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A FAMILY HEALTH CARE REPORT

HEALTH IMPACT GUIDELINES FOR THE DESIGN OF DEVELOPMENT PROJECTS IN THE SAHEL

Volume II

Reference Manual

Under Contract No. AID/afr-C-1138
Work Order No. 19

Family Health Care, Inc.
1211 Connecticut Avenue, N.W.
Washington, D.C. 20036

Submitted:

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Permanent Interstate Committee for Drought Control in the Sahel (CILSS)
Ouagadougou, Upper Volta

Final Report: April 13, 1979
Agency for International Development
Washington, D.C. 20523

Please return: T.A. Lukes

A Family Health Care Report

HEALTH IMPACT GUIDELINES FOR THE DESIGN OF DEVELOPMENT PROJECTS IN THE SAHEL

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Author's Note

This volume is presented as a reference manual to be used in conjunction with Volume I of the Health Impact Guidelines. The information contained here can be applied to any region of the world where tropical diseases are present; however, the text has been particularly geared to the Sahel.

The introduction and preface have been made identical to those in Volume I to emphasize the complementarity of the two volumes. The tropical disease review, glossary and the bibliography are presented as additional reference material. A selected list of organizations is also included for those who wish to seek further information, advice and/or assistance.

ACKNOWLEDGEMENTS

The author of the Health Impact Guidelines for the Design of Development Projects in the Sahel is Victor Barbiero, Family Health Care, Inc. (FHC) Research Analyst, and Doctoral Candidate, Department of Pathobiology, the Johns Hopkins School of Hygiene and Public Health. Members of the CILSS Secretariat in Ouagadougou, Upper Volta, and of AID's Sahel Development Program in Washington, D.C. should be given much of the credit for their recognition of the need and value of producing this document, and for their assistance in formulating its basic concepts. The spectrum of activities which comprise the development process is far-reaching and often fraught with problems, not the least of which involve health. Recognizing health as a fundamental and essential component of the development process and emphasizing the need to consider the relationship between health and development in the design of future projects, is commendable and reflects the concern, insight and commitment of the organizations mentioned above. Therefore, it is hoped this document will contribute to the mitigation of adverse health impacts and be used by field personnel, project officers, ministry officials and others who take an active part in the development process.

The author thanks Dr. William Bicknell, Health Policy Institute, Boston University, who provided invaluable suggestions on the content and organization of the entire document; Anne Lebowitz, who edited Volume I; Dr. Thomas W. Simpson, the Johns Hopkins School of Hygiene and Public Health, who

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Some of the French language material in the Bibliography was located based on the suggestions of Dr. Jean Mouchet, ORSTOM/Paris; and many of the French documents were identified and assembled by Antoine Farah, also of ORSTOM, whose hard work and thoroughness are much appreciated.

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Although FHC, Inc. is indebted to all those individuals mentioned above, it accepts full responsibility for the substance of all materials found within this document.

PREFACE

This book is part of a two-volume series commissioned by the Permanent Interstate Committee for Drought Control in the Sahel (CILSS) to familiarize project officers, design teams, and ministry personnel at the national level with the adverse effects on health which might result from the various types of development projects implemented in the region.

The Health Impact Guidelines can be used to anticipate health problems that may result from a project, to predict the extent and seriousness of such problems, and to minimize or prevent these potential threats to health while pursuing the project's objectives. They have been prepared primarily for technicians in sectors other than health. As such, the Guidelines describe practical approaches that design officers can consider for incorporation into their development projects; they also provide a systematic assessment procedure to promote informed decision-making throughout the process of project design. It should be noted at the outset, however, that the Guidelines are a tool intended for use during the initial design of a development project; they do not provide a method of evaluation for use after a project is approved, being implemented or operational.

In pursuing the twin goals of regional food self-sufficiency and sustained economic growth in the Sahel, it is important to be aware of the overlap which often exists among different

portions of the environment. For example, seemingly unrelated projects designed to achieve increased crop production, improved animal production, better transport systems, ecological conservation, improved sanitation, and better quality drinking water are very likely to have a significant impact upon each other. They may complement each other and facilitate the pursuit of mutual goals, or they may undermine each other and compromise their long-term benefits.

Indeed, CILSS views its development efforts in horizontal as well as vertical terms. For example, increased food production is a vertical function of the irrigated and dryland agriculture sector; it is called vertical because it is limited to the sector in which it originates. Its horizontal functions--outcomes manifested in other sectors--might include better nutrition, increased resistance to disease, increased cash flow, improved marketing, and better water retention of the soil. A reservoir built for irrigation may also serve as a watering-hole for cattle, or, if appropriate, a source of drinking water for human beings; these are among its horizontal functions. The complementary aspects of these horizontal functions as they overlap among sectors should be recognized and incorporated into project designs whenever feasible. If this is carried out, time, money and lives may be saved in the future.

The first volume of the document includes chapters on "Dryland and Irrigated Agriculture," "Livestock Development," "Fisheries Development," "Transportation," "Special Issues in

Development," and "The Methodology for Assessing and Avoiding Adverse Health Impacts." Volume II is a reference manual and examines in detail the major diseases prevalent in the Sahel. It also includes a glossary of terms, a bibliography, and a list of organizations from which further information and consultation may be obtained.

INTRODUCTION

Health and Development in the Sahel

Because health is associated with vigor, productivity, mental alertness, and motivation, a sick person tends inevitably to be less productive than a healthy person. Health is thus linked on a broader scale with economic and socio-demographic trends: if the population of a region is chronically sick, economic output suffers.[1] And--individually, nationally, and regionally--lowered production and productivity may lead to lowered food availability and consumption, poorer nutrition and in turn increased susceptibility to disease. Thus, a downward spiral of disease and poor nutrition is likely to occur. Demographic trends are also affected since people tend to have large families in areas where disease is prevalent in order to insure that some children survive to adulthood.[2]

In the Sahel, as elsewhere in the world, one of the basic assumptions of development efforts is that this downward spiral can be eventually reversed and the quality of life of the population improved. Despite considerable progress toward this goal, the health status of the people of the Sahel is still far

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1. See Bibliography: 13, 126, 140, 146, 151, 152, 159, 160, 163, 173, 202, 224, 227.

2. See Bibliography: 197, 198, 202, 208, 258, 268.

from satisfactory. As development programs in the region increase in size and number, attention should be given not only to activities of the health sector designed to improve health status, but to all development programs and projects in order to insure the most favorable impact on the population.

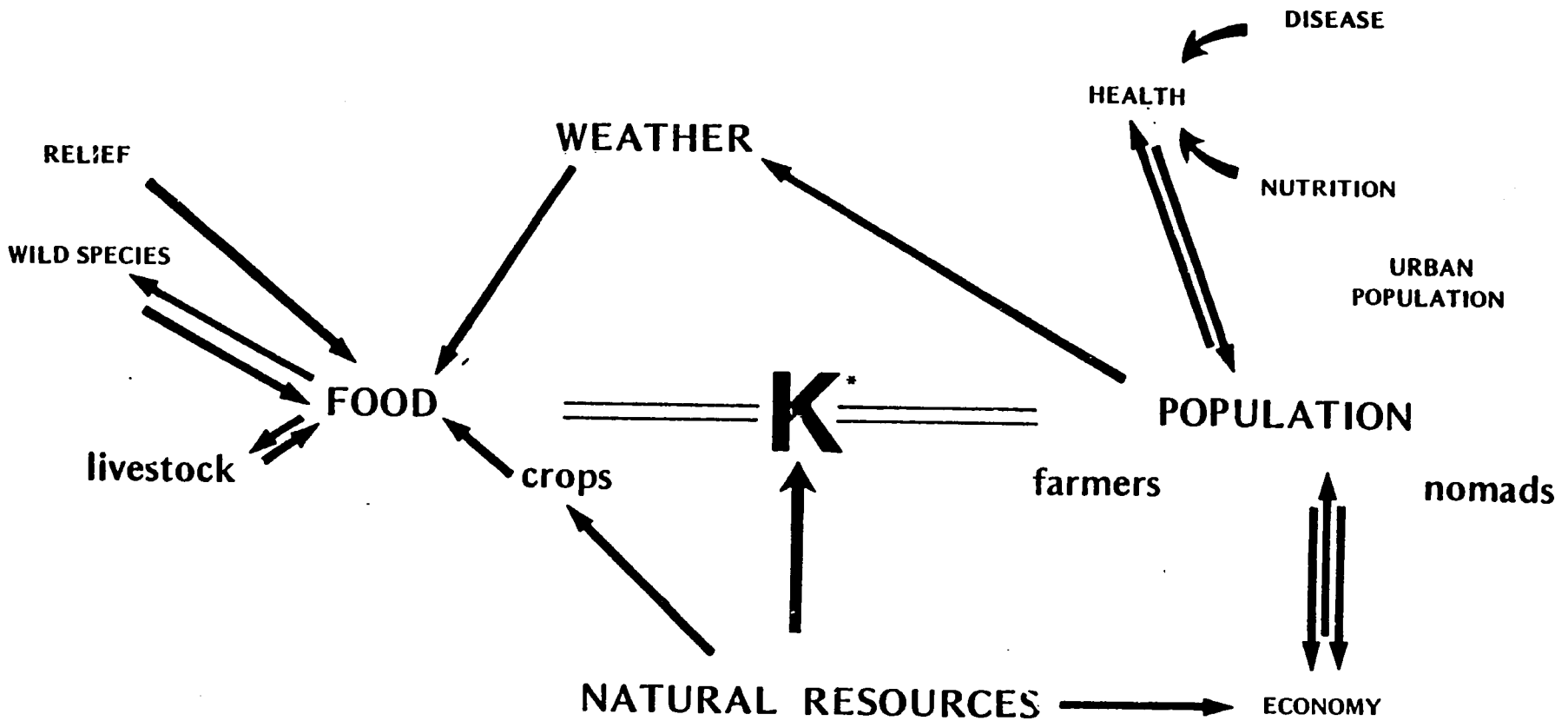
Since development frequently results in changes in the environment and since these changes may adversely affect human health, it is vitally important to anticipate the changes which a development activity may cause and the adverse effects it may provoke. Project officers and others who are aware of possible unwanted outcomes will be in a position to evaluate the potential significance of these outcomes and act to minimize them. By thoroughly considering the potential effects their projects may have on human health, development personnel will enhance the overall success of their endeavors and perform a valuable service to the people of the region.

An Ecological Perspective

In order to assess impacts on health, it is necessary to understand how development can affect health. The relationship is not always direct. Figure 1 portrays the Sahel as a single ecosystem, a community of organisms--human beings, animals, and plants--interacting within the physical environment.[3] The arrows signify dynamic or changeable relationships within the system and the links among its components. Figure 1 indicates

3. See Bibliography: 85, 117, 123, 126

Figure 1: The Ecological Balance in the Sahel



*K = carrying capacity

that each component is related to all of the others. It depicts ecological interaction and interdependence. While reading further, keep in mind the ecological principle that any change in one part of the environment ultimately affects other parts of the environment. Development does not occur in a vacuum; thus, one has to be concerned with both intended and unintended results.

In the Sahel, cities have risen where forests once grew; crops are being harvested from fields that at one time were only seasonally grazed; energy is being extracted from the earth, from rivers, and even from the sun; minerals are mined for export and industrial purposes; and diseases are being controlled by means of vaccination, health education, and aerial spraying of insecticides.

However, progress has another side... Cities are polluted by factory and automobile exhausts which can cause heart and lung disease as well as changes in climate. Migration and urban overcrowding break up families, and tension contributes to high suicide rates. The clearing of forests alters climate and eliminates a renewable source of fuel. Continued cropping of fragile semi-arid soils can lead to erosion and desert encroachment. Mining and other activities which destroy the natural plant cover can increase the risk of floods. High-flying aircraft emit gases that reduce the earth's protection from the sun's harmful radioactive energy. Unfavorable food-crop-to-cash-crop ratios may sacrifice nutritional health for economic stability.

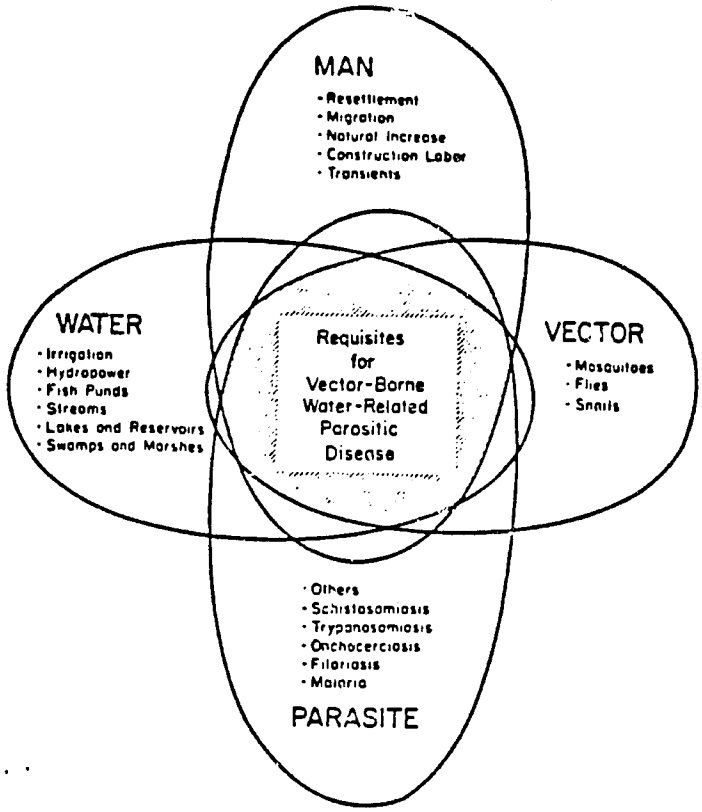
Chemicals may contaminate water supplies, and some types of progress may promote the spread of disease.

Since ecology deals with the study of relationships among living organisms and their natural surroundings, it can help us to examine phenomena ranging in scope from very large to very small. By investigating the interactions among the forces of nature, ecologists can investigate why the Sahel suffered a devastating drought and famine in 1968-1974; or they can explain how several types of bacteria interact to turn milk into yogurt. The subject matter of ecology is virtually limitless, since all living things must interact with each other and within their environment in order to survive.

Like other living things, the organisms which cause disease must eat, excrete wastes, find satisfactory places to live, and reproduce. In the field of public health, such patterns are examined in terms of the ecology of disease (Figure 2). Specific environmental conditions are required for disease organisms to complete their often complex life cycles. Changes in the environment of such an organism that promote its welfare and survival thus tend to maintain and spread the disease it causes. And, as we have mentioned, environmental change is an inevitable result of development. Of course, development is only one factor in a complex set of inter-related factors: climate, geography, flora and fauna, cultural patterns, social structure, political attitudes, ingrained traditions, and socio-economic conditions can all contribute in one way or another to the maintenance and spread of disease agents.

FIGURE 2

THE ECOLOGY OF DISEASE



Source: Owolabi, S., 1976.

Environmental Change and Its Impact on Health

The major threats to the health of the people of the Sahel may be divided into three categories: endemic diseases (air-borne, water-borne, vector-borne, infectious, zoonotic), poor nutrition, and contamination of food and water by toxic substances. Given the fragile environment in which Sahelians live, it is not unusual for one change in the environment to cause change (or changes) in another part of the environment and subsequently result in an undesired effect on health. For example, let us look at some specific ways in which environmental change can affect the incidence of disease. Vector-borne diseases[4] associated with water, such as malaria, schistosomiasis, onchocerciasis, and dracontiasis (guinea worm) occur primarily in the southern portions of the Sahel. If, however, water-related development projects such as irrigation systems, dams, and reservoirs are implemented in the semiarid north, excellent breeding habitats can be created by which the northward spread of these vector-borne diseases might be facilitated. This can be particularly serious if the exposed population has little or no acquired immunity to a disease such as malaria.

The northern portion of the Sahel differs epidemiologically from the south. Poor general nutrition due to lack of protein and calories is probably the most widespread health problem in the north, particularly common in children under five. Measles

4. Diseases passed from infected to uninfected individuals through other organisms, or "vectors," such as flies, mosquitos, snails, etc.

and tuberculosis are also prevalent, as are trachoma, and cerebrospinal meningitis. Some zoonotic diseases[5] carried by cattle, such as anthrax and brucellosis, occasionally affect man. Populations resettled from the northern to the southern Sahel will be exposed to certain diseases to which they have developed no immunities. Thus, although the Sahel exhibits widespread spatial distribution of diseases due to its climatic and sociocultural variation, the potential for introducing a particular disease into an area previously free of it is considerable.

As more and more people come to occupy a particular area, it becomes increasingly likely that air-borne, water-borne, and vector-borne diseases will spread. A rise in population density due to a development project tends to bring about closer contact among individuals; it also increases the likelihood that sanitation systems of fixed capacity will prove inadequate. Therefore, consequent rises in the incidence of measles, tuberculosis, amoebic and bacillary dysentery, respiratory infections, intestinal worms, and vector-borne diseases can be expected.

In addition to diseases and nutritional deficiencies, toxic substances introduced into the environment by man or by natural processes can cause serious health problems if they enter the food or water systems. Health can also be affected indirectly by a decline in soil fertility due to the misuse of land. Poor productivity decreases the amount of food available which may adversely affect nutritional status. A decline in nutritional status may increase an individual's susceptibility to disease.

5. Diseases that can be transmitted from animals to man.

The following chapters in this volume deal more specifically with the interactions between development and health. The complementarity of the horizontal aspects among sectors is consistently brought out. A total perspective approach underpins each sector review and, if applied, will be manifested in the optimum application of development resources and consequent successful development activities. This document presents information, methodologies and ideas. It is hoped that it will stimulate the reader to think about alternative project designs, predict adverse impacts and avoid unwanted results through intersectoral cooperation and planning.

DISEASES IN THE SAHEL

DISEASES IN THE SAHEL

The Patterns of disease in the Sahel have changed very little over the past several decades, despite significant efforts to eradicate or control major endemic diseases and to provide health services to the population. Infant mortality is higher than in any other area of the world, and life expectancy at birth averages under 40 for the region. Poor nutrition contributes to an increased severity of the most common communicable diseases, especially among children. An understanding of the determinants of health and nutritional status in the Sahel is essential for the implementation of a successful long-term development program.

Diseases are caused and transmitted by living things, collectively called organisms. Organisms may be very small (microorganisms) or very large. Organisms that cause disease are often referred to as disease agents. These microorganisms may live anywhere in the definitive host (an organism in which the disease agent reproduces) and sometimes need other organisms (intermediate hosts) for their development before they can infect man or other definitive hosts. Those intermediate hosts may also be called vectors. Vectors can be mosquitoes, fleas and flies, snails, lice and ticks. Diseases which require intermediate hosts are often called vector-borne diseases.

There are six major groups or classes of organisms which cause disease. These are: protozoa (single celled organisms), helminths (worms), bacteria, viruses, spirochetes, and rickettsia. A brief description of their characteristics is presented below.

Protozoa - These organisms are single celled and may live either outside or inside the cells of the host. They therefore are referred to as intracellular or extracellular parasites. They reproduce by cell division and may or may not require an intermediate host (vector).

Helminths - These organisms are multicellular and usually live in the tissue of the host. They are relatively large and adults can often be seen with the naked eye. They are all worms of one type or another, (i.e., roundworms, flatworms or segmented worms). They reproduce either sexually or asexually. They may not kill the infected person, but often make him ill and less able to work. They usually require an intermediate host to be transmitted.

Bacteria - Bacteria are single celled organisms that usually live in the tissues of the infected person. They may invade the respiratory system, digestive tract, nervous system and skin. They multiply by cell division and have various shapes and sizes. They are prevalent throughout the world and each species may have a great number of different types.

Viruses - These are the smallest living organisms. They live and multiply only within cells. They have the ability to change very rapidly to suit a new environment. They are spread by air, insect bites and close contact. They may attack cells of the respiratory tract, digestive system, nervous system and skin. They are difficult to control because of their ability to adapt and their ease of transmission.

Spirochetes - Spirochetes are organisms that are neither viruses nor bacteria. They are usually associated with venereal disease (i.e., syphillis). However, non-venereal forms exist. They also cause diseases characterized by severe fevers.

Rickettsia - These organisms are single celled and are usually transmitted to man by an arthropod (flea, tick, louse). They are extracellular or intracellular parasites. Small rodents often are reservoirs (an organism which carries the disease agent but does not get sick) for these parasites.

The organisms which cause disease can be thought of as being transmitted in four general ways. Table 1 presents these routes of transmission, their definition, the names of diseases associated with the type of transmission, the disease causing organism, the class of the organism, and when applicable, the vector required to transmit the disease. Figure 3 presents these routes of transmission and the associated diseases diagramatically.

When reviewing Table 1, Figure 3 and the following descriptions of the diseases, keep in mind the underlying concept of health as a cornerstone of development, and the idea of the ecology of disease. Think about how your sector activites might effect the transmission of disease.

TABLE 1

MAJOR ROUTES OF TRANSMISSION OF DISEASE AND OTHER RELATED INFORMATION

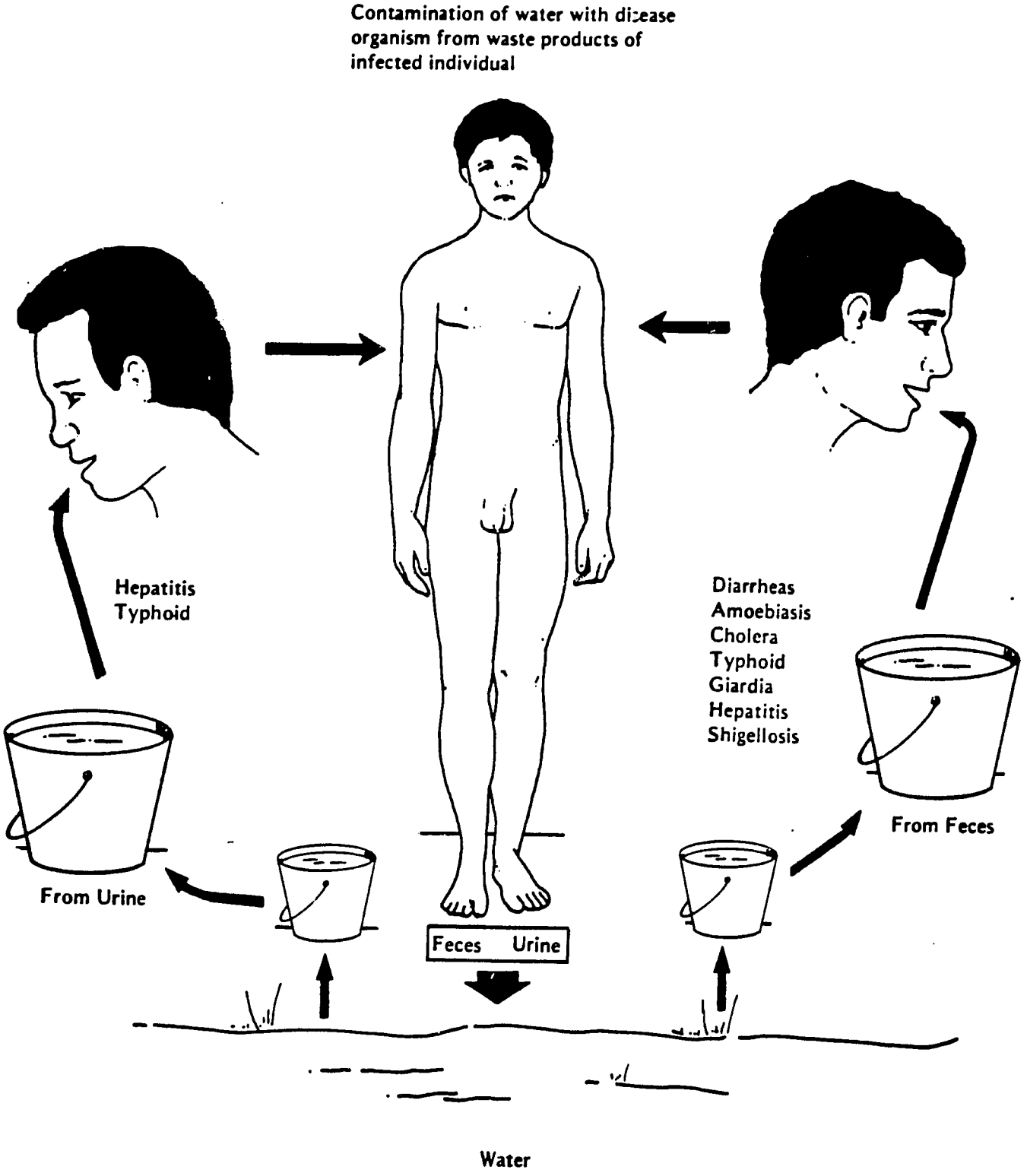
ROUTE OF TRANSMISSION	DEFINITION	DISEASES TRANSMITTED BY THIS ROUTE	DISEASE AGENT (ORGANISM)	CLASS OF ORGANISM	VECTOR
Water-borne	Water is contaminated by waste products from infected person (urine or feces)	Amoebiasis Cholera Hepatitis Dracontiasis Typhoid fever Giardiasis Leptospirosis Shigellosis	Entamoeba histolytica Vibrio cholerae Hepatitis B Dracunculis medinensis Salmonella typhi Giardia lamblia Leptospira sp. Shigella dysenteriae	Protozoan Bacteria Virus Helminth Bacteria Protozoan Spirochete Bacteria	Cyclops (small crustacean)
Food-borne	Food is contaminated by waste products from infected person (urine or feces) or from dirty hands or from material from nose (nasal discharge) or from material from the mouth (oral discharge)	Amoebiasis Food Poisoning Dysenteries Cholera Ascariasis Trichuriasis Tapeworm Trichinosis Giardiasis Aspergillosis	Entomoeba histolytica Staphylococci sp. Bacterial, viral Vibrio cholerae Ascaris lumbricoides Trichuris trichiura Taenia solium, T. saginata Trichinella spiralis Giardia lamblia Aspergillus toxin	Protozoan Bacteria Bacteria, Virus Bacteria Helminth Helminth Helminth Helminth Protozoan Fungus	
Direct (from soil, air, wounds, bites, intercourse)	The organisms go directly into the body from the air, nose or mouth, or may penetrate the skin by (a) direct invasion, (b) wound or (c) bite	Ancylostomiasis (Hookworm) Strongylodiasis Measles Tuberculosis Pneumonia Poliomyelitis Viral Respiratory Disease	Ancylostoma duodenale Strongyloides stercoralis Measles virus Mycobacterium tuberculosis Streptococcus pneumoniae (plus others) Poliovirus 1, 2, 3 Miscellaneous viruses	Helminth Helminth Virus Bacteria Bacteria & Virus Virus Virus	

TABLE 1, Cont'd

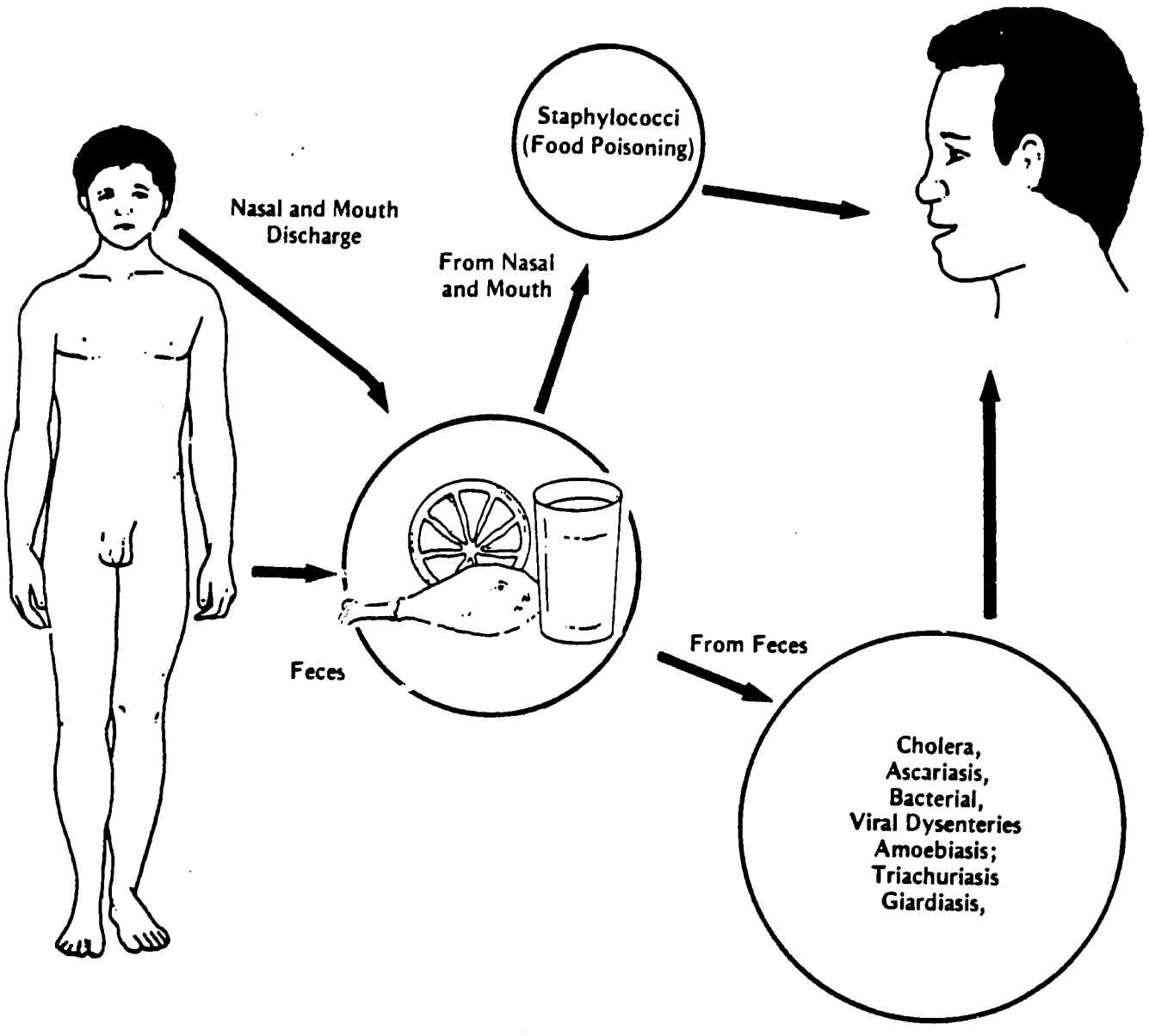
ROUTE OF TRANSMISSION	DEFINITION	DISEASES TRANSMITTED BY THIS ROUTE	DISEASE AGENT (ORGANISM)	CLASS OF ORGANISM	VECTOR
Direct (cont.)		Influenza	Influenza virus	Virus	
		Tetanus	Clostridium tetani	Bacteria	
		Brucellosis	Brucella abortus	Bacteria	
		Tularemia	Francisella tularensis	Bacteria	Wood ticks
		Anthrax	Bacillus anthraxis	Bacteria	
		Leprosy	Mycobacterium leprae	Bacteria	
		Rabies	Rabies virus	Virus	
		Tracoma	Chlamydia trachomatis	Bacteria	
		Syphilis	Treponema pallidum	Spirochete	
		Yaws	Treponema pertenue	Spirochete	
		Gonorrhea	Neisseria gonorrheae	Bacteria	
Vector-borne	The organisms infect a person only after they have developed and/or multiplied within another larger organism (the intermediate host). This organism is usually an insect but is also commonly another organism such as a snail or a tick.	Malaria	Plasmodium sp.	Protozoan	Mosquito (Anopheles gambiae)
		Schistosomiasis	Schistosoma hematobium, S. mansoni	Helminth	Snail (Bulinus sp.)
		Trypanosomiasis	Trypanosoma gambiense	Protozoan	Tsetse Fly (Glossina sp.
		Leishmaniasis	Leishmania donovani	Protozoan	Gnats (Phlebotomus sp.)
		Onchocerciasis	Onchocerca volvulus	Helminth	Blackfly (Simulium sp.)
		Elephantiasis	Wulcheria bancrofti	Helminth	Mosquito (Culex sp.)
		Loaiasis	Loa loa	Helminth	Flies (Chrysops sp.)
		Dracuculiasis	Dracunculus medinensis	Helminth	Crustacean (Cyclops)
		Yellow fever	Yellow fever virus	Virus	Mosquito (Aedes aegypti)
		Dengue fever	Dengue fever virus	Virus	Mosquito (Aedes aegypti)
		Viral Encephalitides	Various arboviruses	Virus	Mosquito, other insects
		Plague	Yersina pestis Pasteurella pestis)	Bacteria	Flea (Xenopsylla cheopis
		Relapsing fever	Borrellia recurrentis	Spirochete	Lice (Pediculus humanus)
		Rickettsial infections	Rickettsial organisms	Rickettsia	Ticks, Lice
		Typhus	Rickettsia prowazeki	Rickettsia	Lice (Pediculus humanus)

Figure 3: Types of Disease Transmission

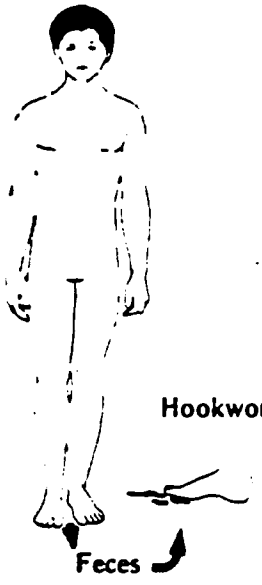
WATER-BORNE



FOOD - BORNE


Contamination of food with
waste from infected individual
Staphylococci
(Food Poisoning)
Nasal and Mouth
Discharge
From Nasal
and Mouth
Feces
From Feces
Cholera,
Ascariasis,
Bacterial,
Viral Dysenteries
Amoebiasis;
Triachuriasis
Giardiasis,

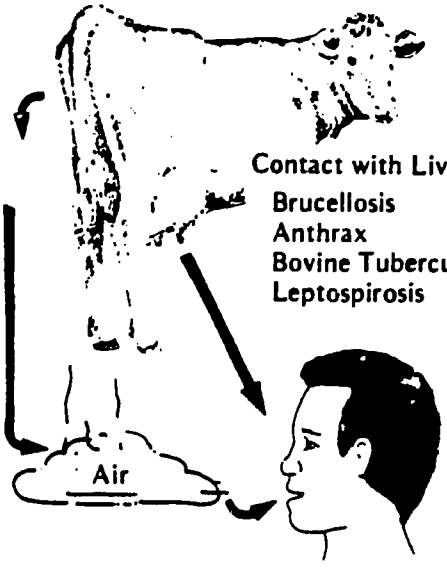
DIRECT: Soil, Air, Wounds, Bites, Intercourse



Hookworm

)IL

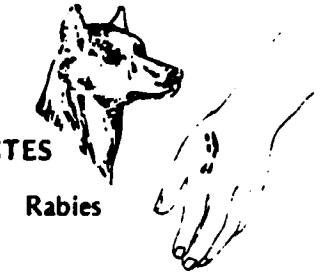
Feces



Contact with Livestock

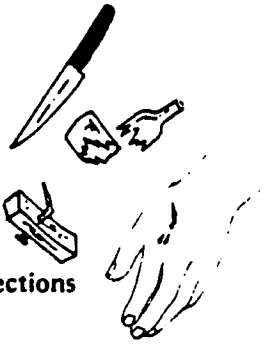
Brucellosis
Anthrax
Bovine Tuberculosis
Leptospirosis

Air



BITES

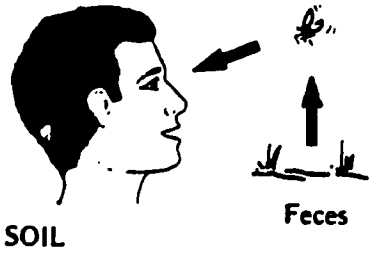
Rabies



'OUNDS

Tetanus

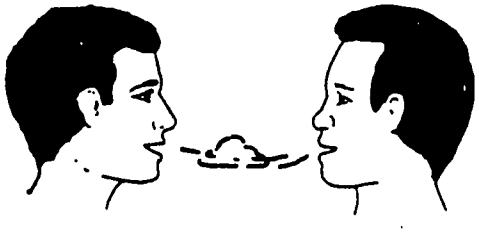
ondary Infections



Trachoma

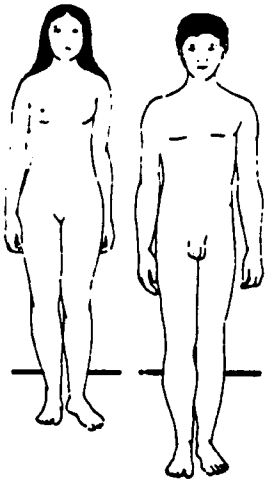
SOIL

Feces



AIR

Measles, Pneumonia, Influenza,
Viral Respiratory Diseases,
Tuberculosis, Leprosy

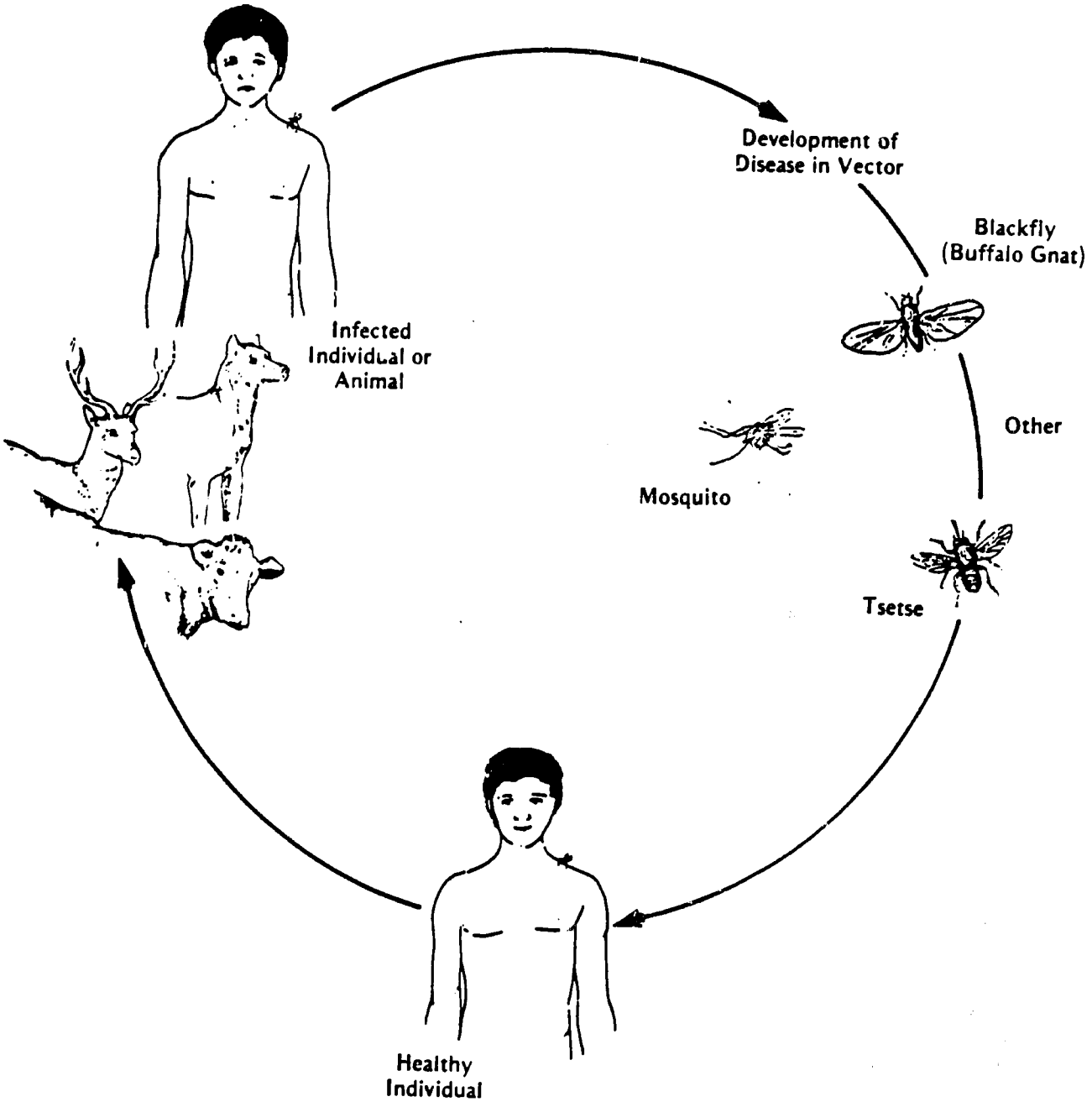


INTERCOURSE

Syphilis
Gonorrhea

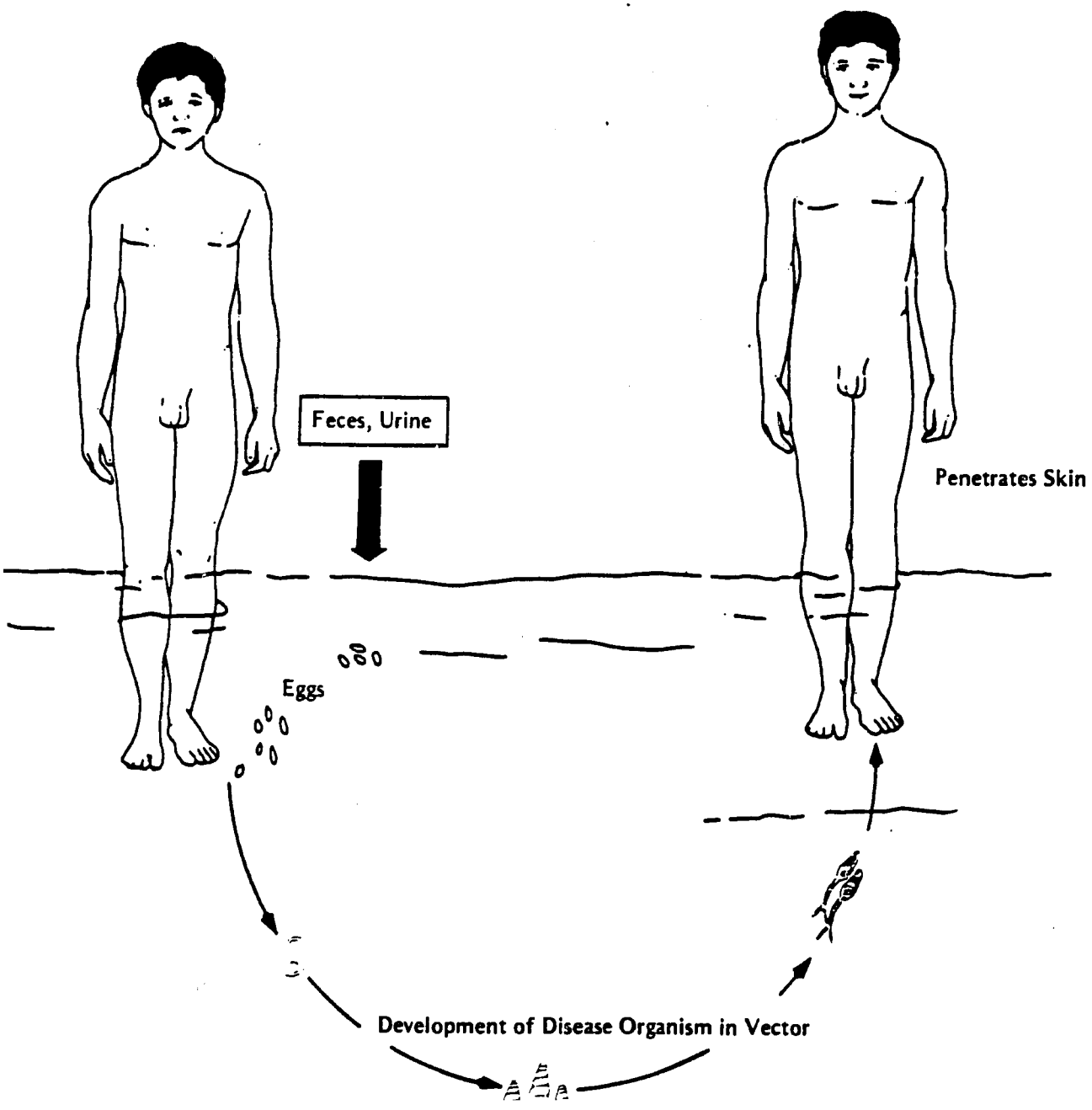
VECTOR-BORNE (Insect Vector)

Malaria, Onchocerciasis, Trypanosomiasis, Leishmaniasis, Elephantiasis, Loaloa, Yellow Fever, Dengue Fever, Viral Encephalitis, Relapsing Fever, Typhus, Rickettisial Fevers



VECTOR-BORNE (Snail Vector)

Schistosomiasis



Malaria

Millions of people are exposed each year to malaria and thousands die as a result of this infection. The malaria parasite (a protozoa in the genus Plasmodium) is carried and transmitted by a female mosquito (genus Anopheles). There are four types of human malaria, each caused by a particular species of the parasite; they are: Plasmodium falciparum, P. vivax, P. ovale and P. malariae. P. falciparum is the most dangerous malaria parasite because it multiplies rapidly in the bloodstream and can kill the victim 12-24 hours after he begins to show symptoms of the disease. Plasmodium vivax, a less severe form of malaria, is the most common type of malaria found in the Sahel.

The malaria parasite lives, grows and multiplies in the red bloodcells of human beings. Infected individuals experience severe fever and chills at the onset of the disease. These symptoms are often thought to cause severe anemia (a decrease in the normal number of red blood cells per cubic millimeter of blood). Malaria attacks the young and old alike, but children 0 - 5 years of age are most susceptible to the disease because they have not yet developed resistance to the parasite. Indeed, a great deal of the Sahel's high infant mortality rate may be due to malaria.[1]

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1. See Bibliography: 163, 188, 198, 226, 267.

The transmission of malaria is complex (figure 4). In order to complete transmission, there must be a suitable mosquito, an infected person, and a noninfected person. In the Sahel, the primary vectors are Anopheles gambiae and Anopheles funestus.[2] These mosquitos breed in areas where surface water accumulates. The mosquito lays her eggs in the water where they soon develop into larvae. Larvae swim, eat, and grow in the water for about two weeks, then they rest. After a period of internal development for approximately 2 to 3 days, the young mosquito emerges from the water. The entire process from egg to adult takes about one month. After the young female mosquito has emerged, she rests for a short time, finds a mate to fertilize her eggs, and then begins her search for blood in order to live and develop her eggs to maturity. The fertilized female lays between 500 and 1,000 eggs in her lifetime. If man is close by, he will be the source of blood for the mosquito. By biting a non-infected person, the infected insect transmits the infection. The mosquito remains infected with the parasite throughout her lifetime. The blood of human hosts can retain the infectious parasite for up to 3 years.

The feeding behavior and the long lifespan of the mosquito (approximately three months) facilitate the spread of malaria

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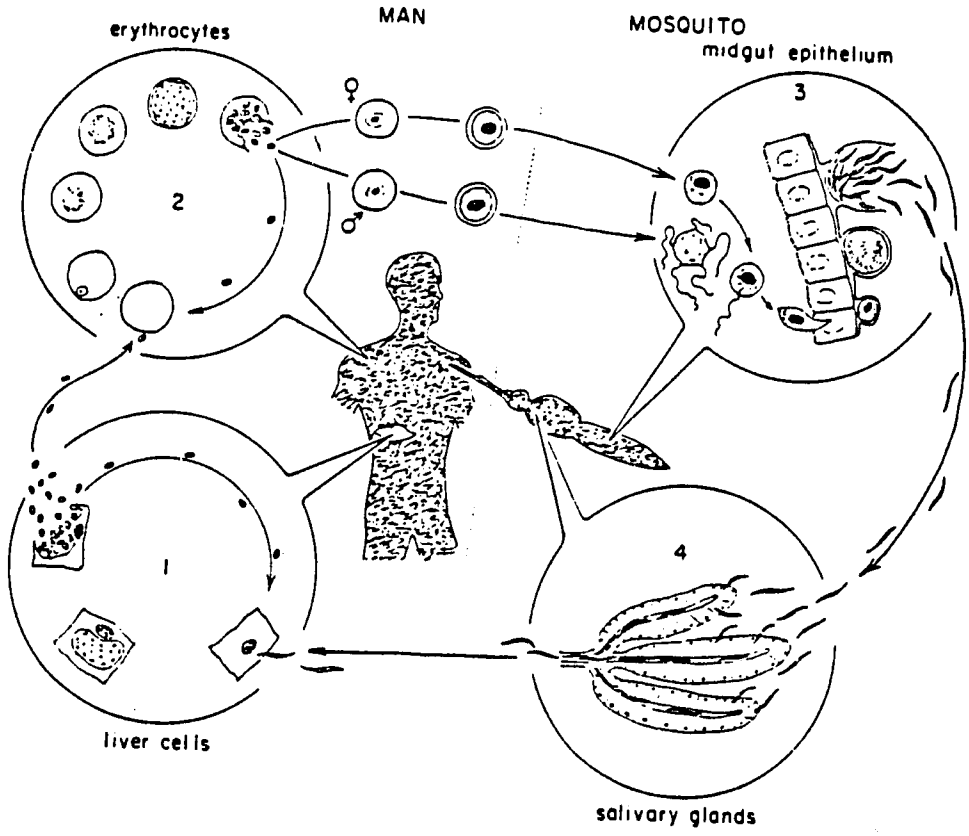
2. See Bibliography: 116, 226, 267.

Figure 4

TRANSMISSION CYCLE OF HUMAN MALARIA



Man Cycle

1. Sporozoites are introduced into man from salivary glands of mosquito in act of biting (arrow from *4* to *1*) and, *1*, sporozoites enter parenchyma cells of liver to establish primary exerythrocytic schizogony. In man there is only this single cycle in *falciparum* malaria; in malaria and various Haemosporidia of man and other animals secondary cycles are characteristic.

2. Merozoites are formed and invade (arrow from *1* to *2*) erythrocytes (red blood cells) where the developing stage is called a trophozoite. The trophozoite grows, destroys its erythrocyte to release merozoites which enter more erythrocytes to continue erythrocytic cycles. Micro (male) and macro (female) gametocytes are also periodically released from erythrocytes and, when ingested by an *Anopheles* mosquito (arrows from *2* to *3*), the microgametocyte divides to form motile microgametes.

Mosquito Cycle

3. A microgamete enters a macrogamete to form a zygote that becomes a motile ookinete. Ookinetes pass through the midgut epithelium to form oocysts that grow, burst, and release sporozoites into the hemocoel (arrow from *3* to *4*).

4. Sporozoites are active, pass freely throughout body cavity, and concentrate in salivary glands where they can be introduced into blood of vertebrate in act of feeding.

Source: James, M.T., 1969.

and make the disease difficult to control. Because of the short development time of the mosquito from egg to adult (approximately one month) it is easy to understand how the number of mosquitoes can increase rapidly and the transmission of malaria succeed in areas where a suitable environment exists.

Susceptibility to malaria is universal, but sometimes the severity of the disease is lessened by partial immunity conveyed through previous infections. Adults in highly endemic areas may be more tolerant to the particular species of malaria transmitted in that area. Although the subject of resistance to malaria is far from complete, certain populations in Africa have been known to show partial resistance to the infection (particularly *Plasmodium vivax*). Additionally, the presence of the *sickle cell trait* in the negro race has been shown to be an evolutionary safeguard against malaria.

The conditions which contribute to the presence of malaria are widespread. Such conditions may be created or avoided by new development activities. These conditions include:

1. *A suitable breeding place for mosquitoes* (pools made by tire tracks, borrow pits, standing water around wells, seasonal ponds, irrigation canals and feeding reservoirs, rice paddies, depressions made by livestock, hoofprints, lakes created by dams, etc.);

2. *A resting place for newly emerged mosquitoes and mature adults* (small bushes, bamboo groves, houses, abandoned equipment, shade trees);

3. *An infected population* (adult residents, migrant workers, immigrants, travellers, construction workers);

4. A susceptible and exposed population (resident children and adults, migrant workers, construction workers);

5. A suitable air temperature and altitude (Anopheline mosquitoes do not breed well above 1610 meters or 37° C).

The impact of malaria on development has been discussed a great deal.[3] Although a satisfactory cure exists for malaria, control is preferred if possible. For example, a reduction in the amount of standing water by proper drainage facilities may reduce the size and number of breeding sites and thereby limit the mosquito population and consequently control the transmission of the disease. It should be noted that not every pool can be eliminated, but those that do occur can be identified, and if treated with appropriate chemicals or drained periodically to eliminate mosquito larvae, reduce the mosquito population. It is important to remember that it is not necessary to kill every mosquito to control malaria, but only decrease the numbers of mosquitoes in the area below a critical level at which transmission will not occur.

The regular use of malaria suppressive drugs (for example, chloroquine phosphate, nivaquine, pyrimethamine and primaquine) can do a great deal to reduce the severity of malaria in highly endemic areas. Furthermore, effective treatment for acute and chronic cases of malaria are available. Thus, malaria can also

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3. See Bibliography: 24, 116, 126, 129, 151, 163, 203, 213, 215, 247, 257, 271.

be controlled by decreasing the parasite load within the human population through the administration of prophylatic drugs.

Additionally, malaria can be controlled through the vector (Anopheline mosquitoes). The application of residual insecticides (chlorinated hydrocarbons such as DDT, dieldrin and benzene hexachloride) in suitable concentrations and practical applications inside the walls of dwellings or other surfaces upon which a mosquito rests, can do a great deal to control the vector. These compounds must be applied carefully so they do not contaminate water supplies. However, before control plans are carried out against the vector, an investigation into the ecology of the disease needs to be performed and a prediction of the potential runoff of these highly toxic chemicals should be carried out. In the long-run, this type of preventive investigation will not only save money but also protect the environment from unnecessary contamination and improve the efficiency of long-term control efforts.

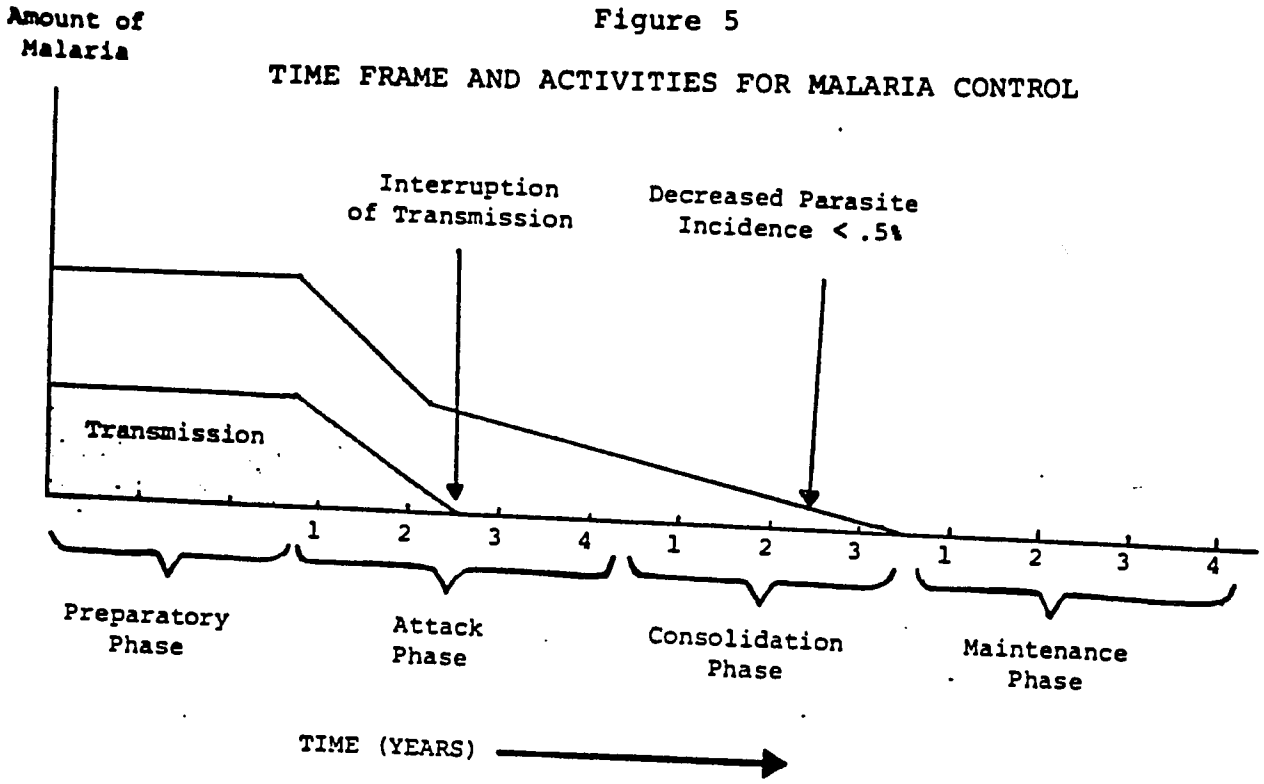
The transmission of malaria may also be decreased by installing screens in living quarters and using bed nets in endemic areas. Insect repellents can be used as well. The sanitary improvements which result from a development scheme can also do a great deal to decrease the abundance of standing water which serves as a primary breeding habitat for the mosquito vector. Larvicides (such as oil and Paris Green) can also be

used when spraying adulticides is difficult. Hydrocarbons are not recommended as larvicides since they may contaminate the water supply. However, organo-phosphorus compounds such as temephos (Abate) or fenthion may be of value. It is important to remember that the effectiveness of larviciding varies with a particular vector, the habitat, and the logistical capability available in the project area.

The control of malaria cannot occur overnight. It is process that must be pursued over a long time period. All project personnel should be aware of the status of malaria and the control possibilities in their respective countries and particularly in their project area. Before a new project is implemented in an area, the feasibility of the various malaria control measures should be assessed and plans made for implementing them. Figure 5 illustrates the ideal time frame and activities for malaria control. A brief explanation accompanies the figure.

Figure 5

TIME FRAME AND ACTIVITIES FOR MALARIA CONTROL



1. Preparatory Phase: This is the initial step in malaria control/eradication. It involves determining the geographic limits of the disease, the number of people infected and susceptible and the behavior of the mosquitos.

2. Attack Phase: This phase involves the attack on the mosquito at all points. Larvae and adult mosquitos are sprayed with chemicals to drastically decrease the population of mosquitos. Breeding habitats previously identified are destroyed if they are artificial. The goal of this phase is to break the transmission cycle. It can last from 2-5 years depending on the size of the geographical area attacked.

3. Consolidation Phase: This phase follows the attack phase and is directed at eliminating all remaining pockets of the disease. It involves a house-by-house investigation to identify infected people and treat them with antimalarial drugs. Any mosquito breeding sites remaining will also be eliminated during the phase.

4. Maintenance Phase: This is the final phase and it is most crucial to the entire eradication/control plan. Long-term monitoring of the area must be carried out for a period of 10-15 years. Monitoring the prevalence[9] and incidence[9] in the human population as well as the population of the vector is essential. If this phase is abandoned too early, a relapse may occur and malaria will return.

Source: James. M.T., 1969.

REVIEW OF MALARIA

DISEASE:	Malaria
AGENT:	Plasmodium species (protozoa: P. falciparum, P. vivax, P. malariae, P. ovale)
VECTOR:	Anopheline Mosquitos (Anopheles gambiae, A. funestus)
MODE OF TRANSMISSION:	By bite of infected female mosquito.
SYMPTOMS:	Fever and chills:
	Benign tertian malaria - fever recurs every 48 hours (P. vivax, P. ovale)
	Malignant tertian malaria - fever recurs 48 hours (P. falciparum)
	Quartan malaria - fever recurs every 72 hours (P. malariae)
TIME OF ONSET:	10-30 days (bite to symptoms)
GROUPS AT RISK:	Young children, adults (males and females equally exposed)
PREVENTION:	Chemical insecticides* (sprayed in dwelling and other adult resting sites)
	Chlorinated hydrocarbons - DDT, benzene hexachloride, dieldrin (be aware of vector resistance)
	Carbamate compounds - propoxur
	Organophosphates - malathion, fenitrothion
	Screens - in living and sleeping quarters
	Repellents** - diethyltoluamide, dimethylphthalate, 2-ethylhexane-diol, 1, 3 (612 repellent)

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* In all chemical applications be aware of toxicity of chemicals and keep drinking water free from contamination with insecticide.

** Repellents must be applied repeatedly and are often very expensive.

PREVENTION:	(cont.)	Sanitary improvement - filling holes left by construction proper drainage for water, health education to identify man-made breeding sites (tires, pots, hoof prints, etc.) Larvicides - oil, Paris Green, temephos (Abate), Fenthion Larva-eating fish - minnows (*Gambusia* or *Tilapia species*)
CURE:		Nivaquine, Chloroquine phosphate (Aralen); quinine sulphate; pyrimethamine (Daraprim); primaquine phosphate

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NOTE: Effectiveness of each of the preventions above depends on the species of vector present in the area.

Schistosomiasis (Bilharzia)

Over 200 million people are infected with schistosomiasis throughout the world. It occurs in the Sahel, North Africa, East Africa, Asia, Central and South America and the Caribbean. Although the disease is rarely fatal, it is extremely important throughout the developing world because it may decrease the infected individual's strength and ability to work.[1] Schistosomiasis is caused by a worm (genus Schistosoma). There are three species of the schistosome parasite which infect man (Schistosoma hematobium, S. mansoni, S. japonicum). S. hematobium and S. mansoni are both common in the Sahel. S. japonicum is found only in Asia.

Like malaria, schistosomiasis is directly related to development projects which involve water. It is a vector-borne disease. The vector for schistosomiasis is a small (3-15mm) fresh water snail which lives along the banks of lakes, slow moving rivers, drainage ditches and irrigation canals. Snails may be introduced into an area by migrating birds, by mud carried on vehicles and animals (both wild and domestic) which come to a water source to drink. The snail has the ability to reproduce rapidly if a suitable environment exists or if one is created. All it needs is slow moving water, suitable vegetation

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1. See Bibliography: 92, 112, 113, 125, 126, 157, 158, 160, 163.

(aquatic reeds, etc.) and a tolerable water temperature. Figure presents the transmission cycle of schistosomiasis.

A great deal has been written about the relationship between schistosomiasis and development.[2] Since the presence of the disease is often linked to water-related development activities, the prevention of water from becoming contaminated by human wastes can do a great deal to decrease the spread of infection. Children, who often use water sources as a source of drinking, waste disposal and recreation, play a particularly important role in the transmission of this disease. Women are also at high risk to infection because they wade into water to wash their clothes or collect water for drinking, cooking and bathing. Farmers, tending newly irrigated plots or watering their livestock, also wade into water and therefore increase their chances of becoming infected. Thus, schistosomiasis is very much associated with the daily activities of rural populations. Any development activity which creates the right set of conditions (standing water, and infected population, the snail vectors, and inadequate sanitation), can thereby contribute to the spread of this disease.

Although schistosomiasis represents an important public health problem on an humanitarian level, a strong case also

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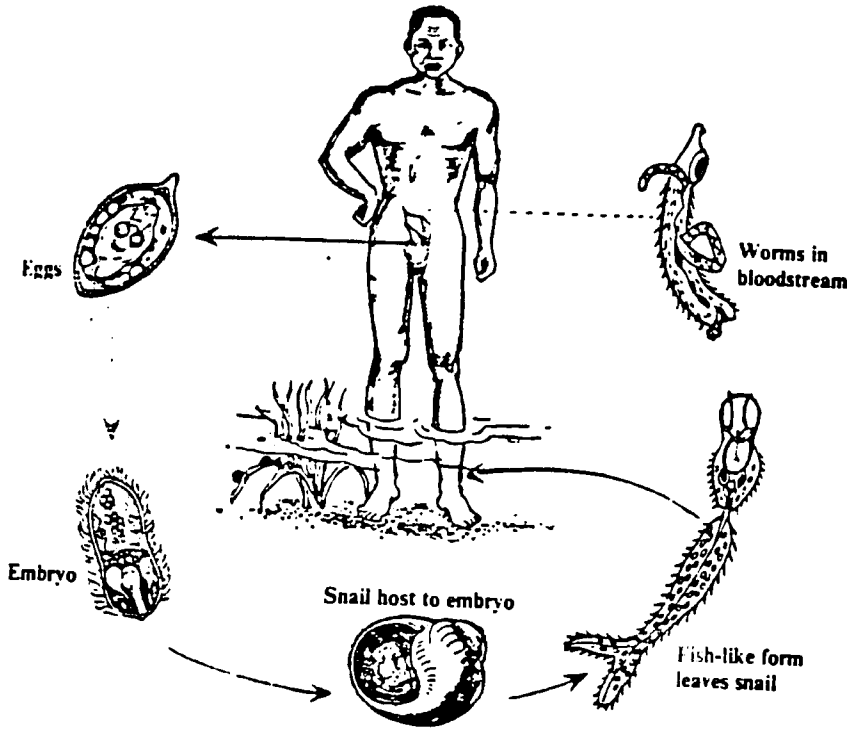
2. See Bibliography: 82, 83, 92, 95, 96, 107, 112, 113, 116, 126, 129, 152, 159, 163, 175, 176, 201, 221, 255, 265.

FIGURE 6

THE TRANSMISSION CYCLE OF SCHISTOSOMIASIS



1. Male and female adult worms are living in the veins of the urinary tract (S. hematobium) or in the veins of the intestine and liver (S. mansoni). They produce eggs.

2. The eggs are passed out in the urine (S. hematobium) or feces (S. mansoni) into water (rivers, lakes, irrigation canals, rice paddies, fish ponds). They hatch and are free-swimming organisms called embryos or mericidia.

3. The embryos penetrate a snail host (genus Bulinus, Planorbis, Biomphalaria) and multiply and grow in the snail.

4. The embryos mature to a fish-like form of larvae called a cercaria. These burst out from the snail into the water.

5. When humans enter the water to farm, wash their bodies, clothes or animals or play, the cercariae penetrate through the skin and enter the bloodstream. They grow and eventually mature in the veins of the urinary tract or intestine depending on the species.

Note: This parasite is very much associated with rural populations. Since rural people need water and often wade into water unprotected, they are at particular risk to infection. Poor sanitation increases the likelihood that eggs will be deposited in water and therefore contributes to the spread of schistosomiasis.

Source: Wyatt, G.B., 1973.

has been made which implies that this disease has little effect on an individual's production potential and lifespan. Schistosomiasis is often thought of as a disease that can be lived with. Recent evidence points to situations where individuals who are infected do not show any less ability to perform their daily tasks. It has also been said that the economic benefits of curing the disease do not justify the cost of control practices.

On a clinical level, this dilemma can be partially resolved. Severe cases of schistosomiasis can lead to enlarged livers and spleens (accompanied by eventual malfunction), high blood pressure in the veins from the intestine to the liver (portal hypertension), cancer of the colon, nutritional deficiencies and kidney disease. However, the vast majority of persons infected with schistosomiasis are not seriously ill. They may experience abdominal pain, some diarrhea and occasionally a recurring fever. The disease is often manifested in higher rates of absenteeism at work and in school, decreased vigor, lethargy, and general malaise. This decrease in the overall work potential of infected individuals represents the real and important threat to successful development posed by schistosomiasis.

Practically speaking, schistosomiasis can be controlled in a number of ways. Proper sanitary disposal so that the eggs

of the schistosome will not reach bodies of fresh water containing the intermediate hosts (snail) can do a great deal to decrease transmission. Health education can also help limit exposure to the disease. Improved water delivery can decrease transmission by limiting direct contact with contaminated water. There is no prophylaxis for schistosomiasis. Some specific drugs are available such as potassium antimony tartrate (tartar emetic), stibophen (fuadin), sodium antimony dimercaptosuccinate (astiban), hycanthone and niridazole (ambilhar). However, none of these treatments is entirely satisfactory. A number of them may produce severe toxic effects and some have been implicated as being mutagenic (i.e. some of these drugs may cause biochemical changes in the cell and affect their replication).

Since schistosomiasis is so prevalent in the region, it should be considered whenever any new water related development activities are being implemented. Its control will require intersectoral cooperation. Safe water delivery, improved methods of engineering, health education, medical treatments, and long-term surveillance of the transmission of the disease can help to limit its spread in the future. If the disease can be controlled, the likelihood of achieving increased productivity and regional food self-sufficiency by the year 2000 will be improved.

REVIEW OF SCHISTOSOMIASIS

DISEASE:	Schistosomiasis
AGENT:	Schistosoma sp. (Helminth; *Schistosoma mansoni*, *S. hematobium*)
VECTOR:	Fresh water snails (*Bulinus sp.*, *Planorbis sp.*)
MODE OF TRANSMISSION:	Penetration of skin by cercariae
SYMPTOMS:	Lack of vigor, general malaise, diarrhea with blood, enlarged liver and spleen, hepatic portal hypertension, shortness of breath
TIME OF ONSET:	Long, 6 months to five years
GROUP AT RISK:	Children, women, farmers
PREVENTION:	Education Lining canals with plastic or cement Using pipes for irrigation Proper waste disposal Fences around irrigation works and ponds Periodic flushing of canals with fast moving water Remove emergent vegetation by hand Molluscicides Filling up holes produced by construction
TREATMENT:*	Potassium antimony Tartrate Stibophen (Fuadin) Sodium antimony dimercaptosuccinate (Astiban) Hycanthone Niridazole

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None completely satisfactory -- side effects include nausea, vomiting, abdominal pain, anorexia, diarrhea, headache and dulled senses.

Onchocerciasis (River Blindness)

Onchocerciasis is a disease whose economic significance is as important as its public health significance. It is endemic to huge areas of the Sahel. Often areas with high agricultural potential are underutilized because of this disease. This has been the case in the Volta River Basin (Figure 7). Ochocerciasis is caused by a roundworm (genus; Onchocerca). Only one species of this parasite infects man (Onchocerca volvulus). The parasite is transmitted to man by the bite of a small blackfly (genus; Simulium), which lives and breeds close to swiftly moving water. Ochocerciasis, like malaria and schistosomiasis, has a definite link to water-related development activities.

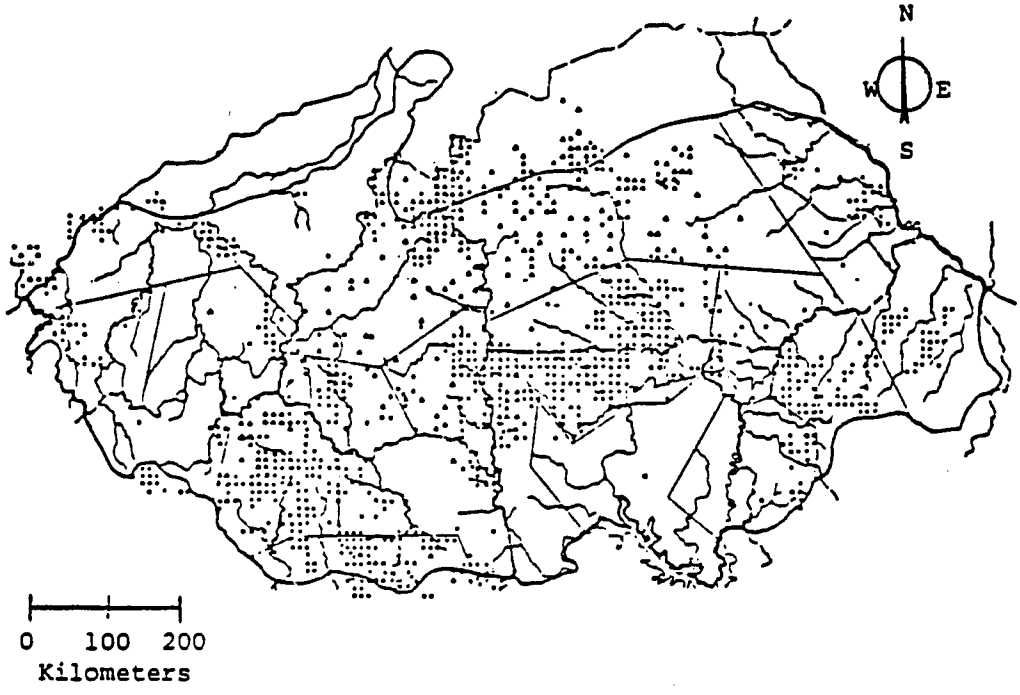
The disease was endemic in the Sahel when the ancient empires of Gao, Timbuktu, and Songhai flourished. It took hold in the fertile valleys of the Casamance, Senegal, Volta, and Niger Rivers. In those areas, the most common vectors of onchocerciasis in the Sahel (Simulium damnosum) reproduced successfully and established those areas as peak transmission sites. The small (1 mm) blackfly is an excellent flyer and a persistent feeder. Like the malaria-transmitting mosquito, only the female blackfly feeds on blood and is the vector for onchocerciasis.

When the female blackfly feeds, juvenile forms of the parasite are picked up from the skin of the infected person.

FIGURE 7

THE PREVALENCE OF ONCHOCERCIASIS

IN THE AREA OF THE VOLTA RIVER BASIN



Note: ▫ No infection
△ Sporadic Cases
○ Low endemicity
• Medium endemicity
● High endemicity

Source: W.H.O., 1976.

These immature forms are called microfilaria. This young form of the parasite must develop within the body of the female blackfly for 6-10 days to be infective to man. Since the female fly feeds many times during her lifetime, once she becomes infected and the parasites develop to the infective stage, the parasite can be transmitted when the female fly feeds again. Therefore, the parasite needs the fly to complete its development and to complete the transmission of the disease. In the Sahel up to 10% of the blackfly population is infected and since thousands of bites may be received by a person in one year, it is easy to see how the disease is maintained and spread. This fact, coupled with the fact that the vectors may fly over hundreds of square kilometers in their lifetime, represents a very difficult control problem for public health and other development personnel. Figure 8 illustrates the transmission cycle of onchocerciasis. The steps in this cycle are reviewed on the page following the figure.

The name "river blindness" predates the generic name onchocerciasis. Over three centuries ago, farmers in West Africa associated blindness with certain river systems and with certain blackflies.[1] Since that time, a great deal of work

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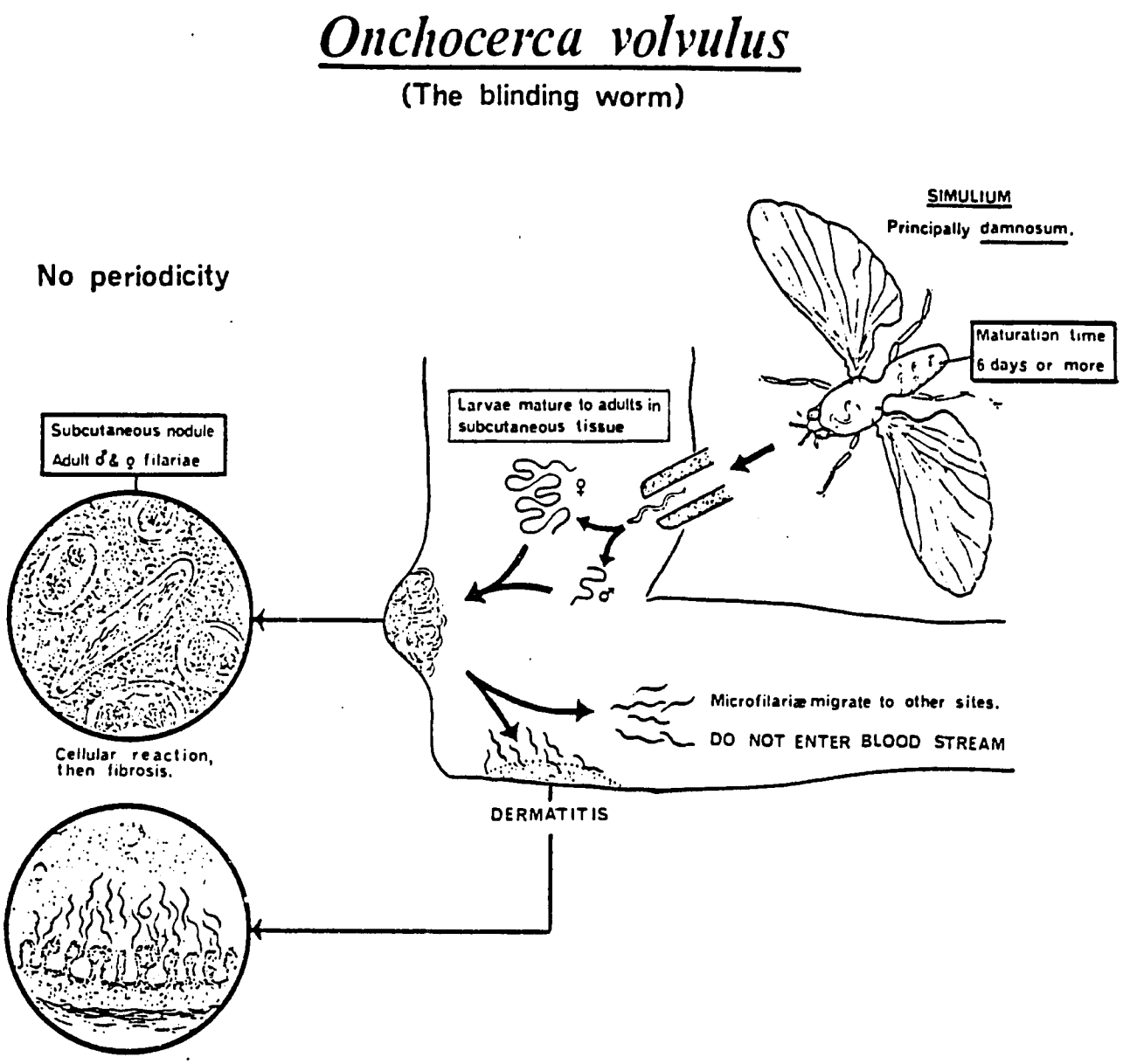
1. See Bibliography: 163.

FIGURE 8

THE TRANSMISSION CYCLE OF ONCHOCERCIASIS



Source: Jeffery, H.C., 1968.

TRANSMISSION CYCLE OF ONCHOCERCIASIS EXPLANATION

1. The blackflies (*Simulium damnosum*) breed in fast-moving water such as rivers, fast streams, dam spillways, etc. The female fly emerges from the water after a 60-day development period. She mates and begins to take the first of many bloodmeals she needs to develop her eggs. She prefers to feed on human blood.

2. Humans who have settled near swift moving water are at higher risk to the bite of the blackfly.

3. Often people go to a water source to get water for home use, wash their bodies, clothes and animals, or to play. They are then exposed to the bite of the fly. Blackflies bite the most between the hours of 10:00 a.m. and 2:00 p.m. Exposure at this time increases the risk to infection.

4. If an uninfected female fly feeds on an infected person, she may pick up some immature worms of *O. volvulus*. These worms go into the fly's stomach and penetrate the wall of the stomach. They move to the head of the fly while they are growing and maturing. They are ready to infect man within 10 days after developing in the fly.

5. When the female feeds again, she may transmit infective microfilaria to man. The worm will move through the skin for about one or two years while growing. Mature male and female worms will then meet and mate. They become stationary and a nodule (hard tissue) forms around them.

6. The female worm produces many live juvenile worms which move through the skin to be picked up by a blackfly.

7. The microfilaria may enter the eye and cause blindness or terrible itching of the skin.

8. Therefore, for onchocerciasis transmission, there must be: blackflies, a suitable breeding site, infected people, susceptible people, and an adequate amount of fly-man-fly contact.

has been done on the epidemiology and ecology of onchocerciasis.[2] In 1974 the United Nations, the Food and Agricultural Organization (FAO), and the International Bank for Reconstruction and Development (IBRD) initiated a 20 year program to control onchocerciasis in seven West African nations (Upper Volta, Mali, Niger, Ivory Coast, Ghana, Togo, and Benin). With the World Health Organization (WHO) as the executing agency the Onchocerciasis Control Program (OCP) was established. This effort is aimed at clearing vast areas of the Volta River basin of the vector (Similium damnosum) in order to allow resettlement.

The onchocerca parasite causes blindness in up to 10% of those infected.[3] Blindness is not caused directly by the adult worm, but rather by the first stage larvae (microfilaria) which the female worm produces. These larvae move through the upper layers of the skin and can also cause severe itching. They may sometimes collect in the lymphatic system and cause swelling around the genital area (a condition known as hanging groin). Pairs of adult worms often settle over joints and produce painful "calabar" swellings (referred to as nodules).

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2. See Bibliography: 155, 159, 179, 235, 238, 246, 248, 263.

3. See Bibliography: 226, 267.

Intense scratching of the skin often leaves severe secondary infections and a puritic rash. However, the most feared and severe consequences of this infection are total blindness or seriously impaired vision. Microfilariae often lodge in the cornea or optic nerve of the eye. After they have lodged in these tissues they are attacked by the body's defense (immune) system and it is thought that during this process the tissues of the cornea or optic nerve may be damaged. Damage to the optic nerve usually leads to total blindness in the affected eye. (The condition in the cornea may be reversed or stopped if it is diagnosed and treated quickly.) The way microfilaria get into the eye is not completely understood.

Susceptibility to onchocerciasis is universal. Re-infection may occur as long as exposure to the parasite is continued. The severity of the disease depends on the cumulative effects of exposure and intensity of infection. Treatment of onchocerciasis patients is difficult. Diethylcarbamazine (Hetrazan) is useful in appropriate doses but may cause severe skin reactions and sometimes death. Furthermore, Hetrazan does not kill the adult worm. Suramin (Naphuride or Antrypol) kills the adult worms and leads to a gradual disappearance of the microfilariae, but undesirable reactions may also occur and administration of this drug requires close medical supervision. Neither drug is suited for mass treatment.

It is generally agreed that the total eradication of the blackfly as a means to eradicate onchocerciasis is impossible.[4] However, it is important to think about how the blackfly population can be controlled in order to limit the spread and intensity of transmission. Water related projects often create excellent breeding habitats for the African blackflies. Therefore, structural amendments to the project design might be considered so the rate of water flow can be decreased and thus be unsuitable for Simulium development. The process of onochocerciasis control is long and expensive. Since the disease is so widespread in the Sahel, its relation to development activities cannot be ignored. Although the disease cannot be limited by mass treatment at present, alternative methods such as larviciding (killing the immature forms of the vector with a chemical applied to the water), health education, control and monitoring of immigration, protective clothing and biological control might be thought about in the future. Project officers might try to identify potential breeding sites for the flies and estimate how often people go to them for their water needs.

Development personnel should understand the potential their projects have to attract individuals infected with onchocerciasis and other diseases from other areas. Associating a health service with the project design, which would be capable of diagnosis

4. See Bibliography: 179, 238, 248, 271.

and partial treatment of this and other major tropical diseases, might prove to be very benefical. In addition, some of the control measures mentioned earlier can be organized and carried out at the village level by local residents trained as village health workers. It should be remembered that the onchocerciasis problem is a long-term problem. Every effort should be pursued to limit the spread of this disease in the future and thus optimize the opportunity for achieving regional food and economic self-sufficiency by the year 2000.

REVIEW OF ONCHOCERCIASIS

DISEASE:	Onchocerciasis
AGENT:	*Onchocera volvulus*
VECTOR:	Simuliidae (Blackflies) (*Simulium damnosum*, *S. neveai*)
MODE OF TRANSMISSION:	By the bite of an infected female blackfly
SYMPTOMS:	Nodules, blindness, visual impairment, itching of skin, hanging groin, secondary skin infection
TIME OF ONSET:	9 months to 2 years after bite of fly are required for female onchocerca to reach maturity; they live for 18 years and continue to produce microfilaria
GROUPS AT RISK:	Children, women, farmers
PREVENTION:	Chemical larvicides - temephos (Abate), aerial spraying, ground applications
	Avoidance of peak biting period (10:00 a.m.-2:00 p.m.)
	Clothing - shirt and trousers
	Controlled migration - screen immigrants to new area for infection
	Biological control - Gambusia, niad larvae, Dropsophila larvae
TREATMENT:	Diethylcarbamizine* (DEC) - microfilaricide
	Suramin* - adulticide

Both Surimin and DEC are toxic and the side effects make treatment dangerous.

Trypanosomiasis (Sleeping Sickness)

African trypanosomiasis (sleeping sickness) is caused by a protozoan parasite (genus, Trypanosoma) and is transmitted by the bite of an infected tsetse fly[1] (genus, Glossina). The disease has been present in Africa for centuries and it is particularly important because it is so widespread and is caused by a number of different species of the parasite. Two species attack man and others attack domestic animals. The disease is difficult to control because many wild animals act as reservoirs for human and animal parasites. (Reservoirs are animals which carry the trypanosoma parasite but do not get sick.)

Trypanosomiasis is found in large areas of West Africa and East Africa, and it is important both medically and ecologically. Development projects are directly related to trypanosomiasis because they may create conditions which increase its prevalence and contribute to its spread. The importation of infected tsetse flies to noninfested areas may occur when people travel along bus lines and highway systems, or move to different areas because of seasonal herding practices. The control or eradication of the disease carries with it the danger of overgrazing and desertification resulting from increased herd size due to the improved health and survivorship of livestock.

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1. "Tsetse" comes from the Sechuana langauge of the Bechuanaland and means "fly destructive to cattle."

The following discussion of the transmission and ecology of trypanosomiasis will be confined for the most part to West African trypanosomiasis which is common in the southern parts of the Sahel. (East African trypanosomiasis is caused by *Trypanosoma rhodesiense* and is more serious than the West African form. Wild animals are reservoirs for this disease and thus it presents more difficult control problems.)

In the Sahel, human trypanosomiasis is caused by *Trypanosoma gambiense*. The disease in livestock is caused by *T. brucei* and *T. evansi* among others. Both human and animal trypanosomiasis is transmitted by the bite of an infected tsetse fly.[2] Unlike malaria and onchocerciasis, which are transmitted by the bite of an infected female mosquito or blackfly, trypanosomiasis can be transmitted by either sex of the tsetse fly.

The tsetse fly is found over huge areas of Africa. These areas are called fly belts (areas where the flies live) and cover almost 400,000 square kilometers of land (figure 9).[3] The tsetse fly is a large fly (10 to 20mm) and a strong flyer.

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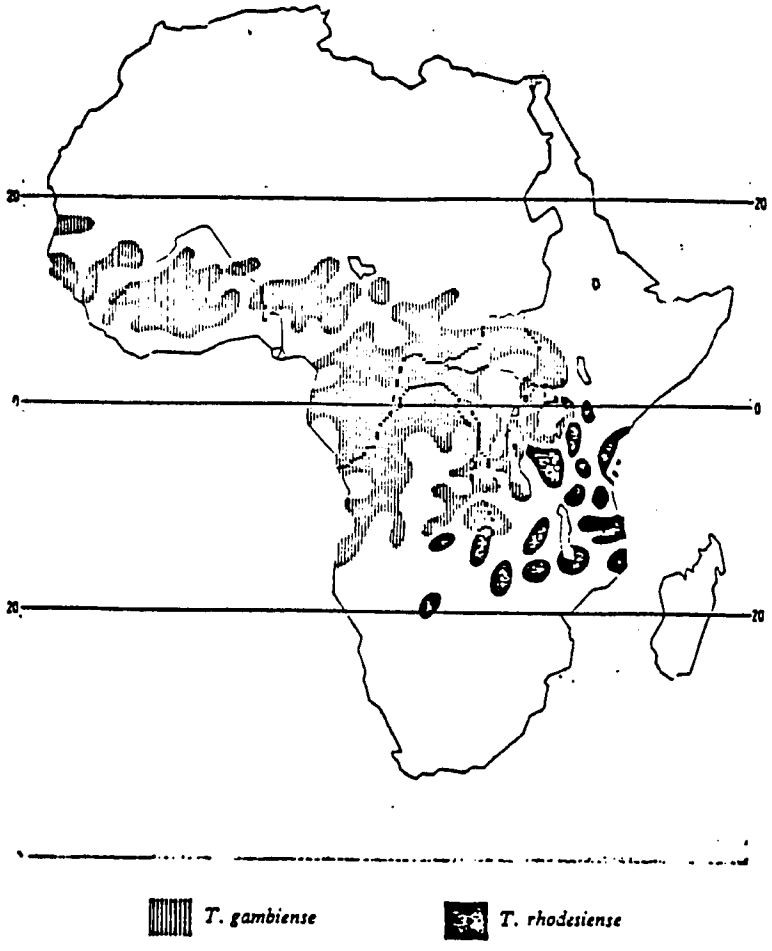
2. *T. evansi* is mechanically transmitted by Tabanid flies and bats.

3. See Bibliography: 228.

FIGURE 9

THE DISTRIBUTION OF HUMAN TRYPANOSOMIASIS

IN AFRICA



Source: Wilcocks, C., 1972.

A number of species transmit the trypanosome in West Africa, including Glossina palpalis, G. tachinoides, G. morsitans. Tsetse flies can be identified by the angle of their proboscis (feeding tube) and the characteristic pattern of the veins on their wings (a cleaver cell). They live and breed along shaded river banks and in shaded grasslands (savannahs). Like other disease vectors, they require a specific environment in order to reproduce. Glossina palpalis, the most widespread vector in West Africa, breeds in sandy soil along shaded waterways. After mating the female deposits living larvae (3/4 of her own size!) on to the ground. Unlike most other insects, who lay large numbers of eggs, the female tsetse fly produces only 8 - 10 larvae in her lifetime.

The fact that tsetse flies live and breed near permanent waterways or shaded grasslands is most important to the transmission of trypanosomiasis. This requirement greatly increases the chance of human-fly contact. Rural people use natural waterways a great deal. They wash, draw water, live and consistently travel along rivers and often graze their herds in the annual grasses of the West African savannah. Well travelled bridges across rivers and paths taken to nearby markets increase exposure to the bite of the tsetse and to trypanosomiasis. When new projects are being implemented in a trypanosomiasis endemic area

an investigation into the ecology of the transmission of trypanosomiasis should be considered. The location of tsetse breeding habitats, the frequency of human visitation, the number of people exposed and the number of flies in each area should be determined. In order to better understand the transmission of this disease, the transmission cycle of West African trypanosomiasis is presented in figure 10 . A brief explanation follows the figure.

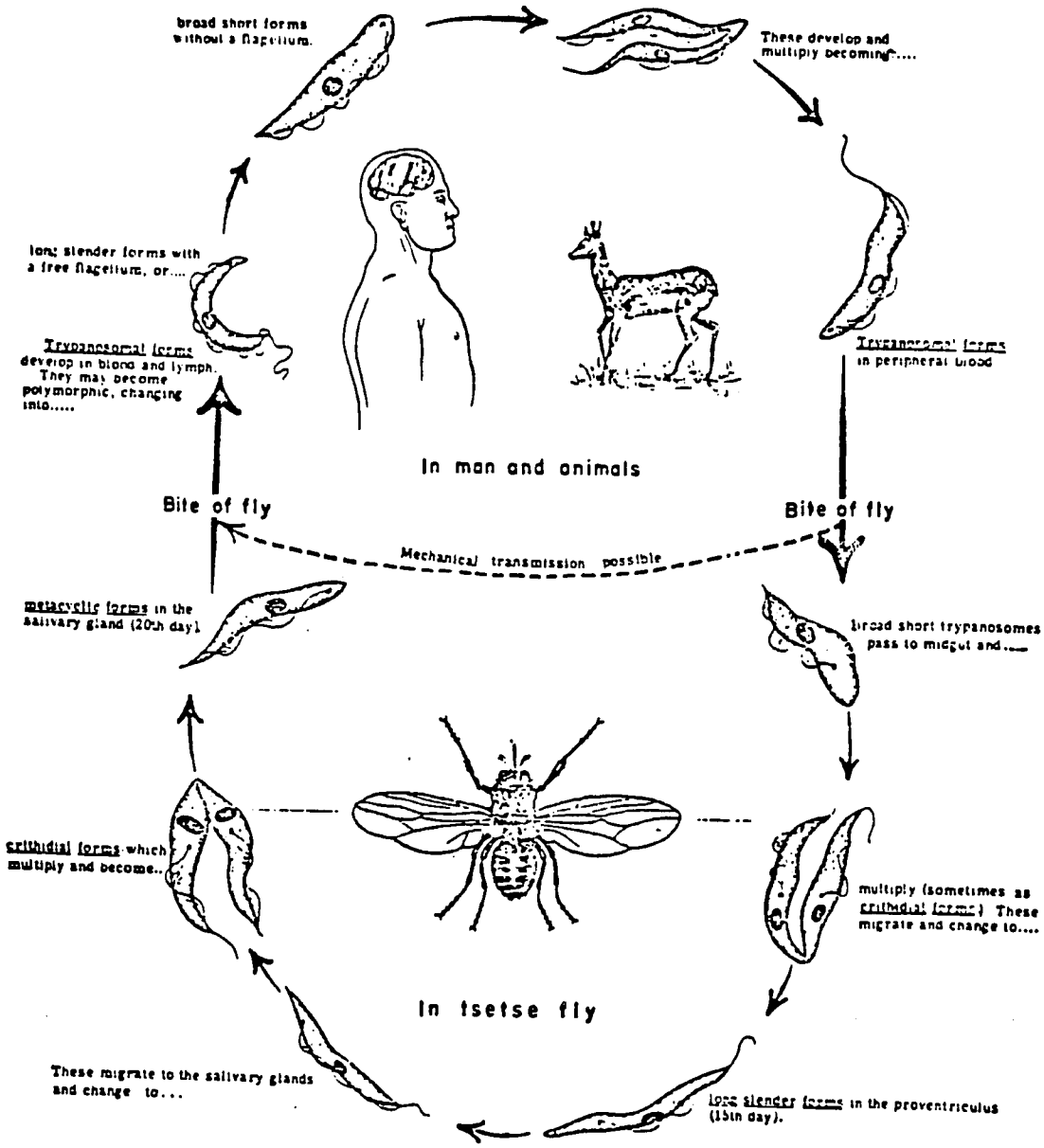
Many development activites can contribute to the spread of trypanosomiasis. Transport systems may increase the resident population in an area and thus increase the amount of man-fly contact. Resettlement schemes may attract people to areas where many flies exist and thus increase transmission. Rural populations are often closely associated with waterways and savannah grasslands and therefore may be at increased risk to infection. Herders may import cattle trypanosomiasis because of their seasonal movements and thereby decrease the economic benefit derived from marketing their livestock because of infection.

West African (Gambian) trypanosomiasis is a chronic disease which takes from 3 to 5 years to develop (at which time the disease is often far advanced and very serious). Damage to the brain and spinal cord is often irreversible and the victim may die a slow death often from starvation or infection due to his lowered resistance. When a person is bitten by an infected

FIGURE 10

THE TRANSMISSION CYCLE OF

AFRICAN TRYPANOSOMIASIS



Source: U.S. Navy, 1965.

EXPLANATION OF TRANSMISSION CYCLE OF WEST AFRICAN TRYPANOSOMIASIS

1. The female tsetse fly deposits her larvae in soft sandy soil usually found along river banks. She needs blood to develop the larvae and feeds on man preferably. The female tsetse must feed three times before she deposits each larvae. She can only produce 8-10 larvae in her lifetime. Once deposited by the female, the larvae burrow into the soft shaded soil to a depth of only a few centimeters. The larvae will die if they are exposed to the sun. After the larvae burrow they form a hard shell around them. They are now called pupae. This stage lasts for 3-4 weeks or longer depending on soil temperature. After this time the yound tsetse fly emerges and flies to a nearby bush to rest.

2. After resting, the flies seek blood. Since they are near a river, the chances are good that an animal or human will pass by. They will follow any moving object and will attack quickly. Their bite is very quick as well and the victim may experience pain and swelling after the bite.

3. The flies mate soon after they have emerged or found their first blood meal. They will then continue to feed for the remainder of their lives. Remember; both the male and female flies feed on blood. The flies feed during the daylight hours thereby increasing the chances that they will find food.

4. If a fly bites an individual infected with trypanosomisis, it will pick up the parasite in the blood. Less than 10% of the flies who pick up parasites become infected.

5. The parasites multiply in the gut of the fly and grow. They move to the head and are injected into a new victim in about 1 month. They need this time to develop and grow. Since the fly lives for 3-4 months it is able to transmit the parasite.

6. The parasites enter the blood of the victim and multiply there. They affect the brain and spinal cord and cause weakness and laziness. When they are circulating in the blood they may be picked up again by a biting tsetse fly.

tsetse fly little happens for a pericd of several days to a few weeks. Occasionally there will be a swelling, redness and pain at the site of a bite, but this soon disappears. At the end of a few weeks, the trypanosomes will begin to multiply in the bloodstream. At this time, the parasites may die out or, if the person is susceptible, they may begin to take a stronger hold. If they do take a stronger hold, a fever will occur and the individual will feel nauseous and have aches and pains throughout his body. This condition will last about one week. During the fever period, the glands at the base of the neck may swell. This is a diagnostic sign for trypanosomiasis and is called Winterbottom's sign. Even after the fever and general malaise have occurred, the parasite may die out at any time without infecting the nervous system. However, if a person gets weaker and increasingly lazy, nervous involvement is likely. Increased apathy, weakness, confusion, the loss of appetite, muscles tremors and the loss of muscular control in the face, lips and fingers may occur from 6 months to 1 year after the first symptom is seen. The final stages of the disease may give rise to changes in character, mental deterioration, coma and death. When trypanosomiasis is suspected, every effort should be made to have it properly diagnosed, by examination of the blood, and then treated. If the infection is diagnosed at the early stages, the potential for cure is good. However, if nervous

involvement has occurred, there is little that can be done for the victim.

Although fairly effective drugs exist for trypanosomiasis, there is no completely satisfactory treatment for the disease. Suramin and tryparsamide have been the standard drugs used in West Africa. Mel B (Arsobal) is also used, however, it is potentially toxic. Pentamidine is also effective and has been the drug most often used to stop epidemics. Due to the potential toxicity of these drugs used in treating trypanosomiasis, and the difficulty of mass treatment, prevention is easier than cure in areas where the disease is highly prevalent.

As a means of prevention, people might be educated about the transmission of the disease and they should be discouraged from frequenting breeding sites of the tsetse fly. Breeding sites might be cleared of scrub brush and exposed to direct rays of the sun to eliminate the fly before it emerges from the pupal stage. Flies might be caught by hand or insecticides sprayed on existing vegetation where the flies rest. People coming into the area might be checked for infection with trypanosomiasis in order to decrease the number of parasites which exist in the human population (this may also be done for livestock). Furthermore, animal reservoirs such as large game animals might be checked periodically and eliminated when feasible. These

prevention schemes are not simple and require substantial investments of time, money and manpower.

Another facet of trypanosomiasis involves its role in livestock development. Livestock has played and continues to play an important role in ecology of the Sahel. Susceptible animals exposed to infected tsetse flies (the same kind of fly that transmits human trypanosomiasis) may die in one year from an animal trypanosome. This disease is called nagana and presents a serious threat to livestock development in the southern portions of the Sahel. If livestock become sick, they often lose weight and therefore their value on the market decreases. This lowers the economic security of the herder and can cause serious problems for pastoralists throughout the region. Thus, trypanosomiasis is not only an important human disease, it also plays an important role in livestock development in the Sahel and the economic security of pastoralists throughout the region.

In the future, efforts should be made to control and/or prevent trypanosomiasis whenever possible. Development personnel must be aware that their activities can increase the transmission of this disease and create both public health and economic problems.

REVIEW OF TRYPANOSOMIASIS

DISEASE:	Gambian Trypanosomiasis, Nagana
AGENT:	*Trypanosoma gambiense*, *T. brucei*, *T. vivax*
VECTOR:	Tsetse flies (*Glossina sp.*)
MODE OF TRANSMISSION:	By the bite of infected tsetse fly
SYMPTOMS:	Acute: muscle ache, fever, abdominal pain, diarrhea, weakness
	Chronic: extreme weakness, fever, headache, muscle spasms, discoordination, laziness, personality change, loss of appetite, coma
TIME OF ONSET:	Acute: short, 3 months - 1 year
	Chronic: longer, 1 year - 3 years
GROUPS AT RISK:	Children, women, herders, farmers
PREVENTION:	Education Exposing breeding sites to direct sunlight Catching flies by hand Spraying insecticides at breeding sites Control and screening of immigrants Identification of existing and potential breeding sites Burning of savannas Elimination of reservoir animals
TREATMENT:*	Suramin Tryparsamide Mel B (Arsobal) Mel W Pentamidine

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* Drugs are successful but may produce severe toxic side effects.

Dracontiasis (Guinea worm infection)

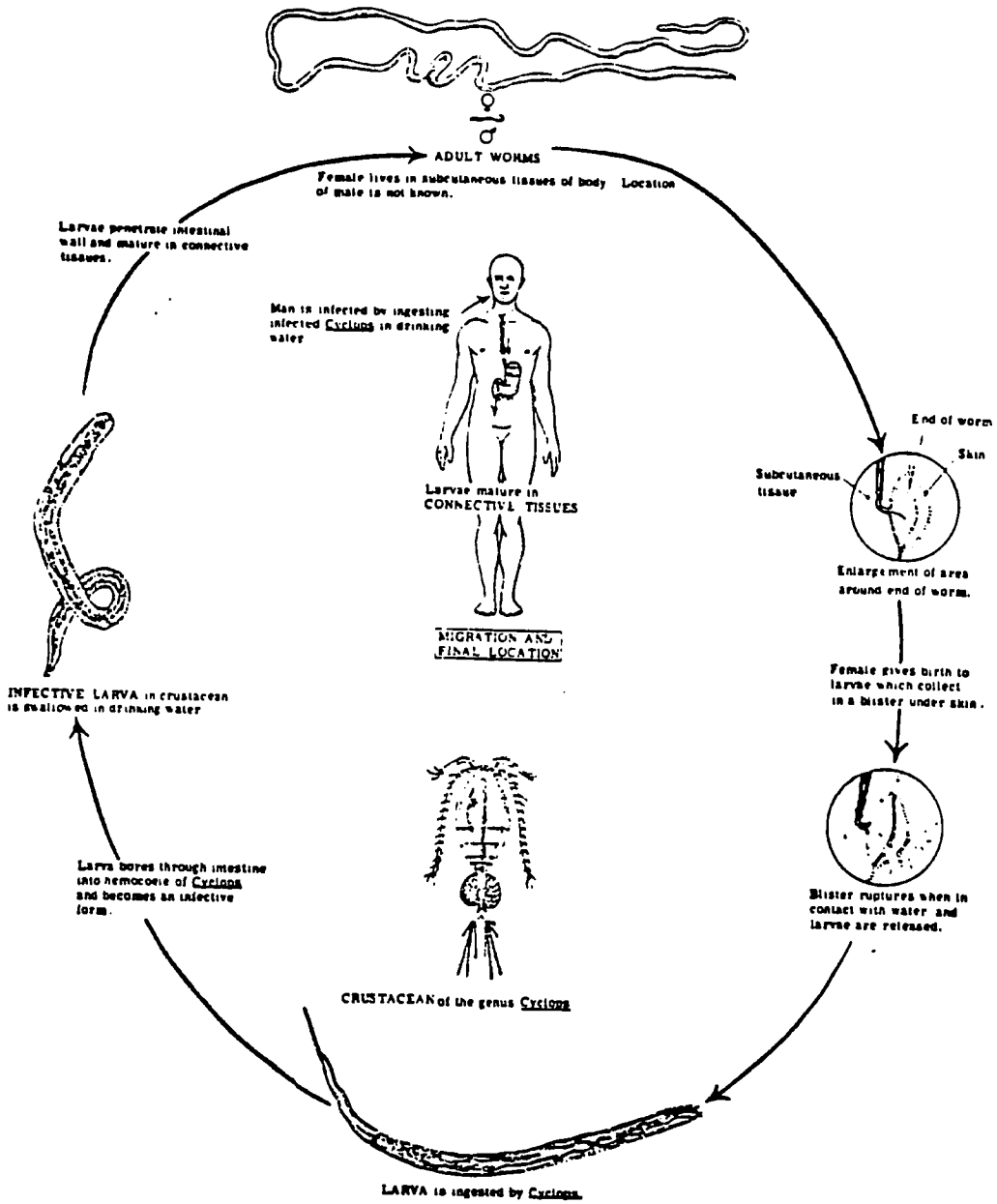
Dracontiasis or guinea worm infection is found in Africa (particularly in the Sahel), India, and parts of Latin America. The parasite which causes guinea worm infection is called Dracunculus medinensis. This disease is very closely associated with a number of development projects, because it is transmitted by drinking water containing the immature form of the parasite. Open pools, into which people must wade in order to obtain water, are ideal environments from which this parasite may be transmitted.

The transmission cycle of the guinea worm is complex (see figure 11). It requires a secondary (or intermediate) host. This host is a small crustacean called a Cyclops, which lives and multiplies in standing water. The person infected with guinea-worm may show a blister or swelling on any limb (usually the lower legs and feet). When this individual goes into the water, the blister may burst and the female guinea worm will then deposit her young into the water. These small immature worms (called larvae) move around quickly and attract the Cyclops which eats the larvae. However, the larvae do not die. When eaten by the Cyclops they develop into a form which is infective to human beings. This development takes between 4 and 6 weeks to occur. After people drink water containing the Cyclops infected with guinea worm larvae, the worms break out of the

FIGURE 11

TRANSMISSION CYCLE OF DRACONTIASIS

(GUINEA WORM INFECTION)



Source: U.S. Navy, 1968.

Cyclops as it is digested. They penetrate the stomach wall of man and move into the lymphatic channels. They then mature in the body of the human being for approximately 4 months. After this time, male and female worms mate and the male dies. The total process from immature to adult forms takes approximately 6 months to 1 year for the female and the majority of this development time takes place in the lower layers of the skin. The female is then ready to give birth to her young.

After development is complete, the female worm migrates through the lower layers of the skin to the arms, legs or feet of the infected person. When she is ready to lay her larvae, she pushes up to the upper surface of the skin and forms a blister by secreting a chemical to break down the skin. When the infected person goes into water, the female worm breaks through the blister and lays her larvae into the water. These are then eaten by the crustacean (Cyclops) and the life cycle continues. It takes from 15 to 20 days for the female to complete her deposition of larvae into the water.

There is no successful treatment for guinea worm. However, the use of diethylcarbamazine (Hetrazan) has been used for treatment and prophylaxis. (It should be remembered that the use of this drug may cause undesired side effects.) Another drug, niridazole (Ambilhar) has been introduced for the treatment of guinea worm. This drug acts against the adult worm and

should be administered in doses of 20 to 25 milligrams per kilogram per day for 7 to 10 days. It too has side effects and needs to be administered under medical supervision.

The prevention of guinea worm is primarily a question of protecting drinking water from pollution by persons infected with guinea worm. The crustacean (Cyclops) can be killed by raising the temperature of the water a few degrees, but providing villages with a small portable heating device which would heat the water periodically to kill these crustaceans is really not feasible. Alternatively, the addition of a trace of potash to the water can be equally effective. If the area from which guinea worm is being transmitted is large, a certain type of fish (Barbus puckelli) which feed very heavily upon Cyclops might be introduced. Finally, standing water sources might be treated every two weeks with a chlorine solution (i.e., that commonly used in bleaching powder), although people might dislike the taste and seek new (and possibly contaminated) sources of drinking water.

REVIEW OF DRANCONTIASIS

DISEASE:	Dracontiasis (guinea worm)
AGENT:	*Dracunculus medinensis*
VECTOR:	Small crustacean (*Cyclops*)
MODE OF TRANSMISSION:	By drinking water contaminated with the guinea worm parasite containing *Cyclops* which have ingested the immature form of guinea worm.
SYMPTOMS:	Swelling and redness of the lower leg and feet, blister or blisters on the limbs, the emerging of the female worm from the blister.
TIME OF ONSET:	One year (period from ingesting infected *Cyclops* to the emergence of the adult female worm).
GROUP AT RISK:	All individuals drinking from a contaminated source.
PREVENTION:	Education Elevating temperature of water Biological control via fish in water source (*Barbus puckelli*). Water treatment
TREATMENT:*	Diethylcarbamizine (Hetrazan) Niridazole (Ambilhar)

*Note: These drugs may cause severe side effects and should be used cautiously. It should be remembered that these drugs are not totally effective against guinea worm infection.

Dysenteries (diarrheal diseases)

The word dysentery is most often associated with diarrhea. Diarrhea simply means frequent passage of soft or watery feces. The dangers associated with dysentery are very important and include dehydration, intestinal malabsorption, and the malfunction of muscles (due to an imbalance of salts in the body created by dehydration). These diseases are sometimes called filth diseases and are very common when sanitation is poor and population densities are high. Additionally, flies help to spread these diseases by mechanically carrying the disease agents to food. The spread of dysenteries is usually due to the consumption of food or water contaminated with feces or vomit from infected individuals. Dysenteries are most serious in infants because infants are easily dehydrated and can die very quickly if not rehydrated continuously during the time when they are infected.

Dysenteries may be caused by a number of organisms. Chronic diarrhea (the major symptom) might be caused by bacteria, viruses, protozoa and worms.[1] The infected individual may often have one or more disease agents within his/her system at one time thus making the problem very serious and complex.

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1. Among infants and young children being weaned, diarrhea can also be caused by a change in diet and transition from milk to a variety of solid foods.

Table 2 presents an overview of the causes and mode of transmission of dysenteries in the Sahel.

The spread of dysenteries is primarily caused by the consumption of food or water contaminated with human wastes. Therefore, whenever a new project is implemented, and the attraction of large numbers of people is anticipated, a well designed and adequate sanitary waste disposal system and clean water supply should be considered. Additionally, the utilization of village health workers within the newly formed community can do a great deal to reduce the severity of dysenteries. These individuals can monitor the incidence of diarrhea and make an effort to assure the rehydration and treatment of those individuals who are seriously affected. Another method of controlling the spread and severity of dysenteries is to provide the people in a community with proper information about the transmission of these diseases, and feasible means to prevent their spread. Health education concerning personal hygiene and proper waste disposal can do a great deal to decrease the incidence of dysenteries. It would be particularly useful to inform young mothers about the transmission and prevention of these diseases and thus help to decrease infant mortality rates.

Since dysenteries are caused by so many agents, the potential to control them is both good and bad. The fact that many exist implies that many methods are available for control.

TABLE 2

THE ETIOLOGY AND MODE OF TRANSMISSION OF DYSENTERIES IN THE SAHEL

Agent	Disease	Classification	Mode of Transmission
Entamoeba histolytica	Amoebiasis	Protozoa	Food or water contaminated with feces from infected persons
Vibrio cholerae	Cholera	Bacteria	Food or water contaminated with feces, soiled hands, or flies
Salmonella typhi	Typhoid Fever (enteric fever)	Bacteria	Food or water contaminated with feces or urine of infected person
Shigella dysenteriae flexneri	Shigellosis	Bacteria	Food or water contaminated with feces from an infected person
70 nm Reovirus 27 nm Parvovirus	Infantile Diarrhea Viral Gastro-enteritis	Virus Virus	Unknown, possibly fecal-oral
Escherichia coli (enterotoxigenic strains)	Enteropathogenic Diarrhea	Bacteria	Food or water contaminated with feces from infected persons
Giardia lamblia	Giardiasis	Protozoa	Water or food contaminated by feces of infected person
*Ancylostoma duodenale**	Hookworm	Helminth	Skin penetration by larvae
*Ascaris lumbricoides**	Ascariasis	Helminth	Food contaminated with feces
*Strongyloides stercoralis**	Strongyloidiasis	Helminth	Food contaminated with feces
*Schistosoma mansoni**	Schistosomiasis	Helminth	Penetration by cercaria

* These organisms may cause some diarrhea, but are usually not the cause of severe dysenteries.

However, since so many do exist the scope of the problem is enormous. It might be useful to review Table 2 for the various types of organisms which cause dysentery. Note the mode of transmission (primarily food or water contaminated with feces from infected people). Then, think about the importance and feasibility of a sanitary system and the provision of clean drinking water in a newly formed community or project area. This is probably the most efficient and effective way to control dysenteries.

It should be noted that dysenteries should not be taken lightly. They cause a great deal of suffering and death, especially among infants and preschool children throughout the Sahel. Part of the problem of poor nutrition in the region is due to the fact that many of the youngsters are infected with these diarrheal diseases. It is important, therefore, that efforts be undertaken to control them.

Measles

Measles is a common and important disease in the Sahel. It is one of the most serious acute infectious diseases in Africa.[1] It is caused by the measles virus and is transmitted most commonly by droplet spread from nasal or throat secretions. In the past, there have been terrible epidemics of measles when the disease was introduced into a susceptible population. In West African epidemics up to 40% of infected children have been killed by measles. Usually about 5-10% of those infected die from the disease. Measles can be very deadly if it occurs at the same time as whooping cough (Pertussis--a bacterial infection). It may also reactivate tuberculosis in the infected person.

Measles attacks mostly young children between 1 1/2 and 2 1/2 years of age. It can be recognized by a rash and red, running eyes and it may also attack the mouth, throat, intestine and respiratory tract. Measles is most dangerous in areas where the food supply is low. The disease occurs mostly during the dry season when food is in short supply and children have a lowered resistance. Diarrhea may occur and thereby weaken the child even more. Sores on the mouth and in the throat may decrease the intake of food and cause malnutrition.

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1. See Bibliography: 231.

In the past, epidemics have occurred after holidays or religious festivals due to great congregations of people. Many customs have evolved to cure measles. In some parts of the Sahel local people do not feed an infected child and some forbid washing and the drinking of water. Purges are common and are thought to "flush out" the infection.[2]

There is no specific treatment for measles. It is important to maintain an adequate intake of food and fluid to resist malnutrition. The most effective defense against measles is immunization. A great deal of immunization has been done in the Sahel. Children should be vaccinated between the ages of 9 and 10 months. Some 15 million children have been vaccinated in West and Central Africa thus far.

Projects which may increase the population density of an area may also increase the risk to and incidence of measles. Since it affects almost all young children (up to 90%) it cannot be ignored. Development personnel should be aware of the immunization status of the people in their project area. If they anticipate a risk of a measles epidemic due to population concentration, every effort should be made to vaccinate the exposed population as soon as possible. This procedure is extremely cost effective since the vaccine is relatively in-

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2. See Bibliography: 218.

expensive (often free) and simple to administer. However, the vaccine must be refrigerated if it is to be transported. This represents a significant obstacle to effectiveness of immunization campaigns.

REVIEW OF MEASLES

DISEASE:	Measles (hard measles, rubeola, red measles)
AGENT:	Measles virus
VECTOR:	None
MODE OF TRANSMISSION:	By droplet spread or direct contact with nasal or throat secretions or urine of infected persons; less commonly air-borne, or by articles freshly soiled with secretions of nose and throat. One of the most easily transmitted communicable diseases
SYMPTOMS:	Slight fever, conjunctivitis, chest conjestion, a characteristic dusky-red blotchy rash appearing on the third to seventh day and lasting 4 to 6 days
TIME OF ONSET:	About 10 days, varying from 8 to 13 days
GROUPS AT RISK:	Mainly in children less than 2 years of age; occasionally from postinfectious encephalitis Measles is very severe among malnourished children (5 to 10% fatality rate); much more severe in adults
PREVENTION:	Vaccination (live attenuated measles virus vaccines are widely used and effective Education (encourage young mothers to have their children vaccinated)
TREATMENT:	No specific treatment available

Tuberculosis

Although tuberculosis has been reduced in much of Europe and North America, it is still prevalent in many parts of Africa, India, Southeast Asia and South America. In some parts of the world it is one of the most common fatal diseases. It has been estimated that 20 million people in the world are infected with tuberculosis. Every year more than 2 million new cases occur. Between 1 and 2 million people die each year from this disease.

Tuberculosis is caused by a bacteria (*Mycobacterium tuberculosis*). Cattle are infected with another species of the tuberculosis bacteria which can infect man by the ingestion of unboiled milk. Tuberculosis has historically been associated with crowded and unsanitary conditions. Malnutrition, occupational stress and other infections are usually associated with the more serious cases. In the late 1800's the United States had a large tuberculosis problem. The rapidly growing cities provided an excellent environment in which the bacteria could multiply and spread. It has also been associated with the movement of rural populations to urban centers today.

During the 1968-1974 drought and famine in the Sahel, thousands of families flocked to urban and rural centers in the hope of finding shelter and relief food. The makeshift relief centers did not provide adequate sanitary facilities and were

extremely overcrowded. Tuberculosis was a constant threat along with cholera, measles, dysenteries and pneumonia. For the most part, tuberculosis may be thought of as an urban or town disease. Lower infection rates have been recorded in rural areas (however, this may be due to the lack of valid surveys in remote rural areas).

The potential to spread tuberculosis is of great importance to development personnel. Any activity which brings people together increases the chances of spreading this bacteria. The tuberculosis bacteria live in the respiratory system. They are transmitted from one person to another by air (sneezing or coughing or spitting). Under unsanitary conditions, especially in crowded towns or even households, transmission is facilitated.

A person infected with tuberculosis takes from one to three months or many years to show symptoms. The bacteria may appear in the lungs, lymph glands, abdomen or spine and many other organs. The respiratory form is the most common. Clinical symptoms of the disease include fever and a loss of weight. The weight loss usually occurs in young children. By far the most common symptom of pulmonary tuberculosis is coughing. A long-lasting cough (more than 3 weeks) is a fair indication that tuberculosis may be present. Sputum may be watery at first and later turn yellow with pus. Blood in the sputum is not uncommon. Some victims have a shortness of breath or a pain in one side of

the chest. The tuberculosis bacteria may also attack the lymph glands in the neck or other parts of the body. The bacteria may also affect the spine and cause deformity in the later cases. The bacteria may also lodge in the abdomen causing general abdominal pain and swelling accompanied by fever and general malaise.

Satisfactory treatment exists for tuberculosis provided the strain of the bacteria is not resistant. The most commonly used antibiotics include streptomycin, sodium PAS (para-amino-salicylic acid), and Isoniazid. The cost of treatment is often high and this makes proper curative measures difficult.

The link between tuberculosis and development is a subtle one. The disease is present throughout urban centers in the developing world and will occur whenever people come together. Roads, irrigation systems, new land development, resettlement activities or any other activity which encourages people to congregate, increases the risk of spreading this disease. Development personnel should be familiar with the transmission and prevalence of tuberculosis in their project area and take measures to limit its spread.

REVIEW OF TUBERCULOSIS

DISEASE:	Tuberculosis
AGENT:	Bacteria: *Mycobacterium tuberculosis*
MODE OF TRANSMISSION:	By air, aerosol droplets in cough, sneeze, sputum
SYMPTOMS:	Pulmonary tuberculosis: cough, fever, general malaise, pain in chest Lymph gland tuberculosis: swelling of lymph glands, fever, pus from swelling gland, local pain Abdominal tuberculosis: general abdominal pain, fever, swelling of abdomen Spinal tuberculosis: back pain, cough, curvature of spine, deformity
TIME OF ONSET:	1 - 3 months
GROUPS AT RISK:	Children (less than 3 years), young adults, undernourished children, and adults
PREVENTION:	Improve social conditions decrease crowding health education improved sanitation Establish medical laboratories Public health personnel in rural areas (develop rural health care delivery system) Improve personal hygiene Boil milk Periodic X-ray screening Periodic tuberculosis testing
TREATMENT:	Isoniazid (3mg/kg) to 300 mg once daily Streptomycin (1.0 gram daily by intramuscular injection) Sodium PAS (5-6 grams twice daily)

Pneumonia (Pneumococcal, other bacterial pneumonias, Mycoplasmal pneumonia).

Pneumococcal pneumonia is a rapidly occuring bacterial disease which is characterized by a sudden onset of a single shaking chill with fever, pain in the chest, and a rough cough which produces red colored sputum. Pneumococcal pneumonia is an important cause of death in infants and the aged. It usually affects the upper respiratory tract (bronchial tree) and before the widespread use of antibiotics, the fatality rate ranged from 20 to 40% of those infected. In the Sahel, the disease is very serious when it occurs since the availability of broad spectrum antibiotics is limited.

The disease occurs in all climates and all seasons. Direct diagnosis of the infectious agent (*Streptococcus pneumoniae*) can be made from the laboratory investigation of blood or specimens from the lower respiratory tract. There are approximately 32 types of pneumococci which cause pneumococcal pneumonia. Man is the reservoir of the bacteria and it is found in the upper respiratory tract of healthy persons throughout the world. The infection is spread by direct oral contact or indirectly through articles that are freshly soiled with discharges from the respiratory tract of infected persons. A high degree of person-to-person contact facilitates transmission,

thus indicating an important link to changes in population density which might be caused by development activities.

Resistance to this infection is generally high, but it may be lowered by exposure to cold, a wet environment, by physical fatigue, alcoholism, a concurrent infection or poor nutrition. The susceptibility to pneumonia is particularly high in undernourished children. Moderate to long-lasting immunity is conveyed by the specific form of the bacteria infecting the individual.

The disease can be treated quite easily through the administration of penicillin. However, prevention can also be achieved by the avoidance of crowded living quarters and unsanitary living conditions. Education concerning proper personal hygiene can also help to limit the spread of this disease.

There are a number of other bacterial pneumonias besides pneumococcal pneumonia. These also cause high fevers and other acute and chronic symptoms. They may be concurrent infections with viruses of the respiratory tract, particularly influenza. The distribution of other pneumonias is world wide and can be caused by a number of bacteria found in the mouth, nose and throat, such as Staphylococcus aureus, Klebsiella-pneumoniae, Haemophilus influenzae, and Streptococcus pyogenes. Like pneumococcal pneumonia, the reservoir is man and the infection

is spread by direct oral contact or through articles of clothing which are soiled with the discharges of infected persons. Resistance is likewise high except in persons suffering from other diseases or nutritional stress. Good personal hygiene and the avoidance of unsanitary conditions can do a great deal to prevent the spread of these infections. Broad spectrum antibiotics can be administered to treat the patient when these infections are diagnosed and can also be used, if available, as a prophylaxis.

Mycoplasmal pneumonia is an upper respiratory infection which sometimes progresses to bronchitis or pneumonia. The onset is gradual with the occurence of headache, malaise, cough, and chest pain. This disease is caused by a pleuro pneumonia-like organism (PPLO) called Mycoplasma pneumoniae. The reservoir is man and mode of transmission is probably by droplet inhalation or oral contact with articles freshly soiled with discharges from the nose and throat of infected persons. Like the other pneumonias, the resistence to the disease is good but if the person is in a weakened condition he may be susceptible. Preventive measures include the avoidance of crowding, unsanitary living and sleeping conditions, and health education.

The problem of pneumonias in the Sahel is very serious. Young children and the aged who are nutritionally stressed are at greatest risk to these infections. Therefore, every effort

should be made to protect the population associated with a particular development activity from exposure to this set of disease agents. Since a good treatment exists for pneumonia, whenever cases are suspected they should be reported to a local health official, diagnosed and treated appropriately. It should be emphasized once again that these diseases primarily affect the very young and the very old. Since these groups are the least likely to complain about sickness and those who might be most often overlooked, particular attention should be paid to these diseases and to the means which are available to limit their spread.

REVIEW OF PNEUMONIA

DISEASE:	Pneumonia (pneumococcal pneumonia)
AGENT:	Streptococcus pneumoniae (pneumococci of types 1 to 32) (mostly type 3)
VECTOR:	None
MODE OF TRANSMISSION:	By droplet spread; by direct oral contact; or indirectly through articles freshly soiled with respiratory discharges Person-to-person transmission is common
SYMPTOMS:	Single shaking chill with fever, pain in the chest, and cough producing "rusty" sputum. Difficulty in breathing may occur, as may vomiting and convulsions as primary manifestations
TIME OF ONSET:	Not well determined; believed to be 1 to 3 days
GROUPS AT RISK:	Infants and the aged primarily; those in a weakened or debilitated condition due to malnutrition or other infections
PREVENTION:	Avoid crowding in living quarters whenever possible Maintain surveillance of ill individuals to determine sources of infection Educate people as to the symptoms and the serious consequences of the infection Report all suspected cases to health clinics Provide adequate sanitary facilities so secondary infections do not occur
TREATMENT:	Penicillin intramuscularly; (oral penicillin V is effective in mild cases) Erythromycin Tetracyclines

Poliomyelitis (Infantile paralysis)

Poliomyelitis (polio) is a rapidly ocurring viral infection. It is caused by three types of poliovirus (types 1,2 and 3). The disease caused by this virus has various degrees of severity which range from inapparent infection to nonparalytic and paralytic disease. Polio occurs worldwide and is particularly important in the Sahel because many children have not yet been immunized against the infection. Symptoms include fever, headache, abdominal pain, general malaise and stiffness of the neck and back with or without paralysis.

The disease is spread by direct contact with throat secretions (sputum) or feces of infected persons through close association. Therefore, food contaminated with throat secretions or feces from infected individuals represents the primary mode of transmission. The virus enters the intestinal tract and then it may spread throughout the body and invade the central nervous system attacking motor nerve cells and causing paralysis. Paralysis most often occurs in the lower extremities. Polio is not always a fatal disease, but it is a debilitating one. The extent and site of paralysis depends upon the location of the virus in the nervous system (spinal cord and brain stem), and the amount of nerve cell destruction involved. Polio is characteristically a disease of children and adolescents; although all ages are

affected if they have not been immunized either naturally or artificially.[1] The seriousness of this disease increases with age.

The virus can be isolated by tissue cultures from feces or throat secretions early in the course of infection. The disease must be differentiated from other forms of nonbacterial meningitis, tuberculosis meningitis, brain abcess, leptospirosis, infectious mononucleosis, and the encephalitides. The onset of disease takes from 3 to 21 days to occur. The virus can be isolated in throat secretions as early as 36 hours from the period of infection and in the feces as early as 72 hours after infection. Before invading the central nervous system, the virus persists in the throat for approximately one week and in the feces for 3 to 6 weeks or longer. The virus can be transmitted most easily from 7 to 10 days before the onset of symptoms.

There is generally a wide range susceptibility to poliomyelitis, however, few people who are infected develop any type of paralysis. Immunity to the disease is long-lasting and follows both clinically recognizable and inapparent infection. Infants who are born to immune mothers have transient passive immunity. There is an increased susceptiblity to paralytic poliomyelitis in nonimmune pregnant women.

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1. Age-specific incidence depends on overall prevalence pattern and age at exposure.

This disease can be controlled by active immunization campaigns. The usual practice of immunization includes the administration of oral trivalent vaccines which will immunize the individual against all three types of the virus. The vaccine should be initially administered to all children between the ages of 6 to 8 months. If there is a threat of an epidemic, additional doses of the vaccine may be administered to suppress the spread of infection. Health education explaining the benefits of the immunization procedure can do a great deal to prevent the spread of polio in the Sahel. Obviously, a proper sanitation system in a community can also do a great deal to prevent its spread as can proper education in personal hygiene. Schools can be utilized to immunize children and thereby control the epidemic potential of this disease.

Whenever people are brought together, the risk of spreading polio through a nonimmune population is high. Therefore, every effort should be made to control the spread of this infection by proper health education methods, surveillance, improved and adequate sanitary facilities, potable water, and a widespread immunization program geared at immunizing those individuals at greatest risk (i.e. children and adolescents).

REVIEW OF POLIOMYELITIS

DISEASE:	Poliomyelitis (Infantile Paralysis)
AGENT:	Poliovirus types 1, 2 and 3
VECTOR:	None
MODE OF TRANSMISSION:	Direct contact with secretions from throat or feces of infected persons through close association
SYMPTOMS:	Fever, headache, gastrointestinal disturbance. Malaise and stiffness of neck and back with or without paralysis
TIME OF ONSET:	7 - 12 days on average with a range from 3 to 21 days
GROUPS AT RISK:	Characteristically a disease of children and adolescents; all ages are affected where artificial or natural immunity has not been acquired
PREVENTION:	Active immunization with trivalent vaccine administered orally or by injection accompanied by booster doses of vaccine in epidemic situations Education of the public as to the advantages of immunization and the severity of the disease Adequate spacial distribution of settlements to avoid crowding Educate people in personal hygiene Provide adequate water and sanitation facilities Provide medical centers in close proximity to population centers
TREATMENT:	No treatment available for advanced cases especially with paralytic complications

Trachoma

Trachoma has been associated with mankind for at least five thousand years. The armies of Egypt and Rome spread it, the Crusaders brought it to Europe (along with leprosy), the Spanish conquistadors carried it across the Atlantic, the Islamic armies took it to the far east and Napolean's army brought it to France in 1798 from the campaigns in North Africa.

Trachoma is caused by a bacteria (Chlamydia trachomatis). Although it is not confined to the tropics, it is more prevalent there than elsewhere. It is found wherever nutrition is poor, housing conditions unsatisfactory, people crowded, sanitation inadequate and pure drinking water scarce. The bacteria may be spread by dirt, dust or flies. It can be highly contagious. Under these conditions, the disease is contracted during the first few years of life in the home or in the schools. Adults are just as susceptible as children. WHO estimates that over 500 million people are infected worldwide. Flies are the major vehicle of transmission. When flies come in contact with the eye of an infected person they pick up the bacteria and can transmit it to another person when they again alight near the eye. The bacteria may also be spread by direct contact with liquid discharges from the eye of an infected person, discharges from the nose or material soiled with these discharges. More

women than men tend to be infected. This is not due to a greater susceptibility on the part of the female, but rather environmental or behavioral factors.

The infected person may or may not show symptoms. In many areas children are infected but show no signs and the infection soon dies out. If the infection does take hold a number of signs occur. After a five to ten day period, the infected person will have a swelling in one or both eyes accompanied by tearing. This may last for many months. The eye then becomes covered with many tiny blood vessels and vision is decreased. It then becomes cloudy and its tissues become hard and scarred. Finally, the eye becomes deformed and cannot be closed properly. Dust and other materials may enter the eye causing further damage. If the disease is diagnosed early, it may be treated with sulphonamides and antibiotics.

Development personnel should be aware of the disease and its dangerous effects. Whenever people come together there is a risk of spreading this disease. The risk is increased if many flies are present in the area. Case-finding facilities and treatment should be provided. Public education stressing improved personal hygiene and the disease's transmission would be valuable.

REVIEW OF TRACHOMA

DISEASE:	Trachoma
AGENT:	Bacteria: *Chlamydia trachomatis*
VECTOR:	Fly: (as a vehicle only - no development of bacteria)
MODE OF TRANSMISSION:	By direct contact with eye discharges Utensils soiled with eye discharges By mechanical transmission from fly contaminated by eye discharges
TIME OF ONSET:	Five-ten days or longer
PREVENTION:	Health education/personal hygiene Provision of diagnostic and treatment facilities Improved sanitation Encourage use of soap and water Epidemiological studies (house surveys, family contacts, etc.) Screen on houses/fly protection
TREATMENT:	Sulfomamides (USA) Broad spectrum antibiotics tetracyclines (oral or topical) erythromycin (oral or topical)

Cerebrospinal meningitis (meningitis, meningococcal infection)

Cerebrospinal meningitis (CSM) is endemic to the Sahel. Of the four existing strains of the parasite, one strain, Group A, is the agent found most often in the region. It is caused by a bacteria (*Neisseria meningitidis*). The disease is spread directly from person to person and does not require an intermediate host. It can be spread by infective discharges from the nose and throat. Most people do not show symptoms, making the diagnosis of this disease particularly difficult.

CSM usually affects children and the case fatality rate (the number of those infected who die) may be as high as 40% in those individuals who remain untreated. The World Health Organization in 1970 stated that approximately 10,000 cases of this disease occur in West Africa annually and that approximately 12% of those infected die. When symptoms occur they include fever, headache, nausea (often with vomiting), stiff neck, delirium and coma. These symptoms occur between 2 and 10 days after the person has been infected. The infection can be transmitted as long as the bacteria is present in discharges from the nose and throat. Susceptibility to infection is high, but clinical disease is low. Immunity of unknown duration follows both clinical and non-clinical infections.

The epidemiology of CSM is interesting. Most infections occur during the dry season when nights are cool and people

sleep inside their homes. The close physical contact which occurs during this season favors the spread of the infection. Additionally, the sand and dust stirred up and put into the air by the harmattan winds (which occur during the dry season) are also an important factor in carrying the bacteria through the air, thereby facilitating the spread of this disease. Since many development projects often tend to attract people to a new area, increased crowding may occur, and the spread of this infection may increase. However, it should be noted that this is a difficult disease to control because, as mentioned earlier, the cases are very difficult to diagnose.

A number of vaccines have been developed to immunize children against cerebrospinal meningitis. Although the effectiveness of these vaccines is still in question, the potential to control this disease in the future is good. Education in personal hygiene should be encouraged to avoid droplet infection. Penicillin can be used as a treatment of diagnosed and suspected cases.

REVIEW OF CEREBROSPINAL MENINGITIS

DISEASE:	Cerebrospinal meningitis
AGENT:	*Neisseria meningitides*
VECTOR:	None
MODE OF TRANSMISSION:	Close contact with secretions from nose and throat
SYMPTOMS:	Possibly none at all, fever, general malaise, headache, stiff neck, convulsions, altered consciousness
TIME OF ONSET:	3 - 4 days
GROUPS AT RISK:	Primarily children 1 to 3 years of age
PREVENTION:	Education/personal hygiene
	Avoidance of crowded conditions in schools, working places, living quarters
	Cleaning of clothing soiled with discharges from nose and throat
TREATMENT:	Penicillin, Ampicillin, Chloramphenicol

Syphilis and Gonorrhea

Syphilis

Syphilis is a disease that is caused by the spirochete *Treponema pallidum*. Spirochetes are small organisms, bacteria, that live within tissues of the skin, bone, nerves, heart and abdomen.

When we think of syphilis we usually think of a venereal disease transmitted by sexual intercourse. This is not entirely true. There are two forms of syphilis. Both are caused by the same organism but the symptoms and transmission cycles are different. One form is venereal syphilis and the other is non-venereal syphilis or endemic syphilis. Both are found all over the world. Endemic syphilis is particularly prevalent in the Sahel.

The association between syphilis and development is not clear. There are no obvious cause-effect relationships. Projects which tend to attract immigrants or promote part-time employment often increase the incidence of syphilis.

The venereal form of syphilis is subtle and takes time (3 weeks or more) to develop. Males infected with syphilis develop a painless and firm ulcer on the penis (called a chancre) about six weeks after they have had intercourse with an infected female. In the female, the *chancre* may be external and therefore obvious or internal and remain unnoticed. Thus, an infected

female may have the disease and may be transmitting it without knowing it.

Although the signs of infection may disappear within a short-time, untreated venereal syphilis may lie dormant for 2 to 30 years and then reappear in any organ of the body including the heart and brain. Blindness, insanity, crippling and heart failure may result from the untreated case. Approximately 10% of those exposed to the disease become infected. The disease can be effectively treated by penicillin.

Venereal syphilis is quite appropriately termed a social disease. It is distributed worldwide and survives particularly well within isolated populations. Various development activities may encourage the concentration of people and thus contribute to the spread of disease. It is important that development personnel be aware of the disease and monitor its prevalence when implementing large scale development projects.

A non-venereal form of syphilis also exists. It is transmitted by close contact with the infectious early lesions (sores) on the skin. This is usually accomplished by eating with contaminated utensils or using a towel contaminated with the spirochete. It is caused by the same organism that causes venereal syphilis, Treponema pallidum but is a different strain of organism. It is particularly common in the arid regions of

Africa particularly among the herding people. The disease causes severe skin lesions and attacks the bones of the arms and legs. It does not go into the brain or heart and is seldom fatal.

Health education and medical screening for early diagnosis are the most efficient forms of prevention. All suspected cases should be reported to local clinic for diagnosis and treatment to control the spread of the disease in the community.

Gonorrhea

Gonorrhea is probably the most prevalent venereal disease on earth. It is caused by the bacteria *Neisseria gonorrhoeae*. Its importance is increased by the fact that in many cases it causes no symptoms. This makes detection and control particularly difficult. Approximately 85% of the women and 15% of the men infected will carry and transmit the disease but have no symptoms.

In women, signs and symptoms when they occur include vaginal discharge, painful intercourse or pain in the lower abdomen. Fever may be present in serious infections. Untreated cases may result in internal scarring which may interfere with future pregnancies or cause sterility. In men, symptoms include a whitish discharge from the penis and a burning pain when urinating. Scar tissue may result from the infection and impede the flow of urine.

This disease should be considered when implementing development projects which encourage immigration, migrant labor or urbanization. Individuals coming into the area should be screened for this disease (and others) to maintain control. Public education is essential and the reporting of suspected cases should be encouraged.

REVIEW OF VENEREAL SYPHILIS

AGENT:	*Treponema pallidum*
VECTOR:	None
MODE OF TRANSMISSION:	By direct sexual contact
SYMPTOMS:	Primary lesion (chancre): 3-6 weeks after exposure on or near genitals, then disappears within 4-6 weeks Secondary lesion: Rash; appears on any part of the body about 12 months after the primary lesion has disappeared. Lesion will subside in 6-12 months Tertiary lesions: May involve nervous system (brain) heart and bone. May lead to insanity, blindness and heart failure
TIME OF ONSET:	Early: 3-6 weeks, primary chancre Moderate: 12 months, secondary lesions Late: 2-20 years; system involvement
GROUPS AT RISK:	Young adults: those particularly sexually active
PREVENTION:	Detection and treatment of recent contacts Health education: Parents, Pre-school children, secondary school children Improved sanitation and personal hygiene Improved economic conditions Increased community awareness of disease Screening of entire resident, immigrant and migrant population and treatment of those infected Provision of facilities to monitor the disease Encouragement of reporting of suspected cases to health authorities Control of Prostitution
TREATMENT:	Penicillin (about 2.4 million units in one dose for early, 3 million units for late) Oral tetracycline (for three days) Erythromycin

NON-VENEREAL SYPHILIS

AGENT:	*Treponema pallidum*
VECTOR:	None
MODE OF TRANSMISSION:	Contact with infectious lesions often by eating or drinking utensils and unsanitary conditions
SYMPTOMS:	Sore on skin; often first around mouth other lesions follow on trunk and folds of skin Inflammation of skin and along bones of legs and arms
TIME OF ONSET:	2 weeks - 3 months
GROUPS AT RISK:	All ages of poor population; particularly those people living in the drier areas of the world
PREVENTION:	Health education Improved sanitation and personal hygiene Improved economic condition Screening of people for the disease Encouragement of reporting of suspected cases
TREATMENT:	Penicillin (about 2.4 million units in one dose for early, 3 million units for late) Oral tetracycline (for three days) Erythromycin

REVIEW OF GONORRHEA

AGENT:	*Neisseria gonorrhoeae*
VECTOR:	None
MODE OF TRANSMISSION:	By contact with lesions of infected person through sexual contact
SYMPTOMS:	In males: White discharge from penis, painful urination In females: Vaginal discharge, painful intercourse or pain in lower abdomen
TIME OF ONSET:	2-10 days
GROUPS AT RISK:	Sexually active adults
PREVENTIVE:	Detection and treatment of recent contacts Health education Improved personal hygiene Better sanitary condition Screening of residents, migrants and immigrants in a town or village Availability of treatment Encouragement of reporting of suspected cases
TREATMENT:	Penicillin Tetracycline Trobicin

Yaws

Yaws is a disease that was very common at one time in the Sahel. Today however, the prevalence of the disease has greatly decreased and the incidence (the number of new cases per year) is also low. Yaws is caused by a spirochete (*Treponema pertenue*). It is in the same genus of organisms which cause syphilis. Yaws is a chronic disease which can be identified by open and wet lesions on the skin and destructive changes in the bone. It is found throughout the tropics, and it is particularly prevalent among lower social and economic groups. The disease occurs predominantly in children and the infection occurs more often in young male children than female children.

Yaws is spread by direct contact with the substance found in the open sores which form on the skin. After the initial exposure to the spirochete, symptoms take between 1 and 3 months to develop. The infection can be transmitted to other persons for a period of several years, however, this depends on whether the lesions which are present are still moist and producing the fluid which contains the infecting organism. There is no evidence so far that any particular group of people has resistance to this infection. However, once an individual is infected with yaws, an immunity does develop. This immunity also appears to protect the individual from syphilis.

There are a number of ways to control the infection in the human population. Promotion of health education, better sanitation (including the use of soap and water) and the improvement of socio-economic conditions over a period of years will reduce its spread. Periodic surveys to diagnose the prevalence of infection in human population may also help to decrease its spread. The treatment of yaws has been revolutionized by penicillin to which the early stages of the disease respond very well after a single injection. In situations in which the disease is very prevalent, mass treatment should be given, that is, all patients with active yaws should get a full dose of penicillin to clear them of the infection. Medical officers and other personnel such as the heads of villages or communities, should be alert to the possibility that yaws may be brought into an area when a new development project is implemented. Again, the provision of safe water supplies, soap and promotion of personal hygiene can help to control this disease.

REVIEW OF YAWS

DISEASE:	Yaws (Frambesia tropicia, Pian, Bouba, Parangi)
AGENT:	Treponema pertenue (a spirochete)
VECTOR:	None
MODE OF TRANSMISSION:	Principally by direct contact with the exudates of moist skin lesions of infected persons
SYMPTOMS:	Lesions of the skin, eruptions of papules (small reddened areas), distructive lesions of the skin and cartilage (gangosa)
TIME OF ONSET:	2 weeks to 3 months
GROUPS AT RISK:	People in the rural tropics and subtropics of the lowest socioeconomic status
PREVENTION:	Health education of the public about the disease Better sanitation incuding the recommendation of using liberal quantities of soap and water (i.e. improved personal hygiene) Improved socioeconomic conditions Provision of facilities for the early diagnosis and treatment of this disease
TREATMENT:	Penicillin

<u>Hepatitis A</u> (endemic hepatitis, endemic jaundice, infectious hepatitis, viral hepatitis type A)

Hepatitis A (infectious hepatitis) is found all over the world, but is especially prevalent in hot climates. It constitutes a great risk to non-immune immigrants that may come into an area because of a development project. This is particularly true in the Sahel. It may be associated with school systems and other institutions for children where sanitary facilities are poor.

The cause of infectious hepatitis is a virus which lives in the intestinal tract and is excreted in the feces of infected persons. It is therefore a disease that is closely associated with poor sanitation and contaminated water. Affected individuals may pass the organism in their urine, feces, or blood for several weeks after they have been infected. Man is the primary source of infection, although chimpanzees have been implicated as reservoirs.

Most individuals are susceptible to infectious hepatitis. Epidemics often evolve slowly and spread over wide geographic areas and last many months. The disease is most common among school age children and young adults. Infectious hepatitis is not easily diagnosed. It may be confused with jaundice caused from other diseases such as yellow fever, leptospirosis, relapsing fever, and malaria among others. Therefore, whenever

hepatitis is suspected, blood should be examined for the virus and serum should be taken to differentiate it from leptospirosis.

There is no satisfactory treatment for this disease. Infected individuals should not eat a great deal. The most important aspect in the prevention of infectious hepatitis is proper sanitation, particularly personal hygiene, the proper cleaning of kitchen utensils, and the control of flies which may serve as mechanical vectors for infection. If at all possible, a prophylactic dose of serum immuno-globulin (750 mg) can protect the individual for approximately 6 months.

Undoubtedly the best prophylactic measures are proper sanitation, personal hygiene and health education. If an outbreak of infectious hepatitis does occur in a newly developed area, the source of infection should be determined. Individuals within the community should be tested to see if their urine, fever or blood contain the virus, and water sources should be tested to see if they are being contaminated with human wastes.

REVIEW OF HEPATITIS A

DISEASE:	Hepatitis
AGENT:	Hepatitis virus (similar to enterovirus in size)
VECTOR:	None
MODE OF TRANSMISSION:	Person-to-person contact by fecal-oral route, contaminated water, milk, meats, salads, bakery goods
SYMPTOMS:	Fever, malaise, anorexia, nausea, abdominal discomfort and eventually janudice
TIME OF ONSET:	From 15 to 50 days with an average of 28 to 30 days (dose related)
GROUPS AT RISK:	Low socioeconomic groups in rural areas, school age children (especially those attending schools)
PREVENTION:	Educate the public toward the good of sanitation and personal hygiene with special emphasis on the sanitary disposal of feces Provision of adequate sanitary facilities Proper cleaning of kitchen utensils Delivery of clean water Administration of prophylatic dose of serum immuno-globulin (750 mg) (if feasible)
TREATMENT:	No specific treatment available

Nutrition in the Sahel (Current Status, Causes, Nutrition and Disease)

The CILSS' goal of regional food self-sufficiency by the year 2000 is ultimately aimed at improved nutritional status for the people of the Sahel. Indeed, at the present time, the scope of nutritional problems in the region is very great and as the population of the area continues to increase at a rapid rate (2.7%), serious food shortages are becoming more commonplace. Climate, inadequate knowledge of nutrition, poor distribution of food, and the prevalence of disease all contribute to undernutrition. It has been estimated that between 5 and 10% of the children in the Sahel under six years of age are acutely undernourished or chronically undernourished.[1]

Undernutrition, perhaps the most widespread health problem in the region, is caused by a number of factors, not the least of which is simply a lack of food. Scarce food supplies may result from natural causes such as the lack of rainfall and ensuing crop failures or man-made factors due to poor distribution systems or high market prices. Furthermore, undernutrition may occur because of a poor knowledge of nutrition and consequently poor eating habits, traditional beliefs which limit the consumption of nutritionally important foods, the improper use of existing foods, or the inability to cultivate new foods and

1. See Bibliography: 223.

prepare them in a nutritious fashion. The latter often comes into play when new foods are introduced into a community through agricultural extension efforts. Finally, undernutrition may be caused by infection. Various types of intestinal infections decrease the appetite and inhibit the absorption of nutrients into the intestine. Dehydration due to diarrhea may also prevent proper absorption of nutrients and therefore cause malnutrition.

Three major nutritional problems may be considered. They are: protein-calorie malnutrition, protein malnutrition, and deficiency syndromes. Protein-calorie malnutrition (PCM) is probably the most widespread nutritional problem in the region. This condition is caused by overall lack of food and may be recognized by a rapid or slow loss of body weight and retarded physical and mental growth. It is commonly called wasting or marasmus. This problem is most often seen in infants who receive an inadequate amount of maternal milk or those who are unable to assimilate their weaning food due to its indigestibility or the presence of infection.

Inappropriate feeding practices by mothers often provoke PCM. For example, there seems to be an increase in the number of young mothers who feed their children powdered milk rather than breast milk. Powdered milk has become a symbol of status in the developing world and therefore young mothers feel that it

is naturally a better food. Unfortunately, the milk is often diluted beyond the recommended ratio (of powder to water) and therefore the child gets less nutrients than he requires. Furthermore, the powdered milk is often diluted with contaminated water or placed in a contaminated container and therefore the infant may receive high doses of the disease-causing organisms. With the lack of refrigeration, bottled milk spoils rapidly and the consumption of spoiled milk may also cause digestive problems. Thus, the use of powdered milk in the Sahel can cause not only nutritional problems but disease problems as well.

Marasmus (wasting) often leaves the child with long-lasting physical problems. Limited growth of muscles, bone, and brain tissue often occurs. The problems associated with ignorance increase the risk to this condition. Even when a variety of foods is available, young mothers may not know what the best foods are for their children. They may give the child less food when indeed the child needs more food, or they may give it the wrong type of food thinking that they are helping the child but in fact doing more harm than good. These problems are linked to the traditional lifestyles of the people of the Sahel, and are also a function of a lack of nutrition education throughout the region.

The second nutritional problem in the Sahel is caused by a lack of protein. Since protein is needed for proper physical

and mental development, it is one of the most important nutrients for man. Protein malnutrition is commonly called kwashiorkor.[2] This condition usually occurs in children between the ages of 2 and 4 years. Protein malnutrition can be recognized by edema (swelling of the body due to fluid filling up the spaces in the skin), a swollen stomach, a reddish tint to the hair, spotty dermatitis (a peeling skin condition), and a generally non-responsive child. Protein malnutrition occurs in children between the ages of 2 and 4 years because this is time when the consumption of milk decreases and they begin to consume solid foods. If the child is unable to completely digest these new foods, or if it does not get enough of them, protein malnutrition is likely to occur. Therefore, the overall absorption of nutrients may be low and particularly low in protein. Protein malnutrition is less prevalent in the Sahel than protein-calorie malnutrition (marasmus) mainly because of the greater availability of ground nuts. However, it is still an important problem in the region. Illustrations of marasmus and kwashiorkor can be seen on the following page (Figure 12).

The third category of nutritional problems is the deficiency syndromes. These include vitamin A deficiency (Xerophthalmia or

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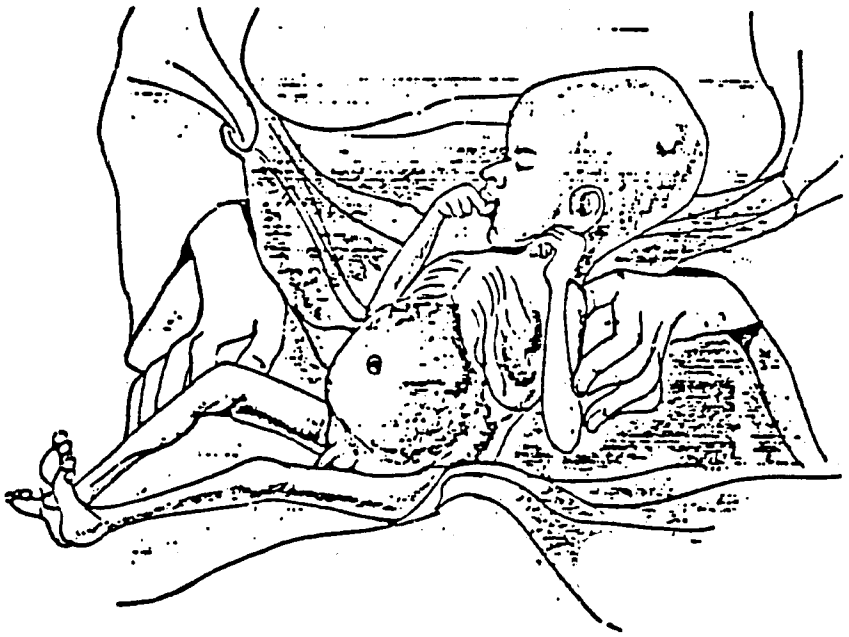
2. It should be noted that the condition of kwashiorkor can produce an increased susceptibility to disease. It has often been documented that a child with kwashiorkor, once rehabilitated, is very susceptible to communicable diseases such as measles, tuberculosis and other respiratory infections.

FIGURE 12

MARASMUS AND KWASHIORKOR



Marasmus: a very thin hungry baby.

Kwashiorkor: a miserable child with flaking skin, oedema of the feet, and discoloured hair.

night blindness), goitre (due to iodine deficiency), rickets or osteomalacia (due to a lack of vitamin D and an inadequate exposure to sunlight), scurvy, (due to a lack of vitamin C), pellagra (caused by an inadequate intake of niacin), and beriberi (due to a lack of thiamine). A number of nutritional anemias also occur which are caused by inadequate intake of iron, folate and vitamin B_{12}. These may lead to intestinal malabsorption and further nutritional stress due to the inadequate assimilation of nutrients.

Another important factor affecting nutritional status in the Sahel is the interaction between nutrition and disease, a phenomenon which has received much attention in the past.[3] The presence of an infection can provoke poor nutrition by decreasing the ability to absorb nutrients (this is particularly true when a person has intestinal infections). Conversely, poor nutrition can lead to increased susceptibility to many disease-causing organisms. For example, if infectious agents are introduced into an undernourished community by a development project, the risk of an epidemic may be high and the risk of greater severity of infection may also be high. On the other hand, if an infectious agent is introduced and spread because of increased contact between susceptibility and infected persons, those who become infected may show nutritional problems because their

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3. See Bibliography: 195, 197, 253.

appetite and their ability to digest and absorb nutrients are adversely affected.

The implications of the relationship between nutrition and infection need to be appreciated and taken into account by planners and field personnel. Development projects provoke changes among people and in the environment in which they live. These changes can lead to decreased availability of food and increased transmission of disease. Therefore, the potential exists for a decline in nutritional status and a concomitant shift in the pattern of disease. Together, these two factors can result in a poorer quality of life for the people who are the intended beneficiaries of development projects. Therefore, whenever new development projects are being implemented, the diets of local people should be monitored closely as well as the patterns of disease transmission. In the case of newly resettled populations, food subsidy should be provided for at least the first two years of the resettlement activity in order to protect resettled populations from nutritional stress. Infant feeding, weaning practices, and the seasonal availability of foods also need to be considered.

The problems involved with human nutrition in the Sahel are very complex. A great deal still needs to be learned about the dietary preferences and traditional cooking practices of many of the Sahelian peoples. Proper nutrition planning will be

a valuable component in any new development project, especially if the attraction of large numbers of people is anticipated. Additionally, the relationship between poor nutrition and the spread of disease is important to understand and every effort should be made to neutralize the adverse effects of poor nutrition as they relate to the spread of disease and to general health status. This might be done by providing clean water and proper waste disposal, health education (particularly maternal and child health), the monitoring of the prevalence of disease in newly formed communities, and monitoring the general nutritional status of the population in the project areas; paying particular attention to groups at particular risk (i.e. children, pregnant and lactating women).

Nutritional problems cannot be solved overnight. In order to improve nutritional status of the people in the Sahel, a collaborative and concerted effort by all development personnel is required. The future goals of sustained economic growth and regional self-sufficiency depend on the adequate supply of food throughout the region and the resulting improvement in the nutrition status of the Sahelian people.

Zoonotic Diseases (Anthrax, Brucellosis, Bovine Tuberculosis, Leptospirosis)

Zoonotic diseases are diseases which infect both man and animals. They are particularly important in the Sahel because of the great deal of association between man and animals in the region. Understandably, they are most directly linked to livestock development. Furthermore, they may play a significant role in the development of animal traction in the Sahel. The zoonoses discussed here are anthrax, brucellosis, bovine tuberculosis, and leptospirosis. These four disease are by no means the only zoonotic diseases present in the Sahel, but they are probably the most important.

Anthrax

Anthrax is caused by a bacteria (*Bacillus anthracis*). It is a disease that develops quickly and usually affects the skin, but it may rarely involve the lungs or the intestinal tract. Early stages of the infection are characterized by an intense itching of exposed skin surfaces which are then followed by a lesion (a raised pimple-like bump) which develops into a depressed blackened scab after approximately five days. Occasionally this scab is surrounded by moderate swelling. Pain is infrequent and if it is present, it is usually due to a secondary infection which has been contracted after the individual has been infected with anthrax. If the infection is left

untreated it may spread to the blood stream and infect the entire body. Untreated anthrax has a case fatality rate (the number of those infected who die) of between five and twenty percent, but with antibiotic therapy few deaths occur. The initial symptoms which occur directly after the anthrax bacillus has been inhaled are non-specific, and they resemble a common upper respiratory distress (difficuty in breathing), fever, and shock in three to five days after which death shortly follows. Diagnosis of anthrax depends on laboratory confirmation of organisms in the blood, lesions, or culturing the organism in mice, rabbits, or guinea pigs.

Anthrax is commonly an occupational hazard of those people who work in livestock processing plants. Infection may occur by direct contact of the skin with the spores of the bacillus, the inhalation of the spores, or the ingestion of contaminated, undercooked meat. There is no evidence that milk from infected animals transmits anthrax. The disease is difficult to control because the spores (which are the resting forms of the bacteria), remain viable in the environment for many years. They may be attached to animal hides or hair or may be carried by biting flies. Animals get the disease through contaminated soil or food or through eating meat in the case of carnivorous animals. Articles such as clothing, towels, or boots and gloves can become contaminated with spores and remain infective for many

years. There is little information about the susceptibility and resistance to anthrax, therefore, whenever livestock programs are being implemented, the possible presence and spread of this disease need to be taken into account.

Anthrax can be controlled in a number of ways. Education concerning personal cleanliness and in the way in which anthrax is transmitted is valuable. Taking care of skin cuts for employees handling hides and processing animals is also recommended. If people are working on processing meat indoors, efficient control of dust and proper ventilation should be provided. Additionally, all employees working in slaughterhouses (abattoirs) should receive periodic medical examinations and prompt medical care for all suspected cases. All skin lesions should be examined and cleansed immediately. The washing, disinfection or sterilization of hair, wool, hides and bone meal or other offal should be performed prior to processing. The hides of animals that are infected should not be sold nor should their carcasses be used as food or food supplements (either for animals or humans). Animals that are diagnosed as being infected with anthrax should be examined when they die and care should be taken not to contaminate soil or the surrounding environment with blood or infected tissues. The carcasses should be burned or deeply buried with calcium oxide (quicklime). All animals that are diagnosed as being infected with

anthrax should be treated with penicillin or tetracyclines if possible. Over the long term, annual vaccinations of animals for this disease might be considered.

Brucellosis

Brucellosis is a systemic disease with fast or slow onset. It is caused by the bacteria Brucella abortus. The disease is characterized by a continued irregular fever, headache, weakness, sweating, chills, depression, generalized malaise and aching pains. It may last for several days or several months and occasionally for several years. It may affect the bones. Most cases recover and the case fatality rate is about two percent. The disease can be diagnosed by isolating the causative organism from the blood, bone marrow, or other tissues of the patient.

Brucellosis is found all over the world. It is predominately an occupational disease of those individuals who work with animals, especially farm workers, veterinarians and people who work in slaughterhouses. Cattle, sheep, pigs, goats, and horses can carry this disease. Brucellosis is spread by contact with the tissues, blood, urine, and vaginal discharges of the infected animals. It also is caused by the ingestion of milk or dairy products (cheese) from these infected animals. Air-borne infection may occur among animals when they are put into pens and crowded together. The infection takes from 5 to 21 days to develop and occasionally much longer. There is no

evidence that the disease can be transmitted from man to man. Adults are most often affected since it is related to meat processing (and consequently most often males are infected). There is some evidence that immunity is aquired after infection but the duration of this immunity is still in question.

The best way to control brucellosis is to eliminate the infection among domestic animals. Farmers and workers in slaughterhouses can be educated about the transmission of brucellosis and a search for the infection in livestock should be recommended whenever new livestock development projects are being implemented. Immunization of calves is recommended only in areas where there is a high prevalence of infection. All milk and dairy products should be pasteurized and the boiling of milk is a practical and effective approach when pasteurization is impossible. Care should be recommended in the handling and disposal of discharges from animals and from aborted fetuses. Each should be inspected periodically, and carcasses which are infected should be burned.

The infection can be treated by tetracycline and the treatment may be enhanced by the addition of streptomycin in severely ill patients. Relapses can occur in about 5% of the patients treated and they should be treated again when this occurs. Whenever outbreaks occur, the vehicle of transmission

(usually unpasteurized milk or milk products from infected animals) should be identified.

Bovine tuberculosis

Bovine tuberculosis is very similar to human tuberculosis. It is an important cause of disability and death in many parts of the world. It is caused by a bacteria (*Mycobaterium bovis*) and is found in cattle, pigs, and other animals. The symptoms which this disease produces in man are virtually indistinguishable from that of pulmonary and intestinal tuberculosis (caused by *M. tuberculosis*).

The early stages of the infection usually go unnoticed. However, it may progress into active pulmonary tuberculosis later on. Serious outcome of the primary infection is more frequent in infants and adolescents than in older persons. Pulmonary tuberculosis generally arises from an untreated primary infection, and the diagnosis can be performed by identifying the bacteria in the sputum or by X-rays. The infection is characterized by cough, fatigue, fever, weight loss, hoarseness, and chest pain. The disease is found in all parts of the world. Although bovine tuberculosis is much more rare than human pulmonary tuberculosis, it still merits sincere consideration.

Bovine tuberculosis is transmitted by the ingestion of unpasteurized milk or dairy products from tuberculous cows. Sometimes it is spread by air to animal handlers and workers in

slaughterhouses. It takes from 4 to 12 weeks to develop but it may be years before the clinical signs and symptoms occur. Susceptibility is highest in children under 3 years of age and lower in later childhood. It is again high in adolescence and young adults and is particularly important if those individuals are undernourished.

The disease can be controlled by identifying infected animals when they come into an area to be slaughtered or exported. Health education can play an important role in reducing exposure to this bacteria. The disease can be treated by an antimicrobial called Isoniazid. Probably the most effective preventive measure is the administration of BCG vaccine to tuberculin negative people (especially infants and children).

Leptospirosis

Leptospirosis is caused by a number of different spirochetes in the genus Leptospira (approximately 170 variations or serotypes have been recognized from various parts of the world). The disease is manifested by fever, headache, chills, severe malaise, vomiting, muscular aches and irritation of the eye. Some anemia may occur in later stages of the infection. The clinical aspects of the disease may last for a few days to three weeks and relapses may occur. The infections are often asymptomatic and the fatality rate is low but increases with the advancing age of the individual and may reach 20% or more in patients who have kidney damage.

This disease is transmitted by contact with water, moist soil, or vegetation contaminated with the urine of infected animals. Often people contract the disease when swimming in contaminated water or coming in contact with water because of occupational needs. They may also become infected by directly contacting infected animals. The infection presumably results from the penetration of skin through an open wound or the mucus membrane by the spirochete or possibly through the ingestion of food contaminated with urine or feces of infected animals. Farm animals including cattle, horses and swine may be reservoirs for the disease as well as a number of domestic animals including dogs, cats, etc. Wild animals such as mice and wild pigs may be reservoirs. Direct transmission from man to man is negligible and susceptibility to the disease is general, varying with the serotype of organism encountered.

In order to prevent the disease a number of things can be done. Individuals who are working closely with animals may be protected by wearing boots and gloves. Water sources should be tested periodically to see if they are contaminated. Education concerning the transmission of a disease and the avoidance of contaminated swimming areas can do a great deal to prevent its spread. The control of rodents may do some good and the separation of domestic animals from recreational areas and living quarters might be recommended.

The disease can be treated with broad spectrum antibiotics such as penicillin, streptomycin, tetracycline antibiotics, and erythomycin. These drugs must be given in high doses at the early stages of infection to be completely effective. Although leptospirosis is not widespread in the Sahel, it needs to be mentioned because it can be transmitted very commonly through contaminated water sources. Children may be particularly vulnerable to the disease because they often play in water frequented by animals.

GLOSSARY

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Abate A nonresidual larvicide that is used widely in the control of *Simulium damnosum* in the onochocerciasis infested river basins of Upper Volta and other parts of West Africa. It is usually sprayed from airplanes or dumped in diluted concentrations into rivers. Abate is a larvicide, that is, it destroys the immature forms or larvae of the flies which transmit onochocerciasis.

Aquatic vegetation This term refers to any plants that live along the shores of rivers, lakes or irrigation canals. They are particularly important in the transmission of schistosomiasis. Snails, which are the intermediate hosts of schistosomiasis, often require various forms of aquatic vegetation for a resting place and food.

Acute This term means having rapid onset, with severe symptoms and a short course. It is the opposite of chronic, which implies a longer period of onset and a longer duration of a disease or other clinical symptoms.

Acute malnutrition This term refers to the rapid onset of malnutrition. It is usually used when a young child (less than 6 years of age) is 80% or less than his expected weight for age. Ten to twenty percent of the children in the Sahel suffered from acute malnutrition at the end of 1974, resulting from the famine that occurred in the region during that year.

Aedes aegypti *Aedes aegypti* is a mosquito which is found throughout the African continent and other parts of the world. This mosquito is most widely known for its role in the transmission of yellow fever, a disease found in many parts of Africa and South America. It is a mosquito that breeds in and around urban areas. The breeding habitats for *Aedes aegypti* mosquitos include old tire tracks left on the sides of roads, tin cans, and various other vessels which may collect water.

Agent Something which causes an effect. For example, a bacteria that causes disease is said to be an agent of that disease. An agent may be considered as a disease-causing organism.

Agronomy The study of the management of farmland. The art and science of crop production. Agronomy will play an important role in the successful integrated development of the Sahel. Indeed, food self-sufficiency of the region depends a great deal on the science of agronomy and the individuals who practice this science.

Airborne Airborne is a term which refers to one of the types of transmission of a disease. It is that route in which disease particles can travel through the air without assistance from any other vehicle of transmission. Many viruses and bacteria are transmitted by this route.

Ambient temperature Ambient temperature refers to the surrounding temperature within an environment. It can be considered, for the most part, as the temperature of the air in and around an area of concern.

Ambilhar Ambilhar is a drug that is used to treat schistosomiasis. It is not a totally satisfactory drug because it causes a number of side effects including nausea, vomiting, diarrhea, and abdominal pain. Ambilhar has been found to be a mutagen, this means that it has been linked experimentally, to the abnormal development of cells and may indicate that it is a cause of cancer. At the present time, ambilhar is used to treat schistosomiasis, although, in the face of recent evidence, it may not be the most satisfactory drug available today.

Amoebiasis Amoebiasis is a very wide spread infection throughout the world. It is caused by the protozoan Entamoeba histolytica. This protozoan parasite lodges in the intestine and causes severe diarrhea and intestinal destruction. It may also migrate to the liver and cause liver disfunction. Amoebiasis is transmitted through water or by fecal oral contact. It is particularly dangerous to small children who contract the infection when drinking contaminated water. The acute diarrheal symptoms increase the chances of dehydration and rapid loss of weight for the infant, increasing his risk to an early death. The cure for amoebiasis is available, but it is difficult to treat because so many children and adults are infected throughout the world.

Ancylostomiasis Ancylostomiasis is hookworm disease. It is caused by the roundworm, Ancyclostoma duodenale. It is a very important tropical disease because the worm lodges in the intestine and sucks blood. Many children throughout Africa become severely weakened because of this disease, their strength being sapped by the worms' daily intake of blood through the intestinal wall. Hookworm is a very important disease in the developing world because of its direct link to human vigor, strength, and productivity.

Anemia. A condition in which there is a reduction in the number of circulating red blood cells, or in hemoglobin, or in the volume of red blood cells per 100 milliliters of blood, or in combination of these above factors. A number of tropical diseases can cause anemia. Poor nutrition, hookworm disease, malaria, and other blood borne infections have been known to cause anemia in children and adults. It is a particularly important condition because it has a direct link to vigor, strength, and human productivity.

Ancylostoma duodenale. Ancylostoma duodenale is the agent or the disease causing organism of hookworm.

Anopheles gambiae. Anopheles gambiae is a malaria carrying mosquito. It is widespread throughout West Africa and most important in the transmission of malaria in the Sahel. Anopheles gambiae breed in standing water. Any development scheme which increases the amount of standing water should be viewed as a potential threat in terms of increasing the numbers of Anopheles gambiae mosquitos and thus producing an increase in the incidence of malaria in that project area.

Anorexia Anorexia is the loss of appetite. It is seen in malnutrition, and at the beginning of all fevers and illnesses, and also in the disorders of the digestive tract, especially the stomach.

Appropriate technology. Appropriate technology is a term that was coined by Ernest Schumacher, a German born economist, in 1973. This term refers to the transfer of technology at the local level, through local means and materials. The approach has gained widespread acceptance in recent years and has been successful in a number of development projects.

Anthropophilic. Anthropophilic refers to the feeding behavior of a disease carrying insect. It is the preference of an insect to feed on man, thus enabling the transmission of disease to occur particularly easily.

Arthropoda. Arthropoda is the name of a phylum in the animal kingdom. It is the largest phylum containing the most species in the scientific nomenclature. Insects are in the phylum arthropoda and contribute a great deal to the transmission and spread of disease in the tropics.

Ascaris lumbricoides. This is a large intestinal roundworm transmitted by unsanitary conditions and fecal-oral contact. It lodges in the intestine and in some areas over 90% of the people are infected with this parasite. It is usually not fatal but causes discomfort and may decrease the vigor and productivity of the infected individual.

Asexual. Asexual refers to reproduction without sex. Many of the protozoan and other single-celled animals reproduce by cell division, which is one form of asexual reproduction.

Atabrine. Atabrine is a malaria prophylactic. It is distributed widely in the tropics where malaria is prevalent.

Attack Phase. Attack Phase refers to initial period during a malaria control/eradication campaign. It involves the identification of breeding habitats and the treatment of these breeding habitats with nonresidual larvicides. It also involves the spraying of chemicals to kill adult mosquitos and the distribution of malaria prophylactics such as chloroquine and atabrine.

Bacteria. Bacteria are small single celled organisms which cause a number of diseases in the Sahel. Diseases caused by bacteria are usually transmitted through air or water contaminated with human or animal waste products.

Bagdad Boil. Bagdad boil is a common name for leishmaniasis in the Middle East. It is caused by the protozoan Lieshmania donovani.

Beriberi. This is a nutritional disease caused by a deficiency in thiamine (vitamine B_1). It is characterized by nervous disorders, heart failure, and edema.

Bilharzia. Bilharzia is another name for schistosomiasis. Schistosomiasis is commonly referred to as bilharzia throughout Africa.

Biological Control. Biological control is a method of controlling the vectors which transmit a disease, using natural means. For example, mosquito larvae may be biologically controlled by placing fish into water which feed on the larvae, similarly mosquito larvae may be controlled by placing in the water larvae of other larger mosquitoes which may feed on them. Biological control also involves what is known as the sterile male technique, which means males are reared in a laboratory, sterilized and then released into the wild. When they mate with a female mosquito, no viable eggs are produced.

Birth Rate. Birth rate is simply the number of live births per 1,000 population. It is a good indication of the growth rate of a community or nation.

Blackwater Fever. Blackwater fever is malaria. It refers to hemolytic anemia produced by the malaria parasite and is often recognized by a dark, almost black color of the urine.

Bloodmeal. Bloodmeal refers to the feeding behavior of vectors which cause disease. A bloodmeal is often required by vectors of disease (mosquitoes, black flies, tsetse flies) before they can lay eggs which will hatch.

Bloodstream. Bloodstream refers to the circulatory system and it involves both veins and arteries (i.e. those vessels coming into the heart and those going away from the heart respectively).

Borehole well. Borehole wells are deep wells dug to tap underground water sources. They are particularly important to the Sahel because they have the potential to deliver great amounts of water to areas that have little rainfall. They also have the potential to create ecological damage by attracting great numbers of livestock to a small area and thus result in overgrazing the area and destruction of the groundcover. This results in erosion and the eventual wasting of huge areas of land. This was evidenced in the Sahel in 1973.

Borellia Recurrentis. *Borellia recurrentis* is the agent which causes relapsing fever. It can be transmitted by the bite of a flea or tick.

Botany. Botany is the study of plants. It is particularly important in the Sahel because much of the future prosperity of the region depends on the efficient development of agricultural and cash crops. The botanist can often work hand in hand with an agronomist or an agricultural expert to develop the highest yielding crops and those most suited for a particular area.

Breeding Habitat. Breeding habitat refers to the environment in which a vector of a disease reproduces. Breeding habitats can be any place that water accumulates (thus increasing the number of mosquitoes, or snails) or can be fast moving water such as that found in dam spillways or can even be dryland savannahs.

Bulinus sp. *Bulinus* is the genus of snail which transmits Schistosomiasis throughout West Africa. It is a fresh water snail and can usually be found along lakesides and irrigation canals. These snails can be eliminated periodically by the complete drying of the water source, and this should be thought about in terms of feasibility when implementing any project that might increase the amount of standing water in a particular area.

Calorie. Calorie is a unit of energy. Strictly speaking, it is the amount of heat needed to raise one gram of water one degree centigrade. In practical terms, it is a unit of energy that is associated with the amount of food taken in. For

example, one gram of fat contains approximately nine calories, one gram of protein and one gram of carbohydrate each contain approximately 4.5 calories. Approximately 2,200 calories are needed per working man per day.

Carbohydrate. Carbohydrate describes a type of food material. Carbohydrate is eventually broken down into sugar and used by the body as its prime source of energy.

Cash Crop. Cash crop refers to those crops which are grown but not used as food. These crops include to some extent, peanuts, cotton, sesame, and cocoa.

Cercaria. Cercaria refers to the infecting stage of the schistosoma parasite. It is a small fork-tailed organism which penetrates the human skin when people wade into water infested with schistosomiasis. The cercaria develop inside of a fresh water snail (Bulinus) and can live for approximately 24 hours before it penetrates a human host.

Cestode. Cestode refers to flat worms. Tapeworms are cestodes and may be seen periodically throughout the Sahel.

Chloroquine. Chloroquine is a drug which is used to treat malaria and used in malaria prophylaxis. It has been used extensively throughout malaria endemic areas and has been quite successful.

Cholera. Cholera is caused by bacteria (Vibrio cholerae). It is a very serious disease when it occurs and it is transmitted primarily through water contaminated with the fecal material of an infected individual. It can cause a great deal of suffering and death throughout a community if it does occur and is particularly serious in infants and small children.

Chronic. Chronic refers to the long-term development of a disease. It is the opposite of acute. A chronic disease is one which takes a relatively long time to show symptoms and cause death.

Chronic Malnutrition. Chronic malnutrition is a condition which occurs often in the Sahel. It is caused by a continued low intake of both calories and protein and can have serious effects including stunted growth, mental retardation, and increased susceptibility to disease. A child classified with chronic malnutrition is usually below 90% of his expected height for age.

Clever cell. The clever cell refers to the pattern of veins on the wing of a tsetse fly. This cell is used in the identification of tsetse flies (the vectors of trypanosomiasis).

Closed well. A closed well simply refers to a well that is closed on the top. It is a well that is designed to prevent contamination of the water witnin the well by human and animal waste products. Closed wells are usually recommended whenever a water development scheme is to be implemented and should be continually maintained.

Consolidation Phase. Consolidation Phase refers to the third stage of malaria control/eradication. It is the phase that is implemented to wipe out any residual pockets which may remain in a malaria endemic area. This can be done by identifying cases of malaria and treating them appropriately. The consolidation period usually lasts from three to five years.

Contagious. This refers to the transmission of a disease from one person to another. A disease is said to be contagious if it can be transmitted through air from one individual to another.

Contamination. Contamination refers to the polluting of a pure water source with human or animal waste or chemicals, thus spreading a number of food-borne and water-borne diseases or diseases caused by chemical poisoning.

Corneal Opacity. Corneal opacity refers to the gradual whitening and hardening of the cornea due to an infection or a parasite. It is usually seen in trachoma and onchocerciasis cases. Corneal opacities can sometimes be reversed through surgery, but at the present time this is not feasible in the Sahel on a large scale.

Cyclops. A Cyclops is a crustacean and is the intermediate host for the guinea worm (Druncunculis medinensis). It is found in standing water around wells where people often go to fill water containers. These water sources should be checked periodically for the Cyclops to prevent the spread of guinea worm in the developing area.

DDT. The generic name for DDT is chlorophenothane. It is a long-lasting insecticide which has been used throughout the world to control mosquitoes and other insects which carry disease. DDT can concentrate in living tisue and can cause clinical problems. Its use has been decreasing in recent years due to more and more evidence implicating DDT as a dangerous and harmful chemical.

Death Rate. Death rate refers to the number of people dying per thousand people in the population. It is a fair indication of the health status of a country or region.

Definitive Host. A definitive host is a host in which an organism reproduces. For example, man is the definitive host for

the schistosomiasis parasite. However, the mosquito is the definitive host for the malaria parasite.

Density. Density refers to the number of living things per unit area of space. The density of an area may increase quite rapidly due to the implementation of a development project. Increased human density and animal density may cause increased spread of disease or the overuse of a region's sanitary facilities and food supply.

Desertification. Desertification is the process of desert encroachment, or the spreading of deserts. The word was coined in the Sahel by the French and has taken on great meaning there. The Sahara Desert is expanding at the approximate rate of 30 kilometers per year and the desertification process must be stopped if the region is to develop successfully and achieve the goals of food self sufficiency and economic stability by the year 2000.

Developmental Host. A developmental host is an intermediate host. It is an organism in which a parasite develops into an infective stage. For example, the snail is the developmental host for the schistosomiasis parasite, and the blackfly is the developmental host for onchocerciasis.

Dienthylcarbamizine. This is a drug that is used to treat onchocerciasis and elephantiasis. The drug kills the immature worms in the skin and in the blood quite readily. However, it may have some side effects which make it a marginally satisfactory.

Disease. Disease refers to any condition that is caused by another organism which reduces the life span or the productivity or vigor of the infected organism. Malnutrition may also be considered a disease although it has no specific agent. In simple terms disease may be considered as the absence of health.

Draconctiasis. Draconctiasis is caused by the parasite Dracunculus medinensis. It is transmitted by drinking water containing the infected vector of the guinea worm (Cyclops).

Dysentery. Dysentery refers to acute or chronic diarrheal symptoms. It can be caused by bacteria, protozoa, and a number of viruses. It is one of the most important diseases for children in the developing world and often takes a heavy toll on their survival.

Ecological Integrity. This term refers to the status of an ecosystem. A stable ecosystem might be thought of as having a high degree of ecological integrity. This is also an ecosystem which can resist a significant amount of change. The regional

goals of food self-sufficiency and sustained economic growth in the Sahel depend on a certain amount of ecological integrity and the ecology sector is striving continuously to improve the ecological integrity of the region.

Ecology. Ecology is the study of interaction between living things and their environment. Strictly speaking, ecology involves the investigation of all the interactions between living and nonliving things throughout the biosphere. However, the present needs of the Sahel dictate that a complete and accurate identification of the ecological problems within the region be conducted. Thus, the role of the ecologist is not only one of defining the problems but also solving them in a sense that he is the individual who will bring the various sectors together in order to optimize their effect on the environment.

Endemic. Endemic refers to the state of disease transmission in a particular area. An endemic disease is a disease that has been and continues to be highly prevalent in a specific geographic area. For example, malaria, schistosomiasis, and onchocerciasis are endemic diseases in the Sahel.

Entomoeba histolytica. This is the organism which causes amoebic dysentery. It is a single celled organism which invades the intestinal tract and has the ability to spread throughout the intestinal wall. Occasionally it will break through the wall, lodge in the liver and cause severe problems with liver functions. It is probably one of the most important diseases in the Sahel since it attacks old and young people alike. Much of childhood mortality might be due to the acute diarrheas which are caused by this parasite.

Epidemic. Epidemic refers to the state of disease transmission. An epidemic is often seen as a rapid outbreak of a disease in a particular area. It is evidenced by an increased number of cases in the region and a rapid spread. Epidemics of measles, tuberculosis and influenza are particularly important diseases in the Sahel and have been known to spread and kill quickly.

Eradication. This term refers to the elimination of a disease. It is a very difficult thing to achieve and it has only been achieved one time as far as disease is concerned. Smallpox is the only disease which has been eradicated thus far. More appropriately, the term control should be used when talking about disease in the tropics. Every parasite need not be eliminated to control a disease and therefore it is more feasible to speak about control rather than eradication.

Famine. Famine is a period of time characterized by a severe shortage of food. It may be caused by a combination of natural (climatic) and man-made forces. The period of time is

also characterized by a rise in human starvation and severe nutritional stress. It may be followed by outbreaks of cholera, malaria, measles, tuberculosis, and many other infections.

Fecal. This word refers to solid waste material passed out of the human body. Fecal wastes are usually sources of infections such as amoebic dysentery, cholera, intestinal worms, and other parasitic and infectious diseases. The contamination of food and water supply with fecal material represents one of the most important problems facing development personnel in the Sahel today.

Fertilizer. Fertilizer is material applied to soil to increase the growth of crops. It may be natural (i.e. human or animal wastes containing high amounts of nitrogen), or it may be artificial (commercial fertilizers used and sold throughout the world).

Filariasis. Filariasis is a general term that refers to a parasitic worm that can be found in the blood or in the skin of the human host. Diseases which are Filariases include onchocerciasis, loa loa, and elephantiasis. Each of these diseases is found to a greater or lesser extent in the Sahel.

Fungicide. A fungicide is a chemical used to kill fungus which may grow on living or stored crops. It may be applied from airplanes, helicopters, or by hand and is used very often in the Sahel. It is particularly important in the prevention of the growth of the Aspergillus fungus which has been found in the Sahel and has been shown to produce very dangerous chemicals (aflatoxins) which cause severe nervous disorders and cancer. Additionally, fungicides may find their way into water supplies and contaminate them.

Gambusia. Gambusia are fish that are used throughout the world to control the spread of malaria. These small minnow-like fish may be placed in irrigation canals, ponds, lakes, and other sources of standing water, to consume the mosquito larvae that may breed in that water. They have been particularly effective in the past and have a great potential to be used not only as a biological control for malaria but as a supplementary food source.

Glossina species. These are tsetse flies. They are found throughout the southern portions of the region and are the vectors for trypanosomiasis (sleeping sickness).

Goiter. Goiter is a condition that is caused by a low intake of iodine. It is commonly recognized by the swelling of the neck glands.

Hansen's Disease. Hansen's disease is another name for leprosy.

Helminth. This is the scientific name for parasitic worms. Any worms which cause diseases such as schistosomiasis, onchcerciasis, ascarsis, etc. are helminths.

Hemolytic Anemia. Hemolytic anemia is a condition caused by malaria. It is the loss of red blood cells due to their destruction by the malaria parasite.

Holoendemic. Holoendemic indicates the prevalence of a disease in a given area. If an area is holoendemic for a certain disease, it is likely that over 75% of those individuals living in the area are infected with the disease in question. Generally speaking, holoendemic means that many people are infected.

Hookworm. Hookworm is usually a disease of young children. It is caused by the parasite Ancyclostomia duodenalae. This is primarily a disease of children since the parasite is contracted when children walk barefoot on soil contaminated with feces from infected people. It lodges in the intestine and draws blood from the vessels there and therefore may cause severe anemia in young children who are heavily infected.

Host. A host is an organism which harbors a parasite. There are different types of hosts. There are definitive hosts in which the adult parasite lives, intermediate hosts in which the parasite develops, and reservoir hosts in which the parasite may live but which are not the primary host for that organism.

Hycanthone. Hycanthone is a drug which is used to treat schistosomiasis. It is the drug that has been recommended by the World Health Organization and is used frequently throughout Africa. However, it should be noted that this drug may have serious adverse consequences due to its toxic potential (it has been shown to alter the structure of cells and thereby may cause cancer).

Incidence. Incidence is a term used to indicate the spread of infection over time. It is the number of new cases which occur over a given period of time (usually one year). A rise in incidence indicates a disease is spreading, and conversely a fall in incidence indicates that a disease is being controlled.

Infant Mortality Rate (IMR). The infant mortality rate is the number of infants dying in one year per 1,000 live births. The infant mortality rate of a country is usually an indication of the health status in the country and therefore should be one of the things that is looked at when determining the level of health in a country or the amount of good a project is doing

to improve the overall quality of life of people in a project area.

Insecticide. Insecticides are inorganic chemicals that are used to control insects. They may be used to control insect pests such as those which attack crops or they may be used to control insect vectors of disease such as mosquitos, blackflies, or tsetse flies. They have the potential to cause dangerous effects since these chemicals can be very harmful to human beings if they find their way into drinking water or food supplies.

Intermediate Host. An intermediate host is the secondary host of an organism. Parasites very often require intermediate hosts in which they must develop before they can infect human beings. For example, the snail which transmits schistosomiasis is the intermediate host for this parasite. An intermediate host may also be called a developmental host.

Kwashiorkor. Kwashiorkor is the term commonly used for a nutritional problem created by a low intake of protein. This problem usually occurs in children between the ages of 2 and 5 years. It often occurs when children are taken off the breast and begin to eat solid foods. Symptoms of the disease include swelling of the limbs and abdomen, dermititis, a reddish tint to the hair, and lethargy.

Larvae. Larvae are the immature forms of insects. They are the developmental stage of insects which preceed the pupal stage.

Larvicide. A larvicide is a chemical that is used to kill insect larvae. They are particularly used to control mosquito and blackfly populations (the vectors of malaria and onchocerciasis respectively).

Leprosy. Leprosy is a disease caused by the bacteria *Mycobacterium leprae*. It is a chronic disease which usually attacks the nerves. People who have leprosy normally have disfigured faces or fingers due to the death of nerves in the face and limbs. It is disease of limited importance in the Sahel.

Loa Loa. Loa loa is a filaria which is carried by a fly (*Chrysops sps.*). The worm migrates through the lower layers of the skin and takes three to four years to develop. It may live as long as 15 years in the human body but causes little sickness. The worm can often be seen migrating across the eye of the infected individual.

Lymphatic System. The lymphatic system is a drainage system for the human body. Many of the toxic substances which are produced by infections are often drained into the lymphatic system

and then passed out of the body. The lymphatic system is particularly important in the control of disease and may serve as a route for infectious agents when they enter the body, therefore facilitating their spread throughout the human being. If the lymph glands become blocked, the limbs closest to those lymph glands will swell due to this blockage. This is what causes the swelling in elephantiasis.

Maintenance Phase. Maintenance phase refers to the final stage of malaria eradication or control. It involves surveillance for cases of malaria and the treatment of remaining infected individuals. The maintenance phase may last for 20 years.

Malignant Tertain Malaria. Malignant tertain malaria is the most severe form of malaria and is caused by the parasite *Plasmodium falciparum*. Once falciparum parasites are detected in the blood the person may die within 24 hours. It is a fulminating infection and is probably the most serious infection throughout the world. It is not the most common form of malaria in the Sahel.

Malnutrition. Malnutrition means poor nutrition. It may be caused by a lack of protein, or a lack of calories and protein. Additionally, malnutrition may refer to an excessive intake of food, leading to obesity. However, in the Sahel malnutrition usually refers to insufficient food intake.

Marasmus. Marasmus is a nutritional problem which is caused by a chronic lack of both calories and protein. It is characterized by a thin or wasted individual. Usually infants and young children (0-1 year) become marasmic.

Matrix. A matrix is a fill-in table or chart. It contains both columns and rows. The second part of the guideline procedure contains a matrix.

Measles. Measles is a disease caused by a virus. It is very wide spread throughout the Sahel and attacks children of preschool age. The disease may be fatal if left untreated. It is also made more serious when it is combined with a lack of proper nutrition. A good vaccine exists for measles and immunization campaigns usually include measles vaccinations.

Metamorphosis. Metamorphosis refers to the changing of form in the development of an organism. This usually occurs in insects. The complete form of metamorphosis includes four stages; egg, larvae, pupae, and the adult. Many of the control measures aimed at decreasing vector populations are aimed at eliminating one or more of these intermediate stages in the development of insect vectors.

Microfilaria. Microfilaria are the immature stages of filarial worms. In the case of onchocerciasis they are the disease-causing organism. Microfilaria are the offspring of the adult worms. Loa loa, onchocerciasis, and guinea worm each produce microfilaria.

Multiple Infection. Multiple infection refers to a condition in which the infected person harbors a number of different types of parasites. For example, a person might be infected with malaria, schistosomiasis, onchocerciasis, amoebic dysentery, and ascaris all at the same time. Multiple infections can result in severe clinical symptoms and may cause death.

Night soil. Night soil refers to the application of human wastes for fertilizer. It is a good way to spread infection since many people infected with a number of different parasites spread their wastes on fields in order to fertilize them. Infective material then gets on food and the infection spreads when the food is consumed.

Onchocera volvulus. This is the organism which causes onchocerciasis. It is transmitted by the blackfly (*Simulium sp.*) and is endemic to many parts of the Sahel.

Open Well. An open well is a well that is not protected. It is a good source of infections such as dysentery, guinea worm, and various other water-borne infections. Open wells are used extensively throughout the Sahel because they are inexpensive. However, a closed well system should be implemented whenever possible in order to control the spread of many water-borne diseases.

Parasite. A parasite is any organism which lives within a host and causes damage. Parasites are organisms which take from, and do not give anything to, the host in which they live. There are many parasites in the Sahel which cause disease. Parasites can be spread through the air, water, soil, food, and close physical contact. The term parasite is usually restricted to helminths and protozoa. However, viruses and bacteria are also parasites.

Pesticide. A pesticide is a chemical that is used to control pests. These are chemicals that are sprayed on crops, into water, and even applied directly to the body to control the spread of organisms which cause disease. Pesticides can be very dangerous if they find their way into water supplies because they can concentrate in human tissue and cause very serious effects. Therefore, when using pesticides, caution should be exercised to prevent the contamination of water and food supplies.

Plague. Plague is caused by the bacteria Yersina pestis. It is transmitted by the bite of a flea and is found very often as an infection in rodents. Plague has caused tremendous health problems for mankind, and should be thought of whenever new development projects are implemented. The incidence of plague in the Sahel is low, but the potential for its spread still exists.

Planning Phase. Planning phase is the first stage in the control of malaria. It is a time when the malaria situation in the project area is assessed and the number of cases and potential cases estimated. The planning phase may take between 1 and 3 years to be implemented and serves for a strong base for the following phase (attack phase) of malaria control or eradication.

Plasmodium vivax. This is the malaria parasite found most often in the Sahel. It is a less severe form than Plasmodium falciparum. In some areas of the Sahel up to 100% of the exposed population are infected with this parasite at one time in their lives. Therefore, whenever planning a new development project, this disease should be considered and its control incorporated into the project design.

Prevalence. Prevalence is an indication of the number of people infected in an area at one point in time. The prevalence of a disease indicates the number of people infected. Investigations into the prevalence of infection should be carried out before a project is completed. If people move into a new project area, the prevalence of infection may increase due to the importation of the disease agent. Prevalence should not be confused with incidence which is the number of new cases of a disease arising throughout the year. The prevalence is a point-in-time estimate of the disease in a given population.

Protein-Calorie Malnutrition (PCM). Protein-calorie malnutrition is caused by a balanced undernutrition. The symptoms of protein-calorie malnutrition are a wasting of body tissues. Protein-calorie malnutrition is often called marasmus.

Protozoa. Protozoa are organisms which cause a number of different types of diseases. Amoebic dysentery, trypanosomiasis, and a number of other tropical diseases are caused by these single celled organisms. They can be spread by water, contaminated food, or by the bites of insects.

Pupae. Pupae are the third stage in the development of an insect. This stage follows the larval stage.

Reproductive Potential. The reproductive potential of an organism refers to its reproducing capability. If an organism has a high reproductive potential (for example a mosquito) one

adult can produce many offspring. If an organism has a low reproductive potential (man, tsetse fly) the adult organism does not produce many offspring.

Reservoir. A reservoir is a host for a parasitic infection. It is usually an organism other than man which supports a human infection but is not sickened by the infection. For example, wild animals represent a reservoir for trypansomiasis, and rodents represent a reservoir for plague. Remember, reservoir hosts support adult infections. They should not be confused with intermediate hosts which support a developing form of a disease-causing organism.

Resistance. Resistance refers to the capability of an individual to resist disease. It is based on a complex system of cells, chemicals, and general nutrition. If a person is ill his resistance may be lower. Similarly, if a person is poorly nourished he may be more susceptible to disease.

Resting Habitat. Resting habitat refers to that part of the environment where a disease vector (for example a mosquito or a blackfly) rests after taking a blood meal. Resting habitats are often low lying bushes in an area near a breeding habitats.

Ricketts. Ricketts is a nutritional deficiency caused by inadequate intake of vitamin D and/or an inadequate exposure to sunlight. This disease often affects young children between the ages of one and three years and can be recognized by the malformation of bones (particularly in the legs).

River Blindness. River blindness is another name for onchocerciasis.

Salmonella. Salmonella is a widespread bacteria that often causes diarrhea. It is transmitted by food contaminated with the bacteria from an infected person. A great deal of infant mortality might be due to salmonella infections since they are so prevalent throughout the world. Typhoid fever is caused by a type of salmonella (*Salmonella typhi*).

Schistosomiasis. Schistosomiasis is a helminthic disease and is caused by the parasitic worm *Schistosoma mansoni* and *S. hematobium* in the Sahel. It is a very widespread disease and even today it continues to spread throughout the river basins of the Sahel.

Sickle Cell Anemia. This disease is caused by a malformation of red blood cells. It is found in members of the negro race and has been linked to an evolutionary trait. In individuals possessing half of the genetic material needed to cause sickle cell disease, this trait seems to prevent the malaria parasite from causing severe effects.

Simulium Damnosum. Simulium damnosum is the vector for onchocerciasis. It is a small blackfly (often called a buffalo gnat) and is found throughout the river basins of the Sahel.

Stunting. Stunting is a condition which is caused by the chronic lack of food. Chronic undernutrition often causes stunting because the growing child does not get enough food to eat and therefore he is not able to grow to his full genetic potential. Stunting may be recognized by a low height for age in the growing child.

Susceptibility. Susceptibility is a condition that is seen in an individual who does not possess sufficient resistance against a particular disease agent. Certain people are more susceptible to disease than others because of previous exposure or poor nutrition and the concomittant lack of immunity to the pathogenic agents.

Trade-off Concept. The concept of trade-offs is very important in international development. Very often a significant number of adverse effects accompany positive effects. Whenever development projects are being implemented, a full consideration should be given to the negative aspects of these development projects and every effort should be made to minimize the adverse effects whenever possible. For example, an irrigation network may produce great quantities of food and significantly improve the nutritional status of the population it is designed to serve. However, irrigation may also increase the amount of standing water in an area and thereby contribute to the spread of malaria by providing a suitable habitat for the mosquito vectors to develop. Thus, when thinking about irrigation, positive and negative trade-offs should be considered.

Transmission. Transmission is the process by which a disease is spread. The transmission of a disease includes not only the life cycle of the disease agent, but also the life cycle of the vector and the ecological milieu in which the organisms exist. When we speak about the control of parasitic diseases we talk about controlling the transmission of the disease by identifying the factors in the environment which facilitate the spread of pathogenic agents and the vectors which transmit these agents.

Trypanosomiasis. Trypanosomiasis is a protozoan infection. It is caused by the parasite Trypanosoma gambiense in the Sahel. This disease is transmitted by the tsetse fly and is found thoughout the southern areas of the Sahel. An animal form of trypanosomiasis exists (called nagana) and poses a significant threat to livestock development in the Sahel.

Tuberculosis. Tuberculosis is a bacterial disease caused by the bacteria Mycobacterium Tuberculosis. It is a disease that

causes severe respiratory distress in people throughout the Sahel. It is particularly important in dryer areas where people have not been exposed to this disease before.

Undernutrition. Undernutrition is probably one of the most important health problems in the Sahel. It is generally caused by a chronic shortage of food and can cause retarded mental and physical growth. Acute undernutrition was widespread during the Sahel famine and every safeguard should be implemented in order to prevent this condition from occuring again. The regional goals of food self-sufficiency and sustained economic growth are aimed at alleviating the dangers of undernutrition and the pervasive status which it now holds throughout the Sahel.

Vector. A vector is an organism which is necessary for the transmission of a disease. Vectors are often insects (such as mosquitoes, blackflies, tsetse flies) and are widespread throughout the Sahel. Indeed, many of the most important tropical diseases are vector-borne diseases. Malaria, schistosomiasis, onchocerciasis, trypanosomiasis and guinea worm infection are vector-borne diseases. Often the parasite can multiply and/or develop within the vector, thus making the vector essential for transmission. A great deal of effort has been aimed at controlling vectors, thereby controlling the diseases which they transmit.

Wasting. Wasting is an example of acute undernutrition. It is caused by a severe lack of food over a short period of time. The condition of wasting is often called marasmus. Wasting can cause severe retardation and poor physical growth. It often results in death from either starvation or secondary infection due to the victims' weakened condition. Marasmic children usually exhibit a low weight for age.

Xerophthalmia. Xerophthalmia is caused by vitamin A deficiency. It is also called night blindness. Children throughout the Sahel suffer from this disease and permanent eye damage can occur if the condition is not diagnosed early in its course.

Zoonosis. A zoonosis is an infectious agent which is transmitted from vertebrate animals to man. Examples of zoonoses include anthrax, brucellosis, bovine tuberculosis, and leptospirosis. Probably the best known zoonotic disease is rabies, which is present but rarely encountered in the Sahel.

BIBLIOGRAPHY

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The references have been arranged and alphabetized under sector-specific headings (i.e. agriculture, livestock, general development, etc.), but numbered sequentially to enable easy cross-referencing from the text of each volume. Selected citations have been briefly annotated within the list to indicate both their substance and importance as a reference on a particular issue. A reference book list has also been compiled and appears at the end of the bibliography.

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49. Lapeyronie, A. 1975. Intensification de la production animale dans le delta et la basse vallee du Senegal. Modifications dans l'exploitation des paturages de decrues consecutives a l'amenagement de barrage du delta du fleuve Senegal. Paris, Ministere de la Cooperation; Maisons-Alfort, IEMVT, 122pp.

50. Ormerod, W.E. 1976. Ecological effect of control of african trypanosomiasis. Science, 191(4229):815-821.

This hallmark article discusses the ecological effect of controlling African trypanosomiasis. It presents the control of this disease as a dual-edged sword. On one hand, many livestock will be saved by controlling this disease, but on the other hand, the ecological consequences resulting from increased herd size due to increased livestock survivorship can be ecologically disasterous. Huge expanses of the African Savannah may eventually be denuded by the herds of cattle which otherwise would have succumbed to the trypanosome infection. The article presents an interesting perspective into the control of endemic diseases throughout the world and since it is ecologically oriented, it is particularly pertinent to the problems which face the Sahel at present and those which may arise in the future.

51. Rapp, A. 1974. A Review Of Desertification In Africa: Water, Vegetation and Man. SCIS report #1, Stockholm, Sweden.

This is probably the most comprehensive reference on desertification in Africa. It deals with the sociological, climatic and geographical components of the desertification process. Man-made factors which increase the spread of deserts are reviewed, particularly the borehole well effect that occurred in the Sahel in the early 1970's. It also addresses land use patterns in the region and their relation to desertification.

52. U.S. Department of Health, Education, and Welfare, Public Health Service. 1973. Zoonotic Diseases. DHEW Publication No. (CDC) 75-8182. 12pp.

53. West, O. 1972. The Ecological Impact of the Introduction of Domestic Cattle into Wildlife and Tsetse areas of Rhodesia, Pp. 712-725, in The Careless Technology, Farvar and Milton eds., The Natural History Press, Garden City, New York, 1030pp.

54. World Health Organization. 1971. Society, Stress, And Disease. Oxford University Press. WHO Chron., 25:168-178.

55. World Health Organization. 1978. Prevention and Control of Zoonoses and Foodborne Diseases due to Animal Products. Report by the Director-General. Thirty-First World Health Assembly, Provisional Agenda item 2.6.12. 5pp.

56. _____. 1977. Situation de l'elevage au Niger. Bulletin de l'Afrique Noire, no 942, 18 janvier 1977, p. 414-415.

Fisheries

57. Bah, A. 1978. Environnement marin et nutrition en Afrique de l'Ouest. Revue Tiers-Monde, Bol. XIX, no 73 janvier-mars 1978, p. 179-184.

58. Ezenekwe, A.O. 1974. Nigeria Develops Fishing to Meet Food Demand. Fishery News International, 13(9):42-49.

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62. Hildingstam, J. 1977. Fish Farming Trends. Veterinary Records, 100(13):256-259.

63. Hilton, T.E. 1967. The Fisheries of the Volta System in Ghana. Oriental Geographer, 5(1):21-34:61.

64. Jackson, P.B. 1978. Health and Disease in Intensive Aquaculture. Journal of South African Veterinary Assoc., 49(1):57-59.

65. Keita, M.S. 1977. Mali, developper la peche et la rendre operationnelle. Le Moniteur Africain, No. 756: 14-15.

66. La peche en Afrique. 1976. Afrique Agriculture, No. 18:28-63.

67. Laure, J. 1974. Valeur nutritionnelle de produits de la peche conserves artisanalement au Cameroun et au Tchad. Bondy, ORSTOM, 1974, 79 p. 12 photogr., bibliogr. (collection Trav., Doc. de l'Orstom no. 36).

68. Sims, G.G. et al. 1977. Organochlorine Residues in Fish and Fishery Products From the Northwest Atlantic. Bulletin of Environmental Contamination and Toxicology, 18(6):697-705.

69. Tobol/TSEV, B.N. and P.M. Sokolov. 1977. Measures for the Care of the Young of Fishes. Veterinariia, for: 31-32:77.

Transportation

70. May, J.M. 1972. Influence of Environmental Transportation in Changing the Map of Disease, Pp. 19-34, in The Careless Technology, Farvar and Milton eds., The Natural History Press, Garden City, New York, 1030pp.

This article discusses the influence of a transportation system on the spread of disease. It discusses how disease vectors may be imported by vehicles which travel on the roads, how viruses can be imported over national boundaries through air transport, and the way parasitic infections can be carried into an area by the ease of travel created by a road. It is a good review of the effect of transportation on health and the potentialities which exist to increase the transmission of disease through the much needed transportation systems in the developing world.

71. Presentation de l'etude preliminaire sur les effects a long terme de la realisation d'un axe lourd est-ouest au Sahel. in : Bulletin de l'Afrique Noire, no 944, ler fevrier 1978.

72. Reynolds, D.J. 1956. The Cost of Road Accidents. Journal of the Royal Statistical Society 119:393-409.

73. Schram, R. 1968. The Curse of the Road. East African Medical Journal, 45(5):358-363.

This article reviews the cost in terms of human life from the establishment of a road in Uganda. It expresses a direct correlation between the number of vehicles licensed and the number of injuries and deaths caused by road accidents. It is a fine example of the way in which traffic accidents hinder the development of a country and the need for more structured and enforceable rules for driving vehicles in the rural areas. The author stresses the need for more police checks, improved vehicle maintenance, the maintenance of roads, licensing, and driver education throughout the coming decades. The author closes the article by stating the road is not cursed but rather the curse of the road is the irresponsible road user.

74. [illegible]low, J.L. 1973. Transportation Factors in The [illegible]ivery of Emergency Health Care. San Diego Biomedical Symposium Proceedings, San Diego, California; Jan. 31-Feb. 2, 1972. (Published by San Diego Biomed. Symp. [Vol. 12] California, 1973.)

75. Thedie, J. and Abraham, C., Economic Aspects of Road Accidents. Traffic Engineering and Control 2:589-595, 1961.

76. _____. 1977. La route transsaharienne devrait etre terminee en 1980. Europe Outre-Mer, no 569, juin 1977, p. 15-18.

77. _____. 1977. La Troisieme Conference Routiere Africaine a Abidjan. 1977. La Route en Afrique. Reveue Generale Africaine, No. 11:23-63.

78. _____. 1977. Ou en sont l'etude et la realisation de la route transsahar[illegible] ? Revue Generale Africaine, No. 11:6-9.

Technology Transfer/Village Water Supply/Ecology

79. Ackerman, W.C. et al. 1973. Man-Made Lakes: Their Problems and Environmental Effects. American Geophysical Union, Washington, D.C. 87-97pp.

This book deals with the problems and environmental effects of man-made lakes. It is a compendium of articles dealing with the adverse health consequences associated with water development. It is a fine general reference and should be consulted whenever projects are being planned which involve large scale water sources and water delivery schemes. All the major tropical diseases, socioeconomic problems and psychosocial factors which involve the use and establishment of man-made water sources are presented.

80. Agency for International Development. 1969. Small Wells Manual. Dept. of State, Washington, DC.

81. Attoungblan, Y. 1977. Le projet de reforestation de la TZG (Societe allemande pour la Cooperation technique) en Haute-Volta, in Developpement et Cooperation, no. 4/77, pp. 17-18.

82. Bradley, D.J. and P. Emurwon. 1968. Predicting the Epidemiological Effects of Changing Water Sources. East African Medical Journal, 45(5):284-291.

This article discusses the changes in disease transmission which might result when water sources are changed. The epidemiological effects considered deal primarily with contamination of drinking water sources. Fecal coliform counts were performed in three areas of East Africa. Dug wells and protected springs reduced but rarely eliminated the pollution of water sources. The many factors complicating the epidemiological interpretation of fecal coliform counts in small water sources are discussed and in general, the idea that water will eventually be contaminated if not closely monitored is brought out. The quantitative indices of pollution are expressed; however, the epidemiological repercussions that this pollution might have are noted but no definite statement is made. It is a good review

article to see how water sources can be evaluated for quality when they are implimented.

83. Bradley, D.J. 1968. Predicting the Epidemiological Consequences of Changing Water Sources. Part II. A Comparative Approach to Suburbanization. East African Medical Journal, 45(5):333-340.

84. Centre International de L'enfance - Paris. 1976. l'Enfant en Milieu Tropical: Numero Six, No. 103, 36pp.

85. Chamard, P. 1975. Environnement, agriculture et nutrition dans la zone sahelienne. L'Information geographique, 3:125-129.

This article reviews the interface which exists between the environment, agriculture and nutrition in the Sahel. The development of agriculture and improved nutrition is noted as a worthwhile pursuit, however, the interaction between the attainment of that goal and the environment is consistently mentioned. The brevity of this article is an advantage and it should be considered as a good reference source.

86. Chambers, R. 1970. The Volta Resettlement Experience. Praeger Publishers, New York. 286pp.

87. Chu, K.Y. 1978. Trials of Ecological and Chemical Measures for the Control of Schistosoma Hematobium Transmission in a Volta Lake Village. Bulletin WHO, 56(2):313-322.

88. Darrow, K. and R. Pam. 1974. Appropriate Technology Sourcebook. A Guide to Plans and Methods for Village and Intermediate Technology. 52-65pp.

89. Deom, J. 1976. Mise en valeur des ressources hydriques et sante. Bibliographie selective, 1er supplement. Organisation Mondiale De La Sante, MPD/77.7 (Addendum 1 to MPD/76.6) 11pp.

90. Deom, J. 1976. Mise en valeur des ressources hydriques et sante. Bibliographie selective, Organization Mondiale De La Sante. MPD/76.6, 67pp.

91. Deschiens, R. and M. Cornu. 1976. Commentaires ecologiques et epidemiologiques concernant les bilharzioses et le lac de retenue de Kossou (Cote d'Ivoire). Bulletin de la Societe de pathologie exotique, 69(2): 163-169.

This article discusses the creation of Lake Kossou in 1972 and the marked rise in the incidence of urinary and intestinal schistosomiasis which occurred in the Ivory Coast. The authors discuss the Ecology of the Kossou Lake Basin and the pattern of transmission of schistosomiasis in the Ivory Coast. It is a very good review article and can be used as a case study for future reference for those interested in the transmission of parasitic diseases and the effects of man-made lakes on their transmission.

92. Farid, M.A. 1975. The Aswan High Dam Development Project, Pp. 89-102, in Man-made Lakes and Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

This article reviews the ecological, social, economic and health consequences associated with the Aswan High Dam development project. It is a comprehensive reference and can be used to determine what can happen when new water sources are created through dams and lakes. It has value to the layman and technician as a good source of important information concerning the development of lakes and dams in the future.

93. Feachem, R. et al. 1977. Water, Waste, and Health in Hot Climates. John Wiley and Sons, New York.

94. Fresson, S. 1978. La participation paysanne sur les perimetres villageois d'irrigation par pompage de la zone de Matam au Senegal. Paris, Centre de Developpement de l'OCDE, 1978, 65p., annexes, selection de tableaux.

95. Gannett Fleming Corddry and Carperter, Inc. 1978. Interim Report for O.M.V.S. Assessment of Environmental Effects of Proposed Developments in the Senegal River Basin, Supplemental Report, Harrisburg, Pa., 40pp.

96. Gannett Fleming Corddry and Carperter, Inc. 1978. Interim Report for O.M.V.S. Assessment of Environmental Effects of Proposed Developments in the Senegal River Basin, Chapter IV, pp. 88-102.

97. Giri, J. and B. Meunier. 1977. Evaluation des energies nouvelles pour le developpement des Etats africains Paris, Ministere de la Cooperation; Montrouge, SEMA, 1977.

98. Glantz, M.H. 1977. Desertification: Environmental Degradation in and around Arid Lands. Westview Press, Boulder, Colorado. 346pp.

This book deals with the overall process of desertification. It goes into considerable detail about causes, problems and solutions. It is a compendium of articles from different authors and presents views ranging from the U.N. perspective of desertification, the energy crisis, rainfall and meteorological statistics, demographic trends and efforts to reclaim land lost to the desert. It is a fine reference book and should be used by those readers who are more interested in the desertification process.

99. Gratz, N.G. 1976. The Importance of Chemicals in the Control of Tropical Diseases. Springer-Berlag, Berlin Heidelberg, New York, 85-180pp.

100. Groupement Manantali. 1977. O.M.V.S. Etude d'execution du barrage et de l'usine hydro-electrique de Manantali: Etude des incidences sur l'environnement de l'amenagement du lac de barrage de Manantali sur le Bafing - Senegal, 14:95-103.

101. Hollister, A.C. et al. 1955. Influence of Water Availability on Shigella Prevalence in Children of Farm Labor Families. American Journal of Public Health, 45:345-362.

102. Howe, James W. Energy for the Villages of Africa. Recommendations for African Governments and Outside Donors. Washington, D.C., Overseas Development Council, 1977, 136 p., bibliogr.

103. Hubbard, F.H. 1977. Lake Chad Basin Commission (LCBC) : Multidisciplinary Mission. Environment Sector. Hastings-on-Hudson, NY. 75-20, 55pp.

104. IBRD. 1974. International Development Association, Central Projects Staff: Public Utilities Department. Village Water Supply and Sanitation in Less Developed Countries. P.U. Report No. Res 2. 24-28pp.

105. Kawata, K. 1967. Providing a Safe Water Supply In The African Bush. Public Health Reports, 82(12):1057-1062.

106. Kawata, K. 1978. Water and Other Environmental Interventions-The Minimum Investment Concept. The American Journal of Clinical Nutrition, 31:2114-2123.

107. Kassas, M. 1972. Impact of River Control Schemes on the Shoreline of the Nile Delta, Pp. 178-188, in The Careless Technology, Farvar and Milton eds., The Natural History Press, Garden City, New York, 1030pp.

This article discusses the relationship between the formation of the Aswan High Dam and the shore line of the Alexandria Delta Region. The author states that since the flow of the Nile was severely impeded by the formation of the dam, the shore line of the Delta was significantly altered. This affected the sardine industry and the amount of silt that flows into the Delta during the rainy season. The article aptly points out that seemingly fool proof and well intentioned plans can cause serious adverse effects in other often remote areas of the environment.

108. Logan, J. 1963. The Quantitative Relationships between Community Water Supplies and Economic Development. International Review of Tropical Medicine 2:27-39.

109. Malek, E.A. 1975. Effect Of The Aswan High Dam On The Prevalence Of Schistosomiasis In Egypt. Tropical Geographical Medicine, 27:359-364.

110. May, J.M. 1972. Influence Of Environmental Transformation In Changing The Map Of Disease, pp. 19-35, in The Careless Technology, Farvar and Milton eds., the Natural History Press, Garden City, New York, 1030pp.

111. McCullough, F.S. et al. 1968. Water Resources and Bilharziasis Transmission in the Misungwi Area, Muanza District, North-West Tanzania. East African Medical Journal, 45(5):295-308.

112. McJunkin, F.E. 1970. Engineering Measures for Control of Schistosomiasis. A report to the Agency for International Development. Department of Environmental Sciences and Engineering School of Public Health, University of North Carolina, Chapel Hill, N.C. 27514. 66pp.

This report is one of the best references concerning the engineering aspects of controlling schistosomiasis. It provides essential background information on the biology and ecology of the disease and the various aspects of controlling the parasite through treatment, prevention, vector control, and destruction of intermediate forms of the parasite. The final portion of the pamphlet involves the engineering methods designed to limit the spread of infection. These include channel design, reservoir design, environmental sanitation, public water supply, agricultural practices, and recommendations for the practical application of these control measures. It is written in a simple and succinct style and is readily understood by both the technician and the layman.

113. McMullen, D.B. et al. 1962. Bilharziasis Control in Relation to Water Resources Development in Africa and the Middle East. Bull. Wld. Hlth. Org., 27:25-40.

114. Mission ORSTOM aupres de l'OCCGE. Etude de l'environnement sanitaire du futur site du barrage de Noumbiel. No. 6.384/Doc. Tech. OCCGE. 37pp.

115. Morse, E.V. 1976. Salmonellosis in Man and in Animals as an Environmental Health Problem. Journal of the Environmental Sciences and Health, 12:755-769.

116. Obeng, L.E. 1975. Health Problems of the Volta Lake Ecosystem, Pp. 221-232, in Man-made Lakes and Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

This review article discusses the problems involved with the creation of the Volta Lake. It presents information and data on the transmission of malaria, schistosomiasis, onchocerciasis and other vector-borne infections. It deals with the question of resettlement and the administration of suitable support for relocated populations.

117. Odum, E.P. 1968. The Strategy of Ecosystem Development. Science, 164:262-270.

This is a technical article which explains the development of an ecosystem. It explains successional stages of flora and fauna involved with the evolution of a stable ecosystem. Interdependent ecological relationships are mentioned as is the ecological concept of species diversity promoting ecological stability.

118. Philippon, B. et J. Mouchet. 1976. Repercussions des amenagements hydrauliques a usage agricole sur l'epidemiologie des maladies a vecteurs en Afrique intertropicale. Colloque International: L'eau et les activities agricoles. Paris, 3-5 mars 1976. Cahiers du C.E.N.E.C.A., 3213. 13pp.

This article discusses the various vector-borne diseases as they relate to the development of agricultural systems. Onchocerciasis, malaria, schistosomiasis, and trypanosomiasis are discussed. Particular attention is paid to the habitats created by these development activities for the vectors which transmit tropical diseases.

119. Raybould, J.N. 1968. Change and the Transmission of Onchocerciasis. East African Medical Journal, 45(5): 292-294.

This brief article deals with the changes created in the environment and the transmission of onchocerciasis. Dam building projects are mentioned not only as providing new breeding habitats for the vector, but also resulting in the attraction of large numbers of people and thereby creating favorable conditions for the rapid transmission of

this disease. Artifical breeding places such as spillways erected for traffic or irrigation purposes are an important factor in the epidemiology of this disease. Increasing water pollution in an area may decrease the number of larvae in an onchocerciasis stream as may bush clearing. The article mentions that since the vectors for onchocerciasis breed in thick forest streams, the clearing of such forests or surrounding bush may facilitate the transmission of the disease by enabling the fly to expand its flight range. Furthermore, efforts to make the habitat unsuitable for the simulium flies which transmit onchocerciasis may enhance the conditions for the snail vectors which transmit schistosomiasis. The author concludes by stating that major dam building and irrigation projects and resettlement schemes should only be undertaken after prior consultation with entomologists, vector biologists and epidemiologists to determine the impact on the transmission of these major tropical diseases, onchocerciasis being particularly important.

120. Rzoska, J. 1976. A Controversy Reviewed; The Arguments Over the Aswan High Dam on The River Nile. Nature, 261:444-445:76.

121. Saunders, R.J. and J.J. Warford. 1976. Village Water Supply: Economics and Policy in the Developing World. A World Bank Research Publication. The Johns Hopkins University Press, Baltimore and London. 279pp.

This book represents a definitive reference on village water supply. It discusses the nature of the problem, the goal of improving human health, the cost benefit analysis of investments into rural water supply and sanitation, and the planning of rural water supply programs. It includes appendices which present data on diarrheal diseases, parasitic diseases and mortality associated with contaminated water. It is a fine book for those development personnel who are dealing with rural water supply and can be beneficial to both the expert and layman when planning or designing village water supply systems.

122. Schliessmann, D.J. 1959. Diarrhoeal Disease and the Environment. Bulletin World Health Organization, 21:381-386.

123. Schumacher, E. 1973. Small Is Beautiful. Harper and Row, 305pp.

The author of this book was the individual who coined the phrase "appropriate technology" and the book centers around the theory, characteristics, and feasibility of appropriate technology in the developing world. All aspects of technological input are reviewed throughout the book. Although not every aspect of appropriate technology is applicable in the Sahel, this source contains a great deal of information that can be applied now and in the future to improve the chances of successful development in the region.

124. Scudder, T. 1975. Resettlement, Pp. 453-472, in Man-made Lakes and Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

125. Simpson, D.I.H. 1975. The Kisumu Study, Pp. 209-220, in Man-made Lakes and Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

126. Stanley, N.F. and N.P. Alpers. eds. 1975. Man-made Lakes and Human Health. Academic Press, New York. pp. 495.

This book is one of the best references for the individual who is interested in getting a broad perspective on the impact of man-made lakes and

water sources on human health. It is a compendium of articles dealing with almost every aspect of man-made lakes and their relation to human health. All the major tropical diseases are discussed as are the political and socioeconomic factors associated with the transmission of these diseases. Case studies are presented throughout the book and it is written for the expert as well as the layman.

127. Wagner, E.G. and J.N. Lanoix. 1958. Excreta Disposal for Rural Areas and Small Communities. World Health Organization, Geneva. Monograph Series. No. 39:187.

128. Weber, F.R. Reforestation in Arid Lands. New York, VITA, Action/Peace Corps, 1977, 248 p., bibliogr. (Manual Series no 37E).

129. Webster, M.H. 1975. Medical Aspects of the Kariba Hydroelectric Scheme, Pp. 69-88, in Man-made Lakes and Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

130. Weir, J.M. et al. 1952. An Evaluation of Health and Sanitation in Egyptian Villages. Journal of Egyptian Public Health Association 27:55-114.

131. Westerman, A.G. et al. 1969. Dams and simulium damnosum. WHO Chron., 23:89.

132. White, G.F. et al. 1972. Drawers of Water: Domestic Water Use in East Africa. The University of Chicago Press, Chicago and London, 306pp.

This book discusses the association between water delivery and human health. It presents designs for water delivery systems and the dangers which are associated with them. Inappropriate and costly efforts are reviewed and the positive and negative aspects of both are discussed. The book is filled with diagrams and engineering procedures to maximize the use of water delivery and case studies are consistently presented to inform the reader of the hows and whys of village water development.

133. White, G.F. 1972. Organizing Scientific Investigations to Deal with Environmental Impacts, 914-962pp., in The Careless Technology, Farvar & Milton, Natural History Press, Garden City, N.Y., 1030pp.

134. Wolman, A. and H.M. Bosch. 1963. U.S. Water Supply Lessons Applicable to Developing Countries. Journal, American Water Works Association, 55:946-956.

135. Wolman, A. 1971. Water Supply and Environmental Health. Journal, American Water Works Association, 62:746-749.

136. World Bank. 1974. Environmental, Health and Human Ecologic Considerations in Economic Development Projects. World Bank, Washington, D.C. 142pp.

137. World Bank. 1976. Village Water Supply (A World Bank Paper). World Bank, Washington, D.C., 96pp.

This book reviews the major aspects of water supply in the developing world. Its chapters touch on the situation of water delivery now and in the future. The technical aspects and cost of water delivery, the organization and management of water delivery programs, the justifications for investments in village water supply and the priorities involved with implementing water delivery in small villages are presented. It is a good handbook and can be readily obtained through the World Bank and has great value in the field for those involved with water development activities.

138. _____. 1978. Installations solaires a l'usage du developpement rural. Afrique-Agriculture, no 32, ler avril 1978, p. 15.

General Development

139. Agency for International Development. 1975. Water, Engineers, Development and Disease in the Tropics. Department of State, Washington, DC.

140. Barton, W.L. 1971. Health As An Investment In Developing Countries. Trans. of the Royal Society of Tropical Medicine & Hygiene, 65(4):29-39.

141. Banerji, A.P. 1977. Environmental and Infrastructural Aspects of Housing. J. Assoc. Eng. India, 52(2):115-126.

142. Benneh, G. and G.A. Semiti. 1976. Nutrition and the Human Environment. African Environment: Occasional Paper, 76(8):1-36.

143. Black, R.H. 1975. Human Ecological Factors of Significance, Pp. 363-374, in Man-made Lakes and Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

This article discusses the role of human behavior, the surrounding environment and the transmission of disease as they are associated with man-made lakes. Traditional practices such as water gathering, bathing, herding, and farming are considered in the context of exposure to parasitic organisms. Ecological change brought about by the development of water sources (i.e. lakes) are emphasized and the way in which disease transmission relates to these changes is discussed. This is a good general review article to increase the reader's awareness of the importance of ecological change and the bearing it has upon the transmission of tropical diseases.

144. Bradley, D.J. and P. Emurwon. 1968. Predicting The Epidemiological Effects Of Changing Water Sources: Part I. A quantitative approach. East African Medical Journal, 45(5):284-291.

145. Browne, S.G. 1976. Research in a "Bush Hospital." Tropical Doctor, 6:187-189.

This article discusses the personal experience of Dr. Browne from 30 years of a busy mission in the Belgian Congo. It reviews the mistakes that were made in research into tropical diseases and sets out guidelines as to what should be done to facilitate investigation into the transmission of tropical diseases in the bush. A number of the major tropical diseases are discussed.

146. Bryant, J. 1969. Health & the Developing World. Cornell University Press, Ithaca and London. 345pp.

This book is one of the classic references on health and its relation to international development. Rural health care delivery systems are explained and practical approaches to the delivery of health care are presented. A broad spectrum view of health and development forms the basis of the book and it is an invaluable reference for those interested in implementing rural health care in the developing world.

147. Carter, L.J. 1969. Development in the Poor Nations: How To Avoid Fouling the Nest. Science, 163:1046-1048.

The author stresses the importance of learning from past experiences that severe environmental consequences accompany well intentioned development activities. Problems in pollution, disease transmission, habitat and wildlife all are seen as potentially negative and serious effects. Industrialization vs. rural development is considered and the author maintains that these decisions must be tempered with extreme caution. Dams, reservoirs, resettlement, new lands development, pest control, and island development are all considered in the article and the need to recognize adverse environmental impacts is constantly emphasized. The author states that in order to avoid fouling the nest, basic changes in human behavior must accompany future development activities.

148. Chung, H.F. 1977. How Schistosomiasis Control Work is Run in New China. Chinese Medical Journal, 3(2): 86-94.

149. Claireaux, H. 1977. Sante et developpement rural en Haute-Volta. Nations Solidaires, No. 62:12-13.

150. Clinton, J.J. 1979. Health, Population and Nutrition Systems in LDC's: A Handbook. Family Health Care, Inc. Washington, DC.

151. Conly, G.N. 1975. The Impact of Malaria on Economic Development: A Case Study. Pan American Health Organization, Scientific Publication #297.

Although this booklet is not Sahel specific, the information contained in its pages can be quite valuable for development personnel in the Sahel. It reviews the transmission of malaria and its relation to economic development (i.e. human vigor and productivity). It is a quantitative statement on the impact of malaria on local economy. Although few direct relationships are unequivocally stated, the relationships are seen as real and very valuable insights can be gained from reviewing this document.

152. Dalton, P.R. 1976. A socioecological approach to the control of Schistosoma mansoni in St. Lucia. Bull. WHO, 54:587-595.

This article presents the possibility of controlling schistosomiasis by lowering the amount of host-parasite contact. This was done on a comparative basis by evaluating the amount of contact with water and how much human-water contact was decreased when a household water supply was provided. The author maintains that consideration should be given to measuring and assessing the relative importance of different activities involving contact with water since they form the basis for transmission for a number of water related diseases and can do a great deal to formulate control strategies. Although the article deals with a situation in the Caribbean, the basic concepts of the sociological approach to control of the disease can be applied to the Sahel and throughout the world.

153. Dejene, T. and S.E. Smith. 1976. Experiences in Rural Development: A Selected, Annotated Bibliography of Planning, Implementing, and Evaluating Rural Development in Africa. Overseas Liaison Committee, American Council on Education, Washington, D.C. 48pp.

154. Downing, R.I. Health and National Economy. Medical Journal of Australia 1:297-303, 29 February 1964.

155. Eckholm, E.P. 1977. The Picture of Health. New York: Norton & Co. 256pp.

156. Fabrega, H. Jr. 1972. The Study Of Disease In Relation To Culture. Behavioral Science, 17:183-203.

157. Farooq, M. 1963. A Possible Approach To The Evaluation of the Economic Burden Imposed On a Community By Schistosomiasis. Annals of Tropical Medicine and Parasitology 57:323-330.

158. Farooq, M. 1964. Medical and Economic Importance of Schistosomiasis. Journal of Tropical Medicine and Hygiene 67:105-112, May 1964.

159. Farvar, M.T. and J.P. Milton. (eds.) 1972. The Careless Technology: Ecology and International Development. The Natural History Press, Garden City, New York. pp. 1030.

This book is an excellent general reference on the environmental impacts of international development. All aspects of environmental impacts are considered and there are numerous articles which deal specifically with health problems. The literature contained in the book is worldwide in nature but specific examples from Africa are presented throughout its pages. The authors of the articles write in a simple and straight-forward manner and it is a book that all development planners should be aware of and refer to whenever planning or implementing new development activities.

160. Forsyth, D.M. and D.J. Bradley. 1966. The Consequences of Bilharziasis, Medical and Public Health Importance in North-west Tanzania. Bull. Wld. Hlth. Org., 34:715-735.

161. Glantz, M. 1976. The Politics of Natural Disaster. Praeger Publications, New York, 340pp.

162. Hamon, J. 1963. L'importance des changements de comportement chez les insectes. Bull. Org. mond. sante. Bull. Wld. Hlth. Org. Suppl., 115-120 pp.

This article discusses environmental change as it relates to increases in populations of disease vectors. Increases in standing water, the flow of water, human settlements, population density, all the basic factors that are involved with disease transmission, are considered and viewed as part of environmental change.

163. Hughes, C.C. Disease and "Development" in Africa. 1970. Social Science and Medicine 3:443-493.

This should be one of the first articles read by anyone interested in pursuing the relationship between international development and disease. It is Africa specific and relates to the problems with development from the standpoint of all tropical diseases, as well as nutrition. All the basic concepts of disease transmission are reviewed and the ways in which development activities may impact upon them are considered. The article has an extensive bibliography and should be referred to whenever decisions concerning the implementation of new development activities are being made.

164. Hughes, C.C. and J.M. Hunter. 1972. Development and Disease in Africa. The Ecologist, 18-23 pp.

165. Jordan, P. 1977. Schistosomiasis: Research to Control. American Journal of Tropical Medicine and Hygiene, 26(5):877- 886.

166. Kafando, T.W. 1974. Les incidences du projet de developpement integre du Liptako-Gourma sur l'ambiance milieu social milieu naturel. Dakar, IDEP, CS/2576-3: 19p.

167. Kaidi, H. 1977. Mali: Vers une constante amelioration de la situation alimentaire. Jeune Afrique, No. 839:24-25.

168. Lacoste, Yves et le Docteur Chkili. 1976. Sante et habitat "sous-integre". Environnement Africain: Etudes et Recherches, 76(6):1-16.

169. Lauture, H. et al. 1978. Medecine de developpement: l'exemple de Guinguineo au Senegal. Environnement Africain: Etudes et Recherches, 78(26):1-31.

170. Maegraith, B.G. 1975. Movement of People, Pp. 375-386, in Man-made Lakes in Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

This article discusses the movement of people in the developing world when new projects are implemented. Spontaneous immigration is considered and the problems associated with it in terms of disease transmission are reviewed. Population density increases are noted as a prime mechanism for the spread of infectious and parasitic diseases. It makes the very important point that changes in population distribution, density and social structure are probable when new projects are implemented and should be anticipated before the project becomes operational.

171. McNaught, S.J. 1977. Diversity and Stability of Ecological Communities: Comment on Role of Empiricism in Ecology. American Naturalist, 111(979):515-525.

172. National Council for International Health. 1977. Interaction of Health and Development. International Health Conference. International Council for International Health. 165pp.

173. Newell, K.W. 1975. Health by the People. Division of Strengthening of Health Services, World Health Organization, Geneva, Switzerland. 206pp.

174. O.C.C.G.E. - Centre Muraz-Entomologie: Problemes de sante publique poses par la mise en valeur des regions de Kossou et de San Pedro en Republique de Cote d'Ivoire, Les vecteurs des principales maladies tropicales, Situation actuelle, Perspectives d'avenir. No. 262/ENT. 70. 47pp.

175. Omran, A.R. 1966. Impact of Economic Development on Health Patterns in Egypt. Arch. Environ. Health, 13:117-124.

176. Pairault, C. 1977. Health and Social Factors in Economic Development Projects Relating to the OCP Area. Epidemiological Evaluation Unit, Draft Working Paper OCP/EPI/77.20. Onchocerciasis Control Programme in the Volta River Basin Area. World Health Organization, 21pp.

177. Prothero, R.M. 1961. Population Movements and Problems of Malaria Eradication in Africa. Bull. Wld. Hlth. Org. 24:405-245.

The author examines in some detail the types of population movements and their relation to malaria problems in Africa. He concludes that these movements cannot be stopped and must be taken in the planning of malaria irradication programs. More information on these movements and a complex relationships between parasites, vectors, and hosts, is required, and interterritorial cooperation is essential in obtaining the information and planning.

178. Public Utilities Dept. 1974. Central Projects Staff, 1974. Village Water Supply And Sanitation In Less ·eloped Countries. International Development ..ociation. P.U. Report No. RES 2, pg. 110-139.

179. Rolland, A. 1972. Onochocerciasis In The Village Of Saint Pierre: An Unhappy Experience Of Repopulation In An Uncontrolled Endemic Area. Transactions of the Royal Society of Tropical Med. and Hygiene, 66(6):913-915.

This article discusses the problems which occured when a village was reopened after being cleared of onchocerciasis. As people migrated back into the village, health problems began to arise pertaining to not only onchocerciasis but other endemic diseases such as schistosomiasis, malaria, and enteric infections. The author states that clearing one disease from an area does not necessarily solve

the health problem of that area. A broad perspective approach to development and the opening of new lands is emphasized and maintained by the author.

180. Sahel Documentation Center. 1975-78. Sahel Bibliographic Bulletin. ISSN 0145-9481. Sahel Documentation Center. Michigan State University Libraries, East Lansing, Michigan.

181. Scheyer, S.C. and S.C. Joseph. 1977. A strategy For Health As a Component of The Sahel Development Program. Family Health Care Inc., Washington D.C., USAID Contract #AID/AFR/ C/1138, work order #8.

182. Schistosomiasis Control Leading Group. 1976. Destroying Snails by Storing Water Within Low Embankment: A Summary of Mass Experience In Schistosomiasis Control. Chinese Medical Journal, 2(5):347-352.

The authors recount that a project to flood the habitat of snails was successful. Embankments were constructed which took 88,000 work days during two seasons for two full years by 250 people. The project was integrated with agricultural production and the two complemented each other. This is an example of labor intensive activities directed towards the control of parasitic infections.

183. Sheets, H. and R. Morris. 1975. Disaster In The Desert. Carnegie Endowment For International Peace, New York. 108pp.

This book discusses in detail the causal factors associated with the Sahel drought and famine. Although it does not attempt to quantify the ecological parameters which contributed to the drought, it does do a great deal to give the reader an indication of the sociological and political components which contributed to the spread of the famine in the early 1970's. The book should be read by all development personnel since it does present a different perspective of the causes and relief efforts associated with the Sahel famine.

184. Snyder, J.C. 1972. Population And Disease Control. The American Journal of Tropical Medicine and Hygiene, 21(4):386-389.

This brief article relates the present and future problems found in the tropics because of high population growth rates and the presence of endemic disease. The author outlines the present dangers and the future problems which will be encountered if proper planning in both the population and health sectors is not executed.

185. Sorkin, A.L. 1976. Health Economics in Developing Countries. D.C.Health and Co., Lexington, Mass. Pgs. 52-57, 176-177.

186. Springett, J.A. 1975. Problems of Insect Vector Control, Pp. 323-338, in Man-made Lakes in Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

187. Sturrock, R.F. 1973. Control of Schistosoma mansoni transmission: Strategy For Using Molluscicides on St. Lucia. International Journal of Parasitology, 3:795-804.

188. Symonds, R. 1970. International Targets for Development. Harper & Row, Publishers, New York and Evanston. 266pp.

189. UNFAO. 1977. A Guide to Food and Health Relief Operations for Disasters. United Nations, New York, 10017. pp. 206.

190. World Bank. 1975. Environment and Development. World Bank. Washington, D.C. 33pp.

This pamphlet discusses the relation between the physical environment and development projects. The pamphlet reviews the bank's accumulated knowledge and states that environmental problems have an additive impact. If only remedial action is taken after a problem is encountered, the overall outcome will not be as successful as if the problem was foreseen and avoided or minimized at the design

stage of an activity. Additional cost for environmental and health safeguards are seen to have a range from 0 to 3% of the total projected cost and in the end are probably more cost-effective than otherwise unsatisfactory remedial action. Although the pamphlet is a general statement on the association between environment and development, it is a good review and should be considered by project personnel interested in this topic.

191. Zukin, P. 1971. Planning A Health Component for an Economic Development Program. AJPH, 61(9):1751-1759.

General Disease

192. African--American Scholars Council. 1977. Working Conference, Programmatic and Research Strategy for the Control of Major Endemic Diseases in Africa. African--American Scholars Council, Washington, DC.

193. Axnick, N.W., Shavell, S.M. and Witte, J.J. 1969. Benefits due to Immunization against Measles. Public Health Reports 84:673-680.

194. Baldry, D.A.T. 1972. A History of Rhodesian Sleeping Sickness in the Lambwe Valley. Bull. Wld. Hlth. Org. 47:699-718.

195. Beaton, G.H. and J.M. Bengoa. 1976. Nutrition in Preventive Medicine: The Major Deficiency Syndromes, Epidemiology, and Approaches to Control. World Health Organization, Geneva. 590pp.

This book is the most recent definitive work describing the importance of nutrition in international development. It is a compendium of articles written by world experts in the fields of nutrition, tropical disease, epidemiology, and health care planning. It is filled with data from all over the world and is an excellent reference book for those individuals interested in pursuing the topic of nutrition in greater detail. The major nutritional deficiency syndromes are discussed, the epidemiology of nutrition is discussed, approaches to controlling malnutrition in the developing world are reviewed and field methods for assessing nutritional status and planning nutritional programs are discussed. It is published by the World Health Organization and can be readily obtained through that agency in Geneva.

196. Benerji, D. 1965. Tuberculosis: A Problem of Social Planning in Developing Countries. Medical Care 3:151-159.

197. Berg, A. 1973. The Nutrition Factor: Its Role in National Development. The Brookings Institution. 290pp.

This general reference places the worldwide problem of undernutrition in an interesting and easily understandable context. The worldwide problem of undernutrition is discussed and the relationship between malnutrition and underdevelopment is reviewed. Nutrition education, agricultural development and nutrition, economic growth and nutrition, and improved nutrition as it relates to population increases are also reviewed. New foods, nutrition planning, feeding programs, and policy directions and program needs are presented throughout the text. It is a good reference that can be used by either the layman or the expert for obtaining more detailed information on nutritional problems in the developing world.

198. Brown, R.E. 1966. Medical Problems of the Developing Countries. Science 153:271-275.

199. Centre de Recherches pour le Developpement International. 1974. La lutte contre les tse-tse. Rapport d'un groupe scientifique consultatif reuni a l'Universite Memoriale de Terre-Nueve, St. Jean, Canada.

200. Challier, A. 1971. La transmission de la trypanosomiase humaine en Afrique Occidentale: Ecologie et controle des vecteurs. Ann. Soc. Belge Med. Trop., 51(4-5):548-558.

201. Challier, A. et M. Eyraud. 1977. Etude Complementaire sur les "Consequences de la creation de la cuvette de retenue de Koulbi-Noumbiel (Haute-Volta) sur les populations d'insectes vecteurs de maladies humaines. I.-Consequences sur les populations de glossines vectrices de la maladie du sommeil". O.C.C.G.E. - Centre Muraz. Laboratoire D'Entomologie, 6.538:1-6. Doc. Tech. OCCGE.

202. Cole, T.J. and J.M. Parkin. 1977. Infection and its effects on the growth of young children: A comparison of The Gambia and Uganda. Trans. of the Royal Society of Tropical Medicine and Hygiene, 71(3):196-198.

203. Coz, J. et al. 1968. La resistance des anopheles aux insecticides en Afrique Tropicale et a Madagascar. Cah. O.R.S.T.O.M., Ser. Ent. Med., VI(3):207-210.

204. Dejoux, C. 1975. Action du molluscicide "Frescon" sur certains elements de la faune non cible des lacs tropicaux. Cah. O.R.S.T.O.M., Ser. Ent. Med. et Parasitol. XIII(2):81-83.

This article discusses the fact that stagnant bodies of water provide a suitable habitat for the development of aquatic snails and the transmission of schistosomiasis. In Molluskicides Frescon (N-trityalmorpholine) is highly toxic for these intermediate hosts and can be used to control them. However, the author states that very little is known about the effects of this chemical on non-target organisms like small aquatic insects. The experiments carried out in the article suggest that using Frescon on a large scale may not be entirely harmless. Numerous invertebrates and small fishes may be adversely affected. Therefore, the author stresses caution and further research before Frescon is applied on a large scale.

205. Diamant, B.Z. 1976. Vector Control Problems With Contradicting Host Habitats. Public Health Engineer, 4(1):1-6.

The writers say that the best control of vector-borne diseases such as schistosomiasis is environmental control using civil engineering. Chemical control, which practices the use of poisons to which vectors can become resistant, is only secondary to the environmental control.

206. Dias, L.C. et al. 1978. Parasitological and Ecological Aspects of Schistosomiasis Mansoni in the Valley of the Paraiba Do Sul River 1. Trans. Roy. Soc. Trop. Med. Hyg., 496-500.

207. Duvallet, G. et al. 1977. Le foyer de trypanosomiase humaine de Gueua (Haute-Volta) Enquete clinique, parasitologique et immunologique. Organisation De Coordination Et De Cooperation Pour La Lutte Contre Les Grandes Endemies. Centre Muraz, Section Biologie No 183/Bio. Mai. 1977. No 6358/Doc. Tech. OCCGE, 3pp.

208. Eckholm, E.P. 1977. The Picture of Health: Environmental Sources of Disease. W.W. Norton & Company Inc. New York. 256pp.

209. Erasmus, D.A. 1977. Host-Parasite Interface of Trematodes. Advances in Parasitology, 15:201-242.

210. Farooq, M. 1963. A Possible Approach to the Evaluation of the Economic Burden imposed on a Community by Schistosomiasis. Am. J. Trop. Med. Parasit., 57:323-331.

This article approaches the quantitative assessment of schistosomiasis and disability and a means for evaluating the economic burden imposed by this disease. The study was conducted in the Philippines. The average economic loss of a person infected with schistosomiasis was 52 pesos and by a comparison with a recent estimate of economic loss due to malaria, schistosomiasis was seen to be probably more important. A need is stressed for more precise methods both in the clinical classification of disease and determination of its economic consequences.

211. Farooq, M. 1964. Medical and Economic Importance of Schistosomiasis. Jour. of Trop. Med. and Hyg., 67:105-112.

212. Goodwin, L.G. 1977. Seventeenth Seminar on Trypanosomiasis, Session I-IV. Roy. Soc. Trop. Med. Hyg., 71(1):1-15.

This series of articles presents an overall view of the trypanosomiasis problem throughout the world. It investigates the ecology, biochemistry, immunology, and vector control as well as other aspects of the disease. It is a fine review article for those interested in the more technical aspects of disease transmission and the ways in which it may be controlled in the future.

213. Hamon, J. et al. 1965. Etudes entomologiques sur la transmission du paludisme humain dans une zone de steppe boisee, la region de Dori (Republique de Haute-Volta). Bulletin de l'I.F.A.N., 27, Ser. A, 3:1115-1150.

This article represents a cumulation of six inquiries over 14 months which studied the distribution of anopheline mosquitos in the region of Dori in Northeast Upper Volta. It is an area that is inhabited primarily by nomads. Human densities were determined as were the proximity of living quarters to breeding sites and the prevalence and incidence of the infection in the human population. Anopheles gambiae and A. funestus were the primary vectors. Point 31% and point 15% respectively were infected. The article presents a good deal of data and can be referred to by both the expert and the layman to better understand how a malaria prevalence survey can be conducted.

214. Hamon, J. 1967. Culex pipiens fatigans (Wiedemann), Wuchereria bancrofti (Cobbold), et le developpement economique de l'Afrique tropicale. Bull. Org. Mond. Sante, (37):217-237.

215. Hamon, J. et al. 1970. Problems Facing Anopheline Vector Control: Vector Ecology and Behavior Before, During, and After Application of Control Measures. Miscellaneous Publications of the Entomiological Society of America. 7(1):28-44.

216. Hamon, J. et al. 1971. La transmission du virus amaril en Afrique occidentale. Ecologie, repartition, frequence et controle des vecteurs, et observations concernant l'epidemiologie de la fievre jaune. Cah. O.R.S.T.O.M., Ser. Ent. Med. Parasitol., IX(1):3-60.

217. Hardy, A.V. and M.M. Galton. 1955. Salmonellosis, The Role of Food Processing Plants in the Dissemination of Salmonella. Am. Jour. Trop. Med. Hyg., 4:725-738.

218. Imperato, P.J. 1969. Traditional Attitudes Towards Measles In The Republic Of Mali. Transactions of the Royal Society of Tropical Medicine and Hygiene, 63(6):768-780.

219. James, M.T., and R.F. Harwood. 1969. Medical Entomology: Sixth Edition. The Macmillan Company, Toronto, Ontario, 484pp.

This is one of the best general references available on the subject of Medical Entomolgy. It reviews all aspects of medical entomology from the vector standpoint and also covers the transmission of vector-borne diseases. It is a source of numerous references and although slightly dated (1969), it still remains a fine reference for the medical entomologist and any personnel interested in learning more about the field of medical entomology.

220. Jeffery, H.C. and R.M. Leach. 1968. Atlas of Medical Helminthology and Protozology. E.S. Livingstone Ltd. London. 121pp.

221. Jobin, W.R. et al. 1976. Schistosomiasis In The Gorgol Valley of Mauritania . The American Journal of Tropical Medicine and Hygiene, 25(4):587-594.

222. Klarman, Herbert E. 1965. Syphilis Control Programs. In: Measuring Benefits of Government Investments. R. Dorfman, editor. Brookings Institution, Washington, D.C..

223. Kloth, T.I., et al. 1976. Sahel Nutrition Survey, 1974. American Journal of Epidemiology, 103(4):383-390.

This article was the result of a study conducted by a Center for Disease Control team in 1974 in the Sahel. It presents some very valuable information about the seriousness of the drought of the early 1970's in the Sahel and the groups most affected by it. The article indicates that up to 15% of the children between the ages of 6 months and 6 years were acutely undernourished. Although the review is slightly technical, it has benefit both to the layman and the expert interested in nutrition planning for the entire region.

224. Latham, M.C. and F. Cobos. 1971. The Effects of Malnutrition on Intellectual Development and Learning. American Journal of Public Health, 61:1307-1324.

225. Lemasson, J.M. et O.T. Diaw. 1978. Donnees epidemiologiques de la bilharziose urinaire dans le delta du Fleuve Senegal. S.A.E.D. project DEBI Lampsar, Etudes Sanitaires, 18 SE.

226. Markell, E.K. and M. Voge. 1976. Medical Parasitology: Fourth Edition. W.B. Saunders Company. Philadelphia, PA, 393pp.

This book is probably the best general reference for parasitology today. Although it is not as detailed as most parasitology books, the information contained in it is quite comprehensive and more than enough for those non-parasitologists interested in finding out specific information about a particular parasitic disease. The book is filled with photographs and tables and data from areas throughout the world and presents a fine general review of the field of parasitology.

227. Manson, P. and P. Manson-Bahr. 1972. Manson's Tropical Diseases. Wilcocks & Manson-Bahr, The Williams and Wilkins Company, Baltimore, 1164pp.

For those interested in pursuing the topic of parasitology and tropical disease in general in greater detail, this book is the best field reference available. All aspects of tropical disease are covered in this book as are every tropical disease in the world. The epidemiology, chemotherapy, prevention, ecology, and almost every aspect of tropical disease one can think of is included in the book. It is highly recommended for anyone who wants to pursue the topic of tropical medicine in great detail.

228. McKelvey, J.J. 1973. Man against The Tsetse -- Struggle For Africa. Cornell University Press, Ethica, New York, 286pp.

This book is an excellent review of the trypanosomiasis problem in Africa today and in the past. It is a book that is written for the expert and layman alike and provides an interesting and valuable amount of information for the interested reader. It delves into the problems with the problems of controlling trypanosomiasis in both East and West Africa, the successes and failures, and the outlook for the future control of this disease. It is a book that is orientated towards the ecology of

transmission of trypanosc [illegible] and is written in a style that is both enjoy[illegible] informative.

229. Millar, J.D. and W.H. Forge. [illegible]9. Status of Erradication of Smallpox (and Control of Measles) in West and Central Africa. The Journal Of Infectious Diseases, 120(6):725-732.

230. Mondot-Bernard, J.M. 1974. Essai d'analyse de situation alimentaire en Afrique. CD/SDD/292. OCDE, Paris, France.

231. Morley, D. 1969. Severe Measles in the Tropics.--I. Medicine In The Tropics. British Medical Journal, 1:297-300.

A survey in West Africa shows the mortality in children admitted to a hospital with measles to be 12.3%. However, this hospital admitted only those children who were the most seriously ill and mortality was respectively about 2 to 4 times as great as the overall figure. However, this article states and clearly shows that measles is indeed a severe disease in tropical countries. It is a good general review for the reader who is interested in obtaining more information about the transmission of seemingly benign diseases in tropical countries.

232. Mouchet, J. et al. 1976. Resistance aux insecticides d'aedes aegypti L. & culex pipiens fatigans en Afrique Centrale. Cah. O.R.S.T.O.M. Ser. Ent. med, et Parasitol, 10(4):347-354.

233. Murray, J. et al. 1978. The Biological Supression of Malaria: An Ecological and Nutritional Interrelationship of a Host and Two Parasites. American Journal of Clinical Nutrition, 31(8):1363-1366.

234. Noquer, A.K. 1978. La bataille contre le paludisme. Sante Monde, avril, 1978:12-17.

235. O.R.S.T.O.M. 1978. L'onchocercose humaine en Afrique de l'ouest.

236. Owolabi, S. 1976. Environmental and Cultural Determinants of the Problems of Human Nutrition and Disease in East and West Africa. University Microfilms International, Ann Arbor, Michigan, London, England. 494pp.

237. Pacific Consultants. 1978. Report of Ad Hoc Committee On Control of Endemic Diseases in Africa. Pacific Consultants, 2020 K Street, N.W., Washington, DC 20006.

238. Phillipon, B. et J. Mouchet. l'Onchocercose. O.R.S.T.O.M., Bondy, France.

239. Pieron, R. et al. 1978. A propos de 357 cas de tuberculose du noir africain transplante. Medecine d'Afrique Noire, 25(11):633-649.

240. Prod'Hon, J. 1977. Bilan des etudes epidemiologiques menees dans les foyers d'onchocercose de l'OCCGE. XVII Conference Technique. Bobo-Dioulasso Du, No. 6.429/77. Doc. Tech. OCCGE.

241. Prost, A. et al. 1978. Les niveaux d'endemie dans l'onchocercose. OCP/STAC. 7.1, OCP/EPI/78.38. Septieme reunion, Brazzaville.

242. Prothero, R.M. 1961. Population Movements and Problems of Malaria Eradication in Africa. Bull. Wld. Hlth. Org., 24:405-425.

243. Quelennec, G. et M. Ovazza. 1968. La lutte contre les simulies. Cah. O.R.S.T.O.M., Ser. Ent. Med., 5(3/4):198-205.

244. Quilici, M. et al. 1978. Prevalence des treponematoses parmi les populations nomades sedentarisees des villages de Djebok et Tin Aoukert, Region de Gao. Republique du Mali. Medecine d'Afrique Noire, 25(5) 299-303.

The authors indicate the prevalence of treponema infections in sedentary nomads of Moli. Data is presented on the percent infected (42%), the age and sex distribution of the infections (males

36.6%, females 45.3%), and the reasons for the presence of the infection in these groups. It is a good article to show the way in which a prevalence study can be conducted and the importance of treponema infections in the Sahel.

245. Quilleriere, D., Gouzy, Ml, Sechan, Y. et Pendriez, B. 1977. Etude du complex sililum damnosum en Afrique de l'Ouest VI. Analyse de l'eau des gits larvaires en saison des pluies, comparaison avec la saison seche. Cah. ORSTOM, Ser, Ent. Med. Prasitol. Paris, Vol. 15, No. 3:195-207.

246. Raybould, J.N. 1968. Change and the Transmission of Onchocerciasis. East African Medical Journal, 45(5): 292-294.

247. Roberts, J. 1964. The Control of Epidemic Malaria in the Highlands of Western Kenya. Journal of Tropical Medicine and Hygiene 67:161-168.

248. Royal Society of Tropical Medicine and Hygiene. 1978. Medical Entomology Centenary. Symposium Proceedings, 23rd to 25th November 1977. Royal Society of Tropical Medicine and Hygiene, London, Supplement.

This article reviews the symposium proceedings on medical entomology. It is an article that can be reviewed by both the expert and the layman and be interesting and informative to both. The general aspects of vector ecology are considered particularly as they relate to the control of onchocerciasis and malaria in the world. Many of the features of vector control brought out in the article are particularly applicable to the Sahel and should be noted by the reader interested in finding out more about the methods of control and the future possibility of successful control endeavors.

249. Sales, P. 1977. Rapports et communications se rapportant aux trypanosomiases recus au Centre De Documentation Et De Statistique De L'O.C.C.G.E. No. 6.565/Doc. Tech. OCCGE. 85pp.

250. Sales, P. 1977. Rapports et communications se rapportant au Paludisme recus au Centre De Documentation Et De Statistique De L'O.C.C.G.E. No. 6.543/Doc. Techn. OCCGE. 91pp.

251. Sales, P. 1977. Rapports et communications se rapportant aux bilharzioses recus au Centre de Documentation et de Statistique de L'O.C.C.G.E. No. 6.542/Doc. Techn. OCCGE. 17pp.

252. Schwabe, C.W. 1969. Veterinary Medicine and Human Health. The Williams and Wilkins Co. Baltimore, Maryland. 713pp.

This book is a fine reference source for those interested in veterinary practices. It explains the ecology of zoonotic diseases, their importance, and solutions. Although the book is geared primarily towards United States problems, the information contained within its pages can be of use to those planners in the Sahel.

253. Scrimshaw, N.S. et al. 1968. Interactions of Nutrition and Infection. World Health Organization, Geneva. Monograph Series, No. 57:329.

This monograph describes in detail the many interactions which exist between nutrition and infection. A great deal of data is presented throughout the monograph and the association is clearly indicated. It is a book which is geared to the expert, however, a very great deal of valuable information can be learned by the layman if he reviews the document carefully. This monograph does a great deal to clarify the interaction which exists between nutrition and infection and substantiates many of the theories previously put forth about the association.

254. Sellin, E. et al. 1965. Etude de la repartition des mollusques hotes intermediaires des schistosomes humains en Afrique de l'Ouest: 1 - Premiers resultats. No. 6.659/Doc. Tech. O.C.C.G.E. 16pp.

255. Smith, C.E.G., 1975. Changing Patterns of Disease in the Tropics, Pp. 345-362, in Man-made Lakes in Human Health, Stanley and Alpers eds., Academic Press, New York, 495pp.

This book reviews the change in disease incidence, prevalence, and distribution due to development in the tropics. It is an excellent general review and discusses the impact of environmental change on the pattern of disease. Relocation of people, increased population density, migration, growth of cities and towns, all aspects of international development and "progress" are included in this article.

256. Stewart, W.H. et al. 1955. IV. Diarrheal Disease Control Studies: The Relationship of Certain Environmental Factors to the Prevelance of Shigella Infection. Am. Jour. Trop. Med. Hyg., 4:718-724.

257. Strategy of Malaria Eradication: A Turning-Point? Lancet 1:598-600, 21 March 1970.

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