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The Sahel Epidemiological and Environmental Assessments Project

Section I Part B
VOLUME THREE

Environmental Health Assessment - Lofa and Bong Counties, Republic of Liberia

ENVIRONMENTAL HEALTH ASSESSMENT

LOFA and BONG COUNTIES

REPUBLIC OF LIBERIA

Studies and Report by: Ulric Gibson, Ph.D.
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SAHEL EPIDEMIOLOGICAL AND ENVIRONMENTAL ASSESSMENT PROJECT

June 1977

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I. INTRODUCTION

The American Public Health Association (APHA) has entered into contract No. AID/AFR-c-1253 with the Agency for International Development (AID) for the provision of technical services aimed at providing the basis for AID's contribution to the development of health delivery systems in the lesser developed countries of Africa, particularly the Sahel region.

The contract involves the undertaking of Environmental Health Assessments in selected sites of the Niger River and Lake Chad basins, Liberia and Swaziland and health vector assessments in selected sites of the two basins. The environmental health assessments are to place emphasis on the major endemic diseases, schistosomiasis, onchocerciasis, trypanosomiasis and malaria.

As a result of the foregoing, a four-member team visited Liberia between February 11, 1977 and March 4, 1977 on behalf of APHA to undertake environmental health assessments in accordance to the above mentioned contract.

A. Objectives

The objectives of the Team were:

1. To carry out an Environmental Health Assessment of Liberia with an emphasis on the major endemic parasitic diseases schistosomiasis, malaria, onchocerciasis, filariasis and trypanosomiasis.

2. To carry out an Environmental Health Assessment of the proposed Upper Bong County Integrated Rural Development Project in accordance with the AID Environmental Procedures and Guidelines.

3. Team Composition

The Team was comprised as follows:

1. Ulric P. Gibson, Ph.D., Environmental Specialist, American Public Health Association - Team Leader
2. Margaret M. Grigsby, M.D., Professor, Howard University - Physician Epidemiologist
3. Ernesto Ruiz - Tiben, M.S., Sanitarian/Epidemiologist, Center for Disease Control, Puerto Rico - Schistosomalogist
4. Henry van der Schalie, Ph.D., Professor, University of Michigan, Ann Arbor - Malacologist
5. Emmet Dennis, Ph.D., Director, Liberian Institute of Bio-medical Research - Schistosomalogist

The Team for Liberia, with the exception of Dr. Emmet Dennis, was assembled in Washington, D.C. on February 7, 1977 for briefings by the APHA and AID through February 10, 1977. The Team then departed for Liberia on February 10, 1977, arriving in Monrovia on February 11, 1977. Team preparations for the studies continued in Monrovia throughout the ensuing weekend following which the Team reported on its presence and objectives to Mr. Stanley Siegel, Director, USAID Mission on February 14, 1977 and the Honorable Estrada Bernard, Minister of Health and Welfare, Government of Liberia. The very cordial welcomes of these two gentlemen set the tone for the entire visit and have contributed immensely to the successes achieved. To them, their staffs and all others with whom we have been in contact (Appendix I) the Team expresses its sincerest gratitude.

II. BACKGROUND INFORMATION

A. Country Description - General

Liberia lies at the southwestern extremity of the western bulge of Africa and is bordered by Sierra Leone, Guinea and the Ivory Coast (see Map 1). The land area of the country is 43,000 square miles. The capital, Monrovia, has a population of approximately 100,000. From a narrow strip of level coastal land dotted with lagoons, tidal creeks and marshes, the rolling country rises in a series of plateaus. Low mountains are found intermittently throughout the country but are rarely more than 3,000 feet in elevation. Six principal rivers, the St. Paul and the St. John Rivers being the largest, flow to the Atlantic Ocean.

Liberia lies within the tropical rain forest belt and has a distinct wet and dry seasons. Almost all rainfall occurs between April and November and averages 150-170 inches annually. Along the coast it may exceed 200 inches. The average annual daily temperature is approximately 80 degrees F.

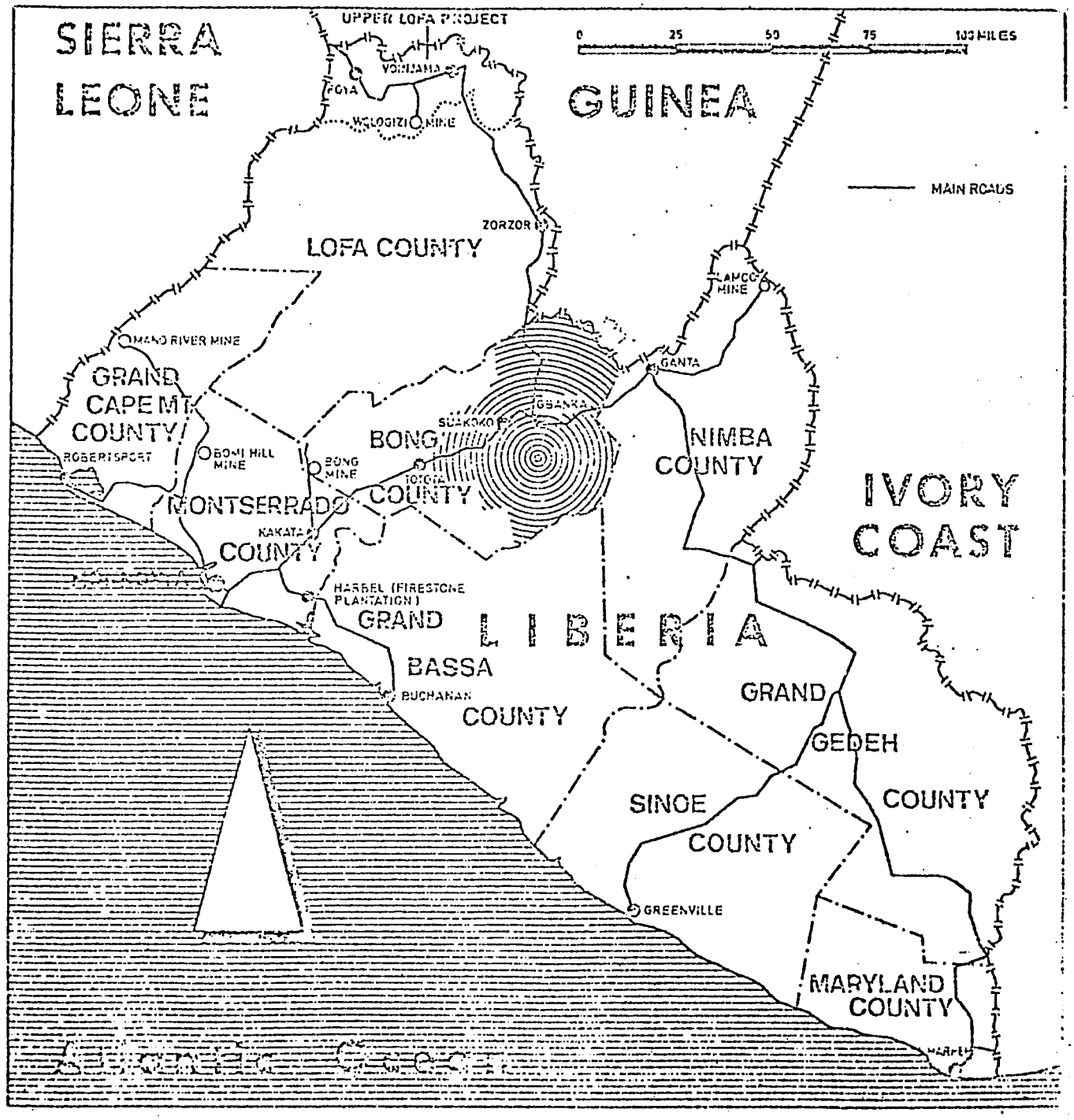
According to the official 1974 population census, Liberia has 1.65 million inhabitants divided into 16 recognized tribal groups and about 45,000 descendants of emancipated slaves from the U.S. About 5,000 foreigners reside in Liberia.

The country is divided into nine counties, five of which are costal, viz., Cape Mount, Grand Bassa, Montserrado, Sincoe and Maryland, and the others inland, viz. Gong, Lofa, Nimba and Grand Gedeh. These counties are further subdivided into districts, clans and townships.

The first rural development projects are planned for Lofa and Bong counties situated in the northeast section of the country. The Lofa

LOCATION OF PROJECT AREA IN LIBERIA

Map 1



project is already in progress while that for Bong County is in the final stages of development.

B. Upper Lofa County Rural Development Project

1. General - The project area is centered on Voinjama in Lofa County in Northwest Liberia (see map). It is bordered by Sierra Leone to the West and by Guinea to the north and east. The project area covers some 3,300 km^2 and contains nearly 14,000 farming families (90,000 people). The climate is tropical withe ample rainfall of over 2,500 mm; topography and soils are suitable for the proposed development program.

2. Water - The project area is drained by three major rivers, and intersected with numerous streams. Swamps are formed from the bottom land which is permanently or temporarily waterlogged. Swamp rice cultivation during the rainy season is reasonably assured and a small proportion of swamps have sufficient water for two rice crops a year. The project area contains an estimated 16,000 ha suitable for swamp rice development.

3. Local Administration - Lofa County is divided into four chiefdoms administered by elected paramount chiefs, which embrace 32 clans, each with its own elected clan chief, and hierarchy of town and village chiefs and elders. The county is administered by a County-Superintendent, the personal representative of the President, but who reports administratively to the Minister of Local Government and Rural Development. In recognition of their importance and considerable traditional influence, the paramount and clan chiefs subject to confirmation by the President and County Superintendent respectively.

4. Communications - There is an unpaved primary road linking the main towns of Foya, Kolahun, Voinjama and Zorzor with Monrovia and numerous

poorly maintained feeder roads and tracks link other population centers. The project would upgrade the maintenance standard of both primary and feeder roads. At present there are nine small airfields in the project area used only by GOL and small private aircraft, however, Liberia airways is experimenting with a trial scheduled service between Monrovia and Voinjama. As telecommunication facilities with Monrovia are limited to a few GOL and private radio sets, the project organization would install its own radio.

5. General Infrastructure - Social and related services are limited and village water supplies would be improved under the project. While education and health facilities are also inadequate, improvements to education would be made through GOL Community Schools program to be financed in part by IDA and augmented by project farmer training efforts; improved health facilities will be provided through an approved USAID financed rural health program for Lofa County supported by a project financed Schistosomiasis surveillance unit.

6. Farming Systems - The upland farming system of shifting cultivation consists of rice intercropped with vegetables, maise, peppers, beans, plantains, etc., in the first year; followed by root crops and sugar cane in the second year; thereafter th land is left fallow for five to ten years. This very long fallow period is indicative of the areas relatively low population pressure. At any one time up to 10,000 ha of the project area will be under upland rice cultivation. A small number of swamps, (about 700 ha), have been developed for rainfed rice cultivation on a semi-permanent basis and are fallowed for a short period every 3 to 5 years. A mixture of local rice varieties are grown on both uplands and swamps without the use of fertilizers or pesticides. Tree crops grown in the project area

are coffee 4,600 ha, cocoa 3,000 ha, and oil palm 500 ha. Cultivation standards are low, and fertilizers and insecticides are not used. Total area presently under cultivation in food and tree crops is 19,000 - 20,000 ha annually, about 10 percent of land suitable for cultivation. The 1971 Census of Agriculture covering a substantial part of the project area indicated a highly skewed farm size distribution, 90 percent of the farms are less than 4 ha covering 46% of the surveyed area while the remaining 10% of the farms are larger than 4 ha covering 54% of the surveyed area. However, of the remaining 10% about half the farms are less than 10 ha and only 80 farms are larger than 20 ha, and many of these larger farms are neither fully developed nor intensively cultivated. Four ha is about the maximum that the typical farm family can handle without hired labor (except at harvesting). Availability of suitable land is not a constraint to improving the production of the smaller farmers. Most farms have some upland rice, and a few also have swamp rice; all farms grow the other traditional food crops for home consumption and some obtain cash income from vegetables and fruit trees. Coffee and cocoa tend to be cultivated by the larger farmers, but many small farmers have small plantings, usually up to 0.5 ha., to provide a cash income. Based on the 1971 Census of Agriculture, the average family labor force is 2.3 adult equivalents on farms of 4 ha or less. Labor requirements are unevenly distributed over the year with peaks from March to June/July (land preparation, planting) and from mid-October to December (harvesting). In between these peaks there is seasonal underemployment.

C. Upper Bong Rural Development Project

1. Characteristics of the Project Area - Traditional agriculture in Upper Bong County reflects most of the characteristics of the small farm

sector mentioned previously, only some of them stand out in bolder relief. The project area has a total population of 140,000 with a farm population of 100,000 people living on 19,000 farm holdings. Some 87% of all farmers in the region cultivate less than five acres. As much as 40% of rural households in Upper Bong cultivate holdings of less than 1.25 acres, which is considered to be below subsistence level. The average area farm size is only 2.3 acres.

Since land availability is not a constraint, the large percentage of below-subsistence farms in the project area is perhaps best explained by the highly cyclical labor requirements of traditional agriculture, due to cropping patterns and climatic variables. It is estimated that the employment capacity actually utilized averages only 15% of the potential over the year.

In contrast to Lofa County, the project area of Bong County represents a more difficult challenge, in some respects, to agricultural development efforts. Although the region is closer to product markets than Lofa (the capital of Upper Bong, Gbanga, is only 125 miles from the port of Monrovia, while Voinjama, central town of Lofa, is 247 miles), the rural residents of Upper Bong are more poorly serviced by farm-to-market roads. In Lofa, all but 20% of the rural population live on or within a mile of a road. In Bong, about 45% do not have easy road access.

Climatically, both rainfall and river water resources are less abundant in Bong, where a protracted dry season prevents double-cropping of swamp rice as is possible in Lofa. Furthermore, Upper Bong is a much larger project area than Upper Lofa, with population more widely scattered. But finally, and this is perhaps the most critical difference, agricultural

cooperatives, three in all, have been operating successfully in Lofa for several years. They have trained managers and bookkeepers, established marketing services to farmers, built huge produce storage facilities and have large and growing memberships. In Bong County, on the other hand, this institutional innovation for channeling development service to small farmers is still to be attempted.

2. Project Goal - To improve the welfare of the rural population in Upper Bong County.

3. Project Purpose - To increase and maintain agricultural productivity and income of small farmers in Upper Bong County.

The project strategy hypothesizes that since only 3% of farmers in the project area are currently using improved seeds and fertilizers, the income of project participants will be considerably increased through the provision of improved inputs together with supervised credit, agricultural extension, and improved marketing channels.

4. Description of the Project -

a. General Features - The project would be implemented over a five-year investment period from 1977 to 1982. It is designed to increase the productivity and income of 9,000 farm families (48% of the farm holdings in Upper Bong County). The project would have the following components:
(i) Farm and Crop Development - Long-term (development) and seasonal credit would be provided to finance increased productivity of the following crops on the targeted acreages:

Upland Rice	5,750 hectares
Swamp Rice	2,050 hectares
Coffee	1,500 hectares
Cocoa	3,000 hectares
Cassava	1,350 hectares

It is anticipated that the application of the improved technology being introduced under this project would result in the following per hectare increases in yields and income:

Crop	Traditional		Project		Increment	
	$/ha	$/manday	$/ha	$/manday	$/ha	$/manday
Cocoa	153	4.1	468	4.8	315	.7
Coffee	191	3.8	855	4.2	664	.4
Rainfed & Swamp	350	1.5	546	2.1	196	.6
Irrigated Swamp	-	-	724	1.9	-	-
Improved Upland	235	1.7	298	2.1	63	.4
Advance Upland	235	1.7	386	1.9	151	.2

(ii) Farm to Market Road Construction and Maintenance - The project will include financing for the construction of 170 kilometers of new farm-to-market laterite roads, the rehabilitation of 130 kilometers of existing roads, and the development of a system for the permanent maintenance of the total system, i.e., 300 kilometers. It was assumed in the draft PRP that funding of rural roads would be provided under the third IBRD Highway Loan. This is not now possible since funds under that loan have been committed for other projects and funding will now be included under this project.

(iii) Revolving Credit Fund - Jointly administered by agricultural cooperatives and the Project Management Unit (PMU), approximately US$3.4 million would be loaned over a five-year period to finance fertilizer, seed, tools non-recurring labor costs and other input requirements of project participants. Loan money would be available from the time of project start-up, and as the project progresses, a more permanent, appropriate institution would be found to administer the fund.

(iv) Agricultural Cooperative Development - Six cooperative societies would be organized in the project area. With back-up administrative and extension staff support by the project, the co-ops would provide technical assistance, supervised credit, input supply, limited machinery and produce marketing services to their farmer-members.

(v) Agricultural Extension and Credit Supervision - To maintain an extension ratio of 1:50 for first-year participants, 1:100 for second-year participants and 1:150 through year five, as many as 73 extension aides will be hired. Up to 30 aides (five per co-op) are required for maintenance of a 1:300 ration for 9,000 farmers after the fifth year. Additionally, all co-ops will have two credit supervisors initially financed by the project.

(vi) Training Programs - For the five-year project period, 70 weeks of extension aide training, 23 weeks of co-op staff training and 140 weeks of farmer training are planned. All training will be conducted at the Central Agricultural Experiment Station (CAES) at Suakoko, where in addition to existing facilities the project will construct a farmer training center and dormitory (15-bed capacity).

(vii) Agricultural Research - The project will operate an adaptive research program to test new crop varieties and recommended practices. Experiments will be conducted at CAES in Suakoko in addition to field trials on the land of project participants under typical small farm conditions.

(viii) Health Services - The Schistosomiasis Surviellance Unit of the Lofa County IBD will be expanded to monitor the incidence of schistosomiasis infection in Upper Bong County and in coordination with the Public Health Service make available disease treatment services.

(ix) Project Management and Coordination - A semi-autonomous Project Management Unit (MU) will organize and administrate project activities for a five-year period, after which its functions will be absorbed by the Ministry of Agriculture, LPMC, and by the cooperatives in the project area. The PMU will be divided into five divisions: Administration/Personnel, Agriculture Services, Training, Cooperative/Credit, and Finance.

(x) Project Coordination - To integrate the project into the National Government sector, a Project Steering Committee has been established, directed by the Minister of Agriculture to provide policy guidance to both the Lofa and Bong IRD Project. At the local level, a Project Coordinating Committee composed of county officials, tribal chiefs and co-op representatives will be created. At the village level, project beneficiaries will be organized into cooperative sub-groups to coordinate member training, loan preparation, input deliveries, produce marketing and loan repayment activities.

(xi) Project Planning and Monitoring Evaluation Unit - The monitoring of the project's inputs (resources) and outputs (services) will be divided among the respective PMU divisions in accordance with their unique functions. The evaluation of project success at the purpose and sector goal level will be handled by a special Monitoring/Evaluation Unit attached to the PMU. This unit will also be responsible for organizing periodic discussion meetings with project participants to capture their feedback on project performance. The unit will also conduct special research studies (on a trouble-shooting model) to explain the causes of project success or lack thereof, to compare the performance of project participants with non-participants and to repeatedly test the assumptions upon which project planning rests.

(xii) Establishment of Project Headquarters at Suakoko - A project headquarters would be constructed at Suakoko and include the PMU office (15,000 square feet) and eight staff houses for senior project staff. Additionally, it is planned to construct six small regional offices, a schistosomiasis laboratory, and to expand the training center now under construction at CAES. Approximately 33,000 square feet of accommodations of different types would be constructed during project implementation.

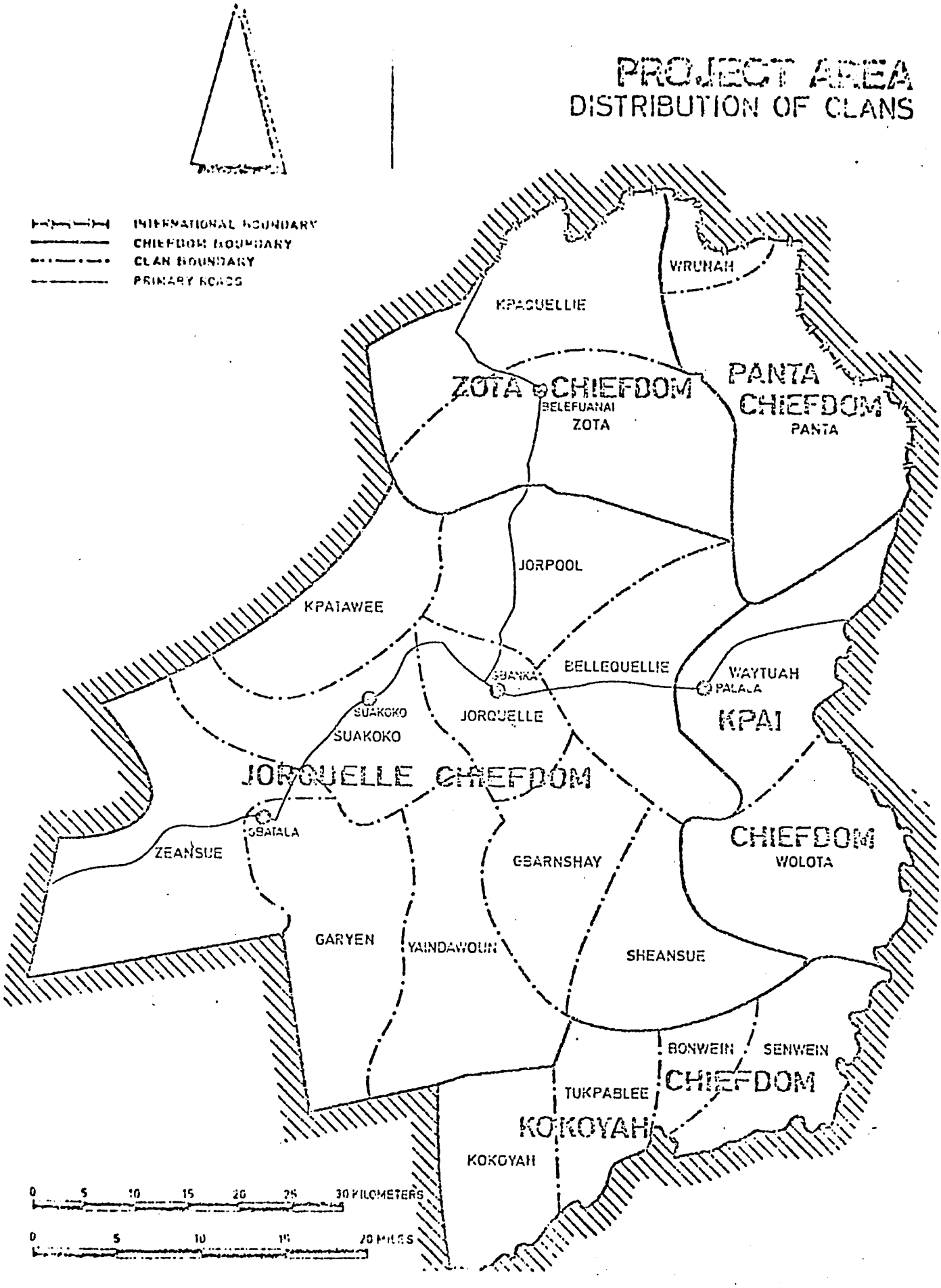
(xiii) Non-Project Financial Services - In coordination with the Ministry of Education, seven "Community schools" -- offering rural-oriented education to children and literacy and community development training to adults -- will be constructed and operated in the project area. The establishment of the schools will be funded under the "Second Education Loan" from IBRD to GOL.

b. Detailed Features - Swamp Rice - There are already 1,500 hectares of traditional and 200 hectares of improved swamp in the project area. By promoting the clearing and leveling of swamp plots and the construction of water control structures (development costs are estimated at circa $500 per hectare) the project expects to create permanent agricultural properties of great value. Development operations will be spread over a three-year period, with the variety Gissi 27 used in the first two years because of its resistance to iron toxicity, and IR 5 used thereafter. Direct seeding, combined with chemical weed control, will be recommended over transplanting, with seed application rates ranging from 60 to 100 kilograms per hectare depending on the roughness of the field. Using the Gissi 27 initial yields will increase from 1,000 kg to 2,500 kg per hectare. Recurrent cash expenditures (excluding development costs) are estimated at $130 per hectare and family labor inputs at 264 mandays. With a 3,000 kg

yield, an average net return of $458 per hectare or $1.71 per manday is anticipated (after the development loan has been repaid).

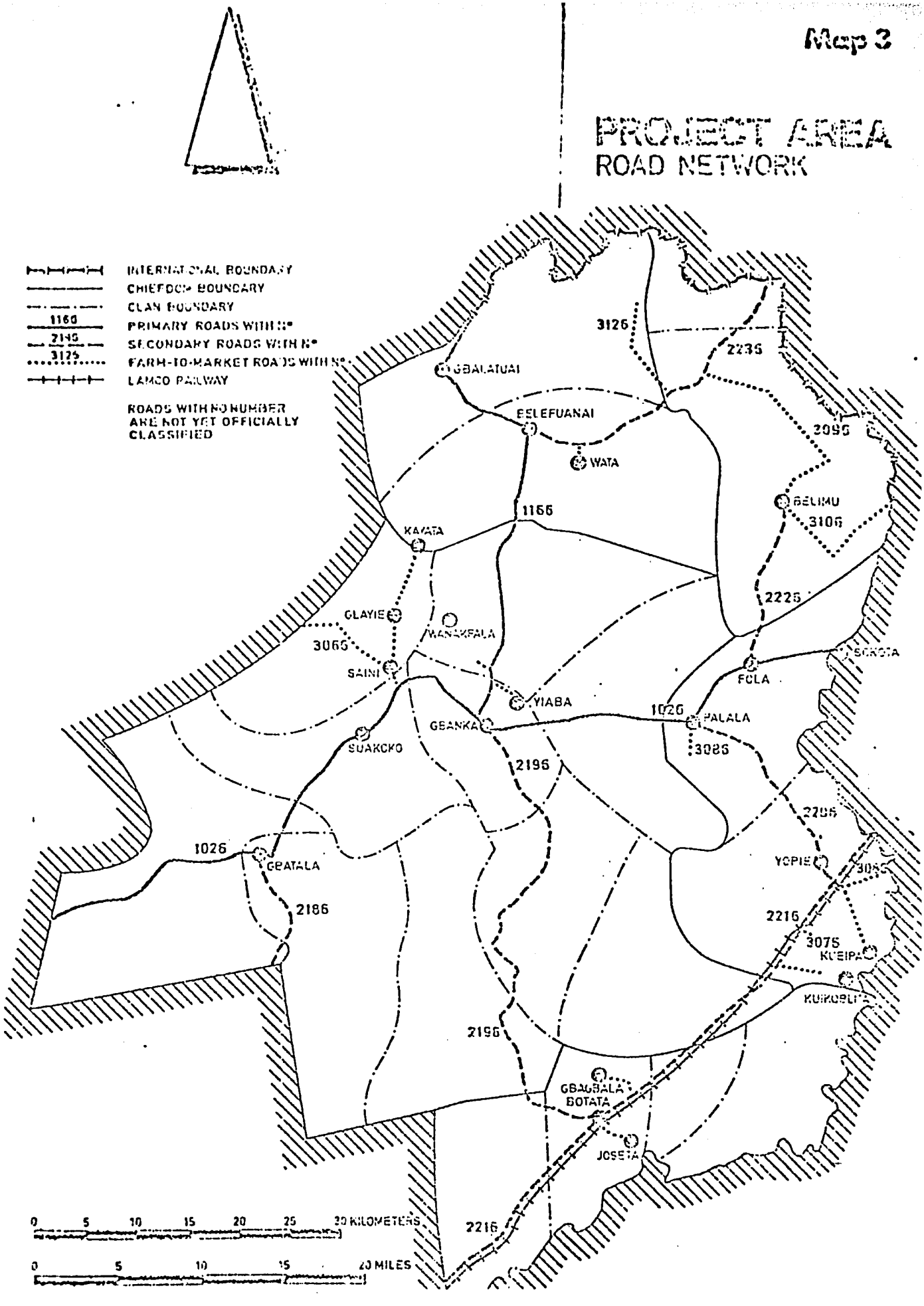
The project would reclaim 1,650 hectares of new swamps and improve about 400 hectares of existing swamps. Out of this approximately 300 hectares would be developed as pilot schemes for double cropping of rice. Small earthen barrages and other rudimentary structures would be constructed for storing rainwater and run-offs from upstream catchment areas for use during the rain season. Land clearing on virgin swamps would be done manually with the help of small hand equipment; flood protection and water control would be through peripheral drains, field bunds and leveling. The project would provide assistance in making simple topographical surveys and soil analyses for selecting swamps for development. The main focus on the on-farm measures would be on proper swamp management, timely planting and fertilization, and use of varieties that are resistant to iron toxicity.

PROJECT AREA
DISTRIBUTION OF CLANS



Map 3

PROJECT AREA
ROAD NETWORK



III. ENVIRONMENTAL HEALTH PROBLEMS

A. Methodology

The Team adopted the following methodology:

1. Assemble and review all available basic data, documents, etc. pertinent to the establishment of the status of environmental health both country-wide and particularly in the Upper Bong County Integrated Rural Development Project Area.

2. Carry out epidemiological field studies with a view to obtaining complementary data to those of (1) above.

3. Assess all of the above information, determine the weaknesses of the existing systems, the needs, the likely impacts of the proposed Upper Bong County Integrated Rural Development Project and make relevant recommendations.

4. Prepare a comprehensive Environmental Health Assessment Report.

1. Data Collection and Review - Visits were paid to the following major sources of available basic data:

a. The Ministry of Health and Social Welfare
   (i) Head Office
   (ii) Preventive Services Division
b. The Liberian Institute of Bio-medical Research
c. The Ministry of Planning and Economic Affairs
d. The Upper Lofa County Integrated Rural Development Project
e. The Schistosomiasis Surveillance Unit, Lofa County
f. The Phebe Hospital, Bong County
g. The C.B. Dunbar Health Center, Gbarnga, Bong County

h. The Superintendent's Office, Gbarnga, Bong County

i. The Paramount Chief's Office, Palala, Bong County

j. The Commissioner's Office, Gbetala, Bong County

k. The Suakoko Central Agricultural Station, Suakoko, Bong County

l. United Nations Development Programme

m. John F. Kennedy Memorial Medical Center

n. United States Agency for International Development

The data collected pertain to the major endemic parasitic diseases schistosomiasis, malaria, onchocerciasis, filariasis, and trypanosomiasis; other parasitic diseases such as hookworm and ascaris; environmental sanitation; and the health infrastructure.

Generally, only prevalence data were available, and these were based on hospital and health center records of in-patients and out-patients. Incidence data, intensity of infection and morbidity data (where applicable) were not available. The reliability of much of the data is indeed questionable because of the general lack of laboratory confirmation of often very doubtful system diagnoses.

The exception to this is the Phebe Hospital in Bong County whose laboratories provide excellent diagnostic services and whose records are well kept.

2. Epidemiological Field Studies - Field surveys have been undertaken to complement the available data and to improve reliability as well as the bases upon which evaluations can be made. These surveys were undertaken in Lofa County and Bong County.

a. Lofa County Schistosomiasis Survey - The field surveys for the appraisal of schistosomiasis in the Upper Lofa County Integrated Rural Development Project during June/July 1976 (i.e., the rainy season) were repeated at this time (dry season) to obtain seasonal variations and perhaps for the first time in Liberia, incidence data on this disease.

Urine and stool samples (80 each) have been taken from the occupants of the same households surveyed last year in Velezela.

Snail surveys for the intermediate hosts of schistosomiasis were also carried out at three sites in Velezela, the Chinese Rice Demonstration Project at Foya and a stream at Foya Dundu.

A snail survey was also undertaken at Seleza, the site of the first new swamp rice field developed under the Upper Lofa County Integrated Rural Development Project.

b. Upper Bong County Surveys - The surveys in Upper Bong County Integrated Rural Development Project Area were undertaken to provide general baseline data with respect to the diseases of interest and particularly to provide information for the environmental impact assessment of the Project.

Since the major concern is the environmental health impact of the proposed increase in swamp rice development, two areas were chosen for survey - one in which swamp rice is the major agricultural pursuit and the other in which there is essentially no swamp rice. Discussions with Dr. Gwenigale, Medical Director, Bong County, Mr. J. Kolleh Yorwatei, Superintendent, Bong County and at a Consultative Staff Meeting of the Superintendent of Bong County, all Chiefs, Mayors and Commissioners of the County led to the selection of Palala as the swamp rice survey site and Gbatala as the none-swamp rice site.

Blood smears and skin snips were taken from 72 persons at Palala and 173 at Gbatala. These persons were also checked for spleen and liver enlargements. Recorded information included tribe, clan, house number, age, sex and period of residence. Stool and urine samples numbered 200 at Gbatala and 114 at Palala.

The collection of stained slides (blood smears) and fixed urine and stool samples were taken to the U.S.A. and Puerto Rico for microscopic examination and analysis.

Snail surveys were carried out at several swamps, streams and rice fields in and around Palala, Zowienta, Wenshue and Suakoko.

B. Findings and Results

1. Review of Health Records and Reports -

a. Health Infrastructure -

(i) National - Health infrastructure is based upon the Ministry of Health and Social Welfare (MHSW) which is headed by a Minister of cabinet rank. The three main Bureaus are: The Bureau of Medical Services, the Bureau of Preventive Services and the Bureau of Planning and Development. The organizational chart of the MHSW is shown on page 20. The Ministry is assisted by various advisory bodies.

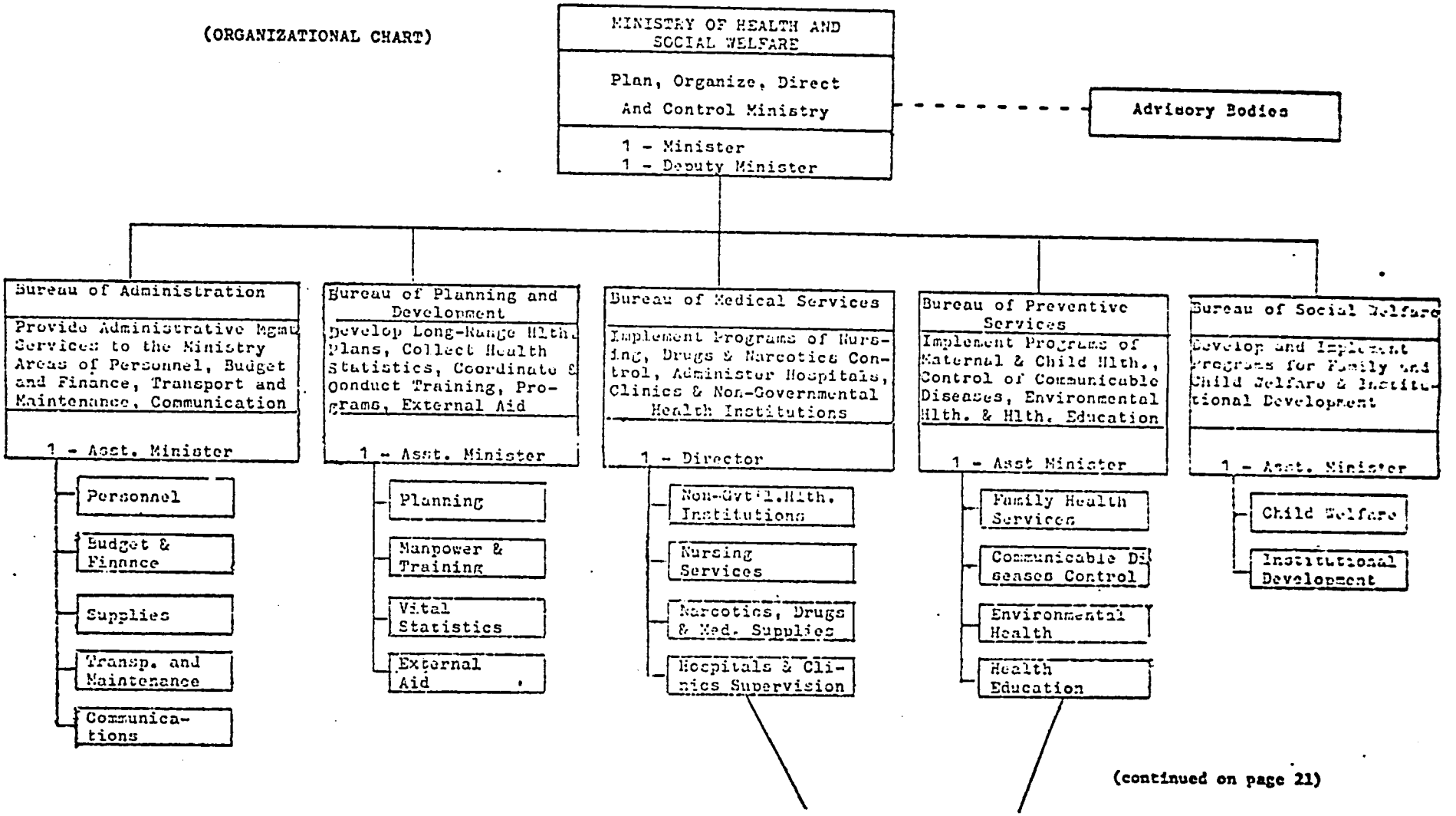
The Ministry has, over the years, also received assistance from foreign sources such as USAID, WHO and UNICEF.

Below the national level, the Ministry has a weak infrastructure.[1] This deficiency is emphasized in the report: A Preliminary and Comprehensive Analysis of the Health Situation in Liberia -- 1976, Bureau of Planning and Development. A review of that report is shown in Appendix II.

MINISTRY OF HEALTH AND SOCIAL WELFARE

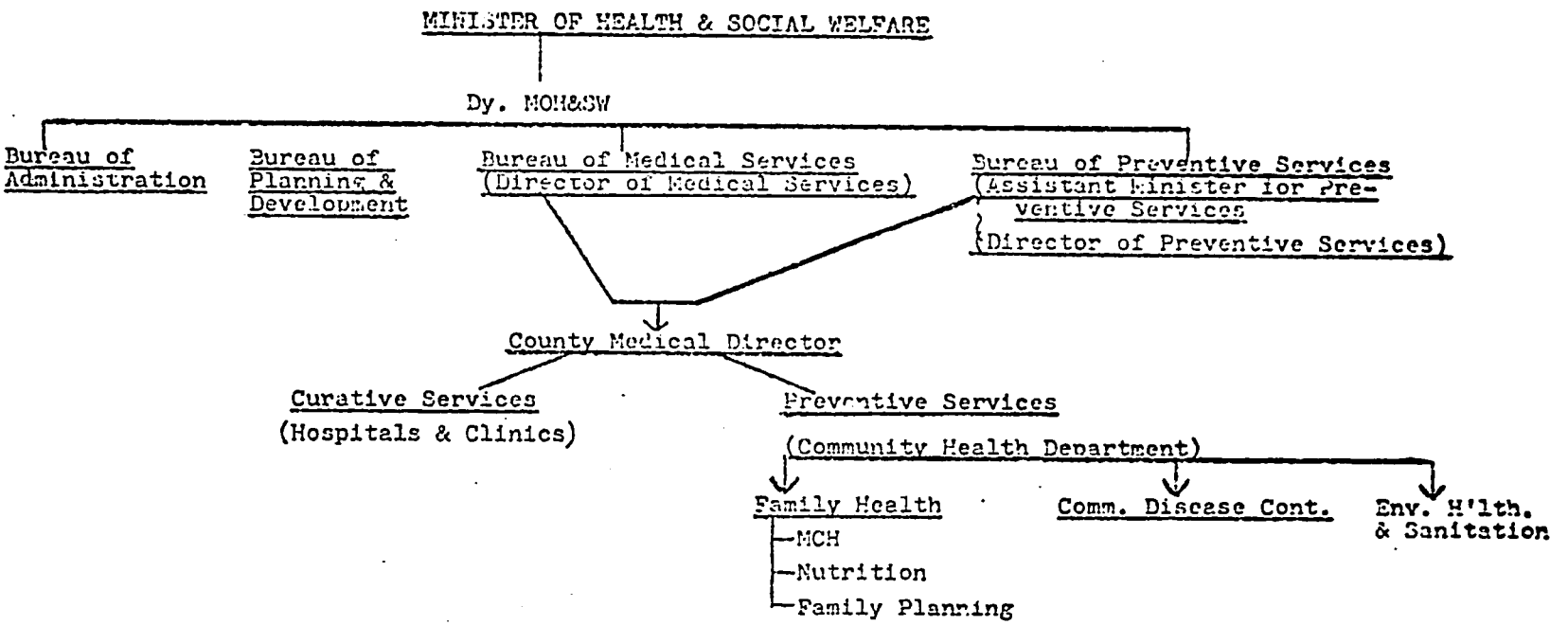
ORGANIZATIONAL CHART

(ORGANIZATIONAL CHART)



(continued on page 21)

(Organizational Chart continued)



The immediate administration of hospitals and clinics is the responsibility of local administrators. A medical director is in charge of each region except in Montserrado County which has a Medical Director of Public Health Clinics in charge of 25 clinics.

Liberian government agencies have taken increasingly active roles in health care and there are a number of programs in puplic health. However, medical missionaries, Bong Mines and Firestone Plantations Co. play major roles in health care delivery in Liberia. It is estimated that missions and concessions supply as much as 50% of the total of health care in the country.

The publication, Synopsis: Liberia VII, gives a good breakdown on the disparity in the distribution of hospital beds between Monrovia (Montserrado County) and other counties in Liberia. The ration being decidedly in favor of Montserrado.

(ii) Bong County

(a) Population 1976 - 194,191

(b) County population with direct access to health facilities - 14, 138

(c) Number of health facilities - 36

(government clinics - 31)

(d) Number of hospitals - 2

- Phebe
- Sekou Touré

(e) Government physicians - 5

(f) Dentists - 1

(g) Other physicians - 8

(h) Doctor/population - 1/22,830

(i) Professional Nurses - 27

Only 7.3% of the Bong County population has direct access to health facilities. The facilities were built in relationship to existing roads. This is the situation in most of Liberia, for only about 33% of the total population is being served. The situation is more acute in rural areas.

The Annual Report -- 1976 of the MHSW contains statistical data on the various health facilities, personnel and on reportable diseases.

The health section of the National Socio-Economic Development Plan June 1976 - June 1980 is shown in Appendix III.

b. Major Endemic Disease Problems at Phebe Hospital and C. B. Dunbar Clinic - The major endemic diseasee problems of Bong County were surveyed from data obtained from the MHSW, the Phebe Hospital and the C. B. Dunbar Clinic.

Data from Phebe Hospital are shown in Tables 1-4 covering 1973 through 1976 (May). These parasitological statistics over a 3½ year period reveal that malaria schistosomiasis, onchocerciasis and hookworm are the most prevalent endemic parasitic diseases.

Data from the C.B. Dunbar Clinic show essentially the same distribution of the major endemic parasitic diseases. (See Table 5)

Other diseases of significance were diarrhea, dysentery and leprosy. All of which reflect the poor environmental health and sanitation situation in Bong County.

During the period of January 1, to September 30, 1976, the following were reported to the MHSW. (See Table 6)

TABLE 1. PIEBE HOSPITAL - 1973 BONG COUNTY PARASITOLOGICAL STATISTICS

MONTH	TOTAL # PTS. IN-PTS.	TOTAL # PTS. OUT-PTS.	URINE EXAM.	S.HAEM. + / %	STOOLS EXAM.	HKW + / %	S.MAN + / %	E.H. + / %	ASC. + / %	STRONG + / %	TRICH. + / %	MALARIA SMEARS	MFL. + / %	SCHIS SKIPS	CYCHO + / %
JANUARY			1,012	131 / 12.9	1,387	196 / 14.1	52 / 5.1	116 / 8.3	195 / 14.0	79 / 5.6	28 / 2.0	556	336 / 60	105	36 / 33
FEBRUARY			711	133 / 18.7	975	170 / 17.4	55 / 5.6	74 / 7.5	104 / 10.6	48 / 4.9	20 / 2.0	731	218 / 30	71	26 / 37
MARCH			878	121 / 13.8	1,141	170 / 14.9	55 / 4.8	73 / 6.4	166 / 14.5	48 / 4.2	17 / 1.5	824	267 / 32	90	29 / 32
APRIL			838	92 / 10.9	1,010	147 / 14.5	42 / 4.1	60 / 5.9	167 / 16.5	52 / 5.1	29 / 2.8	876	315 / 36	106	20 / 19
MAY			690	72 / 10.4	955	130 / 13.6	39 / 4.0	55 / 5.8	139 / 14.5	44 / 4.6	28 / 2.9	937	342 / 36	54	18 / 33
JUNE			580	61 / 10.5	717	123 / 17.2	35 / 4.9	34 / 4.7	89 / 12.4	37 / 5.1	2 / 0.2	1,198	219 / 18.2	54	10 / 18.5
JULY			584	64 / 10.9	792	91 / 11.5	36 / 4.5	52 / 6.5	101 / 12.7	30 / 3.7	19 / 2.4	1,979	678 / 34.2	63	23 / 36.5
AUGUST			615	72 / 11.7	680	70 / 10.3	27 / 3.9	64 / 9.4	96 / 14.1	25 / 3.6	15 / 2.2	1,065	281 / 26	62	20 / 32
SEPTEMBER			588	62 / 10.5	669	100 / 14.9	36 / 5.4	60 / 8.9	98 / 14.6	31 / 4.6	14 / 2.0	665	194 / 29	53	14 / 26
OCTOBER			640	99 / 15.4	717	91 / 12.7	37 / 5.2	79 / 11.0	88 / 12.2	20 / 2.7	13 / 1.8	973	202 / 20.7	61	22 / 36
NOVEMBER			593	84 / 14.2	594	71 / 11.9	26 / 4.4	77 / 12.9	47 / 7.9	29 / 4.9	12 / 2.0	919	135 / 14.6	49	33 / 67
DECEMBER			581	69 / 11.8	658	101 / 15.3	46 / 7.0	82 / 12.4	82 / 12.4	33 / 5.0	28 / 4.2	931	163 / 17.5	35	16 / 4.9
TOTALS			8,310	1,060 / 12.8	10,295	1,460 / 14.2	485 / 4.7	826 / 8.0	1,372 / 13.3	476 / 4.6	225 / 2.2	16,654	3,350 / 28.9	506	267 / 31.2

TABLE 2. PIEBE HOSPITAL - 1974 BONG COUNTY PARASITOLOGICAL STATISTICS

MONTH	TOTAL # PTS. IN-PTS.	TOTAL # PTS. OUT-PTS.	URINE EXAM.	S.HAEM. + / %	STOOLS EXAM.	HKW + / %	S.MAN + / %	E.H. + / %	ASC. + / %	STRONG. + / %	TRICH. + / %	MALARIA SMEARS	M.F. + / %	SCHIS SKIPS	SCHIS. + / %
JANUARY			825	105 / 12.7	913	132 / 14.5	35 / 3.8	84 / 9.2	105 / 11.5	24 / 2.6	19 / 2.0	1,295	203 / 16	35	19 / 43
FEBRUARY			909	146 / 16	1,017	180 / 17.7	37 / 3.6	82 / 8.0	213 / 21	31 / 3.0	29 / 2.8	1,385	252 / 18	96	31 / 32
MARCH			704	104 / 14.7	786	110 / 14	57 / 7.2	57 / 7.2	76 / 9.6	24 / 3.0	20 / 2.5	647	206 / 32	55	21 / 38
APRIL			682	98 / 14.3	925	122 / 13.2	56 / 6.0	51 / 5.5	104 / 11.2	51 / 5.5	26 / 2.8	618	268 / 42	58	14 / 2
MAY			881	106 / 12	975	160 / 16.4	76 / 7.8	127 / 13	88 / 9.0	51 / 5.2	38 / 3.9	713	327 / 46	65	26 / 40
JUNE			781	91 / 11.6	925	144 / 15.6	42 / 4.5	65 / 7.0	101 / 10.9	95 / 10.3	30 / 3.2	608	281 / 46	10	8 / 80
JULY			796	95 / 11.9	1,037	118 / 11.4	57 / 5.5	87 / 8.4	88 / 8.5	38 / 3.6	28 / 2.7	1,105	307 / 27.8	47	19 / 40
AUGUST			696	147 / 21	1,378	197 / 14.3	70 / 5.0	186 / 13.5	150 / 10.8	35 / 2.5	35 / 2.5	1,061	295 / 27.8	61	29 / 48
SEPTEMBER			988	271 / 24	960	176 / 18.3	62 / 6.5	67 / 6.9	87 / 9.0	36 / 3.7	14 / 1.5	916	230 / 25	53	29 / 55
OCTOBER			956	141 / 14.7	668	187 / 28	85 / 12.7	51 / 7.6	91 / 13.6	54 / 8.0	39 / 5.8	728	328 / 45	65	26 / 40
NOVEMBER			924	113 / 12.2	566	97 / 17.1	37 / 6.5	50 / 8.8	62 / 10.9	20 / 3.5	23 / 4.0	1,418	311 / 22	83	27 / 33
DECEMBER			930	115 / 12.3	952	123 / 13	61 / 6.4	65 / 6.8	103 / 10.8	23 / 2.4	22 / 2.3	1,369	380 / 27.7	71	21 / 29
TOTALS			10,072	1,502 / 14.9	11,102	1,748 / 15.7	675 / 6.1	972 / 8.8	1,268 / 11.4	482 / 4.3	323 / 2.9	11,863	3,393 / 28.6	699	699 / 38.

TABLE 3. FIRBE HOSPITAL - 1975 BONG COUNTY PARASITOLOGICAL STATISTICS

MONTH	TOTAL # PTS. IN-PTS.	TOTAL # PTS. OUT-PTS.	URINE EXAM.	S.HAEM + / %	STOOLS EXAM.	EKM + / %	S.MAN + / %	E.H. + / %	ASC. + / %	STRONG + / %	TRICH. + / %	MALARIA SMEARS	MAL. + / %	SCHIS.	ONCHO. / %
JANUARY	270	2,512	836	135 / 16.1	800	179 / 22.4	53 / 6.6	0 / 0	178 / 22	45 / 5.6	28 / 3.5	1,377	988 / 71.7	61	40 / 65.5
FEBRUARY	263	2,292	988	233 / 23.5	960	176 / 18.3	57 / 5.9	67 / 6.9	87 / 9.0	36 / 3.7	14 / 1.4	932	205 / 21.9	86	65 / 75.5
MARCH	308	2,666	568	89 / 15.6	988	156 / 15.8	68 / 6.8	81 / 8.2	105 / 10.6	33 / 3.3	32 / 3.2	485	228 / 47	52	25 / 48
APRIL	309	2,841	1,110	148 / 13.3	909	104 / 11.4	29 / 11.4	63 / 6.9	96 / 10.5	34 / 3.7	12 / 1.3	1,235	364 / 29.5	56	23 / 41
MAY	300	3,131	909	95 / 10.5	1,033	180 / 17.4	37 / 3.6	82 / 7.9	213 / 20.6	31 / 3.0	25 / 2.4	873	227 / 26	68	41 / 60
JUNE	297	2,562	1,210	107 / 8.8	909	108 / 11.9	42 / 4.6	51 / 5.6	79 / 8.6	39 / 4.3	17 / 1.8	541	282 / 52.1	44	35 / 79.5
JULY	253	2,521	1,025	150 / 14.6	1,385	149 / 10.6	44 / 3.2	66 / 4.7	78 / 5.6	40 / 2.8	27 / 1.9	1,552	305 / 19.6	62	23 / 37
AUGUST	292	2,492	923	92 / 9.9	902	134 / 14.8	33 / 3.6	35 / 3.9	89 / 9.8	38 / 4.2	27 / 2.9	966	312 / 32	59	26 / 44
SEPTEMBER	240	3,437	913	95 / 10.4	1,716	156 / 9.0	47 / 2.7	19 / 1.1	92 / 5.3	26 / 1.5	23 / 1.3	935	284 / 30	66	34 / 51.5
OCTOBER	290	2,783	761	508 / 66.7	986	185 / 18.7	66 / 6.7	40 / 4.0	93 / 9.4	52 / 5.2	41 / 41.5	1,178	279 / 23.7	81	33 / 37.5
NOVEMBER	241	2,332	711	142 / 20	1,018	125 / 12.3	35 / 3.4	18 / 1.7	62 / 6.0	24 / 2.4	27 / 2.6	1,396	228 / 16.3	69	28 / 40.5
DECEMBER	271	2,337	842	107 / 12.7	794	111 / 14	43 / 5.4	53 / 6.6	63 / 7.9	20 / 2.5	23 / 2.9	1,176	233 / 19.8	88	31 / 35
TOTALS	3,611	31,906	10,796	1,901 / 17.6	12,400	1,763 / 14.2	554 / 4.5	575 / 4.6	1,313 / 10.6	418 / 3.4	296 / 2.4	12,646	3,935 / 31.1	792	404 / 51.0

TABLE 4. PIEBE HOSPITAL - 1976 BONG COUNTY PARASITOLOGICAL STATISTICS

MONTH	TOTAL # PTS. IN-PTS.	TOTAL # PTS. OUT-PTS.	URINE EXAM.	S.HAEM. + / %	STOOLS EXAM.	HKW + / %	S.MAN + / %	E.H. + / %	ASC. + / %	STRONG. + / %	TRICH. + / %	MALARIA SMEARS	MAL. + / %	SCHI. SMEARS	ONCHO. + / %
JANUARY	280	2,412	741	134 / 18	654	142 / 22	44 / 6.7	48 / 8.9	95 / 14.5	33 / 5.0	45 / 6.9	1,559	195 / 12.5	117	63 / 54
FEBRUARY	301	2,793	998	124 / 15.5		163 / 16.3	71 / 7.1	66 / 6.6	101 / 12.6	45 / 4.5	24 / 2.4	1,375	668 / 48.6	108	41 / 38
MARCH	311	4,500	1,025	68 / 6.6	1,387	149 / 10.7	44 / 3.2	68 / 3.2	78 / 5.6	40 / 2.9	27 / 1.9	1,552	305 / 19.7	62	23 / 37
APRIL	319	2,678	936	131 / 14	1,087	170 / 15.6	62 / 5.7	48 / 4.4	96 / 8.8	30 / 2.8	34 / 3.1	1,376	187 / 13.6	68	54 / 79
MAY	318	2,617	892	101 / 11.3	1,050	230 / 22	83 / 8	33 / 3	128 / 12	30 / 3	49 / 5	1,108	343 / 31	118	52 / 44
JUNE	295	2,994													
JULY	279	2,941													
AUGUST	319	3,281													
SEPTEMBER	245	432													
OCTOBER	303	4,567													
NOVEMBER	328	3,840													
DECEMBER	350	3,414													
TOTALS	3,378	36,469	4,395	558 / 12.6	5,176	854 / 16.5	304 / 5.9	263 / 5.1	498 / 9.6	178 / 3.4	179 / 3.5	6,970	1,698 / 24	473	233 / 49

TABLE 5. C.B. DUNBAR CLINIC - 1976 GBARNGA, BONG COUNTY PARASITOLOGICAL STATISTICS

MONTH	TOTAL # PTS. IN-PTS.	TOTAL # PTS. OUT-PTS.	URINE EXAM.	S.HAEM. + / %	STOOLS EXAM.	HKW + / %	S.MAN + / %	E.H. + / %	ASC. + / %	STRONG. + / %	TRICH. + / %	MALARIA SMEARS	MAL. + / %	SKIN SNIPS	CYCLO. + / %
JANUARY			120	22 / 18.3	77	21 / 27.2	9 / 11.7	1 / 1.3	16 / 20.7	4 / 5.2	10 / 12.9	103	57 / 55.3	16	2 / 12.5
FEBRUARY			185	26 / 14	174	25 / 14.4	12 / 6.9	7 / 4.0	16 / 9.1	6 / 3.4	11 / 6.3	187	113 / 60	9	3 / 33
MARCH			224	33 / 14.7	225	64 / 28.4	21 / 9.3	10 / 4.4	26 / 11.5	9 / 4	5 / 2.2	222	149 / 67	34	8 / 23.5
APRIL			349	78 / 22.3	345	83 / 24	26 / 7.5	12 / 3.5	32 / 9.3	22 / 6.4	6 / 17.4	425	312 / 73.4	32	10 / 31.2
MAY			249	80 / 32	271	91 / 33.5	28 / 10.3	6 / 2.2	20 / 7.4	12 / 4.4	4 / 1.5	300	222 / 74	43	18 / 42
JUNE			176	56 / 31.8	183	69 / 37.7	17 / 9.3	2 / 1.1	22 / 12	5 / 2.7	13 / 7.1	310	206 / 66.5	44	16 / 36
JULY			209	37 / 17.7	236	33 / 13.9	14 / 5.9	5 / 2.1	18 / 7.6	4 / 1.7	4 / 1.7	288	171 / 59.3	30	12 / 40
AUGUST			299	50 / 16.7	301	76 / 25.2	28 / 9.3	2 / 0.6	41 / 13.6	15 / 4.9	9 / 2.9	339	227 / 66.9	52	14 / 26.9
SEPTEMBER			360	103 / 28.6	355	109 / 30.7	31 / 8.7	4 / 1.1	35 / 9.8	13 / 3.6	13 / 3.6	362	242 / 66.8	65	29 / 44.6
OCTOBER			281	51 / 18.1	296	45 / 15.2	19 / 6.4	4 / 1.4	29 / 9.8	12 / 4.0	8 / 2.7	296	167 / 56.4	43	18 / 42
NOVEMBER			132	34 / 25.8	222	29 / 13.1	19 / 8.5	2 / 10.9	15 / 6.7	8 / 3.6	11 / 4.9	209	112 / 53.6	57	21 / 37
DECEMBER			235	32 / 13.6	246	43 / 17.4	15 / 6.0	0 / 0	28 / 11.4	9 / 3.6	2 / 0.8	341	228 / 66.8	67	30 / 45
TOTALS		14,000 (approx.)	2,819	602 / 21.4	2,931	688 / 23.5	239 / 8.2	57 / 1.9	298 / 10.2	119 / 4.1	96 / 3.3	3,382	2,206 / 65.2	492	181 / 36.7

TABLE 6

COMMUNICABLE DISEASES
7/1 - 9/1/76

DISEASE	LIBERIA		BONG COUNTY	
	CASES	DEATHS	CASES	DEATHS
Malaria	42,032	70	3,465	2
Schistosomiasis	1,077	-	191	-
Pneumonia	3,149	151	87	3
Measles	1,420	55	46	1
Dysentery	3,425	-	28	-
Cholera	508	8	-	-
Diarrhea	15,379	75	1,513	2
Leprosy	2,303	-	455	-
Tetanus	446	49	2	1
Pulm. TB	726	22	5	-
Pertussis	1,161	1	1	-
Onchocerciasis	1,082	-	2	-
Infectious Hepatitis	226	-	1	1
T O T A L	72,934	431	5,796	9

These figures may be considered as incomplete for the following reasons:

1. The Phebe Hospital and the C.B. Dunbar Clinic reported in 1976 the detection of 1,703 cases of schistosomiasis. Although this figure may reflect more than one examination on the same patient and therefore may not represent all new cases, yet the difference in the numbers is significant.

2. In the same vein, the figures for malaria in Table 6 contrast sharply with data obtained from the Division of Records and Vital Statistics, MHSW on symptomatic malaria cases. The cases were reported from clinics in Bong County in 1976 and revealed 37,994. Although not all were probably diagnosed microscopically, again the difference in the figures is significant. For instance, from C.B. Dunbar Clinic alone in 1976, 2,206 cases of malaria were diagnosed from blood smears and for a 5-month period in 1976, the Phebe Hospital made the microscopic diagnosis of malaria in 1,698 cases.

Thus it would appear that there is definite under-reporting of endemic diseases.

3. Data from Phebe Hospital for the 5-month period of January 1 - May 31, 1976, revealed 233 cases of onchocerciasis, 558 cases of Schistosoma haematobium infection, 304 Schistosma mansoni infections and 1,698 cases of malaria.

The data from Phebe Hospital and C.B. Dunbar Clinic were obtained from laboratory records and may reflect incidental findings on persons who attended the clinics or were hospitalized for other reasons.

(1) Malaria - INTRODUCTION: Malaria has the highest endemicity among communicable diseases in Liberia and constitutes a severe problem.[1] This is shown by hospital and clinic records and by limited malariometric surveys carried out a few years ago in the counties of Lofa, Nimba, Bong, Grand Bassa, and Grand Gedeh.[1]

In this matter, Liberia reflects the situation in virtually all of tropical Africa. Malaria affects practically the entire population of tropical Africa and it has been estimated that every year the disease causes the death of one million children under the age of 14 years.[2,3]

In some rural areas of Liberia, the parasite rate in children is stated to be as high as 80-100%.[1] According to the Annual Report of the National Public Health Service for 1969, 73.6% of 743 blood samples from employees and their families were positive for malaria parasites.[1]

CLINICAL AND PARASITOLOGICAL INFORMATION - When a non-immune, susceptible person is bitten by an infected anopheline mosquito, the infecting forms of the parasite, sporozoites, are injected with the mosquito's saliva. The sporozoites reach the liver via the bloodstream. They multiply in the liver, one sporozoite giveing rise to 2,000-20,000 merozoites. This stage of malaria is clinically inapparent and is called tissue schizogony.[4]

At the end of the incubation period, the merozoites enter the bloodstream and parasitize the enthrocytes. The first clinical attack occurs when the parasites in the blood reach a certain density.[4]

Four major factors determine the pathology of malaria[4]:

1. the rate of asexual multiplication of the parasites in the blood.
2. the amount of erythrocyte destruction.
3. the degree of immune response of the host, and
4. in falciparum malaria, the occurrence of capillary blockage.

The severest forms of malaria are caused by P. falciparum malaria, the predominant species in tropical Africa, while P. vivax and P. ovale produce malaria of lesser severity. P. malariae is clinically the least severe, but is actually the most persistent form of malaria.

The acute stage of P. falciparum malaria is often fatal, particularly if cerebral or "algid" malaria ensue. Infections due to P. Falciparum, P. vivax and P. ovale are self-limiting, while infections due to P. malariae may last a lifetime.

PRESENT STATUS OF CONTROL MEASURES -

1. Tools and Methods Available for Control[4] - In general, control measures may be directed to interfere with one or more links in the chain of transmission: infected man - infected mosquito vector-susceptible man. This could be achieved by:

a. treating infected persons and thus eliminating the parasite;

b. attacking the vector in its larval or adult stages, or preventing the vector from breeding;

c. protecting susceptible persons through drug prophylaxis or by impeding man-vector contact through the use of mosquito nets, screens or repellants.

At present, few if any, of these measures are being carried out in Bong County. Malariometric surveys and control measures are applied mainly in Monrovia and its environs (within a 25 mile radius).[5,6]

No recent data are available on vectors or vector density with regard to malaria and Anopheline mosquitoes in Bong County. Vector species collected in the Monrovia survey revealed A. gambiae, A. funestus, A. hancocki and A. coustani. A. gambiae was the predominant species collected.

A feasibility test on weekly chemoprophylaxis, at Bentol, as a measure of malaria control, showed a significant reduction in endemicity.[5] The parasite rate fell from 76% before chemoprophylaxis to 38% afterward.

REVIEW OF PAST ACTIVITIES AND EPIDEMIOLOGICAL DATA[5] -

1. The first results of malaria survey in Liberia published by the Harvard African Expedition (1926-27) showed that out of 150 children and adults examined, 34.6% were positive for malaria.

2. GOL and WHO, Malaria Control Programme (Liberia-5), 1951. Residual insecticide spraying in Bong and Nimba counties (9,000 square miles). By second half of 1957, a widespread resistance of A. gambiae to Dieldrin and BHC was established.

3. In 1958, a Malaria Eradication Pilot Project (MEPP-Liberia-16) was superimposed on the previous one. DDT was sprayed at one year cycles, last spray - 1961.

4. 1954-57 - A. funestus was predominant at 57%, next came A. gambiae - 32% and A. hancocki at 10%. By 1958, A. gambiae represented 98% and A. funestus only 1.5% of the Anopheline population.

5. 1961 - Parasite rate - 18.5%. 85% was P. falciparum, P. malariae - 12.5%, P. ovale - 2.5%, mixed infections 10.6%.

6. Malaria Pre-Eradication Project (MPEP-Liberia 20), 1963. Malariometric surveys in Nimba, Bong, Grand Gedeh, Sinoe, Lofa and Grand Bassa revealed parasite rates for all age groups ranging from 57-88%.

7. Entomological surveys in 1965 were done in the sprayed and unsprayed areas of former project Liberia - 16. Seven species of Anopheles were recorded of which A. gambiae was the only one found infected.

No subsequent data on Bong County, with regard to malaria surveys, were available.

An assessment of malaria incidence in two villages in Bong County was done by the team. The villages selected were within the Bong County Rural Development Project area. One village, Gbatala, was in a non-swamp rice area and the other village, Palala, was in a swamp rice area. Both villages were in Gbarnga District.

A report of this assessment is attached.

(ii) Schistosomiasis - A brief review of Phebe Hospital records for the six-month period of July 1, 1976 through December 31, 1976 revealed that 22 persons were hospitalized with schistosomiasis as the primary or secondary diagnosis. Six of the cases were in children less than ten years of age. The remainder were described as adults. Thirteen cases were S. mansoni (one double infection) and 10 cases were S. Haemetobium infections (one double infection). These findings indicate that as a primary or secondary cause of hospitalization for schistosomiasis, S. mansoni is quite significant. This may also suggest that S. mansoni occurs more frequently than routine stool examinations may indicate. These findings are summarized in Table 7.

TABLE 7

PHEBE HOSPITAL SCHISTOSOMIASIS CASES
7/1 - 12/31/76

AGE	SEX	VILLAGE	SCHISTO. SP.
7 yrs.	Male	Wainsue	S. haematobium
Adult*	Female	Gbarnga	S. mansoni
8 yrs.**	Male	Gatwah	S. Mansoni
Adult	Female	Kautah	S. haematobium
Adult	Female	Quaito	S. haematobium
Adult	Female	Palala	S. mansoni
Adult	Female	Gbarnue	S. mansoni and haematobium
Adult	Male	Kandotterla	S. mansoni
Adult	Male	Tubman Farm	S. haematobium
3 yrs.	Male	Gbandala	S. haematobium
Adult	Female	Melekie	S. mansoni
Adult	Female	Kayata	S. mansoni
8 yrs	Female	Dornenai	S. mansoni
Adult	Female	Gbarnga	S. mansoni
9 yrs.	Male	Ziensue	S. haematobium
Adult	Female	Galai	S. mansoni
30 yrs.	Male	Melekie	S. mansoni
Adult	Female	Wainsue	S. mansoni
5 yrs.	Male	Suakoko	S. haematobium
Adult	Female	Melekie	S. haematobium
Adult	Male	Kokoyah	S. mansoni
Adult	Female	Simpson Farm	S. haematobium

* Also amebic live abscess and hookworm.
** Also hepatitis, hookworm and ascariasis.

DR. MILLER'S STUDIES - 1954-1957 - Basic studies relating to schistosomiasis were undertaken in Liberia at the former Liberian Institute for Tropical Studies (LITM) at Harbel, Liberia. In the Annual Report for 1954, the then Director Max Miller reported treating patients with reprodal or fuadin - an antimony compound. This drug has drastic side effects and is not the modern drug of choice. Dr. Miller studied the urines of 20,000 employees of the Firestone plantation. An interesting observation was that "if the urine specimen is taken in the afternoon it will be positive in practically 100% of the cases." The results of his study appeared in 1957 in a paper with the title: "A Survey of Schistosoma haematobium Infections in Liberia" (Amer. J. Trop, Med. & Hyg., 6: 712-714). His summary statement is, as follows:

> "By examining the labor populations, recruited from different parts of the country, of several rubber plantations and a mining company located in areas where transmission of Schistosoma haematobium has never been known to occur, it has been possible to determine the general distribution and comparative intensity of this infection throughout Liberia. The coastal half of the country was found to be free of infection as was the entire Eastern Province and much of the Western Province. The highest infection rates were centered in the upper part of the Central Province between the St. Paul and St. John rivers; groups from this region showed infection rates above 50 per cent."

It is clear from this early study of some 20 years ago that the coastal region for some 60 miles or more inland (as shown on the map, p. 173) is free of schistosomiasis, but that the region in the Central Province of Upper Bong County around Gbarnga had a relatively high prevalence of both Schistosoma haematobium and S. mansoni.

DR. HANS VOGEL'S STUDIES - 1958 - In the LITM Annual Report for 1958, Dr. Hans Vogel of the Hamburg Tropenkrankheit Institut reported on several studies he made. Some of the information pertinent to this Upper Bong region identifies the following three snail species as important to schistosomiasis studies in Liberia:

Biomphalaria pfeifferi - at Gbarnga

Bulinus (Physopsis) globosus - at Baesala near Ganta

Bulinus forskalii - fish pond at Suakoko

These snails are also important species in studies of this disease in Liberia today. Dr. Vogel experimentally infected Bulinus globosus with Schistosoma haematobium. Since the distribution pattern in Liberia had such a characteristic pattern, Dr. Vogel collected water samples from some 18 localities with the following water pattern distribution:

(a) without Bulinus globosa and Biomphalaria pfeifferi
(7 localities)

(b) with B. globosus and without B. pfeifferi
(6 localities)

(c) with B. pfeifferi and with or without B. globosus
(5 localities)

These samples were analyzed by Dr. A. D. Hauck at Firestone Plantation Botanical Research Laboratory and the results given in Table VII (p. 39) indicate that where Biomphalaria and Bulinus are absent the water appears to be very soft. While the differences in Ca, Mg and K are not essentially great, it would appear that relative hardness is an important factor at sites where the intermediate host snails appear. More analyses on limnological relations to the snail populations are warranted.

Dr. Vogel also has information in the 1958 LITM Report with the title "Bilharziasis Survey in the Central Province" which contains some excellent basic information in relation to the present proposed study on schistosomiasis in Bong County. He used good criteria to determine whether an infection was acquired locally or was brought from elsewhere. He also indicated the methods he used for collecting and "shedding" cercariae from snails. Altogether he studied 21 communities in Central Province which essentially includes Bong County. He examined: 1737 urines; 1086 stools; and 2552 snails. While the rates in both species of schistosomes were quite high (see Table VIII, p.44), he found that for S. mansoni it was mugh higher than he expected. A table giving the vector snails for specific localities in the Bong area (Table IX, p. 45) will prove important for reference in future studies of prevalence in the region. It is again evident that there are marked seasonal variations both in the density of snails and in the snail infection rates at the 37 stations listed. For example, Dr. Vogel observed a wide range of variation at Beisala and then stated:

"Probably the effects of the dry season, lowering of water level, intensive sunshine and very high water temperatures, had killed off the greater part of the snails. Only in places shaded by high swamp plants a few snails had survived."

This observation was followed by an astute suggestion for the need of complete studies on seasonal variations which "promise interesting results as well as indications as to the optimal time for future applications of molluscicides."

Finally, the LITM 1958 Report gives Dr. Vogel's observations on studies of the life history of some Liberian trematides in which he reported two species of strigeid cercariae. Since they have forked-tail cercariae somewhat similar, but not the same, as schistosome cercariae, the field and laboratory assistants will need training to learn how to separate them from the characteristic forms to be recognized as schistosomes.

DR. HAROLD J. WALTER'S OBSERVATIONS - 1960 LITM REPORT - Some of the results of Dr. Walter's studies are given under the caption: "Field Studies on the Ecology and Bionomics of Snail-Vectors of Schistosomiasis." In his extensive survey, Dr. Walter made a number of significant observations. He conducted a year-round study of schistosome snail intermediate hosts at hosts at four stations: Beisalah, Gbanga, Cuttington and Toendee. His results showed that "snail populations reach peak dimensions early in the year toward the end of the dry season." At Toendee Bulinus globosus during the first half of the dry season was slow but there was "a six fold increase in numbers within a two month period ending in April." Then there was a drastic decline

over the next three months. At maximum production the collecting rate was 7.2 snails per man-minute: at Beisalah it was 1.2. For Biomphalaria pfeifferi, the rate at Cuttington was 7.3 while at Gbanga it was 6.0. In his use of markers to establish water levels or depths, he got fluctuations as high as 28 inches.

Low water levels correspond with high water temperatures so that Bulinus globosus at Beisalah registered a high of 34°C, while at Toendee it was 25°C with a range of 23° to 26°C. In the Biomphalaria habitats the snails thrive at 25°C to 31°C. Other limnological observations indicate: a wide range of pH with higher pH at the end of the dry season. His studies involved measuring MO alkalinity, free CO_2, O_2 (higher in heavy vegetation); the alkalinity at Toendee and Cuttington ranged from 10 to 20 ppm.

Disturbing the canals did lower the Bulinus snail populations; the young Biomphalaria were hard to collect and found a great increase in young during February at Gbanga. Young snails occurred throughout the year and egg-masses were often hard to find. For Bulinus globosus the eggs were common in February and March with the peak development of adults in March. Bulinus forskalii appeared at Beisalah in small numbers. At the Cuttington station he found 7 species of mollusks: Biomphalaria pfeifferi, Bulinus globosus B. forskalii, Gyraulus costulatus, a Segmentorbis, and a finger-nail -clam - Pisidium

In all some 330 sites were examined of which but half yielded mollusks. The habitats were distributed in the following categories: 215 were in creeks and rivulets, 25 in rivers, 70 in pools or ponds, 2 in lakes. Many of these habitats joined

rice fields or marshes. This program was an extensive survey in which Bulinus globosus was found at 42 sites and was more prevalent than any other mollusk; none were found inthe Eastern Province. Biomphalaria pfeifferi was one of the least common of the mollusks.

In the 1961 LITM Report, Dr. Harold Walter provided additional information relating to the Upper Bong County program. A field trip in December, 1961, enabled him to establish 40 stations with 3 of those in Suakoko-Gbarnga area and the remaining 37 in Zorzor, Voinjama and Kolahun. Among those,22 yielded snails, with Bulinus globosus the most common appearing in 14 localities, while Biomphalaria pfeifferi was found only at three sites in the Central Province. Of the 255 Bulinus collected only one shed schistosome cercariae; it was from the station at the Gbanga Methodist Mission Farm. Surprisingly 25% of the bulinids collected shed strigeid cercariae - not to be mistaken for the somewhat similar forked-tailed schistosomes. The Biomphalaria with schistosome infections also came from the same Mission Farm where 9% of those snails were infected.

DR. D.M. LEVINE'S STUDIES - 1961 - In the same 1961 LITM Report, Dr. Levine gave a method used to culture 5 species of intermediate host snails while he tried to maintain them in a uniform way he found great variation in snail production. He thought that the well water used was too acid. Hence he began to use distilled water to which marble chips were added. For some excellent information dealing with culture methods a recent paper by Dr. Yung-san Liang should prove helpful;

it has the title: "Cultivation of Bulinus (Physopsis) globosus (Morelet) and Biomphalaria pfeifferi pfeifferi (Krauss), Snail Hosts of Schistosomiasis." (Sterkiana, No. 54:25-75, 1974).

It is of interest to note that Dr. Levine also successfully infected Bulinus forskalii in the laboratory. While this snail can carry infection in the field it is not as common and widespread a species so that its importance in transmission remains questionable. Its ecology is more like that of Bulinus globosus; it usually is found in flowing water.

DR. WM. A. SODEMAN'S REPORT - 1973 - While stationed at the LITM, Dr. Sodeman made a survey from November 1967 to February 1968, along a 10 mile stretch of the road in the Suakoko area. He stated: Within this special study area 3 monthly visits were made." His assessment was given in the article with the title: "The Distribution of schistosome vector snails in Central Liberia (Ann. Trop. Med. & Parasit., 67: 377-360, 1973). In this article he reported (p. 360):

> *"This modest prevalence of stites positive for vector and infection should be contrasted with the prevalence of human infection. Surveys at schools at Suakoko and Gbarnga showed the prevalence of S. mansoni was 49.6% of 328 school children in Suakoko and 66% of 221 children in Gbarnga. The prevalence of S. haematobium was 49.7% of 380 children in Suakoko and 44.4% of 234 children at Gbarnga. Complete results of the parasitic survey will be reported in detail, but these preliminary figures suggest a substantial prevalence of disease commensurate with the prevalence of vector snails and parasites."*

SUMMARY - "A systematic survey for the presence of schistosome intermediate host snails was carried out in central Liberia during 1967-68. Biomphalaria pfeifferi and Bulinus globosus, the previously identified hosts for Schistosoma mansoni and S. haematobium respectively were present at 40 of 177 sites visited (22.3%) and infected snails at 15 (8.5%) of the sites. B. pfeifferi and B. globosus sites seemed equally prevalent, but S. mansoni-infected sites outnumbered S. haematobium sites 3 to 2. Of the many kinds of sites sampled only seepage wells were regularly free of host snails. Surveys of human infection on the study area indicated a prevalence for S. mansoni of 56% of 549 children and a prevalence for S. haematobium of 47.7% of 614 children."

THE ROBERT HIATT AND ERNESTO RUIZ REPORT - 1976 -- SCHISTOSOMIASIS IN UPPER LOFA COUNTY, LIBERIA - This report contains many important observations on conditions as they relate both to the intermediate and definite hosts. Some of the essential information relating to snail studies is contained in section "B" (pp. 8-9). These recommendations are sound and bear repeating for future Bong County surveys. Just how this work can best be implemented could be determined within the Snail Surveillance program. The stress again should follow the pattern here recommended in that once the baseline information is established "surveillance should be tied to control." The policy of the program was well stated:

> *"On the basis of this interpretation of the project's objectives, we recommend that the purpose of surveillance be to find infected people and snails, and to apply*

appropriate control measures. In terms of protecting the inhabitants, we do not see the benefit of 2 to 4 years of surveillance alone and believe that control measures can be instituted early in the course of the project."

(iii) Onchocerciasis - The most dramatic form of filariasis is onchocerciasis or river blindness caused by the worm Onchocerca volvulua, which is transmitted by the black fly, Simulium damnosum.[10]

In 1926 the Harvard Expedition gave the first evidence of the occurrence of onchocerciasis in Liberia (Strong 1930). Burch, et al. (1955), Miller and Frang (1958), Rebe and Hoeppli (1964) and Gratama (1966) determined the prevalence in the population of several clinical lesions, as well as the regional occurrence of endemic foci in rural areas.[11] Burch, et al. found the highest prevalence of skin nodules and positive skin snips was among people from Western Liberia, while there were fewer microfilaria carriers from the coastal belt.

Data on parasitological and clinical findings from a homogeneous rural population at Bong Range were evaluated by Frentzel-Beyme.[11] He found that from a sample of 1,252 persons from a total population of about 15,000 of the Kpelleh tribe, 783 (63.2%) were carriers of microfilariae of O. volvulus. Age-specific prevalence rates revealed that at an age of 16-18 years more than 50% of the population had detectable larvae in the gluteal skin. Among the adult population, the male sex showed a significant predominance of positive results.

The rate of blindness of 1.18% found in the Bong Range was more than twice as high as in onchocerciasis free regions of Liberia. Blind-

ness appeared related to onchocerciasis in the majority of cases. The average age of onset of blindness was 48 years. In the unilaterally blind, the average age was 40 years and the blindness seemed less related to onchocerciasis.

The study by Frentzel-Beyme[12] on blindness in Liberia with relation to onchocerciasis suggested that 50% more blindness occurred than would be expected without exposure to onchocerciasis sometime in life.

Studies on the epidemiology of onchocerciasis in Liberia included a survey on the breeding places of the vector Simulium damnosum, which was found to be distributed throughout the country.[13] The species appeared to be more common in regions where the original tropical rain forest had been destroyed and replaced by farmland, rubber plantations, low-bush or savanna.

Garms and Vajime[14] studied the ecology and distribution of the Simulium damnosum complex in Liberia and Guinea. S. damnosum Theobald and S. sirbanum Vajime and Dunbar were found breeding in rivers and irrigation systems.

Brinkman[15] studied quantitative measurements on skin snips in onchocerciasis. He found that the largest proportion of microfilariae in skin snips emerged within the first 30 minutes after immersion in Normal saline.

Laboratory records of the Phebe Hospital and C.B. Dunbar Clinic on skin snips show a positivity range from 33% to 51% over the period of 1973-1976.

(iv) Trypanosomiasis - This disease is not widespread in Liberia. However, in many parts of the country there are several species of tsetse fly capable of transmitting trypanosomiasis. In the mid-60s surveys indicated that the disease seemed to be limited to northern Liberia. The small number of cases found there indicated that trypanosomiasis is not now a major health problem.[1] Review of records at Phebe Hospital for the period of 1967-77 revealed only 13 cases, most were residents of the proposed area.

In view of the fact that trypanosomiasis does exist in Bong County raises the possibility of increased incidence with increased swamp rice production. The reason for this statement is as follows:

A reservoir of easily transmissible trypanosomiasis exists among the Kissi tribe along the border. Two reasons are given for this endemic focus:

1. The Kissi raise swamp rice in a tsetse habitat and
2. The Kissi are migratory. They live in small settlements surrounded by inadequately cleared vegetation so that the tsetse fly breeds in the immediate vicinity.[1]

At present, it does not appear that trypanosomiasis is a major health problem in Bong County. However, Sekou Toure Hospital reported 5 positive slides for trypanosomes in May 1976.

Again, a brief review of hospital records on all persons hospitalized at Phebe Hospital over the 10-year period, 1967-1977, revealed only 13 cases. The species of parasite was identified only twice and that was T. Gambiense. The two most recent cases seen in February 1977 were suspected as being due to T. Rhodesiense. The hospital does not routinely do studies

on blood for trypanosomes. However, because of its acute nature, patients with Rhodesian sleeping sickness will usually seek medical aid.

A summary of the trypanosomiasis cases is shown in Table 8. These findings indicate that although trypanosomiasis is endemic, it does not appear to be a major problem at this time.

(v) Filariasis - There were no reports on filariasis from hospital data or the MHSW. However, filariasis is known to occur in Liberia but does not appear to be a major health problem at this time. One report from Sekou Toure Hospital for April 1976 revealed eight out of eight positive coverslip examinations for microfilariae. It was not clear whether this was for W. bancrofti or O. volvulus as nothing was reported under skin snips. No accurate figures exist from the records of the Phebe Hospital and the C.B. Dunbar Clinic as to the incidence of this infection.

(vi) Other Parasites - Intestinal parasites were quite prevalent, expecially hookworm in laboratory summaries from Phebe and C.B. Dunbar Clinic. Hookworm and ascaris were the most prevalent. (See Tables 1-5.)

2. Epidemiological Field Studies -

a. Lofa County Schistosomiasis Survey

(i) Laboratory analysis of urine and stool samples collected in the village of Vezela have not been completed at this date.

(ii) Malacological Surveys at Sites Visited in 1976: Revisited in 1977 -

Velezala
Feb. 17 (1) creek across road from Velezala
conditions as given in Table 3 of previous report
no snails found.

TABLE 8

PHEBE HOSPITAL TRYPANOSOMIASIS CASES
1967-1977

DATE	CASE #	AGE	SEX	VILLAGE	REMARKS
1/7/67	1	3 yrs.	Male	Gbatala	Recovered
7/8/67	2	38 yrs.	Male	Samay	T.gambiense, Recovered
9/29/67	3	26 yrs.	Male	Gbekon	Expired
7/31/70	4	12 yrs.	Female	Tonkpayah	Discharged 8/5/70
11/24/71	5	6 yrs.	Male	Nyenwuma	T.gambiense, Discharged 11/29/
2/1/72	6	41 yrs.	Female	Gbanga	Discharged 2/19/72
3/31/75	7	42 yrs	Male	Taylorata	Discharged 4/25/75
10/27/75	8	Adult	Female	Wainsue	Discharged 11/17/75
3/13/76	9	9 yrs.	Male	Ivory Coast	Typhoid Fever, Discharged 3/29/76
3/19/76	10	17 yrs.	Male	Garyea	Discharged 3/27/76
1/26/77	11	26 yrs.	Male	Gbanga	Expired 2/3/77, 4 mos. after onset
2/15/77	12	Adult	Female	Yontah	Still Hospitalized at Report
2/21/77	13	Adult	Male	Samoyed	Expired, Prob. T.rhod.

(2) Zeliba River, ½ mile south of village

sandy and irregular bottom; no snails found.

(3) swamp, flowing into river, ½ mile south of

village conditions dry; no Bulinus forskalii

found swamp had many large Lymnaea

Seliga

Feb. 18 (1) swamp rice field being expanded

many Bulinus globosus within the rice paddies

46 B. globosus examined Feb. 19; none infected

Feb. 19 (2) Seliga stream, about 1 mile north of village

collected 34 Bulinus globosus; all on or

buried in mud along shore; 29 uninfected; 3

with strigeids; 1 with schistosome; 1 double

infection

Foya

Feb. 20 (1) Foya Dundu

stream with sandy bottom; women washing clothes

24 Bulinus globosus in mud along shore

none infected

(2) Chinese Rice farm

13 Bulinus globosus on mud in the rice paddies;

none infected, 2 Lymnaea

Zorzor

Feb. 22 stream north of Zorzor on road to Yeala

Bulinus globosus abundant in area used as a

dump; none infected

b. Bong County Surveys -

(i) Malaria -

GBATALA

A non-swamp rice area.

Number of huts = 362

Approximate population = 679

A sample of 172 persons was examined for splenomegaly and hepatomegaly. Blood films for malaria and other blood parasites, skin snips for onchocerciasis and urine and stool samples for Schistosome ova and other intestinal parasites were obtained.

No trypanosomes or microfilariae were detected on the blood films. The remainder of the results of the survey for malaria and onchocerciasis are shown in the following data.

Distribution of Parasites among 172 subjects.

1. Plasmodium Falciparum

   Number positive = 51
   Percent of subjects = 29.65 or 30%
   Percent of malaria parasites = 61.4%

2. Plasmodium malariae

   Number positive = 30
   Percent of subjects = 17%
   Percent of malaria parasites = 36.2%

3. Plasmodium ovale

   Number positive = 2
   Percent of subjects = 1
   Percent of malaria parasites = 2.4%

Gametocyte Rate

P. Falciparum

Number positive = 5
Percent = 9.8% or 10%

TOTAL POSITIVE FOR MALARIA = 83
PERCENT POSITIVE = 48%

Spleen Rate = 14%
Parasite Rate = 48%
Cameotocyte Rate = 10%
Infant Parasite Rate = 25% (2/8)

Approximate population of Gbatala = 679
Percent of population studied = 25%

Prevalence (the total number of cases of disease at a certain time in a designated area).

Based upon a population sample of 25% (172) total positive for malaria was 83 (48%).

$$172:679 : : 83:X$$

$$172X = 56,357$$

$$X = 327$$

327 = Estimated total number of malaria cases in Gbatala at the time of the survey.

Approximately 48% of the population was infected with malaria.

The incidence rate cannot be calculated as it refers to the number of new cases during a specific time divided by the population in the area. The data on new cases in Gbatala are not available.

The prevalence per 1,000 population would be 481.

$$327:679 : : X:1,000$$

$$679X = 327,000$$

$$X = \frac{327,000}{679}$$

$$X = 481$$

TABLE 9. GBATALA AGE AND SEX DISTRIBUTION OF MALARIA

AGE	MALARIA SP. P.f. M	P.f. F	P. M. M	P. M. F	P.) M	P.) F	TOTAL MALARIA CASES	TOTAL IN AGE GROUP	PERCENT INFECTED	REMARKS
≤ 2 yrs.	5	3	1	2	0	0	11	19 (10 males / 9 females)	57.8% (60% M / 55.5% F)	
2-9 yrs.	7	17	4	4	0	2	34	52 (20 males / 32 females)	65.3% (55% M / 71.8% F)	
10-14 yrs.	3	4	0	3	0	0	10	20 (6 males / 14 females)	50% (50% M / 50% F)	
15-19 yrs.	0	4	1	3	0	0	8	17 (3 males / 14 females)	47% (33% M / 50% F)	
20-24 yrs.	0	4	0	5	0	0	9	15 all females	60% (0% M / 60% F)	
25-29 yrs.	1	1	0	3	0	0	5	15 (2 males / 13 females)	33% (50% M / 31% F)	Number of males in sample small Figure probably not significant
30-39 yrs.	0	0	0	1	0	0	1	13 (7 males / 6 females)	7.6% (0.7% M / 16.6% F)	Infection rate low in age group
40-49 yrs.	0	1	2	0	0	0	3	8 (7 males / 1 female)	37.5% (28.5% M / 100% F)	Number of females too low to be significant
50-59 yrs.	1	0	0	0	0	0	1	6 (5 males / 1 female)	16.6% (20% M / 0% F)	Number of females too low to be significant
≤ 60 yrs.	0	0	0	0	0	0	0	6 (5 males / 1 female)	0% (0% M / 0% F)	Number of females too low to be significant
UNKNOWN	1	0	0	0	0	0	1	1 male	100% (100% M / 0% F)	Number too low to be significant
T O T A L	18	34	9	21	0	2	83	172	48.25% (39.3% M / 53.7% F)	

PALALA

A swamp rice area.

Number of huts = 201

Approximate population = 455

A random sample of 10% of the huts (about 120 people) was selected and 71 turned up for the assessment. However, urine and stool containers were issued to all in the sample and those who did not come for blood sampling returned 2 days later with urine and stool samples.

The skin snips for onchocerciasis revealed 4 positive (5.6%). No trypanosomes or microfilariae were detected on blood films.

The remainder of the results of the survey for malaria and onchocerciasis are shown in the following data.

Distribution of Parasites among 71 subjects.

1. Plasmodium falciparum

   Number Positive = 28
   Percent of subjects = 39%
   Percent of malaria = 71.8%

2. Plasmodium malariae

   Number positive = 8
   Percent of subjects = 11%
   Percent of malaria = 20.5%

3. Plasmodium ovale

   Number positive = 3
   Percent of subjects = 4%
   Percent of malaria = 7.7%

Gametocyte Rate

   P. falciparum = 0

TOTAL POSITIVE FOR MALARIA = 39
PERCENT POSITIVE = 55

Spleen Rate = 21%
Parasite Rate = 55%
Infant Parasite Rate = 66% (only 3 infants less than one year of age)

Approximate population of Palala = 455
Percent of population studied = 15%

PREVALENCE - Estimated total number of malaria cases at time of survey = 249.

$$71:455 : : 39:X$$
$$71X = 17,745$$
$$X = \frac{17,745}{71}$$
$$X = 249$$

Estimated prevalence per 1,000 population.

$$249:455 : : X:1,000$$
$$455X = 249,000$$
$$X = \frac{249,000}{455}$$
$$X = 547$$

DISCUSSION:

GBATALA

MALARIA - A spleen rate of 14% indicates that malaria is mesoendemic in Gbatala.

The parasite rate was 48% and P. falciparum constituted 61.4% of malaria parasites seen.

The infant parasite rate of 10% indicates that malaria is being transmitted during the dry season. Also a gametocyte rate of 10% carries the same connotation.

Roughly half of the population was infected with malaria at the time of the survey (the dry season).

TABLE 10. PALALA AGE AND SEX DISTRIBUTION OF MALARIA

AGE	MALARIA SP. P.F. M	P.F. F	P.M. M	P.M. F	P. O. M	P. O. F	TOTAL MALARIA CASES	TOTAL IN AGE GROUP	PERCENT INFECTED	REMARKS
2 yrs.	1	0	1	1	0	0	3	5 (3 males, 2 females)	60% (66.6% males, 50% females)	
2-9 yrs.	7	5	1	2	1	0	16	27 (13 males, 14 females)	59% (69.2% males, 50% females)	
10-14 yrs.	4	1	0	0	0	1	6	9 (6 males, 3 females)	66.6% (66.6% males, 66.6% females)	
15-19 yrs.	2	4	0	0	0	0	6	9 (2 males, 7 females)	66.6% (100% males, 57% females)	
20-24 yrs.	0	1	0	0	0	0	1	4 (1 male, 3 females)	25% (0% males, 33% females)	
25-29 yrs.	0	0	0	0	0	0	0	4 (1 male, 3 females)	0% (0% males, 0% females)	Small Numbers
30-39 yrs.	1	2	0	2	0	0	5	7 (2 males, 5 females)	71% (50% males, 80% females)	Small Numbers
40-49 yrs.	0	0	0	0	0	1	1	3 (2 males, 1 female)	33% (0% males, 100% females)	Small Numbers
50-59 yrs.	0	0	0	1	0	0	1	3 (1 male, 2 females)	33% (0%, 50% females)	Small Numbers
60 yrs.	0	0	0	0	0	0	0	0	0%	
T O T A L	15	13	2	6	1	2	39	71	54.9%	

NOTE: 2 infants 1 yr infected, indicating dry season transmission.

The highest rate of infection was in the 2-9 year age group, after that age, the infection rate tended to fall. In six persons ≥ 60 years of age, no malaria parasites were noted. The majority of subjects were lifetime residents of the village.

PALALA

MALARIA - A spleen rate of 21% indicated that malaria is meso-endemic in Palala.

The parasite rate was 55% and P. falciparum constituted 72% of malaria parasites seen.

Because of the small sample of infants ≤ 1 year of age, the infant parasite rate of 66% may not be accurate. However, this does indicate that malaria is transmitted during the dry season in Palala.

Half the population was infected with malaria at the time of the survey (dry season). The highest rate of infection was in the 10-19 year age group and in the 30-39 year age group, however, no group showed less than 33% infection rate except the 20-24 year age group which had no infection (only 4 persons).

(ii) Schistosomiasis - GBATALA VILLAGE: Out of nearly 200 urine samples collected, 162 have been microscopically examined. Twenty-eight (17%) have been found positive for S. haematobium eggs. An egg count of 1200 eggs/10 ml of urine has been recorded in one positive individual. Sixty-three of nearly 200 stool samples collected have been examined. Nine (14%) have been found positive for S. mansoni thus far. The highest egg count recorded to date is one with 1,164 eggs/gram of feces. Results of 114 stool and urine samples collected in Palala are still pending.

MACOLOGICAL SURVEYS -

Palala
Feb. 21 (1) stream on road south of village; dry with stagnant pools; no snails

(2) stream west of village; stagnant pools, no snails

(3) clothes washing site on river in forest; deep pools; no snails

(4) Charlie Too's Rice Field - a long way from Palala at Zowienta; extremely dry - no snails

Wainsu
Feb. 23 several streams along road examined; no snails; a rice farm without snails; "Molluscicide" mentioned turned out to be rice fertilizer

Suakoko
Feb. 24 Pond on Tubman Research Farm - Found Biomphalaria pfeifferi abundant along shore in vegetation. Fish ponds almost dry and without snails; Lymnaea along with the Biomphalaria - cattle enter pond so watch for fascioliasis!

(iii) Onchocerciasis - Skin snips done on 71 subjects by the team at Palala revealed microfilariae in 5.6% of the sample. The skin snips done at Gbatala dried-out before they could be read. The finding of only 5.6% infection rate at Palala contrasts with the average of 40% infection rate at Phebe Hospital and 63% rate in the survey by Frentzel-Beyme. This may indicate that at present, the water conditions at Palala are not conducive to Simulium breeding (stagnant pools and dried streams). Also because of work site conditions of no privacy, snips were taken from the calf rather than the buttocks. However, it is known that Simulium flies may be distributed irregularly. A good reference on Simuliidae and their control is a paper by Jamnback.[16] Also papers by Quelennec[17] and by Quillivere, et al.[18] are useful references on Simuliidae.

(iv) Other Parasites - (Pending Results of Schistosomiasis Studies)

3. Environmental Sanitation - Environmental Sanitation is generally poor throughout most of Liberia and constitutes the major factor affecting public health nationally. The prominence of malaria, various helminthiases, parasitic and enteric diseases, and schistosomiasis among the major causes of morbidity and mortality throughout the country clearly point to the very low level of sanitation.

The effects of poor sanitation are magnified by climatic conditions and topography which favor the propagation of insect vectors and intermediate hosts of communicable diseases, water borne and other intestinal parasites. Extensive flooding of low-lying areas by heavy rainfalls result in the contamination of water supplies, the proliferation of insect vectors and the spread of mycotic infections.

The most accute environmental sanitation problems are the severe lack of adequate potable water supplies, the improper disposal of human wastes, the proliferation of disease vectors and intermediate hosts, and poor food handling.

The assignment of priorities, allocation of resources and a lack of understanding of the relationship between personal hygiene and cleanliness to disease are among the major contributory factors to the continued existence of these problems. Thus in Monrovia where most of the health resources are concentrated and personal hygiene is better, environmental sanitation is generally of a higher level.

Institutional Arrangements

Ministry of Health and Social Welfare (MHSW)

The Ministry of Health and Social Welfare through its Bureau of Preventive Services has broad responsibilities for environmental sanitation throughout Liberia. It's functions are more of an advisory and monitoring nature than one concerned with the execution, operation and maintenance of sanitary works and facilities. The provision of water supplies, for instance, is mainly the responsibility of the Ministry of Local Government and the semi-independent Public Utilities Authority. The Ministry of Health and Social Welfare provides these agencies and the public with technical advice on water supply systems, the design and location of wells, septic tanks and pit latrines. The water supply and sewerage systems of the private concessions do not come under the jurisdiction of the Ministry of Health and Social Welfare. The Ministry reportedly does not have the legal authority to regulate water supply and waste disposal systems and facilities. It, however, is authorized to regulate the quality of meat displayed for sale and to regulate and certify food establishments.

The Bureau of Preventive Services executes its environmental sanitation functions at local levels through the County Community Health Departments. The Environmental Health Divisions of these Departments are usually staffed by a few health inspectors surpervised by an Area Environmental Health Supervisor. Staffing, funds, supplies and logistic support are generally grossly inadequate for effective operations. Expenditures of the Ministry for preventive services generally, and environmental sanitation in particular, are virtually miniscule in view of the severity of the problems and their significance to public health. During the 1970's preventive services have been allocated less than 10% of the

health budget which in turn represented about 7.3% of the national budget. The 1976-77 budget allocated $1.185 million to preventive services out of a health budget of $11.82 million (Basic Information for a Country Profile, MHSW,1977). Of this, a mere $0.47 million were allocated to administration and environmental health with approximately $0.3 million being accounted for by personnel. A strong case can be made for significantly increasing these allocations.

Water Supplies

The Ministry of Health and Social Welfare (Basic Information for Country Profile, Jan. 1977) has estimated that approximately 6 to 9% of the population of Liberia was served by public water supply systems in 1975. Approximately 97% of those served lived in Monrovia, the capital with the remainder in the towns of Harper and Greenville. These three public water supply systems are operated by the Public Utilities Authority. These systems served approximately 52% of the population of Monrovia, 15% of Harper and 21% of Greenville.

Small, non-potable water supply systems serve the government administrative compounds in the counties while the Phebe Hospital, Bong County and private concessions such as the Bong Mines and the Firestone Rubber Company have potable systems.

A limited number of hand-dug wells are in use in rural towns as well as in Monrovia. Generally, however, the inhabitants of rural towns and villages obtain their water supplies for all domestic use from polluted creeks and swamps. The hand-dug wells are generally about 3 ft. in diameter, less than 35 ft. deep with a few achieving depths of 75 ft. They are usually completed in sands and gravels in the low-lands or limestone in the highlands. Usually

they are located much too close to pit latrines of approximately the same depths and have improper sealing wooden covers. The ropes used to lower buckets and other containers into the wells are allowed to drag all over the surrounding area thus becoming another source of pollution. It is therefore not surprising that the Area Environmental Health Supervisor, Bong County, reports that all water samples taken from wells throughout the county have shown high coliform counts.

This general lack of potable water supplies must be a major contributor to the prevalence of not only the enteric diseases but also diseases such as schistosomiasis and onchocerciasis from the use of polluted bodies of surface water.

The government, with international aid, has developed some plans and programs for improving the situation. Through a bilateral program with the Federal Republic of Germany, potable water supply systems are to be constructed in the six county towns of Voinjama, Gbarnga, Sanniquellie, Buchanan, Zwedru and Robertsport. Feasibility studies have been completed and bids invited for the construction of three in the towns including Gbarnga, the capital of Bong County.

The United Nations Development Program is providing financial and technical assistance as well as equipment for the rural well drilling and toilet construction program aimed at providing five 4" diameter tube wells with hand pumps and five pit latrines in each of 200 selected communities. Fifty wells have been completed to date at average depths of about 60' in areas along main roads. With 4 drilling rigs in use, it is hoped to progress at the rate of about 100 wells per year.

The National Socio-Economic Development Plan 1976-80 also provides for the expansion of the Monrovia water supply system from a capacity of 8 million gallons per day to 16 million gallons per day of potable water.

Sewage Disposal

The only public sewage disposal system in Liberia serves a section of Monrovia. Small systems exist in the Phebe Hospital compound, Bong County and at concessions such as the Bong Mines and the Firestone Rubber Company.

In the rural areas, septic tanks are to be found only in the Government Administrative Compounds and a few residences. Pit latrines are used in the towns by few residents. Most other people and particularly those in the villages simply use convenient points in the nearby bushes.

The septic tanks and pit latrines in use are generally improperly designed and located. The Ministry of Health provides some advisory services with respect to the design and location of these facilities but exercises no real inspection and enforcement control in these matters. It is not in a position to undertake such control programs with the resources at its disposal.

The widespread disposal of untreated human wastes directly on the land and in nearby water bodies is no doubt a (if not the) major contributor to the highly endemic schistosomiasis and other water borne diseases, the helminthiases and parasitic diseases.

Bong County Integrated Rural Development Project Area

Environmental sanitation in the proposed project area is typical of that described for rural Liberia. The only potable water supply and sewage

disposal systems are to be found at the Phebe Hospital and the Bong Mines.

The small water supply system serving the Government Administrative Compound at Gbarnga, the Presidential Palace and the adjacent Motel, Military Barracks and General Market provides an intermittent supply of untreated surface water between the hours of 7:00 A.M. and 11:00 P.M. daily. The treatment plant is reportedly inoperative because of a lack of chemicals.

The shallow hand-dug wells are of the open type earlier described with inadequate covers, rope and bucket operation and showing evidence of mosquito breeding. Many are too close to very insanitary pit latrines. All reportedly invariably show positive results for coliform organisms.

The Environmental Health Division of the C.B. Dunbar Health Center is staffed by eight (8) Public Health Inspectors supervised by the Area Environmental Health Supervisor. These Inspectors are scheduled to pay project evaluation and routine inspection visits to all districts of the county twice yearly. However, they are not provided with vehicles of any type.

The Division constructed, on a demonstration basis, six community wells and pit latrines in Gbarnga for the Independence Celebrations of 1975. These have since fallen into a state of disrepair for the want of materials to maintain them. No additional ones have since been constructed by the Division.

Plans submitted by the Division for the construction of 75 wells and 50 double compartment community toilets during Fiscal Year 1976-77 at a cost of $37,825 have not been implemented.

The Division in 1972 attempted the introduction of the Philippine Water Seal Latrine by building three (3) in Gbarnga and two (2) at out stations

in the County. These latrines consist of a moulded pit 3 ft. square by 5 ft. deep with a lid. Water for use in them is stored nearby in an oil drum or cement tank. No more have since been built.

The staff also undertake the inspection and regulation of meat displayed for sale, food establishments and drug stores. Their health education programs undertaken in schools during their district visits are severely hampered by a lack of visual aid materials. Their mosquito control programs have not been functioning for a lack of chemicals.

C. Conclusions

1. Malaria is mesoendemic during the dry season in the surveyed areas.

2. No recent entomological surveys on Anopheline mosquitoes have been done but previous studies showed A. gambiae to be predominant. This is the most proficient transmitter of malaria. It has already been shown that these mosquitoes developed insecticide resistance during pre-eradication spraying campaigns.

3. Malaria may reach hyperendemic levels in the area during the rainy season. Eventual construction of barriers and dams may increase mosquito breeding to the point that sufficient vectors are present during the dry season to maintain hyperendemic malaria.

It has been shown that increased malaria infection, especially with P. falciparum is followed by a decrease in agricultural productivity.

4. Schistosomiasis is endemic in Bong and Lofa Counties. Definitive conclusions will be provided in the Final Report following the completion of the laboratory analysis of the urine and stool samples taken during the survey.

5. Onchocerciasis does not appear to be a major problem in Falala at this time. However, Simulium damnosum breeds in running water and inthose areas of the project where such water exists, onchocerciasis can be expected. Also, it has been shown that Simulium damnosum breeds in irrigation canals in Liberia

6. Trypanosomiasis and Bancroftian filariasis do not appear to be major problems at this time.

IV. ENVIRONMENTAL HEALTH IMPACT OF UPPER BONG COUNTY INTEGRATED RURAL DEVELOPMENT PROJECT

The areas of potential negative health impacts of the Project are those related to the transmission of schistosomiasis and malaria.

A. Schistosomiasis

This disease is endemic in the area. All of the ingredients including the definitive host, poor sanitation and personal hygiene, and frequently used water ways infested with the intermediate hosts for the transmission of the disease are present. The potential, therefore, exists for increased transmission to result from an increase of snail infested waterways and increased human contact with those waterways.

A more definitive statement will be presented in the final report upon completion of the analyses of the field samples.

B. Malaria

Malaria is mesoendemic in the project area during the dry season.

The survey shows that transmission occurs in the dry season.

The endemicity during the rainy season is not known and would require a survey. It is, however, known from the Phebe Hospital records that the number of malaria infections increases during the rainy season. How much of this increase is attributable to swamp rice cultivation is not known. A survey would be needed to confirm that swamp rice fields contribute to the increase in vector density. Experiences in Gezira, Sudan[10] have, however, shown that rice irrigation has resulted in increased Anopheles gambiae density and increased malaria.

The project will, in effect, only increase the water area by the acreage cultivated for a second crop during the dry season i.e., by 750 acres or about one percent (1%) of the total swamp area of 73,500 acres in the Project Area. The Project will also develop an additional 4,000 acres of existing swamp for rice cultivation. This transformation of the swamps may possibly result in the development of conditions more conducive to the breeding of malaria vectors as well as increased human exposure to the vectors.

A long-term entemological and epidemiological survey would be needed to determine the potential for increased transmission.

Vector control of mosquitoes by larviciding breeding places and the spraying of huts should be undertaken in the Project Area.

Consideration should be given to the provision of malaria chemo-prophylascis for the Project Area population. Continuing surveillance of malaria throughout the year should be instituted.

Nothing stated within this assessment should be construed as a reason for delaying the implementation of this Project pending further study or the implementation of the recommendations. Nor is it intended that the health needs be neglected. The required studies and other recommendations should properly be implemented simultaneously with and as a part of the Project.

V. RECOMMENDATIONS

The following recommendations are proposed:

A. Schistosomiasis

The control of schistosomiasis in Liberia and the Bong Project Area in particular would require the use of a combination of measures including:

1. Improved environmental sanitation (potable water supplies and sanitary waste disposal) to prevent viable organisms from reaching waterways and reduce human contact with polluted waters. (See later recommendations on sanitation.)

2. The location of fecal areas of the snail intermediate hosts (Bulinus globsus, host of Schistosoma haematobium and Biamphalaria pfeifferi, host of Schistosoma mansoni) and the rendering of these areas free of infestation by molusciciding, maintaining waterways free of weeds, and canal banks relatively steep.

3. The use of chemotherapy.

4. The use of a sustained health education program to familiarize residents with the details and need for the implemented control measures.

5. The Liberian Institute for Biomedical Research and the Schistosomiasis Surveillance Unit (SSU) presently becoming operative in Lova County should be responsible for the implementation of the required control research, surveillance and control programs. This would require the expansion of the SSU's functions as presently defined to include the immediate pursuit of a control program. The estimated requirements for such an expansion are to be found in Appendix 3.

A snail culture facility is needed to maintain stocks of at least three intermediate snail hosts: - Bulinus globosus, Biomphalaria pfeifferi and Pyrgophysa forskalii. A useful paper on culture methods is:

> Cultivation of Bulinus (Physopsis) globosus (Morelet) and Biomphalaria pfeifferi pfeifferi (Krauss), Snail Hosts of Schistosomiasis, by Yung-san Liang (Sterkiana, 53: 1-75, 1973)

With prospects of having fascioliasis appear where cattle are maintained, it would be important to culture Lymnaea natalensis.

Have a field program of studies similar to that carried by Dr. Harold Walter as reported in the LITM Report for 1960. The year around survey would provide snail population information needed to determine both prevalence of disease and control.

Since field programs are dependent on a good deal of mobility proper transportation facilities will remain at the center of the program.

Personnel selected for the program must be properly trained.

The medical aspects of the work requires a physician with expertise both in diagnoses and in drug therapy.

It would seem worthwhile to use the area for a pilot project to test the feasibility of using increased ambient temperatures to eliminate snails in a focal area, such as a pond, pool, rice paddy, etc. Evidence is at hand to indicate snails (pulmonates) are not present where temperatures are maintained in the field at 30°C or higher. Heat would be applied only at the season when the gonads of the snails are producing eggs.

B. Malaria

1. Entomological survey for A. Gambiae and other Anophelines, e.g., A. funestus and A. hancocki.

2. Larviciding of breeding places and spraying of huts.

3. Consideration of Chemoprophylaxis of the population in the Project Area. A study (pilot project) in Bentol townships in 1975, of weekly Chemoprophylaxis with Chloroquine reduced the parasite rate from 76% to 13.7%.

C. Onchocerciasis

Continuing surveillance of onchocerciasis for evidences of clinical disease (blindness dermatitis).

D. Trypanosomiasis

A survey for trypanosomiasis in the Project Area (random sampling).

E. Filariasis

A survey for filariasis in the Project Area (random sampling).

F. Environmental Sanitation

1. Environmental sanitation is generally poor throughout Liberia with the exception of a section of Monrovia, the capitol and the private concessions such as the Bong Mines and the Firestone Rubber Company.

2. This poor sanitation is a (perhaps the) major contributor to the highly endemic schistosomiasis, other water borne, helminthic and parasitic diseases of the country.

3. Current efforts to improve the situation are very inadequate.

4. The resources allocated to the improvement of environmental sanitation are grossly inadequate.

5. A massive environmental sanitation program must be at the core of any plans for significantly reducing and controlling the major endemic diseases of the country, particularly schistosomiasis, malaria, and the various enteric, helminthic and parasitic diseases.

6. Top priority should be given to the provision of potable water supplies on a country-wide basis. This would considerably reduce the need for human contact with polluted, schistosome-bearing surface waters and thus significantly reduce the incidence of schistosomiasis. It will also significantly reduce and control the other water borne and gastro-enteric diseases.

7. Towards this end, a long-term water supply improvement program should be developed by the government with the necessary bilateral and international aid.

8. Simple systems should be adopted to keep costs to a minimum and to ensure that the systems can be properly operated and maintained by local personnel.

9. In the villages and small towns the programs should be aimed at providing water of adequate quantity and quality at road-side stand pipes within easy reach of residents (say at intervals of 100 yds.) in the initial phases. These systems may be later expanded to provide for individual house connections.

10. Wells, when used, should preferably be properly sealed tube wells fitted with suitable pumps. Hand-pump equipped tube well would be much more efficient than hand-dug wells just tapping the top of water-bearing formations. In addition, they will not be subject to the pollution of the currently used improperly sealed hand-dug wells with rope and bucket operation. The use of hand-pump equipped wells would be indicated for small isolated communities with relatively few, perhaps widely separated houses.

11. A similar long-term sewage disposal program should be developed and implemented. It would combine the use of well designed sanitary septic tanks and pit latrines in the rural towns and villages with the expansion of the sewerage system in Monrovia.

12. These long-term programs must provide for the training of the necessary local staff at all levels and the required logistic support.

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APPENDICES

APPENDIX I

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Mr. Herbert Snelter, Director, Environmental Health

Mr. Roger B. Woodson, Sanitary Engineer

Mr. John Prall, Director, Division of Health and Vital Statistics

Mr. Marcus Sarkpa, Statistical Clerk, Division of Health and Vital Statistics

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APPENDIX II

A PRELIMINARY AND COMPREHENSIVE ANALYSIS OF THE HEALTH SITUATION IN LIBERIA - 1976

Part I

Historical Background

1928 - The first organized health work was started in Liberia due to the efforts of President C. D. B. King. The first activities were: (1) sanitation of the City of Monrovia and its surroundings, and (2) the provision of treatment for the indigent sick.

1930 - Creation of a Bureau of Public Health and Sanitation for the purpose of extending the limited health program to other parts of the country. Progress was slow because of the shortage of doctors andlimited financial resources.

1942 - The local health conditions at Roberts Field and Monrovia became of vital importance to the United States Armed Forces who were building and operating Roberts Field. A survey reported on inadequate medical facilities and poor sanitary conditions. At that time there were six doctors and a few trained nurses in Liberia.

1944 - In January, President Tubman requested the U. S. Government to assist in developing a program of medical services; a medical mission was sent from the U. S. A. They found very inadequate medical services. There were a few scattered clinics in the country and only three had qualified physicians in charge. The mission's first activity was to undertake malaria control in Movrovia and its vicinity.

1947 - The Government adopted a five-year plan for expansion of existing health services and facilities and the improvement overall of the economy. Economic resources were studied by an economic mission from the United States and subsequently a development plan was drawn up involving an expenditure of $32,579, 430. Provision was also made for Public Health Projects to the extent of $8, 733, 000.

1951 - The plan was put into effect.

1953 - Progress was unsatisfactory. President Tubman recommended to the Legislature that the five-year Development Plan be extended by an additional four years to a Nine-Year Plan. Under this expanded program, $7.3. million were provided for the development of the public health services, exculuding cost of personnel. There was to be: 1) an even distribution of available services throughout the country and 2) planning on the minumum accepted standards for adequate health services.

The U. S. Public Health Mission continued to function until 1950. They trained nurses and laboratory techicians and conducted surveys into malaria and

Schistosomiasis. By 1957, the Bureau was spending nearly 12% of the total Government budget. The country then had eight hospitals with 426 beds, two hospitalswith 150 beds were provided by the government and the remainder by cocessions and missions. There were 32 physicians and 15 were provided by the government.

1953 - 1963 - May 1953, the Bureau was raised to the status of a Department, "National Public Health Services" and a Director General, (J. N. Togba, M.D.) of cabinet rank headed it. The Department was charged with providing preventive and curative services throughout the country.

Over the following decade, eight government hospitals were built providing 730 beds. By 1963, there were 22 hospitals (14 government, 5 concessionaire and 3 missionary) providing a total of 1,318 beds. Ninety government health clinics, 2 by concessions and 5 by missions existed.

There were 51 doctors, 29 of whom were in Government service. There were seven dentists employed by Government and none by concessions and missions.

Other health personnel were as follow:

1. 486 graduate nurses, practical nurses and nurses aids (246 in Govern-
2. 50 midwives (34 Government service).

Government recurrent budgetary expenditures on health increased from $325,000 to $2.8 million. Medical facilities provided to the people increased more than seven-fold.

1956 - A comprehensive code of Public Health Law enacted.

1960 - Dr. E. M. Barclay appointed Director General.

1972 - Mrs Mai Padmore appointed Director General. Retired because of poor health.

1973 - Hon. Oliver Bright, Jr. appointed Minister of Health and Social Welfare.

External Assistance

1. United States - Involved since 1945 when it assisted the Government of Liberia in organizing a public health program.

   Specific AID inputs:

   a. A loan for construction and equipping the J.F.K. National Medical Center.

   b. Tecnical assistance in operation of the hospital and its associated medical center facilities.

   c. Improvement of the training program at TNIMA.

   d. The Smallpox Eradication/Measles Control Program in Cooperation with C.O.L.

2. WHO and UNICEF - Cooperative projects in medical education, disease and environmental health.

3. Medical missionaries and the concessionaires provide at least 50 percent of the health care received by the population.

Government Accelerated Health Effort

A. Total Government expenditures for health and social welfare - 1975.

   1. $7.6 million

      a. $5.8 million Government of Liberia funds.
      b. $1.8 million foreign loans and grants

   2. Total recurrent expenditures $5.8 million

      a. J.F.K. Center - $3.1 million (53%)
      b. $2.0 million - hospitals and clinics (34%)
      c. $500,000 preventive services (9%)
      d. $200,000 social welfare programs (4%)

During the period under review, more emphasis was placed on construction of health facilities than on making them accessible or on training sufficient health personnel.

Administrative Units of the Ministry of Health and Social Welfare.

I. Bureau of Planning and Development

   a. Division of Planning
   b. Health Manpower and Traingig
   c. Technical Assistance
   d. Vital Statistics

II. Bureau of Medical Service

a. Manpower
b. Communications
c. Facilities
d. Support
e. Division of Nursing Services
f. Activities
g. Nursing Man-power
h. Narcotics, Drugs and Medical Supplies
i. Hospitals and Clinics

III. Bureau of Preventive Services

a. Communicable Disease Control
b. Health Education
c. Environmental Health
d. Family Health

IV. Bureau of Social Welfare

a. Community Welfare
b. Rehabilitation Division

V. Liberian Institution for Tropical Medicine

The purpose of the Ministry of Health and Social Welfare in making a current survey and analysis of the health situation in Liberia 1) is to make an analysis of existing gaps, constraints and benefits of health resources and to examine and evaluate present strategies.

Three important points were suggested:

1. A dramatic shift to provide expanded and inproved rural health services.

2. The incremental costs must be minimized to conform with the financial means of the Government of Liberia

Part II

The Existing Health Situation in Liberia

Despite provision of plans and financial outlays for health improvement, little has been done to develop an overall comprehensive health policy. Compared with other developing countries, the general state of health of Liberia is said to be "fair". Recent demographic surveys have shown a downward trend from a high general death rate.

The major causes of death are still due to widespread malaria and gastro-

intestinal diseases, especially diarrhea and dysentery. Tetanus, measles, malnutrition and anemia account for frequent fatalities.

President William R. Tolbert, Jr., has outlined a comprehensive health policy for his administration. This new policy would specifically:

a. Provide expanded, improved and accessible health care delivery service, especially for rural areas.

b. Place major focus on problems of malnutrition and infant mortality.

c. Minimize health expenditure through incremental costing as the rural economy improves.

d. Maximize its outreach benefits by emphasizing the provision of preventive, curative, and family health services.

Analyses of Existing Constraints in the National Health Care Delivery System

A. Underutilization of Health Facilities

Health care facilities expanded noticeably over the last decade. This was seen largely in terms of the average and annual growth of the number of hospital beds (3.5%) which roughly paralleled the population growth rate.

There are about 300 health centers, clinics and posts throughout the country. However, recent studies reveal there is widespread underutilization of these health services. The problem is more acute in rural areas due to transportation difficulties. Only about 33 percent of the population of 1,503,000 is being served.

There is no integrated system of rural service roads connecting all major towns with 500 or more people within each clan, chiefdom and district for implementation of an effective and efficient health care delivery system.

B. Uneven and Mal-Distribution of Health Facilities

There are serious gaps in the distribution of health facilities throughout Liberia.

a. Some counties with less population have more health institutions than other counties

b. The ratio of health institutions to the total population of any given county shows a wide gap.

c. It is recommended that additional Health Posts and Health Centers be created to correct imbalances and that existing strategically located clinics in high population density zones be improved and upgraded to the level of health centers.

Specific recommendations for equitable distribution of health facilities are made as follows:

a. A health Post for each town with 200 households. The town should also be the clan capital. The Health Post should be headed by a trained Practical Nurse. It should serve several adjacent or satellite villages connected to the town's self-help roads. Villages should not be more than 3 miles or one hour's walk from the Health Post. Villages should also have small First Aid Units operated by local Nursing Aides and supervised by the Health Post. Difficult cases from the Health Posts will be handled by the clinics.

b. In districts with towns of 200-500 households, a clinic should be established serving several adjacent towns connected to it by self-help roads. The clinic will be headed by a Health Assistant and will supervise activities of Health Posts. Surrounding towns should not be more than 5 miles from the clinic. Difficult cases from the clinic will be referred to the Health Center.

c. In districts with towns of 500-1,000 households, a Health Center should be established which would serve several neighboring towns connected to it by self-help roads. The Health Center will be headed by a Medical Assistant and will supervise the activities of the clinic. The sourrounding towns should not be more than 10 miles from the Health Center. Difficult cases at the center will be transferred to the County Hospital.

d. The County Hospitals will supervise medical activities at the Health Centers and other health facilities throughout the county. This will be done by regular scheduled weekly visits including, as far as practicable, a team of specialists and using a mobile health van to implement the county hospitals outreach medical program. Health Centers will be linked to County Hospitals by roads constructed and maintained by the Ministry of Public Works. Health Centers should not be more than 20 miles from County Hospitals. The hospital personnel will be headed by a physician general practitioner. Where possible, specialists should be added to the Health Team at the County Hospital. Difficult cases at the County Hospital will be transferred to J.F.K. National Medical Center in Monrovia.

e. The J.F.K. National Medical Center will supervise the health activities at each of the County Hospitals. A team of specialists will make scheduled visits to the county health care facilities as practicable.

f. The Ministry of Health and Social Welfare will provide comprehensive logistic support for health care delivery service.

g. It is recommended that the existing drug and supplies delivery schedule be improved and strenghtened.

C. Inadequate and Mal-Distribution of Health Personnel

Analysis of the ratio of the distribution of health personnel to the population in each county shows a wide gap and serious imbalance. This leads to more reliance on traditional methods of health care and a high mortality rate.

D. Inadequate Logistical Support

1. One of the most serious problems encountered under the existing rural health system is the lack of an adequate drug and medical supply distribution system.

2. One of the most urgent constraints facing health authorities is the need for establishing a viable system for bulk procurement and storage of medical supplies and an efficient mechanism for distribution to all health institutions.

E. Lack of Adequate Health Data

1. Vital health statistical registration is inadequate.

2. There is urgent need for improving the present method of health data collection as this is essential for careful health care planning, evaluation of available and accessible health care seervice, budgeting, supervising and coordinating of all health activities.

F. Lack of Basic Demographic Consideration

1. Several communities which qualify by having an adequate population size (500) do not have a health facility.

2. Facilities were provided in areas more accessible because of the existence of a road.

G. Need for Improved Preventive Health Care Service

1. A multi-purpose epidemiology team is hampered by lack of transport, but has done much good work and is proving more effective than the use of teams of specialists for each disease.

2. Malaria is still endemic. Current anti-malaria projects such as larviciding, swamp drainage and chemotherapy are limited to only Nimba and Montserrado Counties and conducted on too small a scale to be effective.

3. A safe drinking water supply is currently limited to only a few communities.

4. There is need for improved environmental sanitation through proper facilities for disposal so sewage and refuse.

The Government of Liberia and a WHO/Enviromental Health Program are involved in implementation of preventive health care services and construction of proper wells and sanitary pit latrines. They are also involved in the

training of Public Health personnel.

H. Family Health Care

1. Seventy-three units have been established in clinics and health posts where immunizations are conducted for children against communicable diseases and mothers against tetanus.

2. A massive training program for midwives includes:

   a. In-service Training Program for Professional Nurses, Midwives Practical Nurses.
   b. Traditional Midwives Training Program.
   c. Nutrition classes and cooking demonstrations.

3. All fees attending the care of infants, from birth to 2 years of ages, including hospitalization in government institutions, have been ablolished.

I. Protein-Calorie Malnutrition Among Infants

Protein-Calorie Malnutrition (PCM) is a frequently encountered condition among children in rural Liberia. Kwashiorkor itself causes many death in rural Liveria, but more minimal degrees of protein deficiency add greatly to child mortality by weakening resistance so that common diseases, such as measles, often have a fatal outcome.

Causes:

1. Disrupted families
2. Disrupted traditional patterns
3. Ignorance of the value of local foods for infants and children.
4. Diseases - Illnesses deplete protein reserves.
5. Improper bottle feeding

Prevention:

1. Improving child feeding patterns
2. Vaccinating
3. Early detection of developing deficiencies
4. Child-spacing

J. Budgetary Inequities

Some counties with large populations have small budgetary health appropriations; while other counties with small populations have large health budgets.

K. Training and Manpower Needs

There is a need for massive training of para-medical personnel to staff the various health institutions, especially those in the rural areas.

The following institutions serve the health manpower and training needs of the country:

1. The A.M. Dogliotti Medical College (The J.F.K. Medical Center Teaching Hospital, Monrovia, Montserrado County).

2. Tubman National Institute of Medical Arts (Montserrado County).

3. Cuttington/Phebe Nursing School including other para-medical programs (Bong County).

4. Curran Memorial Hospital Training School (Lofa County).

5. Canta Hospital Nursing School (Nimba County).

6. Firestone Nursing School (Montserrada County).

7. Laboratory School and health training programs (Ministry of Health and Social Welfare, Monrovia, Montserrado County).

The combined output of these institutions is limited. In 1975, there were 155 doctors and dentists, 550 professional nurses, 840 practial nurses and 230 midwives working in Government and private institutions. The ratio to population is inadequate. The proposed Rural Health Training Center at Sanniquellie should have first priority. There is immediate need for the training of Medical Assistants, Health Assistants, Practical Nurses, Nursing Aides, Midwives and Sanitarians.

It is recommended that the following be in charge of the various health units:

a. Health Post - Practical Nurse
b. Health Clinic - Health Assistant
c. Health Center - Medical Assistant
d. County Hospital - A Physician (the current practice).

Part III

Proposed Strategy for the Improvement and Strengthening of the Existing National Health Care Delivery System

The above analysis of existing constraints in the health care delivery system in Liberia highlights a definite need for an integrated health care strategy which could be applied simultaneously throughout Liberia. In this connection in 1975, the Lofa County Rural Health Project was established. This is a joint effort and pilot project of the Ministry of Health and Social Welfare and USAID.

Lofa County Rural Health Project Description

The L.C.R.H.P. is a plan to set-up a well functioning network of Health

Post and Health Centers augmented by mobile health teams which, under hospital supervision, will bring basic health care within walking distance of 90% of the county population. As a pilot project for eventual spread throughout rural Liberia, the cost of the total project would be kept within such a low range that it will be economically possible for the Liberian Government to duplicate it throughout the country.

Para-medical personnel would be fully utilized to operate the facilities. It aims at utilizing all of Lofa County health facilities as provided by Government, church, and eventually private and concession through a coordinated effort under the supervision of the Ministry of Health and Social Welfare.

Basically the plan is for 30 clinics to be distributed across Lofa County. They will be supervised by 5 health centers, which in turn will be supervised by 2 hospitals - Tellewoyan Government Hospital in Voinjama and Curran Lutheran Hospital in Zorzor.

It is planned that the project will be implemented over a 4 year period by the Ministry of Health and Social Welfare. The proposed Health Care Delivery System involves the following major elements:

1. Strategically located health facilities.

2. Staffing with specially trained para-medical personnel.

3. Incorporation of all health facilities in an integrated system for delivering in an ascending order of complexity, expanded curative and preventative health services and family planning services.

4. The development of an adequate drug and medical supply system.

5. The development of a supervisory system for para-medical personnel.

6. The establishment of a radio communications system to facilitate administration and supervision.

Conclusions and Recommendations

The L.C.R.H.P. is a health care delivery strategy which would eliminate or reduce the existing constraints and imbalances current in the Government's health care programs. It is a strategy whose speedy duplication throughout Liberia should become a matter of priority.

The following recommendations are made:

1. The spread of Health Posts and Centers to communities lacking these through construction of a self-help road network.

2. The activities of mobile health teams and units should be greatly expanded.

3. Because of the prevalence of malaria and gastro-intestinal diseases, the Government should institute anti-malarial health care and provide safe water.

4. Helicopter service should augment supervision between the J.F.K. Medical Center and rural health institutions.

5. That General Services Agency units be established in each county.

6. That Phebe Hospital, Bong County should be made a more active partner in the training of rural health manpower, especially para-medicals.

7. There should be equitable budget allocation for health care among the counties.

8. A projection of rural health personnel should be made per county by the M.O.H. & S.W. and accordingly trained over an 8 year period.

9. Distribution and location of health facilities should be equitable.

10. More general practitioners should be trained, and specialists should make periodic scheduled visits to rural health centers.

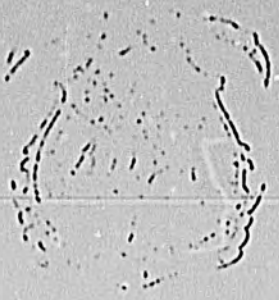
11. Rural health data required from rural institutions on a monthly basis should be provided promptly by those institutions.

12. Programs in health education should be implemented by the M.O.H. & S.W. Vaccination teams should make regular tours and enlarge their areas of operation.

13. The L.C.R.H.P. should be duplicated on a nationwide basis.

14. Pages of this document contain additional specific recommendations for improved health care delivery service throughout Liberia.

APPENDIX III



REPUBLIC OF LIBERIA
NATIONAL PLANNING COUNCIL

NATIONAL SOCIO-ECONOMIC DEVELOPMENT PLAN

July 1976 – June 1980

Monrovia, Liberia
March 9, 1976

Chapter XVI

HEALTH

Background

251. Vital statistics registration is not well-established, but recent demographic surveys indicate rather high general and infant mortality rates. The general death rate is estimated to range from 16-21 per 1,000 population and the infant mortality rate from 137-159 per 1,000 live births. As a result of the prevailing high mortality life expectancy at birth in 1970 ranged between 45-50 years. Inferences from surveys, popular impressions and incomplete hospital records show that the major causes of death are probably malaria and gastro-intestinal disease, especially diarrhea and dysentry. Tetanus and measles are also frequent causes of infant deaths. The fatality of many of these diseases particularly among infants and mothers is often a direct consequence of malnutrition and associated anemia.

252. Preventive control has been a major aspect of public health activities over the last two decades or so. Several surveys conducted in various parts of the country in the past indicated wide-spread prevalence of diseases such as malaria, tuberculosis, yaws and measles which could be eradicated or closely controlled through well-known methods. This is also possible with smallpox which flared into a major epidemic in 1958-59 and cholera which first appeared in Liberia (and other sub-Saharan countries) in 1970 and quickly became a major public health problem in Monrovia. With assistance from WHO, UNICEF and private volunteer groups, Government made major efforts to deal with these diseases. The virtual eradication of yaws and smallpox is the most spectacular achievement. The yaws eradication campaign lasted from 1951 to 1961 and since then there has been continuous surveillance to ensure that isolated cases are promptly treated. A mass eradication program for smallpox carried out in 1967-71 was very effective as evidenced by the fact that no cases were reported subsequently. Cholera has also been largely controlled except for recurrence in some localities. Malaria, however, is still endemic in Liberia. Pilot anti-malaria projects, limited to Kpain (Nimba County) and Monrovia, include larviciding, drainage of swamps, and chemo-prophylaxis. These projects, however, are on much too small scale to substantially reduce the incidence of malaria. A mass BCG vaccination campaign was started in 1974 with the aim of immunizing virtually the entire population under twenty years of age against tuberculosis.

253. In recent years, efforts have been made to provide immunization on a regular and systematic basis in selected areas. The group originally established in 1967 to deal with smallpox and measles in Monrovia, was consolidated in 1970 into a multi-purpose epidemiology team to work on a continuous basis vaccinating against smallpox, tuberculosis, measles, cholera, yellow fever, etc. Although lack of transport often restricts the work of the epidemiology team, it has done much good work and is proving to be more effective than the previous approach using specialized teams for each disease.

254. Health care facilities expanded noticeably over the last decade. The annual growth in the number of hospital beds roughly paralleled population over the last ten years or so. In 1974, the population per hospital bed was about 630. On the basis of this index, Liberia has a greater capacity for in-patient medical care than most other West African countries. Roughly, one-half of the hospitals and hospital beds have been provided by Government, and the remainder is operated by large private companies and by religious missions. There are also about 300 health centers and clinics, mainly operated by Government, scattered throughout the country.

255. The JFK Medical Center in Monrovia is the pinnacle institution in the country's medical care pyramid. The Medical Center includes a 250 bed general hospital, three special hospitals and a para-medical training school. USAID assisted in the planning of the Medical Center and largely financed the construction of the general hospital (JFK Memorial) which was opened 1971. Since the opening of the hospital, USAID has continued to provide about $1 million annually to meet recurrent expenses, particularly for medical supplies.

256. There are no reliable hospital utilization data, except for the JFK Memorial Hospital. Use of the Memorial Hospital facilities increased considerably since 1972, its first full year of operation, as can be seen from the following summary data:

	1972	1974
In-patient days	61,[illegible]8	79,150
Bed occupancy ratio (%)	62	80
Out-patients	47,131	80,786

[illegible] in the use of facilities at the county hospitals [illegible] increases significantly whenever [illegible] Government [illegible]. In principle, the health care delivery system consists of a periphery in the village health posts and clinics which are typically staffed by para-medics [illegible] to provide [illegible] care. More difficult cases are referred to the county hospital which is ideally staffed by [illegible] physicians and with professional nurses. Finally, the specialized facilities and staff of the JFK Medical Center are available for the most difficult cases which cannot be adequately treated [illegible] county level institutions. It is believed that more patients have been drawn from an increasing [illegible], although there is as yet no systematic analysis of patient records. Since the JFK Medical Center [illegible] of the total Health budget, it is [illegible] to ensure that [illegible] according to this basic operational principle.

257. In 1974, there were 155 physicians and dentists, 550 professional nurses, 840 auxiliary nurses and 230 midwives working in Government and private institutions. The number of medical and para-medical personnel is believed to have increased at a faster rate than total population, and there has been a great spread of staff outside of Montserrado County, mainly Monrovia. For example, almost one half of nurses (professional, practical and aides) in public service in 1974 worked outside of Monrovia compared to just over one-quarter in 1963. However, the public health service in rural areas is still not adequately staffed because of the general shortage of personnel but also reflecting the difficulties of motivating people to work in rural areas. The Tubman National Institute of Medical Arts (TNIMA) established in 1946, is the main institution for training nurses and other para-medical personnel. Five private institutions also train nurses, including a degree program at Cuttington College. The Ministry of Health and Social Welfare (MHSW) organizes an important program for training key village women who traditionally deliver babies, in the rudiments of midwifery. The courses last up to six months and the trained traditional midwives are issued OB kits with essential supplies which are replenished once a year at refresher workshops. A medical college has been established at the University of Liberia with JFK Medical Center serving as the teaching hospital. The College graduated its first doctors in 1973. However, the number of graduates is small and many of the students enrolled in the medical college are not Liberians.

TABLE 33—MEDICAL AND PARA-MEDICAL GRADUATES, 1974

Doctors	10
Professional Nurses	40
Other Nurses	34
Empirical midwives	81
Laboratory technicians	5
Other	13

258. The increase in medical facilities and in the staffing of the public health service has naturally resulted in a significant increase in the health budget. Total public expenditure on health, including disbursement of foreign loans and grants, increased from $1.6 million in 1970 to $8.0 million in 1974. As a share of total public expenditure, health expenditures rose from around 4.6 per cent in 1970 to 6.5 per cent in 1974 despite the competing demands of many other priority needs. These impressive increases notwithstanding, in many cases the health service delivery has been below potential because of lack of funds.

Sector Objectives and Policies

259. The available morbidity and mortality data show that there is considerable scope for improving the general standard of health. This is desirable both for its own sake as well as from a strictly economic standpoint in view of its effect on worker productivity. Accordingly, Government's long run objective is to make basic health service easily accessible to people in all parts of the country.

260. The main thrust of a strategy for achieving this objective emphasizes preventive health. There are several dimensions to a comprehensive preventive health program. A key factor is environmental sanitation geared to making safe water supply and sanitary sewerage and other refuse disposal facilities available to the population. Improvements in this area are quickly reflected in lower incidence of enteric diseases such as diarrhea, typhoid, dysentery. Health education stressing nutrition, basic [illegible] aimed at the target group of mothers and school children could result in

[illegible] to community health at relatively low cost. Selective immunization programs [illegible] for each [illegible] of disease vectors similar to those implemented in recent years must be [illegible], particularly for diseases such as malaria and tuberculosis which are still quite common in [illegible].

261. Comprehensive programs must be developed to improve and expand hospitals and clinics. In some cases this results from lack of maintenance in the past and in others because buildings were originally designed for use as hospitals or clinics. However, proper attention to the suitability of the physical plant and equipment must not overshadow the need for adequate and timely medical supplies and properly trained staff. In [illegible] of the past neglect, [illegible] facing the public health authorities is the establishment of a viable system for bulk procurement and storage of medical supplies and an efficient mechanism for distribution, particularly to county and district health clinics. Of course, the problems of procurement and distribution is the core of any strategy for providing basic, comprehensive health services throughout the country.

262. Government intends to give special attention to improving health services in rural areas. While considerably been achieved, e.g. over the last three years, expenditure for rural health services [illegible]. However, Government recognizes that there still is substantial scope for starting new health programmes and policies and improving existing services. A major constraint in developing rural health services has been the difficulty of recruiting staff willing to work in rural areas. The main policy change envisaged at present for dealing with this problem is the establishment of a special institution for training [illegible] staff, more specifically for work in rural areas.

263. Health sector planning is hampered by the lack of basic data. A concerted effort will be made to establish a uniform medical records system and to improve data collection and analysis. This will facilitate evaluation of the quality and effectiveness of the health delivery system, thereby providing a firm basis for delineating new strategies and policies more closely geared to the overall sector objectives.

Development Expenditures, FY 1977-80

264. The proposed program (see Table 34) represents a substantial increase from the present level of development expenditures. Capital outlays for construction, including both expansion and renovation, and equipment account for 55-60 per cent of the estimated $22.6 million expenditures, while the remainder is for non-capital development costs, e.g. personnel cost of starting a significant new activity or the current costs of a clearly defined special program.

TABLE 34 - SUMMARY OF DEVELOPMENT EXPENDITURE, FY 1977-80

Program/Project	Expenditure ($million)
Medical Services	12.4
Hospitals	(6.6)
Clinics	(5.1)
Other	(0.7)
Preventive Services	4.0
Environmental Health	(2.1)
Communicable Diseases	(1.2)
Other	(0.7)
Training and Planning	6.2
TOTAL	22.6

Not reflected in the sector program, however, are substantial incremental current costs which will be required for the normal operation of various projects at the end of the construction or development [illegible]. For example, [illegible] estimates that about $1 million will be needed by 1980 [illegible] to staff, supply, maintain and operate hospitals, health centres and the central medical store which are among the [illegible] projects.

265. [illegible] services [illegible] about 55 per cent of the development program. About three [illegible] will be used for [illegible] and improvement of county hospitals ($13 [illegible]), and [illegible] of medical [illegible] in the small towns and villages ($5.1 million for health [illegible] the Lofa County Health Outreach project). The program, therefore, fully reflects Government's policy of greater attention to the [illegible] people in all parts of the country as is illustrated by the [illegible] of additional physical facilities in Table 35. In this regard, the Lofa County Health Outreach project must be emphasized. This is a pilot project programmed for 1975-78 at a total cost of $5.6 million for which foreign assistance is [illegible] from USAID, UNICEF, CARE and the Lutheran Church [illegible] a hospital in the project area. The project integrates all aspects of public health [illegible] to improving the [illegible] at all levels of the system in Lofa County. A special aspect is the focus on establishing a systematic medical record system to facilitate analysis of the health needs of the population. Similar projects will ultimately be implemented in other counties, and, in order to accelerate the process, construction of physical facilities will be started in all counties (except Montserrado) in co-ordination with increased capacity for training para-medical personnel. Much design and other preparatory work is still to be undertaken for county hospitals and health centers so it would not be surprising if there is significant slippage in the execution of the program. The central medical store to be built in Monrovia in 1976 at a cost of about $0.3 million, will also facilitate the improvement of medical services in rural areas by easing the difficulties of procuring and distributing medical equipment and supplies. The possible need for a maternity hospital in Monrovia and its scope is under study. Since a project has not yet been identified, even tentatively, no financing provision is reflected in the [illegible] development expenditure program.

TABLE 35--DISTRIBUTION OF ADDITIONAL IN-PATIENT BEDS, 1980

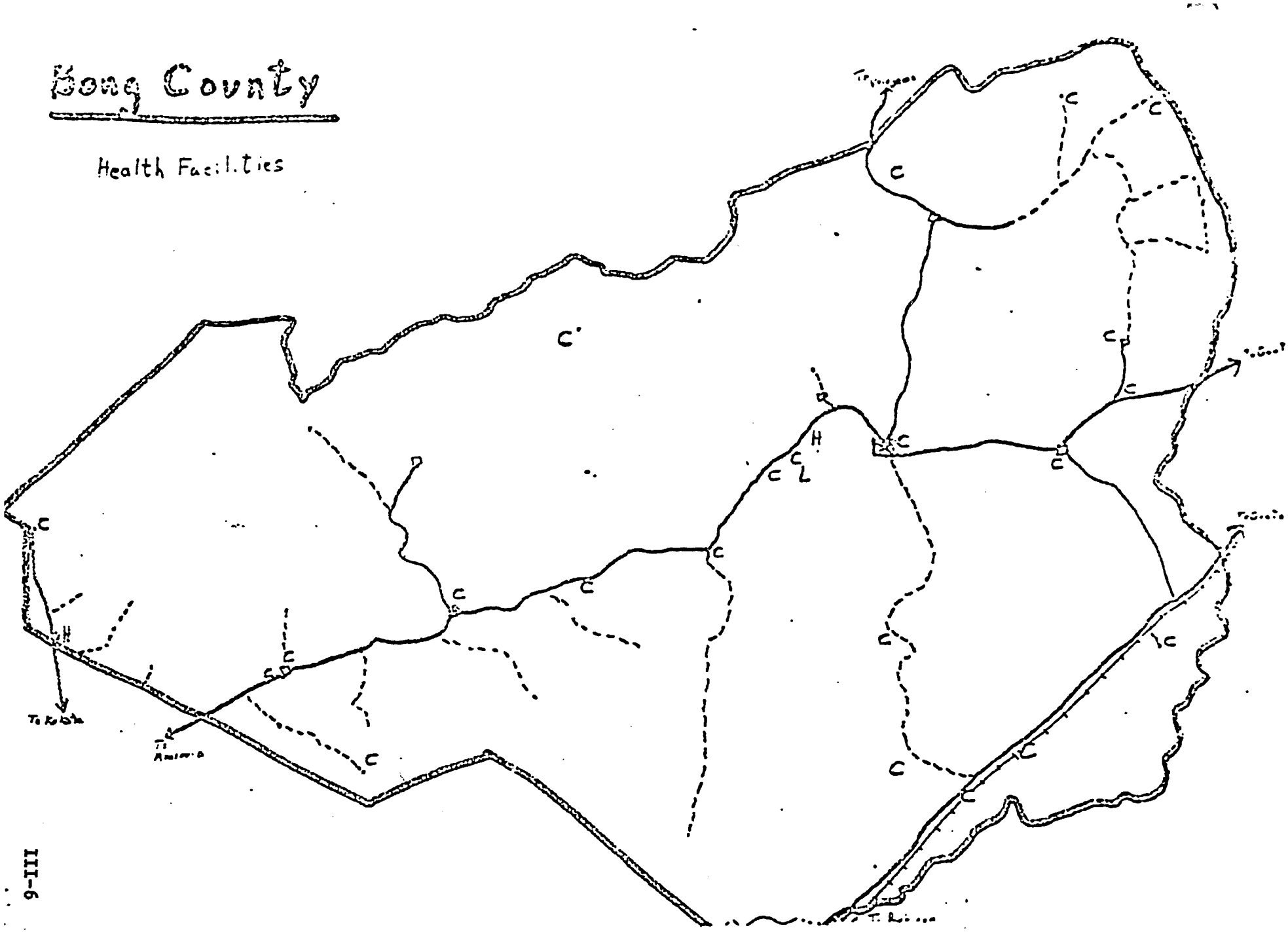
County	Hospitals	Health Centers
Bong	50	60
Grand Bassa	60	40
Grand Cape Mount	10	60
Grand Gedeh	100	20
Lofa	50	50
Maryland	30	40
Montserrado	---	---
Nimba	10	60
Sinoe	130	80
TOTAL	440	410

266. Expenditures for preventive health are largely of a non-capital nature. The malaria control program will be substantially expanded. Multi-purpose epidemiology teams will be started initially in Montserrado, Bong and Maryland counties, then systematically expanded to the other counties. These epidemiology teams will make a special effort to immunize virtually the entire population against tuberculosis, and will also sustain the keen surveillance necessary to minimize the incidence of smallpox and cholera. In order to facilitate the organization and hence improve the effectiveness of community health work, it is proposed to build annexes, preferably to county hospitals or clinics, to serve as the focal point in each county for such work.

267. Adequate numbers of suitably trained staff is absolutely necessary for improving the quality and coverage of the public health system. New quarters will be constructed for TNIMA, which now occupies space at the JFK Memorial Hospital, in order to provide better training facilities and to permit an increase in enrollment to 225 at the end of the project compared to 135 in 1975. Two new programs will be started. A residency training program at JFK Medical Center is the natural extension of its role as the teaching hospital for the [illegible] Medical School. A special [illegible] will be established at [illegible] ([illegible] County) for training [illegible] of para-medical [illegible] personnel [illegible] for work in rural areas.

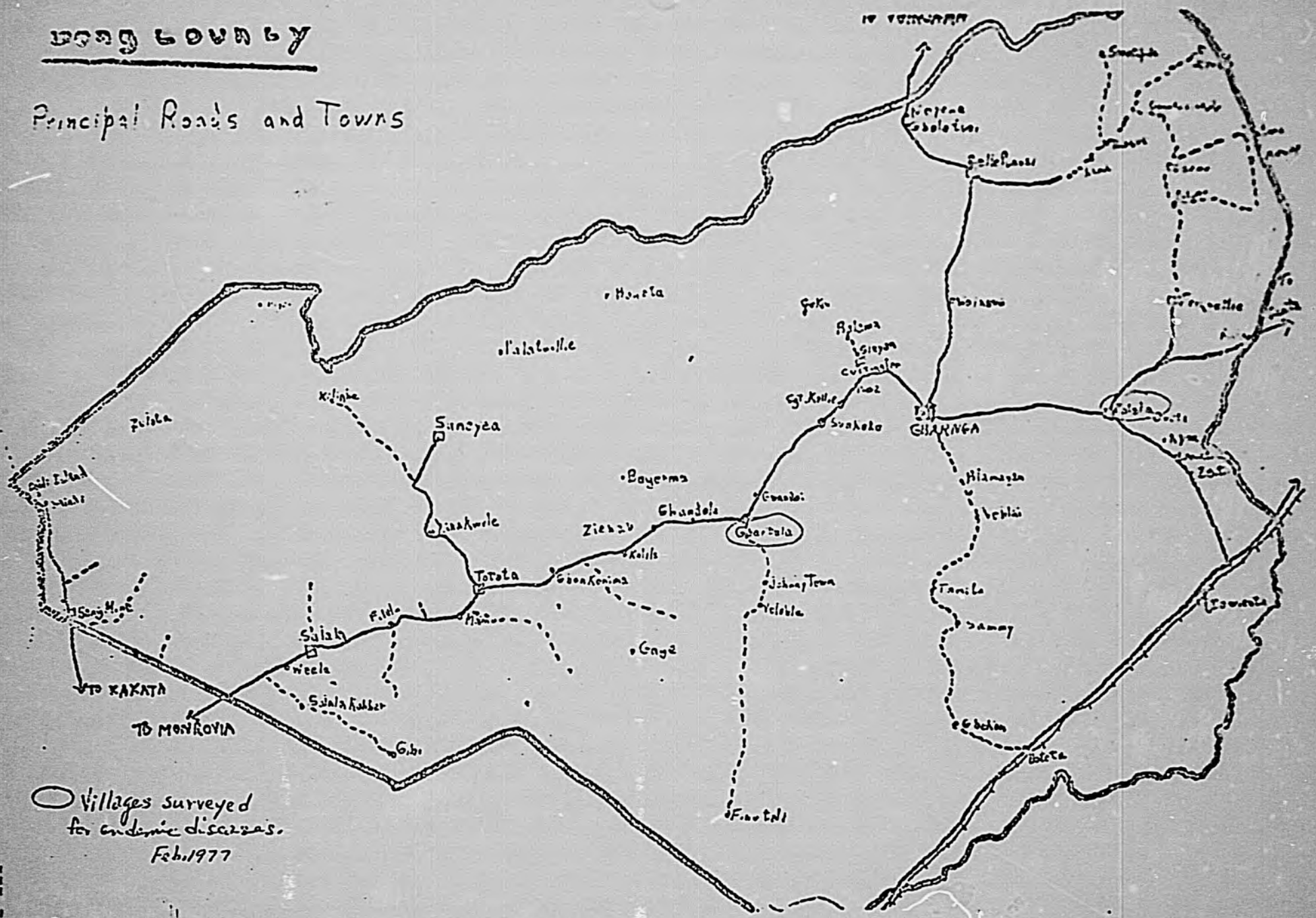
Bong County

Health Facilities



Bong County

Principal Roads and Towns



○ Villages surveyed for endemic diseases. Feb. 1977

SYMPTOMATIC MALARIA CASES REPORTED ACCORDING TO CLINICS
BONG COUNTY - 1976

NAMES OF CLINICS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	TOTAL
Haindee	309	-	-	-	151	-	152	-	[illegible]	152	[illegible]	[illegible]	[illegible]
Bellemu	-	-	271	-	-	-	-	-	-	-	-	33	[illegible]
Gau	72	75	-	89	79	103	61	79	70	82	[illegible]	63	[illegible]
Yormu(Gibi)	26	-	-	40	-	-	-	-	-	-	-	99	[illegible]
Sanoyea	261	255	364	210	264	250	371	-	307	473	415	519	3,728
Sunkoko	45	30	-	28	-	161	160	-	180	162	177	157	1,100
Geecohn	153	108	83	149	231	180	-	201	126	180	96	193	1,597
Foromelife	120	110	120	-	77	125	125	115	96	75	237	85	[illegible]
Zowinta	53	59	103	42	90	42	122	96	60	74	59	[illegible]	852
Maponyea	82	178	108	177	185	120	209	117	104	69	166	101	1,615
Gbarlatuah	101	118	158	100	378	260	276	285	397	300	-	358	2,797
Janyea	70	114	53	63	278	170	-	110	59	93	50	216	1,275
Kayata	41	114	103	91	72	84	53	73	49	-	47	-	732
Boegborn	-	-	-	59	-	90	169	188	78	68	96	140	888
Boneta	13	35	56	45	-	61	99	65	77	89	87	-	[illegible]
Jorkah	-	-	-	-	-	-	-	-	-	-	200	170	370
Shankpallai	451	-	352	362	420	364	177	214	169	240	208	212	3,169

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BONG COUNTY

NAMES OF CLINICS	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
Palala	184	128	46	60	36	53	51	-	48	35	54	64	760
Belefania	236	27	35	58	32	17	22	42	35	62	47	45	655
C.B. Dumbar	152	252	293	463	400	291	332	522	434	313	174	250	4,276
Tuoten Farm	60	57	-	-	53	74	61	60	-	71	-	-	436
Bah-ta	33	37	54	79	101	79	117	95	89	68	70	143	965
Gbartala	31	29	61	88	72	70	54	63	82	100	-	89	759
Klehoa	-	-	201	301	149	267	223	273	179	205	166	-	2,064
Panta (Tolbert's Farm)	42	30	-	32	58	40	32	32	65	41	-	-	412
Tamata	-	-	58	73	50	50	67	56	44	34	41	48	512
Semay	-	125	205	279	105	82	100	140	109	21	22	-	1,188
Kolila	67	60	80	87	84	80	55	75	63	64	-	-	713
Yantoquelle	39	77	63	76	36	-	58	53	38	113	178	61	732
Totota	-	162	89	134	191	159	147	98	311	-	-	126	1,417
Govt. Expt. Station	52	19	32	34	23	70	47	61	-	65	33	44	480
T O T A L	2,093	2,199	3,013	3,159	3,616	3,648	3,490	3,133	3,479	3,315	2,880	3,309	37,994

[illegible]

February 23, 1977

197[illegible] [illegible]:

(1) Pinutoloy area		2[illegible]7	huts	population	about	3[illegible]8
(2) Goryen	"	159	"	"	"	275
(3) Palala	"	201	"	"	"	455
(4) Tratala	"	362	"	"	"	679
Total		1,0[illegible]9				1,7[illegible]9

MALARIA CONTROL IN MONROVIA AND ITS ENVIRONS (NOVEMBER 25, 1975)

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SUMMARY: Planned Malaria Control Programme in Liberia started in 1951, with W.H.O. assistance. This pilot project was based at Kpain, Nimba county. Malariometric surveys were carried out regularly. The control measures applied were residual insecticide spraying, larviciding and treatment of malaria cases.

In 1969, in accordance with the National Health Plan, the antimalaria project at Kpain was closed, and the project transfered to Monrovia based at Lynch Street.

The control activity in Monrovia is directed primarily towards antilarval measures and reduction of breeding sources. Larviciding is carried out regularly with Abate and /or Baytex. Spray sheet collection and larval collection are done fortnightly in ramdomly selected catching stations in the treated area as well as in the untreated area. The survey conducted in March 1976 showed the following:

	Monrovia proper (treated)	Sinkor (untreated)	Bushrod Island (untreated)
Infant parasite rate	8.8	29.5	14.2
Parasite rate (2-9)	22.3	45.0	28.5
Spleen rate (2-9)	5.8	12.8	11.0

The prevalence rate is much lower in the treated area than in the untreated one. (Table 2 Annex 2). Haloriometric and entomological surveys was conducted in 1975 (January & February) in 14 townships within 25 miles radius of Monrovia. The overall parasite rate was 45.9. There were 85.7% P.falciparum, 9.3% P. malariae and 4.8% P.ovale. (Table I, Annex 3). The highest parasite rates among children of 2 to 9 years of age were found at Bentol with 76.1% and the lowest rate at Brewerville with 27.3%.

The vector species collected were A.gambiae, A.funestus, A.hancocki and A.coustani. A.gambiae average density per room for the whole area surveyed was 1.09 but the maximum density per room recorded were 12.3 in Arthington, 3.8 in Careysburg and 3.0 in Bentol. 76 A.gambiae were dissected for sporozoites and 3 were found positive giving a sporozoite rate of 4% approximately. The overall A.gambiae density of over one and the infectivity rate of 4% with the positive infant parasite rate and gametocyte rate found in most of the localities surveyed confirmed that transmission occured during the dry months of January and February. Malaria in 25 miles radius of Monrovia is found to be hyperendemic and in Greater Monrovia within the range of mesoendemicity.

The highest malaria endemicity within the 25 miles radius of Monrovia was found in Bentol township with a parasite rate of 76.1 and a spleen rate of 73.4 among children of 2 to 9 years of age.

Because of this, Bentol was selected for a feasibility test on weekly chemoprophylaxis as a measure of malaria control which was

launched in May 1975. Assessment of this feasibility test conducted after 6 months of operation of the project showed a significant reduction in the endemicity. The malariometric survey conducted before and after the chmoprophylaxis feasibility test in 3 villages; Twanta, Geteleh and Kortu'Ta at Bentol showed:

	Before chemoprophylaxis	6 months after prophylaxis.
Parasite rate	76.1	37.9
Spleen rate in 2 - 9 years	73.4	13.7
Average enlarged Spleen (2 - 9)	2.3	1.7

P. falciparum was the most predominant species found with 95.5% P.malariae with 3.2%, P.ovale in a small percentage of 1.3. Over 25 localities in the test area was surveyed of which 17 had an average room density of A.gambiae of 1 or over. The highest room density of A.gambiae was found at Neh'Ta with 14.5. In June 1976, all the houses in the villages under study were sprayed with DDT after susceptibility studies. Malariometric surveys in these areas are under progress now according to schedule. After one or two years the susceptibility status of the local strain of P.falciparum against chloroquine will be tested.

Geographical Reconnaissance have been completed for the Greater Monrovia area with the assistance of the WHO technical officer (Sanitary Engineer) Mr. S. Roche. G.R. for the 25 miles radius will be undertaken in 1977.

Biological control measures are being tried in a few sites with GUPPY fish (Lebestis reticulatis) which is useful as a larvivorous fish.

As funds become available appropriate control measures will be implemented to reduce the endemicity of malaria according to the plans.

1. Review of past activities and epidemiological data.

The first results of malaria survey in Liberia published by the Harvard African Expedition (1926-27) showed that out of 150 children and adults examined, 34.6% were positive for malaria.

By an agreement signed between the Government and WHO in 1951, a Malaria Control Programme (Liberia-5) using residual insecticides was opened in an area of approximately 9000 square miles at Bong and Nimba counties with a population of about 300,000 people. Dieldrin was used at a dose of 0.4 gm/m2 but during the second half of 1957 a wide spread resistance of A.gambiae to Dieldrin and BHC was established.

In 1958, a Malaria Eradication Pilot Project (MEPP-Liberia-16) was superimposed to the previous one. DDT was used at the dose of 2.6 gm/m2 one spraying cycle per year except one area of the project which was sprayed at six months interval. The last spray cycle ended on 31 August 1961.

During the period 1954-52 A.funestus was predominant with 52%, next came A.gambiae with 32% then A.hancocki with 10%. But in 1958 A.gambiae represented 98% and A.funestus 1.5% only of the anopheline population.

In the project area, during the second quarter of 1961, out of 2829 blood films collected, 576 were found positive giving a parasite rate of 18.5%. The parasite formula was P.falciparum 85%, P.malariae 12.5%, P.ovale 2.5%, mixed infections 10.6%. A.gambiae was found with an average room density of 0.08 and 0.10; larvae of A.gambiae, A.coustani and A.obscurus were also found.

A malaria Pre-Eradication Project (MPEP Liberia-20) started on 15 February 1963. Malariometric surveys were carried out in the following counties: Nimba, Bong, Grand Gedeh, Sinoe, Lofa and Grand Bassa. The parasitological data collected showed variations in the overall parasite rate, for all age groups ranging from a minimum of 57.1 to a maximum of 88.3. The splenometric survey showed an overall spleen rate ranging from 59. to 81.5. In the age group of 2 to 9, the spleen rate fluctuated between 68.4 and 90.6.

Entomological surveys were carried out during 1965 in the sprayed (last spray in 1961) and unsprayed areas of the former project Liberia-16. Seven species of anopheles were recorded of which A.Gambiae was the only one found infected showing a sporozoite rate of 7.1. There was not much difference in vector density between the two areas.

Treatment of malaria positive cases confirmed at the project laboratory at Kpain was introduced. During the period April 1965 to March 1968 about 6,000 cases were treated.

Treatment of suspected malaria cases by voluntary collaborators was introduced in 106 towns and villages of Saniquellie district of Nimba county for an approximate population of 33,700 people living far from health posts or hospitals.

In May 1965 a chloroquine sensitivity test was conducted in Kpain area after false alarm of resistance. The results indicated no resistance of P.falciparum to chloroquine. This was later confirmed by a W.H.O. Short Term Consultant.

Beginning 1969, in accordance with the National Health Plan, Malaria Section was integrated into Basic Health Services, the anti-malaria project at Kpain was closed, its personnel and equipment were then transferred to Monrovia at Lynch Street where it is located now, the Vector/Malaria Control Section, Environmental Health Division of the Ministry of Health and Welfare.

2. Assessment in Greater Monrovia.

The Malaria Control Programme in Monrovia started in 1962 for the protection of an urban population of more than 100,000 by means of mainly antilarval measures.

From April 1971 the town was divided into 20 operational zones (10 in Monrovia proper and 10 in Sinkor) comprising all together 80 sectors. In each zone there were one Team leader and one larvicider. Every 4 zones were put under the responsibility of one supervisor.

Malariol was used first but from September 1970 Abate and Fenthion (Baytex) were introduced. Source reduction was also undertaken by a team of sanitary laborers.

For the present time, due to the lack of personnel and transport facilities, the antilarval operations are confined to Monrovia peoper only, while Sinkor is left untreated since May 1974. There is no activities in Bushrod Island although the extension of the operational perimeter to this part of the town was tentatively planned.

Spray sheet collection and larval collection were carried out fortnightly in ramdomly selected cathing stations in the treated area as well as in the untreated area (Bushrod Island). But starting from 1974 this routine evaluation system could not operate adequately, due to the lack of transport facilities, consequently a certain number of catching stations were not visited regularly according to the pre-established schedule.

In 1962, the results of a malariometric survey conducted in Monrovia and its neighborhood by the Malaria Service of USAID showed an overall parasite rate of 10.9. Infants and children had a parasite rate of 7.9 and 19.4 respectively.

In 1968, a malariometric survey was carried out among school children in Monrovia. 1495 blood slides were found in Bushrod Island and the lowest was found in Monrovia proper with 8.3. The overall spleen rate was 20 ranging from 13.1 to 63.

In a survey carried in 1972 in 22 schools in Monrovia, over 5204 blood films collected, 641 were found positive giving an overall parasite rate of 12.3. There were 97.5% of P.falciparum 1.6% of P. malariae and 0.7% of P.ovale.

In 1974, in a school health survey in 7 selected schools in Monrovia, out of 1509 blood films collected, 641 were found positive giving an overall parasite rate of 26. The parasite formula was in the following: P.falciparum 93.5%, P.malariae 4.2% and

P.ovale 2.1%. In this survey the area under active antilarval operations was not included.

In the 1976 assessment malariometric and entomological surveys were carried out during March 1976 in 16 randomly selected localities, 8 in Monrovia proper where antilarval operations are under progress, 8 in the untreated area out of which 4 are in Sinkor where the antilarval operations were discontinued since 1974 and 4 in Bushrod Island where there is no antilarval operations.

The survey is not carried out in schools as previously in 1968, 1972 and 1974 but is performed over the general population living in the localities selected.

Out of 2590 blood slides collected of which 67.1% are from children of 0 to 9 years of age, 739 are found positive giving an overall parasite rate of 28.5. The infant parasite rate and the gametocyte rate are 17.8 and 1.1 respectively. There are 96.2% of P.falciparum, 3.4% of P.malariae and 0.4% of P.ovale. Among the age group of 2 to 9, the parasite rate found is 31.8 and the spleen rate is 9.7; the gametocyte rate of that group is 1.3. The results of the malariometric and entomological surveys are shown separately for Monrovia proper, Sinkor and Bushrod Island in Tables I and 2, Annex 2.

Greater Monrovia is found to be within the range of mesoendemicity.

With regard to the comparison between the treated and untreated areas the results could be condensed as follows:

	Monrovia proper (treated)	Sinkor (untreated)	Bushrod Island (untreated)
Infant parasite rate	8.8	29.5	14.2
Parasite rate 2 - 9	22.3	45.0	28.5
Spleen rate 2 - 9	5.8	12.8	11.

It is apparent that the prevalence rate is much lower in the treated area than in the untreated one. (See Table 2, Annex 2)

With respect to the results of the entomological survey, not much difference is found in the average room density of culicines between treated and untreated areas (3.2 and 3.3 respectively seen in Table 2 Annex 2); nevertheless a noticeable difference is detected in the average room density of A.gambiae for the two areas concerned.

	ARD A. Gambiae	ARD Culicines
Treated area	0.1	3.2
Untreated area	1.59	0.24

Details of the above are shown in Tables 3 and 4, Annex 2. One can deduct from these comparative results that the effectiveness of the antolarval operations in Monrovia is not neglectable.

Susceptibility tests on C.P.fatigans to insecticides currently used in the malaria programme in Monrovia were conducted during 8-10 May 1975 by M.V. KAMAKRISHNA, WHO entomologist, with the larvae of C.P. fatigans collected from untreated area, Bushrod Island and from the treated area around the Vector/Malaria Con/Sec headquarters, Monrovia proper. The tests revealed that the C.P. fatigans larvae from the sprayed area were resistant to Malathion-while they are still susceptible in the unsprayed area.

Susceptibility tests on A.gambiae could not be performed by the entomologist on the same occasion. Details of the tests on C.P. fatigans are shown below:

	Malathion	Mortality %
C.P. fatigans treated area	0.025 ppm	0%
	0.050 ppm	4%
	0.065 ppm	8%
untreated area	0.025 ppm	100%
	0.050 ppm	100%
	0.065 ppm	100%

	Abate	Mortality
Treated area	0.0002 ppm	100%
	0.0001 ppm	76%
	0.0025 ppm	100%
Untreated area	0.0002 ppm	85%
	0.001 ppm	100%

Control mortalities less than 5% 0.0025 ppm 100%

Assessment of malaria status in 25 miles radius of Monrovia.

The area is approximatively of 95 square miles around Monrovia City and is comprised of townships and localities situated along the seacoast, the Saint Paul river and the hilly country of the pre-coastal plain as far as we get away from Monrovia. The climate is almost the same as that of Monrovia. In and around Monrovia, a large percentage of population are employed in the factories and in growing industries. In the villages, however, the main occupation of the population is argiculture and farming. The habitations are scattered along the roads or concentrated together in small "towns" of 10 to 30 ... houses. The area is well served by a good network of roads. A certain number of towns are accessible by foot about 10 to 20 minutes walking distance from the main road but some remote townships have a clinic at the centre-Bentol township has a hospital in addition to the clinic where antimalaria drugs are adequately supplied.

The estimated population of the designated area is 105,939 in 1976.

Malariometric survey currently with entomological survey were carried out from 2nd January to 6 February 1975, during the dry season, in 14 townships. In almost every townships, at first some towns were visited at random, then the center of the

township itself where most of the time health facilities of some kind were available.

A total of 2295 blood films were collected out of which 1348 (58.7%) were from children of 0 to 9 years of age, and 1054 were found positive giving an overall parasite rate of 45.9. There were 85.7% of P.falciparum, 9.5% of P.malariae and 4.8% of P.ovale. The consolidated results of this malariometric survey along with the entomological findings for the 14 townships is shown in Table I, Annex 3.

With respect to the infant parasite rate, out of 14 townships surveyed, this rate was positive in 12 of them, except 2 at Caldwell and Amina townships. The lowest rate was found at Harrisburg with 8.3%, the highest at Paynesville with 60% but due to the scarcity of the number of infants taken into this survey, these rates were not significant and only gave an indication of the presence of transmission during the dry season but could not be used as a quantitative measurement of that transmission.

The highest parasite rates among children of 2 to 9 years of age were found at Bentol with 76.1% and Paynesville with 81.2%. For this latter the parasite rate was not representative for the whole township due to the fact that only one small town (Wym town) was visited and where only 25 blood films were collected. The lowest rate was found at Brewerville with 27.3%. Out of 14 townships, 8 (Harrisburg, Arthington, Millsburg, Bentol, Gardnesville, Paynesville, Clay Ashland and Amina) showed a parasite rate of 50.% or over. Gametocyte rate was positive in 11 out of 14 townships.

Results of splenometric survey are condensed in Table 2, Annex 3. Over 2140 people examined 639 showed palpable enlargement of spleen giving an overall spleen rate of 29.8% and an average enlarged spleen of 2. while the 2 to 9 age group alone 33.% and 2.1 respectively.

The variations of spleen rate and average enlarged spleen among all age groups are shown in the following:

Age group	Spleen rate	Ave. Enlg. Spleen
12 - 23m	24.2	1.8
2 - 4	28.4	2.2
5 - 9	36.3	2.1
10 - 14	32.8	2.
15 - 19	21.3	1.5
20 +	14.2	1.7

The analysis of the results of this malariometric survey shows that there are indications of a stable malaria in the designated area.

The entomological survey is comprised of:

a. space spray collections in representative houses in the towns,

b. detection of breeding places of vectors in particular and others in general,

c. dissection of A.gambiae for detection of sporozoites in the salivary glands.

In all, 188 rooms were sprayed of which 67 were found positive for the presence of mosquito. A.gambiae average density per room for the whole area surveyed was 1.09 but the maximum density per room recorded was 12.3 in Arthington, 3.8 in Careysburg and 3.0 in Bentol.

Other species collected were A.funestus in Bentol and A.hancocki in Arthington and Bentol and A.coustani in Virginia.

Culicines were generally rare and were found only in six towns with room density lower than one per room.

Breeding of A.gambiae was located in several places but the highest was in the rock pools and river bed pools in drying river

in Arthington. In all other places the breeding was very scanty.

A.aegypti was found breeding in a drum of water in Harrisburg. 76 A.gambiae were dissected for sporozoites and 3 were found positive giving a sporozoite rate of 4% approximately. The infective A.gambiae were found in New Georgia, Arthington and Careysburg.

In malaria control programme in Nigeria it was found that A.gambiae density of one per room was an index to suggest that transmission could take place. The overall A. gambiae density of over one in the designated area and the infectivity rate of 4% with the positive infant parasite rate and gametocyte rate found in most of the localities visited confirmed that transmission occured during the dry months of January and February. Malaria in 25 miles radius of Monrovia is found to be hyperendemic.

4. Feasibility test at Bentol area, on weekly chemoprophylaxis.

It was found from this above survey of the 25 miles radius of Monrovia that Bentol township have got the highest malaria endemicity with a parasite rate of 76.1 and a spleen rate of 73.4 among children of 2 to 9 years of age.

Bentol was then selected for a feasibility test on weekly chemoprophylaxis as a measure of malaria control. The programme launched by May 1975 was put under the responsibility and direct supervision of the Preventive Service of the Ministry of Health and Welfare.

The area, situated at approximately 25 miles North-East of Monrovia is comprised of small hills covered with forest which is cleared in many places for plantation of rice, sugar cane, cassava and rubber etc..... Between the hills are little streams which, in some places, stagnate and form swamps.

Most of the towns (villages) are situated in the forest area near these streams as water is necessary for farming and dosmetic use. The towns are of various size, the smallest are comprised

of 2 to 3 houses while the largest may have 20 to 30 houses. Nearly all the inhabitants are farmers. Usually, around the towns there are plantations of orange, gripefruit, cocoa and rubber. Rice is the most important farming product.

Beside the center of Bentol where the local administration, schools and hospital are divided into 4 sectors each one of them is put under the responsibility of an itinerant agent. These agents were selected from the epidemiological field investigators of the Preventive Service. An itinerary is prepared for each agent in such a way that each locality is visited once a week at a fixed day for the distribution of drug. The agents are given a motocycle for moving from place to place along the motor way or in the forest trial where motocycle could pass. The remote villages not accessible bu motocycle must be covered by foot. It needs one hour, sometimes two walking on foot to reach the fartest locality from the point where motocycle riding becomes impossible.

Chloroquine of 150 mg base by tablet is distributed weekly at dosage of 5 mg per kilo/weight:

Bitrh to one year	¼ tab	Chloroquine	(37.5 mg base)
One to 5 years	½ tab	"	(75. mg base)
Six to ten years 1	tab	"	(150. mg ")
Eleven to fourteen 1 and ½	tab	"	(225. mg ")
Fifteen and above 2	tab	"	(300. mg ")

The weekly chemoprophylaxis programme is aimed at the protection of the most vulnerable group of population, in children from 0 to 5 years of age and pregnant/nursing women, but due to the fact that a psychological impulse should be created among the village people to obatin their full cooperation, at least during the launching period of the programme, decision was taken to start with a wide distribution of the drug to the whole population.

All the inhabitants of each town are registered on the weekly chemoprophylaxis record from (from WCPI seen in annex 4) in which

are shown their age, sex, weekly dose of chloroquine, the pre-planned date of distribution and the attendance of each individual at the distribution day.

Monthly report (forms WCP2 and WCP2 is seen in Annex 4) of weekly chemoprophylaxis are submitted to the Preventive Service by the itinerant agents showing by age group, the number of people treated, the rate of coverage and the quantity of chloroquine consumed.

Assessment of the feasibility test.

The assessment took place during October and November 1975, approximately 6 months after the launching of the programme. It comprised of two parts:

- part 1, operational assessment for determining the rate of coverage, the receptivity and the cooperation of the population, the performance of the itinerate agents, the difficulties encountered and the appropriate measures for solving them.

- part 2, epidemiological assessment for determining the effect of chemoprophylaxis on the malaria endemicity by means of malariometric survey complemented by entomological investigations.

Operational Assessment.

a. analysis of monthly report.

From the analysis of the monthly report submitted by the agents, all the localities were covered on schedule. The rate of coverage which represents the percentage of attendance registered over the number of attendances projected, calculated for the same period of activity, May to November 1975, for each agent gives these following figures:

1st	agent	80.6%
2nd	agent	82.2%
3rd	agent	86.9%
4th	agent	94.6%

b. field investigations.

All the towns under weekly chemoprophylaxis were visited. During the visit, malariometric survey was carried out and entomological investigations were also performed. All the people present in the village were examined for spleen enlargement and blood specimens were taken from them. Those who were not enlisted for chemoprophylaxis, visitors or new arrivals, were discarded. To each individual these following questions were asked:

- what is the day of drug distribution in the village?
- have you taken the drug?
- how many tablets are you given?

This investigation was made most of the time in the absence of the itinerant agent. Many difficulties were encountered due to the fact that the village people were in the farms as it was rice harvest time, for that reason the survey had to be done very early in the morning at 6.00 a.m. or late at night between 8.00 and 9.00 pm.

It was found that all the itinerant agents kept up with the schedule of distribution. All the village people received chloroquine in correct dodage. The absentees were those who travel or those who were transferred to another place. Practically, there were no refysals at all. A very tight cooperation was well established between the agents and the population.

By observing several drug distribution sessions, at night (Quema) or early in the morning (Kagan and Peter Garnette) it was noticed that everybody present in the village even the children came by themselves and absorbed the drug in front of the agent who recognized them by face and even knew in what house they live. The agent gave the drug directly to the benificiaries, no attempt was made to leave the medicine to somebody in the village and ask him to carry out the distribution at his place.

c. performance of the agent.

The number of population protected fluctuated from one month to another, but the maximum number recorded was 1507 for the whole area or per agent, the average population assigned to him was 376. There were 5 working days per week so each day one agent could give treatment to 75 persons. Taking into account the number of remote villages to be visited by foot and the time spent in the villages waiting for the people to come back from their farms, this daily output of 75 was quite reasonable.

d. difficulties encountered.

As stated above, during harvest time, people left the village very early in the morning for their farms and came back late in the evening. It was difficult for the itinerant agents to meet them during the usual working time. The only solution, and it was already applied, was that the itinerant agent had to adjust his schedule of distribution to the time whereby most of the population were present in the village. Another solution which should be tried, is to handle the drug distribution to a voluntary collaborator resident in the village itself who will carry out on fixed day at any moment when the beneficiaries could be met.

At Bentol Center, the difficulties were encountered in the schools. Some school children pretending that they already received preventive tablets at home refused the drug given by the agent. This is a minor obstacle because if these school children belong to wealthy families they should afford to receive adequate medical attention in case they get malaria.

5. Epidemiological assessment.

The consolidated data of the malariometric survey carried out during January 1975, prior to the chemoprophylaxis programme in 3 villages, Twanta, Getelleh and Kortuta, at Bentol, showed a parasite rate of 76.1 and a spleen rate of 73.4 among the age group of 2 to 9.

In this present evaluation, the survey carried over these 3 same villages, during October 1975, after 6 months chemoprophylaxia, gave a parasite rate of 37.9 and a spleen rate of 13.7 among the age group of 2 to 9. The average enlarged spleen of the same age group was 2.3 in January and 1.7 in October 1975. (See Table I. Annex 4).

With regard to the areas where there is no chemprophylaxis programme in the 3 townships of Millsburg, Harrisburg and Clay-Ashland, the consolidated data of malariometric survey carried out in January 1975 showed among 247 children of the age group 2 to 9 a parasite rate of 59.5 and a spleen rate of 39.2 while those of the survey carried out in December 1975 showed among 120 children of the same age group a parasite rate of 56.6 and a spleen rate of 44.1.

It is likely apparent that the malaria endemicity is reduced to some extent in areas under weekly chemprophylaxis while in areas without chemoprophylaxis its remain almost unchanged.

Bentol Center was found to be within the range of mesoendemicity and even very close to the hypoendemic level. Here under are the results of the survey collected among children of 2 to 9 in 3 representative localities:

	Parasite rate	Spleen rate
Euphemic Barclay School	13.3	20.
Bentol Kindergarden	9.8	6.5
Army Barrak	11.7	11.7

Outside Bentol Center, nearly all the villages surveyed were within the range of mesoendemicity except Twanta with a parasite rate of 57. and a spleen rate of 14.2.

P.falciparum was the most predominant species found with 95.5%, P.malariae came next with 3.2%, P.ovale was found in a small percentage of 1.3. Only 2 cases were positive with this species both were children of 3 and 18 months old.

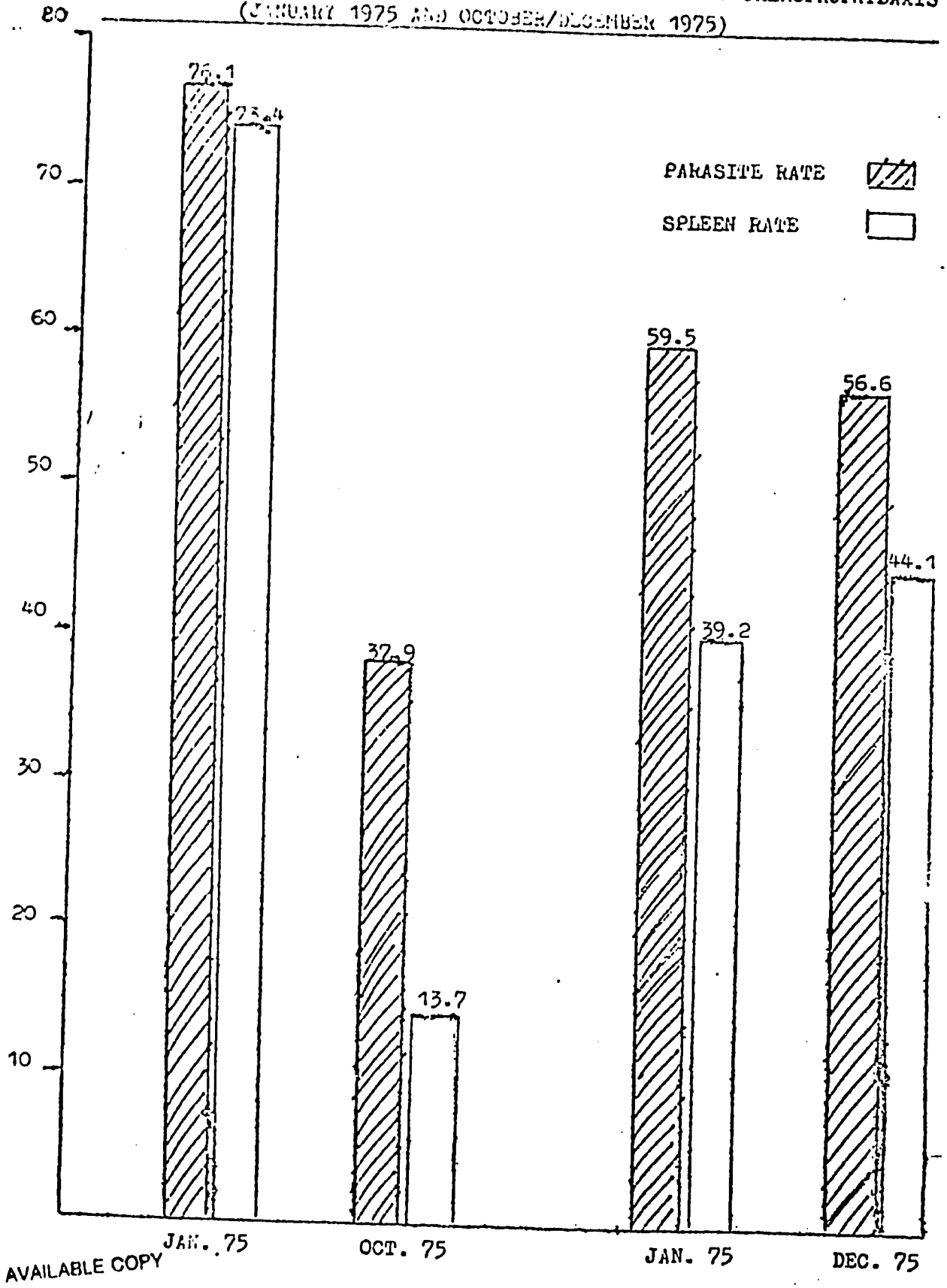
12 individuals were positive with gametocytes among them 9 were from the age group 0 to 9.

Evidence of transmission for the period of survey was of sensible magnitude since infant parasite rate, gametocyte rate were positive in many localities and the average room density of the vectors was high in most of them.

Over 25 localities and areas (few very small towns having the same characteristics were grouped in one area) surveyed, 8 showed positive infant parasite rate, 7 with positive gametocyte rate and 17 with an average room density of A.gambiae of 1 or over. The highest room density of A.gambiae was found at Neh'Ta with 14.5. A.funestus and A.hancocki were also found but in lower density. (See Table 2, Annex 4)

Unfortunately dissection of anopheles could not be performed therefore sporozoite rate remained unknown.

COMPARATIVE RESULTS OF MALARIOMETRIC SURVEYS CARRIED OUT IN AREA UNDER CHEMOPROPHYLAXIS AND IN AREAS WITHOUT CHEMOPROPHYLAXIS (JANUARY 1975 AND OCTOBER/DECEMBER 1975)

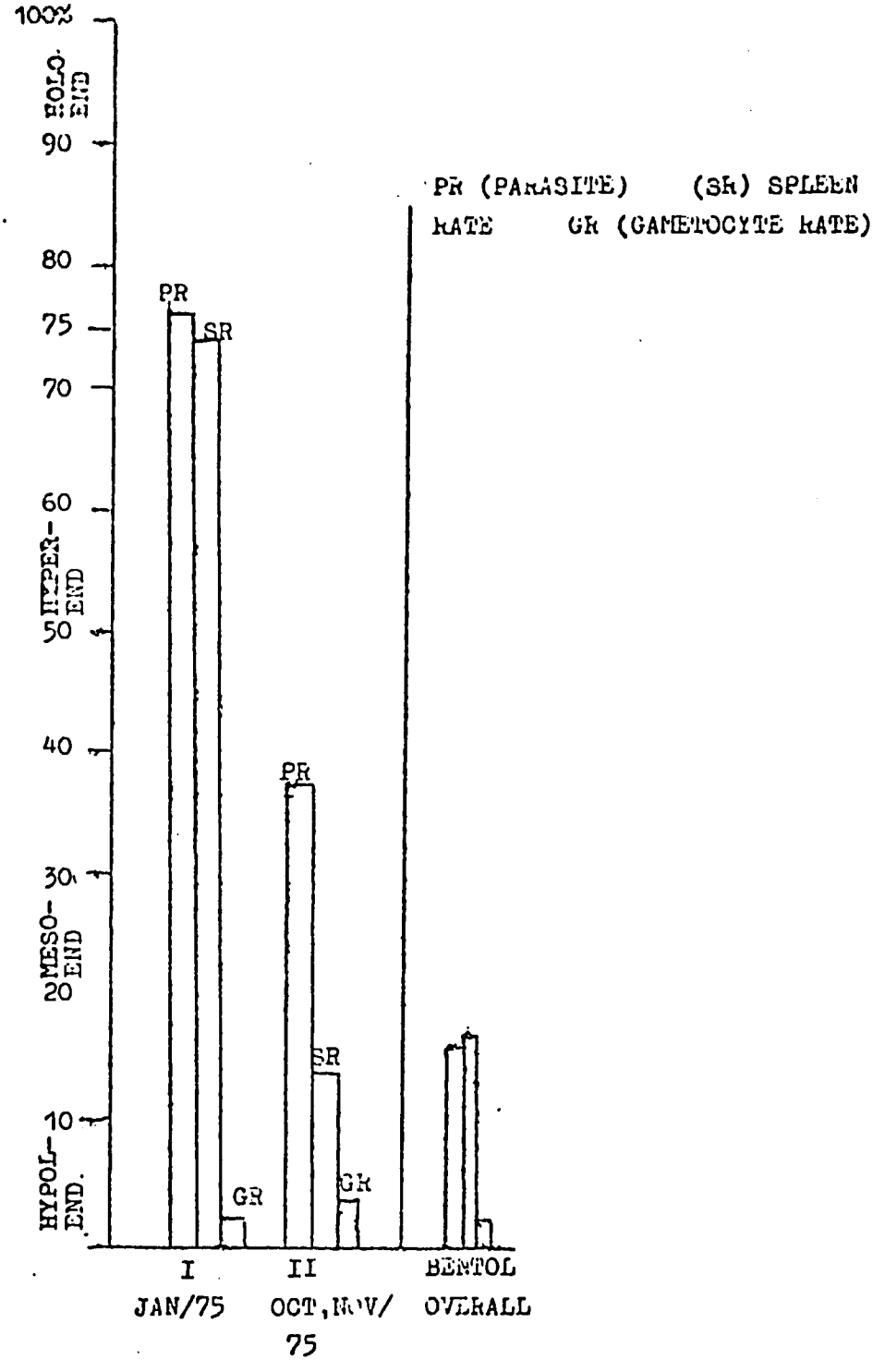


BENTOL
UNDER CHEMOPROPHYLAXIS SINCE MAY 1975

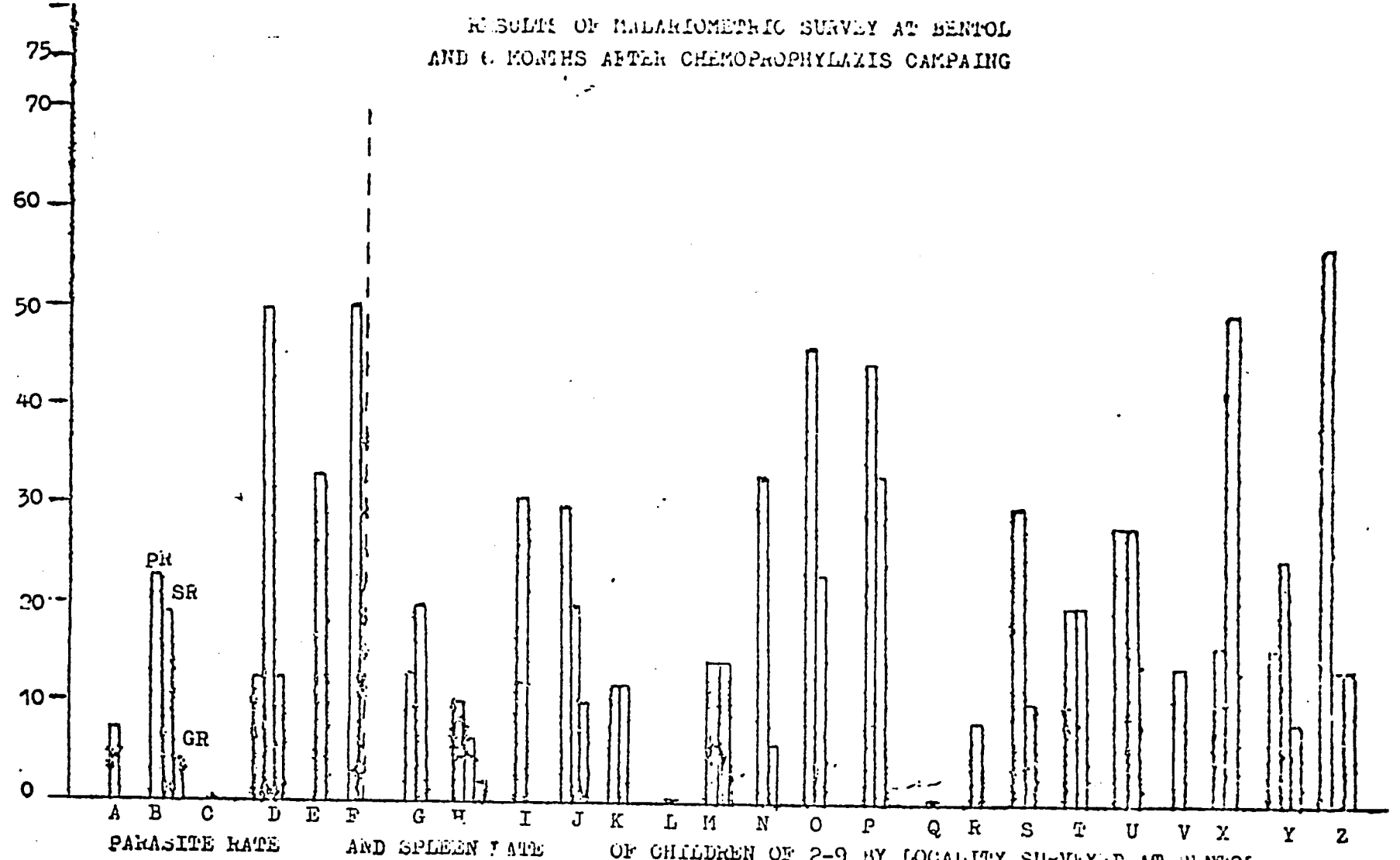
HARRISBURG, MILLSBURG, CLAY ASHLAND NO CHEMOPROPHYLAXIS

HISTOGRAM II

PARASITAEMIA OF 2-9 AT GETELEEN,
KORTUTA TRAINEE BEFORE (I) AND
AFTER 6 MONTHS CHEMOPROPHYLAXIS (II)



RESULTS OF MALARIOMETRIC SURVEY AT BENTOL
AND 6 MONTHS AFTER CHEMOPROPHYLAXIS CAMPAING



PARASITE RATE AND SPLEEN RATE OF CHILDREN OF 2-9 BY LOCALITY SURVEYED AT BENTOL
OCT/NOV 75
DOTTED LINE REPRESENTING UNSIGNIFICANT FIGURES, DUE TO SCARCITY OF SAMPLES.

Table I, Annex I.

POPULATION OF LIBERIA BY AGE
1971

Age-group	Percentage distribution	Population
0 - I	3.I	48 985
I - 4	I3.6	2I4 423
5 - 9	I4.7	230 507
I0 - I4	4I.6	654 3I6
I5 - I9	8.6	I35 527
20 - 24	7.8	I22 342
25 - 29	9.I	I43 379
30 - 34	7.2	II2 3I9
35 - 39	6.6	I04 I28
40 - 44	4.9	76 345
45 - 49	3.8	59 562
50 - 54	3.I	48 99I
55 - 59	I.9	30 623
60 - 64	I.9	29 527
65 & over	3.4	53 9I2
All ages	I00.	I 57I 477

Table 2,Annex 1.

RECORD OF METEOROLOGICAL OBSERVATIONS IN MONROVIA

1973 - 1974 - 1975

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
1973	80	82	82	83	83	82	80	80	79	77	79	77
1974	77	79	79	78	78	77	76	75	75	78	78	78
1975	78	78	80	78	78	77	73	75	-	78	77	78
Rel.humidity												
1973	89	91	91	90	88	85	89	89	89	81	88	91
1974	60	60	69	67	67	76	76	74	72	75	72	69
1975	82	90	89	88	83	91	92	90	-	89	90	91
Rainfalls												
1973	Nil	4.15	5.94	2.63	3.63	14.34	45.50	31.98	16.78	17.40	2.74	4.12
1974	Nil	Nil	0.30	Nil	2.80	11.50	8.00	23.93	26.19	3.11	36.77	Nil
1975	Nil	Nil	7.58	10.72	31.48	53.14	47.81	107.81	-	83.54	12.69	9.83

Notes : Temperature in F°
% relative humidity at 8.00 am
Rainfalls in inches.

Table 1, Annex 2.

CONSOLIDATED DATA OF MALARIA [illegible] SURVEY OF GREATER MONROVIA DURING MARCH 1976.

1. Monrovia proper.

Age		[illegible]	[illegible].Point	[illegible].P	[illegible].P	[illegible].C	[illegible]	[illegible]	Overall
0-11m	Ex	2	18	17	20	2	13	8	80
	IPR	-	5.5(I)	5.8(I)	5.(I)	50.(I)	7.6(I)	25.(2)	8.8(7)
	GR	-	-	-	-	-	-	-	-
12-23m	Ex	I2	I6	24	I0	4	I0	II	87
	PR	25.(3)	I8.7(3)	I6.6(4)	I0.(I)	-	20.(2)	I8.I(2)	I7.2(I5)
	GR	-	6.2(I)	4.I(I)	-	-	-	-	2.2(2)
	SR	-	-	-	-	-	-	9.(I)	I.I(I)
2-4	Ex	35	37	60	35	9	3I	24	23I
	PR	34.2(I2)	I3.5(5)	2I.6(I3)	I4.2(5)	22.2(2)	I6.I(5)	25.(6)	20.7(48)
	GR	-	-	5.(3)	-	-	3.2(I)	4.I(I)	2.I(5)
	SR	II.4(4)	2.7(I)	3.3(2)	-	-	3.2(I)	-	3.4(8)
5-9	Ex	42	53	47	40	26	27	43	278
	PR	35.7(I5)	I8.8(I0)	I2.7(6)	25.(I0)	23.(6)	I8.5(5)	32.5(I4)	23.7(66)
	GR	4.7(2)	-	-	-	-	3.7(I)	2.3(I)	I.4(4)
	SR	9.5(4)	-	I0.6(5)	I5.(6)	II.5(3)	-	9.3(4)	7.9(22)
I0-I4	Ex	I7	38	II	23	24	I7	2I	I5I
	PR	52.9(9)	28.9(II)	36.3(4)	2I.7(5)	25.(6)	23.5(4)	I9.(4)	28.4(43)
	GR	-	-	-	-	4.I(I)	-	4.7(I)	I.3(2)
	SR	5.8(I)	5.2(2)	-	4.3(I)	-	-	4.7(I)	3.3(5)
I5 +	Ex	42	20	7	38	2I	2I	29	I78
	PR	I4.2(6)	20.(4)	I4.2(I)	I0.5(4)	9.5(2)	I4.2(3)	27.5(8)	I5.7(28)
	GR	2.3(I)	-	-	2.6(I)	-	-	3.4(I)	I.6(3)
	SR	-	-	-	-	-	-	-	-
Overall	Ex	I50	I82	I66	I66	86	II9	I36	I005
	PR	30.(45)	I8.6(34)	I7.4(29)	I5.6(26)	I9.7(I7)	I6.8(20)	26.4(36)	20.5(207)
	GR	2.(3)	0.5(I)	2.4(4)	0.6(I)	I.I(I)	I.6(2)	2.9(4)	I.5(I6)
	SR	6.(9)	I.6(3)	4.3(7)	4.7(7)	3.5(3)	0.9(I)	4.6(6)	3.8(36)
2 to 9 only	Ex	77	90	I07	75	35	58	67	509
	PR	35.(27)	I6.6(I5)	I7.7(I9)	20.(I5)	22.8(8)	I7.2(I0)	29.8(20)	22.3(II4)
	GR	2.5(2)	-	2.8(3)	-	-	3.4(2)	2.9(2)	I.7(9)
	SR	I0.3(8)	I.I(I)	6.5(7)	8.(6)	8.5(3)	I.7(I)	5.9(4)	5.8(30)
	AES	2.	2.	I.8	2.3	2.3	2.	2.5	2.I

Notes : Ex : number examined
IPR: infant parasite rate
PR : parasite rate
GR : gametocyte rate
SR : spleen rate
AES: average enlarged spleen
Between brackets : number positives

continued.....

Table 1,Annex 2.

CONSOLIDATED DATA OF MALARIOMETRIC SURVEY OF GREATER MONROVIA DURING MARCH 1975
(continued)

B. Sinkor.

		Joe Bar	Peyma	Cooper cl.	Jallah Town	Overall
0-11m	Ex	10	16	25	20	71
	IFR	20. (2)	43.7(7)	28. (7)	25. (5)	29.5(21)
12-23m	Ex	14	20	12	17	63
	PR	35.7(5)	60. (12)	33.3(4)	52.9(9)	47.6(30)
	GR	7.1(1)	-	8.3(1)	5.8(1)	4.7(3)
	SR	-	10. (2)	-	-	3.1(2)
2-4	Ex	39	58	38	60	195
	PR	35.8(14)	51.7(30)	36.8(14)	38.3(23)	41.5(81)
	GR	2.5(1)	-	-	3.3(2)	1.5(3)
	SR	5.1(2)	10.3(6)	2.6(1)	1.6(1)	5.1(10)
5-9	Ex	41	80	75	75	271
	PR	56. (23)	57.5(46)	46.6(35)	32.3(25)	47.8(129)
	GR	2.4(1)	2.5(2)	1.3(1)	2.6(2)	2.2(6)
	SR	1.7(7)	26.7(23)	13.3(10)	13.3(10)	18.4(50)
10-14	Ex	15	39	19	28	101
	PR	40. (6)	23. (9)	31.5(6)	35.7(10)	30.6(31)
	GR	-	-	-	-	-
	SR	-	2.5(1)	5.2(1)	10.7(3)	4.9(5)
15 +	Ex	32	25	56	50	163
	PR	25. (8)	28. (7)	33.9(19)	30. (15)	30. (49)
	GR	-	-	-	2. (1)	0.6(1)
	SR	-	-	-	-	-
Overall						
	Ex	151	238	225	250	864
	PR	36.4(58)	46.6(111)	37.7(85)	34.8(87)	39.4(341)
	GR	1.9(3)	0.8(2)	0.8(2)	2.4(6)	1.5(13)
	SR	6.3(9)	14.4(32)	6. (12)	6. (14)	8.4(67)
2 to 9 only						
	Ex	80	138	113	135	466
	PR	46.2(37)	55. (76)	43.3(49)	35.5(48)	45. (210)
	GR	2.5(2)	1.4(2)	0.8(1)	2.9(4)	1.9(9)
	SR	11.2(9)	21. (29)	9.7(11)	8.1(11)	12.8(60)
	ABS	2.	1.8	1.7	1.6	1.9

continued.....

Table 1, Annex 2.

CONSOLIDATED DATA OF MALARIOMETRIC SURVEY OF GREATER MONROVIA DURING MARCH 1976.

(continued)

C. Bushrod Island.

		Faninah	Dolomah	New Kru To.	Zoner & P.K	Overall
0-IIm	Ex	7	6	II	4	28
	IPR	-	I6.6(I)	9. (I)	50. (2)"	I4.2(4)
	GR	-	-	-	-	-
I2-23m	Ex	II	I0	I9	5	45
	PR	45.4(5)	40. (4)	3I.5(6)	60. (3)	40. (I8)
	GR	9. (I)	-	-	-	2.2(I)
	SR	27.2(3)	-	5.2(I)	-	8.8(4)
2-4	Ex	27	28	45	39	I39
	PR	I8.5(5)	32.I(9)	24.4(II)	33.3(I3)	27.3(38)
	GR	-	-	-	-	-
	SR	7.4(2)	I0.7(3)	4.4(2)	7.6(3)	7.I(I0)
5-9	Ex	43	45	64	98	250
	PR	37.2(I6)	35.5(I6)	I8.7(I2)	29.5(29)	29.2(73)
	GR	-	-	-	-	-
	SR	I8.6(8)	I3.3(6)	9.3(6)	I3.2(I3)	I3.2(33)
I0-I4	Ex	2I	2	25	52	I[illegible]
	PR	33.3(7)	23.8(5)	20. (5)	38.4(20)	3I. (37)
	GR	-	-	-	I.9(I)	0.8(I)
	SR	9.5(2)	4.7(I)	8. (2)	I5.3(8)	I0.9(I3)
I5 +	Ex	4I	50	38	II	I40
	PR	I4.6(6)	I[illegible] (8)	I0.5(4)	27.2(3)	I5. (2I)
	GR	-	-	-	-	-
	SR	-	-	-	-	-
Overall	Ex	I50	I60	202	209	72I
	PR	26. (39)	26.8(43)	I9.3(39)	33.4(70)	26.4(I9I)
	GR	0.6(I)	-	-	0.4(I)	0.2(2)
	SR	I0.4(I5)	6.4(I0)	5.7(II)	II.7(24)	8.6(60)
2 to 9 only	Ex	70	73	I09	I37	389
	PR	30. (2I)	34.2(25)	2I.I(23)	30.6(42)	28.5(III)
	GR	-	-	-	-	-
	SR	I4.2(I0)	I2.3(9)	7.3(8)	II.6(I6)	II. (43)
	ASS	I.6	2.	2.I	2.I	2.

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Table 2,Annex 2.

CONSOLIDATED DATA OF MALARIOMETRIC AND ENTOMOLOGICAL SURVEYS IN GREATER MONROVIA.March 1976

Localities	0 - 1		2 - 9				Overall				And	
	FR	GR	FR	GR	SR	AES	FR	GR	SR	AES	A.funesti	culicif.
A.Treated area												
Slipway	-	-	35.	2.5	10.3	2.	30.	2.	6.	2.1	0.1	1.6
West Point	5.5	-	16.6	-	1.1	2.	18.6	0.5	1.3	2.	0.2	0.8
Cooper Farm	5.3	-	17.7	2.8	6.5	1.8	17.4	2.4	4.6	1.8	0.	1.5
Bishop Drool	5.	-	20.	-	8.	2.3	15.6	0.6	4.7	2.2	0.1	2.3
Bassa Community	5%*	-	22.8	-	8.5	2.3	10.7	1.1	3.5	2.3	0.	4.6
Buzzie Quarter	7.3	-	17.2	3.4	1.7	2.	16.9	1.6	0.9	2.	0.	5.2
Seniwehn	25.	-	29.8	2.9	5.9	2.5	26.4	2.9	4.9	2.3	0.	5.1
Overall	8.8	-	22.3	1.7	5.8	2.1	20.5	1.5	3.3	2.1	0.1	3.2
B.Untreated area												
B.1.Sinkor												
Joe Bar	20.	-	46.2	2.5	11.2	2.	38.4	1.9	6.	[illegible]	0.1	2.1
Peyema	43.7	-	55.	1.4	21.	1.8	46.6	0.6	14.	1.8	0.1	10.8
Cooper Clinic	26.	-	43.3	0.8	9.7	1.7	37.7	0.6	6.	1.8	0.6	3.7
Jallah Town	25.	-	35.5	2.9	8.1	1.6	34.1	2.4	6.	2.2	0.2	0.6
Overall Sinkor	29.5	-	45.	1.9	12.8	1.9	39.4	1.5	8.4	1.9	0.1	3.8
B.2.Bushrod Isl.												
Banimah	-	-	30.	-	14.2	1.6	26.	1.	10.4	1.6	1.	4.8
Selemah	16.6	-	34.2	-	12.3	2.	25.8	-	6.4	2.	0.	5.2
New Kru Town	9.	-	21.1	-	7.3	2.1	10.3	-	5.7	2.1	1.2	0.3
Zone: a King P.	50%*	-	30.6	-	11.6	2.1	33.4	0.4	11.7	2.1	1.3	0.
Overall Bushrod	14.2	-	29.2	-	11.	1.9	26.4	0.2	9.6	2.	0.8	2.8
Overall untreat.	25.2	-	37.5	1.	12.	1.9	33.6	0.9	8.	2.	0.5	3.3
Greater Monrovia.	17	-	31.8	1.3	9.7	2.	28.5	1.1	6.7	2.	0.3	3.3

Notes ; Total examined : 2590
Positives : 739

P.falciparum : 96.2%
P.malariae : 3.4%
P.ovale : 0.4%

Table 3, Annex 2.

AVERAGE ROOM DENSITY BY HOURS OF FEMALE A.GAMBIAE RECORDED IN CATCHING STATIONS AT GREATER MONROVIA FROM 1969 TO 1975.

YEAR	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	No.Col
1969	Tr	0.26	0.27	0.15	0.11	[illegible]	0.55	0.17	0.06	0.23	0.33	0.34	N.O	0.23	171
	Untr.	0.55	0.33	N.O	12.5	[illegible]	3.13	1.8	3.3	1.5	3.	7.65	N.O	3.17	292
1970	Tr	0.14	0.06	0.25	0.	0.12	0.	0.	0.02	0.	0.	0.03	0.15	0.08	37
	Untr.	2.55	2.61	1.15	0.36	4.65	1.7[illegible]	1.85	0.61	0.67	1.[illegible]0	1.[illegible]5	0.25	1.65	314
1971	Tr	0.09	0.08	0.10	0.	0.	0.14	0.15	0.17	0.12	0.[illegible]1	[illegible].10	0.11	0.14	82
	Untr.	0.29	0.43	0.43	0.47	[illegible]	1.22	N.O	0.2[illegible]	0.79	1.1[illegible]	0.38	0.83	0.67	214
1972	Tr	0.20	0.40	0.09	0.	[illegible].20	0.15	0.[illegible]	0.02	0.10	0.07	0.32	0.30	0.20	166
	Untr.	0.10	0.40	N.O	1.00	0.34	0.34	[illegible]	[illegible].80	0.07	1.43	1.1[illegible]	0.85	0.64	249
1973	Tr	0.11	0.	0.02	0.54	0.42	0.80	0.[illegible]2	0.49	0.48	0.22	0.96	0.02	0.40	327
	Untr.	0.73	1.71	3.83	1.[illegible]6	1.60	6.32	1.52	[illegible].81	1.90	[illegible].30	0.92	1.25	2.29	956
1974	Tr	0.73	0.53	0.39	0.28	0.04	0.25	0.82	0.1[illegible]	[illegible].0	0.	0.	0.	0.36	153
	Untr.	0.91	N.O	0.75	0.33	0.10	4.92	1.3[illegible]	N.O	[illegible].0	0.33	0.	0.	0.97	128
1975	Tr	[illegible].O	[illegible].O	0.	N.O	0.[illegible]0	[illegible].33	0.	N.O	N.O	N.O	N.O	N.O	0.05	3
	Untr.	N.O	N.O	0.33	1.8	7.00	[illegible].O	N.O	N.O	1.33	N.O	0.57	N.O	1.7[illegible]	64

Note : N.O = No observation
Starting from 1974 and 1975 no information were recorded throughout many months due to the lack of transportation.
Tr = treated area
Untr = untreated area

7 years average : Tr 0.20 / Untr 1.59

Table 6, Annex 2

MONTHLY AVERAGE DENSITY/DIP OF A.GAMBIAE LARVAE AT GREATER MONROVIA FROM 1969 TO 1975

Year	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	No.Col.
1969	Tr	0.04	0.	0.31	0.22	0.59	0.04	0.09	0.03	0.24	0.02	0.01	N.O	0.12.	975
	Untr.	0.07	0.02	C.	0.83	0.70	0.	0.11	0.1[illegible]	0.20	2.44	0.02	N.C	0.55	370
1970	Tr	0.05	0.02	0.06	0.03	0.06	0.	0.01	0.41	0.	0.03	0.04	0.01	0.05	665
	Untr.	0.01	0.31	0.15	0.14	0.18	0.15	0.02	2.25	0.06	0.04	0.27	0.17	0.15	583
1971	Tr	0.04	0.01	0.	0.04	0.15	0.02	0.01	0.01	0.02	0.02	0.24	0.04	0.07	731
	Untr.	0.01	0.19	0.02	0.01	0.	0.21	N.C	0.03	0.45	0.20	0.06	0.69	0.30	1036
1972	Tr	0.06	0.01	0.02	0.04	0.02	0.03	0.01	0.	0.02	0.03	0.01	0.02	0.03	901
	Untr.	0.	0.08	N.C	0.23	0.47	0.92	1.61	0.54	0.40	0.53	0.31	0.14	0.45	4971
1973	Tr	0.01	0.02	0.01	0.01	0.04	0.02	0.03	0.01	0.03	0.10	0.01	0.01	0.02	725
	Untr.	0.06	0.19	0.02	0.13	0.32	0.29	0.17	0.45	0.19	1.18	0.31	0.33	0.21	2327
1974	Tr	0.02	0.01	0.01	0.	0.09	0.05	0.01	0.	0.12	0.	0.03	0.06	0.03	731
	Untr.	0.10	0.	0.08	0.	0.22	0.93	0.20	N.O	N.C	0.02	0.22	N.O	0.24	893
1975	Tr	0.02	0.01	0.01	0.03	0.08	0.10	0.01	0.07	0.06	0.08	0.11	0.30	0.05	543
	Untr.	N.C	N.C	0.	0.12	0.02	N.O	0.12	0.01	0.01	N.C	0.03	N.O	0.03	49

Notes : Observations in Untreated area not carried out regularly in 1975 due to lack of transportation.

7 years average Tr 0.05 / Untr 0.24

Table 1, Annex 3.

CONSOLIDATED DATA OF MALARIOMETRIC AND ENTOMOLOGICAL SURVEYS IN 25 MILES RADIUS OF MONROVIA
January - February 1975.

Townships	0 - 11m		2 - 9				Overall				A. gambiae		
	IPR	GR	PR	GR	SR	AES	PR	GR	SR	AES	ABD	SPR	Breed
1. New Georgia	33.3	11.1	38.	9.5	25.3	2.	36.4	7.2	22.5	1.9	0.3	25.	+
2. Cadwell	-	-	36.3	-	16.9	1.7	33.5	0.6	13.	1.8	0.6	-	-
3. Harrisburg	8.3	-	64.7	3.4	50.	2.1	53.3	3.6	39.	2.	0.6	-	-
4. Arthington	14.2	-	50.	-	36.2	2.3	38.9	0.4	28.3	2.2	12.3	2.9	+
5. Millsburg	50.	18.7	56.3	5.7	37.9	2.2	58.	5.8	39.4	2.	0.8	-	-
6. Careysburg	31.2	6.2	48.	0.7	29.4	2.	49.6	1.1	23.6	1.9	3.8	5.	-
7. Bentol	55.5	11.1	76.1	6.3	73.4	2.3	56.1	3.5	53.	2.1	3.	-	-
8. Gardnesville	36.8	-	54.3	2.	26.3	1.9	53.2	1.8	25.8	1.9	0.5	-	-
9. Paynesville	60.	-	81.2	-	75.	2.1	83.3	-	68.	2.2	0.6	-	-
10. Brewerville	33.3	-	27.3	3.5	21.5	2.2	28.8	2.8	20.8	2.1	-	-	-
11. Virginia	33.3	8.3	35.7	1.4	17.1	2.2	3311	1.5	15.	2.1	0.1	-	-
12. Clay Ashland	33.3	-	56.9	4.1	27.7	2.3	55.4	2.8	27.7	2.3	0.5	-	+
13. Roysville	25.5	4.7	42.5	4.2	30.8	2.1	44.8	3.	30.5	2.1	0.1	-	-
14. Amina	-	-	68.1	5.7	46.3	2.4	60.2	4.3	46.3	2.4	0.1	-	+
Overall	31.6	4.5	49.7	3.2	33.	2.1	45.9	2.7	29.3	2.			

Notes : " = preceding
SPR = sporozoite rate

Total examined	2296
Positives	1054
P.falciparum	85.7%
P.malariae	9.3%
P.ovale	4.8%

Table 7, Annex 4

COMPARATIVE RESULTS OF 2 MALARIOMETRIC SURVEYS CARRIED OUT AT 3 REPRESENTATIVE LOCALITIES OF BENTOL (THAITA, GUELLELE, KORTUTA) BEFORE AND AFTER CHEMOPROPHYLAXIS.

Age Groups		Before Chemoprophylaxis January 1975	After Chemoprophylaxis October-November 1975
0 - 11m	Examined	9	3
	IPR	55.5 (5)	33.3 (I)
	GR	11.1 (I)	-
12 - 23m	Examined	6	-
	PR	66.6 (4)	-
	GR	-	-
	SR	66.6 (4)	-
	ABS	2.2	-
2 - 4	Examined	37	17
	PR	78.3 (29)	61.9 (9)
	GR	2.7 (I)	5.8 (I)
	SR	81. (30)	23.5 (4)
	ABS	2.4	1.7
5 - 9	Examined	26	12
	PR	73. (19)	16.6 (2)
	GR	-	-
	SR	61.5 (16)	-
	ABS	2.2	-
10 - 14	Examined	14	8
	PR	57.1 (8)	12.5 (I)
	GR	7.1 (I)	-
	SR	78.5 (11)	-
	ABS	1.	-
15 +	Examined	79	56
	PR	39.2 (31)	19.6 (11)
	GR	-	-
	SR	30.3 (24)	1.7 (I)
	ABS	1.6	2.
Overall	Examined	171	96
	PR	56.1 (96)	25. (24)
	GR	1.7 (3)	1. (1)
	SR	52.4 (65)	5.3 (5)
	ABS	2.1	1.8
2 to 9 only	Examined	63	29
	PR	76.1 (48)	37.9 (11)
	GR	1.5 (I)	3.4 (I)
	SR	73.4 (46)	13.7 (4)
	ABS	2.3	1.7

Notes : The weekly chemoprophylaxis programme started on May 1975
IPR : infant parasite rate; PR : parasite rate; GR : gametocyte rate
SR : spleen rate; ABS : average enlarged spleen.
Between brackets : number positives.

Table 2, Annex 3.

SPLEEN RATE AND AVERAGE ENLARGED SPLEEN ALL AGE GROUPS
25 MILES RADIUS OF MONROVIA
January-February 1965

Age groups	Examined	Pos	Spleen enlargement					SR	AES
			1	2	3	4	5		
12 - 23m	99	24	9	9	6			24.2	1.8
2 - 4	495	141	70	56	51	4		28.4	2.2
5 - 9	688	250	40	121	89			36.3	2.1
10 - 14	503	165	44	72	48	1		32.8	2.
15 - 19	117	25	13	11	1			31.3	1.5
20 +	238	34	10	21	3			14.2	1.7
Overall	2140	639	146	290	198	5		29.8	2.
2 - 9	1183	391	70	177	140	4		33.	2.1

Table 2,Annex 4.

CONSOLIDATED DATA OF MALARIOMETRIC AND ENTOMOLOGICAL SURVEYS AT BENTOL
October - November 1975

Localities	0 - 11m		2 -- 9				Overall				AVRS		
	PR	GR	PR	GR	SR	AVS	PR	GR	SR	AVS	A.GAM.	A.DUR.	A.MAL.
Lassana Bouquelle	75.	25.	-	-	7.1	1.	11.7	1.4	6.2	1.7	0.4	-	-
Benawa & Quema	50.	-	23.	3.8	19.2	2.	15.7	1.4	7.5	2.	1.	-	-
*Kannah Suah	-	-	-	-	-	-	14.2	-	-	-	1.	-	0.3
*Dawolo'Ta	-	-	12.5	12.5	50.	1.5	22.2	3.7	15.3	1.5	2.3	-	1.1
W.R.Tolbert'Ta	-	-	-	-	33.3	2.	4.5	-	8.8	2.	1.	0.2	-
Vayema	-	-	50:*	-	100:*	1.	16.6	-	20.	1.	1.2	-	0.4
Euphemia B.School	-	-	13.3	-	20.	2.3	22.9	0.7	9.6	2.	-	-	-
Bentol Kindergarden	-	-	9.8	1.6	6.5	2.2	9.8	1.6	6.5	2.2	-	-	-
Kannah'Ta	-	-	-	-	30.7	2.	-	-	14.2	2.	0.7	1.5	-
Dee'Ta & Gborblee	25.	-	30.	10.	20.	2.	24.2	3.	6.8	2.	3.	0.6	-
Army Barrak	-	-	11.7	-	11.7	1.5	10.1	1.1	4.5	1.7	3.	-	-
Yakavolo'Ta	-	-	-	-	-	-	10.	5.	5.2	2.	1.6	0.6	1.3
Bellaqua'Ta	-	-	14.2	-	14.2	2.	13.	-	4.5	2.	3.3	-	-
Gotellah	-	-	33.3	-	6.6	2.	25.6	-	2.6	2.	1.6	-	-
Fenetolle *JohnnyC.	100:*	-	46.1	-	23.	1.6	30.	2.5	12.9	2.	1.1	0.4	0.4
*Fagan & *Peter Gar.	25.	-	44.4	-	33.3	2.	23.5	-	16.6	2.	1.4	2.	-
*Gbayequelle	-	-	-	-	-	-	11.1	-	11.7	2.5	-	-	0.3
*Moenjar	-	-	-	-	8.3	1.	4.5	-	2.3	1.	0.2	-	-
Varmuya	-	-	30.	-	10.	3.	8.3	-	2.7	3.	1.6	1.3	0.6
*Yahnkolor & *Goe.	-	-	20.	-	20.	2.5	5.2	-	5.5	2.5	0.6	-	-
Korta'Ta	50.	-	28.5	-	28.5	1.5	10.7	-	7.6	1.5	2.3	1.3	0.6
Gbulu	50.	25.	-	-	14.2	2.	8.5	33.3	3.2	2.	1.6	-	-
*Mehta	-	-	16.6	-	50.	1.3	4.7	-	15.	1.3	14.5	-	0.5
*Kalewu Gbayah	-	-	16.6	8.3	25.	2.3	14.2	3.5	14.2	2.5	1.	-	-
Twanta	-	-	57.	14.2	14.2	2.	37.9	3.4	3.4	1.	0.7	0.1	-
Bentol overall	28.8	4.4	16.5	1.8	16.8	1.8	14.8	1.1	7.7	1.9			

Notes : AVRS = average vector room density
* = locality reached by foot
** = not significant figures

Total examined : 1015
Positives : 151

P.falciparum : 95.5%
P.malariae : 3.2%
P.ovale : 1.3%

Annex 4
Form WCP1

WEEKLY CHEMOPROPHYLAXIS RECORD FORM

County.....
Township.....
Town.....
Agent in charge.....

No	Names	Age	Sex	Dose	M / d											

Notes :.If pregnant women write FP in columnSex ; if nursing women write FN in columnsex.
.Cross the case (X) in regard of name and day of attendance,if absent leave it blanc.
.month/day should be written in advance according to pre-planned weekly appointments.
.At the end of each month the agent in charge prepare and submit the monthly report of weekly Chemoprophylaxis on form wCP2 using the data recorded on this form.

Annex 4
Form WCP2

MONTHLY REPORT OF WEEKLY CHEMOPROPHYLAXIS (WCP) IN A SECTOR
Reporting agent.....
County.....Sector.....Month.....
Township.....Number Town under WCP..... Year.....

A. Results WCP	NR	AP	AR	%A	Chloroquine
A.1.Town.....					
Under I	.....	.....	.....	.....	.....
I to 5	.....	.....	.....	.....	.....
FP	.....	.....	.....	.....	.....
Total	.....	.....	.....	.....	.....
A.2.Town.....					
Under I	.....	.....	.....	.....	.....
and same as above					
A.3.Town.....					
Total Sector					
Under I	.....	.....	.....	.....	.....
and same as above					

B. Chloroquine(in tablets)

B.I. in stock at the beginning of the month .....
B.2. supplied during the month .....
B.3. distributed during the month .....
B.4. in stock at the end of the month .....
B.5. request for supply if any .....

C. Transport (in case a vehicle is supplied)

C.I. mileage covered during the month .....
C.2. gaz consuption .....
C.3. oil consuption .....
C.4. repairs if any.....

D. Number times overnight.....

E. Problem if any.....
.....

Notes : NR : number people registered for WCP
AP : attendances projected = no times distribution in the month multiply by NR seen in form WCPI.
AR : attendances realised = total of the month of cross(X) in cases of form WCPI.
%A : percentage of attendances = $\frac{AR \times 100}{AP}$

In case the agent is also in charge of Single dose treatment, form WCP2 Bis will be used in addition to this form.

Annex 4

Form MCP2 bis

MONTHLY REPORT ON WEEKLY CHEMOPROPHYLAXIS (MCP) AND SINGLE DOSE TREATMENT (SDT)

Reporting agent.....Sector.....
County.....Township.....Health post.....

A. Weekly chemoprophylaxis (MCP)
Number localities under MCP.....

	PA	AP			Chloroquine
Under I					
I to 5					
FF					
FP					
Total					

B. Single dose treatment (SDT)

	Number treated	Chloroquine
Under I		
I to 5		
6 to 10		
II to I4		
I5 +		
Total		

C. Chloroquine.

In stock beginning month			
Supplied during month			
Distributed MCP during month			
Distributed SDT during month			
Total distributed during month			
In stock end of month			
Request for resupply			

Annex 4.
FORM MCP3

INDIVIDUAL RECORD OF A LOCALITY UNDER ACTIVE WEEKLY CHEMOPROPHYLAXIS

Locality.....Township.....County.....

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Under 1												
NR												
AP												
AR												
PA												
1 to 5												
NR												
AP												
AR												
PA												
PP-PF												
NR												
AP												
AR												
PA												
Overall												
NR												
AP												
AR												
PA												
Chloroquine												

FORM SDTI

SINGLE DOSE TREATMENT (SDT) RECORD FORM
Agent in charge.....

Health Post.....Township.....County.....

No	Date	Names Addresses	Age	Sex	Chloroquine

Table 1,Annex 5

HEALTH INFRASTRUCTURE IN MONTSERRADO COUNTY (Population 439 997)
covering Greater Monrovia and 25 miles radius of Monrovia

	Beds
A.Hospitals.	
A.1.Government.	
I. J.F.K Medical Center	744
including : a.JFK Memorial Hospital	
b.maternity Center	
c.Tuberculosis hospital	
d.Mental Hospital(Catherine Mills Rehab.Center)	
2. Careysburg District Hospital(Bentol City)	20
3. Redee Memorial Hospital(Kakata)	25
A.2.Concession	
4. Firestone Medical Center,Harbel	165
5. Liberia mining Company Hospital,Bomi Territory	85
6. B.F.Goodridge Hospital,Bomi Territory	36
A.3.Missions and Others.	
7. St.Joseph Hospital	86
8. Elwa Hospital	52
9. Cooper Clinic	20
10. Samuel Grimes Maternity Center-Kakata	32
B.Health Centers	
I. Barnesville	18
2. Marshall	18
3. Sekou Toure Health Center(DTC)	

C.Clinics (Health Posts)

I. A.F.Russell Clinic-Clay Ashland		28.Paynesville Cl	
2.Antoinette Tubman Cl. Bomi		29.Public Health Cl,Snaper Hill	
3.Antoinette Tubman Child W.Cl Virginia		30.Roberts International Airport Cl	
4.Arthington Cl		31.Roysville Cl	
5.Bah-Barlie Cl	Bomi	32.Scheffin Cl	
6.Bejah Cl	Bomi	33.School of Deaf(special)	
7.Brewerville Cl		34.Senior Citizen(special)	
8.Bondinay Cl		35.Suehn Cl Bomi	
9.Caldwell Cl		36.Todee Cl	
10.Careysburg Cl		37.Virginia Cl	
11.monrovia prison compound Cl		38.West Point Cl	
12.Crozierville Cl		39.White Plains Cl	
13.Cultural Center Cl		40.Zoln Cl	
14.Ella Crozierville Cl		41.Zordee Cl	
15.Gardnesville Cl		42.Todee/Tubmanville Cl	
16.Eva Deline Howe Cl		43.Hamba Point Child Welfare	
17.Gogia Town Cl		44.Red Cross(special)	
18.Harrisburg Cl		45.Jamina Road Cl	
19.Johnsonville Cl		46.Konola Cl	
20.Klay Cl	Bomi	47.Boy's Town(special)	
21.Louisiana Cl		48.Fatima Orphanage(special)	
22.Hamba Point Polycl		49.NDEA Cl Robertsfield	
23.Hambah Cl		50.Child Welfare,Maternity Center.	
24.Kecca Cl	Bomi		
25.Millsburg Cl		Total : Hospitals 10	1265 beds
26.Mount Coffee Cl		Health Cen 3	36 "
27.New Kru Town Cl		Health Posts 50	

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Table 2, Annex 5.

ESTIMATED REQUIREMENT OF CHLOROQUINE (150mg tablet) FOR 5 YEARS MALARIA CONTROL

	1977	1978	1979	1980	1981
A. Greater Monrovia					
Population(a)	179321	185189	190930	196693	202951
A.1. SDT					
Total cases(b)	53886	46297	38186	29547	20295
Cases treated(c)	16165	16204	13274	13207	10147
Chloroquine(d)	32330	32408	30548	26514	20295
Total 5 years					142295
B. 25 miles R. Monrovia					
Population(a)	109222	112607	116098	119697	123406
B.1 SDT					
Total cases(e)	49149	45042	40634	35905	30852
Cases treated(f)	9829	11260	12190	12568	12340
Chloroquine(d)	19658	22520	24380	25136	24680
B.2 MCP					
To be protected(g)	21625	22295	2986	23699	24433
Protected(h)	15137	15606	16090	16589	17103
Chloroquine(i)	544932	561816	579240	597204	615706
Total SDT+MCP	564590	584336	60,620	622340	640386
Total 5 years					3015274
C. Monrovia + 25 miles	599920	616744	634160	646914	660683
Grand total 5 years					3157429

Explanatory notes:

(a) annual growth of population : 3.1%

(b) calculated from parasite rate in Monrovia which is 30.% in 1977 and will decrease gradually in the 4 following years, 25.% in 1978, 20.% in 1979, 15.% in 1980 and 10% in 1981.

(c) number of treated cases 30% in 1977 will increase as a result of development of health services, 35% in 1978, 40% in 1979, 45% in 1980 and 50% in 1981.

(d) estimated average dose per case calculated from infection rate found during March 1976 survey in Monrovia as in the following:

Age group	No positives	Chloroquine used
0 - 11m	32	75mg x 32 : 2400mg
1 - 4	230	150 x 230 : 34500
5 - 9	268	300 x 268 : 80400
10 - 14	111	450 x 111 : 49950
15 +	98	600 x 98 : 58800
Total	739	226050

Average dose : 226050mg : 739 = 305mg or 2 tablets of 150mg per case

(e) calculated from parasite rate of 45% in 1977, which decrease gradually, 40% in 1978, 35% in 1979, 30% in 1980 and 25% in 1981.

(f) number of treated cases 20% in 1977, will increase to 25% in 1978, 30% in 1979, 35% in 1980 and 40% in 1981.

(g) vulnerable group of population to be protected, 0 to 11m 3.1%; 1 to 5 13.6%; pregnant and nursing women 3.1%, in total 19.8% of the total population.

(h) population effectively protected should be at least 70% of the above group, a lower rate of coverage could not bring about a broad result in chemoprophylaxia.

(i) average dose per person under weekly chemoprophylaxis calculated as in the following:

	% vulnerable group	Chloroquine used per year
0-11m	3.1%	37.5mg x 52 weeks x 3.1 = 6045 mg
0-5	13.6%	75 x 52 x 13.6 = 53040
Pill	3.1%	300 x 52 x 3.1 = 48360
Total	19.8	107445 mg

Average per person : 107445 : 19.8 = 5426 mg or 5.26 : 150 = 36 tablets of 150mg

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BUDGET ESTIMATED FOR 5 YEARS MALARIA CONTROL PLAN — Table 3, annex 5.

	1977		1978		1979		1980		1981		Total	
	Rq.	US$	Rq.	US$	Rq.	US$	Rq.	US$	Rq.	US$	5 years	%
A.Greater Monrovia												
A.1 Personnel.Sa/y												
Ass.Direct	3375	1	3375									
Secretary	2250	1	2250									
Sec typist	1100	1	1100									
Filing clerk	900	1	900									
Messenger	600	1	600									
Yard boys	600	2	1200									
Drivers	890	5	4450									
Storekeeper	1500	1	1500	----- same annual expenditures as in 1977 --------								
Sr field sup.	2600	1	2600									
Supervisors	2200	5	11000									
Team Leaders	900	22	19800									
Larviciders	600	26	15600									
Sanit.laborers	600	25	15000									
Mosquito coll.	600	6	3600									
Sr lab tech	3375	1	3375									
Lab tech para	2100	4	8400									
Lab tech ento	2100	2	4200									
Subtotal			98950:		98950:		98950:		98950:		494750:	79.9
A.2 Equip sup. U.p*												
Knds.sprayers	50	40	2000:		: 10.	500:		: 10.	500:			
Swing fog machi	200	2	400:		:	:		:	:			
Hand sprayers	10	12	120:		: 12.	120:		:	:			
Cutlass	1.3	50	65:	50.	65:	50.	65:	50.	65:	50.	65:	
Shovels	5	50	250:	50.	250:	50.	250:	50.	250:	50.	250:	
Rakes	4	50	200:	50.	200:	50.	200:	50.	200:	50.	200:	
Chapiers	3	50	150:	50.	150:	50.	150:	50.	150:	50.	150:	
Raincoats	10	100	1000:	100.	1000:	100.	1000:	100.	1000:	100.	1000:	
Abate (gal)	25	80	2000:	80.	2000:	80.	2000:	80.	2000:	80.	2000:	
Baytex(lit)	8	300	2400:	300.	2400:	300.	2400:	300.	2400:	300.	2400:	
Pyrethrum(gal)	25	5	125:	5.	125:	5.	125:	5.	125:	5.	125:	
Kerosene(gal)	2.3	200	460:	200.	460:	200.	460:	200.	460:	200.	460:	
Oth.insect(DDT)			3000:		3000:		3000:		3000:		3000:	
Lab supplies			1000:		1000:		1000:		1000:		1000:	
Chloroquine % by thousand	.07	33	2310:	33.	2310:	31.	2170:	27.	1890:	21.	1470:	
Subtotal			15480:		12960:		13440:		12540:		12620:	67040: 10.9

Notes : U.p.= unit price.

continued next page..

BUDGET ESTIMATED FOR 5 YEARS MALARIA CONTROL PLAN (continued) Table 3, Annex 5.

	1977		1978		1979		1980		1981		Total 5 years	%
	Rq.	US$	Rq.	US$	Rq.	US$	Rq.	US$	Rq.	US$		
A.3.Transport U.p.												
Toyota P.Up 2t	4500.	2. 9000:										
Toyota S.W	5500.	2. 11000:										
Toyota Land Cr	4500.	1. 4500:										
Gaz 5 x260x.6x5cars.		3900:		3900:		3900:		3900:		3900:		
Maintenance repairs.		2000:		2000:		3000:		3000:		3000:		
Sub-total		30400:		5900:		6900:		6900:		6900:	57000:	9.2
Total Gr.Monrovia		144030:		117810:		119290:		113690:		118470:	613290:	100.
B.25 miles ra.Monrovia												
B.1.Personnel												
Iti.agents	1320.	40. 52800:	---------- same annual expenditures as in 1977-----									
Supervisors	2200.	8. 17600:										
Perdiem 2.5x10x12x48		14400:										
Subtotal		84800:		84800:		84800:		84800:		84800:	424000:	64.
B.2.Chloroquine by thousand .07.												
Chloroquine SdT	20.	1400:	23.	1610:	25.	1750:	25.	1750:	25.	1750:		
Chloroquine wC.	.545.	38150:	562.	39340:	580.	40600:	599.	41930:	618.	43120:		
Subtotal		39550:		40950:		42350:		43680:		44870:	211400:	31.9
B.3.Transport												
Motocycles	470.	20** 9400:										
Gaz 10gx12x.6x2		1440:		1440:		1440:		1440:		1440:		
Oil 10% of gaz		140:		140:		140:		140:		140:		
Maintenance repair		2000:		2000:		2000:		2000:		2000:		
Subtotal		12980:		3580:		3580:		3580:		3580:	27300:	4.2
Total 25m a.Monrovia		137330:		129330:		130730:		132050:		133450:	662700:	100.
Grand Total		282160:		247140:		250020:		251720:		251920:	1281490:	
Total population		288843:		297798:		307028:		316545:		326359:		
Cost per capita		0.97:		0.82:		0.81:		0.79:		0.77:		

Notes: 20** : 20 motocycles, 3 for 3 supervisors and 12 for 12 itinerant agents who can travel on good roads.

Table 1,Annex 6

CONSOLIDATED DATA OF MALARIOMETRIC AND ENTOMOLOGICAL SURVEYS AT LAMCO,OCTOBER 1975.

Localities	0 - 14m		2 - 9				Overall				A.gambiae	A.fun.
	IFR	SR	PR	GR	SR	ABS	PR	GR	SR	ABS	LD	neestus
A.Inside Lamco Com.												
P.Market	-	-	25.7.	-	5.7.	2.	26.	-	8.5.	2.2:	-	-
N.School	-	-	7.4.	1.2.	2.4.	1.5:	8.4.	-	1.6.	1.5:	-	-
Areas A & C	5.8.	-	8.4.	-	3.1.	2.6:	7.3.	-	2.2.	2.6:	0.3	0.12.
Old Yekepa	-	-	30.	3.3.	60.	2.2:	22.2.	1.5.	29.6.	2.3:	1.	-
Area F											nil	
Areas E & U											nil	
Area K											0.11.	
Rice field											0.17.	
Overall	4.5.	-	13.2.	0.8.	10.3.	2.	12.6.	0.2.	7.8.	2.1:		
B.Outside Lamco Com.												
Camp 4	27.2.	9.	40.8.	5.2.	10.4.	2.2:	36.2.	4.3.	9.9.	2.1:	1.07.	1.4. 1.15
Sawmill	3.2.	-	11.5.	1.2.	10.2.	2.2:	9.7.	0.8.	9.4.	2. :	0.46.	0.45. 0.06
Overall	14.8.	3.7:	29.	3.6.	10.3.	2.2:	24.8.	2.7.	9.7.	2. :		

Notes : Other species of anopheles larvae collected was A.coustani from Rice field area,Sawmill, Areas B,F,and K.Because of the scarcity of A.gambiae larvae,larval susceptibility test could not be performed.Results of dissection of the mosquito collected were negative.

Total examined	:	795
Positives	:	128
P.falciparum	:	87.9%
P.malariae	:	7.2%
P.ovale	:	5.8%

IV. SP[illegible] (PROTOZOA) AND THEIR CONTROL

by

Hugo Jamnback[1]

Since 1970 the Vector Biology and Control Division of WHO has prepared, with the assistance of collaborators outside the Organization, a number of papers on vector control. The Expert Committee on Insecticides held in October 1974 (Technical Report Series No. 561) recommended that these documents - general reviews of the ecology and control of individual vector groups - should be continued and revised from time to time to provide workers with up-to-date, practical information on the particular subject. It was also recommended that there should be a feedback to the Organization: readers are therefore requested to write to Vector Biology and Control giving comments on their experience of the subject reviewed.

The following is the first revision of the paper on blackflies (WHO/VBC/71.283).

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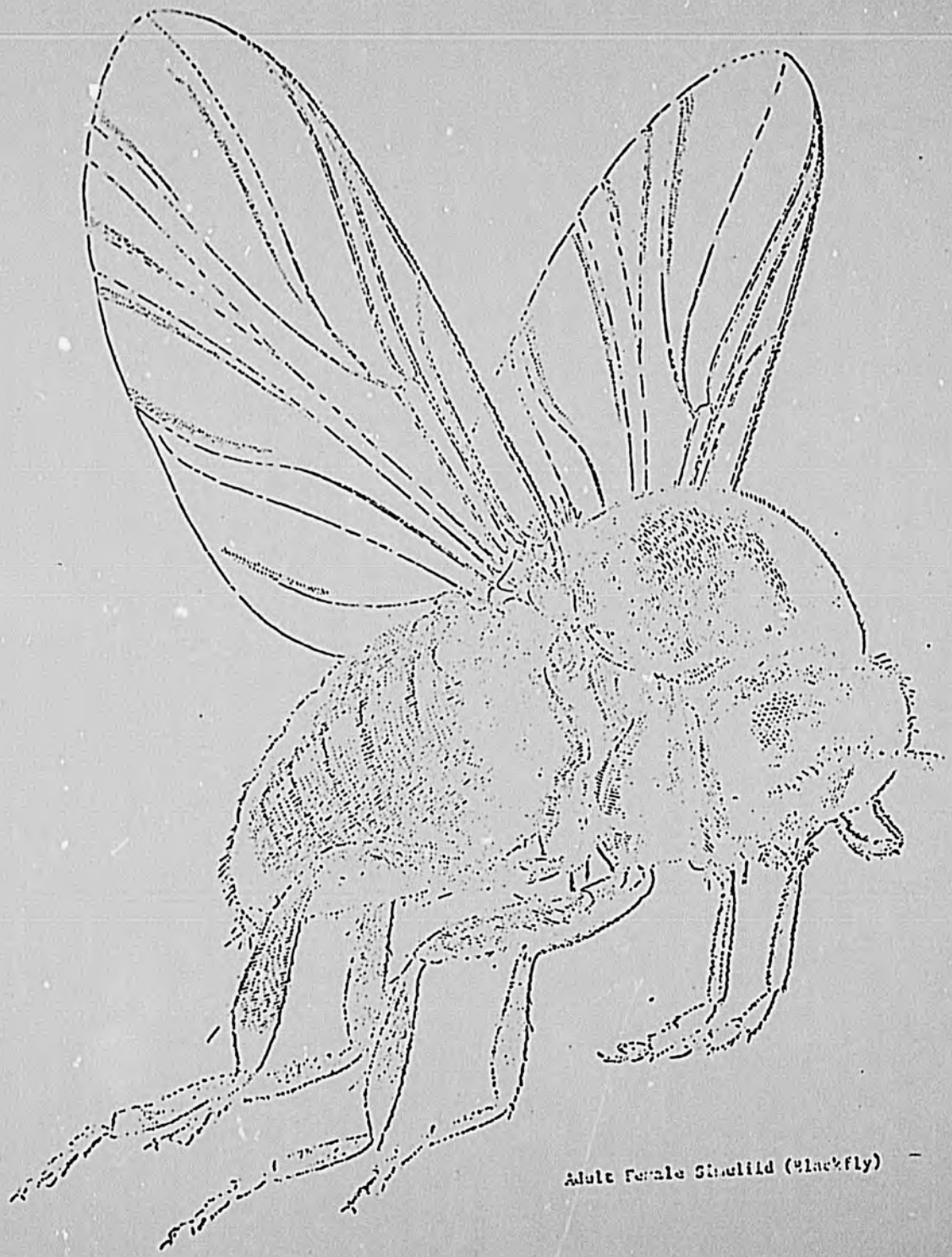

Adult Female Simuliid (Blackfly)

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TEXTFIGURES

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RESTRICTED

FIELD TRIALS OF NEW INSECTICIDES FOR CONTROL OF BLACKFLY LARVAE, 1969[1]

by

C. Quélennec[2]

INTRODUCTION

As part of the World Health Organization's research programme on new larvicides suitable for use against blackfly and capable of replacing DDT, field trials have been conducted on the effectiveness and "carry" of three insecticide formulations in the river Bongouri Ba in Upper Volta.

The section of the watercourse selected for this experiment offered the following advantages:

ready access, which made it easy to make checks

plentiful breeding places, including several for *Simulium damnosum*

comparatively low flow rate at the time of the trials

watercourse interrupted by pools of calm water, which are often responsible for the loss of active product and therefore reveal the formulations with the best carry.

The compounds tested were dimethrin, Abate and Dursban, in that order. Treatment with emulsifiable DDT was carried out at the end of the operation in order to compare its activity with that of the new larvicides.

The treatment technique was the one normally used in this part of Africa for the treatment of small rivers, i.e. the product was poured into the water for 30 minutes from a drum that was pierced with calibrated holes and fitted on a support above the water line. In this particular case the drum was placed on a raft that was drawn backwards and forwards from one river bank to the other so as to spread the insecticide as uniformly as possible.

DIMETHRIN - CMS 13/

This pyrethrinoid had already shown great aptitude for causing the detachment of blackfly larvae (Jamnback, 1966). In these trials it was used in the form of a water-dispersible powder with 25% active product.

The dimethrin was poured into the river in a concentration of 33 ppm for 30 minutes. At that time the flow rate of the Bongouri Ba was 5.6 m3/sec.

Two hours after the end of the treatment all the larvae at the sites 30 m and 150 m from the treatment point had disappeared. However, 24 hours later there were still larvae 500 m

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[1] Originally issued in French as report No. 86/ENT/69 OCCGE/ORSTOM Centre Muraz Entomology Laboratory.

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... from that, that. The density of the larval population indicated that this breeding ... reached by the water-dispersible powder. This shows that dimethoate has a ... larvicidal activity on blackfly; however, the short range of the formulation tested ... it unsuitable for ground-level larvicidal treatment under African conditions.

The early disappearance of its activity could be due either to rapid hydrolysis of the product (although this does not seem very likely as the breeding places 500 m downstream ought to have been reached after about one hour only) or to sedimentation phenomena that ... the insecticide towards the river bottom and prevent it from acting over longer distances. ... noted, it has been noted in the laboratory that this water-dispersible powder settles very quickly.

In the form in which it was used dimethoate seems unusable against blackfly larvae, but it would probably be used in some other form.

ABATE - OMS 786

Abate was tested in the laboratory and in the field by Jamnback et al. (1966) in various formulations, as a water-dispersible powder by Davis et al. (1966), and again in the field by Quelennec (1967) in the form of an oil solution. In the present tests it took the form of an emulsifiable concentrate with 20% active product (Abate 20 E manufactured by the Cyanamid Company), in a concentration of 0.54 ppm for half an hour, with a flow rate in the river of 3.5 m³/sec.

One hour after treatment the larvicide had destroyed the breeding places 30 and 100 m from the starting point. At these sites only nymphs and a few dead larvae were found. Two hours later the larvae attached 500 m downstream had disappeared, and three-and-a-half hours later the breeding site discovered 2 km downstream had also been destroyed.

During the days that followed destruction of the breeding sites were observed at 7.5, 11.5, 14, 18, 22 and 32 km.

The larvae first of all displayed some agitation, and in the course of their convulsive movements their abdomens became detached from the substrate. After vain efforts to attach their abdomens again they were pulled off their substrates but continued to struggle for several minutes, held on by a few centimetres of silken thread. The thread then lengthened suddenly and the larvae disappeared in the current.

At one breeding site, after elimination of all the larvae, 32 nymphs were captured and immediately placed in an atmosphere saturated with humidity. Twenty-five of them produced adults. The action of this product on the nymph stage is therefore very slight if not nil.

No dead fish were found anywhere the larvicide had passed. A few Ephemeropterae larvae were observed 100 m from the treatment point, fully alive, after the insecticide wave had passed.

It therefore seems that this formulation has properties that are extremely useful for blackfly control: effectiveness, range, and non-toxic to other aquatic organisms, this last characteristic having already been noted by Hilla (1966).

DURSBAN - chlorpyrifos - OMS 971

During the laboratory trials conducted by Jamnback (1966) Dursban in an acetone solution was applied for five minutes; in a concentration of 4 ppm it caused the detachment of all the larvae tested, whereas in a concentration of 0.4 ppm its activity was rather moderate.

It is used in the field in the form of an emulsifiable concentrate with 40.8% active product (Dursban M 4E) manufactured by Dow Chemical Company). Applied by the same technique in a concentration first of 0.005 ppm, then at 0.01 ppm for 30 minutes, with a flow rate of 2.5 m³/sec, this insecticide displayed only partial activity at the larval sites. A majority of the larvae disappeared but there were some survivors everywhere, some of which were in the early stages of development.

One hour after the insecticide wave had passed, the larvae at the first breeding place were still in completely normal positions and displayed no agitation. This led to the belief, at first, that the product was completely inactive. The poisoning of blackfly larvae by Dursban is therefore slow, and they do not become detached until well after the absorption of the poison.

These initial results indicated that the destruction of larval sites under African conditions required higher concentrations of Dursban. Consequently a third trial was carried out with a concentration of 0.03 ppm, which gave a suitable safety margin despite the toxicity of the product. The flow rate on the Bougouri Ba was at that time 1.5 m³/sec.

In this concentration, which was applied for 30 minutes, this organophosphorus compound destroyed all blackfly larvae over 7.5 km. The breeding places situated at 12.5 and 14 km were only partially affected.

Along the stretch where Dursban displayed complete effectiveness against blackfly, live larvae of Ephemeroptera and Chironomidae were collected. No dead fish were found along this stretch. This final observation is in conformity with the conclusions of Ferguson et al. (1966) who found that the doses that are active towards arthropods have no effect on the fish that they tested.

COMPARATIVE ACTIVITY OF ABATE, DURSBAN AND DDT FORMULATIONS

The results set out above show that two of the three formulations tested seem to have properties that make them suitable for use in blackfly control. However, in order to obtain a better impression of their true value they were compared with emulsifiable DDT, which up to now (1969) is still the only product used in larvicide campaigns in West Africa. Treatment with DDT at 1 ppm for 30 minutes was therefore carried out immediately after the effects of Dursban at 0.03 ppm had been recorded. The rate of flow on the Bougouri Ba had not changed and was still 1.5 m³/sec.

The purpose of this operation was to find out whether DDT, under the same conditions, was able to destroy the larvae left unaffected by Dursban at 12.5 and 14 km from the treatment point.

Checks made at those breeding sites showed that the passage of the DDT had brought about a further reduction in the number of larvae but that some had survived.

An additional treatment with Abate 200 could not be carried out because the number of larvae that had survived the preceding trials was insufficient for the observations to be properly interpreted. This treatment was therefore postponed until the larval sites were re-established. By the time the trial could be conducted, the flow rate on the Bougouri Ba was only 0.95 m³/sec and the average speed of the current had dropped considerably. At the treatment point the river was now very slow-flowing. Under these conditions Abate 200 displayed only partial activity on the first two sites at 30 and 150 m. This should be compared with a similar observation by Jamnback et al., (1966), who attributed the failure of the product over the first few metres of its route to the slow current and the lack of turbulence in the water. The rapids situated 150 m away mixed the insecticide with the water

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MINISTRY OF HEALTH & SOCIAL WELFARE
DIVISION OF RECORDS AND VITAL STATISTICS
REPUBLIC OF LIBERIA

BULLETIN OF NOTIFIED EPIDEMIC DISEASES
FOR THE PERIOD COVERING DECEMBER 1-31 1976

DISEASES	TOTAL		MONT. CO.		GRD. BASSA		SINOE CO.		MARYLAND CO.		CAPE MT. CO.		LOFA CO.		NIMBA CO.		BONG CO.		GRD. GEDEH CO.	
	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D
MALARIA	5203	12	2978	8	435	1	340	-	178	-	455	-	303	-	514	3	+	+	+	+
SCHISTOSOMIASIS	118	-	-	-	-	-	-	-	-	-	-	-	62	-	56	-	+	+	+	+
PNEUMONIA	920	19	753	14	22	2	52	-	18	1	32	-	9	-	34	2	+	+	+	+
ENTERIC FEVER WIDHOD/PARA-TYPHOID	5	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	+	+	+	+
MEASLES	269	5	220	2	4	-	10	-	14	2	9	-	6	1	6	-	+	+	+	+
DYSENTERY BACILLARY & AMOEBIC	1217	1	979	1	45	-	128	-	-	-	27	-	20	-	18	-	+	+	+	+
CHOLERA	36	-	36	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+
DIARRHEA	2217	14	1701	10	211	1	109	-	46	-	31	-	46	3	74	-	+	+	+	+
CHICKEN POX	10	-	7	-	-	-	3	-	-	-	-	-	-	-	-	-	+	+	+	+
CEREBRO-SPINAL MENINGITIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+
YELLOW FEVER	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	+	+	+	+
LEPROSY	24	-	10	-			11	-					2	-	1	-	+	+	+	+
POLIOMYELITIS	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	+	+	+	+
TETANUS	28	5	12	1	-	-	1	-	2	2	2	1	3	-	8	1	+	+	+	+
TUBERCULOSIS PULMONARY	651	9	627	9	2	-	11	-	-	-	11	-	1	-	9	-	+	+	+	+
MUMPS	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	+	+	+	+
PERTUSSIS(WHOOPING COUGH)	271	-	88	-	1	-	171	-	-	-	-	-	2	-	9	-	+	+	+	+
INFECTIOUS HEPATITIS	8	-	5	-	-	-	1	-	-	-	-	-	1	-	-	-	+	+	+	+
GONORRHOEA	255	-	149	-	6	-	34	-	9	-	17	-	10	-	30	-	+	+	+	+
PLAGUE	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	+	+	+	+
ONCHOCERCIASIS	111	-	-	-	2	-	-	-	-	-	-	-	92	-	17	-	+	+	+	+

SYMBOLS: ''' =Data Not Available; - =Nil; + =Report not received

APPROVED: John M. Prall
DIRECTOR/HEALTH & VITAL STATISTICS

III-62

APPENDIX IV

THE LIBERIAN INSTITUTE FOR BIOMEDICAL RESEARCH AND THE SCHISTOSOMIASIS SURVEILLANCE UNIT

1. Background

In mid 1975, the Government of Liberia, by Legislative Act, established the Liberian Institute for Biomedical Research (LIBR) as an autonomous agency of Government, headed by a Director who reports to a Board of Governors chaired by the Minister of Health and Social Welfare.

LIBR, in its central location, is housed at the physical facilities (a two story two winged laboratory building with attached an mal housing and eight residential buildings) of the former Liberian Institute of the American Foundation of Tropical Medicine (LITM) which reverted to Government when LITM, a private institution, ceased to operate about seven years ago. LIBR assumes most of the practical functions of LITM but in the role as the biomedical research arm of the Ministry of Health & Social Welfare, involved in collaborative efforts with other health related institutions concerned with health care delivery, training, disease prevention and control. In the latter regard LIBR maintains close functional relationships with the Bureau of Preventive Services and the Bureau of Planning, Research and Development of the Ministry of Health & Social Welfare; the Liberian Research Unit of the Hamburg Institute of Tropical Medicine at Bong Mines, Bong County; the University of Liberia, particularly its Medical College, and with Hospitals and Clinics.

2. Finance

LIBR receives financial subsidy from the Government of Liberia through the Ministry of Health & Social Welfare which provides base support for administration, maintenance and the acquisition of basic equipment and supplies and a few technicians. Awards, grants and contracts form a large percentage of the operations of the Institute. While the objectives of the Institute remains clearly geared toward research leading toward the prevention and control of major endemic diseases, its programs are in large part related to its ability to attract externally funded research projects.

3. Coordination

The Ministry of Health directs to LIBR all inquiries and proposals relating to biomedical research in Liberia. As such, the Institute serves as a directive and coordinative center and maintains accounting of all such activities.

4. Library

The Library at LIBR maintains subscriptions to most journals with emphasis on tropical medicine.

5. Clinic

LIBR operates a Clinic headed by Earl Reber, M.D., M.P.H., former Director of LIPM, which serves to provide curative service to the surrounding communities and to monitor disease trends in the area. It is anticipated that clinical research will be pursued.

6. Research Projects

a. Lassa Fever. An epidemiological study on the distribution and prevalence of Lassa Fever in Liberia was initiated in October, 1975 in collaboration with Columbia University School of Public Health and the Yale Arbovirus Unit. Dr. John Frame of Columbia is Principal Investigator.

b. Malaria. A tripartite agreement is being negotiated with Karol'nska Institute, Sweeden, LAMCO Mining Company, Nimba County, for the establishment of a Research Unit of LIBERIA in Nimba to pursue research beginning with drug resistance in malarial infections. The project is to be funded by LAMCO.

c. Hepatitis. Through agreement, the New York Blood Center operates a project of vaccine testing against Hepatitis B antigen at LIBR using some seventy chimpanzees as experimental animals. Alfred Prince (M.D., Virologist) of the New York Blood Center serves as Principal Investigator and is supported by a Veterenarian/Virologist.

d. Schistosomiasis. A major pursuit of LIBR is basic and applied research in Schistosomiasis. Experimental pathology is studied at LIBR in facilities which include rodent room, rat room, and laboratories in Histotechnique, etc. Joining the Institute in May, will be a research fellow and his wife, an experienced lab technician, from the Swiss Tropical Institute to pursue research in the area of serology with emphasis on sero-diagnosis in schistosomiasis infections.

Lofa County Schistosomiasis Unit. LIBR operates the Lofa Schistosomiasis Surveillance Unit which is a part of the Lofa County Agricultural Development Project. The specific aim of the Lofa SSU is to monitor the disease in the project area and after three years to recommend appropriate control measures. For this operation a substation laboratory of LIBR is being renovated. The staff of this unit includes the Director of LIBR as director of the project, a project supervisor-a masters degree Liberian, 4 laboratory technicians and six specimen collectors plus janitor, driver, and clerk typist. Provision is made for consultants.

Although there are several draw-backs in terms of budgetary restraints which dictated a narrow objective, the experience gained by this unit serves as a basis for implementing control measures beyond the life span of the project and beyond

the project area.

The approach of the Lofa SSU has been to incorporate areas of swamp rice cultivation into chosen areas for baseline epidemiological studies. The total chosen areas will then include all areas of swamp rice cultivation plus areas without. Populations of villages within certain radius of a swamp site form a study unit, which also includes the swamp site plus other water contact sites. Initial examination of the population and swamp sites/other water contact sites are made just prior to swamp reclamation. Infected individuals are treated. In the one swamp cultivated thus far, by the initial treatment of infected individuals, we assume, we have been unable to find infected snails in the reclaimed swamp although the population of snails appear to be increasing. It may be necessary, if success in stopping or reducing transmission is to be achieved and maintained when the rice project spreads to the entire project area, to increase the SSU staff to include one physician, another project supervisor, and possibly two technicians and to request for additional funds for transportation, drugs and molluscicides. The director, however, has submitted proposals to a couple of Foundations to investigate other medthods of snail control beside molluscicding.

The Bong County Schistosomiasis Unit. The expansion of the Lofa Schistosomiasis Unit to cover the Bong Project has obvious advantage of the experience gained in Lofa plus ensured coordination through LIBR. However, the disease appears to be more prevalent in Bong than in Lofa County. Careful planning and the experience in Lofa must be utilized. Among other things, the Bong project must make adequate provision for training and immediate control measures to cover a period long enough to permit significant reduction in transmission. Certain additional personnel of the Bong Project could function both in Lofa and Bong. Enclosed is a rough estimate of requirements for the Bong Project.

DRAFT REQUIREMENTS-BONG COUNTY SCHISTOSOMIASIS UNIT

Personnel	
Director of the Project (Lofa, Bong)	$20,000 - $30,000
1 Physician (Epidemiologist	20,000 - 30,000
1 Biologist - Malacologist	20,000 - 30,000
3 Project Supervisors (Masters degree)	30,000 - 35,000
3 Senior Lab. Technicians	9,000 - 16,200
3 Junior Lab. Technicians	5,400 - 9,000
3 Senior Field Technicians	9,000 - 16,200
6 Junior Field Technicians	5,400 - 9,000
1 Secretary	3,600 - 4,800
1 Clerk/Typist	2,400 - 3,600
3 Drivers	3,600 - 5,400
2 Janitors	1,440 - 1,920
1 Messenger	720 - 960
Consultants	4,000 - 6,000
Training	36,000 - 40,000
Health Education	5,000 - 8,000
Local Travel & Per Diem	3,000 - 5,000
Transportation Allowances	6,192 - 7,000
Laboratory/ Office	40,000 - 50,000
Staff Housing	35,000 - 40,000
Three Vehicles	36,000 - 38,000
Office Equipment, Furniture & Supplies	10,000 - 15,000
Laboratory Equipment & Supplies	40,000 - 45,000
Drugs	10,000 - 15,000
Molluscicide	25,000 - 30,000
	380,752 - 491,080

Note: Excludes recurrent costs maintenance & utilities.