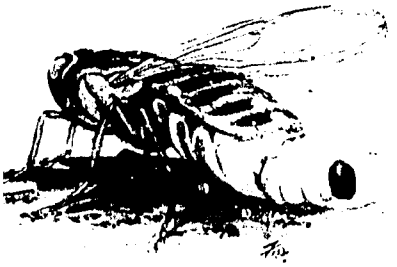
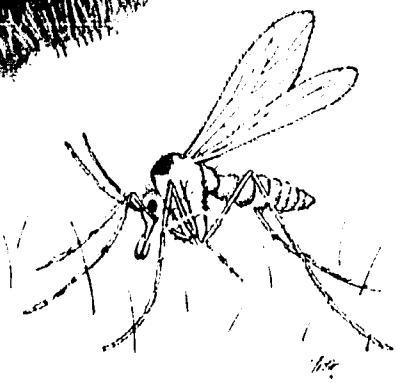
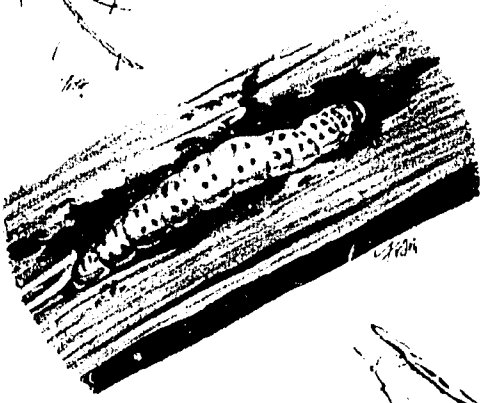
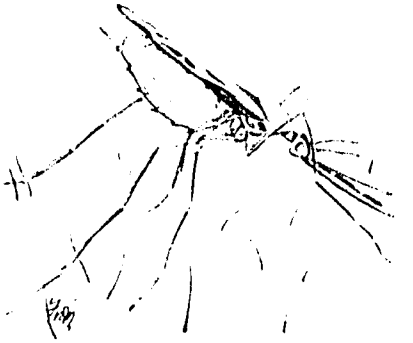








A PROFILE

THE INTERNATIONAL CENTRE OF INSECT PHYSIOLOGY AND ECOLOGY

A PROFILE

THE INTERNATIONAL CENTRE OF INSECT PHYSIOLOGY AND ECOLOGY

ICIPE

CONTENTS

ORIGINS

The International Centre of Insect Physiology and Ecology (ICIPE) was established in April 1970 as an institute for advanced research in insect science and its application. Its world headquarters are in Nairobi, Kenya, and it was originally registered under Kenya Law as a non-profit-making company limited by guarantee and not having a share capital. On 27 November 1986 it was reconstructed as a fully recognised international institution operating under a Charter subscribed to by a wide range of governments in Africa and elsewhere, and secured by a Headquarters Agreement with the host government.

The ICIPE was started, and has evolved over the years, through the efforts of many senior scientists and committed persons, including Professor Thomas R. Odhiambo, its founder and Director, an eminent Kenyan insect scientist who, in the late sixties, recognized the need for high level research into the problems posed by insect pests in the tropics, and especially in Africa. An article written by Professor Odhiambo, then of the University of Nairobi, and published in *Science* magazine in 1967, advocated the establishment of concentrated centres of advanced, multidisciplinary, research in tropical developing countries, to help solve science-based problems and increase scientific capacity in those countries. This article caught the attention of a number of leading scientists in the United States of America and led to exploratory meetings between some of the scientists, senior science administrators and Professor Odhiambo. A planning conference held in Nairobi in October 1969 endorsed the establishment of an international centre of insect physiology and ecology. After registration, the Kenya Government provided the ICIPE with land and facilities in Nairobi, and also granted the Centre a number of privileges under a formal agreement which accorded it limited international status.

To date, the ICIPE remains one of the very few international research centres to be founded and directed by scientists from the developing world themselves. However, it works in close co-operation with the international community, in research, governance, and funding.

The ICIPE came into being at a time when many insect scientists and senior planners were becoming disillusioned by the fact that traditional pesticides, which had already been proved to be environmentally deleterious, seemed to be the main, and in some cases the only, means of pest control. The rise in numbers of insect and arthropod species which were developing resistance to a variety of chemical pesticides, and the threat to beneficial parasites and predators in the course of pesticide use, compounded the problem of environmental pollution. Thus, the Centre was born at a most opportune time, and the fact that it was sited strategically in a tropical developing country assured it of almost immediate international attention.

MANDATE

The prime concerns of the ICIPE are research in integrated control methodologies for crop and livestock insect pests and other related arthropods, as well as insect vectors of tropical diseases crucial to rural health in the tropics (especially in Africa); and the strengthening of scientific and technological capacities of the developing countries in insect science and its application through training and collaborative work. In pursuit of this mandate the Centre seeks:

- To undertake fundamental research on selected pests, to study their identity, abundance, distribution, ecology, behaviour, physiology, pathology, genetics; and to apply this knowledge, through collaboration with national programmes, to the problems of integrated pest and vector management systems, as well as the beneficial use of insects.
- To establish research co-operation with key international research centres and advanced laboratories throughout the world and with the national programmes in Africa and other tropical regions in order to facilitate research as well as the testing and demonstration of pest control strategies.
- To provide advanced training in research methods and techniques for pre-doctoral and post-doctoral fellows, as well as young practitioners in insect science and integrated pest management technology.
- To provide an international forum for the discussion and exchange of knowledge among scientists through seminars, symposia, conferences, and training workshops on new advances in insect science and management strategies for tropical pests and disease vectors.
- To promote by its activities and its special relationships with universities and research institutions, the growth of the scientific community in the tropics, especially in Africa.

GOVERNANCE

Under its Charter the Centre is governed by a Governing Council consisting of sixteen members acting in their individual capacity. Of these, two members are drawn from the host country. Eight members are elected by the Council from nominations solicited from the Sponsoring Group for the ICIPE (SGI), an association of Governments subscribing to the Charter, development assistance agencies, international organisations and others giving financial support to the Centre. The SGI

has its secretariat in the World Bank in Washington, D.C. In selecting candidates for this group of members, experience in the direction and control of international and national research and development (R&D), and in institutional and resource management, are important considerations, as is appropriate geographical distribution.

Five members of the Council are drawn from the world-wide scientific community, eminent in disciplines relevant to the mandate of the Centre (in suitable instances on the recommendation of Academies of Science). The full Council meets regularly once a year. An Executive Board acts on behalf of the Council in between the annual Council meetings on programme policy, management and resources. A Programme Committee established by the Executive Board from the membership of the Council reviews and advises the Executive Board on the scientific programme; and a Nominating Committee advises the Board on nominations for Council membership.

The Director of the Centre, who is appointed by the Governing Council, is the chief executive, and is charged with the responsibility to carry out the mandate of the Centre within the policies and regulations promulgated by the Council, of which he is a full member. He implements Council decisions, and brings to it policy issues. He is thus the main link between the Governing Council and management.

On scientific and technical matters, the Director is supported by a Deputy Director, who acts in his absence and who has responsibility for the scientific programme of the Centre. On other management matters, he is supported by Managers for Administration and Information, and Finance, as well as by the Station Manager for the Centre's largest field facility — Mbita Point Field Station, located in Western Kenya on the shores of Lake Victoria, and the Co-ordinator of the Institutional Building and Interactive Research Unit (IBIRU), which is the focal point within the ICIPE for outreach activities throughout the world.

The Administration and Information Division is charged with the responsibility for human resources management and information as its principal functions, while at the same time looking after general administration, transport services, capital development, the international guest centre system, and utilities. The information section (comprising Publishing and Documentation, and Communication Services) provides an umbrella for the ICIPE Science Press, as well as critical support in areas of publications, documentation, conferences and other public awareness activities. The Mbita Point Field Station Manager ensures that there is proper co-ordination of logistical and other support services and utilities so that the Station and its nearby outstation at Ungoye can function effectively as field facilities. The Finance Division ensures that the Centre's financial management and accounting are in keeping with the financial rules and regulations approved by the Governing Council. It also looks after the supplies function of the whole Centre. A Planning and Develop-

ment Unit (PDU), within the Office of the Director, is in charge of co-ordinating the strategic planning process, budgeting and resource allocation as well as management auditing. An internal audit unit is located within the Office of the Director.

FUNDING

The ICIPE is financed through donations from the United Nations agencies, government aid agencies, and private foundations. The Kenya Government is one of the major donors, and has consistently supported the Centre both financially and in kind.

Since November 1980, the principal ICIPE donors have established an umbrella organisation known as the Sponsoring Group for the ICIPE (SGI), already mentioned above. The World Bank has also established a trust fund for contributions on a grant basis towards ICIPE's capital expenditure. This fund is open to other donors in accordance with the terms and conditions of the agreement between the World Bank and the ICIPE.

The SGI provides the donor members with an opportunity to collectively review, advise and concur in the policies, programmes and goals of the ICIPE; to review proposed biennial budgets and ensure that approved programmes are in line with the anticipated SGI support; and to monitor the quality and relevance of ICIPE's programme performance, especially through the appointment of external review teams from time to time.

The SGI meets regularly to carry out the above functions and to consider requisite funding. The present (1989) membership of the SGI is as listed on page 30.

Presently (1989) ICIPE's recurrent core budget is running at an approximate level of nine million U.S. dollars. In addition the Centre conducts a number of special projects, which are separately funded.

In terms of scientific manpower this means that the ICIPE is operating within a ceiling of 50 international professional staff, with a current (1989) complement of 45 at existing levels of funding. The distribution by percentage of the ICIPE's recurrent resources available for the core research programmes is broadly as follows: Crop Pests 40%; Livestock Ticks 16%; Tsetse 16%; Medical Vectors 8% and IBIRU 20%.

The new Locust Research Programme due to be started in October 1989 will alter these figures.

PROGRAMME

ICIPE's scientific research programme is concerned primarily with tropical insect pests of selected basic food crops and vectors of livestock and human diseases. The crop pests currently under investigation include the borers of maize, sorghum, cowpeas and banana. The livestock pests being studied are tsetse, vector of trypanosomiasis, and ticks, vectors of several debilitating cattle diseases including East Coast Fever. In earlier years, there was considerable emphasis on insect vectors of human diseases. Much of that work has now been phased out, and all that remains is a single project on the sandfly, vector of leishmaniasis (kala-azar), a deadly disease found in the tropics, and especially prevalent in the semi-arid tropics in Africa. However, there are plans to revitalize certain selected aspects of malaria research under the Medical Vectors Research Programme.

ICIPE's research programmes are supported by five research units which provide back-up assistance in chemistry, cell biology, sensory physiology, biomathematics and computer usage, and social science interface. All of the research undertaken by these units is focused on the selected target insects, and most of the work is done in collaboration with the core programmes.

Training at the ICIPE is concentrated in three major areas: professional scientific training at postdoctoral and postgraduate levels; short-term courses in pest and vector management for practising insect scientists and technicians; and a staff development programme for upgrading the special skills and techniques of ICIPE's own employees.

Research support services provide essential elements of support to the research and training programmes. They include Mbita Point Field Station (MPFS), Workshops and Laboratory Service Unit, the International Guest Centre System, the Mbita Point International School, Saint Jude's Clinic at Mbita Point, and Saint Luke's Clinic in Nairobi.

CORE RESEARCH

CROP PESTS

Previously, research on insect pests of crops at ICIPE was carried out under three programmes: Bases of Plant Resistance to Insect Attack, Crop Borers, and Insect Pathology and Pest Management. Since January 1984, following the recommendations of the First Triennial Review, all research on crop pests was amalgamated into one programme: The Crop Pests Research Programme. This programme is divided into four sections: Plant Resistance to Insect Pests (PRIP), Biological Control (BC), Bionomics and Applied Ecology (BAE) and Insect Mass-Rearing Technology (IMRT).

The programme is aimed at developing strategies for the effective management of certain key insect pests of sorghum, maize, banana and cowpea (as the first target crops) by methods which are environmentally safe and economically feasible for subsistence farming conditions in tropical developing countries.

The major target insect pests under investigation are those of sorghum, maize, cowpea, and banana in tropical countries; and of rice in the Philippines by an ICIPE resident team. Studies on the biological control of green spider mite have recently been included under a special IFAD-supported project. These crops have been selected because they constitute the main staple diet of a growing majority of the people of the tropics. The principal target pests and their host crops can be summarized as follows:

Maize and sorghum stem-borers; especially *Chilo partellus, Busseola fusca* and *Eldana saccharina.*

Cowpea pod-borer, *Maruca testulalis.*

Sorghum shootfly, *Atherigona soccata.*

Banana weevil, *Cosmopolites sordidus.*

Cassava green spider mite (biological control only).

Rice leaf-folders *Cnaphalocrocis medinalis* Guenee and *Marasmia patnalis* Bradley (in collaboration with IRRI, in the Philippines).

The major thrust of the Crop Pests research is to refine, for eventual field application, the various components of integrated pest management technology being developed by the different sections. The long-term objective is to make this technology comprehensive, sustainable, adaptive to diverse agroecological systems, and responsive to new developments in areas such as plant biochemistry, plant genetic engineering and the biotechnology of biological control agents.

BIONOMICS AND APPLIED ECOLOGY

This section aims at developing methodologies for (a) assessment of crop losses, (b) monitoring and surveillance of pest populations, and (c) assessment of the efficiency of different cultural control practices and behavioural manipulation in suppressing the pest populations.

Achievements

- Methodology for assessing grain yield reduction caused by the crop borers has been standardized. It has been discovered that losses caused by *C. partellus* are higher when the plants are young (i.e. 20 days after crop emergence) than when they are old (i.e. 40 days after emergence). This fact suggests that early planting of sorghum could reduce losses, since the plants would be old at the time when maximum borer infestation occurs.
- The possibility of rearing *B. fusca* continuously, without an intervening diapause, on natural host has been demonstrated. Information was gathered on the reproductive capacity of diapausing and non-diapausing generations of *B. fusca* and *C. partellus*. These results could hold the key to a new strategy for pest management based on communication disruption.
- Information on the population patterns of stem-borers, in relation to crop phenology and carry-over mechanisms, suggests that cultural practices, such as early planting, disposal of crop residues, and destruction of volunteer or alternative host plants, can suppress the stem-borer populations.
- Borer attacks on the target crops have been demonstrated to differ according to the crop combinations used for intercropping. The crop combinations examined included host and non-host as well as intervarietal combinations; and it has been shown experimentally that intercropping can serve as an important component in an integrated pest management system.

PLANT RESISTANCE TO INSECT PESTS

The main objectives of this section are to elucidate the principles which impart resistance or susceptibility to insect pests in different plant species or varieties. The studies are intended to provide appropriate information to plant breeders in various national or international agricultural centres to facilitate the development of cultivars which incorporate resistance-imparting characters, or which eliminate susceptibility-imparting characters. Cultivation of such cultivars would serve as an important component of an integrated pest management programme. It is also hoped to develop methods of manipulating the resistance or susceptibility imparting plant characters in such a way as to interrupt the build-up of the pest populations and thus contribute to their management.

To achieve the above objectives, the Section is carrying out research to evaluate and confirm resistance in germplasms of the target crops received from different national or international centres against their key insect pests. Investigations into the bases of resistance or susceptibility in these plant materials, and the genetics of their resistance to the target insect pests, are also being studied.

Achievements

- Standardization of methodology for evaluation of maize and sorghum germplasm for resistance to *C. partellus*.
- Development of methodology for investigating mechanisms of plant resistance to the target pests, particularly their colonising responses and the plant characters involved.
- Identification of borer-resistant maize, sorghum and cowpea cultivars belonging to two categories: (a) those cultivars which combine borer resistance with good agronomic qualities, and (b) those cultivars which are agronomically inferior but can serve as good sources of resistance.
- Genetic studies have suggested that inheritance of sorghum resistance to *C. partellus* is polygenic, and that both resistance and tolerance mechanisms are involved. However, the mechanisms of tolerance and resistance appear to be controlled by distinct and different sets of polygens.

BIOLOGICAL CONTROL OF INSECTS

The long-term objective of the Biological Control section is to study and develop biological control as a component of an integrated pest management programme that suits subsistence farming systems in tropical Africa. The cereal stem-borers, *Chilo partellus* and *Busseola fusca*, which are major pests of maize and sorghum; the banana weevil *Cosmopolites sordidus* (Germ.); and the pod-borer, *Maruca testulalis*, a major pest of the cowpea, have been chosen as target pests in an effort to improve the production of these important food staples in Africa.

Achievements

- Identification of certain parasitoids and pathogens of the target pests, which can be investigated further as suitable candidates for use in the biological control of the crop-borers.
- Completion of the studies on the basic biology and incidence of these natural enemies of the target pests.
- Determination of the effects of introducing certain selected pathogens and parasitoids against *C. partellus* under screenhouse conditions or in small field trials.
- Successful rearing of parasitoids and culturing of the pathogens.
- Biotaxonomic investigations have shown that there may be intermediate forms of cassava green spider mites, between *Mononychellus progressivus* and *M. tanajoa*. Evidence for natural mortality agents (pathogens) against the cassava mite has been observed in field-collected mites.

INSECT MASS-REARING TECHNOLOGY

This section is divided into two sub-sections: research and development and support services. The research and development sub-section, located primarily at Duduville in Nairobi, is the research wing, whose function is to formulate and test insect diets for mass production of insects. The support services sub-section caters for the demands of all other programmes and units of the ICIPE, with branches both at Duduville and Mbita Point.

Achievements

- Development of improved techniques for rearing *Chilo partellus* and *Maruca testulalis*.
- Development of diets that last throughout the larvae growth period. An efficient collection system for first-instar larvae of *C. partellus* has also been developed and is now in use.

LIVESTOCK TICKS

Throughout the tropics, but particularly in Africa, tick-borne diseases and the debility caused by tick infestation are major factors limiting livestock production. Some of the diseases transmitted by ticks are not amenable to prophylaxis or chemotherapy. Frequent application of acaricides to the host animals through dips or sprays is associated with many adverse effects, such as development of resistance to acaricides by ticks, toxicity to host animals and the presence of chemical residues in beef and dairy products. But perhaps the greatest disadvantage resulting from intensive use of pesticides to control ticks is that cattle become very susceptible to all tick-borne diseases and are naive to tick infestation. Thus, if acaricide control breaks down for any reason, massive tick populations are produced and thousands of cattle may die.

The Livestock Ticks Research Programme has given high priority to accumulating information on ecology and physiology of selected tick species, and attempts are being made to develop techniques to be used in integrated systems of tick and tick-borne disease control. These control measures will be inexpensive and will avoid total dependence on pesticides. The programme currently deals with the following:

The ecology of cattle ticks
Integrated control of ticks and tick-borne diseases
Production of tick antigens from tick cells grown *in vitro*
Preparation of a model involving population dynamics of the ticks.

The programme has made significant advances towards developing certain components for integrated control of livestock ticks. It has been shown that cattle can be made resistant to the Brown Ear Tick, *Rhipicephalus appendiculatus*, the vector of East Coast Fever, through experimental exposure to ticks or tick-infested paddocks. The cattle thus made resistant can be used to greatly and progressively reduce field population of ticks, especially in situations where the ticks have no access to alternative hosts (e.g. by paddocking). Further, laboratory animals have been made tick-resistant

by inoculating them with the homogenates of engorged ticks. In collaboration with the International Laboratory for Research on Animal Diseases (ILRAD) and the Kenya Agricultural Research Institute, (KARI) at Muguga, ICIPE scientists are carrying out trials using tick-resistant cattle in enzootic areas of western Kenya. Other immunological studies at the ICIPE suggest that antigens are involved in the induction of resistance.

Achievements

- Several antigens and protein sub-units derived from tick midgut tissue have been fractionated. This is the essential first step in the development of an anti-tick vaccine.
- Tick embryonic cell cultures of *R. appendiculatus* and *R. evertsi* have been established. They have been shown to have common antigens with tick salivary glands.
- Soluble protein extracts derived from embryonic *R. appendiculatus* cells have been used in an intra-dermal test in cattle to detect previous exposure to ticks. The antigen produces a local intradermal immediate hypersensitive response of the host. This test shows promise for screening large numbers of cattle to select tick-naive animals for experimental use.
- Tick vitellin has been isolated and purified.
- A comparison of three strains of *R. appendiculatus* from field sites, where they always feed on livestock, with the long-established laboratory strain reared on rabbit, showed that the field strains withstand the effects of tick-feeding induced resistance better than the laboratory strain. This finding will be valuable in selecting the tick strains to be used in assessing resistance.

TSETSE

The tsetse fly is a vector of trypanosomiasis, one of the major tropical diseases in Africa. It is not only a serious public health problem, causing a fatal disease in humans (sleeping sickness), but also causes nagana in cattle, a major limiting factor in livestock production. The overall goal of the Tsetse Research Programme is to contribute to the improvement of animal productivity, as well as the quality of human health through laboratory and field investigations of tsetse vectors in order to reduce trypanosome risk and challenge.

The Tsetse Research Programme, which involves a number of specialized disciplines, is divided into three major project areas: tsetse ecology, tsetse reproductive physiology, and trypanosome vector physiology. A few of the significant findings from tsetse research at the ICIPE are:

- Studies, including the screening of a variety of chemical natural products as a factor in attracting tsetse to traps, have revealed that buffalo urine contains a potent attractant. This is likely to prove a major factor in both tsetse sampling and tsetse control.

- A more effective trap (the Ngu trap), developed at the ICIPE's Nguruman Field Research Site, can be used as part of a community-based strategy for tsetse control. The new trap costs less than the biconical trap, yet catches on average three times more *Glossina pallidipes* than the conventional biconical trap. Moreover, it can easily be made on site by the farmers themselves.
- A dynamic tsetse population model has now been developed using data gathered from three years of research at Nguruman on a Maasai group ranch. The model is already able to predict seasonal population change; and its predictive effectiveness has been improved greatly. Extensive mark-release-recapture studies are being used to relate biconical trap catches to absolute population size. Density-dependent pupal mortality has been demonstrated in the field.
- Research over the years has revealed the presence of a virus which causes enlarged salivary glands in the main trypanosomiasis vector in Kenya, *G. pallidipes*, which makes them rather ineffective in feeding. Further investigations have shown that the virus also causes a high level of sterility in the male tsetse. This finding paves the way for an alternative strategy for biological control of tsetse using a novel sterile-insect technique.
- Scientists at the ICIPE's Mbita Point Field Station have succeeded in rearing *G. pallidipes* in an insectary with rudimentary facilities, whereas many research groups with far more sophisticated facilities have failed to establish *G. pallidipes* colonies.
- *Trypanosoma brucei*-infected tsetse have been shown to be under stress, making them more susceptible to sub-lethal doses of pesticides than normal healthy flies. This implies that control measures, e.g. insecticide-impregnated screens, could reduce trypanosome infection by inducing selective mortality of infected flies.
- The presence of three families of anti-bacterial proteins, namely: lysozyme, attacins, and cecropins has been demonstrated in the tsetse haemolymph. Two proteins of 17 and 70 kD have also been demonstrated to be specifically associated with the disappearance of bacteria in tsetse haemolymph. A mating stimulant (dimethylpentariacontane) associated with the cuticular wax of the female tsetse, *Glossina pallidipes*, has been isolated, identified and synthesized.
- Abortion and sterility can be induced in tsetse by some insect growth regulators (e.g. altosid) and related compounds (e.g. procene).

Findings from population dynamics studies are leading to a better understanding of the environmental forces acting on tsetse populations that determine their abundance and distribution. Efforts to find natural larviposition sites have been successful, and pupal parasites have been identified. As more is known about these natural forces, we will be in a better position to adopt the correct strategies for tsetse control or eradication. Ecological research is also aimed at a better understanding of the concept

of 'challenge' — the risk to livestock of contracting trypanosomiasis in a given tsetse area. A quantitative estimation of challenge is an essential foundation upon which to establish proper animal husbandry procedures and therapeutic prophylactic drug regimens against trypanosomiasis.

MEDICAL VECTORS

The Medical Vectors Research Programme (MVRP) dates back to 1972, making it one of the oldest programmes at the Centre. In the early years, emphasis was placed on mosquito vectors of yellow fever, malaria and filariasis; but in 1979 research was extended to vectors and animal reservoirs of leishmaniasis. Unfortunately due to lack of adequate funding, mosquito research was suspended at the end of 1982, although a nucleus of post-graduate students continued with some investigations.

Recently, however, as a result of increased interest in malaria, the ICIPE decided to revitalize selected areas of mosquito research, with emphasis on integrated vector management strategies based on ecological and epidemiological investigations.

Since 1982 the Medical Vectors Research Programme has been concentrating on identifying and characterizing the vectors, parasites and reservoirs responsible for leishmaniases in tropical Africa, and in undertaking relevant ecological and physiological research which might lead to the development of control methods for reducing leishmaniases in humans through vector and reservoir control. The disease affects a large number of people in potentially productive agricultural areas; and it is estimated that approximately 400,000 new cases are reported every year throughout the world. The disease is often fatal; but even when it is not it causes severe and permanent disfigurement in the affected parts of the body.

The programme is also undertaking epidemiological investigations on target vectors i.e. vector ecology, vector-host interaction, vector identification and vectorial capacity, with the intention of developing integrated management of the disease through vector control.

Achievements

Among the achievements to date the programme can highlight the following:

- Investigations on the feeding habits of sandflies using mammals, reptiles, and birds, have led to the identification of preferred hosts. The findings have been employed to intensify studies on candidate vectors of leishmania of man and animals in Baringo District.
- The breeding sites of most of the species of sandflies in Baringo District have been elucidated through introduction of new techniques and modification of the standard methods of studying sandfly breeding sites. This is a major achievement, since the the question of breeding sites of phlebotomine sandflies has puzzled researchers in East Africa for over two decades.

- Leishmanial parasites were isolated in Kitui and Baringo Districts of Kenya from three species of sandflies which were suspected to be vectors of leishmaniases of man and animals. Through animal infertility studies, the clinical picture that emerged resembled that of *Leishmania major* for parasites isolated from two *Sergentomyia* species, which have so far not been incriminated in transmitting this disease.
- Laboratory experiments on vectorial capacity: A laboratory-bred colony of various species of sandflies was used in investigating the vectorial capacity of *Sergentomyia* species of sandflies; some species were shown to be capable of picking up human leishmania *(L. donovani)*. This goes a long way to show that this group of phlebotomine sandflies can naturally become infected with human-type leishmania.
- Taxonomic studies of complex species of vectors of both visceral and cutaneous leishmaniases were undertaken. Previous to these studies, it was not possible to differentiate between the female forms responsible for the transmission of *L. aethiopica* and the *Synphlebotomus* complex. Questions were raised as to whether these were actually distinct species. The studies have shown that they are distinct biomedically, even though they look alike morphologically.

LOCUST

The long-term objective of ICIPE's newest programme, the Locust Research Programme, is to develop, in collaboration with other concerned research institutes, and with international donor support, a preventive integrated locust management system that can keep the locust in its relatively harmless solitarious state on a sustainable basis. When fully developed, the Programme will have four main components:

- Biological Control
- Semiochemicals
- Endocrinology
- Population dynamics and simulation modelling

In keeping with ICIPE's tradition of selecting some of the most difficult pest management problems for its research and development effort, the new programme seeks to address a challenge that has been with mankind since biblical times.

INSTITUTIONAL BUILDING AND INTERACTIVE RESEARCH

This Unit provides an outlet to national research systems for information, methodologies and technology developed by the Centre and for training opportunities for national manpower development. This strengthens the ICIPE's commitment to existing collaborative linkages in research and development and paves the way for establishing new linkages with more national laboratories for the purpose of sharing information and technology.

INTERACTIVE R & D

The objectives of the ICIPE's interactive research and development are: firstly, to facilitate further testing and development of integrated pest and vector control strategies at the national networks; secondly, to develop national capabilities in order to facilitate and enhance the ICIPE's mandate and objectives in the application of pest management technology, and consequently to create foci for interacting with national research programmes; thirdly, to assist in building local scientific and technological capacities of tropical developing countries, particularly in Africa, where the focus is on strengthening national research programmes to make them better-equipped for transfer of pest management technologies.

TRAINING

Through its training component the unit identifies training needs of national programmes in tropical developing countries, particularly in Africa, in areas of the ICIPE's competence and endeavours to develop suitable training programmes and strategies for delivering the training.

The ICIPE offers various levels of training in order both to meet international institutional goals of staff development and to increase the scientific and technological capacity of developing nations. The objectives of the ICIPE's main training programmes are summarized below:

Postdoctoral Research Fellowship Programme (PRFP)
The Postdoctoral Research Fellowship Programme provides an opportunity for young scientists all over the world to gain experience in a relevant environment, working in one of the core research programmes of the Centre. The programme is also used by the ICIPE to develop its own scientific manpower.

African Regional Postgraduate Programme in Insect Science (ARPPIS)
African Regional Postgraduate Programme in Insect Science (ARPPIS) is a unique approach to postgraduate training. The ARPPIS is a collaborative programme between the ICIPE and 14 African universities in which students register with a participating university for a Ph.D degree of that university but carry out their research work at the ICIPE using the facilities and expertise of the Centre. ARPPIS harnesses together the need of the universities to have high calibre insect scientists with the experience and resources of the ICIPE, and so helps to produce well-trained, highly motivated African insect scientists able to tackle the pressing problems of insect pests in tropical Africa.

Up to 8 students are admitted to the programme in March each year. The course lasts three years and starts with a six-month period of compulsory coursework intended to bring all students to the same high level of under-

standing within essential areas of insect science. After the course examinations have been passed, the students start their research project. This is designed in consultation with ICIPE scientific staff and is directed by an ICIPE scientist, who serves as the external supervisor, with a member of staff from the registering university as the internal supervisor. After three years, a completed thesis is submitted to the registering university for examination and subsequent award of a Ph.D degree.

In order to be admitted to ARPPIS, students must have a Masters degree or its equivalent, in entomology or parasitology, and he or she must come from a member state of the Organisation of African Unity (OAU). Each student is given a scholarship which provides, among other things, university registration fees, a stipend and a small research grant. Many international donors continue to fund these scholarships.

The ARPPIS is advised on all matters of policy by the Academic Board which is composed of the Director of ICIPE as Chairman, a representative of each participating university, and senior administrative staff of the ICIPE. The Academic Co-ordinator is responsible for the day-to-day administration of the programme, assisted by a ten-member Board of Studies.

The 1989 ARPPIS Ph.D. class was the seventh to be admitted to the programme. Almost 60 Ph.D students from 12 African countries have now registered with ARPPIS and the number of participating universities has increased to 14.

By the end of 1988 nine ARPPIS students had been awarded their degrees, five had submitted their theses and were waiting to defend their work, while nine more were finalizing their theses prior to submission. All ARPPIS graduates are working in Africa as active scientists in keeping with the original ARPPIS philosophy.

International Group Training Courses (IGTC)

The International Group Training Course for Ecologically Sound Pest and Vector Management Systems deals with pest management practices in rural farming communities and is intended mainly for practitioners. The programme includes lectures, practical sessions, and field trips for first-hand exposure to actual situations in a rural setting. The course is sponsored jointly by the ICIPE and the United Nations Environmental Programme (UNEP), and attracts participants from all over the developing world.

PESTNET

The Pest Management Research and Development Network (PESTNET) for integrated pest management was initiated in 1985 on recognition by African countries that their individual resources of trained manpower and funds are not equal to the tasks of combating losses due to crop and livestock pests. With the need for collaboration established, the network started in October 1985 with USAID and

UNDP-sponsored missions, followed by a planning workshop in Nairobi with representatives of 5 countries in the region.

A programme of work for PESTNET was endorsed in June 1986 by representatives of 9 member-governments who met in Nairobi. The ICIPE, which was selected to host the Secretariat, started a full-scale programme of implementation soon thereafter.

As at January 1989, there were ICIPE-PESTNET scientists resident in Zambia, Somalia, and Kenya; and there were plans to send similar teams to other African countries, including Rwanda and Senegal.

FAMESA

The Financial and Administrative Management of Research Projects in Eastern and Southern Africa (FAMESA) project was initiated to improve research management skills and performance of managers of national scientific R & D institutions.

Through its activities, FAMESA develops research management training curricula and assists in the implementation of training at the regional as well as national levels by supporting curriculum development and training of trainers workshops.

Apart from curriculum development and delivery of training courses, FAMESA has established R & D management information and documentation and advisory services in order to achieve the long-term objectives of strengthening management capacities of African research institutions.

Research Associate Scheme

The Research Associate Scheme provides an opportunity for mid-career scientists to develop research-related experience in insect or insect related sciences through working with more experienced scientists at the ICIPE on on-going research programmes. The Scheme's main objective is to equip the awardees with effective techniques and methodologies and acquaint them with recent advances in their areas of expertise so as to improve their operational performance.

RESEARCH SUPPORT

CHEMISTRY AND BIOCHEMISTRY

The primary role of the Chemistry and Biochemistry Research Unit (CBRU) is to carry out collaborative research with the ICIPE core programmes in areas of chemistry and biochemistry which are pertinent to their goals. Specifically, the Unit provides support to isolate and characterize antigenic proteins which may be useful in preparing anti-

arthropod vaccines; and to isolate, identify and synthesize insect-active compounds (pheromones, kairomones and allomones) which may be useful in the management and control of insect pests and vectors.

Achievements

In tick biochemistry, the major egg-yolk protein from *Rhipicephalus appendiculatus* has been purified, characterized and tested as an immunogen in rabbit. A carboxyl proteinase in the midgut of *R. appendiculatus* adult female has been identified, partially purified, and characterized. Anti-serum preparation to this enzyme raised in rabbits completely blocked the enzyme activity in an *in vitro* assay.

- A blend of seven simple phenols present in buffalo urine has been shown to give a 7-fold increase in tsetse catches in the field. These compounds appear to be derived from a reservoir of water-soluble precursors, the breakdown of which provides a built-in mechanism for controlled release of the phenols.
- In crop plant allelochemical studies, an ethyl acetate extract of the stems of a resistant variety of cowpea has been shown to have a feeding deterrent effect on *Maruca testulalis* larvae.
- Stimulation of oviposition on sorghum shoots by the sorghum shootfly, *Atherigona soccata,* has been shown to be due to a mixture of polar and non-polar components, two of which have been identified.
- A number of chemicals with anti-insect activities have been isolated from tropical plants, and include several new compounds.

CELL BIOLOGY

The Cell Biology Research Unit supports the ICIPE's core programmes by carrying out research on the morphology and function of cells and tissues of target insects, as well as pathogens and pathological materials. Approximately 60% of the scientists' time is assigned to programme support research, while the remaining 40% is spent on complementary basic research in relevant areas.

SENSORY PHYSIOLOGY

The main objective of the Sensory Physiology Research Unit is to provide supporting evidence to ecological and behavioural studies undertaken by the ICIPE's core research programmes, by determining the role which sensory and chemical systems play in various aspects of insect life, including communication and pest-host relationship. Methods of investigation are based on electrophysiological and behavioural techniques. Knowledge of the sensory basis of behaviour is useful when developing insect pest control methods based on the manipulation of insect behaviour.

The primary goals of the Biomathematics Research Unit (BRU) are (a) to assist ICIPE scientists and their collaborators with quantitative aspects of research, particularly experimental design, data analysis, system modelling, and geographic information systems (GIS); (b) to provide training in data management, biomathematics, computer usage, analytical methodology for the acquisition and interpretation of data; (c) to develop a research capacity to work in on-line data processing and expert decision support systems; and (d) to develop new methods for quantitative analysis of population data, and the interfacing of this data with environmental monitoring.

In the long run the supportive role of the Unit will permeate all the research, training, and administrative activities of the ICIPE.

SOCIAL SCIENCE INTERFACE

The recently established Social Science Interface Research Unit (SSIRU) has given ICIPE's biological scientists the necessary socio-economic framework in which new integrated pest management technologies can be validated and eventually adopted by the resource-poor rural communities in Africa. The Unit's long-term objectives include the following:

(a) Development of an interactive research approach and a multidisciplinary methodology which will enable the Centre to have a comprehensive view of the problem of pest and vector management in its socio-economic context.

(b) Identification and analysis of farmers' indigenous traditional knowledge base in relation to agriculture, and human and animal health.

(c) Analysis of forces of change which shape farmers' opportunities for technology adoption, and their receptivity to new or improved pest and vector management strategies.

(d) Incorporation of socio-economic considerations into the Centre's biological research agenda.

So far social scientists from the Unit have successfully interfaced with the Livestock Ticks Research Programme in Rusinga Island, next to Mbita Point Field Station, and at Mariakani in the Coast Province of Kenya: and with the Crop Pests Research Programme in a joint ICIPE-Economic Commission for Africa (ECA) pilot project at Oyugis in South Nyanza District. Both the target farmers and the biological scientists participating in these projects have fully appreciated the social science input, which will eventually run through all of ICIPE's community-targeted research activities.

COLLABORATION

Scientists at the ICIPE in their respective research programmes work closely with many related advanced laboratories and institutions throughout the world. Collaboration can be on a one-to-one basis, between scientist and scientist, or it may be through a formal agreement between the ICIPE and another research centre or institution. While the following list of collaborating institutions is by no means exhaustive, it gives an indication of the extent and quality of ICIPE's collaboration with other institutions worldwide:

Kenya Ministry of Agriculture: Project on maize and sorghum tolerance to *Chilo*

Ivory Coast: Research and training in insect sensory physiology and fine structure in relation to crop-borers.

International Rice Research Institute (IRRI): Project on the rice leaf-folder; germplasm testing of rice to major pests in Africa.

International Institute of Tropical Agriculture (IITA); Germplasm testing to major African stem-borers, and development of IPM for cowpea-based cropping systems.

Kenya Ministry of Health: Research on leishmaniases and malaria.

International Laboratory for Research on Animal Diseases (ILRAD): Research on livestock ticks and on the sensitivity of trypanosome-infected tsetse to pesticides.

Kenyatta University, Kenya: Resistance to ticks in sheep and goats.

University of Neuchatel, Switzerland: Research on immunological aspects of livestock ticks.

Somalia Ministry of Agriculture: Research and training in stem-borers of sorghum and maize in rainfed and irrigated farming.

International Atomic Energy Agency (IAEA): Research and training on the use of radioisotopes for insect biochemistry and ecology in Africa.

Kenya Agricultural Research Institute (KARI): Agronomic and social science interface research.

Kenya Trypanosomiasis Research Institute (KETRI): Research on the use of traps and insecticide-impregnated screens in the suppression of tsetse in trypanosomiasis-endemic areas.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT): Testing of sorghum shootfly and major African stem-borers.

Centro International de Mejoramiento de Maiz y Trigo (CIMMYT): Germplasm testing to maize stem-borers.

The British Museum (Natural History): Taxonomy of sandflies.

Imperial College, London: Blood-meal analysis for determination of sandfly vector species.

Universidade Federal de Minas Gerais, Instituto de Ciencias Biologicas, Brazil: Identification through immunological studies of leishmaniases animal reservoirs.
Tokyo University of Agriculture and Technology: Studies involving ligation of tsetse larvae.
University of Lund, Sweden: Moth pheromones, with emphasis on *Chilo partellus*.
University of Alberta, Canada: Research on tsetse genetics.
Instituto Guido Donegani, Italy: Screening for anti-pest agents from African tropical plants.
Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD): maize borer research and staff exchange with the Philippine university system.
Kagera River Basin Organisation (KBO): Tsetse control
Somalia: PESTNET resident team.
Zambia: PESTNET resident team.

PHYSICAL FACILITIES

The world headquarters of the ICIPE, including its administrative offices and principal research laboratories (other than those for the Crop Pests Research Programme) are located at Duduville, some 12 kilometres from Nairobi City Centre, off the Nairobi-Thika Highway.

The completed segments of Duduville Capital Development Programme Phase II, comprising laboratories, insectaries, maintenance workshops, stores, and an administrative block, were funded through grants from the World Bank, the Opec Fund for International Development, and the Kenya Government. Work on Phase III, a Swiss-funded Library and Documentation building, will commence early 1990, to be followed, subject to availability of funds, by a training facility and the expansion of the Duduville International Guest Centre. Also still to be funded is a conference centre, which will more or less complete the headquarters development programme for the foreseeable future.

Much of the research of the core programmes requires extensive long-term ecological observations in a variety of tropical ecosystems. For this reason, experiments and data collection are carried out in many different parts of the host country. Kenya is ideally suited for this purpose, as it has a great variety of ecosystems and altitudes ranging from the east coast at sea-level to the highlands that rise to more than 3,000 metres above the sea-level. This enables ICIPE scientists to conduct experiments simultaneously under different climatic and ecological conditions.

MBITA POINT FIELD STATION

Mbita Point Field Station was established in 1978 as a multi-programme research station on a 50-acre plot granted to the ICIPE by the Kenya Government. It is on the shores of Lake Victoria, about 500 kilometres from Nairobi. The Station currently accommodates the Crop Pests Research Programme, as well as long-range ecological aspects of the Tsetse and Livestock Ticks Research Programme.

The Station complex consists of a farm, laboratories, administrative offices, green house, a maintenance facility, an international guest centre and staff housing. Support facilities include an international school and a clinic. The Station has its own electricity and water supplies and has transformed a remote outpost into a bustling little frontier town, with many of the amenities associated with modern city life.

Much of the research at MPFS depends on close co-operation between ICIPE scientists and the neighbouring farmers, and some of the experiments are conducted on the farmers' own fields. Thus, a vital link is maintained between highly sophisticated scientific research and the problems and constraints of subsistence farming in tropical Africa.

Additional land for field experimentation and trials, has been acquired at Ungoye and on the banks of Kuja River. The primary objective of the Station is to provide, to the ICIPE research and training programmes, an infrastructure for long-term ecological studies, field experimentation and a co-ordination focus for on-farm research; facilities for the development, testing and packaging of pest management technologies; and training facilities for insect science and research methodologies to research scholars, pest management practitioners, and visiting scientists.

FIELD SITES

Muhaka: The Muhaka Field Site occupies approximately 320 acres of land on the Kenya Coast, about 15 kilometres south of Mombasa.

Machakos: A long-established site used by the Medical Vectors Research Programme for work on the sandfly.

Ngururman: Right in the heart of Maasailand, this site offers many exciting challenges to the scientists from the Tsetse Research Programme, who use it for long-term ecological studies.

Lambwe Valley: This is one of the few areas in Kenya still infested by tsetse and is thus a natural choice for field experiments focusing on this human and livestock pest. The site is about 20 kilometres from Mbita Point Field Station.

Ungoye: A 200-acre site, 10 kilometres along the lake shores from Mbita Point Field Station. It is being used mainly for large-scale trials, under experimental conditions, for results developed at Mbita Point Field Station.

Marigat: Baringo District, for research on leishmaniases.

Kuja River: Some 480 acres recently acquired for extensive ecological studies, starting with the Livestock Ticks Research Programme.

AMENITIES AND SOCIAL SERVICES

INTERNATIONAL GUEST CENTRE SYSTEM (IGCS)

The International Guest Centre System at present consists of two establishments: Duduville International Guest Centre in Nairobi and Mbita Point International Guest Centre at the field station. The primary objective of the system is to provide accommodation and meals to ICIPE's training and conference activities, as well as to ICIPE staff and guests.

Duduville

The Duduville International Guest Centre (DIGC) provides accommodation for visiting scientists and other ICIPE programmes and functions. With prior arrangements, it is open to any other international organization wishing to hold a meeting in quiet surroundings away from the distractions of the city centre.

The Guest Centre at present offers a temporary conference hall equipped for classroom training, study workshops and audiovisual presentations. The hall can accommodate up to 50 delegates and has hosted many international meetings, with participants drawn from different parts of the world. There are additional meeting areas within the Laboratory complex.

Guest accommodation offers well-appointed rooms, each with a private bath and a secluded balcony. There are 30 rooms arranged in three permanent buildings surrounding a split-level courtyard where official social functions such as receptions and cocktail parties are held.

Mbita Point International Guest Centre

The inauguration of Mbita Point Field Station by His Excellency President Daniel T. arap Moi on 7th August 1986 also saw the official opening of the Station's International Guest Centre. This consists of 16 self-contained guest rooms, a cafeteria complex complete with other complementary facilities, and a lecture theatre. With this modern and well-equipped Guest Centre the Station can now host a wide range of small to medium-sized meetings, workshops and conferences, and is a very popular venue for both national and international scientific groups who prefer a quiet rural setting.

Mbita Point International School

This international preparatory school was established in 1980, primarily to provide educational facilities to ICIPE's multi-cultural staff at Mbita Point Field Station. The school's broad-based curriculum aims at providing the pupils with the capacity to pursue an international system of education, either in Kenya and or elsewhere. Apart from the regular Kenya primary school curriculum, French, music, agriculture and home economics are also offered. The school welcomes voluntary contributions, in cash or kind.

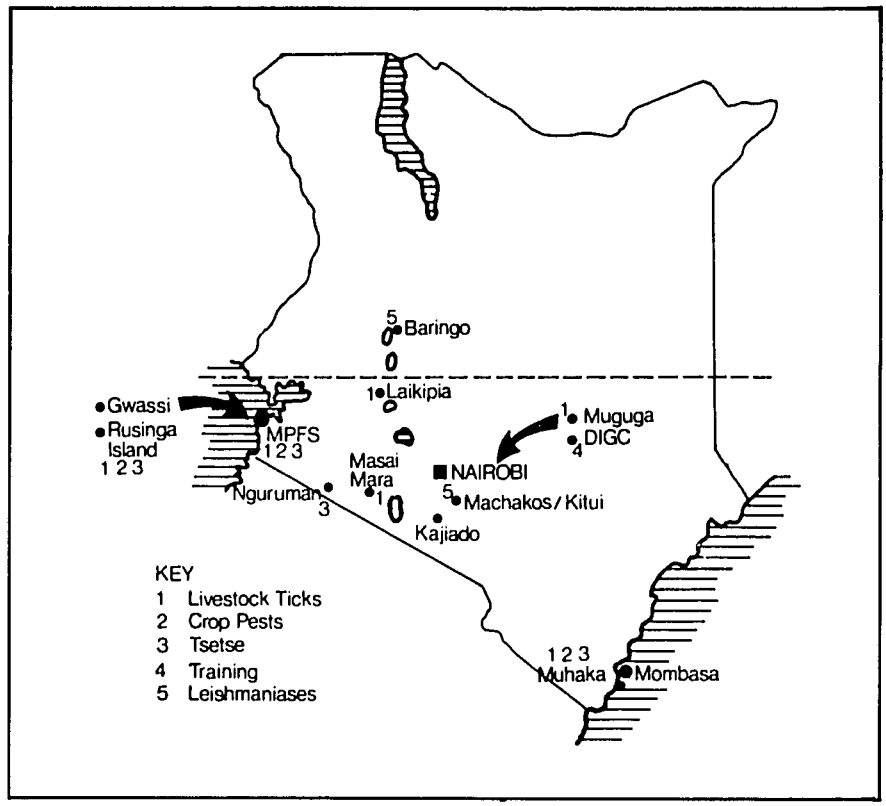
SAINT JUDE'S CLINIC

St. Jude's Clinic started operating at Mbita Point Field Station in July 1982, providing much-needed medical and clinical services not only to ICIPE's own staff and their families but also to the immediate neighbouring rural community. The Field Station is located in an area where a number of major tropical diseases such as malaria, trypanosomiasis and bilharziasis are endemic, and yet the nearest medical facilities are 50 kilometres away and the communications infrastructure is still very poor. The clinic has recently been extended to include a small maternity wing.

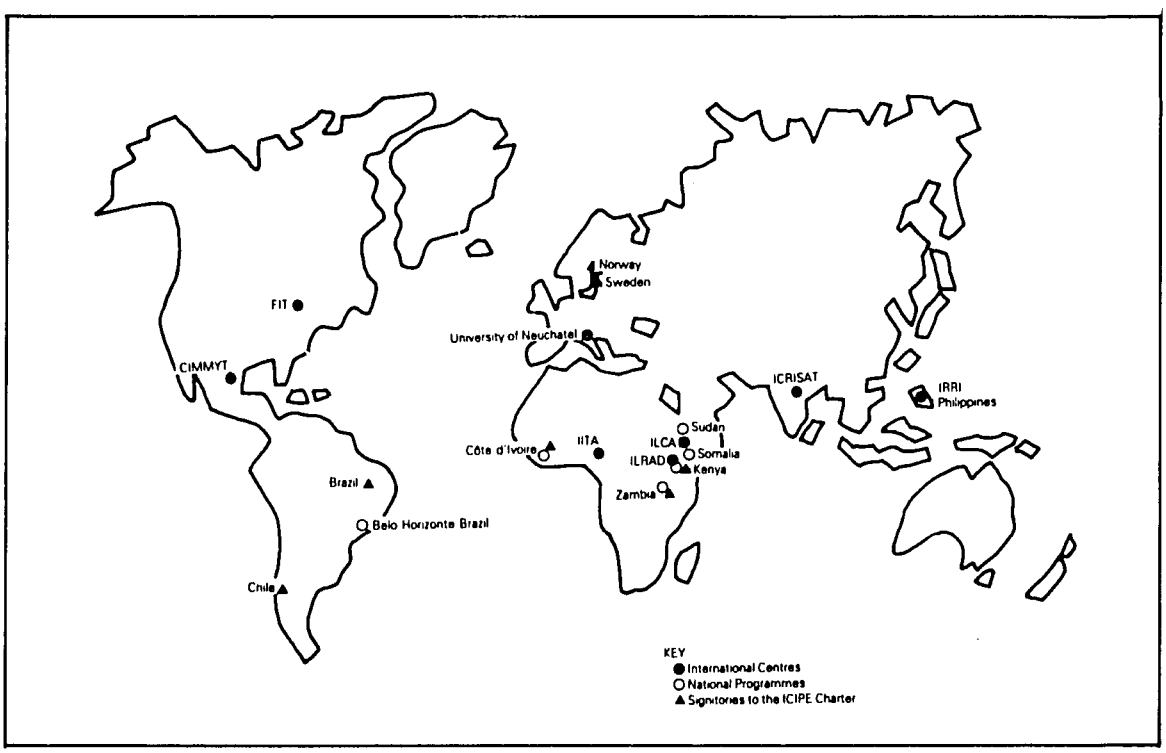
SAINT LUKE'S CLINIC

St. Luke's Clinic, which is part of the new headquarters complex at Duduville, provides medical and clinical services to the Nairobi-based staff and their families, and is the nucleus of an in-house medical scheme run by the Centre. To supplement these services arrangements have been made with selected hospitals in Nairobi for cases which require admission, and for emergency cases outside the opening hours of the Clinic.

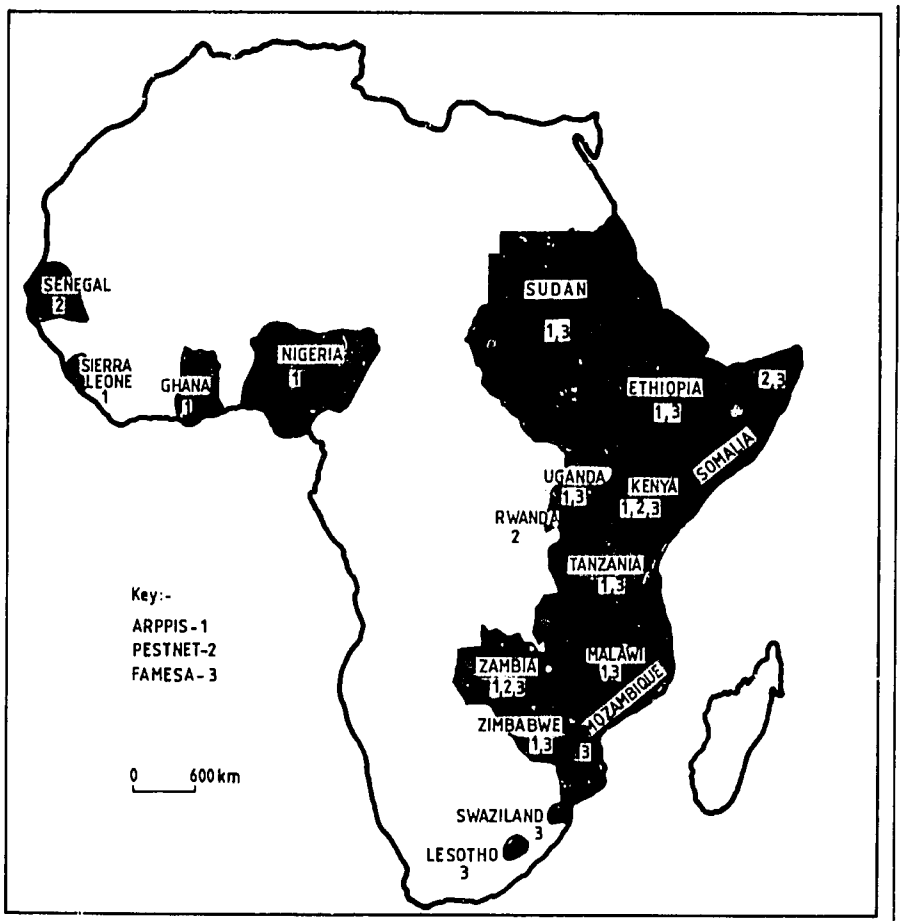
SOME USEFUL INFORMATION



ICIPE's Research Sites in Kenya



ICIPE's International Cooperation



The ICIPE and Africa: ARPPIS, PESTNET, FAMESA

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