their movements, accompanied by their cattle, make them a major problem in malaria control. The disease persists with them more than with settled people; they are difficult to locate for spraying and for drug administration, and the residual effect of insecticide on their grass huts is limited. Some 40% of the Fulani huts examined by the WHO entomologist in the first half of 1959 either had not been sprayed or had been built after the previous cycle of spraying. Mosquito density is found to be consistently higher in Fulani camps than in settled villages, and parasite rates among Fulani have been scarcely affected by the scheme. In 1959 a separate detachment was set up to spray Fulani camps and to distribute a single curative dose of drug. It was found that the number of huts sprayed per man-day was about one-third the normal rate, and that on an average one mile of transport was run for every hut sprayed. This is obviously very expensive in time, manpower and money. In addition there is the problem of making a successful approach to the Fulani, who, like all pastoral people, are reserved and conservative. Frequent visits, including the giving of free medical treatment, are necessary in order to gain their confidence.

There are many indications that the mode of living of at least some groups of this people is changing and that it would be incorrect to apply the term "nomadic" in general to the Fulani in Northern Nigeria. There are three categories that may be distinguished, according roughly to the stages of "settlement" that they have attained:[1]

(1) "Semi-settled" Fulani, who both farm and herd cattle. They have compounds in towns and villages which are permanently occupied by the head of the household and the older members. The younger members move with the cattle during the wet season to pastures away from cultivated areas.

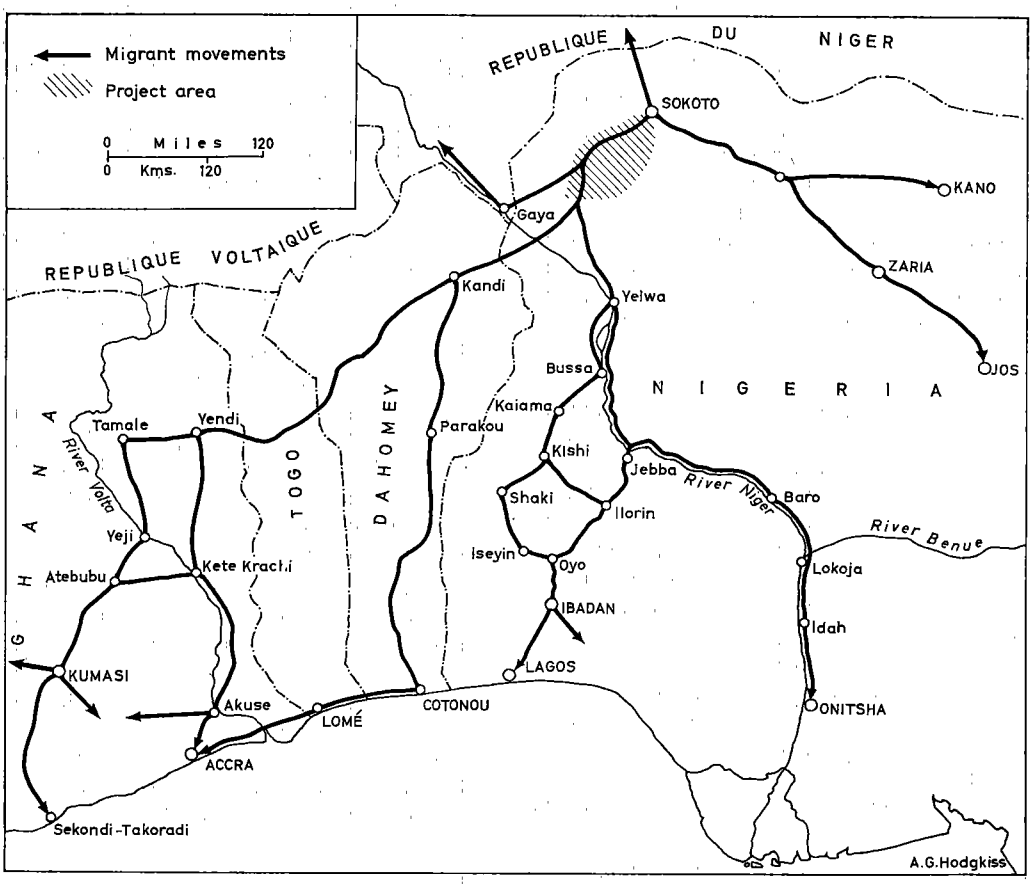
(2) "Semi-nomadic" Fulani, who carry on some cultivation in addition to their pastoral activities, but who seldom have a base to which they constantly return. When the grazing area is changed the whole family moves, and the herds are never split up, except in attempting to evade the payment of *jangali* (cattle tax). This category for the most part cultivates only millet, which is a fast-maturing crop and requires them to remain settled for only a short time.

(3) "Nomadic" Fulani, who never farm, and whose movements are entirely governed by the needs of their cattle for pasture and water. They are found only in areas where there are few or no cultivators; for instance there are none of this category in the part of Sokoto Province where the malaria project is located, but they are found further south.

It has been estimated that about 60% of all Sokoto cattle-owning Fulani come into the category of "semi-settled". These people would probably settle permanently if the required conditions of pasture and water could be made available for them. They think first and foremost of their cattle. For settlement to succeed it is essential to provide for the cattle, for the Fulani say that if their cattle are made

[1] Hanson-Smith, C. J. (1953-55) *Notes on the Fulani*, Sokoto (unpublished report of the Fulani Liaison Officer).

FIG. 7
EXTENT OF MIGRANT LABOUR MOVEMENTS FROM THE MALARIA PROJECT AREA IN SOKOTO PROVINCE, NORTHERN NIGERIA



"at home" in settled conditions, then they themselves will settle down (Hopen, 1958; Stenning, 1959).

CONCLUSION

Movements of population in Africa at the present day, whatever their nature, are a feature of life which cannot be changed in a short time, however many problems they may present in malaria eradication. Movements associated with pastoralists and cultivators have been going on from time immemorial and are part of the lives and traditions of the people who practise them. These movements are not unchanging, but the changes are taking place slowly, and where they are successful they are part of what would seem to be an evolutionary process. Any attempt to push them ahead, say, by legislation, might prove abortive. The fact must therefore be faced that they are taking place at a rate which is too slow to be of any significance for the suggested timetables of malaria eradication.

Nomadic pastoralists in Africa south of the Sahara are not for the most part involved in direct transhumant movements from permanent winter quarters to summer quarters, as is frequently the case in North Africa and the Middle East. Movements are not channelled to the same extent by physical features, which would provide places where reasonable access to the nomads can be gained for spraying and for drug administration. Movements are altogether of a much freer nature and therefore require special study in order to determine their patterns. The huts

of nomads in Africa are composed to a much greater extent of vegetable materials (woven grass and leaves) than the tents of nomads in the Middle East. Dipping instead of spraying with residual insecticide is therefore unlikely to be possible.

Migrant labour, the major category of population movement in Africa, is not traditional but has developed during the present century. Here again there are changes resulting in the greater stability of workers who were formerly migrant. These changes are also taking place slowly, though probably less slowly than those associated with pastoralists and cultivators.

A point that has been made frequently regarding the problems of population instability in relation to malaria eradication is that projects in Africa up to the present time have tended to cover too limited an area, with the inevitable result that there is excessive movement of population in and out of them. The implication is that by enlarging the area of operations this problem would be considerably reduced. This might work in the case of some areas inhabited by nomadic groups, and also in the case of agricultural movements, but it is difficult to see, except by contemplating a continent-wide programme of malaria eradication, how it would meet the problems associated with migrant labour; the latter cross international boundaries almost indiscriminately and they may pass through several territories between their home area and their destination. Legislation would do little to stop these movements; laws might be passed, but it would be difficult to enforce them. Inter-territorial co-operation is essential as a first step.

In Africa there are few natural boundaries which might be effective either in terms of malaria or of population movement. The problems of maintaining a *cordon sanitaire* around an area in which malaria eradication was taking or had taken place would be similar to maintaining a check along a country's borders. The new independent countries of Africa may in the future attempt to maintain closer control over their frontiers than has been the case in the past, and, on the other hand, the emergence of independent countries may in itself initiate new categories of population movements.

It seems inescapable that schemes for malaria eradication in Africa will have to learn to " live with " and accommodate themselves to movements of population and associated problems. In planning malaria eradication programmes the investigation of these movements will be required to a much greater degree of detail than has been attempted in the past. Malaria eradication in Africa seems to be resolving itself more and more into what seems to be essentially a human problem. There are now well-established malariological and entomological techniques for the study of malaria, and the methods of eradication are well established and proved. But malaria occurs where there is an association of parasites, vectors and human beings, and the methods of eradication have to be applied within the circumstances of differing physical and human environments (and the associated complex of these). Little attention has been paid to the latter up to the present time. Not only population instability—the size, pattern and timing of movements—but also the ways in which the population is distributed, settlement patterns, house types, farming practices, communications and water supply (with other factors of probably lesser significance) may be of vital importance in a malaria eradication campaign. There is a great variety of conditions associated with the above factors in Africa, and because of this it is extremely dangerous to generalize from conditions in one area to those in another.

Malaria workers are aware of the importance of these factors and have stressed the need for " adequate geographical reconnaissance " in the planning of eradication programmes. This should include not only the collection of information and data on the factors mentioned above but also a study of them in relation to one another. The physical environment, the malaria parasites, the vectors and the human beings exist in relationship to one another, and an attempt must be made to evaluate and understand these relationships.

The work of geographical reconnaissance, such as has taken place in the past, has devolved on the various members of malaria eradication teams as constituted at the present time, and they have done this work incidentally to their specific duties. Few guiding principles have been laid down as to how it should be carried out. If greater importance is to be placed on geographical reconnaissance in the future, it is doubtful if a satisfactory basis exists on which to organize it. There would seem to be a case for including in eradication teams, during the planning phase of projects, someone trained to carry out geographical reconnaissance, to work under the supervision of the malariologist and in the closest co-operation with him and with other members of the team. He would be responsible for preparing all maps and obtaining all population data required

and for producing an integrated assessment of the factors of the physical environment, the distribution and movements of population and the nature of the settlement pattern, economic activities, communications and water supply in relation to malaria and its eradication.

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RÉSUMÉ

Il est reconnu que les mouvements de population à l'intérieur d'un pays impaludé, au cours de la saison de transmission du paludisme, peuvent entraîner une exacerbation de la maladie et même une grave épidémie. Ces migrations, ainsi que d'autres facteurs socio-économiques, affectent profondément les projets d'éradication du paludisme en Afrique. Les bergers transhument avec leurs troupeaux en quête de pâtures, les travailleurs manuels parcourent de grandes distances pour se faire embaucher, et les pèlerins se dirigent à petites étapes vers les lieux saints. Des déplacements de moindre envergure se produisent à l'intérieur des domaines et des plantations au moment des grands travaux. Certains de ces mouvements de population sont ancestraux, d'autres relativement récents. Ils ne sont soumis pour la plupart à aucun contrôle et ignorent les limites territoriales. Ils ne peuvent être supprimés, même si une législation s'y employait.

L'auteur examine les conséquences de ces coutumes itinérantes sur l'éradication du paludisme au Soudan, en Ethiopie, en Somalie, en Afrique orientale, à Zanzibar, en Rhodésie et Nyassaland, en Nigeria et au Ghana. Malgré une tendance à plus de stabilité, qui semble s'esquisser, les changements sont trop lents pour se faire sentir durant la période prévue pour l'éradication du paludisme, sans parler de nouveaux mouvements qui pourraient prendre naissance et venir s'ajouter à ceux que l'on connaît aujourd'hui. Ce sont les programmes qu'il faut adapter à ces phénomènes migratoires. Il s'agit donc de réunir des renseignements permettant de préciser les relations complexes entre les parasites, les vecteurs, l'homme et son mode de vie, sujet aux changements que provoquent les situations politiques, économiques et sociales. L'éradication du paludisme en Afrique a des aspects essentiellement « humains », auxquels on n'a pas porté jusqu'ici une attention suffisante. L'instabilité de la population, sa répartition, la forme de ses groupements passagers, le type d'habitation, les méthodes de culture, les voies de communication, les sources d'eau, sont autant de variables qui empêchent de généraliser les méthodes de lutte antipaludique d'une région à l'autre. Il importe qu'une reconnaissance géographique, mettant l'accent sur la géographie humaine soit incluse dans tout programme d'éradication. Il semble qu'il y ait place, dans une équipe d'éradication, au stade de la planification, pour une personne chargée de cette reconnaissance géographique, et travaillant en étroite collaboration avec d'autres membres de l'équipe. Il lui incomberait de dresser les cartes, de réunir toutes les données humaines utiles et nécessaires à l'orientation des programmes.

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