

MIGRATION AND HEALTH

R. Mansell PROTHERO
Department of Geography
University of Liverpool
United Kingdom

Relationships between population movements and health are recognised in the literature of the social and the biomedical sciences. These relationships are manifest in the following examples.

a) The effects of movements on the transmission of disease and their impacts on programmes for disease control, both of which may be illustrated in historical and contemporary experience. The former are exemplified in the sleeping sickness epidemics of the late 19th and early 20th centuries, particularly in east and central Africa - people moved, settlements were deserted, population was redistributed and new ecological conditions and patterns of population/land relationships emerged (Ford 1971). The latter are exemplified in attempts to achieve malaria control, with limited success among rural populations, particularly in savanna areas of Africa (Moluneaux and Guamiccia 1980), in the more successful major onchocerciasis control programme in the Volta River headwaters and adjacent parts of West Africa during the last two decades (Remme and Zonzo 1989), and in studies of the as yet only partially understood spread of AIDS.

b) The effects of movements on the physical and mental conditions of those who move. These effects are especially relevant in the rural-urban movements which are common throughout Africa. Physical stress is caused, for example, by changes in patterns of food consumption with resultant undernutrition and malnutrition (especially if the transition to urban life is accompanied by under- and un-employment and deprivation). Mental stress is caused by exchanging close and intense personal contacts in rural life for the relative anonymity of urban life with deprivation of such contacts. The impact of both these sets of stresses is mitigated by the maintenance of urban-rural contacts and by the development of urban support systems which have rural origins.

c) The effects of movements on the need for, the nature of and the provision of health services - in both rural and urban areas: with the relative neglect of the former and emphasis on the latter. There are also the particular needs of traditionally mobile rural people such as nomadic pastoralists.

Health conditions may also affect mobility patterns.

a) Disease in endemic and epidemic forms has been a factor promoting movement (Hunter 1966, 1981)

b) Perceptions of contrasting relative health status (in morbidity and mortality experience) between rural and urban areas may be a factor in promoting movement from one to the other.

c) Psycho-social conditions may operate in the selection of those who move - from rural to urban, and between and within both rural and urban areas.

d) The presence or absence of improved health services, both western and traditional, and variations in quantity and in quality will, among other basic social amenities (such as education), act as both push and pull factors in promoting movement (Good 1987, Stock 1983).

Typologies : Mobility and Health Hazards

These general statements illustrate the variety of migration and health relationships, but they are of course not illustrative of their complexity - the variety of movements in space and time interacting with varied health conditions. Recognition and understanding of these relationships are limited. Truly interdisciplinary studies are difficult to achieve. Awareness of them is greater among social scientists who have an understanding of migration but are limited in their medical knowledge. Among medical scientists there may be recognition of relationships, but medical knowledge is often backed up by paying little more than lip-service to the need for a comparable depth of knowledge of the spatial-social-economic nature of movements. This disciplinary impasse has yet to be satisfactorily overcome.

I have advanced a now long-established typology of population movements in a variety of spatial/temporal forms and a number of major categories of health hazards (Prothero 1977). The typology is a summary indication of what needs to be considered in a more penetrating social/medical interdisciplinary concern than exists at the present time. This typology has been modified and developed in a number of studies concerned with movements and specific diseases, for example malaria in Thailand (Singhanetra-Renard 1986) and guineaworm in Nigeria (Watts (1987)). These typologies may be given historical, contemporary and future dimensions where evidence being greater for the present than for the past, but with there being a great practical need to project from the present into the future. Such a need is related to the contemporary concern for the promotion of Primary Health Care as the most satisfactory way of meeting therapeutic and preventive health requirements of the greatest number of people, in circumstances such as in Africa where demands are high and resources to meet them are limited. These developments in health care are set in the wide context of the World Health Organisation's goal of "Health for All by the Year 2000", a goal which is most unlikely to be realised but from which has developed a variety of active programmes for health improvement which otherwise might not have

been initiated.

Research Directions

Action research on migration and health could be directed towards almost any of the present range of human activities in Africa, the majority of which have a mobility component with health implications. However, there would seem to be three major areas which are of immediate contemporary relevance and which are likely to continue to be of importance in the foreseeable future.

The first of these concerns disease control programmes and programmes for the resettlement of population. The latter may have a recognised health component at the time of their planning, or may have one which assumes importance but which has not been recognised in forward planning. In terms of cost and effort the most significant disease control programme is that concerned with onchocerciasis in West Africa during the last two decades (Remme and Zongo 1989). It is also of significance because it is of an international character, involving Burkina Faso, Ghana, Côte d'Ivoire, Benin and Togo, for the international character of movement and disease has received insufficient attention in the past. Such attention is important, given the absence of differences between internal and international migration in much of Africa south of the Sahara. National boundaries do not contain disease nor do they contain the movements of people, facts which are so obvious but which are so little recognised. The failure to recognise these international characteristics has inhibited programmes for malaria control in the past and may do in the future if, for instance, a malaria vaccine were to become available. Recognition would also be of fundamental importance if the means became available to mount preventive and/or curative campaigns against AIDS.

The re-settlement of river valleys in West Africa, which has become possible through onchocerciasis control, has been planned and organised: its long term success will depend on the maintenance of control. Organised resettlement in Tanzania, mainly for socio-political reasons, has been planned to include improved health services through increasing their quantity and by improving access to them through the concentration of previously dispersed populations (Thomas 1982, McCall 1985). Such concentration may, of course, have negative effects in respect of communicable diseases. Less well-planned resettlement, for political reasons and often under coercion as in Ethiopia, has had deleterious effects on the health of those involved in associated movements - in the spread of schistosomiasis and malaria by movements from relatively healthy plateau lands to lowlands which are environmentally favourable to these diseases and their transmission vectors and agents (Woldemeskel 1989). There have also been large-scale transferences of populations from the more arid parts of northern Ethiopia to the wetter south west, again exposing people to a range of health hazards which they have not previously experienced.

TABLE I
Typology of Population Mobility with Examples of Associated Activities and Health Hazards

Space	Time					
	Circulation			Migration		
	Daily	Periodic	Seasonal	Long-term	Irregular	Regular
Rural-rural	Cultivating Collecting (firewood, water) (1)	Hunting (1)	Pastoralism (1) (1)	Laboring (1) (1)	Gathering (1) (1)	Planned settlement (1) (1)
Rural-urban	Commuting (1)	Pilgrimage (1) (4)	Laboring (1)	Laboring (1) (4)	Drought victims (1) (1) (4)	Laboring (2) (3)
Urban-rural	Cultivating (1)	Trading (2)	Laboring (1)	Trading (2) (3)	Refugees (1) (4)	Retirement (1)
Urban-urban	Intraurban commuting (3)	Pilgrimage (2) (4)	Trading (2)	Official Commercial (4)	Refugees (4)	Change of residence (4)

Note: All activities involving mobility may affect programs for disease control and eradication, and the general improvement of public health (e.g., in the location and utilization of health services).

HEALTH HAZARDS

- (1) Exposure to diseases from movements through different ecological zones (e.g., malaria, trypanosomiasis, schistosomiasis, onchocerciasis)
- (2) Exposure to diseases from movements involving contacts between different groups of people (e.g., smallpox, poliomyelitis)
- (3) Physical stress (e.g., fatigue, undernutrition/malnutrition)
- (4) Psychological stress — problems of adjustment

Table I
Typology of circular mobility in Northern Thailand regarding activities associated with malaria transmission*.

Space	Time				
	Return after dark or late at night	Overnight- < 1 week	1 week- < 1 month	1 month- < 1 year	1 year or more
Rural village to Foothills	Hunting (frogs) Collecting (bamboo shoots firewoods) (1)		Cultivating (maize, cotton) (1)		
Rural village to Upland/Forest		Hunting (game) (1)	Logging, hunting (khiat laeo) Collecting (honey) Labor (sawing logs) (1)	Forest plantation Construction (road, dam) Forest industry (2)	Mining (ores) (1) (2)
Rural village to Burma, Laos, Kampuchea	Smuggling (goods) (1) (2)	Visiting (kin) (2)	Trading (cattle, goods) Laboring (cowhands) (1) (2)	Cultivating (opium) Construction (temples, houses) Mining (gems) (1) (2)	Mining (ores) (1) (2)
Burma, Laos to Forest settlement in Thailand		Visiting (kin) (2)	Laboring (cowhands) (1) (2)	Forest plantation Laboring (farm) Refugees (1) (2)	Mining (ores) Refugees (2)
Burma, Laos to Thai border towns	Trading (goods) (2)	Visiting (kin) (2)		Housemaids Shop/restaurant helpers (2)	

*Adapted from Prothero (1977), Table 1.

- (1) Exposure to malaria from movement through different ecological zones
- (2) Exposure to malaria from movement involving contacts between different groups of people.

Table I. Population mobility and guinea worm disease

Space	Circulation			Migration		
	Daily	Periodic	Seasonal	Long term	Voluntary	Involuntary
Rural-rural	<u>water collect.</u> (f) <u>farming</u>	<u>marketing</u> (f) <u>social visits</u> (f) <u>religious</u> (f) <u>festivals</u> <u>pilgrimage</u> <u>(pre-motor age)</u> <u>out-farming</u>	<u>farm labor</u> <u>farm labor</u> (f) <u>pastoralism?</u>	<u>farm labor</u> (f)	<u>rural</u> <u>colonization</u>	<u>drought</u> <u>famine</u> <u>refugees</u> <u>slave trade</u>
Rural-urban		<u>working in towns</u>	<u>working in towns</u>			
Urban-rural	<u>farming</u>	<u>social visits</u> <u>marketing</u> <u>out-farming</u>	<u>farming</u>	<u>farming</u>		
Urban-urban	<u>water</u> (f) <u>collection</u> Rarely found or transmitted in urban areas					

All movements listed involve drinking infected water. Only those underlined may also involve contamination; occasional examples of contamination are indicated thus -----
Where contamination, observed in the Ilonon area, appears to involve primarily females, it is indicated by (f); in other cases both sexes may be involved in contamination.

In resettlement not only may people be exposed to health hazards by movement between different sets of ecological conditions with differing disease complexes, but also in some parts of Africa resettlement has been associated with developments which have created ecological conditions which are favourable to the development of disease hazards, particularly the creation of large man-made lakes and the development of irrigation schemes (Rounds 1989, Meskal and Kloos 1989).

The second area of particular concern is for movements associated with political disruption and environmental catastrophe. Larger numbers of people are associated with these in Africa than with planned and unplanned resettlement. The health problems of political refugees and environmental victims are in many respects similar, but they may differ as a consequence of the contrast between the rapid build-up of movement in the case of the former and the more gradual build up in the case of the latter. Differing sets of health problems will require differing sets of measures to elucidate and to deal with them. Rapidly accumulating and expanding refugee camps with deficient water, sanitation and waste disposal facilities provide ideal environments for outbreaks of dysentery, typhoid and cholera. Through concentration the densities of population occurring in these camps increased the risks of the spread of diseases such as measles. People moving because of political disruption and because of drought are likely to suffer from varying degrees of under- and malnutrition. The redistribution of population from both these categories will produce changing needs for primary health care facilities and the need for these to be designed to meet specific circumstances. There may be a need for mobile rather than for static facilities and for flexibility to adapt to relatively rapid changes in population distribution : such need may be further emphasised when those who are forced to move are traditionally mobile, as in the case of nomadic pastoralists.

While emphases have been placed on movements associated with resettlement or with forced circumstances, the importance should not be underrated of relatively spontaneous and uncoerced movements which are occurring at all times in rural areas at a variety of spatial and temporal scales; these are significant for disease transmission, health improvement and health service provision. The neglect of these spontaneous movements, from economic and social as well as from health points of view, has been indicated on many occasions.

This neglect has come about from the great emphasis that has been placed in recent decades on rural-urban movement and urban growth which is the third of the major areas of concern to which attention is drawn in this paper. In the context of rural-urban movement it should be borne in mind that

a) rural populations continue to grow despite the rural-urban movements which contribute to high rates of urban growth;

b) high rates of natural increase among urban populations are making significant contributions to urban growth;

c) rural-urban-rural circulation continues as a significant component of overall movement;

d) intra-urban movement and inter-urban movements are important.

These are important features contributing to complexity in relation to health which must be taken into account in any consideration of what may seem on the face of things to be simple rural/urban movements.

Continuing urban growth, through natural increase and in-movement, promote concentrations of population at densities which may favour the transmission of some diseases. In-movement may bring infections which are more common in rural areas into the towns. These may or may not continue to be transmitted dependent on the presence or absence of favourable environments, vectors, etc. Diseases which thrive on the absence or shortage of adequate and safe water, sanitation and waste disposal (dysentery, typhoid, cholera, filariasis, urban malaria) thrive where the pressures on these are great (Stock 1976, Adesina 1984). Continuing intense urban-rural interaction takes diseases which are rife in towns, for example from male/female separation and consequent promiscuity (STDs and AIDS), to rural areas. There are also other diseases which are more particular to towns, which may be selective of some but not all urban dwellers - under and malnutrition and psychological/psychiatric illness to which reference has been made, and the range of so-called "western" diseases (stroke, cardiac arrest, certain cancers) which are appearing with greater frequency in African urban populations consequent on changing habits and lifestyles. Urban health services which are an attraction for rural populations and a factor promoting movement are other elements in urban infrastructures which are usually under considerable strain. Consequently they may be less available to many of the more recent urban migrants at the lowest socio-economic levels, whose expectations of access may therefore not be realised. These services, however, may still be more available than any comparable services in rural areas. Notwithstanding many pressures the towns of Africa have more favourable morbidity/mortality experience than the rural areas at the present time, and also more favourable experience than that of expanding towns of the now more developed parts of the world in the nineteenth century.

The three major areas of concern - resettlement, refugee/environmental victims and urban places - for the most part to date have received only scant, scattered and uncoordinated attention in respect of migration and health. What is required to enhance understanding, to achieve better coordination and to contribute towards solutions of the many varied problems which require attention. Some thoughts are advanced here from the point of view of migration, recognizing that data on it and on disease and health are limited and fragmentary.

Generally speaking there has been an improvement in census data on

migration in the last two decades, but the general patterns which these data delineate go only some way to providing what is required. The decennial character of censuses, coupled with the slowness of output, allow them to be used for only a limited contribution to the study of highly dynamic and rapidly changing situations which involve, for example, population movements and disease outbreaks. These circumstances argue for more on-going monitoring of human conditions than exists at the present time so as to provide longitudinal perspectives. There is some evidence of such data being collected by agencies aiding refugee populations, but with possibly insufficient expertise as to what data should be collected and how collection may be best organised. Very probably too little use is made of expertise in local universities and research institutions which themselves may not be making known the existence of this expertise as they should do. There is a need to advertise, to find out what needs to be done and to assist in getting it done.

For those practising migration studies the kinds of data collected are of the utmost importance. Apart from their out-of-date nature, conventional census migration data also have the drawback of seeming to imply definitive movement between prescribed places over specified periods of time, while we know that the particular nature of many movements which are significant for health are very different. Differences between migration and circulation have been indicated frequently and sufficient attention has been drawn to the latter for it not to require further details (Chapman and Prothero 1983). The importance of movements of a circulatory nature is manifest in rural, rural-urban-rural, intra-urban and inter-urban contexts.

Note has already been taken of the difficulties of developing effective interdisciplinary links between social scientists involved in migration studies and medical colleagues involved in various aspects of health. While the latter often recognise the importance of movements, they still have to be convinced of the need to give these detailed consideration of a comparable nature to that given to their medical specialities. I have many times argued, for example, that in circumstances where diseases involve a causative agent (e.g. a malaria parasite), a transmission agent (e.g. an anopheline mosquito) and human beings, attention is given by medical and entomological workers to the first and second of these, but that there is limited if not inadequate attention and sometimes absolute neglect of the functions and roles of people and their activities, of which migration is one of the most important (Prothero 1989).

There has been some improvement in this situation within the last two decades. At the international level the World Bank/UNDP/WHO Special Program for Research and Training in Tropical Diseases (TDR), which concentrates attention on malaria, onchocerciasis, filariasis, leprosy, leishmaniasis and trypanosomiasis, since the second half of the last decade has had a Scientific Working Group on Socio-Economic Research (SER) (Rosenfield et al. 1981). The latter still has a lesser role as compared with the medical components in TDR, but it has been responsible for promoting research on migration and health (Ministerio da Saude 1982, Fernando 1984). It would be good to be able to report much significant work from Africa, but to the best

of my knowledge this has been limited. Among significant studies, undertaken independently of TDR/SER, are those of Kloos in Ethiopia with particular reference to shistosomiasis and the human factors associated with its transmission and spread (Kloos 1985, 1988). They present classic examples of what can be done, as does the work of Watts in association with medical colleagues on guineaworm in Kwara State, Nigeria (Watts 1987, Edungbola and Watts 1984).

There are TDR/SER reports on work undertaken in South East Asia and most especially in Latin America. From the latter the most important work is from the University of Cali in Colombia and that undertaken in the Amazon Basin in Brazil. The former includes the development of a conceptual and operational model to produce data on human circulation and related malaria risk - it combines the measurement of human presence in a determined "place" defined in spatial and temporal terms with the measure of infectivity of such a place (in terms of the biting habits and infective rates of anophales vectors) to predict the risk of malaria (Sevilla Casas 1988). This work demonstrates the importance of interdisciplinary cooperation between biomedical and social scientists to deal adequately with human mobility as an important and widely recognised factor in malaria transmission.

The Amazon Basin in Brazil is the location of major areas of resettlement with the in-movement of population from other parts of the country to participate in a variety of economic activities. The average annual rate of population growth was 5 percent for the Amazon Basin between 1970 and 1980 and in the state of Rondonia the population increased by 1,200 percent in the three decades from 1950. Economic changes have been accompanied by most marked increases in malaria infection - the number of reported cases in Brazil has increased tenfold since 1970 to 500,000 in 1987, with the majority of these in the Amazon Basin. Non-immune migrant populations are the worst affected, particularly by *P. falciparum* the most dangerous of the malaria infections, while among the indigenous populations malaria infection does not create a public health problem. It is difficult to increase group immunity, not only for immunological reasons but especially because of the high levels of population mobility, not only from in-movements into the Amazon Basin but also because of mobility within the Basin, the latter being both occupational and seasonal. New isolated settlements are most a risk where, apart from mobility, there is limited infrastructure and a poorly developed sense of community on which to build anti-malarial activities. "Frontier malaria", as it has been described, shows an association between the proximity of settlements and the numbers of malaria vectors, and this may account for observed differences in malaria incidence between newly established and long established settlements. To further elucidate these problems and recognising the fact that the Amazon Basin is heterogenous with various types of malaria situations, twelve types of settlement have been described with associated malaria characteristics (Sawyer 1988).

1. NEW SETTLEMENT

A. RURAL

1. Extractive

- a) Rubber states - low population density and low mobility - malaria control measures exist - malaria is stable at low levels - there is some potential for malaria resurgence (Type 1)
- b) Small-scale mining
- (i) Open - new and highly susceptible populations - dispersed settlement, temporary dwellings, poor accessibility - maximum exposure to malaria - few control measures and little community interest in these - "frontier malaria" with highest prevalence (Type 2)
- (ii) Closed - control under federal supervision - little malaria (Type 3)

2. Agricultural

- a) Colonization
- (i) New - official, private and spontaneous colonization - variations in malaria control measures and in disease prevalence (Type 4)
- (ii) Old - relative stabilization of population and of malaria - resurgence can occur with population movement between old and new settlements (Type 5)
- b) Ranching
- (i) New - forest clearance with large amounts of temporary labour - limited control of population - malaria often but not always a problem (Type 6)
- (ii) Old - extensive use of land - little labour required - malaria stable at a low level (Type 7)

B. URBAN

1. New

a) Isolated

- (i) **Spontaneous** - small centres - close contact with forest (urban-rural circulation) - malaria can be a problem (Type 8)
- (ii) **Company towns/camps** - controlled - monitoring of immigrants, vector control, rapid diagnosis and treatment of infections - often malaria free (Type 9)

b) New periurban areas - uncontrolled sprawling suburbs - contacts with vector breeding habitats - malaria risk (Type 10)

- 2. Old - consolidated population, improved infrastructure - little malaria-occasional outbreaks can be controlled (Type 11)

2. INDIGENOUS SETTLEMENT

Traditionally malaria was not a problem - contact with new settlements - **indigenous people** become migrants - cultural problems in application of malaria control measures (Type 12)

In summary - open mining areas, colonization projects, new urban and periurban areas are classified high risk for malaria research and control planning; the others are subject to lesser risk.

Like the work from Cali that for the Amazon Basin involves close interdisciplinary involvement but on a very much larger scale under the aegis of the Superintendency of Public Health Campaigns which is part of the Brazilian Ministry of Health. Both of these Latin American examples indicate kinds of work which might be pursued in Africa in the three major fields in which the need for studies of migration and health have been indicated. This should be action research with the aim of having practical application. Migration researchers in Africa who can coordinate their work with biomedical colleagues have the opportunity to seek support for such work from the TDR/SER which welcomes applications for well-founded projects. Further information may be obtained from the Secretary, TDR/SER, World Health Organisation, 1121 Geneva 27, Switzerland.

REFERENCES

- ADESINA, H.O. 1984 The diffusion of cholera outside Ibadan city, Nigeria 1971. Social Science and Medicine 18, 421.
- BIGGAR, R.J. 1986 The Aids problem in Africa. The Lancet Jan. 11, 1979.
- CALDWELL, J.C. et al. 1989 The social context of AIDS in Sub-Saharan Africa. Population and Development Review 15, 185
- CHAPMAN, M. and PROTHERO, R.M. 1983 Themes on circulation in the Third World. International Migration Review 17, 597
- CRUZ MARQUES, A. 1987 Human migration and the spread of malaria in Brazil. Parasitology Today 3, 166
- EDUNGBOLA, L. and WATTS, S. 1985 An outbreak of dracunculiasis in a peri-urban community of Ilorin, Kwara State, Nigeria, Acta Tropica 41, 155
- FERNANDO, M.A. (ed) 1984 Human population movements and their impact on disease transmission and control. Faculty of Medicine, University of Peradenya, Sri Lanka.
- FORD, J. 1971 The role of the trypanosomiasis in African ecology. Clarendon Press Oxford

- GOOD, C. 1987 Ethnomedical systems in Africa: patterns of traditional medicine in rural and urban Kenya. The Guilford Press, New York and London
- HUNTER, J. 1986 River blindness in northern Ghana: a hypothesis of advance and retreat. Geographical Review 56, 398
- HUNTER, J. 1981 Progress and concerns in the WHO Onchocerciasis Control Programme in West Africa. Social Science and Medicine 15D, 261
- KLOOS, H. 1985 Water resources development and schistosomiasis control in the Awash valley, Ethiopia. Social Science and Medicine 20, 609
- KLOOS, H. et al. 1988 Schistosomiasis in Ethiopia. Social Science and Medicine 26, 803
- KLOOS, H. 1990 Human aspects of resettlement in Ethiopia. Social Science and Medicine 30, 643
- MC.CALL, M. 1985 Environmental and agricultural impacts of Tanzania's villagization programme. In Clarke, J.I. et al. (eds.) Population and development projects in Africa, Cambridge University Press, Cambridge
- MESKALL, F.H. and KLOOS, H. 1989 Vector-borne disease occurrence and spread as affected by labour migration to irrigation schemes in Ethiopia. In Service, M.W. (ed.) Demography and Vector-borne diseases. CRC Press, Baton Roca

- MILLAR, N. and ROCKWELL, R.C. 1988 AIDS in Africa: the social and policy impact. Edward Mellen Press, New York.
- MINISTERIO DA SAUDE 1982 Doencas e migracao humana. Centre de Documentacao, Ministerio da Saude, Brasilia
- MOLINEAUX, L. and GRAMICCIA, G. 1980 The Garki Project: research in the epidemiology and control of malaria in the Sudan Savanna in West Africa. World Health Organization, Geneva
- PROTHERO, R.M. 1977 Disease and mobility: a neglected aspect of epidemiology. International Journal of Epidemiology 6, 259
- PROTHERO, R.M. 1989 Problems of human mobility and diseases. In Service, M.W. (ed) Demography and Vector-borne diseases. CRC press, Baton Roca
- PROTHERO, R.M. and CHAPMAN, M. (eds) 1985 Circulation in Third World Countries. Routledge and Kegan Paul, London
- REMME, J. and ZONGO, J.B. 1989 Demographic aspects of the epidemiology and control of onchocerciasis in West Africa. In Service, M.W. (9ed). Demography and Vector-borne diseases. CRC Press, Baton Roca
- ROSENFELD, P. et al. 1981 Social and economic research in the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases. Social Science and Medicine 15A, 529

- ROUNDY, R.W. 1989 Problems of resettlement and vector-borne diseases associated with dams and other development schemes. In Service, M.W. (ed) Demography and vector-borne diseases. CRC Press, Baton Roca
- SAWYER, D. 1988 Frontier malaria in the Amazon region of Brazil: types of malaria situations and some implications for control. In Report on a technical consultation on research in support of malaria control in the Amazon basin. WHO, Geneva
- SEVILLE CASAS, E. 1988 Human circulation and malaria risk. In Priorities for social and economic research in onchocerciasis, malaria, methodology and health policy. WHO, Geneva
- SINGHANETRA-RENARD, A. 1986 Population movement, socio-economic behaviour and the transmission of malaria in northern Thailand. South-East Asian Journal of Tropical Medicine and Public Health 17, 396
- STOCK, R. 1976 Cholera in Africa. African Environment Special Report 3. International African Institute, London
- STOCK, R. 1983 Distance and the utilization of health facilities in rural Nigeria. Social Science and Medicine 17, 563
- THOMAS, I. 1982 Villagization in Tanzania: planning potential and practical problems. In Clarke, J.I. and Kosinski, L.A. (eds) Redistribution of Population in Africa. Heinemann, London

- WATTS, S. 1987 Population mobility and disease transmission: the example of guinea worm. Social Science and Medicine 25, 1073
- WOLDEMSKL, G. 1989 The consequences of resettlement in Ethiopia. African Affairs 88, 359