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NATIONAL SCIENTIFIC CAPABILITIES

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THE STATUS OF INSECT SCIENCE IN THE TROPICAL WORLD:

A series of ICIPE Annual Public Lectures Delivered by the ICIPE Director

"NATIONAL SCIENTIFIC CAPABILITIES"

By

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THE STATUS OF INSECT SCIENCE IN THE TROPICAL WORLD

The Series of ICIPE Annual Public Lectures is devoted to the general theme of "The Status of Insect Science in the Tropical World". In it, the ICIPE Director examines, each year, the problems and progress of insect scientific research in all its many manifestations, but especially in the way it contributes to national development in Tropical Africa. The ICIPE is interested in investigating new frontiers of insect sciences, in using this knowledge to design novel methods for pest control on a long-term basis, and in building up the capabilities of the African scientific community in meeting these challenges.

On Wednesday, 4th June 1975, the inaugural lecture in this series, "This is a Dudu World", was delivered. In this second lecture, Professor Thomas R. Odhiambo, the Director of the ICIPE, will be exploring the problems associated with "National Scientific Capabilities", especially as they relate to indigenous capacities in insect science and technology.

NATIONAL SCIENTIFIC CAPABILITIES

In a recent review of progress in research in the humid tropical ecosystems, Professor Eberhard F. Brunig[1] of the University of Hamburg had a significant comment to make on the subject of tropical ecosystems, and he said:

> "Before effective and lasting improvements in the utilization of the production potential of tropical ecosytems can be achieved, the existing serious gaps in our knowledge of the structure, functions, stressability and diversity of natural and modified ecosystems in the tropics must be closed."

This by itself is not a profound statement; what makes Professor Brunig's observation profound and at the same time disturbing is his further conclusion:

> "Until the International Biological Programme (IBP) got under way, agricultural and silvicultural research in the developing countries was almost exclusively oriented to meet immediate needs of current land-use practices. Even in recent years, ecological research in the tropics continued to be preoccupied with the general survey of flora, site and vegetation.... There are two main reasons for this general lack of effort and achievement in the study of tropical ecosystems and the consequently wide gap of our knowledge of such systems. Firstly, the countries which are capable of such research, that is the rich industrialized countries, have never as nations been genuinely interested in supporting either basic or applied ecological research in developing tropical countries.... Secondly, the underdeveloped countries themselves are not willing to make or are not capable of making substantial sacrifices and efforts in favour of future-oriented research which is not likely to produce immediately marketable results."

The world therefore remains condemned, whether you look towards the industrialized nations for scientific leadership and financial assistance, or you turn towards the developing countries in the tropical zone for scientific innovation and for first getting their feet wet in the largely uncharted waters of tropical science and technology.

Yet, it is not for lack of a scientific and technological challenge. For instance, the tropics as a whole are the most productive region of the world, due to a number of factors, among them the availability of abundant water, abundant radiation, a high temperature for most of the year, and long and almost continuous biological growth periods. The result is a large net productivity of vegetable biomass in the tropics. Using the actual rate of evo-transpiration as a yardstick for measuring the rate of net productivity, it has been calculated that the world's vegetable cover produces each year approximately 118 billion tons of dry organic matter; of this total, 62% is produced within the tropics.[2] However, it is apparent that the very factors which make possible this extremely high productivity in the tropics also make the tropical terrestrial ecosystems extremely sensitive: wind systems which bring rain with them at the inter-tropical zones and other areas also bring destructive cyclones and floods, torrential rains, hailstorms, anddnddnddnddnddnddnddnddnd large amounts of precipitation are accompanied by high rates of erosion, especially of the very old and deeply weathered soils; large amounts of precipitation together with high temperatures tend to accelerate the processes of weathering and decomposition, which then leads to the production of soils having low absorptive capacity and low nutrient composition due to leaching. Here then is a massive challenge, both scientific and technological, for working with tropical Nature to harvest from it, in an ecologically sensitive manner, those things that the human species requires for its needs and comfort.

I believe that the tropical scientist is at the cross-roads: he must decide for himself whether he should continue to do more of the same thing as his counterpart in the industrialised temperate region, or whether he must take a new orientation and bring scientific and technological salvation to his own impoverished region, with one billion human beings existing at barely subsistence level.

Lawino, the traiditional Acholi wife of Ocol, laments the hard, dedicated modern ways of her husband in Okot p'Bitek's *Song of Lawino*[3], and cries:

"Ocol says he is a modern man,
A progressive and civilized man
He says he has read extensively and widely
And he can no longer live with a thing like me
Who cannot distinguish between good and bad,

He says I am just a village woman,
I am of the old type,
And no longer attractive.

He says I am blocking his progress,
My head, he says,
Is as big as that of an elephant
But it is only bones,
There is no brain in it,
He says I am only wasting his time...

Ocol says he is not
The age-mate of my grandfather
To live with someone like me
Who has not been to school."

There are indications everywhere that the intellectual approach and mental attitude of the new African scientist and technologist – and perhaps that of his mentors also – is not unlike that of Ocol in the domestic arena.

RENAISSANCE OF TROPICAL SCIENCE

One of the most crucial areas of agronomic research which I believe is likely to profoundly transform our present practices of tropical agriculture during the next 5 to 10 years is that on traditional cropping systems in Africa (and of indigenous peoples in other parts of the tropical world). A new burst of interest in a detailed scientific investigation of mixed cropping, relay cropping, and shifting cultivation in the tropics has emerged in the last two or three years. And the circumstances surrounding this shift in concentration is an object lesson for other concerns of the tropical peoples where science and technology are involved.

One of the remedies that has been proposed for solving the world food problem is to bring into agricultural production most of the arable land that is still available in the tropics, with its potential for extremely high productivity. It is true that the largest reserves still remaining in the world for agricultural exploitation are the forest and savannah areas of the humid tropics. While the total world resource of potentially arable land is approximately 3.2 billion hectares, of which 1.4 billion hectares are already under agricultural production, 1.1 billion hectares (of the remaining 1.8 billion hectares) are to be found in the tropics.[4] The critical question we have to ask ourselves before bringing this enormous reserve into agricultural usage is whether it will lead to ecological abusage. We already know that the tropical terrestrial ecosystems are highly sensitive. Can we take an

ecological risk in replacing this system of unused natural reserves, from their present dynamically balanced status and ecologically adapted farming methods – for instance natural forest, traditional shifting cultivation with intervening long fallow period, and extensive nomadic animal husbandry by dynamically unstable, un-balanced derived ecosystems – for instance, monocultures of annual crops, rotation of field crops with short fallow periods, and sedentary animal husbandry?

Tropical ecosystems are not only highly sensitive. Tropical soils, especially those of the humid tropical regions (that is, regions experiencing more than 1,500mm a year of rainfall), have also low productivity in actual fact.[5] This situation stems from a number of factors. Firstly, in humid tropical areas, total rainfall exceeds evaporation; part of the net precipitation therefore percolates through the soil profile and consequently carries away soil's nutrients to a deeper level, where they can no longer be reached by the plant roots. Secondly, the high temperature in the tropics enables chemical decomposition to go much further than in the temperate regions; in time, the old tropical soils consist largely of iron and aluminium oxides, compounds which have a very low adsorptive capacity for plant nutrients. Thirdly, in contrast to the temperate situation where fallen leaves and brances in undisturbed forests act as a storehouse of plant nutrients because of the slow and gradual decomposition processes, in the tropics decomposition is rapid and the nutrient cycle is in effect short-circuited. Nutrients derived from fallen leaves and branches in undisturbed tropical forests are fed directly to the growing trees by the mycorrhizae (that is, the symbiotic complex of fungi and tree roots) or reach the trees as soluble salts before they can go further down the lower levels of the soil profile. Finally, fire is a common event in tropical forests, either through natural causes (such as lightning) or as an agent of man. Whatever the cause or circumstance, fire in a tropical forest leads to the virtual loss of the entire nitrogen stocks of the system to the atmoshphere. Although other nutrients (such as potassium, phosphorus, and calcium) remain in the ashes in a soluble form in sufficient stocks to supply the required nutrients during the first cultivation period after the fire incident, the poor adsorptive capacity of the soils is such that the nutrients that cannot be utilized immediately are not stored but are carried to the lower strata where they can no longer be reached by the crop roots. All these associated factors make the proposition of bringing tropical reserves into agricultural production a hazardous business from the very outset. It surely makes a re-examination of our present usage of the tropical ecosystem a matter of urgent concern.

Let us look at our most modified system in the tropics: the savannah areas. The tropical region as a whole covers an area of approximately 46.0 million sq. km. Of this area, 26.5 million sq. km. can be assigned to the humid tropical areas, and 17.0 million sq. km. to the savannah areas. The area under grass is important for both livestock production and the production of grain and other food crops. Yet we do know that the livestock carrying capacity of these areas is greatly limited, with an actual potential of not more than one head of cattle per 4 hectares, due to pests, diseases, and the limited forage production. We are also becoming aware that these savannah areas are the consequence of a long chain of events arising from ecologically incorrect utilization of the original tropical forests. Nevertheless, it is unthinkable that we should reverse these trends and make the entire tropics revert back to the original tropical evergreen or deciduous forest.

Where the tropical forest has survived in Africa it has survived either because we are stil practising the food-gathering agricultural technique (for example, in Zaire and Liberia), or that we have evolved a food-cultivation agricultural methodology traditionally systematized as so-called shifting cultivation (for instance, in Nigeria and Uganda). Shifting cultivation has been considered a low output system, since food crops can only be cultivated for one to three years before the forest land has to be left to go fallow for another eight to ten years, in readiness for the next short cultivation period. The fallow is important for allowing the original soil structure to be recovered – and so plant nutrients can be built up once again. The alternative – the modern alternative – is to apply sufficient quantities of commerial fertilizers at frequent intervals during a continuous cultivation or rotation system. Not only is this alternative an expensive one, but the problem of supply of plant nutrients is only one facet of the consequences of the permanent removal of the forest cover. Others are to do with the change in water economy, and the change in the micro-climate at ground level. For instance, under forest cover the sun's rays are mostly absorbed by the tree canopy; when this cover is removed, the lower reaches are subject to insolation and the soil temperature becomes extremely high. Indeed, in the tropics, one of the major problems of crop husbandry is that of failure of seed germination due to high soil temperature – a problem the major weeds have efficiently solved during their evolution. Shifting cultivation has none of these disadvantages – although it does appear untidy to one who has been schooled in temperate agriculture.

Equally untidy is the practice of mixed cropping. Dr Bede Okigbo

TABLE 1

MIXED CROPPING IN NIGERIA USING IMPORTANT CROPS AS INDICATORS, 1970/71

Crops	Total Acreage	% Mixed Cropping
Yams	1,236.9	59.2
Cassava	419.8	26.8
Cocoyam	201.3	86.4
Rice	247.2	58.0
Maize	1.448.0	75.5
Melon	360.2	92.8
Cowpeas	3,816.1	99.0
Groundnut	439.5	95.5
Cotton	654.7	80.1
Guinea-corn	5,709.0	79.8
Soya-bean	100.0	100.0
Benniseed	78.1	52.9
Millet	4,922.0	89.6

Source: Bede N. Okigbo[4]

TABLE 2

NUMBER OF TRAINEES AND STUDENTS FROM DEVELOPING COUNTRIES ASSISTED BY OFFICIALS AID

TRAINEES	1965	1973	% Increase
In donor country	29,072	40,773	40
In country origin	335	1,149	273
In third countries	1,584	5,233	230
Total	30,991	47,155	52
STUDENTS			
In donor country	27,842	44,633	60
In country origin	985	4,274	333
In third countries	1,743	1,961	7
Total	30,570	50,868	66

Source: H.M. Philips[10]

of the International Institute of Tropical Agriculture, in Ibadan, Nigeria believes that in the humid tropical areas mixed cropping, especially when it takes the form of what he calls the 'compound farm system', is not only the most widespread traditional cropping system but also offers an attractive permanent farming methodology for the African tropical ecosystem.[6] Recent surveys have shown that mixed cropping is indeed widespread in Africa, and it attains its highest complexity in the compound gardens, especially in the rain-forest areas, where annual staples, vegetables, condiment plants, and perennial fruit trees are inter-cropped. Several characteristics have emerged from a study of the current cropping systems in tropical Africa:

1. The traditional farming system is that of shifting cultivation and mixed cropping
2. This traditional system has an in-built insurance system allowing for the harvesting of starchy staples when the climate is amenable, while ensuring a steady availability all year round and at close range of vegetables and condiment plants.
3. Useful trees harvested from the wild or protected in fallows have ensured the continued existence and exploitation of useful plants, but their cultivation in the compound farms have provided them with a better lease of life as the pace of forest clearance has increased throughout the continent
4. Commercial crops are more likely to be grown as sole crops (so-called 'monoculture') or in association with fewer crops than staples grown mainly for subsistence
5. With the exception of the more temperate sub-tropical areas of Africa classical crop rotations involving sequences of crops grown in monoculture are very rare in traditional farming systems (Table 1 shows mixed cropping prevalence in Nigeria, as an example)
6. Although mixed farming reaches its highest complexity in the rain-forest areas, the practice is just as prevalent in the savannah and drier areas of the tropics.

There are some very real problems in adopting a mixed cropping system in market economy: mechanization of the various husbandry processes is difficult – at least with our present technology; and we just do not have the scientific knowledge to back up this traditional system. Experimentation is certainly more complex. Sure we cannot agree with Ocol – at least immediately and unquestionably – when he shouts at his traditional wife, Lawino, and tells her[7]:

"Weep long,
For the village world
That you know
And love so well,
Is gone,
Swept away
By the fierce fires
Of progress and civilization!"

Or, would you rather agree with Lawino in her answering lament, when she tries to bring reason to Ocol![8]

"Listen Ocol, my old friend,
The ways of your ancestors
Are good,
The customs are solid
And not hollow
They are not thin, not easily breakable
They cannot be blown away
By the winds
Because their roots reach deep into the soil.

I do not understand
The ways of foreigners
But I do not despise their customs
Why should you despise yours?"

We do know now, even from a preliminary assessment of the ecological and economic value of the mixed cropping practice that it has some tremendous advantages: there is an assurance against crop failure; labour and harvesting are spread over the greater part of the cropping season; post-harvest storage problems are minimized; the soil is better protected against erosion and direct sunshine; a more efficient utilization of soil-profile resources is achieved by cropping plants of different heights, rooting systems, and nutrient requirements in a limited area; and diseases and pests do not spread rapidly, and do not seem to reach the same epidemiological proportions as in monocultures.

We are only just beginning to realise that the status of insect pests under mixed cropping – the prevalent farming system for food crops in Africa – is quite different from that under sole-cropping conditions. The pest management problems are probably also novel and unfamiliar. For instance, the traditional small isolated fields found in Zaire, seemingly dotted about at random in the forest and savannah areas, are not so quickly infested with weeds and insect pests as are the orderly blocks of single annual crops[9].

I have devoted some considerable time in discussing the resurgence of interest in a rational and scientific tropical agriculture, not blindly emulating the science and practice of temperate agriculture, but taking its own path to salvation by what Nature itself so abundantly teaches us. This new orientation, not so widespread and not so well understood as yet, is one that is beginning to pervade the whole tropical world: some tropical scientists are even beginning to talk of a 'tropical civilization'. Insect science and technology, a science and technology overwhelmingly having the tropical region as its action theatre, cannot escape from this new intellectual adventure; and the ICIPE will do well to embrace this new change of direction. Under these novel circumstances, what kinds of scientific capacities are required in the tropical countries? How do these countries acquire these capabilities? And have the industrialised countries a part to play in all this?

I cannot pretend to prescribe any panacea for this awesome problem. Certainly, I cannot discuss all those sciences and technologies that are likely to be needed for the modern tropical civilization. What I can do, and what I intend to do, is to give an overview of the problem as I see it in relation to pest management research and application, with the hope that it can serve as a model working paper for other relevant science-based areas.

AFRICAN SCIENTIFIC CAPABILITIES

It seems to me that in considering scientific capabilities in the context of tropical Africa, we should be concerned at the very least with the following eight major questions:

Asking the relevant scientific question
Capacity for scientific research
Capacity for technological innovation and development
Intellectual and industrial property
The management of science
Research training
Ability to communicate scientific knowledge or experience
Scientific literacy and the scientific delivery system.

At the present time, I will only review some of these questions. Probably the easiest question for me to dispose of is the first one, dealing with the problem of asking the relevant question of Nature or the biological and physical material system. This is so because I dealt with this question last year in my first Lecture, in which I hope I suc-

ceeded in portraying the paramount importance of insects in the history, economy, and life of the tropical world. Secondly, in an earlier part of the present lecture, I painted a broad canvass of what the tropical agricultural scientist and pest management researcher should regard as his central challenge. Indeed, I could not improve on what Carroll Streeter had to say recently in a review of his experiences dealing with the agricultural productivity of the tropical peasant farmer[10]:

> "Many an educator has been able to keep busy teaching, without looking up to see whether his teaching was relevant to the problems of the times. Scientists have made an enormous contribution with their research at experiment stations and in laboratories – a necessary first step – but whether it was actually getting used by small farmers was not their main concern. Extension services have often been government bureaucracies, many of them full of people who knew little about actual farming and who seldom ventured out in the hot sun to visit cultivators of two to five acres."

The strategy for the ICIPE is clear: not only should it be concerned with the strictly scientific questions following on the identification of a pest problem as a priority one, but it must do so in the context of the realities of the tropical environment and those of the socio-economic life of the people themselves. This realisation does not in any way dilute the excellence of the scientific investigations being carried out, nor does it tamper with the exciting possibility of adding to the total world pool of scientific knowledge, but it does add a fourth dimension to ICIPE's endeavour – that of making its work relevant to the development impetus in the tropical world. *Excellence* and *relevance* should always be our watchword.

Capacity for scientific research is a question which has been discussed in many forums over the last 15 years, and which I have myself discussed several times over the same period[11]. It is not only a question of getting research equipment or establishing research institutes; it is not only concerned with getting a generous financial backing, or of forming an academy of science; it is not simply a matter of university science education, or trying to re-invent fire-making; it is not a necessary factor that you must first have a high GNP or that you must have an industrial base in order to have this capacity. It is all these, in fact – and more. It is the interaction of all these factors, and the nursing of the product in an intellectual climate that encourages and rewards intellectual adventure, scientific discovery, and technological innovation.

No amount of bilateral, multilateral, or international assistance is

going to help in creating this capacity for elucidating scientific problems – unless the indigenous people themselves have the mental freedom to explore and adventure. By the same token, indigenous capacities in science cannot have a sure and easy developmental period if the scientific community in the temperate regions continue to insist that there is only one way of looking at and practising science, especially in the biological field. Consequently, while those who would wish to assist and collaborate with us in solving our own scientific problems must unfetter their minds of their own classical views of Nature and the management of scientific endeavour in order to re-fit them for tropical work, the young scientific community in tropical regions must have the confidence in their judgement of what is important, and how to go about reaching solutions. As Wordsworth once said:

"Nature never did betray
The heart that loved her."

You will all know that a tremendous effort was made on a global scale in the last two years to help the Republic of Mali in the Sahel to re-stock its livestock herds after the terrible drought from which they are just now beginning to recover. A story is told that an advisory bull was among the first batch of cattle to be sent to Mali for the re-stocking programme. On his arrival at Bamako, capital of Mali, he assessed the situation very quickly and sent a telex message to the FAO in Rome asking for complete documentation and retrieval system to be mounted on all the advisory bulls that had been despatched to developing countries after any drought over the last 200 years and to cable the result of their advisory services. After much delay, a short cabled message arrived stating:

HAVE MADE A SCAN OF DESPATCHES OF BULLS TO ALL EIGHTY DEVELOPING COUNTRIES OVER THE LAST TWO CENTURIES STOP CANNOT FIND CITATION REPEAT CANNOT FIND CITATION OF ADVISORY BULLS STOP SUGGEST YOU ASK US TO SCAN FOR CONSULTANT BULL STOP HAVE ONE GRADUATING SOON.

The United Nations Conference on Trade and Development (UNCTAD) has been meeting in Nairobi for most of the month of May 1976. Of the four principal problems that kept the 5,000 official delegates locked in battle was the question of the transfer of technology, from the industrialized to the developing nations, and on the question of industrial property. These are questions I would wish to consider at greater length at another occasion. For our present purpose, I only wish to stress a vital point: that it is impractical for the young scientific community in the tropical regions to hope to

make any major breakthrough in technological innovation and development without a strong base in fundamental research. More particularly acute are those areas we have alluded to as relevant to tropical civilization, where there is little knowlege in the world pool to draw from in order to sustain a programme of technological research. Therefore, the fundamental knowledge must be acquired in the first instance.

My own belief is that once the tropical regions begin to make important scientific and technological discoveries in their own environmental milieu and for their own identified problem, the question of technological transfer will cease to be a completely one-way traffic. International co-operation and inter-dependence will then become a functional reality.

Although we must, from time to time, pause and ask ourselves whether our current faith in science and technology – whether for the temperate civilization or the emergent tropical civilization – is not misplaced; we must agree that it is now an enormous enterprise and some principles of the theory and practice of the management of science is desperately needed. What criteria does one consider in appointing a director of a pest control institute? Just how far can an international research insect institute be involved in national research programmes? Should it be involved in actual control or extension work? What part should it play in training indigenous personnel? Since many of the developing countries are small in size and resources, is it feasible that the international community can continue to underwrite the activities of international research institutes for the forseeable future? Can 'international staff' in such institutes always be considered as those staff who do not originate from the host country, or should 'internationality' be a kind of a qualifying characteristic as to the level of professional expertise and be unlinked to geographical boundaries? Who decides excellence in research, and have the developing countries any part to play here, or are the yardsticks so embedded in the traditions and fashions of the older scientific communities? These and other questions need to be asked.

RESEARCH TRAINING

At the present stage of the development of the ICIPE, I believe that we have made a good start by asking the relevant scientific questions, by building up and approving plans for a further build-up of the capacity for research on tropical insect problems of major importance for agriculture and human health, and we are now beginning to

launch ourselves into the field of pest management technology research.

I believe that our next important impact area must be that of research training.

Within our limited means over the last four years we have initiated four important programmes that we wish to see grow and mature:

1. *In-house Technical Training Programmes* in the technical disciplines that encompass ICIPE's requirements. The first two classes to complete the initial generalized course will be getting their certificates of course completion later this month. Technical competence in many areas are undoubtedly a continuing for a research centre, such as the ICIPE – in insect and animal breeding, histology and fine structure, chemical analysis and bioassay, statistics and computer services, photography and graphic arts, and the maintenance and servicing of equipment. Nor has the ICIPE confined its meagre training facilities only to its staff; it has already given opportunities to selected senior technical staff from Zambia, Tanzania, Ethiopia, and Nigeria. We wish to intensify our training programmes in this field, when we acquire more training accommodation. In the meantime we are soon making appointments of technically qualified training officers to implement these ideas
2. *The ICIPE Science Bursars scheme* for high-school graduates in science is proving a great success. Every December, the ICIPE selects six to eight students from high schools in and around Nairobi on the recommendation of their headmasters and science teachers to work for six months in selected research programmes at the ICIPE Research Centre before they proceed to the University. We have now followed the career of some of these students while in college; and invariably they have done very well indeed – whether the field is agriculture, veterinary medicine, human medicine, science or engineering. We are most encouraged by this intellectual response by the high-school students. We have not as yet examined all the reasons for this success; but we do know that the experience of investigating a really important question – and not simply an exercise on a school bench or ga... discovering the wheel or recreating Mendel every year – and of doing it to ones topmost level of excellence is a great stimulus for better performance at college. We are this year extending this scheme, on a trial basis, to first- and second-

year University science-based students in the University of Nairobi during their 3-month long vacation. We are also considering whether we should not really expose a small number of science teachers in schools to the same type of experience, which they can then test out in other areas of science?

3. Since mid-1975, the ICIPE has become involved in an entomology *Graduate Training programme* in co-operation with the Department of Entomology of the University of Nairobi. Fifteen graduates are presently undergoing an M.Sc. programme, consisting of one year of taught programmes and a succeeding year of project work. It has been agreed that the ICIPE will be used as the centre for this project work in those areas of insect science that ICIPE scientific staff are competent to supervise. We are excited about this training project, particularly since most of the graduate trainees are serving officers of other research establishments, either of the Kenya Government or the East African Community.
4. *Research Associateships programme.* Under this scheme, a gifted but mature scientist in Africa, with an established teaching or research position in his own country is facilitated through ICIPE funding to come to the Centre for periods of 3 to 6 months every year for 3 or 4 years to carry out a specified research project within ICIPE's priorities. We believe that this is an answer to the question of intellectual isolation that scientists in the developing countries frequently suffer from; it also permits South-to-South scientific communication so lacking at the present time; and, furthermore, it helps to keep a scientist in the insect science field doing excellent and relevant work within his own environment. What little we have done under this programme is an eye-opener; and we intend to extend our facilities for this purpose.

The ICIPE believes in development-oriented research. But it equally believes also in development-oriented training in its widest sense. Although educational assistance over the last two decades has always been thought of as vital for development, it has not always been possible to conceive clearly the relation between education and development or its narrower cousin, 'economic growth'. Although public investment in education in the developing countries has grown from approximately U.S. $1.5 billion a year in 1950 to $12.0 billion by the end of the second decade, education is still seen only as a social service and as an index of social advance[12]. A determined and sustained policy to make it a real investment for development is still lacking, although for a time planned educational projects were seen

as a lever for getting so-called 'high-level manpower' for the newly independent nations.

I believe that the efforts of the international agricultural institutes in implementing large programmes of giving training to production-oriented trainees from developing countries, and ICIPE's programmes of research training, are both imaginative schemes to increase the scientific capabilities of the tropical countries. The most impressive thing about these new developments is that this type of training has not always been conceived as being possible in the developing countries themseves (see Table 2). Up to 1973, the number of trainees assisted by the industrialised countries in their own tropical country was only 2.4% of the total number of assisted trainees – in 1965 it was only 1.1%[13]

I believe the ICIPE should be proud of its achievement if at the beginning of the 1980's it can point to important and development-oriented research in insect science and technology being done throughout the tropical world, and if it can show that the genesis of most of this activity is the ICIPE.

But whether or not women were at the genesis of the world, it is true that in most cases women have the last word. And, in Africa, Lawino has not disappointed us when she spoke her last lament to her modernised husband, Ocol:

"*Listen,*
Ostrich plumes differ
From chicken feathers,
A monkey's tail
Is different from that of the giraffee,
The crocodile's skin
Is not like the guinea fowl's,
And the hippo is naked, and hairless.

The hair of the Acoli
Is different from that of the Arabs:
The Indians' hair
Resembles the tail of the horse;
It is like sisal strings
And needs to be cut
With scissors.
It is black,
And is different from that of white women...

I am proud of the hair
With which I was born

And as no white woman
Wishes to do her hair
Like mine,
Because she is proud
Of the hair with which she was born,
I have no wish
To look like a white woman."

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