Kenya Medical Research Institute

First report
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FOREWORD

This publication is the first annual report of the Kenya Medical Research Institute (KEMRI), covering the period 1979 to 1982. It thus contains more details than an annual report would normally have and within it there is an overview of the Institute's development over the last three years since its establishment. The period covered has been a time for formation and rapid growth of the Institute. At this formative process we have been guided and given direction by the Board of Management. We also greatly value the support given by the Ministries of Health and of Regional Development, Science and Technology, without whose efforts and understanding it would have been impossible to forge ahead.

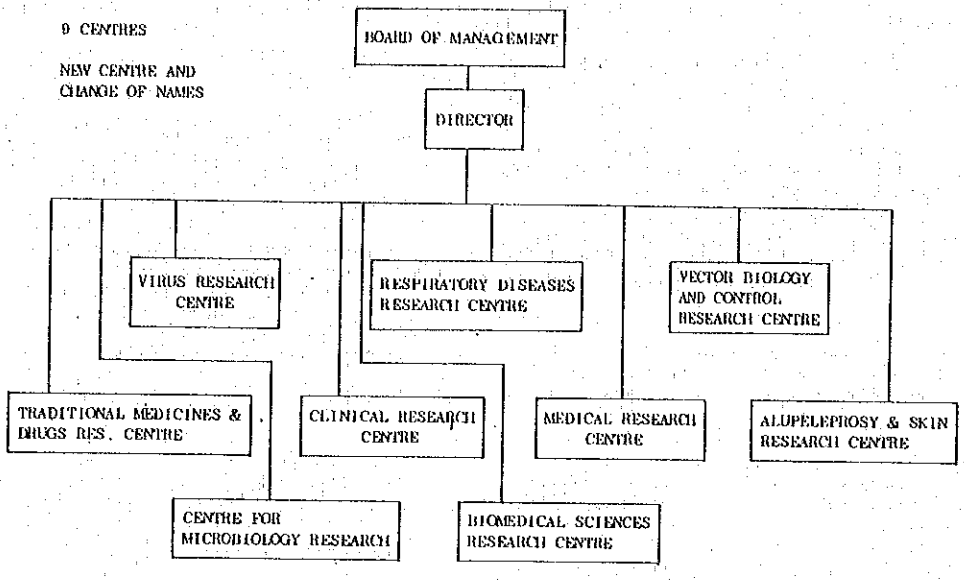
Even at this early formative stage there are signs that make us feel confident that medical research has taken foot in KEMRI. It still needs time, however, for the full research potential of the Institute to be realized. For the latter to happen, imaginative guidance will still be required.

KEMRI will no doubt continue its rapid development during the coming year. To this end an ambitious programme of construction of Headquarters and Central Laboratories complex has just been initiated. To prepare for this we are currently in the process of reorganizing our research programmes so as to align them with the country's priorities in health research.

I take this opportunity to thank all departments for the enthusiastic support they have so far given to the Board of Management and Secretariat in the arduous task of creating a strong and productive institution. Finally, I wish to convey my sincere gratitude to IDRC Nairobi Office for providing Ms Helen van Houten as adviser in scientific editing of the report as part of their research results dissemination project.

Prof. M. Mugambi
Director, Kenya Medical Research Institute

Organization of Kenya Medical Research Institute



BOARD

ORGANIZATION

Board of Management

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	Prof. C.P.M. Khamala
	Mr. E.C. Kotut
	Dr. D.G. Ombati
	Dr. Z. Onyango
	Prof.A.E. Wasunna
Secretary	Director, KEMRI

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Permanent Secretary, Ministry of Education Science and Technology
Director of Medical Services
Permanent Secretary, Ministry of Environment and Natural Resources
Permanent Secretary, Ministry of Industry
Permanent Secretary, Ministry of Agriculture
Permanent Secretary, Ministry of Culture and Social Services
Permanent Secretary, Ministry of Commerce
Permanent Secretary, Ministry of Higher Education
Secretary, National Council for Science and Technology

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	Dr.W.Kahugu
	Secretary, National Council for Science and Technology(or his representative)
Secretary	Prof.M.Mugambi(Director KEMRI)

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	Secretary, National Council for Science and Technology
Secretary	Prof.M.Mugambi(Director, KEMRI)

KEMRI Headquarters

The Kenya Medical Research Institute research centres focus on research activities while the headquarters administers and co-ordinates all the centres' activities and implements the policy decisions of the Board of Management. The headquarters operates under the following departments:

Administrative Services Department
Technical Services Department
Finance and Accounts Department

INTRODUCTION

Historical Background

The Kenya Medical Research Institute (KEMRI) was established in 1979 by the Science and Technology (Amendment) Act of November that year. Under this Act, biomedical research in Kenya except trypanosomiasis, which is the domain of a sister institute, the Kenya Trypanosomiasis Research Institute, has been made the responsibility of KEMRI. The Insitute is directly responsible to the Minister for Regional Development, Science and Technology.

For about a decade or so and up to June 1977 medical research was conducted on a regional basis by the then East African Medical Research Council under the auspices of the East African Community. This organization ran its medical research activities under the following centres:

1. E.A. Tuberculosis Investigation Centre, Nairobi, Kenya
2. E.A. Leprosy Research Centre, Alupe, Kenya
3. E.A. Institute of Malaria and Vector-Borne Diseases, Arusha, Tanzania
4. E. A. Institute of Medical Research, Mwanza, Tanzania
5. E. A. Virus Research Institute, Entebbe, Uganda
6. E. A. Trypanosomiasis Research Organization, Tororo, Uganda
7. Tropical Pesticides Research Institute, Arusha, Tanzania (medical aspects of pesticides)

Upon its creation the Kenya Medical Research Institute immediately incorporated and consolidated most of the activities of the institutions listed above. KEMRI was founded at a time Kenya was formulating a science policy which lays down research priorities in document No. 4 of the National Council for Science and Technology (NCST) entitled "Science and Technology for Development". Thus the Institute is concerned with the implementation of the national policy on biomedical research, providing facilities for research and promoting new work where necessary along the lines likely to contribute to improving the efficiency of the national health care delivery system.

Mandate for KEMRI

The functions of the Kenya Medical Research Institute as stated in the Science and Technology (Amendment) Act, 1979, are:

(a) To carry out research in the field of biomedical sciences;
(b) To co-operate with other organizations and institutions of higher learning in training programmes and on matters of relevant research;
(c) To liaise with other research bodies within and outside Kenya carrying out similar research;
(d) To disseminate research findings;
(e) To co-operate with the Ministry of Health, the National Council for Science and Technology (NCST) and the Medical Science Advisory Research Committee in matters pertaining to research policies and priorities;
(f) To do all such things as appear to be necessary, desirable or expedient to carry out its functions.

Research Programmes

Section 20 of the Science and Technology (Amendment) Act of 1979 requires that the Board of Management publishes at the earliest opportunity approved programmes and projects of research for the Institute. After several meetings and extensive consultations with the directors of KEMRI's six research centres and relevant bodies the programmes and projects were formulated under each Centre and were subsequently approved by the Board. These have now been published in a document entitled "Kenya Medical Research Institute—Research Programmes and Projects 1982-85", October 1982.

Conferences

1. ANNUAL MEDICAL SCIENTIFIC CONFERENCE

KEMRI has jointly with the Kenya Trypanosomiasis Research Institute organized an annual medical scientific conference. This conference serves as a forum whereby medical scientists in Kenya and other countries exchange views, theories and results of research work accomplished over the past year or so. Since 1980 the two institutions have so far held three such conferences and the proceedings have been published. These are:

1980 Recent Development in Medical Research in
1981 Trends in Research on Diseases of the Tropics with Special Emphasis on Leishmaniasis, 3-6 February 1981
1982 Current Medical Research in Eastern Africa with Emphasis on Zoonoses and Water-borne Diseases, 1-5 February 1982.

2. KEMRI FIRST CONFERENCE ON RESEARCH PRIORITIES, 29 NOVEMBER-2 DECEMBER 1982

This conference, organized in collaboration with the National Council for Science and Technology and the Ministry of Health, brought together all those who, in one way or another, are in-services. The conference addressed itself in particular to discussion of on-going and proposed research programmes of services. The conference addressed itself in particular to discussion of on-going and proposed research programmes of KEMRI with a view to determining the most urgent directions for medical research in consideration of the most prevalent health problems encountered in this country. The proceedings of the conference are being published.

KEMRI Headquarters Senior Staff 1982

Director	Prof. M. Mugambi
Principal Administrative Officer	Mr. A.R. Gathogo
Supplies Officer	Mr. J.M. Mbithi
Accountant I	Mr. M. Mutua

KEMRI Staff Establishment 1982

Director	1
Chief Research Officers	2
Principal Research Officer	1
Senior Research Officers	4
Principal Administrative Officer	1
Senior Accountant	1
Administrative Officers I, II, III	7
Research Officers I, II, III	18
Assistant Research Officers I, II	17
Supplies Officer I, II	1
Accountants I, II	4
Chief Laboratory Technologists	3
Senior Laboratory Technologists	6
Public Health Nurse II	1
Public Health Officer	1
Personal Secretary	1
Laboratory Technologists I, II, III	14
Laboratory Technicians I, II, III	35
Administrative Assistants	2
Accounts Assistants	2
Electronic Engineer	1
Shorthand Typists I, II	11
Certified Clinical Officer I, II	1
Senior Clerical Officers	4
Copy Typists I, II, III	11
Storeman	1
Higher Clerical Officers	33
Drivers I, II, III	31
Telephone Operators II, III	2
Artisans I, II, III	2
Ungraded Nurse	1
Laboratory Attendants	18
Subordinate Staff I, II	105
Total	331

Financial Support for KEMRI

The financial allocation to KEMRI from the Government Treasury in both the development and recurrent budgets for 1981/82 amounted to a total of K£852,800 rising to K£1.7 million in 1982/83. This provision falls short of the annual expenditure. The expected optimal provision for 1982/83 recurrent expenditure alone was K£2.6 million.

The other source of financial support for KEMRI comes from a number of international collaborating institutions, namely: WHO, Walter Reed Army Institute of Research of the USA, Centres for Diseases Control of the USA, Wellcome Trust (UK), IDRC of Canada, the British Medical Research Council, the Japanese Government, British Technical Aid and the Netherlands Government. The assistance received from these institutions has contributed to the development of KEMRI in terms of its research activities and physical facilities. However, this assistance fluctuates and in many cases is of a sliding scale nature, making it necessary for the Institute to continue seeking additional funds from international agencies.

RESEARCH PROGRAMMES

KENYA TUBERCULOSIS INVESTIGATION CENTRE

Introduction

The Kenya Tuberculosis Investigation Centre was established in July 1977 following the collapse of the East African Community and so of the East African Tuberculosis Investigation Centre. Research in the field of tuberculosis had hitherto been undertaken on a regional basis, from the early 1950s. By the seventies several hospitals in Uganda, Kenya, Tanzania and to a smaller scale Zambia took part in the co-operative studies, especially in the controlled clinical trials in the therapy of pulmonary tuberculosis.

The Kenya Tuberculosis Investigation Centre took over the functions of the former East African Tuberculosis Centre. Currently there are over 16 district hospitals in Kenya which are enlisted as participating centres in tuberculosis studies. The Centre's offices and laboratory block are situated within the premises of Kenyatta National Hospital. These were built in the early seventies with extensions in 1980.

Senior Staff Establishment 1982/83

Director	1	Dr. J.A. Aluoch
Senior Medical Research Officer	1	Vacant
Senior Medical Research Officer (Immunologist)	1	Vacant
Medical Research Officer	3	Dr. D.E. Oyoo Dr. O.B. Swai Dr. H.W.W. Oyuga
Research Officer	1	Mr. Reuben Agwanda
Chief Laboratory Technologist	1	Mr. E.A. Edwards
Laboratory Technologist	2	Mrs. W.A. Githui Mr. E. Juma
Public Health Officer	1	Mr. D.O. Kwamanga
Public Health Nurse	1	Mrs. G. Musiga
Executive Officer II	1	Mr. A.W. Mumbo

The following scientists, though not employees of Kenya Medical Research Institute, are closely and actively involved in the research activities of the Centre:

Lung Function Studies	Dr. Kungu Kimani
BCG Studies	Dr. P.W. Kok
BCG Studies	Dr. F.E. Onyango
Community Case-Finding Studies	Dr. H. Stott
Chemotherapy Studies	Dr. J. Darbyshire

Training Activities

The Centre offers its services in giving lectures at various institutions. To mark the centenary of the discovery of Koch's bacillus, members of staff participated in one week of mass media health education on tuberculosis. Posters were produced, there were press releases on several aspects of the disease and interviews were conducted on Voice of Kenya radio and television.

In-service training for laboratory technicians is conducted at the Centre's laboratory. A 9-month diploma course for clinical officers is being conducted by the Centre in collaboration with the Ministry of Health and Alupe Leprosy Research Centre. This COTULEP (clinical officer in charge of tuberculosis and leprosy) course offers post-qualification training to clinical officers who will be responsible for tuberculosis and leprosy aspects in the districts. The course was started in 1980 and already two groups of 12 to 15 have graduated.

Dr. O.B. Swai successfully completed 10 months of training at the Prince Leopold Insitute of Tropical Medicine, Antwerp, in Belgium and was awarded a master's degree in public health. Dr. D.E. Oyoo successfully completed a 4-month course in tuberculosis control in Japan.

Research Activities

1. CHEMOTHERAPY STUDIES

Background Information

The standard treatment of pulmonary tuberculosis is of long duration, for up to 18 months or more. Here in East Africa the difficulty in treating tuberculosis has not been lack of effective treatment. The standard regimen that was introduced by the predecessor of this Centre in the early 1960s was found to have a 95% success rate under routine trial conditions. This shortfall under routine conditions can be explained by the inability of routine medical services to implement this regimen to ensure that the patient takes the drugs regularly. Usually after about 3 months of treatment, the patient feels well and often neglects his drugs. At the same time, though more potent antituberculous drugs have been available for the physician, the prices have prohibited their use in developing countries.

It is with these facts in mind that an attempt is being made to reduce the treatment period. With the available potent antituberculosis drugs, we have established effective 6-month regimens through large-scale co-operative studies. The pioneer work on such large co-operative studies was started in East Africa by the former E.A. Tuberculosis Investigation Centre in early 1970 and the results have been encouraging. They still have their disadvantages for general application in our countries and further studies are being carried out to see if the element of cost and that of long duration of treatment can be further reduced.

1. *Fifth Short-course Chemotherapy Study*

In this co-operative study, in which 663 patients were admitted, 513 from Kenya and 150 from Zambia, three 6-month and one 8-month regimens are being studied. The first report, including relapse rates in the first 12 months after stopping chemotherapy, has been prepared for publication in *Tubercle*.

An interim report with results including the relapse rates in the first 18 months after stopping chemotherapy was prepared and presented at the 25th World Congress of the International Union against Tuberculosis in Buenos Aires, Argentina, in December 1982. The findings are summarized below (table 1).

The 6-month rifampicin regimen (2SHRZ/4HR)* was highly effective, a finding confirmed elsewhere, as was the 8-month regimen 2SHRZ/6H. It would seem that the role of pyrazinamide in the continuation phase requires further studies with larger numbers of patients and longer periods of follow-up.

*S, streptomycin, H, isoniazid, R, rifampicin, Z, pyrazinamid.

Table 1. **Bacteriological relapses in 18 months of follow-up of patients with sensitive strains pre-treatment**

Regimen	*Number of patients assessed*	*Bacteriological relapses*		*Relapse in month*			
		No.	%	7-9	10-12	13-15	16+
2SHRZ/4HR	160	4	2	1	1	0	2
2SHRZ/4HZ	155	10	6	5	1	1	3
2SHRZ/4H	148	15	10	8	6	0	1
2SHRZ/6H	166	3	3	0	1	1	1

H—isoniazid
M—ethambutol
R—rifampicin
S—streptomycin
Z—pyrazinamid

2. *Sixth Short-course Chemotherapy Study (Study E)*

There is evidence from a study carried out in Kenya (Humber et al. 1980) that cell-mediated immunity is impaired in untreated tuberculosis. There have been several reports that levamisole, a drug widely used for its anthelmintic properties, would be expected to correct this impairment. A paper from Iraq has reported marked improvement in sputum smear conversion rates and radiological clearing in patients with pulmonary tuberculosis given levamisole in addition to antituberculous drugs.

This study, which is co-operative, investigates the effect of levamisole in addition to antituberculous drugs on sputum smear conversion rates and radiological clearing in patients with pulmonary tuberculosis in Zambia and Kenya. At the end of December 1982, 16 months after the commencement of the study, a total of 314 patients had been admitted. Of these, 258 are in Kenya with 240 being in the main study and 18 in immunology. A further 4 controls have been studied. Zambia has admitted 56 patients into the study. The intake continues until a target of 500 patients is reached. No serious adverse drug reactions have been reported.

3. *Retreatment Scheme*

In this study the same regimen 2SZRM/RM is compared for two durations of 6 and 9 months respectively in the treatment of chemotherapy failures with primary drugs. The intake was

stopped in March 1982. A total of 307 patients was admitted into the study and in an interim analysis of the results 12 months after stopping chemotherapy 153 patients only were assessed. Of the 81 patients on 2SZRM/4RM at the end of chemotherapy one patient (1.2%) had an unfavourable status while in the 72 patients on 2SZRM/7RM none had unfavourable results. The relapse analysis after 12 months of follow-up show that relapses are higher with the 6-month regimen (6%) while the 9-month regimen had only 3% relapse rate.

The main conclusions from this study so far were:

(i) Short-course regimens for failure patients are possible.
(ii) No adverse reactions were recorded during chemotherapy and in particular with ethambutol used at a dose of 20 mg/kg.
(iii) The 9-month regimen may be better than the 6-month regimen but a longer follow-up period and the assessment of more patients are needed before definite conclusions are made.

It is apparent that the regimen will be valuable to patients with isoniazid-resistant strains.

4. *Application of Short-course Regimen in Routine Treatment Services*

This project started in 1980. One highly effective regimen, ISHRZ/5HR, was selected for the project to test the applicability of short-course regimens under routine conditions in two districts. The intake has been very slow. Thus out of 102 patients admitted since May 1980, only 7 patients have been admitted at Kilifi (1982) and the rest at Kerugoya. From March 1982 there was a shortage of Rimactazid/Rifanah (isoniazid + rifampicin combined in one tablet) and now these drugs (rifampicin and isoniazid) have to be given separately. This may in some way affect the results.

However, an interim analysis shows that out of 69 patients with fully sensitive strains none had unfavourable status at the end of chemotherapy and there was only 1 out of 38 (2.6%) after 6 months follow-up who had relapsed.

The numbers are still small but give an indication of the possibility of the use of such regimens in the routine service. It is important to note that there is still a degree of supervision directed towards development and maintenance of co-operation of the patients that is not yet available in general. Results such as these are important indications to start thinking of the possibilities for introducing such a regimen in the general control programme in view of difficulties experienced in drug supplies and their costs, among other factors.

II. COMMUNITY STUDIES

1. *Case-Finding Methodological Studies*

The background and the progress of some of these studies have been discussed in our scientific meetings and presented in the previous Centre reports.

2. *Outpatient Case-Finding Studies in Four District Hospitals—Kirinyaga, Siaya, Kitui and Msambweni*

This study was started in Kirinyaga and later on went on to Siaya, Kitui and Msambweni in that order. It was started in Msambweni District Hospital on 17 September 1981 and ended on 19 May 1982. A total of 18,163 patients aged 6 years and above attended the outpatient department during this period at Msambweni.

Amalgamating the results of the four district hospitals, table 2 shows attendance of 104,576 of the age of 6 years and above. Of these a total of 9,513 were suspects with respiratory symptoms and 2,727 of this latter group were chronic coughers. Examination of the chronic coughers identified 221 patients who were tuberculosis positive on smear and culture.

The value of examining persons with chronic respiratory symptoms attending the outpatient clinic at the district hospital in identifying tuberculosis may be determined by comparing positive cases identified through the study with those identified through the hospital routine service during the same period (table 3).

Table 2. Tuberculosis-positive cases from among chronic coughers with respiratory symptoms in outpatient attendance in four district hospitals

	Total attenders aged 6 years or more	*No. of patients with respiratory diseases*	*Chronic coughers*	*TB positive on both smear and culture*	*TB cases among chronic coughers* %
Kirinyaga	23,402	1,671	768	53	6.9
Siaya	23,679	1,504	298	17	5.7
Kitui	39,332	4,789	1,224	120	9.8
Msambweni	18,163	1,549	437	31	7.1
Total	104,576	9,513	2,727	221	8.1

Table 3. Proportion of positive TB cases identified through the study

	Total TB/positive cases	*Cases identified through hospital routine service*	*Cases identified through the study*	*Percentage TB/positive cases as identified in study*
Kirinyaga	53	4	39	73.6
Siaya	17	4	13	76.5
Kitui	120	15	105	87.5
Msambweni	31	7	24	77.4
Total	221	30	181	82.0

The results above show that of all the TB positive cases diagnosed at the district hospital during the same periods 82% were identified through the case-finding study system. Only 18% were identified through the hospital routine service.

The number with chronic cough in the four district hospitals outpatient during the study period was 2,727 (table 4). The prevalence of tuberculosis cases per 100 chronic coughers was 81. On the average one has to examine 12 chronic coughers to identify one tuberculosis case—a standard finding in high-prevalence areas.

Table 4. Prevalance of chronic cough and of tuberculosis in four district hospital outpatient attenders aged 6 years or more

	Outpatients	*Chronic coughers*	*Prevalence chronic coughers per 1,000 attenders*	*Positive TB cases*	*Prevalence of TB per 1,000*		*Coughers per TB cases*
					Chronic coughers	*Attenders*	
Kerugoya	23,402	768	32.8	53	69	2.26	15
Siaya	23,679	298	12.6	17	57	0.72	18
Kitui	39,332	1,224	31.1	120	98	3.05	10
Msambweni	18,163	437	34.1	31	71	1.71	14
Total	104,576	2,727	26.1	221	81	2.82	12

It is evident therefore that about 82% of all tuberculosis positive cases who actually report to the four district hospitals with their symptoms during the early stages of the disease go undiagnosed as TB cases and are therefore treated for other respiratory complaints. The problem of having to examine large numbers of suspects (12 to identify one) is well known and is an important factor in case finding at the peripheral health units.

Looking at returns on chronic coughers from the hospital routine service during the same periods of the year as the surveys were conducted shows that on the average only 38 tuberculosis cases are diagnosed in the same time of the year at these institutions.

3. *Pilot Study for Case-Finding Study through Child Welfare and Antenatal Clinics in Kitui and Kirinyaga Districts*

It is proposed to set up a system in all child welfare clinics in a district in which a register will be made of all suspects with a chronic cough in the household of the parent who brings the children (usually the mother).

This is, so far as is known, a totally new approach to tuberculosis case finding. The child welfare clinics have several potential advantages for they are popular, well attended, and relatively well staffed by staff orientated to preventive rather than curative medicine. Furthermore, the clinics are normally conducted throughout the district and are run by trained supervisory staff from the district hospital, for whom transport is available. Further, the high level of attendance of these clinics suggests that the families have an orientation towards health.

So far the study has been conducted in eight child welfare

and antenatal clinics in both Kitui and Kirinyaga districts. A register was made of all suspects aged 6 years and above with a cough for one month or more or blood spitting at any time identified by each person bringing a child or coming for the first time to the child welfare clinic or antenatal clinic. The identifying person is given a card to take home to the suspect, who is in turn asked and urged to report to the local district chest clinics where two sputum specimens are taken: one for smear examination at the local laboratory and the other for culture examination and if positive for sensitivity test at the Kenya Tuberculosis Investigation Centre Laboratory.

All suspects attending the chest clinic are treated for their complaints.

Since the beginning of the study, Kirinyaga District has produced a total of 19,937 attenders registered in its four static clinics and one mobile clinic, as compared to 12,254 attendances registered in Kitui's four static clinics.

A total of 103 suspects (44%) attended the Kirinyaga Chest Clinic and 58 (27.6%) suspects attended the Kitui Chest Clinic, among the 237 and 210 suspects registered at the Kirinyaga and Kitui child welfare/antenatal clinics respectively.

So far, Kirinyaga District has produced 2 tuberculosis-positive cases which is 1.9 per 100 suspects, by culture and smear examinations, at the TB laboratory only whereas in Kitui 1 tuberculosis case (1.7 per 100 suspects) was identified in both the local hospital laboratory and KTIC laboratory.

It is interesting to note here that, although the study started in Kitui four months later, Kirinyaga had registered only 1.7 suspects per 100 attendances during that period. The numbers are still small and the study will continue through 1983.

III. BCG SURVEYS

1. *National BCG Scar Surveys*

This survey was completed in June 1981 and the first report has now been prepared.

The major findings were that out of the 53,986 children aged 0 to 16 years examined for BCG vaccination scars an average of 68.9% had definite scars with a range of 48% to 81%, according to various age groups and districts. The district with the lowest coverage, Kakamega, had 46.3% BCG scar present while Kitui with the highest had 82.8% coverage.

This indicates as from this survey, a satisfactory BCG vaccination coverage in some districts reaching the targeted 80% while in others, it is still very unsatisfactory and more efforts should be directed to these areas through the KEPI Programme. The pre-school age group in particular (0-5 age groups) will need special attention.

On the basis of the findings of this survey, a survey to estimate the annual risk of infection and its trends for all parts of the country is now under preparation.

2. *Contact Examinations in the Evaluation of BCG Vaccination Programme*

This study is intended to evaluate the efficacy of BCG vaccination in offering protection against tuberculosis, especially in young children who are a high risk group as contacts of index cases. Secondarily it will provide information on the incidence of tuberculosis in children.

3. *BCG Immunization in Infants and Children*

A BCG immunization study was carried out in 1981-82 in the Joint Project Area of Machakos among children in the age group 0-2 months. This aimed at showing the influence of various factors on the outcome of BCG-induced tuberculosis conversion. The findings are summarized below. The Mantoux readings were positive after Glaxo, Danish and routine service BCG immunization in 65%, 75% and 57% respectively.

No differences in induration were seen in the different age groups 0-30 days, 31-60 days and 61-90 days though the pattern was the same as above.

Other factors considered were technical problems: duration of vaccine exposure, and nutritional status of children, which do not seem to contribute much to the poor tuberculin conversion rates of around 50%.

Quality of vaccine would account for about 10% of the variation and care of vaccine and skill of administration for another 10% or leas. It is possible that the African child is refractory to tuberculosis conversion. It is concluded that under the best conditions for BCG immunization, not more than 75% of the children convert to tuberculin positive. However further studies relating to humoral immune responses and tuberculin sensitivity would be of immense value before a recommendation for increased dose is made.

PROPOSED STUDIES

Chemotherapy Studies

1. Intermittent Chemotherapy

This has been proposed for a long time now but suitable centres are busy with present studies. It is however hoped that a proposed short-course intermittent regimen will be studied in Nairobi and Mombasa as soon as study E is closed.

Community Studies

1. Tuberculin survey among children to determine the annual risk of infection and other factors.

A recent BCG scar survey in 17 randomly selected areas in 11 districts of Kenya show a distinct difference in vaccination coverage in the different districts, age groups and between school children and non-school attenders. Coverage ranged between 46.8% to 86.8% in the districts.

It was initially planned to conduct a tuberculin survey among school children only but now it seems a definite bias would be introduced if the non-school attenders are excluded.

It is thus planned to do this survey in schools and in five sample areas for non-school-going 0- to 5-year group.

2. Kenya Tuberculosis Survey. This survey is proposed to start in 1984.

Non-tuberculosis Respiratory Diseases Research Activities

The background of the non-tuberculosis respiratory disease research was given in the 1979 and 1980 Annual Reports of the Centre. It has already been launched and has three broad projects:

(1) Occupational respiratory diseases
(2) Respiratory infections and allergies
(3) Respiratory physiology—normal lung function of the Kenyan population

The first two projects have a lot to do with atmospheric environmental pollution. This may be conveniently categorized into four groups:

(1) Community atmospheric environmental pollution (urban and rural),
(2) Occupational atmospheric environmental pollution (industrial and agricultural);
(3) Domestic atmospheric environmental pollution (emanating from cooking, warming and lighting devices and also passive smoking, domestic spray chemicals and powders),
(4) Personal (individual) atmospheric environmental pollution including smoking and allied smokes, perfumes and allied personal spray chemicals and powders).

Atmospheric pollutants include dusts, fumes, gases, vapours, liquids and radiant energy. The dusts can be inorganic or organic. It is recognized universally that a heavy load of atmospheric environmental pollution is mainly encountered at work in specific occupations. However sight of increasing atmospheric environmental pollution from other sources in the community and home must not be lost. Urbanization and industrialization are increased sources of environmental pollution which affects all contacts.

OCCUPATIONAL RESPIRATORY DISEASES

On-going Studies

1. *Respiratory symptomatology and ventilatory function in industrial workers exposed to silica and/or asbestos.* The objective of this study is to investigate respiratory sympotomatology and ventilatory function in workers exposed to asbestos fibres at the Simbarite Ltd. factory and in workers exposed to silica-containing dusts at the Bamburi Portland Cement factory in Mombasa District. This study was undertaken in view of the fact that there are no data in Kenya on ventilatory function and respiratory symptomatology in industrial workers exposed to silica and/or asbestos dusts.

At the two Mombasa plants, 1,048 industrial workers were investigated for respiratory symptomatology and ventilatory function in the first quarter of 1982. The investigations included questionnaire administration (detailed personal particulars, past

and present medical history, occupational history, smoking, physical examination, spirometry, anthropometry and radiography (PA CXR at full inspiration).

The data collected at the two coastal plants are now being analysed. The results of this study will help establish the minimum length of exposure to the dusts that leads to structural and/or functional respiratory disability in Kenyans working in such plants under Kenyan climatic conditions. Besides, the most affected sections in the factories will be identified and hence the appropriate recommendations can be made for safety precautions.

Proposed Studies

1. *Maize flour mill workers cardiopulmonary performance and symptomatology.* There are no data in Kenya on the effect of exposure to maize flour dust on cardiopulmonary function in Kenya maize flour mill workers. Workers in the urban milling factories and the rural maize mills are exposed to the cereal dust and any other materials the cereal might have acquired in growth, harvesting, transportation, storage and milling stages. The cereal might acquire in the premilling stages such contaminants as fertilizers, herbicides, fungicides and insecticides. Other possible contaminants in the premilling period include fungi and their metabolites, bacterial endotoxins, debris of insects and mites. Some of these materials contain potential allergens or may cause structural and/or functional changes in the pulmonary parenchyma and stroma.

   The objective of the study is thus to investigate cardiopulmonary performance in maize flour mill workers chronically exposed to maize flour dust.

2. *Respiratory symptomatology and cardiopulmonary performance in Kenyan rural carpenters exposed to wood dust.* In recent years there has been an ever-increasing number of carpenters graduating from schools of technology and village polytechnics and finding work in both rural and urban areas. This makes carpentry an important industry in the country with effects on the immediate environment of the workers. These workers are exposed to wood dust which when inhaled may cause respiratory symptoms in those exposed.

   The objective of the study is to investigate respiratory symptomatology and cardiopulmonary performance in Kenyan rural carpenters exposed to wood dust for a period of two years or more.

3. *Blood carboxyhaemoglobin levels in Nairobi traffic police after 2-hour exposure to city traffic fumes at heavy traffic points during peak periods and their cardiopulmonary performance.* The city of Nairobi is heavily "populated" with motor vehicles. It is a major road, air and rail communication junction in eastern Africa. Heavy duty traffic vehicles from Mombasa to Rwanda, Burundi, Uganda and southern Sudan pass through the city. The exhaust from the international trailers, railway engines, and international airbuses adds to the exhaust from Nairobi's own heavy vehicle population. The first "regular" inhaler of the city's surface transport vehicles' fumes, who is the subject of this study, is the controller of the traffic who receives it still thick before atmospheric dilution.

   The objective of the project is to, determine the carboxyhaemoglobin levels in Nairobi traffic police after a 2-hour exposure to city traffic fumes at heavy traffic points during peak periods. Their cardiopulmonary performance will also be assessed.

4. *Incidence of respiratory symptoms and cardiopulmonary performance in Nairobi traffic police who have never smoked.* The objective of this project will be to assess the response to the city's traffic police to *chronic exposure* to the city traffic fumes. Whereas subjects in the main study of project 3 will be "freshmen" in the traffic police department, those on project 4 will be "old timers". The study will commence in mid 1983.

5. *Respiratory symptomatology and cardiopulmonary performance in Kenya village children exposed to domestic wood smoke.* Wood is still a major source of energy for cooking and warming houses at night in most of rural Kenya. In most instances, rural structures lack good ventilation and therefore the concentration of wood smoke can remain high even long after the fire has been put out. During the rainy season when it can be cold at night and especially in the highland regions wood has to be burnt for some time during the night to keep the houses warm.

   Children in the age group 5-14 years constitute almost half of the Kenyan population. Most of them live in the rural areas where wood is the main domestic source of energy. As a result, most rural children are chronically exposed to domestic wood smoke. The results of the performance of these children will be compared with the data got from the National Normal Lung Function Survey and also with those of other rural children whose household's domestic energy source is not wood.

Laboratory Studies

1. *Research Laboratory*

During the year new admission to study E was at its peak, generating the maximum work load during the period of a study.

New admissions were received from study Alpha and the Community Studies, although at a lower rate than in the previous year, and the follow-up of studies Y and Z were almost completed.

A total of 9,931 (7,899) (figures for 1981 in parenthesis) were examined during the year, a monthly average of 827 specimens, which is below the optimum work load of 1,000 specimens per month. From these specimens 839 (592) sensitivity tests and 2,155 identification tests were set up. All strains were identified as *M.tuberculosis* microbacteria *hominis*. Also 2,080 (625) urine specimens were examined for the presence of anti-tuberculous drugs.

In addition to the bacteriological investigations 540 blood specimens were examined for haemoglobin, total and differential white cells counts as a special requirement of study E.

As in the previous year the laboratory participated in a number of training programmes, in particular the COTULEP training programme and the DMLT Clinical Microbiology course.

Collaborating Institutions

The Ministry of Health and the Medical Research Council Tuberculosis and Chest Diseases Unit, London, are the principal collaborators of the Centre. Considerable assistance has also been received from the Canadian International Development Research Centre (IDRC) and the pharmaceutical companies Brocco of Milan, Ciba-Geigy of Basle and London, and Lepetiti of Milan.

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CLINICAL RESEARCH CENTRE

Introduction

The establishment of the Clinical Research Centre (CRC) was proposed in the middle of 1978 by the Ministry of Health after consultations with the World Health Organization (WHO) and local medical experts. The aim was to establish a Centre for clinical investigation of those diseases considered to be of priority in Kenya. Following the establishment of the Kenya Medical Research Institute (KEMRI) in 1979 it was considered most appropriate to have CRC, which had no official affiliation at the time, as one of the Centres of KEMRI rather than as part of the Ministry of Health or the University of Nairobi Medical School. CRC became operational in the second quarter of 1979.

Currently the Clinical Research Centre has no permanent premises of its own. Its laboratories and staff are scattered all over the Kenyatta National Hospital complex. The patients' beds are being provided at the Infectious Diseases Hospital over a kilometre's walk from the Centre's main laboratories.

Director	Dr. Davy K. Koech
Principal Research Officer	Dr. W.M. Kofi-Tsekpo
Senior Research Officer	Dr. Alwi M. Shatry
Research Officers	Dr. Charles N. Chunge
	Mr. Kimani Gachuhi
	Mr. John Githure
	Dr. Baldip Khan
	Mr. Gerald M. Mkoji
	Dr. Joab B.O. Were
Assistant Research Officers	Dr. George S. Gachihi
	Miss Tamara Kipingor
	Dr. Leah W. Kirumbi
	Dr. Richard Muigai
	Dr. Nathan Gatheru-Thagana
	Dr. Juma R. Rashid
	Dr. Kevine M. Wasunna
Leishmaniasis Co-ordinator	Dr. Jeffrey D. Chulay (LTC)
Visiting Scientist, Malaria Co-ordinator	Dr. Harrison C. Spencer
Visiting Scientist, Medical Entomologist	Dr. Raymond F. Beach (CPT)
Project Leader (Hypertension) Kenya/Wellcome Trust Laboratory	Dr. Neil Poulter
Consultant Physician, Kenya/ Wellcome Trust Laboratory	Dr. John Sanderson

Technical Staff

Chief Laboratory Technologist	Mr. Stanley K. Miriti
Senior Laboratory Technologists	Mr. Charles Muthaura
	Mrs. Maria N. Mwita
Laboratory Technologists I	Mr. David Iha
	Mr. Richard Agure
	Mr. Ben Muigai
	Mr. B. Omondi
Laboratory Technologists II	Mr. M. Adoyo
	Mr. Jim Mwaniki
Laboratory Technologists III	Mr. David Boriga
	Mr. Charles Magiri
	Miss Jayne Mwaniki
	Mr. Alex Wamachi
Laboratory Technicians	Mr. Timothy Kamau
	Mr. Simon Kiarie
Trainee Laboratory Technicians	Mr. Edward Kamau
	Miss Dorothy Mlagui
Field Supervisors	Mrs. C.J. Poulter
	Mr. J.D. Lury
Field Workers	Mr. Dominic Onomo
	Mrs. Mary Were
	Mrs. Anna Ajwang

Training

Two of the Centre's scientists are currently training overseas and more scientists and technical staff are programmed for training in the following years.

The Clinical Research Centre also offers training opportunities for both technical and scientific staff, the latter up to post-doctoral levels. A considerable number of medical students spend their elective periods at the Centre.

Goals and Objectives

Functionally, CRC is the clinical base for all the departments of KEMRI and does basic research to support some of these departments.

The primary goals and objectives of CRC are:

(i) To conduct and co-ordinate clinical investigations on humans;
(ii) To establish operational research programmes in tropical and other diseases considered to be of priority in Kenya, as specified in the terms of reference;
(iii) To produce properly trained and competent Kenyan clinical investigators by offering research and training opportunities to selected individuals.

Research Programmes

Currently, the CRC is involved in some five major programmes:

(i) Leishmaniasis
(ii) Malaria
(iii) Schistosomiasis
(iv) Cardiovascular diseases
(v) Other clinical disorders. This covers other areas of clinical investigations and presently includes certain aspects of human reproduction, immunodermatology and malignancies.

Each programme has a co-ordinator, appointed by and responsible to the Director. This person is involved in the planning of work within the programme and assists in the preparation of research protocols, also performing an important role in training and evaluation.

Summary of Achievements

The Clinical Research Centre has produced results of quality, some of which have been directly applied in diagnosis, treatment and management of certain diseases. The following is a summary of CRC's achievements:

(i) Serum immunoglobulin levels and functional activity of complement components have been established and their role in the immunopathology of visceral leishmaniasis explored.
(ii) The nature of immune defect has been defined in visceral leishmaniasis. Immune unresponsiveness has been established to be both specific and non-specific. Recovery of non-specific responses precedes specific immunity.
(iii) The development of micro ELISA technique in the diagnosis of visceral leishmaniasis may replace the more risky and uncomfortable approach of spleen aspiration. The antigens used in serodiagnosis and skin testing are prepared at CRC.
(iv) A new treatment schedule for visceral leishmaniasis has been recommended which may considerably reduce the period of hospitalization.
(v) A technique has been developed for enumerating parasites in splenic aspirates on a logarithmic scale, which has proved of value in estimating total parasite burdens, assessing the results of chemotherapeutic trials and distinguishing slow from non-responders.
(vi) It is now possible to measure blood levels of antimony, allopurinol, 4-aminoquinolines and other drugs.
(vii) Local staff have been trained to undertake *in vitro Plasmodium falciparum* culture and the use of the technology in assessing the sensitivity of *P.falciparum* to a variety of antimalarials.
(viii) Despite the changing response pattern of *P.falciparum* to antimalarials, it has been demonstrated that chloroquine still remains the appropriate drug of choice in the treatment and management of malaria in Kenya. Some of the antimalarials have been shown to be ineffective and have since been removed from the market.
(ix) It has been demonstrated that immunity resulting from prior exposure to malarial infection plays a big role in the susceptibility of malaria parasites to chemotherapeutic agents.
(x) It has been demonstrated that successful treatment of schistosomiasis *mansoni* leads to the development of some degree of immunity to re-infection in some idividuals. This is particularly important in the strategic planning of the control measures. There is also the first clear evidence for a difference in susceptibility to *S.mansoni* infection that is not attributable to water contact habits.
(xi) Eosinophil levels in schistosomiasis patients undergoing treatment may be used as a prognostic feature as the levels change on recovery.
(xii) CRC has been able to advise and assist in various ways on several other projects. Assistance and advice of this sort will definitely assume an increasingly important role.

Research Activities

COMPLETED RESEARCH PROJECTS

I. *Leishmaniasis*

(i) *Comparison of two-dosage schedule of sodium stibogluconate (Pentostam(R)) treatment of visceral leishmaniasis.* Pentostam(R) administered at 20 mg Sb-kg/d (twice the usual dose) for 28 days was safe and well tolerated, and in children caused a more rapid disappearance of parasites from spenic aspirate smears, than 5 mg Sb/kg/d.

(ii) *Comparison of three-dosage regimens of Pentostam(R) treatment of visceral leishmaniasis.* Pentostam(R) administered at 10 mg Sb/kg/every 8 hours (30 mg Sb/kg/d) for 10 days was safe and well tolerated and caused a more rapid reduction in parasite density in splenic aspirates smears than 10 Sb/kg once daily for 30 days;10 mg Sb/kg twice daily for 15 days caused an intermediate response.

(iii) *Treatment of cutaneous leishmaniasis in Kenya caused by* L.aethiopica. Treatment using Pentostam(R) at conventional doses led to poor response. In three such patients, 20 mg/kg twice daily for 30 days was safe, well tolerated and effective.

(iv) *Ocular complications in visceral leishmaniasis.* Uveitis occurred in 7 of 71 patients, usually after finishing treatment. This may be due to a cell-mediated immune response directed against parasites for parasite antigens present in the eye.

(v) *Electrocardiographic abnormalities during Pentostam(R) treatment.* ECG changes were dose-dependent, rarely occurring with doses less than 20 mg Sb/kg/d. The most common abnormality was flattening or inversion to T waves. Less common was reduced QRS or a prolonged QT interval.

(vi) *Quantitation of amastigotes in splenic aspirate smears.* A logarithmic scale to quantify parasites in serial splenic aspirates was useful in managing patients, especially those unresponsive to usual treatment, and in comparing the speed of response to sufficient treatment regimens.

(vii) *Comparison of microscopy and culture for detecting* L.donovani *in splenic aspirates.* Evaluation of splenic aspirate smears and cultures were complementary. Culture in Schneider's medium was more sensitive than culture in NNN or RPMI 1640, especially during treatment.

(viii) *Use of an ELISA for field diagnosis of visceral leishmaniasis.* An ELISA high sensitivity and specificity was developed using *L.donovani* promastigote antigens. It has been useful in selecting patients who warrant further investigation with splenic aspiration.

(ix) *Gastrointestinal function in visceral leishmaniasis.* Among 10 patients, vitamin A absorption was impaired in 7 and d-xylose absorption in one. In 5 of them leishmania were found in small bowel biopsies; two patients had partial vilous atrophy. Abnormalities improved after treatment.

(x) *Immune suppression in visceral leishmaniasis.* Delayed cutaneous hypersensitivity and *in vitro* lymphocyte blastogenesis were depressed in response to leishmanial antigens (specific) and tuberculin and streptokinase-streptodornase (non-specific). Recovery of non-specific immune responses preceded the development of specific immunity.

(xi) *Antileishmania antibodies and complement in visceral leishmaniasis.* Levels of IgM and IgG_1 but not IgA, were elevated. Antileishmania antibodies, were mostly components of class IgM and subclasses IgG_1 and IgG_3. Reduced levels of complement components C_2 and C_3 suggest *in vivo* activation of complement via the classical pathway. The direct Coombs' test was almost always positive, usually with C_3d and IgG on the erythrocyte surface.

(xii) *Concanavalin A and cell-mediated suppression in visceral leishmaniasis.* Suppression cell activity was studied on peripheral blood mononuclear cells with active disease. Concanavalin A (Con A) at the concentration used ($50\mu g/4x10^6$ cells) could activate functionally active supressor cells from both patients and clinically normal individuals. Mitomycin-treated (inactivated) Con A-activated cells from patients caused 70% suppression while those from controls caused 31% suppression using PHA as the mitogen and autologous cells as the responder cell population.

(xiii) *Effect of sodium stibogluconate on lymphocyte responses in visceral leishmaniasis.* The effect of Pentostam(R) on lymphocyte responses was studied. The drug was incubated with mononuclear cells at concentrations ranging from $0.1/\mu g/Sb/2 \times 10^5$ cells from clinically normal individuals. A progressive inhibition of ^{3}TdR incorporation in PHA-stimulated cells on increasing the concentration of the drug was observed. When serum obtained 3 hours after intramuscular administration of Pentostam(R) was incubated with autologous cells, synergism was observed.

(xiv) *Sandfly colonies and experimental transmission of* L.donovani. Laboratory colonies have been established of *Phlebotomus martini*, the probable vector of visceral leishmaniasis in Kenya, and a species of lizard-feeding sergentomyia. After experimental infection with *L.donovani*, the parasites persisted and moved to an anterior position in *P.martini*. But in *S.schwetzi*, the parasites were never found anterior to the midgut and the infection was gradually lost. *P.martini*, but not *S.schwetzi*, was able to transmit the infection to hamsters.

(xv) *Identification of new sandfly species in Kenya.* During field collections related to establishing sandfly colonies, *P.duboscqi*, not previously known to occur in Kenya, was identified. This species is a vector of cutaneous leishmaniasis caused by *L.major* in West Africa. *L.major* is enzoonotic in rodents in Kenya but the role of *P.duboscqi* in its trasmission here has not been established.

(xvi) *Prevalence and spectrum of visceral leishmaniasis in Kivaa Sublocation, Machakos District.* In a cross-sectional study of 374 people in 50 households, active disease was found in 0.3%, a positive leishmanin skin test in 7.2%, and antileishmanial antibodies in 3.7%. These findings suggest the existence of a spectrum of disease from subclinical and self-healing to the syndrome of kala-azar.

(xvii) *Epidemiological studies in Perkerra Area, Baringo District.* Leishmania skin testing in the population disclosed a gradual rise in the prevalence of positive tests between ages 6 and 16. Positive tests were more common in individuals living along dry river beds than in open plains. Serological testing of 662 people detected two possible subclinical infections. Over 6,000 sandflies have been caught and examined, mostly members of *Sergentomyia*. Flagellates were cultured from 27 of these. No parasites were isolated from 296 *P.martini* and 27 *P.duboscqi*. Among 789 rodents of 10 different species, *Leishmania* were isolated from the spleens of 15, including *Tatera robusta* and *Avicanthis niloticus* (14), the isoenzyme pattern of these isolates and the disease caused in experimental animals are the same as a reference strain of *L.major*.

II. *Malaria*

(i) *Susceptibility of* Plasmodium falciparum *to pyrimethamine and sulfadoxine/pyrimethamine.* Field studies were conducted in Kisumu to assess the susceptibility of local strains of *P.falciparum* to pyrimethamine alone (by a standard 7-day *in vivo* test and a 48-hour *in vitro* field test) and to sulfadoxine-pyrimethamine (by a 7-day *in vivo* test). Both *in vivo* and *in vitro* tests demonstrated that pyrimethamine resistance was very common. Parasite susceptibility to sulfadoxine-pyrimethamine was uniformly greater when the isolates were tested *in vivo* thus indicating that this drug combination remains potent despite high frequency of resistance to pyrimethamine alone.

(ii) *Kenya Saradidi community-based malaria project: response of* P.falciparum *to chloroquine.* School children from Saradidi, Kenya, were treated with chloroquine. All infections were sensitive *in vivo* and all isolated in the Rieckmann macro test. Repeat tests several months later revealed that the *in vivo* test was as before but 2 of 20 isolates examined showed *in vitro* resistance with persistent shizont development. Changing pattern of the *in vitro* response of *P.falciparum* isolates in Saradidi to chloroquine was demonstrated.

(iii) *Differences in sensitivity of* P.falciparum *to amodiaquine and chloroquine.* Eleven isolates of *P.falciparum* from Kisumu were tested for their sensitivity to amodiaquine *in vivo* and to amodiaquine *in vivo* in a 7-day test. *In vitro* 5 of 8 successful isolates in the Rieckmann micro test and 3 of 8 isolates in a modified 48-hour test were more sensitive to amodiaquine. The ID_{50} in a radioisotopic assay was 14.8 nmol/l for amodiaquine and 44.9 nmol/l for chloroquine. Similar results were found for three known chloroquine-resistant isolates; all three were more sensitive to amodiaquine ($\leq$ 60 nmol/l) than chloroquine ($\geq$ 300 pmol/l in the 48-hour test and the ID_{50}s were markedly different: 11.4 to 21.3 for amodiaquine and 105 to 215 for chloroquine.

(iv) *Infant study.* The first *in vivo* chloroquine-resistant *P.falciparum* malaria in a Kenyan was demonstrated in an infant. *P.falciparum* isolates from 42 infants aged 6 to 24 months were examined *in vivo* and *in vitro*. In the standard WHO 7-day *in vivo* test, 41 infections were sensitive. One infection was

resistant *in vivo*, parasitemia cleared on day 3 but recrudesced on day 4 (RII resistance by WHO criteria). In the Rieckmann macro *in vitro* test 18 of 25 isolates were resistant to chloroquine (schizont inhibition only occurred at concentrations>8 pmol/l).

(v) *Pyrimethamine, cycloguanil and proguanil studied in Kisumu.* Eighteen of 19 *P.falciparum* infections in school children were resistant to pyrimethamine *in vitro*. Proguanil was inactive *in vitro*. Ten of 12 isolates were more sensitive to cycloguanil than to pyrimethamine *in vitro* although *in vitro* resistance to cycloguanil was also suggested.

(vi) *Field evaluation of 48-hour test.* A 48-hour *in vitro* test for determining the chloroquine sensitivity of *P.falciparum* isolates was evaluated in Kisumu and Malindi, Kenya. *In vivo* and *in vitro* tests were done on 14 isolates from children aged 5 to 13 years. All 14 infections cleared with 3 days of beginning chloroquine treatment and no recrudescence occurred during the 7-day or 28-day follow-up period. Although all isolates tested were chloroquine sensitive *in vitro*, different response patterns were observed. The results demonstrated that the 48-hour test is an important addition to existing *in vivo* and *in vitro* methods for determining the chloroquine sensitivity of *P.falciparum* in the field.

(vii) *Response of* P.falciparum *isolated to chloroquine and mefloquine.* *P.falciparum* isolates from Kisumu and Malindi were tested for their sensitivity to chloroquine *in vivo* (21 isolates) and to chloroquine and mefloquine *in vitro* (21 isolates plus 16 additional isolates). Eight patients received chloroquine base 10 mg/kg on day 0 and 13 patients 25 mg/kg over 3 days. All were found to be sensitive *in vivo*. One infection treated with 10 mg/kg recrudesced on day 4 but cleared after treatment with 25 mg/kg. Successful Rieckmann macro *in vitro* tests to chloroquine and mefloquine were done on 26 of 37 *P.falciparum* isolates. Results demonstrated different *in vitro* response patterns for Kenya *P.falciparum* isolated to mefloquine in the absence of drug pressure and suggest that should mefloquine become available in Kenya, it should be used judiciously with continued *in vivo* drug sensitivity monitoring.

Another study was done to test the *in vitro* sensitivity of 14 *P.falciparum* isolated to chloroquine in Malindi using the Rieckmann micro *in vitro* test. All isolates were sensitive *in vitro*.

(viii) *Activity of proguanil and its metabolites against* P.falciparum. Using an *in vitro* radioisotopic method, the activity of proguanil, its metabolites cycloguanil and p-chlorophenyl biguanide (PBG), pyrimethamine, and chloroquine against seven Kenyan and three South-East Asian strains of *P.falciparum* was measured. Five Kenyan isolates were sensitive to both pyrimethamine and cycloguanil *in vitro*, while the Smith and two Kenyan strains were resistant to both drugs. Cross-resistance was incomplete: the camp strain was resistant to cycloguanil but not pyrimethamine. Both proguanil and PBG exhibited weak antimalarial activity *in vitro*, but inhibitory blood levels of either compound are unlikely to occur after a normal human dose of proguanil. The results indicate that the activity of proguanil against *P.falciparum* is due entirely to the action of its active metabolite, cycloguanil.

(ix) *Synergism of pyrimethamine and sulfadoxine against* P.falciparum in vitro. An *in vitro* system was developed for evaluating synergy between pyrimethamine and sulfadoxine against *P.falciparum*. Critical in the development of this system were the concentrations of p-aminobenzoic acid (PABA) and folic acid in the medium. In medium containing physiological concentrations of folic acid and no PABA, synergy between pyrimethamine and sulfadoxine (fractional inhibitory concentration 0.20) was demonstrated for pyrimethamine-sensitive and resistant strains of *P.falciparum*. Radioisotope uptake studies showed that both pyrimethamine and sulfadoxine were active when tested in medium without PABA and without folic acid, but activity was antagonized in the presence of folic acid in concentrations 100-fold greater than physiological. It is possible that folic acid antagonizes the activity of both pyrimethamine and sulfadoxine by metabolism to p-aminobenzoyl glutamate (PABG).

(x) *Test conditions on* in vitro *activity of dihydrofolate reductase inhibitors (DHFRI).* Because of the mode of action of DHFRI, the test medium composition and the time of incubation during *in vitro* testing would be expected to affect the concentration of the drug required to produce a certain degree of inhibition of growth. Comparing normal RPMI 1640 medium and one containing no PABA and physiological amounts of folic acid and either 24 or 48 hours incubation in the presence of the drug has shown that test sensitivity is increased using the modified medium and the longer incubation period. This increase in acitivity was found to be greater with cycloguanil and an experimental pyrimethamine analogue M&B 35769 than with pyrimethamine.

III. *Schistosomiasis*

These studies were conducted in conjunction with the Japanese team on "Communicable Diseases Research and Control Project" (CDRCP).

(i) *Circumoval precipitation in* Schistosoma haematobium *infection* *S.haematobium* eggs were recovered in urine from school children in Kwale District and on direct examination, they showed a pattern similar to that observed in a circumoval precipitin (COP) test. Pepsin treatment of eggs removed the observed precipitates. However, trypsin treatment had no effect. The treated eggs were incubated with urine supernatants and similar precipitates were observed. Use of the fluorescent antibody test revealed the presence of IgG and IgM in the precipitates. IgG, IgM, IgA and C_3 were also identified on examination of urine by immunodiffusion. These observations suggest the participation of the above components in precipitate formation. It is therefore important to treat *S.haematobium* eggs with pepsin prior to a COP test.

(ii) *Incidence of antibody to circulating anodic antigen in* Schistosoma japonicum *and* S.mansoni. A comparative study of the incidence of free antibodies to circulating anodic antigen (CAA) in *S.japonicum* and *S.mansoni* infection was done using counter immunoelectrophoresis. In *S.japonicum* infection, antibodies to CAA were found in 20 out of 66 *dd* mice and 2 out of 23 Balb/C mice tested. A significant but inverse relationship was observed between the incidence of anti-CAA and worm burdens: antibody-positive mice had a significantly smaller number of males and females, compared to the antibody negative mice. There was a high incidence of anti-CAA in *dd* mice without female worms. Results suggest that the difference in the incidence of anti-CAA in serum of infected mice by the two species of schistosomes could be due to CAA concentration in circulation, and could also relate to the severity of infection.

IV. *Cardiovascular Diseases*

These studies were conducted in collaboration with St. Mary's Hospital London and financed by the Wellcome Trust.

(i) *Blood pressure survey of a rural Kamba population.* This population showed a significant rise in blood pressure with advancing age. Consequently the area was unsuitable as a based for intended migration study.

(ii) *Relationship between sport and 24-hour urine sample in a rural Luo community.* This study will be extended since correlations have been found between blood pressures and spot urinary Na^+/K^+ ratio and K^+/Cl ratio in the study population.

(iii) *Blood pressure and possible correlates in urban and rural Luo.* The rural and urban Luo population showed significantly different patterns, when blood pressure is plotted against age. The rural group satisfies the criteria of low blood pressure population whereas the urban Luo showed westernized patterns of blood pressure.

(iv) *Cross-sectional study of blood pressure in rural Luo.* This study included 2,338 subjects aged 17-45, who were studied in an effort to amass a rural pool of potential migrants. Despite using only casual urine samples, blood pressures correlated positively with urinary Na^+/K^+ ratio and negatively with K^+/Cl ratios. Other correlations of years of education and types of occupation were found.

(v) *Comparison of renin and B-blocker levels in 12 black and 12 white healthy volunteers.* This study was designed to try to explain the apparent difference in efficacy of beta-blockers in treating black and white hypertensives. Data analysis is being done.

(vi) *Pilot study on effect of sweating on urinary electrolyte excretion in a rural Luo community.* Sweating appeared to make no difference to total sodium excretion in this small study. The same study is being repeated with more people, using a higher sodium diet.

(vii) *Acute effect of nifedipine-vs-placebo on blood pressure of African hypertensives.* Nifedipine produced a significant fall

in blood pressure with only a slight reflex tachycardia and only a slight rise in plasma renin.

(viii) *T-lymphocyte subsets in idiopathic dilated (congestive) cardiomyopathy.* Compared to controls, the percentage of helper T-lymphocytes was significantly higher in patients with idiopathic dilated cardiomyopathy (IDC). The helper/suppressor T cell ratio was generally higher than the normal range. The results suggest a temporary immune defect in patients with IDC, perhaps due to defective function of a subset of suppressor cells which allows an excessive immune reaction to occur following a viral myocarditis.

V. *Other Area/Clinical Disorders*

(i) *Immunoregulatory factors in Kenya patients with carcinoma of the cervix.* Patients studied revealed a relationship between lymphocyte response to mitogen (phytohaemagglutinin, PHA) and response to radiotherapy. Low and suboptimal responders were identified. Immunosuppression was also identified as a characteristic feature, and the degree of this unresponsiveness may relate to the response to therapy and prognosis of the disease.

(ii) *Cytochrome oxidase activity in variously modulated macrophages.* Cytochrome oxidase activity in mouse peritoneal macrophages activated using *Listeria monocytogenes* was found to be similar to resident macrophages. However, the enzyme activity in Na caseinate-elicited macrophages was found to be twice as much.

NEW AND ON-GOING RESEARCH PROJECTS

I. *Leishmaniasis*

(i) *Comparison of four-dosage regimens of sodium stibogluconate (Pentostam(R)) treatment of visceral leishmaniasis.* A collaborative study of patients at CRC and five district or provincial hospitals has been organized by CRC to compare Pentostam(R) at 10 mg Sb/kg/d × 30d, 20 mg Sb/kg/ × 30d and 15 mg Sb/kg twice daily for 15 or 30 days, in an attempt to reduce the relapse rate. Four hundred patients will be studied, beginning in January 1983.

(ii) *Treatment of relapsed visceral leishmaniasis.* Ten relapsed patients have been treated with twice the usual daily dose of Pentostam(R) (20 mg Sb3Kg/d) for twice the usual duration (60 days). The secondary relapse rate (20%) was half that reported previously. More patients must be studied before conclusions can be drawn about the efficacy of this treatment.

(iii) *Treatment of visceral leishmaniasis unresponsive to conventional dose of Pentostam(R).* Twelve patients have been treated. Therapies which proved useful include higher doses of Pentostam(R) (up to 20 mg Sb/kg every 8 hr = 60 mg Sb/kg/d), pentamidine isethionate (4-5 mg/kg 2-3 times/week for 4-6 months), and a combination of allopurinol (20 mg/kg/d) with one of these drugs.

(iv) *Hyperamylasaemia during pentamidine treatment of visceral leishmaniasis.* Because of the previous occurrence of abdominal pain, occasional diabetes, and (in one instance) pancreatitis during pentamidine treatment, serum amylase was retrospectively measured in seven pentamidine-treated patients. Three of these had progressive hyperamylasemia during and shortly after treatment. A prospective study is planned to evaluate serum amylase and amylase/creatinine clearance ratios before and during treatment with Pentostam(R) and pentamidine.

(v) *Electron miscroscopy of amastigotes in splenic aspirates.* The ultrastructure of *L.donovani* in human spleens was found to be similar to that described in laboratory animals. During treatment with Pentostam(R), there was a general disruption of cellular integrity, but with preservation of a normal appearing kinetoplast. This differs from previous descriptions of changes during pentamidine treatment of cutaneous leishmaniasis.

(vi) L.donovani *parasitemia in visceral leishmaniasis.* Parasites have been found in blood films from seven of nine patients and in cultures of leukocyte-rich plasma from four of the nine.

(vii) *Pharmacokinetic studies in visceral leishmaniasis.* Blood has been collected from 40 patients during Pentostam(R) treatment, but Sb concentrations have not been measured because the required atomic absorption spectrophotometer accessory has not yet been delivered. A high pressure liquid chromatography (HPLC) method for measuring allopurinol and some of its metabolites has been developed and should be useful in a planned evaluation of allopurinol riboside treatment. The HPLC may also be useful for evaluating pentamidine pharmacokinetics.

(viii) *T lymphocyte subpopulations in visceral leishmaniasis.* In untreated patients, there was an increase in peripheral blood suppressor/cytotoxic T cells and a decrease in helper/inducer T cells. Serial evaluations after treatment show a gradual return towards normal over one year.

(ix) *A mouse model for Kenyan visceral leishmaniasis.* Several strains of mice have been evaluated for their ability to become infected with *Leishmania* isolated from Kenyan patients with visceral leishmaniasis. So far, the Balb/C strain is most susceptible.

(x) *A primate model for visceral leishmaniasis.* Vervet monkeys, Sykes monkeys, baboons and bush babies were incubated with a Kenyan strain of *L.donovani*. Bush babies appear to be resistant to infection. The other three species have had positive cultures from spleen or liver aspirates for 2-4 months, associated with a transient anaemia and leukopenia. The self-limited infection may be analogous to the situation in many humans. Because of their convenient size and availability, the vervets appear to be a suitable model for evaluating immune responses during self-limited infection. Follow-up studies are being done in order to delineate possible mechanisms of observed phenomena.

(xi) *Taxonomy of Kenyan species of* Leishmania. A cellulose acetate method of enzyme electrophoresis has been implemented which readily distinguishes between *L.major* and *L.adleri*. Kenyan isolates have been sent to collaborators in Cambridge and Washington, DC, for DNA characterization, to collaborators in London and Israel for additional isoenzyme and serological characterization, and to collaborators in Boston, USA, to develop species-specific monoclonal antibodies.

(xii) In vitro *drug resistance by intra-macrophage leishmania.* Workers in CRC are establishing methods for growing *Leishmania* in mouse peritoneal macrophages and human peripheral blood monocytes/macrophages in order to evaluate the *in vitro* activity of antileishmanial drugs against Kenyan isolates of *Leishmania*. Isolates have also been sent to collaborators in Beckenham, UK, and Washington, DC, for studies using similar methods.

II. *Malaria*

(i) *The Saradidi community-based malaria control project.* The objectives of this project are to organize the community at a village level to deliver presumptive therapy for malaria to individuals requesting it and (selective) chemoprophylaxis to pregnant women and then to measure the impact of the project on mortality and morbidity rates. With further assistance from the SWG-FIELDMAL, presumptive treatment and chemoprophylaxis (to pregnant women) began 1982 in Area A (16,000 persons), presumptive treatment alone in Area B (12,000 persons), and a census done in Area C (control, with 12,000 persons), two 6-month updates for births, deaths, migration, abortions, stillbirths and new households were done in Areas A and B, studies of response of *P.falciparum* to chloroquine were done in May, and malaria surveys were completed (February, May, October). Weekly evaluation of serum antibody and chloroquine levels from pregnant women infected with malaria were begun. In addition, birth weights, of newborns together with enumeration of school absenteeism in pupils were done.

(ii) *Socio-economic research.* Studies on utilization, knowledge, attitudes and practices of the community were under way. Surveys of knowledge about malaria and use of antimalarials, recognized symptoms of diseases and records of community processes are continuing.

(iii) *Drug response studies in Saradidi.* In 1981, 41 *P.falciparum* infections were sensitive *in vivo* to chloroquine base 25 mg/kg or 10 mg/kg. Of the 41 isolates, 17 were sensitive to chloroquine in the Riekmann macro *in vitro* test. In 1982, 20 infections were sensitive *in vivo* to 10 mg/kg. However, 2 of 14 isolates in the Rieckmann were resitant to chloroquine. The data are beginning to sugest a changing response pattern to chloroquine.

(iv) *Pryimethamine/sulfadoxine studies in Kisumu.* Forty-eight children infected with *P.falciparum* were treated with pyrimethamine/sulfadoxine, 47 infections were sensitive *in vivo*. In one infection, parasitemia cleared on day 3 then one parasite was seen on day 7. However, urine samples

revealed very low drug levels.

(v) In vitro *test for pyrimethamine/sulfadoxine.* This test is being evaluated in Malindi. So far, parasitemia has developed in 5 out of 35 patients during a 35-day follow-up period. Four of 5 had pyrimethamine/sulfadoxine inhibitory concentration of 0.1 nmol pyrimethamine + 1 ng/ml sulfadoxine compared with 4 out of 30 who did have recurrent parasitemia ($p = 0.006$ Fisher's exact test).

(vi) *Synergy in the cycloguanil/sulfadoxine system in* P.falciparum. Previous *in vitro* studies have shown that cycloguanil frequently exhibits comparatively high activity against pyrimethamine-resistant parasites when tested in medium containing minimal quantities of PABA and folic acids. The object of this study is to determine whether synergy in the cycloguanil/sulfadoxine system is comparable to that in the pyrimethamine/sulfadoxine system, with a view to the possible utilization of the former combination, if clearly advantageous, in the malarial prophylaxis and/or treatment.

(vii) *Gene 'mapping' of* P.falciparum. One of the problems of field work in relation to the *in vivo* testing of drug activity is the exclusion of reinfection during the 35-day follow-up. This study attempts to determine whether the parasite genotype can be adequately mapped using 96-well pre-dosed microtitre plates, utilizing 8 concentrations of each of 12 antimalarial compounds, and whether statistically valid discrimination between strains is practicable.

(viii) *Development of an* in vitro *test for determining the sensitivity of* P.falciparum *to pyrimethamine/sulfadoxine (Fansidar(R)).* Previous work on the synergistic action of this combination has led to an *in vitro* design which has been tested successfully in the field. The initial test design together with a modified design are presently being compared in the laboratory using *in vivo* Fansidar(R)-sensitive and -resistant strains.

(ix) In vivo *and* in vitro *comparison of chloroquine and amodiaquine.* In view of the impending decline of chloroquine usefulness in East Africa, this study will help clarify the present status of amodiaquine as an alternative drug. The study will be complementary to a previous comparison in Kisumu but will supply data from Malindi, a coastal location where the indications are that chloroquine resistance is more widespread.

(x) *Inducement of concomitant resistance to several antimalarials in* Plasmodium falciparum in vitro *(new project).* This study will involve cloning of *P. falciparum* isolates, inducement of resistance to several antimalariais and the testing for concomitant resistance to other antimalarials. This will be followed by investigations into the mechanism of cross resistance.

III. *Schistosomiasis*

(i) *Immunity to human* Schistosomiasis mansoni. An area in Machakos District with a high level of *S.mansoni* infection has been identified (Iietune area). The children attending Iietune Primary School were examined on three separate occasions by the Kato technique, and extensive observations were made of the patterns of water contact of both these children and other members of the community. Additional data were collected on snail numbers and infection rates at the water contact sites and on climatic factors. So far, it has been possible to establish a detailed picture of transmission in the area. A group of 129 children was arbitrarily chosen to show a scatter between low water contact but high egg output (predicted to be immune) and high water contact but low egg (predicted to be non-immune). Sixteen children showed high levels of reinfection, in spite of high levels both of total water contact and of contact with sites containing infected snails. This is the first clear evidence of a difference in susceptibility to *S.mansoni* infection that is not attributable to water contact habits.

(ii) *Eosinophil function.* A series of patients has been studied for changes in eosinophil-killing activity during the period of eosinophilia that follows treatment of schistosomiasis. Eosinophils isolated from 11 patients 2 to 5 weeks after treatment were more effective in killing schistosomiasis than eosinophils collected before treatment or 8 to 9 weeks after treatment. The change in eosinophil-killing activity showed some relationship with the change in eosinophil counts, with the peak of eosinophilia preceding the peak of killing activity in some individuals. *In vitro* lymphocyte response to mitogen concanavalin A) was also investigated at the same time, and a new assay to investigate the capacity of patients' mononuclear cells to enhance eosinophil killing is being started. Other studies are being done by CRC collaborators in Cambridge and London.

(iii) *Molluscan competitors of human schistosome intermediate hosts in Kenya (new project).* Studies are being planned to map the distribution of potential molluscan control agents of schistosomiasis and to find out whether potential control agents have any regulatory effects on populations of schistosome intermediate hosts.

IV. *Cardiovascular diseases*

(i) *The effect of migration to Nairobi on blood pressure of members of a rural Luo community.* This is a study involving an 18-month follow-up period at 0, 3, 6, 12, and 18 months for each individual. So far, 213 individuals have been studied at 0 month, 145 at 3 months, 93 at 6 months, 37 at 12 months and 9 at 18 months. The study is expected to be completed in August 1985.

(ii) *Double-blind cross-over trial of atenolol and chlorthaidone in the treatment of mild to moderate hypertension in African patients.* Nineteen subjects have been studied so far and the study is expected to be completed by the end of 1983.

(iii) *Comparison of a beta-blocker/diuretic combination (Tenoretic) and a reserpine/diuretic combination (Hydromox(R)) in the treatment of mild to moderate hypertension in African patients.* Fifteen subjects have been studied so far.

(iv) *Comparison of the plasma renin levels of 100 African hypertensives with those of age- and sex-matched controls.* One hundred patients plus 40 controls have been studied.

(v) *Double-blind randomized cross-over controlled trial of propranolol/diuretic and nifedipine/diuretic in moderately severe hypertensives in Kenya (new project).* Expected date of completion is December 1983.

(vi) *Suppressor cell function and T-lymphocyte subsets in patients with idiopathic dilated cardiomyopathy.* This study is a follow-up of a previous one and is aimed at studying functional aspects of T cells. So far, 21 patients have been studied.

(vii) *Endomyocardial biopsy findings (by light and electron microscopy) in African dilated cardiomyopathy patients and its relation to prognosis.* So far, 29 patients have been studied and preliminary data are being processed.

(viii) *Physiological findings in the endomyocardial biopsies in postpartum cardiomyopathies (new project).* Ten patients studied so far.

(ix) *Double-blind trial of nifedipine and placebo in addition to standard treatment of chronic congestive heart failure due to dilated cardiomyopathy.* Twenty patients have been studied so far.

(x) *Viral studies in idiopathic dilated cardiomyopathy in Nairobi serology and coxsackie DNA in biopsy specimens.* In this study, 34 serological studies and 28 biopsy specimens have been done.

V. *Other Areas/Clinical Disorders*

(i) *Evaluation of the significance of a genetically determined metabolic factor in the aetiology of primary liver tumour amongst Kenyans.* Forty-seven patients have been studied so far.

(ii) *Aetiology of azoospermia.* Patients studied so far demonstrate a good relationship between reduced testicular volume and evaluated FSH levels. About 18% of the patients had features of first-degree testicular failure. However, the majority of azoospermic patients were normo-gonadotropic, hence further studies are being done in order to determine the cause of azoospermia in this group. This study is principally based in the Department of Obstetrics and Gynaecology, NCRR, Medical School.

(iii) *Effects of fixed combined dose and the triphasic oral contraceptives (new project).* Individuals will be recruited from the Family Planning Clinic. Inclusion and exclusion criteria for the study have been explicitly laid down. This study is also an NCRR activity.

Support for the Centre

Support for CRC's activities comes from a variety of sources, both local and overseas. The main sources of support are the Walter Reed Army Institute of Research, UNDP/World Bank/WHO-TDR, Centres for Diseases Control, Wellcome Trust/St. Mary's Hospital, National Council for Science and Technology, KEMRI, Ministry of Health, Edna McConnel Clark Foundation, and the University of Nairobi. In the 1981/82 financial year, total funding for CRC from these sources amounted to approximately US$974,400 covering personnel emoluments and allowances together with equipment and supplies.

Collaboration and Collaborating Institutions

There is an awareness of the need to continue collaborating with other institutions and organizations in order to maintain research and training capability and productivity expected of a centre of excellence in clinical research. CRC has received a lot of support, through formal collaboration, from the following institutions and organizations.

(a) *UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases*

Institutional strengthening grants have been received for the past three years. These have been used for the purchase of various pieces of laboratory equipment and supplies together with the purchase of vehicles. A consultant has also been paid from this grant. Grants have also been received from the Scientific Working Groups on Malaria, Leishmaniasis and Schistomiasis.

(b) *US Army Medical Research Unit, Walter Reed Institute of Research, Washington, DC, USA*

Besides the provision of considerable amounts of laboratory equipment and supplies, the Walter Reed Project has provided a physician, a parasitologist, an entomologist, a clinical laboratory officer, a technologist, and a laboratory attendant. The main involvement has centred itself on leishmaniasis and to a small extent on malaria.

(c) *Centres for Diseases Control, Atlanta, GA/USA*

A physician/medical epidemiologist has been on secondment to CRC since 1979 and has been involved largely in malaria investigations. In addition, some laboratory equipment and supplies have been provided together with transport facilities.

(d) *Division of Vector-Borne Disease (DVBD), Ministry of Health, Kenya*

The Ministry of Health has contributed to CRC mainly through the provision of laboratory facilities in both Nairobi and outside stations. In addition CRC has made full use of a senior scientist, five technologists in Nairobi and several others in field stations, all from DVBD. DVBD has also provided basic epidemiological data.

(e) *Wellcome Trust and St. Mary's Hospital, London*

Collaborative work has been done on cardiovascular diseases (hypertension* and dilated cardionmyopathies). Collaborating staff have included phycisians, two scientists, two technologists, two technicians and other support staff.

(f) *Communicable Diseases Research and Control Project, Japan International Co-operation Agency (JICA)*

Collaboration has involved *S.haematobium* infection studies along the coastal belt of Kenya. JICA has provided two parasitologist.

(g) *Other Centres of KEMRI*

Non-institutionalized (informal) collaborative work with CRC exists at departmental or individual level. This includes:

(a) *International Centre for Insect Physiology and Ecology (ICIPE)*
Vector biology and epidemiology of leishmaniasis.

(b) *Harvard University Medical School, Boston, MA*
Use of monoclonal antibodies in the identification of *Leishmania* isolates.

(c) *University of Cambridge, England*
Immunological aspects of schistosomiasis.

(d) *University of Nairobi (Department of Obstetrics and Gynaecology, Biochemistry, Human Pathology, Medicine and Zoology)*
Collaboration is centred on a variety of areas such as in leishmaniasis, human reproduction, and neoplasia.

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MEDICAL RESEARCH CENTRE

Introduction

The Medical Research Centre (MRC) is situated within the premises of Kenyatta National Hospital, Nairobi. Just after independence in 1963, the Kenya Government granted a request by the Dutch Government through the Royal Tropical Institute to establish a Medical Research Centre in Kenya. The agreement was signed in May 1964 and later enacted in the Kenya Parliament. The Centre was built in 1965 and was opened by the late President Jomo Kenyatta in March 1966.

Official discussions between the two governments for the integration of MRC into a local organization started in the late 1970s following the break-up of the East African Community in 1977, the establishment of the National Council of Science and Technology, and the formation of KEMRI in 1979. Following an MRC evaluation mission comprising representatives of the Kenya and Dutch governments, a plan of operations (Planops) was developed and accepted. MRC was taken over by the Kenya authorities as of 1 July 1982 as a department of KEMRI, but the major part of its financial assistance continues to come from the Netherlands. The period of this report covers the beginning of a noteworthy watershed in both the organization and the administration of MRC. Several factors account for this phenomenon:

(i) It marks the first half year during which MRC operated after ceasing to be a department of the Royal Tropical Institute of Amsterdam (RTI);

(ii) It also marks the first half year of operation of the joint project between RTI and KEMRI, in which MRC is to continue being absorbed into KEMRI so as to be fully integrated by 1987;

(iii) It is during this period that the first Kenyan Director and Head of Administrative Affairs were appointed;

(iv) This period saw the need for revitalizing research activity and other operations after most programmes had been finalized by the outgoing Dutch scientists;

(v) This period also saw the transition during which KEMRI was transferred from the Ministry of Health to the Ministry of Regional Development Science and Technology with direct consequences regarding the integration of MRC into KEMRI. Co-operation and understanding between these ministries, the Treasury and the Royal Netherlands Embassy has helped smooth the transition.

Organization of the Centre

As a department of KEMRI, and as defined by the Planops, MRC has four divisions: Nutrition, Epidemiology and Community Health, Parasitology, and Biostatistics. Technical Services forms the fifth division that will in future serve not only MRC but the whole of KEMRI. There are also plans to start a dental health research unit at the Centre in the near future. The research priority proposals for Kenya and the planned restructuring of research mandates for the Centres may alter the divisions in future.

Personnel

When the Medical Research Centre was functionally transferred to the Kenya Medical Research Institute on 1 July 1982, all staff of MRC were automatically transferred to the employment of KEMRI without termination of services.

They were provisionally offered temporary appointements by KEMRI with effect from the date pending their grading, with the offer of more specific terms of appointments soon after.

By the end of 1982, the MRC establishment consisted of 54 local and 9 expatriate staff.

Director	Dr. S.N. Kinoti	Designate
	Dr. Theo Hanegraaf	Outgoing
Administrator	D.M. Mathenge	Designate
	Theo Kubbinga	Outgoing
Research Scientists	Dr. P.R. Kenya	
	Dr. L.N. Mutanda	
	Mrs. B. Theuri	
	Mrs. A. Pertet	
	Mrs. M. Katsivo	
	Dr. A.B.N. Maggwa	
	Dr. J. Leeuwenburg	
	Dr. P. Kok	
	Mr. W. Gemert	
	Mr. W.'t Mannetje	
	Dr. B. Johnson	

Consultant Engineer	Mr. G. Hillenaar
Laboratory Technologists	Mr. John Kyobe
	Miss Ensering
Laboratory Technicians	Mr. M.T. Nthiwa
	Mr. G. Kiilu
	Mr. W. Wamwea
	Mr. T.S. Wandiba
	Mr. P.O. Oboyo
	Mr. N.W. Mutiso
	Mr. N. Kaleli
	Mr. A. Makau
Data Machine Operator	Mr. S. Gesora

During 1982, MRC continued giving assistance to the Virus Research Centre by paying for training and salary expenses for two laboratory technologists, two laboratory/technicians and six auxiliary staff.

Training

MRC encourages staff to make use of any relevant training opportunities available in order to improve their careers. A number of officers have therefore been sponsored for various courses, mainly at the Kenya Polytechnic. Those who chose correspondence courses had fees paid for and in some cases were also assisted with the purchase of recommended books.

The following staff were sponsored and participated in courses at the Kenya Polytechnic:

L.G. Gitau	*Higher Diploma in Med. Laboratory Technology*
E. Mukhaye	*Junior Laboratory Technician Course*
N. Kyangu	*Junior Laboratory Technician Course*
E. Otieno	*Junior Laboratory Technician Course*
Stephen Gesora	*Institute of Statisticians Examination Stage I*
Michael Nthiwa	*Higher Diploma in Medical Laboratory Technology*
Paul Mutiso	*Correspondence Course in CPA Part I*

The training of scientists for higher degrees and/or to acquire special skills is planned for in the plan of operations document.

Past Activities

The Royal Tropical Institute in Amsterdam, an association with corporate status, is primarily concerned with the accumulation of scientific knowledge on tropical and subtropical countries and its dissemination, mostly within the framework of development co-operation in this field. The institute contributes to the efforts of the Netherlands Government and of relevant organizations and institutes both in the Netherlands and abroad. The four major fields of activity of the institute are:

(a) Research carried out on specific agricultural, social and health problems of the developing world;

(b) Education and training for all those who are assigned to work in developing countries including general briefing sessions, specialized courses and language courses;

(c) Consulting services and development projects including feasibility and evaluation studies, management of projects, execution of projects initiated and sponsored by the institute, and backstopping services;

(d) Information and publicity. Besides transfer of knowledge through participation in projects and training, many contributions are made through technical information services, symposia, educational programmes, and cultural manifestations.

Since its establishment, the Medical Research Centre has carried out a number of joint projects with the Royal Tropical Institute, especially with regard to projects in the well-known "Joint Project Machakos" (JPM). A major achievement of the studies in the JPM area is the monograph that is in the final stages of preparation. This monograph will put together results and recommendations relating to maternal and infant health based on the work done in the JPM area.

A summary of some of the past projects in the JPM area is given as follows:

JOINT PROJECT MACHAKOS

Project	Ecological studies
Staff	W. Gemert, T. Schulpen, R. Slooff
Publications	Short-term changes and stable "components" in the household environment, by R. Slooff (Internal Report, Amsterdam, KIT, December 1981)
Project	Perinatal mortality
Staff	A.M. Voorhoeve, H.J. Nordbeck, R. Slooff
Duration	1974-1981
Project	Schistosomiasis transmission in relation to some socio-economic and other environmental factors
Staff	H.J. Nordbeck, R. Slooff
Duration	1980-1981
Progress	The analysis has been finalized. A paper submitted to TGM will be published in June 1982
Project	Perinatal mortality in Machakos area, Kenya
Staff	H.J Nordbeck, R. Slooff, A.M. Voorhoeve
Duration	1981-1982
Progress	The analysis is finalized. A draft paper "Perinatal mortality in a rural area in Kenya—a multi-variate approach" was written.

HEALTH CARE

Project	Patient satisfaction study/cum utilization of modern and traditional medicine by the Kamba of Machakos District, Kenya
Staff	J.N. van Luyk, J.D. Speckmann
Duration	1978-1983
Progress	1. Proposal for the analysis of the utilization of health services survey was completed. Data of the 10-week survey of the sample of 110 household (950 persons) were coded and punched. 2. Data on Kamba traditional medicine were partly reported. 3. Further study will be made of the literature on Kamba culture and society and the introduction of medicine in Kenya.
Publications	Proposal analyes general utilization study by J.N. van Luyk' (Amsterdam, KIT, March 1981). Traditional medicine among the Kamba of Machakos, District, part I (Amsterdam, KIT, September 1981).
Project	A longitudinal, observational study of maternal nutrition in relation to outcome of pregnancy
Staff	J.A. Kusin, W.M. van Stenbergen, U.H. Renqvist, B. Brabin, F. Shamier, A.A.J. Jansen and S. Lakhani
Duration	1978-1981
In co-operation with	Medical Research Centre, Nairobi, University of Nijmegen
Progress	The project was terminated in December 1980. The longitudinal data of food consumption of pregnant women are being analysed.
Publications	Food consumption of pregnant and lactating women in Machakos, Kenya, by J.A. Kusin, W.M. van Steenbergen, S. Lakhani, A.A.J. Jansen, U.H. Renqvist and J.W.H. Elvers. *Tropenmed. Parasitol.* 32: 202, 1981.
Project	A study on lactation performance of Akamba mothers
Staff	W.H. van Steenbergen, J.A. Kusin, C. de With, F. Shamier
Duration	1979-1982
In co-operation with	Medical Research Centre, Nairobi
Progress	Data of the 1979 study are being analysed. The results of the cross-sectional part will be presented in the workshop, Nutrition and the Development of the Child, Baroda, India, 8-15 January 1982.
Publications	Lactation performance of Akamba mothers, Kenya. Breastfeeding behaviour, breastmilk yield and composition, by W.M. van Steenbergen, J.A. Kusin, M.M. van Rens. *J. Trop. Pediatr.* 27: 155; 1981.
Project	Food intake and growth of pre-school Akamba children
Staff	U.H. Renqvist, W.M. van Steenbergen, J.A. Kusin, H.J. Nordbeck, A.A.J. Jansen, S. Lakhani, W. 't Mannetje, J.W.H. Elvers
Duration	1979-1982
In co-operation with	University of Nijmegen and Medical Research Centre, Nairobi
Progress	Food consumption data of low birth weight and normal birth weight infants and their mothers are being analysed.

Current Research Programmes

1. JOINT PROJECT MACHAKOS

Although the disease surveillance studies have been concluded,

work in areas related to the Kenya Expanded Programme on Immunization (KEPI) has continued.

(a) The results of the pertussis 2 versus 3 doses DPT vaccination study which have shown similar efficacy will be published in the Bulletin of the World Health Organization.

(b) A comparative study on intestinal immunity after either oral or injectable polio vaccine has started and is going on now in northern Machakos. This is to be finalized later in 1983.

(c) The final manuscript on measles immunization studies in JPM area has been prepared under the title of "Measles immunization with further attenuated heat-stable measles vaccine using five different methods of administration" (Kok, Kenya and Ensering). Results suggest that exposure of vaccine before use and after reconstitution led to fast deterioration and reduced seroconversion.

(d) The results of a study, "The delivery of health education to a rural community through primary and secondary school children", has now been presented for a Master of Arts thesis at the University of Nairobi by Mrs. Nyambura Katsivo. Results suggest that school children are an important target for health education to the community.

(e) "Patient satisfaction and utilization of health services in North Machakos" by J. van Luijk was finalized later in 1982. Results have been analysed and presented for a Ph.D. at the University of Leyden, Netherlands.

(f) In collaboration with the Kenya Tuberculosis Investigation Centre of KEMRI, the BCG vaccination study was finalized. Results suggest low conversion rates, related to the vaccine efficacy, technique of administration, and nutrition status of children.

2. SUMMARY OF FIELD WORK ON LEISHMANIASIS IN THE PERKERRA AREAS NEAR MARIGAT, BARINGO DISTRICT

The aim of the study is to investigate in one delineated area, human, entomological and zoological factors relevant in the epidemiology of leishmaniasis. For this purpose the Perkerra Area was considered suitable, because in 1981 two kala-azar cases were identified there (by population screening using splenic aspiration in persons with enlarged spleens), living at a distance of only 500 m from each other.

There is regular determination of Elisa antibody titres in the human population (+1.000 persons) and examination for splenomegaly, whilst skin-testing is done at 6-month intervals to determine conversions to positive in individuals and to identify those households where more intensive transmission has occurred. With the use of an accurate map it is possible to look at spatial clustering of serological findings and of transmission levels for a given area. Such areas are then more intensively studied with regards to the sandfly fauna.

(a) The insect vector work since July 1982 is summarized below. Out of just over 6,000 female sandflies, caught during the past 8 months, 27 were found to harbour flagellates. These were inoculated in NNN (later Scheider's) medium or inoculated in hamsters or mice. A major difficulty has been that it has so far not been possible to maintain the isolates in culture. It is very likely that these isolates have been *L.adleri* (a lizard species), *Leptomonas* and *Herpetomonas*, possibly also lizard trypanosomes. No sandfly species thought to be important in the human epidemiology (*P.martini* or *P. duboscqi)* have been found infected with leptomonads. Currently, attempts are made to identify which factors are responsible for the contamination of inoculates. This is done in close collaboration with staff of the Walter Reed Project (Dr. Beach and Dr. Hendricks). No autopsy has been done of laboratory animals in which isolates were inoculated.

The data of the sandfly work have been put in a format which is easy to code and the data of the first half year have been computerized now, according to species, time of collection, place and method of catch. female sandflies have been recorded according to being fed, unfed, parous, nulliparous, half-gravid and gravid. It should be noted that many *P.duboscqi* female sandflies have been caught, after the first report by Beach (in *Trans R Soc Trop Med Hyg* 76: 707-708, 1982) of the occurrence of this potential vector of cutaneous leishmaniasis (*L.major)* in Kenya. No female sandflies of *P.martini* have been caught as yet.

(b) Human epidemiology

Leishmanin skin testing carried out in September 1982 reveals the presence of more pronounced hypersensitivity along dry river beds than in open plains. There is an increase in the proportion of skin-test positive persons by age: low levels of delayed-type hypersensitivity are found at young ages, but from 6 years onwards the proportion of leishmanin positives rises to reach adult levels (about 40% positive) around the age of 16 years.

In September 1982 blood specimens were collected on filter paper for ELISA test. Out of 662 persons there were 25 who had an elevated ELISA titre. A second sample of these 25 persons was collected in December 1982 (serum + capillary blood). There were two persons who then showed an antibody titre in the range as observed in parasitologically confirmed patients treated at the Clinical Research Centre. On revisit, however, neither person had splenomegaly, so a splenic aspirate could not be carried out. They appeared healthy. Further serological follow-up is done. These may be two cases of clinical infection.

Further serology and skin-testing of the entire population are planned.

(c) Animal reservoir work

This work has been carried out by Mr. Githure (CRC) in the same area. He has obtained 17 isolates from various rodents that produced skin lesions in mice. The isolates still have to be typed, but there is a distinct possibility that they are *L.major.*

3. FILARIASIS

Filariasis research at the Kenya Coast continues mainly under the Division of Vector Borne Diseases as MRC's contribution was finalized early 1982. A manuscript on this work is being prepared for publication. Some results suggest low rates of transmission despite stoppage of control measures. Prophylaxis with diethyl carbamazine (DEC) at the community level was also studied.

4. NUTRITION

(a) All nutrition field work was completed by 1 July 1982. However, analysis and preparation for publication have continued, mainly by Dr. A.A.J. Jansen, Mrs. B. Thiuri and Ms. Sheila Lakhani. Several papers relating to mother and child health and nutrition in the JPM area are in print in the East African Medical Journal.

(b) A preliminary survey has been completed on the functional capacity of mild and moderate malnutrition in Embu. This research is in collaboration with the Universities of Nairobi and California. MRC's support is in assessment of food intake and laboratory analysis aspects of the study though Dr. S. Kinoti and Mrs. Anne Pertet.

(c) Five reports have been completed by Sheila Lakhani on the nutritional status of pregnant women in urban groups in relation to the outcome of their pregnancies and the growth of the infants.

(d) A study on breast-feeding patterns and the nutritional state of children in Kilifi District has been completed. Analysis has started. A general morbidity study was carried out with the assistance of medical students. Results will be published in the near future.

(e) Data collection on the clinical epidemiology study on acute diarrhoeal disease is continuing and will be finalized in 1983, when the community-based study will commence. The proposal is ready, the study site selected, and the baseline demographic work being initiated.

(f) Because of the death of Mr. E. Lacko in October 1982, studies on vitamin E/sickle cell disease and vitamin A were interrupted but will be initiated as soon as a biochemist is recruited.

(g) A study on the growth and development of malnourished, low birth weight and normal control infants through pre-adolescent and adolescent stages of growth in the JPM project is in preparation. This study, when started (May 1983), will provide very interesting data relating to the development of these categories of children.

New Projects

(a) Under the Division of Epidemiology and Community Health, a study on the role of primary health care in control of *Schistosoma mansoni* infection in the Mwea Rice Irrigation Scheme has been developed and approved and is being funded by IDRC of Canada. Field work is due to begin early 1983.

(b) In the Division of Nutrition, a community-based longitudinal study on acute childhood diarrhoeal disease has been developed and approved. Field work starts early 1983, in Kiambu District, Nderu and Lusigetti locations, to go on for 5 years.

Statistical Backup

The Division of Biostatistics has continued to provide backup in design and development of protocols. During 1982 a new computer was installed. Arrangements to store JPM data and new programmes for data analysis are being made.

Support Services

1. The Medical Illustration Services unit provides materials and support for publication and conference papers.
2. The Technical Services unit maintains equipment and buildings mainly for MRC but it does assist the Kenyatta National Hospital and other KEMRI Centres.

Finance

The Planops governing the integration of MRC and KEMRI started functioning on 1 July 1982. During the 1982/83 financial year, the Netherlands contribution through the Royal Tropical Institute (RTI) was 75% of total expenditure operational costs and local staff costs, while that of the Kenya Government through KEMRI was 25% in additional to providing local management costs. During 1982 both parties honoured their contributions admirably. The funding was done on a quarterly basis after the financial report for each previous quarter and the funds request for the following quarter had been submitted to the executive authorities. The total contributions over this period were KShs. 1,776,922 and KShs. 678,845 from RTI and KEMRI respectively. Quarterly financial reports were submitted to both executive authorities.

In addition to these sources of funds, some other projects will be sponsored by WHO and IDRC. Within KEMRI, therefore, MRC will continue to solicit funds from willing donors for specific research projects and for institutional strengthening.

Collaboration in Research with Other Institutions

1. MRC has three projects going on in collaboration with the Department of Obstetrics and Gynaecology of the University of Nairobi:
   (a) The relationship of Depo-Provera and neoplasia
   Neoplasia and steroid contraceptives
   (c) Cardiovascular disease morbidity and normal contraception.
   Results of these will be available in the near future.
2. Nutrition and *Schistosoma haematobium* study, MRC/Cornell University, will be finalized early 1983. *S.haematobium* infection affects the growth and haemaglobin status of school children.
3. Further collaboration with the Royal Tropical Institute of Amsterdam in research is under discussion.
4. The Ministry of Health collaborates in most research activities.

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VIRUS RESEARCH CENTRE

Introduction

The main activities of the Virus Research Centre are undertaken in the Medical Research Centre's building. The Department of Microbiology of the Medical School has kindly accommodated the Acute Respiratory Disease (ARD) Project. The single room housing the project is now very overcrowded with equipment as well as workers. When all the sterilizers, autoclaves, driers, fridges, freezers, incubators, centrifuges, etc., are working the room becomes uncomfortably hot.

The lay administrative staff of the Centre are accommodated in a wooden annex at the back of the National Public Health Laboratory Services. By the end of the year the Japanese-built laboratory annex was brought into full use. It accommodates the Japanese team of bacteriologists and virologists. It will also accommodate the electron microscope which is on its way from Japan.

Accommodation for a biohazard laboratory has now been identified at the Medical Research Centre building. This has been achieved by relocating the parasitology department of the Medical Research Centre on the ground floor. Equipment worth more than US$200,000 is being granted to the Virus Research Centre by USAID through the Walter Reed Institute.

Lack of a security-tight insectary is affecting projected plans to run virus transmission experiments using mosquitoes.

Staff List

SCIENTIFIC STAFF

Director	Dr. P.M. Tukei[1]
Chief Arbo-virologist	Dr. B.K. Johnson[2]
Epidemiologist	Dr. P.R. Kenya
Entomologist	Miss R.M. Kirui
Microbiologists	Miss E.M. Muniu
	Mr. G. Nakitare[3]
	Mr. J. Magana[3]
Virologists	Dr. L.N. Mutanda[4]
	Dr. Y. Makino[5]
	Dr. Matsumoto[5]
	Dr. W. Ochieng
	Dr. D. Hazlett[6]

TECHNICAL STAFF

Senior Technologists	Mr. J. Muli[3]
	Miss H. Ensering[2]
Technologists	Mr. G. Ademba[3]
	Mr. D. Kaptich[3]
	Mr. P. Ogaja[3]
	Miss S. Oogo[3]
	Miss G. Mutura[3]
	Miss G. Wangui[5]
	Mr. P. Kinyanjui[3]
	Mr. G. Gitau[7]
	Mr. D. Ochieng
	Mr. O. Lichenga
Technicians	Mr. A. Gichogo[7]
	Mr. G. Kamau[7]

Training

As in previous years the senior scientific and technical staff were involved in giving lectures and demonstrations to several groups of trainees including:

(i) Undergraduate students in medicine, dentistry and pharmacy
(ii) Postgraduates in surgery and paediatrics
(iii) Advanced diploma in nursing
(iv) Trainees at the Kenya Polytechnic
(v) Trainees at the Medical Training Centre

1. WHO Medical Officer
2. Royal Tropical Institute, Amsterdam
3. National Public Health Laboratory Services, Kenya
4. International Centre for Diarrhoeal Disease Control, Bangladesh
5. Japanese International Co-operation Agency
6. University of Nairobi
7. Medical Research Centre

Dr. Kenya, who was then an epidemiologist at the Centre, participated in the following seminars and workshops:

1. KEPI management training seminar—Kilifi District
2. Preparation of the background paper for a WHO/MOH workshop on the teaching of epidemiology in the African region.

In 1982 there were five technologists undertaking advanced studies for the Diploma in Virology at the Kenya Polytechnic. One other student is undergoing a junior technican's course at the same institution. One biochemist left for Japan to undertake an 18-month study of molecular virology.

Research Programmes

Five major programmes were undertaken in 1982:

1. Arbovirus surveillance
2. Acute respiratory disease
3. Diarrhoeal disease
4. Viral hepatitis
5. Poliomyelitis surveillance and research

Besides the above research programmes, the Centre also provided limited routine diagnostic services, particularly with regards to rubella serology and subacute sclerosing pan encephalitis.

Consultant services were also rendered to Kenyatta National Hospital and the Ministry of Health in general.

1. ARBOVIRUS SURVEILLANCE

(a) *Haemorrhagic Fever Virus Surveillance*

A total of 27 acutely ill patients suspected of suffering from possible viral haemorrhagic fevers was investigated. In two cases trypanosomes were detected after blood was subjected to ion exchange chromatography. Contagious pustular dermatitis (orf) virus was recovered once and in one other case rabies fluorescence was demonstrated on corneal impressions. No haemorrhagic fever was isolated and no convalescent serum sample exhibited antibodies to Congo haemorrhagic fever, Rift Valley fever, Ebola, Lassa virus or or Marburg virus (CRELM viruses).

Populations from five areas of differing geographical, ecological and ethnic parameters were sampled for antibodies to CRELM viruses. These were from Lodwar, Nzoia, Laisamis, Masinga and Kilifi/Malindi. Ebola antibodies were detected from all regions, the highest antibody prevalence rates being found among the Turkana and Samburu tribesmen of northern Kenya. The same two groups had the highest antibody rate to Marburg. Rift Valley fever antibodies were detected in all the areas except Masinga. Congo virus antibodies were rare and no Lassa was detected.

Further testing of the Ebola positive revealed that the coastal samples showed higher titres with the Sudan strain of Ebola virus whereas the rest exhibited a higher affinity with the Zaire strain.

(b) *Dengue Fever Virus at the Kenya Coast*

A virus was isolated from the blood of a Canadian tourist who fell ill in Malindi in March 1982. This was identified by immunofluorescence, using monoclonal antibody, as dengue virus type 2. Following this, further surveillance led to the isolation of five additional dengue 2 strains from human patients from Malindi, Mombasa, Nairobi and one tourist from Mogadishu, Somalia.

Serological surveys mounted in June, July and October indicated that an epidemic of dengue fever had established itself at the Kenya coast. Antibody prevalence rates rose from 10% through 30% to over 55% in October.

Entomological investigations showed the presence of *Aedes aegypti, Aedes albocosta* and *Aedes albocephalus*. Virus isolation attempts are under way on the entomological material.

It should be noted that this is the very first time that the dengue virus has been isolated from anywhere in Kenya or indeed East Africa. It therefore represents a very significant new public health problem that deserves urgent in-depth studies.

2. ACUTE RESPIRATORY DISEASE (ARD)

Over 764 children admitted to Kenyatta National Hospital have been studied. Nasopharyngeal secretions and throat swabs from each child were examined by the indirect immunofluorescence technique and inoculated into tissue cultures as well.

A total of 390 viruses was demonstrated between October 1981 and September 1982. No virus was demonstrated in the other 374 specimens.

Observations

(i) Respiratory syncytial virus was shown to be rare during the hot dry months but it becomes almost epidemic when the long rains start and the cold weather sets in during the end of March through April, May, June and July. This is a pattern similar to that seen in temperate countries.

(ii) Parainfluenza type 3 appears to be present throughout the year.

(iii) Measles is also continuously present and brings a significant number of children to hospital with severe respiratory symptoms in the period before the rash appears, which is precisely the time they are most infectious.

(iv) Adenoviruses were relatively rare but appeared to occur most frequently during the short rains.

(v) The picornaviruses were the largest single family demonstrated, comprising 177 of the 390 viruses identified. Of these, so far 25% appear to be rhinoviruses and the rest enteroviruses. Both groups—rhino and entero—were present throughout the survey period although enteroviruses showed a marked peak during the hot dry season.

(vi) A more vexing problem is that an unusually large number of strains of herpes simplex virus were isolated with a peak during the hot dry season. The isolates themselves appeared unusual in that both human and similar cells infected with them non-specifically took up rabbit serum and as a result fluoresced strongly after staining with normal rabbit serum and fluorescein-labelled anti-rabbit globulin.

The preliminary serological results indicate that there were primary infections in many of the children.

(vii) The relative importance of immunofluorescence and tissue cultures in the identification of viruses in this survey is clearly demonstrated. There is a considerable difference in the pattern of acute respiratory infection (ARI) viruses in temperate climates from that in Kenya. Whereas immunofluorescence alone would be reasonably adequate in temperate climates, in Kenya it would appear both techniques are essential for such studies.

(viii) Following trials with different cells in various combinations, it was found that VERO, primary baboon kidney and human foetal fibroblasts gave the best results.

In conclusion, the respiratory virus laboratory in Nairobi is now fully established and is capable of continuing ARI studies provided all basic supplies and reagents obtainable from abroad through WHO continue to be supplied.

A full report of this work was compiled by Dr. Bell, who has since returned to Newcastle-upon-Tyne. It was distributed to WHO offices in Nairobi, Brazzaville and Geneva.

3. DIARRHOEAL DISEASE PROGRAMME

Diarrhoea is a major cause of morbidity and mortality, particularly in children under 5 years. In view of this the Ministry of Health set up a National Diarrhoeal Disease Control Programme with the technical assistance and collaboration of WHO.

The initial phase of the hospital-based component of the study has the following objectives:

(i) To determine the incidence of rotavirus diarrhoea in different areas of Kenya;
(ii) To document the serotypes involved;
(iii) To investigate the significance of enteroviruses other than rotavirus in childhood diarrhoea.

This project, now ongoing, is receiving material and technical support from:

(a) The Japanese International Co-operation Agency (JICA)
(b) The World Health Organization (WHO)

4. VIRAL HEPATITIS

The programme of research on viral hepatitis has now received a new boost. The Royal Free Hospital, London, has posted one physician to Nairobi to collaborate with the Department of Medicine, University of Nairobi, and the Virus Research Centre.

The following protocols are now being put into operation:

(i) *Neonatal risk of hepatitis B.* The objective is to assess the risk of neonates acquiring hepatitis B infection from mothers who are carriers of hepatitis B in the Kenyan environment.

(ii) *Drug trial on hepatitis B carriers.* The objective is to determine whether ARA-A-monophosphate with or without BCG will reduce the infectivity of hepatitis B surface antigen (HBsAg) carriers, especially those who are antigen positive.

(iii) *Hepatitis B vaccine trial.* This protocol is being developed in collaboration with the Pasteur Institute in Paris. The intention is to use HEVAC B vaccine in 1983/84.

5. POLIOMYELITIS SURVEILLANCE AND RESEARCH

(a) *Surveillance*

The Virus Research Centre continues to run a passive surveillance on acute cases of poliomyelitis. This is done by inoculating stool specimens received from health units all over the country. The response is however considered still very poor.

Type 1 poliovirus is still the dorminant isolate in the few specimens received.

(b) *Research*

A field research project has been initiated in collaboration with the Medical Research Centre, Nairobi, to assess the immunity induced by either live or inactivated polio vaccine. The field activities will be concluded in 1983.

Collaboration in Research

The Virus Research Centre has continued a policy of international collaboration as evidenced by the following:

1. The WHO diarrhoeal disease programme has enrolled the Centre in the global network of virus laboratories carrying out research on the viral aetiology of diarrhoeas. The Director of the Centre is a member of the WHO scientific working group on viral diarrhoeas.
2. The International Centre for Diarrhoeal Diseases Control and Research, Bangladesh, seconded Dr. L.N. Mutanda to the Virus Research Centre to undertake collaborative research on diarrhoea.
3. The Japanese International Co-operation Agency (JICA) has continued to support two Japanese virologists working at the Centre.
4. The University of Newcastle-upon-Tyne, UK, permitted Dr. T.M. Bell to spend one year's sabbatical leave at the Centre. He undertook work on the aetiology of acute respiratory disease (ARD) in children at Kenyatta National Hospital and trained Virus Research Centre staff on rapid virus diagnostic methods for ARD.
5. WHO has recognized the Centre's activities and subsequently designated it as a National Influenza and Viral Hepatitis Research Centre as well as a joint collaborating centre for Rift Valley fever research.
6. The Royal Free Hospital, London, posted one physician to Nairobi to collaborate with the Virus Research Centre on intervention studies on viral hepatitis.
7. The Medical Research Centre, Nairobi, which is a department of the Royal Tropical Institute of Amsterdam, continues to support the Virus Research Centre in terms of general services which include the actual building and equipment maintenance.

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MALARIA AND OTHER PROTOZOAL DISEASES RESEARCH CENTRE

Introduction

The Malaria and Other Protozoal Diseases Research Centre (MOPDRC) was established in 1977 following the collapse of the East African Community. Hitherto major research work in malaria and vector-borne diseases was conducted on a regional basis under the auspices of the East African Medical Research Council.

The staff of the Centre were first accommodated in the former E.A. Community regional headquarters building on Ngong Road, Nairobi. From there the staff moved to the National Public Health Laboratories at Kenyatta National Hospital. In January 1979 the Centre moved to Kisumu, Nyanza Province, where it is currently located in the former British Medical Research Council laboratories at the Old Nyanza General Hospital. The Centre has also two functional field units, one at Taveta in the Coast Province and one at Webuye in Western Province.

The Centre inherited very little of the former E.A. Community facilities. It has developed from very humble beginnings with almost complete absence of personnel, lack of laboratory, office space and equipment. With its location away from the major establishment of scientific activity such as the University Medical School and other regional and international research bodies in and around Nairobi, the Centre has started to face squarely the challenge to delineate and study the problems of health and diseases in those major areas that affect the cultural, social, physical, mental and economic welfare of the rural communities in the country. Its location offers the excitement and legitimate reward to a committed scientific community of reviewing these problems from an entirely different background and horizon, that of a rural orientation in which about 90% of the population of Kenya share, work and live.

Over this period of its infancy the Centre has acquired some useful research equipment and some more office and laboratory space through assistance and co-operation mainly from the Provincial Medical Officer and the Medical Superintendent, Nyanza General Hospital. But generally the organization and operation of the Centre's research programme are much curtailed by the relatively underdeveloped laboratory and scientific research manpower facilities.

Staff List

SCIENTIFIC STAFF

Director	Dr. F. Kamunyi
Research Officer	Mr. N.I. Adungo
Assistant Research Officers	Mr. A.K. Githeko
	Mr. E.M. Muniu

TECHNICAL STAFF

Senior Field Officer	Mr. W.O. Obudho
Laboratory Technologists	Mr. A.P. Situbi
	Mr. M.L. Owaga
	Mr. P.M. Kaliech
	Mr. J.P. Odhiambo

There are 14 other laboratory and field technical staff. Altogether about 73 staff were working at the Centre in 1982.

Training

Training has been slow, partly because the Centre had no scientists to train. The Centre's first scientist joined the Centre in September 1978 and left for further studies a year later. Unfortunately she did not return to the Centre. Two B.Sc. graduates were recruited to the Centre in late 1981. Arrangements have been finalized for their placement for post-graduate training in the United Kingdom next year. Two of the Centre's technicians were sponsored to the Kenya Polytechnic in Nairobi and are expected to finish the training soon.

An in-service training programme has been developed to assist improving research and technical skills of the Centre's staff. Contact has also been established with institutions such as the International Laboratory for Research in Animal Diseases (ILRAD), the University of Nairobi, and the Kenya Agricultural Research Institute (KARI), for on-the-job training of the Centre's personnel in specific skills.

Research Activities up to 1981

The main scientific and related activities of the Malaria and Other Protozoal Diseases Research Centre (MOPDRC) up to 1981 are summarized below. The results of most of the studies are reported in the proceedings of the First Annual Medical Scientific Conference of the Kenya Medical Research Institute and Kenya Trypanosomiasis Research Institute, 29 January—1 February 1980, and the proceedings of the Second Conference, 3-6 February 1981.

1. *A Survey of Intestinal Helminths in the Areas of Kisumu Municipality*

   This study was undertaken from August to September 1978. Its main objective was to examine dogs in selected areas of Kisumu Municipality in order to establish the presence or absence of intestinal helminths of medical importance. The results showed hookworm to be the most prevalent; ascaris was the second commonest worm infestation. From these findings it was not easy to correlate worm infestation with socio-economic class although lower income groups should show higher incidence of infection by worms. It was also observed that quite a number of dogs showed multiple worm infection. Other worms detected included *Trichura trichiris* and *Trichostrongylus orientalis*.

   Need for further research. It should be established whether there is any relationship between infection in dogs and that in man. Dog worms like *Toxocara canis* should also be more actively searched for.

2. *Comparative Study of Malaria Transmission by* Anopheles gambiae *Giles and* Anopheles funestus *in Kisumu Area, Kenya*

   The study was conducted from October 1978 to August 1979. In this study *Anopheles gambiae* and *Anopheles funestus* were sampled from 16 villages. Mansonia and culicines were also recorded.

   Results. Sporozoite rates in *A.gambiae* species A and B and *A.funestus* were determined. Species A was the main vector of malaria in the highlands and foothills regions. Species B played a minor role in the Kano Plains, Nyando Valley and along the shores of Lake Victoria.

   A.funestus was the main vector. Species A was also a minor vector in the lowland region. The number of fed *Anopheles* females was greater than the gravid ones and that of unfed resting indoors was quite low.

   The study further showed that peak populations of *A.gambiae* occurred towards the end of the "long rains" (May, June) and the short rains (December to early January). However, the populations of *A.gambiae* in the irrigated ricefields are controlled by three major factors: water depth, rice height and predation (Chandler and Highton 1975). With the high population of anophelines in the irrigated area, especially Ahero, no positive case of sporozoite infection was encountered. The reasons are not clearly understood but a partial explanation could be that the low vectorial activities of *A.gambiae* are due to the predominance of species B, which tends to be bovid biting and endophilic rather than the more anthropophilic species A (Service 1970 and Highton 1979).

3. *Surveillance of* Plasmodium falciparum *Resistance to Chloroquine in Kenya: Sensitivity Test in Nangina, Busia District*

   The study was conducted between February and April 1979. The findings showed that there were no persistent parasitaemias following treatment with either extended or single doses of chloroquine. Some recurrent parasitaemias which were cleared by subsequent treatment with the extended dose of chloroquine could have been due to reinfections or inadequate dosing in the single dose regimens.

4. *Colonization of* Toxorhynchites brevipalpis *under Normal Laboratory Room Temperature in Kisumu, Kenya*

   Object. Establishment and maintenance of a laboratory colony of *T.brevipalpis* in Kisumu, observations on larval growth, feeding rates, adult and egg production. The work was started in April 1979.

   The ultimate aim is to apply the findings for a large programme of biological control in malaria. The results in the laboratory indicate that this mosquito species is a potential agent for biological control as a larva predator. Furthermore, its life cycle is almost three times as along as that of the prey larvae which would ensure the presence of the predator in the breeding sites long enough for the purpose of control. This mosquito has the advantage that it does not bite man and does not transmit malaria. Its females do

not need a blood meal for their reproductive cycle unlike other mosquitoes.

5. *Study on the Prevalence of Intestinal Protozoal in Kisumu Municipality*

Aim. To establish the presence or absence of amoebiasis. The work was done between 30 July and 21 September 1979. The results established the presence of amoebiasis in Kisumu Municipality. The intestinal protozoa, particularly *E.histolytica* and *E.coli*, were evenly widespread in the parts of the municipality despite some socio-economic differences.

6. *The Problem of Diagnosis of Malaria in the Rural Health Units And Its Implications for the Health Service in Kenya*

Period. Conducted between September 1979 and October 1980.

Objective. To evaluate the reliability of the clinical diagnosis of malaria in the rural health units as against the use of ordinary simple microscopy.

Results. The findings point to the need for the search for simple and economically feasible diagnostic tools for the rural health units where the majority of patients are attended. We advocate the introduction of specially trained microscopists for the rural health units in order to improve diagnosis. The results showed that with microscopy for the patient, considerable savings on the drugs used would be realized, increase in confidence and improved performance of clinical officers was suggested, besides beneficial increase of employment opportunities.

7. *A Pilot Study of Malaria Vectors in a Large-Scale Sugar Growing Rural Area in Kenya*

Period. The study was conducted between November and December 1980, at Awendo, South Nyanza District, Nyanza Province.

The area is hyperendemic. According to previous malaria parasite surveys conducted in children 2-9 years old in the area a combined parasite rate was 50% positive out of 102 random examinations. Transmission is maintained by *A. funestus* and *A.gambiae* species A. The latter is more anthropophilic and endophilic than *A.arabiensis* (Coz and Brengues 1967, Davidson et al. 1967, Chauvet 1969, Service 1970, and White et al. 1972). The results of our survey showed that malaria is prevalent in the study area. The high sporozoite rates are typical of *A.gambiae* species A, which appears to be of more importance in transmission of human malaria than other species.

8. *A Pilot Study of the Prevalence of Human Intestinal Protozoa among Patients Attending Rural Health Units in South Nyanza District, Kenya*

Objective. To establish the presence of intestinal protozoa in Awendo, South Nyanza District, Kenya. The results indicated that the intestinal protozoa *E.histolytica* is evenly distributed in the areas of study: 19.7%, 24.7%, 27.7%, 16.0%, 25.4% 23.5%, for Sony, Awendo, Mariwa, Rinya health centres and Otharo and Oyani dispensaries respectively. *E.coli* infection was slightly higher with an average percentage of 20.6%. The infection of *G.lamblia* and *I.butchlii* was not remarkably high. Common intestinal helminths, e.g. *A.lumbricoides*, hookworm and *Taenia* spp., had remarkably high rates of infection.

9. *The Dilemma and Some of the Implications of the "Clinical Malaria" Syndrome for the Health Service in Kenya*

This paper was presented at the Kenya Medical Association Annual General Meeting Scientific Conference held at Kisumu, 19-22 March 1981.

The object of the study was to review some of the major implications of the diagnosis of malaria and to bring into focus some of the possible solutions as well as discussion on the situation.

10. *Medical Research and the Nursing Profession in the Promotion of Health and Prevention of Illness and Disease*

A paper was presented at the Community Health Nursing and Infection Control Workshop held from 29 June to 10 July 1981 at Kisumu. The object of this presentation was to stimulate interest among the nursing staff and to emphasize the important contribution the nursing profession can render to the promotion of medical research.

Current and Future Research Activities

MANDATE

The Centre's broad sphere of assignment is to promote, organize, coordinate and conduct research in the problems of malaria and other human protozoal diseases except trypanosomiasis, the latter being the domain of the Kenya Trypanosomiasis Research Institute.

A major landmark in the Centre's development has been the specific prescription of the Centre's terms of reference by the Board of Management of the Kenya Medical Research Institute. This has enabled the Centre to map out its strategy with full confidence and clear vision. The Board has directed that the Centre shall carry out research on:

1. Epidemiology of malaria and other protozoal diseases except trypanosomiasis;
2. Social and cultural factors that lead to non-acceptability and underutilization of available facilities for malaria and other protozoal disease treatment with a view to devising appropriate health education methods;
3. The place of malaria and other protozoal diseases in the methodologies of primary health care delivery and their effectiveness in the various situations in Kenya;
4. The influence of malaria and other protozoal diseases on the health of the mother and child at both the ante- and post-natal periods;
5. Bionomics, ecology and control of malaria and other protozoal disease vectors;
6. Simple, reliable and economic malaria diagnostic techniques particularly suitable for field work;
7. Vaccine development with a view to developing suitable, effective and economical immunization to malaria and other protozoal disease;
8. Development and improvement of more effective chemotherapy and chemoprophylaxis in malaria treatment;
9. Socio-economic and cultural factors that influence the effectiveness of malaria and control measures;
10. Appropriate medical technology for control of malaria and other protozoal diseases and their vectors.

In response to the terms of reference, the Centre has drawn out priority programmes of research which are presented elsewhere in this report.

Organization of the Centre

The organization of the Centre has been reached after careful appraisal of several factors and consultations. The Centre is now organized in two units, each with a corresponding number of sections.

Scientific and Technical Unit

(a) Sections:
1. Epidemiology and Clinical Studies
2. Helminthology
3. Protozoology
4. Entomology
5. Vector Biology, Ecology and Control
6. Animal and Aviary Unit
7. Scientific Illustration and Cartography
8. Haematology
9. Histology
10. Biochemistry
11. Immunology
12. Library Services

(b) Field Stations:
1. Webuye Field Station
   (i) Parasitology Section
   (ii) Entomology Section
2. Taveta Subcentre
   (i) Entomology Section
   (ii) Animal Sections
   (iii) Parasitology Section

Non-scientific and Technical Services Unit

1. Administration
2. Accounts
3. Supplies and Stores
4. Transport
5. Maintenance

Programmes

In early March 1981, the Director of the Centre presented to the Kenya Medical Research Institute Board of Management the Centre's proposed research development programme entitled "A Summary of Research Programmes Submitted to Kenya Medical Research Institute Board of Management's Meeting on 15 January 1982, Nairobi". The paper outlined the background to the Centre's proposed development, its organization, the research work programme and collaborative studies. On 9 March 1982, the Centre organized its first

Malaria and Other Protozoal Diseases Research Centre Projects Conference under the chairmanship of Professor Kihumbu Thairu, Chairman, Board of Management, Kenya Medical Research Institute, held at the Centre's Headquarters, Kisumu. Twenty scientists from the Centre, University of Nairobi, Nyanza Province and Kenya Medical Research Institute attended the conference.

Following this first conference, the Centre's research activities were streamlined into distinct research programmes. In order to facilitate proper and accelerated development of the Centre, five programmes were recommended. Under each programme a number of projects were identified and mapped out. Under projects, several studies, would be undertaken. The programmes are:

1. Human Intestinal Protozoa Research
2. Malaria
   (i) Malaria Vectors
   (ii) Malaria Infections
3. Vectors of Other Protozoal Diseases in Kenya
4. Support Facilities
   (i) Research Library and Scientific Literature
   (ii) Scientific Illustration and Cartography
   (iii) Animal Unit
   (iv) Major Capital Equipment
5. Social, Cultural and Economic Research in Protozoal Diseases in Kenya

The introductory summary on each programme is provided in the following paragraphs.

1. HUMAN INTESTINAL PROTOZOA RESEARCH

The magnitude of intestinal parasitoses, medical and economic, has not been determined in Kenya. In Latin America, Botero (1981) recently reviewed the situation and found to his dismay that the situation had not changed over the past 50 years.

This programme is focusing on the epidemiology of human intestinal parasitoses in Kenya in general, with particular reference to intestinal protozoal infections. Study of the aetiological agents and vectors is continuing. Sero-epidemiological surveys have been planned. Particular emphasis is being focused on developing improved techniques and methodology for community diagnosis of intestinal protozoal infections. Immuno-diagnosis shows promise as a reliable diagnostic approach with a good cost/benefit ratio.

The work on vectors is expected to start as soon as the Centre can acquire the services of an entomologist or the services of a consultant in entomology.

2. MALARIA RESEARCH PROGRAMME

(i) *Malaria Vectors*

The Centre's cardinal aim is the control of malaria through the understanding of the bionomics of malaria vectors. To this goal various surveys have been initiated in order to establish the distribution and prevalence, population dynamics, densities, seasonal cycles and both diurnal and nocturnal behaviour of *Anopheles gambiae* and *Anopheles funestus* in large-scale agricultural industries, notably the Awendo sugar industry. The philosophy of this study is that large-scale agricultural industries alter the natural ecosystems of the mosquito vectors and thereby possibly their bionomics. The effect of alterations in such economic enterprises is understandably of much importance.

(ii) *Biological Control of Malaria Vectors*

The ever-increasing resistance of the mosquito vector to insecticides behoves a new approach to the control of this vector using new methods, preferably natural biological predators and pathogens. The Centre initiated two projects:

(a) Use of larvivorous mosquito *Toxorhynchites brevipalpis*

(b) Larvivorous fish.

(iii) *Biochemical Studies on Vectors of Malaria*

Biochemistry of the mosquito vectors:

(a) Biochemistry of the Aquatic Environment—Huma Hills, Hot Water Springs and Lake Simbi Salt Lake, South Nyanza District.

3. CURRENT RESEARCH ACTIVITIES

(i) *Preliminary Studies on Human Intestinal Protozoal Infections*

In the latter half of 1982 the Centre started work on sero-immunological diagnostic techniques for field application in parasitic infections with special emphasis on protozoal infections initially involving amoebiasis and giardiasis. First an appraisal review of the magnitude of intestinal parasitism in Kenya was established by reviewing records in three provincial hospitals (table 5), which shows that patient numbers in each hospital are well over 10,000. On projection, this suggests that about 1.7 million Kenyans may be suffering from one or more intestinal parasites.

Table 5. **Analysis of outpatient attendance at three provincial hospitals in Kenya and the rates of intestinal parasitism (1981)**

Province	*Hospital*	*Total number of attendances*	*Number with intestinal parasitism*	*%*
Rift Valley	Nakuru	215,099	12,998	6.0
Nyanza	Kisumu	296,116	13,087	4.4
Western	Kakamega	262,467	11,626	4.4

(ii) *Giardiasis among Patients Attending an Urban Health Centre in Kisumu Municipality, Nyanza Province, Kenya*

A pilot study was carried out on protozoal agents of diarrhoea in the urban set-up. The study showed that the protozoal *G.lamblia* accounted for over 15% of diarrhoeal diseases. At the close of 1982 several reports on these studies were being prepared for presentation at the Fourth Annual Medical Scientific Conference of KEMRI/KETRI due in early 1983.

Future studies will be directed to the study of the immunological balance between human and parasite with special emphasis on trigger mechanisms involved in invasive and non-invasive interactions in amoebiasis and giardiasis.

(iii) *A Pilot Study of Malaria Vectors in a Large-Scale Sugar-Growing Rural Area in Kenya*

In order to identify mosquito vectors of medical importance resting in houses in a large growing industry at Awendo, South Nyanza District, the Centre started spray catches in selected houses in the study area.

Pyrethrum spray catches were carried out weekly over a period of two months. Species of mosquitoes were identified and were dissected in order to determine the sporozoite rates. Cytogenic studies on chromosomes were carried out in order to differentiate the *A.gambiae* species complex. Ovaries from 331 mosquitoes were collected, speciation was done on all of them and all were found to be *A.gambiae* species A (100%). No *A.arabiensis* was identified during the period of heavy rainfall, high relative humidity and low temperatures which favour mainly *A.gambiae* species A.

The results of sporozoite rates are summarized in table 6. The results indicate that:

(a) Malaria is prevalent in the study area;
(b) The high sporozoite rates are typical of *A.gambiae* species A,
(c) This species is the most predominant transmitter of malaria.

(iv) *Biochemistry of the Haemolymph of* Anopheles gambiae *Mosquitoes*

Chemotherapy of malaria and use of insecticides against the mosquito vector are being rendered increasingly ineffective by the increased resistance of both the *Plasmodium* parasite and the mosquito vector. The present studies are geared towards understanding the biochemical factors which sustain the sporozoites in the mosquito in order to control their development by chemical and immunotherapeutic agents.

(v) *Biochemistry of the Aquatic Environment of* Anopheles gambiae *Species Complex of Huma Hills Hot Water Springs and Lake Simbi Salt Lake*

Earlier work in Uganda (White 1973) showed that *Anopheles gambiae* species D was found living in hot water springs, but not transmitting malaria. It had also been reported that *A.melas* and *A.merus* were found breeding in salt water in the west coast and east coast of Africa respectively. A study was initiated to establish the species of *Anopheles gambiae* in the hot water springs of the Huma Hills and Lake Simbi Salt Lake. It was found that:

Table 6. Results of anopheles salivary gland dissections to determine sporozoite rates in the study area

Area	A.gambiae collected			Total	Dissected	Positive			%	A.funestus collected			Total no dissected
	U	F	G*			U	F	G		U	F	G	
Nucleus	14	157	76	247	238	0	0	1	0.4	1	2	4	7
Out-Growers	24	217	167	408	387	0	3	2	1.3	3	64	74	141
Undisturbed	10	222	150	382	382	0	7	5	3.1	1	15	8	24
Total	48	596	893	1,037	1,007	0	10	8	1.8	5	81	86	172

U = unfed
F = fed
G = gravid

(a) In Lake Simbi Salt Lake no larvae of *Anopheles* were found;
(b) A good number of larvae of different species were collected and identified from man-made temporary pools along Lake Simbi;
(c) In the three hot water springs of Huma Hills a good number of larvae of different species were collected and identified.

Biochemical studies were initiated in order to establish the physio-chemical, biochemical and biological characteristics of the aquatic environment and to correlate them to the sustenance of various forms of larval life. The preliminary results are shown in table 7.

The object of measuring and quantifying these chemical properties was to try to correlate them to the mosquito larvae density.

The measurements have to be repeated several times a year before a clear pattern emerges. The present data are not sufficient to draw any useful conclusions; nevertheless, certain interesting observations have been made.

At Site No. 402 where the pH was only slightly alkaline (7.2), the salinity very low and the oxygen absorbed relatively high (28 ppm), very few larvae were obtained. On the other hand in Site No. 404 where the pH was highest (10.1), oxygen absorbed 16.0 ppm and salinity low, the larvae density was very high. It seems the larvae in that area are adapted to low hydrogen ion concentration.

Table 7. Water analysis

Site no.	Colour hazen units	pH	Electrical conductivity (micro mhos/cm)	Turbidity (JTU)	Dissolved solids (ppm)	Free CO_2 (ppm)	Oxygen 1/4 27°C (ppm)	Water temp. C°	
399	<5	8.4	10,000	1.2	9,000	Nil	2.0	70	Very high
400	500	8.8	12,300	300	6,000	Nil	10.0	56	very high
401	500	8.3	2,800	400	1,500	Nil	23.0	48	High
402	325	7.2	1,650	60	1,200	Nil	28.0	35	Very low
403	<5	8.3	16,500	10	8,000	70	10.0	50	High
404	100	10.1	17,000	15	8,000	Nil	16.0	27	Low
405	50	8.8	12,000	30	8,500	Nil	4.0	35	High
406	500	9.3	29,000	17	17,500	Nil	45.0	69	Very high
407	500	8.8	19,000	25	9,500	Nil	3.0	70	Very high
408	<5	8.5	19,000		9,500	Nil	1.0	51	Very high
409	5	8.6	kmk41	1.2	2,000	Nil	1.0	27	Very high

Number	Site
399	Bala Hot Springs—Location 3
400	Abundu Cave
401	Ayombo Sample 3
402	Lake Simbi—man-made holes
403	Ayombo hot water springs
404	Lake Simbi—South point
405	Abundu Down Spring
406	Bala Hot Spring—Location 1
407	Bala Hot Spring—Location 2
408	Abundu Hot Spring
409	Lake Simbi inlet

6. *Biological Control of Malaria Vectors using* Toxorynchites brevipalpis

Toxorhynchites brevipalpis is a giant mosquito which does not bite man. Its larvae are predatory on the larvae of other mosquitoes, thereby making it a natural predator which could be adapted to the systematic control of the larvae, hence the population, of *Anopheles* mosquitoes.

Several abortive attempts have been made to use *T.brevipalpis* larvae to control tree hole breeding mosquitoes (Burton and Hopkins 1927; Swezey 1931; Williams 1931; Paine 1934). Failures seem to have been due to unsuitable environment conditions, e.g. time of release or low densities of *T.brevipalpis* released (Tripis 1972).

The Centre initiated studies to colonize *T.brevipalpis* in the laboratory and feed it on *Anopheles gambiae* larvae. The initial results were promising, as:

(a) *T.brevipalpis* larvae survived under laboratory conditions for averages of 15 days. This means one cycle of *T.brevipalpis* can eat two to three cycles of *Anopheles* larvae,
(b) At the fouth instar *T.brevipalpis* killing behaviour became vicious as it killed not only for food requirement but also to create its territorial monopoly before pupating. This behaviour was indeed conducive to the purpose of population control of the mosquito larvae, which the project was geared to.

Considering the large quantity of other mosquito larvae consumed by *T.brevipalpis* larvae from first instar and the killing behaviour of 4th instar larvae, it is obvious that this species is a great potential agent of biological control in sites where they co-exist with larvae of other mosquitoes of medical importance. Introduction of abundant laboratory-reared *T.brevipalpis* in any area with favourable environmental conditions before the rainy season begins would ensure a high egg production resulting in large numbers of predator larvae which would start controlling prey larvae forthwith during the rainy season and shortly thereafter. As the life cycle of *T.brevipalpis* is almost three times as long as that of the prey larvae (Tripis 1973), this would ensure the presence of the predator in the breeding sites long enough for the purpose of control.

(vii) *Preliminary Studies on Dietary Habits of* Barbus *and* Ctenopoma murie *Fish Species Using Mosquito Larvae*

Barbus fish species were caught in the Ahero ricefield scheme. *Ctenopoma murie* fish species were simultaneously caught in streams running through the rice fields. Both species of fish were reared in an aquarium in the laboratory for a period of over two years, feeding them on mosquito larvae as the sole diet.

The survival of these fish for such a long period on mosquito larvae was indeed encouraging and subsequently led to a collaborative programme between the Centre and the Kenya Marine and Fisheries Research Institute. This study's aims include:

(a) Use of various indigenous species of fish including *Barbus* and *Ctenopoma* for control of malaria vectors;
(b) The rationale of large-scale use of larvivorous fish for the control of malaria vectors;

(c) Identification of the most larvivorous fish species.
(d) Understanding the biological behaviour of the selected fish by small-scale field of their larvivorous habits.

4. SUPPORTING SERVICES

Library and Research Data Bank

The nature of research requires that research staff have access to an optimum and reliable supply of scientific literature appropriate to the field of their work. This is the more so since the Centre is situated in Kisumu where availability of medical and scientific literature is very limited.

Kisumu Municipality where the Centre is situated is served by a few libraries, notably the British Council Library and the Kenya National Library Services. But these libraries do not stock materials and journals specially needed for scientific research.

It was in consideration of the difficulties involved in obtaining reference materials for research that the Centre initiated an embryonic scientific literature service designated Library and Research Data Bank. This unit was located in one of the rooms which also served as a lecture room. In the same room a rudimentary library was started towards the end of 1980.

In 1981 the Centre's efforts were boosted through a grant of £1000 of books through the ODA Book Presentation Programme of the British Overseas Development Administration.

In 1981 the library took great strides when it moved into a new building which has ample space and an office. Miss Kate MacDonald of the British Council, Nairobi, assisted the Centre in drawing up the seating plan. Other donors to the library are ILRAD, University of Nairobi Medical Library, KARI/ARD Library and Wellcome Library. For cataloguing, the universal decimal classification system was adopted. Apart from rendering reading materials, the library also offers literature services to the Centre's scientists by requisitioning reprints from other libraries and literature searches within its own collection.

From a simple unit the library has gradually developed though its growth is seriously curtailed by the lack of a librarian to run it. The Centre has also received donations of materials and books from other sources including:

WHO Geneva—several publications
Messrs. Pfizer Laboratories Limited, Nairobi—"Atlas of Medical Parasitology"

Chief, Distribution Centre, Pan American Health Organization—*PAHO Bulletin*

The Centre lacks essential journals and receives only *East African Medical Journal* and *Medicom*. Other journals are from time to time donated by senior staff to the library. But this cannot be a reliable source of scientific literature for a young and growing research Centre.

Scientific Illustration and Photography

In early 1981 a rudimentary Illustration and Photography Unit was started. Two of the technical staff were attached for a period to Mr. Eric Edwards of the Kenya Tuberculosis Investigation Centre where they had some basic demonstration in the preparation of slides and practice of photography.

The section is well equipped to meet adequately the Centre's needs. However, the absence of a qualified technologist to man it has denied the Centre one of the most essential services for scientific research. Despite the need for services rendered by such a unit such as photography and graphic art, this section was dormant for most of the year due mainly to lack of trained staff.

Animal House

The main role of the section is to provide various kinds of animals to the Centre's other sections for experimental purposes. In the early part of the year the Animal Section successfully maintained large numbers of guinea pigs, rabbits and mice which adequately met the Centre's needs for experimental animals. Later in the year many animals, notably guinea pigs, died due mainly to overcrowding in the animal house which measured only 7 × 7 feet. Although nutrition of the animals which adequate, some foodstuffs such as carrots were insufficient. Owing to unsatisfactory conditions and inadequate diet many animals suffered from anorexia, diarrhoea and general body weakness, sometimes resulting in paralysis of both hind and front limbs. Death always followed a day after the manifestation of these symptoms. Modifications to improve the animal house were proposed and submitted to the KEMRI Headquarters for action.

Consequent to the events outlined above, the Centre's progress has been curtailed by the absence of optimum facilities and funds to maintain a reasonable unit for experimental animals.

Financial Support

The main service of funding of the activities of the Centre comes from the Treasury through the Kenya Medical Research Institute headquarters. The Ministry of Health has given considerable support, especially in the allocation and use of facilities and personnel. The Centre's activities are also being sustained through the generous contribution from various other sources both local and overseas, notably:

(i) British Overseas Development Administration (ODA), U.K.
(ii) British Council, Nairobi and Kisumu
(iii) University of Nairobi Medical Library
(iv) Editor Pan American Health Organization (PAHO Bulletin), USA
(v) Kenya Marine and Fisheries Institute Laboratory, Kisumu
(vi) Kenya Agricultural Research Institute (KARI)

Collaboration in Research

In pursuance of the Institute's policy on collaboration in research with other institutions and scientists, MOPDRC has developed collaborative work in the following areas:

1. *WHO Saradidi Community-Based Malaria Chemoprophylaxis and Chemotherapy Control Project*

This project is under the auspices of the World Health Organization. It is being carried out as a collaborative project between the Clinical Research Centre and MOPDRC at Saradidi. The Parasitology Section of MOPDRC is actively in the project. This section has also participated in the epidemiology study carried out by a WHO team in October and November 1982, "Prevalence of malaria and anaemia among children aged 2-9 years in Muhoroni Division of Kisumu District".

2. Malaria Nephropathy in the Lake Basin Development Authority

No serious study has been done before in Kenya on the renal manifestations of malaria. Therefore this project is aimed at studying this problem with special reference to the acute and chronic response to various malarial attacks.

The Centre is collaborating with a team of colleagues from the Faculty of Medicine, University of Nairobi. The University team is headed by Dr. L. S. Otieno of the Department of Medicine. The research team includes Dr. J.G.C. Amolo of the Lake Basin Development Authority. The team has so far produced the following publications on this study:

1. Okelo GBA, Otieno LS, Kinuthia DMW, Ondijo SO, Kamunvi F, Situbi AP, Seroepidemiology of malaria. Paper read at the Conference of Renal Specialists, Faculty of Medicine, University of Nairobi.
2. Otieno LS, Okelo GBA, Kinuthia DMW, Ondijo SO. Preliminary report on G-6-PD and sickling test in a malaria area: a concurrent study of malaria nephropathy. E.Afr.Med. J.60; 1982.
3. Okelo GBA, Ondijo SO, Otieno LS, Kamunvi F, Situbi AP, Kinuthia DMW. Intestinal parasites at Awendo.
4. Ondijo SO, Otieno LS. The importance of mobile laboratory services in rural areas to augment research.

3. *Malaria Nephropathy along the Coastal Belt of Kenya*

The project was started in October 1981, with the same object as that in the Lake Basin. It is important to emphasize that this is not a duplication of the former project.

Many formal surveys have shown that there is increased incidence of hypertension, proteinuria and renal disease in general along the coast and in the Lake Basin. This has been attributed partly to malaria and partly to other parasitic infections such as schistosomiasis. There is, however, evidence that environmental and other factors including the distribution and types of species of malaria vectors differ in a number of important aspects which could influence the pattern of nephropathies in the area.

At one visit, for instance, the investigators in the project attended a ward round in Taveta hospital. Out of 60 patients they saw, 2 had overt nephrosis and another 8 had proteinuria. This admittedly is a high percentage of protein in the urine for such a population and the situation merits investigation, especially as the slides of a large number of the patients were positive for malaria parasites, irrespective of the reason for the patient's admission.

4. *Nyanza General Hospital Research Committee Research Programme*

This programme needs special mention to bring into focus the role the Kenya Medical Research Institute is playing in meeting one of its major obligations to collaborate with other bodies and researchers.

At a meeting held on 29 July 1981 at the Nyanza General Hospital, Kisumu, the provincial consultants resolved to become much more involved in research. To this end a research committee with all the heads of departments at the hospital was formed with the Director of MOPDRC as its interim chairman.

The Committee is now undertaking useful research in the following projects:

1. Ocular traumatology in Nyanza Province with special reference to traumatic hyphaema of the eye. E.W. Madadi, Provincial Eye Surgeon, Nyanza Province.
2. The epidemiology of Burkitt's lymphoma and other jaw tumours in Nyanza Province. Dr. F. Kamunvi, Director, Malaria and Other Protozoal Diseases Research Centre, and Dr. M.J. Njino, Provincial Dental Surgeon, Nyanza Province.
3. A study of the health status of the school child in Kisumu District.
4. The epidemiology of dermatoses in Nyanza Province with special reference to protozoal infections. Dr. M.B. Pancholi, Provincial Dermatologist, Nyanza Province.

Other studies have been proposed to include tooth decay and fluoride levels in the Sugar Belt, a study of normal biochemical data among adult communities and haemoglobinopathies as seen in Nyanza Province. While some of the work is at an adanced stage, other projects have been curtailed for lack of equipment and other facilities at the Centre. Notwithstanding this, the example set by the consultants at Nyanza General Hospital could be emulated in the other provinces with considerable benefit to the country and medical research.

The Centre has participated actively in these programmes. Some of the projects have progressed well and have shown evidence that the work may be useful in solving practical problems of immediate relevance to health in the country.

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ALUPE LEPROSY RESEARCH CENTRE

Introduction

The Centre which is now known as Alupe Leprosy Research Centre was established in 1953 as the East African Leprosy Research Centre. When the East African Community collapsed in June 1977 it became known as Alupe Leprosy Research Centre and was absorbed within the Kenya Government. Its main objective was to study the problems of leprosy so as to work out practical methods of leprosy control and research of effective chemotherapy methods against the disease.

Research work at Alupe was started by Dr. Ross Innes, its first director, who carried out early work on lepromin in therapeutic trials. Dr. John Garrod and Dr. C.M. Ross, the next two directors, continued between 1957 and 1964. Dr. Innes also started early studies on the epidemiology of leprosy in East Africa, particularly Kenya. Other important surveys have been carried out in Kenya by D.G. Leiker, Y. Otsyula and A.W. Mugenya.

Between 1965 and 1968 the East African Leprosy Research Centre experienced a shortage of research manpower. However, between 1969 and 1971, research officers were recruited and initiated some research work. From 1970 to 1975 the research carried out included study on fluorescence techniques, biochemical picture of DDS in the blood, drug trials, cross reactivity of mycobacterial antigens, monitoring dapsone in urine, drug combination trials, and various epidemiological studies. In 1976 the modern laboratory buildings were completed. The new laboratories are up to date. The Centre envisages undertaking active research work under the following departments:

Epidemiology
Clinical Dermatology
Pharmacology/Biochemistry
Microbiology/Mycology
Pathology/Histopathology
Immunology

Staff List

In 1982 the Centre had an establishment of both pensionable and non-pensionable staff of 139. The scientific and technical staff were:

Director	Dr. D.M. Owili
Medical Research Officer	Dr. P.A. Orege
Research Officer	Dr. J.O. Nyawalo
Assistant Research Officer - Senior Laboratory Technologist	Mr. J.K. Mwatha
	Mr. N.A. Ochieng
Laboratory Technologists	Mr. J. Opiyo-Odhiambo
	Mr. Michael Bwire
	Mr. Michael Were
	Mr. J. Kuria
Certified Clinical Officer	Mr. Cornel Ibworo
Laboratory Technicians	Mr. I.M. Ofuyo
	Mr. Michael Ngila
	Mr. Stephen Kaniaru
	Mr. Justus Kakai
	Mr. Timothy Makokha
	Mr. David Kyanya
	Mr. Stephen Makokha
	Mr. Francis Wanyonyi
	Ms. Agnes Ondusye
	Mr. Christian Orodi
	Mr. Maurice Abwogar
	Mr. Boaz Kamazi
Ungraded Nurse	Mr. Pheanus Odenyo

Staff Matters

The problem of inadequate scientific staff in this Centre may continue for some time. The Centre has another problem which it inherited from its predecessor: the overstaffing of non-trainable personnel who cannot be deployed in useful work.

Staff housing is still a major problem at the Centre because both the Kenya Trypanosomiasis Research Institute and this Centre share the only available houses consisting of 18 junior houses, 16 intermediate and 8 senior staff houses. There is therefore an urgent need for additional quarters to accommodate all the staff of the Centre.

Training

The position on staff training at the Centre in 1982 is as follows:

1. Dr. P.A. Orege left in October 1982 to take a course leading to Master of Public Health (MPH) degree at Harvard University.
2. Dr. P.M. Owili visited the National Insitute for Medical Research, Mill Hill, London, in June 1982.
3. Mr. J. Kuria, Laboratory Technologist, visited the National Institute for Medical Research, Mill Hill, London, for 3 months from June 1982 to study animal house management and mouse foot pad technique.
4. Mr. N. Ochieng visited AHRI, Addis Ababa, and the Jalma Leprosy Institute, India, in November 1982. He is still away.
5. Mr. Odire Anyango is studying for the final part of the ordinary diploma in Medical Laboratory Technology in April 1983. He passed his pretechnician course in 1979.
6. Mr. F. Wanyonyi, Laboratory Assistant, is sitting for pretechnician pretechnician examinations in April, 1983.
7. Miss Goretti Egessa, Laboratory Assistant, passed the pretechnician examinations in April 1983.
8. Mr. James Etyang and Mr. Gabriel Mondi will sit for the final examinations in Junior Laboratory Animal Technology in April 1983. They were previously Animal House Attendants.
9. Mr. Michael Bwire attended a course on mycology at Kenyatta National Hospital. He has now started a mycology department at the Centre.
10. Mr. James Oite, Driver Grade III, passed Government Trade Test Grade II.

30th Anniversary

Alupe Leprosy Hospital celebrated its 30th anniversary in November 1982. This was used as a forum for exchanging ideas on leprosy and its control. Participants were drawn from within and outside Kenya. The staff of the Centre attended most of the functions.

Outpatient Clinic

An outpatient clinic at the premises of the Centre caters for the general outpatient including maternal and child care. This service is for the local community. The management of the outpatient clinic is currently facing problems of manpower and space which may lead to its collapse. The system relies heavily on clinical officers from the Leprosy Research Centre and the Kenya Trypanosomiasis Research Insitute (KETRI) whose priority is in research work. The outpatient clinic will have to close once the clinical officers get fully involved in research activities. The building currently housing the clinic belongs to KEMRI. It is hoped that the Ministry of Health through the medical officer in charge of the Leprosy Hospital will rectify the situation by providing alternative space and staff. The clinic is a busy one catering for up to 400 patients per day including maternal and child care cases.

Dermatology Clinic

During the year a referral system was started in which all skin and VD cases were referred from the outpatient clinic and elsewhere to the skin clinic run by a medical research officer. The provincial dermatologist visits the clinic from time to time for consultation.

The clinic had started to gather dermatological data from the community around. This information will be useful for research purposes since the Centre now carries out research on other skin diseases apart from leprosy. The response has been encouraging and the clinic is fast gaining popularity. Some non-dermatological cases were seen inevitably. Total number of patients seen including re-attendance was 285

Research Programmes

The Centre is running several ongoing projects. Initial stages of these projects have been completed and the reports and papers on these will be published in local and international journals.

EPIDEMIOLOGY OF FUNGAL SKIN INFECTION IN PRIMARY SCHOOL CHILDREN IN KISUMU MUNICIPALITY, NYANZA PROVINCE

Superficial infection is a public health problem in Kenya and world wide. In our country there is little information regarding the magnitude, the various factors affecting the prevalence, and the pattern of actiological fungal agents.

It is hoped that the information from this study will be beneficial to health workers and researchers in setting priorities for the control of these diseases.

Summary

A total of 3,568 pupils were screened for dermatological conditions. Of these 18.1% were found to be affected; 57.2% of the affected had fungal skin infections, i.e. 10.3% of the total population screened.

Various factors were found to influence the distribution pattern to

varying degrees. Such factors were age, sex, habits, housing and family size.

The commonest dermatomycosis was tinea capitis with *Trichophyton violaceum* as the commonest aetiological species (40.8%).

Material and Methods

The survey was carried out in primary schools and all pupils were screened except for one school that was partially done. Field data collection was done in approximately four weeks. Screening was done by a clinical officer and a medical officer with the consultation of a dermatologist. Skin scraping was done on the spot. The specimens were kept and transported in envelopes for KOH preparation and culture at our laboratories. We used Sabouraud's medium. The germ tube test was used to distinguish *Candida albicans* species. Pencillin 20u/ml and streptomycin 40u/ml was added to Sabouraud's medium.

Results

The detailed results of the study are available at the Centre. However, here below is a summary of the findings:

(i) Tinea capitis was seen as the commonest superficial mycosis. This was also true in one previous study in Kenya (Verhagen and Maniar 1969) and another in Uganda (Lubwama 1981). In a study in Tanzania (Nsanzumuhire and Masawe 1974), tinea cruris was the commonest.

Intertrigal candidiasis of the feet is higher in the list than it was in the Kenya series (Verhagen and Maniar 1969); pityriasis versicolor is lower. This could be explained by the influence of age and habits, which are different in the two study groups.

(ii) Tinea capitis and tinea corporis are predominant in younger age groups.

(iii) There is a female preponderance in most superficial mycoses except tinea capitis where more males than females are affected. This is unlike the Uganda series which had a male to female ratio of 2.1 (Lubwama 1981).

(iv) The lower income groups (families) were more frequently affected. The majority of the affected cases had less than five rooms in the household.

(v) In tinea capitis most of the negative specimens were early cases or partially treated cases. Some of the negative specimens were those taken to rule out seborrhoeic dermatitis.

In tinea corporis some of the negative specimens came from small early lesions. Specimens taken to rule out pityriasis alba were negative. Most of these were from facial lesions. The higher percentage of negative specimens in tinea corporis infections could be attributed to difficulty in distinguishing clinically early tinea corporis from pityriasis alba. Again some cases were partially treated. For intertrigal candidiasis not all specimens were examined fresh. This could explain the low percentage of positive cases. No specimens were taken from pityriasis versicolor cases.

EPIDEMIOLOGICAL SITUATION IN YIMBO AND SEME LOCATIONS, NYANZA PROVINCE

Leprosy is generally a chronic disease caused by *Mycobacterium leprae* affecting the peripheral nerves, skin and the mucous membranes. The more severe forms tend to deteriorate with time and the most severe and contagious forms last for life. More than one-third of untreated or advanced cases result in disabilities that increase with time and are permanent.

The disabilities and deformities in leprosy patients have in many cultural systems resulted in the belief, which may even be held by health workers, that the disease has necessarily incurable consequences.

As no preventive method is yet available, the disease control is based on appropriate treatment delivery which can only be done when the cases have been diagnosed.

Early detection and eventual prevention of the disease can be effective only if the epidemiological situation of the disease is known, but our knowledge of epidemiology of leprosy is still incomplete. We still need information in almost every aspect, infection reservoir transmission, risk factors, susceptibility, subclinical infections, and protective immunity. We still need reliable data on prevalence and incidence of infection.

It is with this in mind that the Leprosy Research Centre has decided to do a cross-sectional epidemiological survey. These survey has so far been done in Yimbo and Seme locations in Nyanza Province.

Yimbo Location

Methodology. Yimbo Location is situated around the shores of Lake Victoria. It has a population of 20,000 according to the 1978 census and is divided into five sublocations.

A house-to-house survey was conducted in randomly selected villages in all the sublocations and in primary schools. In total about 5,000 people were physically examined for any diagnostic patches of skin and any sign of nerve enlargement 45 cases were found to have clinical signs of the disease. Skin smears were taken from the 45 cases and skin biopsies from 10.

Results. The results were as tabulated in table 8. It can be observed that:

(a) Leprosy is rare in the younger age groups. This could be due to the slow multiplication of *Mycobacterium leprae*.

(b) Leprosy is more prevalent in the older age groups, i.e. those above 40 years form 53% of the cases.

More females than males have leprosy in the ratio of 4.1.

From table 9 it can be observed that most of the patients had tuberculoid leprosy (71%). The polar lepromatous type (LL) was seen in only 4.4% of the patients, while 11.1% had the borderline lepromatous type; thus the infectious type was 15.6%. Therefore, we can conclude that with improved control methods, leprosy could be controlled effectively in the region by finding and treating the few infectious cases.

Table 8. **Leprosy cases by age group in Yimbo Location**

	0-5 yrs	6-10 yrs	11-15 yrs	16-20 yrs	21-25 yrs	26-40 yrs	Over 40	Total
Males	0	0	1	2	0	1	5	9
Females	0	9	2	2	1	2	20	36
Total	0	9	3	4	1	3	25	45

Table. 9. **Leprosy cases by type and age group in Yimbo Location**

Type	0-5	6-10	11-15	16-20	21-25	26-40	Over 40	Total
T	0	0	0	2	2	3	25	32 (17%)
BT	0	0	0	0	1	5	1	6 (13.3%)
BL	0	0	1	0	0	1	3	5 (11.1%)
LL	0	0	0	0	1	0	1	2 (4.4%)
Total	0	0	1	2	3	5	34	43 (100%)

T - tuberculoid leprosy
BT - borderline tuberculoid
BL - borderline lepromatous
LL - lepromatous

Table 10. **History of contact and BCG vaccination among leprosy patients Yimbo Location**

Type	BCG		Contact		Total
	Negative	Positive	Negative	Positive	
T	27	5	9	23	32 (71.11%)
BT	5	1	2	4	6 (13.33%)
BL	3	2	4	1	5 (11.11%)
LL	1	1	1	1	2 (4.44%)
Total	36	9	16	29	45
	(80%)	(20%)	(35.56%)	(54.44%)	(100%)

It can be seen from table 10 that 54.44% of the patients had a history of contact while 80% of the patients had not had nay BCG.

Seme Survey

Seme Location has a population of 59,567 according to the 1978 census. Out of 6,530 people physically examined, there were 136 with leprosy. This gives a rough prevalence of 20.82 per 1,000. This is indeed very high and calls for intensification of leprosy control efforts in this area.

Table 11. **Age and sex of leprosy patients, Seme Location**

	0-5	6-10	11-15	16-20	21-23	26-40	Over 40	Total No. %
Male	1	3	5	3	3	9	33	57 41.91
Female	0	1	6	0	2	11	59	79 79.09
Total	1	4	11	3	5	20	92	136
	0.74%	2.94%	8.89%	2.21%	3.68%	14.70%	67.64%	100%

The findings were as tabulated in table 11, which shows that the majority of the patients were females (79.09%) and that most of the patients were 40 years and above (67.64%).

Table 12. Leprosy cases by type and age group, Seme Location

Type	*0-5 yrs*	*6-10 yrs*	*11-15 yrs*	*16-20 yrs*	*21-23 yrs*	*26-40 yrs*	*Over 40 yrs*	*Total No. %*
T	1	3	9	4	5	15	47	84 61.76
BT	0	1	2	0	1	7	32	43 31.62
BL	0	0	0	0	0	0	4	4 2.94
LL	0	0	0	0	0	1	4	5 3.68
Total	1	4	11	4	6	23	87	136
	0.74%	2.94%	8.89%	2.94%	4.41%	16.91%	63.98%	100%

T - tuberculoid
BT - borderline tuberculoid
BL - borderline lepromatous
LL - lepromatous

It can be seen from table 12 that the infectious type of leprosy forms only 6.62% of the cases found in this area. The transmission of the disease can be controlled easily by identifying patients with the infectious type and putting them on treatment.

Table 13. History of contact and BCG vaccination among leprosy patients, Seme Location

Type	*BCG*		*Contact*		*Sex*		Total
	Positive	*Negative*	*Positive*	*Negative*	*M*	*F*	
T	75	9	54	30	31	53	84
BT	4	9	24	19	23	20	43
BL	4	0	2	2	2		4
LL	5	0	4	1	1	4	5
Total	118	18	84	52	57	79	136
	86.76%	13.23%	61.76%	38.23%	49.91%	50.09%	100%

It can be seen from table 13 that the majority of the patients (86.76%) did not have BCG vaccination; however, the majority (61.76%) were also contact negative, which contradicts the facts found in Yimbo Location where the majority were contact positive. Further analysis is continuing to determine the associated factors.

DRUG COMPLIANCE IN THE TREATMENT OF LEPROSY

Leprosy, though a mildly infectious disease, is still a threat in the endemic areas of this country and elsewhere—more so when one considers its disabling nature and the accompanying social stigma. Chances, especially in the endemic areas, are that the number of cases will be on the increase, if proper methods of case finding and treatment of the already registered cases are not designed. The Leprosy Research Centre has embarked on both aspects and drug compliance studies are aimed at strengthening the treatment of this dreadful disease.

In the treatment of leprosy, dapsone, chemically known as 4, 4 diaminodiphenyl sulphone, is still the most widely used drug although WHO recommends its use only in combination with other antileprosy drugs. However, means have not yet been devised to implement the WHO recommended therapy and dapsone monotherapy is likely to remain the drug of choice in the antileprosy campaign for a long time to come. Studies elsewhere have shown that drug compliance is a very widespread phenomenon, especially for chronic diseases like leprosy where most of the cases are outpatients.

Outpatient treatment of leprosy involves the collection of dapsone tablets by the patients once a month when they visit a leprosy clinic, which they are advised to self-administer for the full month till the next clinic day. Failure to comply with treatment means that patients either fail to report at the clinic for the collection of the drugs or fail to ingest the drugs. If all leprosy patients could be hospitalized, dapsone compliance would not be a problem since the patients would take their drugs under the supervision of health personnel. However, inpatient treatment of all leprosy cases is, as with most other diseases, not practical and outpatient treatment will continue to be the backbone of the leprosy control programme. For the leprosy control to be a success dapsone compliance of outpatients must not be taken for granted. Studies must be undertaken to assess the reliability of outpatient compliance, both in collection and ingestion of drugs, and efforts must be made to improve the level of compliance if not found satisfactory. Besides the above, dapsone compliance studies can assess the suitability of a given leprosy endemic area for future antileprosy drug trials. Dapsone compliance is therefore an important parameter of assessing the success and improvement of the leprosy control programme.

Presented here are studies of two compliance cases from two different leprosy endemic areas, Bunyala Location in Busia District and Kadem Location in South Nyanza. Bunyala clinics have on average a very low turnout of patients for drug collection and investigations were carried out on the reasons behind the low attendance rate and how the situation could be improved. Regular ingestion of the collected drugs was also tested. Kadem clinics have, in contrast, a very high attendance rate and ingestion of the collected drugs is the factor which was mainly investigated.

Attendance Rate for Drug Collection

As already stated, attendance is known to be very low for Bunyala leprosy outpatients. To investigate this poor situation, we used a questionnaire specifically concerning drugs at the clinics, location of the clinics, follow-ups for health education, and any other complaints regarding the drugs used in leprosy control.

Ingestion of Collected Drugs

Ingestion was assessed by collecting urine specimens from patients and analysing them for dapsone (or its metabolites as dapsone and creatinine). Outpatient regularity of dapsone ingestion was obtained by comparing dapsone/creatinine ratios in urine specimens from patients receiving treatment with those from non-treated individuals.

Urine samples were collected as follows:

(i) From 20 patients at Alupe Leprosy Hospital who take their drugs under strict supervision and receive the same denomination as the outpatients. Ten specimens of these were from lepromatous patients on 100 mg DDS OD and ten from tuberculoid patients on 50 mg DDS OD.

These specimens were collected a day after the patients ingested their drugs. The samples collected from the hospitalized patients were referred to as positive controls.

(ii) From ten non-treated seemingly healthy individuals.

(iii) From leprosy outpatients after making surprise visits to their homes or places of work in Bunyala Location or after they had visited the clinic. In Kadem Location, urine specimens in this case were only collected from patients who had visited the clinic and obtained the drugs the month preceding the study.

Urine specimens from the controls were analysed immediately after collection while the outpatient specimens were preserved in an equal volume of 2m HCl. After analysis the dapsone concentration was expressed in μg/ml while creatinine was expressed in mg/ml. The dapsone/creatinine ratio was then calculated for each specimen and expressed as a range for each of the three categories.

Results

Attendance rate and questionnaire. Table 14 shows the attendance rates at the various clinics in Bunyala for the collection of drugs during the month of April 1982. Overall the attendance rate for April was only 43%.

Table 14. Attendance of leprosy patients at Bunyala Location clinics

	Registered patients	*Patients collecting drugs in April*	*Attendance rate for April (%)*
Port Victoria	32	19	59
Budalangi	38	4	11
Mukhobola	18	4	22
Mudembi	14	4	29
Rukala	33	27	82
Total	135	58	43

From the questionnaire, the main reasons found to be responsible for the poor attendance rates were:

1. Irregular supply of drugs
2. Location of clinics
3. Role of leprosy assistants
4. Leprosy case reviews.

Urine analysis results. control groups. Negative controls (not on DDS): 3.35-8.56/μg/mg. Positive controls (on DDS). (i) patients on 50 mg DDS OD 22.28-48.43/μg/mg; (ii) patients on 100/mg DDS OD; (iii) patients on 100/mg DDS OD 32.84-69.04/μg/mg.

The patients' level of compliance was categorized into three classes depending on the DDS/creatinine ratios in their urine when compared with the positive and negative controls.

(i) *Not taking or grossly irregular.* This group of patients had DDS/creatinine ratios within the range of the negative controls. The range in this category was therefore negative control range 3-10/μg/mg.

(ii) *Taking but irregular.* Patients with their DDS/creatinine ratios falling within the negative controls but below the minimum for the positive controls range. The ranges in this category were:

50 mg DDS—9-20/μg/mg

100 mg DDS OD—9-30/μg/mg

(iii) *Regular.* Patients with DDS/creatinine ratios falling within the range of the positive controls. For patients on 50 mg, DDS OD 22-48/μg/mg. For patients on 100 mg, DDS OD 32-69/μg/mg.

Studies carried out elsewhere show that the patients classified as regular had at least taken their dapsone tablet 48 hours prior to collection of urine sample while the irregular group had taken it 2 to 4 days before. The grossly irregular patients had either not been taking their drugs or last took them at least a week prior to the collection of their urine sample.

In Bunyala urine samples from a total of 39 patients were analysed out of which only 12 were taking their drugs regularly; 17 were grossly irregular while 10 were irregular. If it is assumed that this is the general level of compliance among all the patients who had collected their drugs, the number of patients complying out of a total of 58 who had collected the drugs would be only 17.

From Kadem, the total number of specimens analysed was 144. Urine analysis results were as follows:

	Number	*Percentage*
Grossly irregular or not taking	39	27
Irregular	30	21
Regular	74	52

The most serious consequences of poor dapsone compliance are the low or no clinical response to treatment and emergence of *Mycobacteria leprae* strains completely insensitive to inhibition by dapsone. This would highly inflate the cost of leprosy control since other drugs usually much more expensive than dapsone would have to be applied. However, if dapsone is used regularly as prescribed it has a low bacterial resistance and is reasonably effective. After the patient has missed 10 consecutive doses, the plasma concentration has fallen below that necessary to inhibit multiplication of *M.leprae* fully susceptible to dapsone.

FURTHER WORK IN DRUG COMPLIANCE—KILIFI AND KADEM

Kadem Study

Various methods have recently been developed to investigate the regularity of dapsone self-administration by leprosy outpatients. This Centre is interested in knowing which of the methods is most suitable. The object of the Kadem study was therefore to collect specimens from outpatients on dapsone to assess the applicability of the various methods in terms of reliability, sensitivity, convenience and cost.

Kadem was chosen since it was already known to have a very high attendance rate for drug collection. From the compliance studies we could also test whether Kadem leprosy patients would be suitable for future antileprosy drug trials.

The methods selected for comparison were:

1. Bratton and Marshall
2. Enzyme-linked immunosorbent assay (ELISA)
3. Haemagglutination inhibition technique (HI)
4. Spot test

Urine and blood specimens were collected from the patients when they visited the clinic for the collection of drugs. The specimens collected in the field were preserved accordingly, pending their laboratory analysis at the Centre. Two specimens were collected from every patient that attended the clinic. Each patient's specimens were subject to the above tests.

All the specific reagents for carrying out ELISA, HI and the spot test were provided by the Royal Tropical Institute of Amsterdam, who also provided one of their scientists to carry out the three tests for which they provided the reagents. The scientist also trained one of the Centre's technologists in the ELISA and HI techniques. The Bratton and Marshall method was carried with the material and personnel from Alupe. From the specimen analysis table 15 shows the preliminary results.

Table 15. **Specimens positive from various test methods (in percentages)**

Method	*Tuverculoid*	*Lepromatous*	*Overall*
Bratton and Marshall on urine	69	54	68.6
ELISA on blood	63	72	64.96
Haemagglutination	58.9	56	58.04
ELISA on urine	83	92	84.7

These results suggest that ELISA techniques are more sensitive, with urine ELISA being the most sensitive. Results, especially of ELISA, are only provisional and the specimens are in Holland for quantification at the Royal Tropical Institute. However, using the Bratton and Marshall method, the Centre went further and assessed the regularity of dapsone ingestion. The results are as follows:

Number of specimens analysed	—	144	100%
Regular ingestion	—	75	52%
Irregular ingestion	—	30	21%
Grossly irregular to not taking	—	39	27%

Therefore there is a higher regularity in drug ingestion at Kadem (52%) than at Bunyala (30%). It is important to note that in general regular patients had taken their dapsone tablets at least two days prior to their urine sample collection. Kadem attendance rate is over 95%. The dapsone ingestion and attendance rate suggest that Kadem patients are better motivated than Bunyala patients. The factors that account for this are being isolated and will appear in the final report on the comparative study of the various methods of the compliance in Kadem.

Kilifi Study

This project is being carried out at the Coast Province. Part of it had already been done in Kwale District by the Coast Leprosy Control Programme with whom we are doing the study.

The study is aimed at finding out leprosy cases that are suspected to harbour dapsone-resistant *M.leprae*. To do this one would have to ascertain that the patients are complying with treatment even though their bacterial index does not improve. The parameters chosen were:

1. BI/MI—bacterial and morphological index
2. Duration of treatment
3. Attendance rate
4. DDS blood levels to test the regularity of dapsone ingestion

Lepromatous patients only were the ones under the study since they are the most dangerous if harbouring dapsone-resistant *M.leprae*. This is because this class is the infectious one and they would pass their *M.leprae*. Also dapsone resistance would make the control of leprosy much more difficult and expensive.

The criteria to be used in selecting which cases should be suspected for dapsone resistance would be where though the duration of treatment is long with a regular attendance rate and a regular ingestion of dapsone, the BI and MI continue to rise or are stationary. Appropriate action may then be taken either to hospitalize the patient and supervise his DDS ingestion or put him on other antileprosy drugs straightaway. Analysis of blood samples for regular ingestion of dapsone is not yet complete. It is important to note that in this study too the samples for the test were taken from only those patients who collected their drugs the month preceding the study; they numbered 181.

The skin smear results were as follows:

Total number of smears examined	—	181
Number of positive smears	—	105
Number of negative smears	—	76

A report on the actual BI and MI results will be written once the blood sample analysis is over.

A PRELIMINARY ASSESSMENT OF SENSITIZATION BY ENVIRONMENTAL MYCOBACTERIA IN BUSIA DISTRICT, WESTERN KENYA

Summary

Evidence from many parts of the world suggests that contact with environmental mycobacteria has important effects on leprosy, which include:

1. direct protection from infection with leprosy bacilli
2. enhancement of susceptibility to infection
3. interference with the protective effect of BCG vaccination
4. determination of distribution of leprosy
5. determination of the proportions of patients at different points in the leprosy spectrum.

The study described is being carried out to decide what part immunologically effective contact with non-leprosy mycobacteria may play in Kenya.

Mycobacteria induce two main forms of cell-mediated immunity, one that appears to protect from infection and the other that may be associated with susceptibility to infection and with some of the pathogenic process of mycobacterial disease. Both types of cell-mediated process can be induced by casually met organisms in the environment.

In the study, healthy children of two age-groups, 6-9 and 13-16, have been skin tested with four reagents from a range of 20 new tuberculins prepared from environmental species. The study area was around Alupe itself with a possibility of extending it from Mount Elgon to Lake Victoria. If the study provides useful information, it will be extended to other regions. So far, 7 species or subspecies appear to be absent from the area studied, another 7 are relatively frequently encountered and 6 are very frequently encountered. The effect this may have on BCG vaccination is presently being assessed.

On the basis of the information available from this study, by the middle of 1983, reagents will be selected for a major prospective investigation of skin-test responsiveness in relation to subsequently developed leprosy.

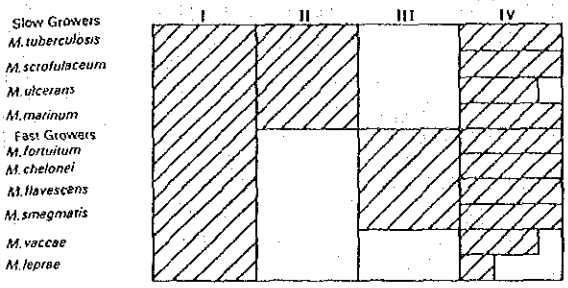


Figure 1. Antigen groups possessed by various *Mycobacterium* species.

From figure, 1, which shows the results of numerous immunodiffusion studies, it can be seen that all species have group i antigens in common and all possess antigens specific to themselves, group iv. Besides these, other groups of antigens are shared by slow growers (group ii antigens), or by fast growers (group iii antigens). The particularly important antigens to remember are those of group i, which are the only ones shared by both the tubercle and the leprosy bacilli.

Table 16 shows the results of five trials of BCG vaccination, three against tuberculosis and two against leprosy. It should be noted that BCG is as

Table 16. **Results of five trials of BCG vaccination**

Protection against tuberculosis		*Protection against leprosy*	
United Kingdom	80%	Uganda	80%
Georgia and Alabama, USA	14%	Burma	17%
South India	0%	Papua New Guinea	50%

good or as poor a vaccine for tuberculosis as it is for leprosy, the results depending on the places where the studies were carried out. The data, when taken together with data obtained from experimental animals in which almost any mycobacterial species operates can be used as a vaccine against any other, show that protective immunity operates through immune recognition of the group i antigens.

Mycobacteria are ubiquitous in the environment, especially the tropical environment, and with the possible exception of desert nomads, all Kenyans must encounter environmental mycobacteria in their daily lives. Contact with these apparently insignificant organisms can give protection from tubercle bacilli and perhaps leprosy bacilli, and can both enhance or block the protective effect of BCG vaccination.

As an essential early step at Alupe in our investigation of the epidemiology of leprosy and immunity to it, we must know to which mycobacterial species the population is sensitive. Such a study, carried out as a student elective project, employed new tuberculins (prepared by ultrasonic disruption and filtration) made from 21 species or subspecies of mycobacteria.

Table 17 lists the reagents that have been used so far. Two skin tests are performed on each forearm and read after 72 hours. The persons tested are school children from villages around Alupe. They are divided into younger and older age groups so that rates of acquisition of positivity to individual species can be measured. The presence or absence of a BCG scar is also noted for each child.

For this work definite induration of 2 mm or more has been taken as a positive response (this is based on many previous studies in other parts of the world). The older children (aged 13-16) were tested first and only those reagents to which 20% or more responded were tested on the younger children (aged 6-9).

Table 17. **Mycobacterial species and the new tuberculins prepared from them**

	Tuberculin
Slow growers	
M.avium (3 immunodiffusion types)	Aviumin A, B C
M.sp.A* (unnamed slow grower)	A*-in
M.gordonae	Gordonin
M.marinum	Marinin
M.scrofulaceum	Scrofulin
M.tuberculosis	Tuberculin
M.ulcerans	Burulin
M.xenopi	Xenopin
Fast growers	
M.chitae	Chitin
M.diernhoferi	Diernhoferin
M.duvalii	Duvalin
M.flavescens	Flavescin
M.fortuitum	Ranin
M.gilvum	Gilvin
M.neoaurum	Neoaurumin
M.nonchromogenicum	Nonchromogenicin
M.rhodesiae	Rodesin
M.vaccae	Vaccin

Table 18 gives the results obtained in school children. The tuberculin response is undoubtedly affected by a BCG vaccination, but no correction has been made for this. The results have been divided into three groups based on the frequency of positivity. *Mycobacterium avium* immunodiffusion type, *M.duvalii, M.flavescens, M.gilvum, M.neoaurum, M.rhodesiae* and *M.xenopi* produce a sensitive response sensitization in less than 20% of the older children and are therefore taken as absent, infrequently encountered or not exerting a sensitizing influence.

Mycobacterium avium immunodiffusion types A and C, *M.kansasii, M.ulcerans* and *M.vaccae* were the most frequent sensitizing agents in the region. *Mycobacterium chitae, M. diernhoferi, M. fortuitum, M.gordonae, M. marinum, M. nonchromogenicum,* and the unnamed species referred to as *M.* sp.A* were present, but perhaps less common.

The younger age group was tested with those species inducing at least 20% reaction in the older age group. The sizes of the groups tested with each reagent varied from 94 to 107 in the younger and from 85 to 99 in the older age group. Tuberculin was included in each set of four reagents and was tested in 490 younger children and 657 older children.

Increasing acquisition of positivity with age and experience of the environment is seen with every species except *M.scrofulaceum.* This

Table 18. **Positive tuberculin response in school children (in percentages)**

		13-16 yrs	*6-9 yrs*
Common	Tuberculin	62	44
	Aviumin A	55	35
	Aviumin C	78	99
	Burulin	57	44
	Kansasin	72	33
	Scrofulin	56	68
	Vaccin	52	38
Present	A*-in	46	40
	Chitin	27	22
	Diernhoferin	34	31
	Gordonin	30	6
	Marinin	44	38
	Nonchromogenicin	43	17
	Ranin	35	10
Uncommon	Aviumin B	12	
	Duvalin	6	
	Flavescin	3	
	Gilvin	14	
	Neoaurumin	10	
	Rhodesin	13	
	Xenopin	13	

anomalous result may be due to chance and requires further investigation. The results were obtained from a number of villages and previous experience suggests there is variation in contact environmental species, even when villages are next to each other.

In 1974 Dr. R.S. Paul carried out some skin test studies in four towns in Kenya, using seven of the reagents employed in our present study. Based on our older age group and Dr. Paul's 11+ age group we have made some comparisons for these reagents, based on 50% or more positive, 20-50% positive. Values for tuberculin positivity to the different areas are shown also; it can be seen that there is considerable variation in sensitization to different species from place to place.

In conclusion, our studies already show that contact with environmental mycobacteria is very common in the Alupe area and that some named species appear to be much commoner than others. We are in the process of completing this initial phase of our work which should identify all major mycobacterial sensitizing influences. Once these are known we intend to investigate the possible importance of each of these species in relation to the epidemiology of leprosy and to the efficacy of BCG vaccination in the study area.

Table 19. Skin-test studies in Kenya towns

	Common	*Present*	*Uncommon*	*Tuberculin positivity (%)*
Kericho	*M. gordonae* *M. neoaurum*	*M.* sp. A* *M. nonchromogenicum* *M. vaccae*	*M. duvalii* *M. fortuitum*	58
Kitale	*M.* sp. A* *M. fortuitum* *M. gordonae*	*M. neoaurum*	*M. duvalii* *M. nonchromogenicum* *M vaccae*	87
Lodwar	*M.* sp. A*	*M. duvalii* *M. fortuitum* *M. nonchromogenicum* *M. vaccae*	*M. gordonae* *M. neoaurum*	45
Marsabit	*M.* sp. A* *M. gordonae*	*M. fortuitum* *M. vaccae*	*M. duvalii* *M. neoaurum* *M. nonchromogenicum*	61
Busia	*M. vaccae*	*M.* sp. A* *M. fortuitum* *M. gordonae* *M. nonchromogenicum*	*M. duvalii* *M. neoaurum*	62

From Paul et al. 1975.

Proposed Studies

In addition to the above ongoing projects, the following are proposed:

1. *A study of the historical, cultural and socio-economic aspects of leprosy in Busia District of Kenya*
   This is being planned in collaboration with the Department of Sosiology of the University of Nairobi. The World Health Organization is funding the project.
2. *A study of multiple-drug regimen using the standard WHO regimen*
   Dapsone monotherapy, which has been employed for more than 25 years, has been shown to possess two serious disadvantages when used for the treatment of lepromatous (BL and LL) patients:
   (a) A significant proportion of patients relapse during treatment due to emergence of dapsone-resistant straints of *M.leprae*.
   (b) Another significant proportion of patients who have been apparently successfully treated for many years, until all clinically and bacteriological signs of the disease have disappeared, relapse after stopping treatment. Many of these patients relapse with dapsone-sensitive strains of *M. leprae*.

It is generally agreed that the best approach to prevent relapsing during treatment with drug-resistant leprosy is to introduce combined therapy, in which patients are treated with a combination of at least two unrelated antileprosy drugs. Multiple-drug regimens would also reduce the likelihood that these relapses would be with dapsone-sensitive *M.leprae*.

Multiple-drug chemotherapy regimens are now being introduced in some endemic countries, but little is known concerning the potential benefits of the different regimens, their efficacy and acceptability.

Kitui District is earmarked for the study.

KENYA MEDICAL RESEARCH INSTITUTE

ALLOCATION OF FUNDS FOR FINANCIAL YEAR 1984/85

ITEM	Clinical Research Centre K£	Respi-ratory Diseases Research Centre K£	Research Centre K£	Vector Biorogy Control Research Centre K£	K£	K£	K£	TMDRC K£	KEMRI HQS K£	RESERVE K£	TOTAL K£
000 Personal ments									820,000		820,000
040 Gratuity & Pcnsion Contributions									100,000		100,000
050 House Allowance									90,000		90,000
060 Other Personal Allowances									11,000		11,000
080 Passages and Leave Expenses									8,000		8,000
100 Transport Operating Expenses	5,500	5,500	5,500	5,500	5,500	3,000		3,000	12,000		60,000
110 Travelling & Accommodation Expenses	2,000	2,500	2,500	2,500	2,500	1,000		1,000	10,000		30,000
120 Postal and Telegrams Expenses				50	50				1,000		1,100
121 Telephone Expenses	500	3,000	500	3,000	2,500		500	500	11,500		22,000
130 Official Entertaiment	20	20	20	20	20	20	20	20	240		400
131 Board Committees & Conference Expenses									15,000		15,000
140 Electricity, Water & Conservancy	100	1,400	300	300	2,000				20,000	5,900	30,000
151 Drugs and Dressings	15,000	12,000	12,000	10,000	10,000	15,000	13,000	15,000	5,000	48,000	155,000
152 Purchase of Research Animals				200	200	1,500		100			2,000
160 Food and Rasions(Patients)	4,000				1,000						5,000
164 Feeds of Animals				500	500	3,500		500			5,000
171 Publishing and Printing									5,000		5,000
172 Uniforms and Clothing									13,000		13,000
173 Library Expenses									12,500		15,000
174 Purchase of Stationery	250	250	250	1,000	1,000	250	250	250	9,500		13,000
175 Advertising and Publishing									1,000		1,000
181 Payments of Rents									80,000		80,000
190 Miscellanceous Other Charges	250	250	250	250	250	250	250	250	3,000		5,000
192 Insurance Expenses									15,119		15,119
195 Training Ezpenses									10,000		10,000

KENYA MEDICAL RESEARCH INSTITUTE

ALLOCATION OF FUNDS FOR FINANCIAL YEAR 1884/85

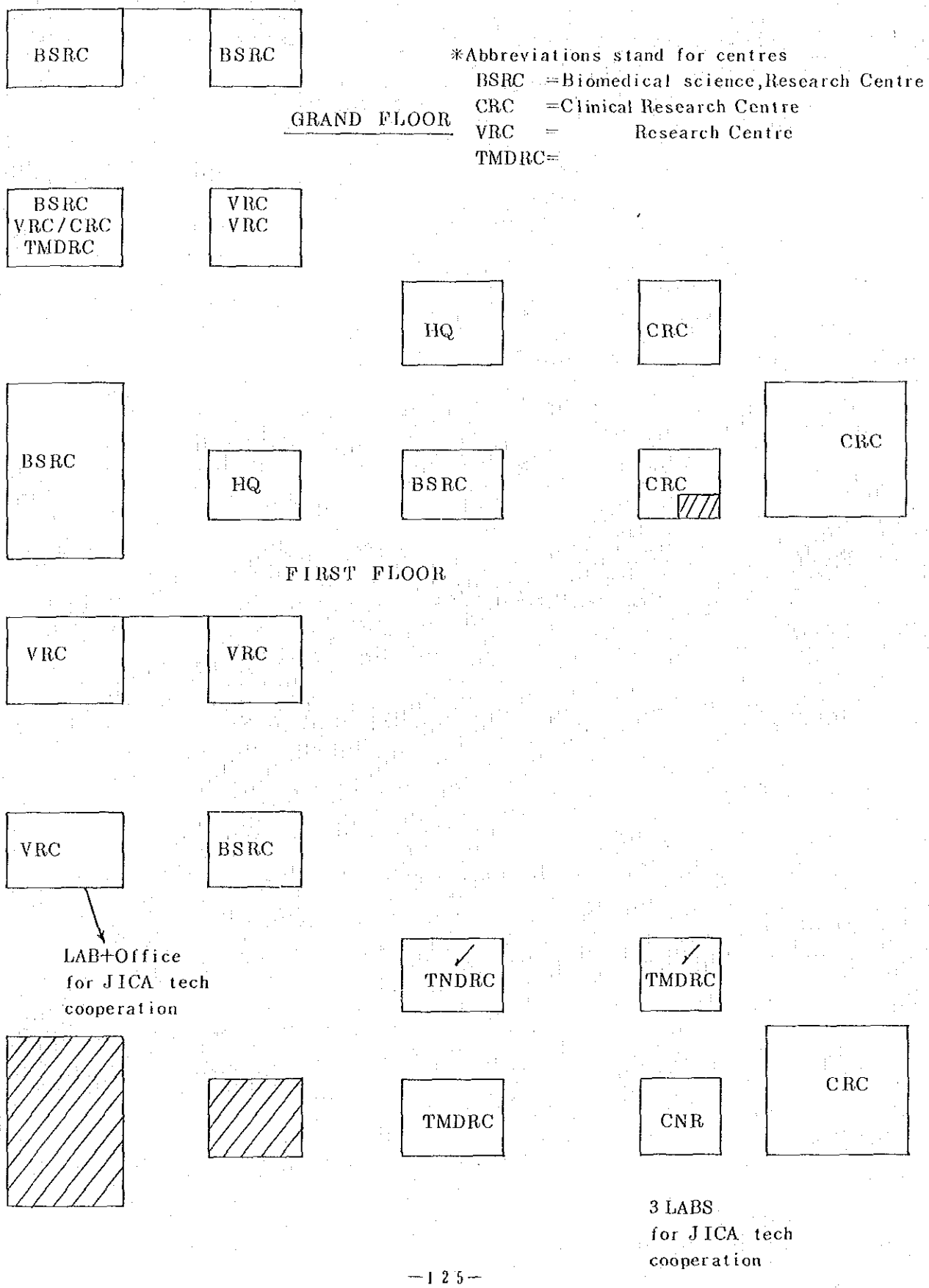
ITEM	Clinical Research Centre K£	Respi-ratory Diseases Research Centre K£	Research Centre K£	Vector Biorogy Control Research Centre K£	K£	K£	K£	TMDRC K£	KEMRI HQS K£	RESERVE K£	TOTAL K£
197 Medical Ezpenses											10,000
220 Purchase of Medical Equipment											30,000*
230 Office Equipment											5,000*
250 Maintenance of Equipment			500	500							5,000
260 Maintenance of Buildings			500	500							5,000
	27,620	24,920	21,320	25,820	27,520	24,520	19,520	20,620	1,301,359	68,400	1,561,619

* No expenditure can be incurred under this item until a requisition to incur expenditure has been signed.

Medical Research Centere is omitted as this is in development durine the handover from the dutch

LAB ALLOCATION

APPENDIX I



EXPATRIATE SCIENTISTS IN KEMRI

NATIONALITY	NO.	FIELDS OF RESEARCH
Ugandan	6	Virology - (2) Microbiologist - Vector Biology Haemology & Blood Transfusion Laboratory Technology
Ghanian	1	Medicinal Chemistry
Tanzanian	1	Tuberculosis & Chest Diseases
Canadian	1	Virology & Immunology
Dutch*	1	Laboratory Equipment Maintenance
Ethiopian	1	Leishmaniasis
British	5	Tuberculosis & Bacteriology Malaria Medical Research (3)
American	3	Malaria - Leishmaniasis (2)
Dutch*	6	Epidemiology Public Health Stastitics (2) Demography Arbovirology

KENYA MEDICAL RESEARCH INSTITUTE

INTERNAL OFFICE MEMO

FROM: ADMINISTRATIVE OFFICER TECHNICAL	DATE: 18th April, 1985
TO: ADMINISTRATIVE SECRETARY	REF:

SUBJECT: SOURCES OF FINANCIAL SUPPORT FOR THE INSTITUTE

1. Walter Reed Army Institute of Research, Washington D. C. U.S.A.

PROGRAMME: Leishmaniasis

CENTRE: B.S.R.C.

SUPPORT: (a) Laboratory equipments
(b) Medical experts.

2. Centres for Diseases Control Atlanta Ga. U.S.A.

PROGRAMME: Malaria

CENTRE: B.S.R.C.

SUPPORT: Transport facilities Laboratory equipments and Medical experts.

3. Wellcome Trust UK.

PROGRAMME: Hypertension

CENTRE: B.S.R.C.

SUPPORT: Medical Experts

4. BRITISH MEDICAL RESEARCH COUNCIL

PROGRAMME: Tuberculosis Research

CENTRE: R.D.R.C.

SUPPORT: Medical Equipments
Training grants
Medical experts

5. Japanese Government

PROGRAMME: Communical Diseases Ephasis Diarrhoea

CENTRE: C.M.R.

SUPPORT: Laboratory equipments
Training facilities
Training grants
Medical experts who have left.

6. W.H.O.

PROGRAMME:	Malaria Leishmaniasis Schistosonomiasis
CENTRES:	B.S.R.C. V.R.C.
SUPPORT:	Research grants Medical Experts Consultants Library Materials Running courses Training grants Reagents.

7. The Netherlands Government

PROGRAMME:	They support all MRC Projects
CENTRE:	M.R.C.
SUPPORT	Training of staff Running courses Medical experts Research Collaboration between KEMRI AND R.T.I.

E. J. Momanyi (Mrs)
(AOT)

HEADQUARTERS

Director	-	1

RESPIRATORY DISEASES RESEARCH CENTRE

Chief Research Officer	-	1
Principal Research Officer	-	0
Senior Research Officer	-	1
Research Officer	-	1
Assistant Research Officer	-	2

VECTOR BIOLOGY & CONTROL RESEARCH CENTRE

Chief Research Officer	-	1
Principal Research Officer	-	0
Senior Research Officer	-	o
Research Officer	-	3
Assistant Research Officer	-	2

CENTRE FOR MICROBIOLOGY RESEARCH

Chief Research Officer	-	1
Principal Research Officer	-	1
Senior Research Officer	-	1
Research Officer	-	1
Assistant Research Officer	-	3

TRADITIONAL MEDICINES & DRUGS RESEARCH CENTRE

Chief Research Officer	-	0
Principal Research Officer	-	1
Senior Research Officer	-	0
Research Officer	-	0
Assistant Research Officer	-	2

CLINICAL RESEARCH CENTRE

Chief Research Officer	-	0
Principal Research Officer	-	0
Senior Research Officer	-	0
Research Officers	-	4
Assistant Research Officer	-	5

MEDICAL RESEARCH CENTRE

Chief Research Officer	-	0
Principal Research Officer	-	2
Senior Research Officer	-	0
Research Officer	-	6
Assistant Research Officer	-	9

BIOMEDICAL SCIENCES RESEARCH CENTRE

Chief Research Officer	-	0
Principal Research Officer	-	1
Senior Research Officer	-	1
Research Officer	-	6
Assistant Research Officer	-	1

LEPROSY & SKIN DISEASES RESEARCH CENTRE

Chief Research Officer	-	0
Principal Research Officer	-	0
Senior Research Officer	-	0
Research Officer	-	1
Assistant Research Officer	-	2

VIRUS RESEARCH CENTRE

Chief Research Officer	-	0
Principal Research Officer	-	0
Senior Research Officer	-	1
Research Officer	-	4
Assistant Research Officer	-	3