Inaugural Lecture

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Education Centre

UNIVERSITY OF NAIROBI

"... and Foresight is Power"
The Inaugural Lecture Series enables newly appointed Professors of the University of Nairobi to deliver their first public lecture in Kenya. Funds for the publication of the series have been made available through the University Deans' Committee and copies of the lectures are on sale at book stores.

This is not Professor Mohamed Hyder's first public lecture in Kenya. As an eminent scholar, he has lectured, toured and discussed many research problems not only in Kenya but also at International conferences. In recognition of his personal achievement in the academic world he remains the first person to have been promoted to a Professorship at the University of Nairobi when established positions were all filled.

In this lecture the author contends that the most vital contribution that a Zoology Department of an African University can make is to build a sound understanding of the principles regulating the availability of biological resources inherent in a given area. Ways should be found to intensify problem-orientated research in key areas, within a framework of inter-departmental and University-Government structure. Quicker rewards could then be expected not only in the solution of the problems but also in the generation of appropriately trained post-graduates and correctly orientated undergraduates.
Mohamed Hyder was born in Mombasa, educated at the Serani Boys' School before gaining admission into Makerere in 1950 where he finished with an upper second Diploma in Education in 1953.

After teaching General Science and Mathematics for a few months, he won a Kenya Government Bursary to study Zoology in Britain. After a year at Chelsea, he joined the University of St. Andrews, Scotland where he became President of the Biological Society and later, the first Overseas student in the University's history to graduate with a First Class Honours Degree in Zoology.

He was immediately awarded a coveted Carnegie Scholarship to proceed with his Ph.D. work. This was supplemented with a Mohammedali Rattansi Scholarship. In 1960 he became one of the first Commonwealth Scholars when the Commonwealth Scholarship Plan was inaugurated. In 1961, he moved to the University of Leeds to continue with his Ph.D. work. After a year he was awarded his Ph.D.

He returned home in 1962 to take up a Nuffield Foundation Fellowship at the East African Freshwater Fisheries Research Organization at Jinja and the Department of Zoology, Makerere University College.

In 1963 he was appointed the first African Lecturer in the Department of Zoology in the then Royal College, Nairobi. In 1966 he was promoted Senior Lecturer and in 1970 to a Personal Professorship in Zoology.

Professor Hyder has been identified with many services to the Government by the University. Thus, off and on, he has been Chairman of the Board of Trustees of the Kenya National Parks since Independence, he has served on three Government Commissions, has represented Kenya at a United Nations Committee on the Peaceful Uses of the Sea-bed, and was associated with the production and presentation of a number of Educational programmes on Kenya Radio and Television.

His main research interest is the reproductive physiology of the freshwater fish, *Tilapia*.
There are at least as many different approaches to Inaugural Lectures as there are Professors to deliver them. Traditionally, Inaugural Lectures have been intellectual exposés by newly appointed Professors largely directed towards an internal academic audience. Not surprisingly therefore it has usually been a self-centred synthesis of the immediate intellectual pursuits of the Professor himself.

As I understand it, the aim of the present series of Inaugural Lectures is to create a focal point of intellectual contact between the University, the Government and the Public through the medium of the newly appointed Professors. This might appear to be a slight and even subtle change of emphasis but is nevertheless a highly significant evolutionary transformation of the concept of Inaugural Lectures. In this new context, I must confess the approach to one’s Inaugural Lecture becomes a little more ambiguous. Clearly, there will always be the temptation or desire (some might say, obligation) for the University don to share the excitement of his intellectual pursuits with others. I am quite confident that were we to approach these Inaugural Lectures on this basis, most of us would at least be able to achieve the bare minimum: informing the Public and the Government of the University’s intellectual vigour. I can also confidently predict that in a significant majority of cases, these would be intellectually scintillating (even inspiring) deliveries.

I cannot dispute such an approach to these series of Inaugural Lectures and I think it is a worthy and a valid approach. Indeed some of my colleagues will quite rightly have followed the same pattern. I must confess that my own original approach to this Inaugural Lecture was much the same. The more I thought about it, however, the more convinced I became that this present series of Inaugural Lectures presents a unique opportunity to provoke some hard thinking and perhaps create an atmosphere of dialogue and cooperation within the Trinity: the University, the Government and the Public. We all three shape the destiny of this country; and while we might “render to Caesar the things that are Caesar’s” there is a considerable area where concerted action is not only possible but, I contend, the only way of shaping the future of this country. I have therefore abandoned what might have been a search for self-justification and have used the
Inaugural Lecture as an excuse for self-examination, giving the word “self” a wide elasticity. The primary question that I would like to answer in this Inaugural Lecture is this: What role should Zoology play in the development of this country and to what extent is the University potentially capable of making an even more positive contribution in this development? For this reason if I were to give a sub-title for this Lecture it would be: WHITHER ZOOLOGY?

I am making the assumption that we are all agreed that the University has developmental obligations to fulfil in this country, as the following quotations from the speeches of the Chancellor and Vice-Chancellor of this University indicate.

“The Nairobi University must both serve and reflect its surrounding society. There is a positive obligation, both to recognise and to try and resolve the problems and frustrations of rapid nation-building.”

And again:—

“This Institution, while being a living centre of national culture and character, must assist in the pursuit of our urgent national objectives. This vital contribution need not dilute the main responsibility of the University in such fields as freedom of inquiry and the broadest advancement of knowledge. All who are privileged to pass through or be associated with this University, must recognise an obligation deeply rooted in the people’s sacrifice and effort.”

Chancellor of the University of Nairobi
His Excellency, The President of Kenya,
Mzee Jomo Kenyatta. (October 1971)

The Vice-Chancellor, Dr. J. N. Karanja, on the other hand had this to say:—

“Over the last year the University has continued to expand and to grow. This is natural. There is need for continued but planned expansion. More and more people are demanding higher education and provision must be made for everyone who wishes it and who is qualified by ability and attainment. This is the principle which guides our University and I believe it is what is required of us as a national University in providing high level manpower for national development and growth.”

And again:—

“You, Sir, have said ‘that the primary object of higher education in the difficult early years of a new country, is to produce the technical and professional manpower needed to promote and control all aspects of development’. In our plans we pursue our mission with vigour and relevance.”

Vice-Chancellor of The University of Nairobi,
Dr. J. N. Karanja (October 1971)
What I am not sure about is whether we are clear in our minds on how we should fulfil this role. There is a tendency to take refuge behind the statistical outflow of "high level manpower". We could be accused of being an academic "factory" (i.e. an automatic and unthinking plant) producing academic "sausages" (i.e. supposedly nutritious consumables without realizing that the "sausages" can themselves easily be poisoned and so can (therefore) the consumer as a result. Since the "consumer" is "The Development Apparatus", Universities in developing countries could, as Professor Colin Leys reminded us earlier this year, run the risk of being "major instruments of under-development".

What we need, however is a detailed definition of development (or more appropriately, under-development) and an examination of its underlying causes. Colin Leys has synthesized a definition based on an interpretation of the concepts of development prevailing in the last decade. It is as follows:

"Development was seen as a linear path of change along which the industrialised nations had already travelled and which the under-developed countries were now following. It was seen primarily as a matter of 'economic growth', and secondarily as a problem of securing social change necessarily associated with 'economic growth'. It was taken for granted that organising the march along the development path was the prime concern of Governments, and hence the problem of adapting the role of the University to the requirements of development was seen largely as one of making them serve Government development programmes."

There was and there still is apparently an underlying conception that the role of the University is no more than a passive one of responding to suitable stimuli from Governmental quarters. Colin Leys very rightly challenges the validity of this assumption in the same communication:

"The old concept of Universities as 'instruments of development' appears from this point of view, as coming dangerously close to a surrender of their very identity as centres of fundamental thinking and intellectual leadership."

Nearly two years ago I had myself advocated a much more active role of the University in the definition of national development. I said then:

"Let us now examine some ways in which the mobilisation of the creative resources of the University and the State could be pooled and sharply focussed on the problems of national development. The starting point in any such
creative venture is the clearest possible definition of the problems involved. This initial impact of the University can be felt here in this definition of the problems surrounding national development. Academics are singularly suited to undertake this task. They are supposed to have analytical minds that are accustomed to looking at the problems dispassionately, critically and realistically. They are professionally vain about their ability to collate and reassemble data in order of significance. They are presumed to have learnt to convey their thoughts clearly and accurately. They are supposed to be knowledgeable about other countries with similar problems. They should thus be able to offer a range of available options in the way of solutions. They can be hard working and they often have no political axes to grind. They might be misguided but are rarely tribalistic or parochial largely because they know the long and short term dangers of both these characteristics. In short, they are presumed to have the right backgrounds and expertise to analyse problems of national development and offer solutions."

In other words, the University should participate in defining under-development and its causes in specific detail and be involved in the formulation of strategies to combat the problem. Each disciplinary pursuit should undertake this exercise on its own. Without it, we could generate misfits rather than developmental catalysts. In our zoological world, Terry Hirst has visualized some of these misfits in the illustrations below. He could be a misguided Afro-Saxon Game Warden such as is shown in Fig. 1.

Good morning chaps, I’m the new Game Warden! Which way is the Club?
Or, he could be a frivolous beneficiary of sophisticated equipment, untuned to the demands of dedication required of him as in Fig. 2.

Switch off VOK for a while — and let's count some animals!

Or he might be a teacher whittling away the very spirit of Science Education in any underdeveloped country as shown in Fig. 3.

Pay attention! I shall now tell you all you need to know about this animal, for the exam.

I have in two previous communications put forward some ideas on this subject some two years ago. These were entitled: “Science Education and Grassroot Creativity” and “The Univer-
sity, the Government and National Development in Kenya.” Today I wish to examine what I believe should be the basic objectives of the zoological pursuits in Kenya and to propose some ideas to be tested in the 1970s.

Zoology or Biology and Man are, of course, inseparable entities. This is partly because Man himself is part of the living animal world and partly because his survival throughout his relatively short history on this planet has depended on his understanding of the biological environment and exploitation of it for his own benefit. As Wells, Huxley and Wells remind us:

“Biology, the science of life, was practical before it became systematic. Man was a Biologist perforce long before the dawn of history, classifying plants into edible and inedible, and accumulating a lore of the animals he hunted, and perhaps of the animals that hunted him.”

If I am challenged to pronounce an overall objective of the science of Zoology in Kenya it would be as follows: to give as accurate and as detailed an understanding of the animal world in this tropical environment bearing in mind the utilization of such understanding for the physical and spiritual welfare of Man in Kenya and the world. Such knowledge and understanding of the animal world in this tropical environment is really the cornerstone of any attack of the biological problems that confront Man in this country.

I have sometimes wondered if what we need in Africa today is not the re-kindling of the spirit prevailing in the Hellenic Empire of Alexander in the 4th Century B.C. which is credited with the label: “dawn of modern science.” As H.G. Wells says:

“...during this period the thought and the creative and artistic impulse of the Greeks rose to levels that made their achievements a lamp to mankind for all the rest of history.”

And in another context Wells, Huxley and Wells said this:

“It was a period of immense curiosity, which declined only as a dark shadow of Roman Imperialism fell upon the Mediterranean world.”

Perhaps the most significant piece of practical philosophy from our point of view is that of Aristotle who was indeed a product of the same period. Aristotle, often called “The Father of Natural History”, rejected the Utopian world of his teacher’s (Plato’s) Republic which has been described as “a dream of a Communist aristocracy”. Aristotle did not advocate the creation of imaginary Utopias around ourselves but firmly
believed that before Man could really control his
destiny, Man "needed far more knowledge and
far more accurate knowledge than he had
possessed." And so it was that he engineered
and master-minded that systematic collection of
knowledge which nowadays we call Science. He it
was who sent out explorers to collect facts. And it
was probably he who, in his search for facts,
sent out emissaries from Greece to seek know-
ledge, inspired no doubt by the example of Hanno
the Carthaginian who had undertaken his memori-
able coasting voyage about Africa to bring back
skins of gorillas which hang in the Temple with
inscribed records. As Professor D'Arcy Wentworth
Thompson (Professor of Natural History at St.
Andrews University from 1919 to 1948) reminds
us, Aristotle's approach was often very pragmatic
as he kept insisting "...we must be content if
the mere facts are known". What we should
heavily underline in Aristotle's philosophy is that
if Man is to tame and exploit but not destroy
and ravage the biological resources that are his
heritage here, he must seek a deep and accurate
understanding of the nature and the extent of
these biological resources without which he would
be unquestionably permanently impoverished.

Professor Sir D'Arcy Thompson reminds us of
another great Aristotelian theme of relevance to
us in Kenya today:

"the search for relations between things ap-
parently disconnected, and for 'similitude in
things to common view unlike'. Newton did not
show the cause of the apple falling but he
showed the similitude ('the more to increase
our wonder with an apple') between the apple
and the stars. And by doing so he turned old
facts into new knowledge..." (My italics.)

In Kenya (as in Africa) today, the twin Aristot-
elian themes — the meticulous gathering of new
facts and the search "for similitude in things to
common view unlike" thus turning "old facts into
new knowledge" — are applicable with equal
force. Indeed, zoologically there are so many new
exciting discoveries to be made in Africa today
that it is easy to lose sight of the need to set
clear priorities. This fountain of zoological know-
ledge from Africa has only recently been acknow-
ledged by the zoologist, Dr. F. Fraser Darling, in
the following words:

"Something new is certainly coming out of
Africa these days, something just as dramatic
as the appearance of unknown species like the
okapi in 1900 and the African peacock in 1937.
We are discovering patterns in the fabric of life
in which the habits and life histories of individual species of plants and animals are the threads."

And out of our desire —

"...to watch...animals, define how they use the environment, how they differ from each other in their demands upon it and how they contribute to the maintenance of their chosen habitat"

— has come this new understanding which Fraser Darling states is "coming out of Africa, now and for a long time to come." And he goes on:

"We've grown to understand that conservation of the wildlife of Africa depends largely on preservation of the several habitats in which it lives. Our growing awareness that communities of plants and animals develop into ecosystems as complex as the environmental conditions will allow has led us to realize that to remove a species from an ecosystem is to make it less efficient as an energy-circulating and energy-conserving system. In countless places in Africa the incoming European has thought that where there are so many hoofed animals must surely be a good place for stock raising. But instead of substituting 20 or 30 species of domesticated animals for those removed, he has put one or two, or at most three — cattle, sheep and goats — and has found that productivity is nothing like as good."

Our task is thus to strike a balance between forging the new understanding and keeping Man's overall interests in sharp focus all the time. We have recently been undertaking some serious thinking within the Department of Zoology to delineate our strategy for the 70's. Our task: Excellence with Relevance and the definition of priorities within this framework.

We have studied this problem for a while now and have identified four major areas in which the Zoology Department can give a significant leadership. These are:—

1. Terrestrial Wildlife Ecology
2. Freshwater Biology
3. Marine Biology
4. Parasitology

I have underlined the word Zoology Department to emphasize that were we to operate outside of the existing Departmental barriers, our horizons would be expanded and be unquestionably more useful to this country. But not until we have crossed that evolutionary bridge would we be able to undertake a significant revision of our outlook. Under the umbrella of a School of Biological Sciences, for instance, many of the currently-
prevailing artificial barriers to inter-departmental cooperation could be done away with and a more vigorous and rational re-grouping of interests result. The four areas of the Zoology Department's intended development should be seen as in interim though, we believe, relevant strategy.

One of these areas — Terrestrial Wildlife Ecology — is already (thanks to a Ford Foundation grant) in an expansive phase with a regular intake of M.Sc. students being trained by both coursework and research. The other three areas are as yet undeveloped although we should soon reach take-off point with one other — Parasitology. The other two should be operational by the beginning of the next triennium, we hope.

It will be immediately clear that our selection of the four areas of specialization might be related to the much-quoted "high-level manpower needs" of this country. In fact this is only partly true. More correctly, it is related to what we regard as the areas of development that we could participate creatively in. The outlook is thus wider than the statistical symbolism of producing "high-level manpower" in these specializations. The aim is to build an understanding and NOT to palliate the conscience. The motivation is to make the University pivotal in the solution of the problems preventing a rational exploitation of our biological resources and NOT be a peripheral eccentricity we are sometimes made to understand we are. In short, we want to make an effective contribution.

Having defined this operational framework, how does one translate this into practical realization? There are three levels of implementation in this exercise. These are:—

(a) University Research
(b) Postgraduate training
(c) Undergraduate training

We ought to discuss University research first since a relevant orientation of this with respect to national development has a decisive impact on our postgraduate and undergraduate training. I believe that insufficient attention has been given to the maximization of the impact of University research on development. In theory, one might be led to expect well-nigh total University opposition to the very idea of academic enquiry being given a directional orientation. The blind and extreme protagonists of "academic freedom" would rise in protest at the very thought of developmental emphasis or relevance influencing University research. In Science, some may take too rigid a view of what Professor J. Arthur Thomson (Professor
of Natural History at the University of Aberdeen) said in one of his Gifford Lectures at the University of St. Andrews in 1915-16:—

"... the aim of science is to describe natural phenomena and occurrences as exactly as possible, as simply as possible, as completely as possible, as consistently as possible, and always in terms which are communicable and verifiable."

And again:

"The direct motives of science are, in the main, intellectual curiosity, a self-preservative dislike of obscurities, a desire for unity and continuity in outlook. Often, in particular cases, the immediate motive may have been utilitarian — a desire for mastery; but the great majority of important practical discoveries have behind them a long labour of theoretical research pursued for its own sake."

We might of course retort with Galileo's celebrated philosophy; "the only purpose of science is to ease the hardship of human existence." It would be wrong to assume from this that there is something inherently contradictory between "intellectual curiosity, a self-preservative dislike for unity and continuity in outlook" on the one hand and, on the other, meeting the intellectual challenges fundamental to development, challenges which are often as demanding of "a long labour of theoretical research pursued for its own sake". Here commitment should be reinforced by conviction. The distinguished British Zoologist, Sir Ray Lankester, was perfectly right when he said:

"Science commends itself to us as does Honesty and as does great Art and all fine thought and deed — not as a policy, yielding material profits, but because it satisfies man's soul."

But few things should satisfy the soul more than the meticulous building of an understanding for the benefit of Humanity.

In practice, however, many scientists have a deep attachment to the long-term relevance of their investigations. I know of no great scientist who has not derived persistent inspiration from the thought that his discoveries might have a useful application to humanity. Who knows, indeed, how many potentially great scientists have not frittered into triviality by the mid-course blurring of the vision of their discoveries bringing benefits to Mankind. Relevance is clearly never a deterrent to good science — often the reverse. An issue of more significance is the part the University has
to play in defining the nature of the research to be pursued. In other words: Who determines relevance? At the moment, the University does have an opportunity of taking a justifiable leadership in the determination of this relevance. If it does not, however, it will only have itself to blame if it leaves it to others to do so. In my opinion this would be a disastrous abandonment of the function of a University.

I would now like to summarize my own work in the field of the biology of Tilapia, not so much from the viewpoint of giving a detailed public account of what we have achieved but as an illustration of the typical consciousness among many University colleagues — and not just those in the sciences — of venturing into areas of high potential significance to the welfare of Man in this country. I would like to high-light some of the problems that University people often meet and rarely make a public moan of. I would hope to indicate the many inhibitions and frustrations that often accompany the choice of research that we might wish to pursue. I would like to show that there is more fortitude required in the pursuit of "relevant research" than is often admitted or conceived. I must finally indicate that where sufficient pig-headedness is exercised the rewards can be exciting. But most important of all, I would like to hope that the foundations that some of us have laid and are still laying, have helped create the conditions wherein the more dynamic and fruitful cooperation between the University and the Government and the Public that I would like to propose, would be shortly engaging our attention and achieve implementation. In so doing, I would like to emphasize how much an approach could significantly reward our teaching at both post-graduate and undergraduate levels.

For at least a century two of the most prominent families in the old town of Mombasa have been the House of Matano and the House of Shallo. My grandfather's father is the Matano, and my grandmother's father is the Shallo. The two families have been well-known in three professional fields: Teaching, Medicine (especially Obstetrics and Gynaecology) and Fishing. Were I to conform to my historical antecedents, therefore, I would be destined professionally into one of these three lines. On reflection, therefore, I should not have been surprised to find myself combining all three by becoming a University teacher with primary research interests in the reproductive physiology of Tilapia. Both these families were well-known for two other character-
istics: abundant generosity and perpetual poverty. On my maternal grand side the same characteristics are well-known but their most prominent feature was obduracy. I shall not comment on the part these characteristics have played in my professional pursuits.

My entry into the study of Tilapia has taken place twice: first, through the “backdoor” and the second time through the “front door”. It is almost precisely as Coleridge said of knowledge:

“All knowledge begins and ends with wonder, but the first wonder is the child of ignorance, while the second wonder is the parent of adoration.”

When I first came back home in 1962 on a Nuffield Foundation Fellowship to “study the biology of Tilapia,” it was truly the case of “the first wonder” being “the child of ignorance”. It was only at the interview in Scotland that I discovered that Tilapia was a fish at all! That “backdoor” first year entrance into the study of Tilapia could hardly have been more disastrous. The man who was to give me a detailed appraisal of the Tilapia “problem” was Dr. Vernon van Someren, the then Director of the East African Freshwater Fisheries Research Organization at Jinja and until shortly before, the Chief Research Officer in the Fisheries Department (Kenya). I had talked to him on the phone from Mombasa a few times to make routine arrangements about purely pedestrian matters, such as housing, etc. A day before my leaving Mombasa by train, he collapsed and died of heart failure at Jinja and we never met again after my interview in Scotland. Thereafter, everything at Jinja began running down.

My main task that first year was no more than a definition of the “Tilapia problem” and mapping out my general plans to attack it. This “problem” can be summarized thus:

(1) Tilapia is a genus of the Cichlid family of fish with some 30 or more species (as was then believed — the number is now said by some authorities to be more like 80), sustaining a considerable part of the economic exploitation of the freshwater lakes of Africa.

(2) Tilapia is a delicious source of protein of almost universal acceptability — all the more remarkable since no other source of protein (except snakes, possibly) generates as much superstition as fish.

(3) In an attempt to promote rural productivity of this protein source for purposes of both
health and wealth, the Governments of East Africa had encouraged the development of Tilapia pond culture. Some 30,000 Tilapia fish ponds were estimated to have been stocked throughout East Africa with the hope of making Tilapia fish farming a valuable source of rural income.

(4) Practically uniformly, these fish ponds have proved an embarrassing disaster with severe ‘runting’ (i.e. stunted growth) of the fish. Instead of the fish attaining the marketable table size of over 20-25 cm. hoped for, they reached maturity and were reproducing at sizes as low as 5 cm!

(5) Somehow, under these equatorial pond conditions, Tilapia get stimulated to reproduce and once they have attained maturity, they grow no further.

(6) While there was a reasonable amount of information about the reproductive physiology of temperate climate fish, there was as yet little information on tropical, let alone equatorial, fish. Certainly there were no published, detailed studies on the physiology of reproduction of Tilapia although in contrast, behaviour studies on Tilapia were relatively extensive.

Here I was, faced with the conviction that what was needed was the opening up of a long term study of the reproductive physiology of Tilapia in the tropical environment. I must also confess that all my previous experience was with another hormone gland — the thyroid gland. That was my backdoor entry into a field that came to be my principal research challenge. Only on the basis of understanding the mode of operation of the reproductive physiology of Tilapia, I argued, would we hope to break the vicious circle of intense reproduction and consequent stunted growth. I was neither versed in the discipline nor could I fall back on others’ experience as a take-off point. Literature was virtually non-existent, laboratory facilities and equipment scarce. It was, as I said, a true case of “the first wonder” being “the child of ignorance”.

A year later (after spending three months flood-bound at Sagana), I was appointed as the first African Lecturer in the Department of Zoology.

Entry into the University meant that I could make a “front door” entry into the field of research that I personally chose. Behind me was the nagging conviction that I had not met the challenge of Tilapia. In this case ignorance was no bliss and the folly of wisdom was beckoning me compellingly. There was also the nausea of
more and more of the young African intellectuals talking (increasingly vociferously) about the value of research without doing any ourselves.

It was with this background that I consciously embraced the challenge of *Tilapia* reproductive physiology — Coleridge’s “second wonder is the parent of adoration”. What we already knew of *Tilapia* fascinated me but what I did not know provoked my curiosity even more.

Today I can humbly say that through the strong moral support from this University, first the Chairman of the University Council, Mr. B. M. Geega, the previous Principal, Dr. Arthur T. Porter, the Registrar (Mr. S. W. Karanja) and later at the most critical times, the Vice-Chancellor, Dr. J. N. Karanja, I was able to secure a series of grants from outside bodies to sustain me through the present and some forthcoming studies of the reproductive physiology of *Tilapia*. To Nuffield Foundation and the Wellcome Trust I owe a special debt of gratitude. But my deepest personal gratitude must go to Sir Malin Sorsbie and Lady Sorsbie who through the Munitalp Foundation and their own personal contribution have given me the most encouragement in the pursuit of my *Tilapia* studies.

I must also state very categorically that had it not been for the continued support of the Fisheries Department of the Republic of Kenya most of our work would not have been possible. The facilities for the collection of fish during our studies have been critical in enabling us to achieve whatever we have done so far.

Effectively in the last five years we can summarize the advancement of our knowledge of *Tilapia* in the following few words:—

From a number of field and laboratory studies, we have been able to decipher some of the complicated coding of the *Tilapia* gonad (i.e. the male and female reproductive organs). We have been able to show that this complexity arises almost directly from the tropical (or more correctly, the equatorial) environment that the fish are in. Compared with temperate fish where there is a sharp population synchrony of reproductive development and activity, such synchrony is an exception rather than the rule in our equatorial *Tilapia*. Here individuality has replaced population conformity and the beautifully ‘simple’ patterns seen in temperate fish have given way to highly individualistic cycles of spectacular variation. Not only is there variation between individuals, there is also variation within the same individual. It took many a nightly vigil and a combination of peace,
patience and pig-headedness to piece together the basic endocrine jigsaw of the *Tilapia* gonad. Those interested in following the details of this story will have to look at the technical papers themselves. What I will say here is only in broad outline. From a study of Lake Naivasha and Sagana pond specimens of *Tilapia* it became obvious that two of the principal factors influencing gonadal maturation are light and temperature — with pond specimens being clearly very highly stimulated. We have been able to define such stimulation in reliable histological parameters of the gonads. We have, in the case of the male, demonstrated the nature and site of production of the principal sex hormone of *Tilapia* and how its production is related to histological and behavioural changes. For a time, further experimental analysis of the role of the environment on the reproductive activity of *Tilapia* defied us by virtue of the highly individual variability already mentioned. A means of synchronizing and reversibly blocking gonadal activity became necessary. Through the use of a drug 'Methallibure' (generously donated by I.C.I., Britain) we have — after what seemed like endless trials — been able to define specific conditions which will give us the desired blockage. At the 6th International Symposium on Comparative Endocrinology this last June we were the first people to report the use of this system as a very useful analytical tool of complex reproductive patterns such as those found in *Tilapia*. Many of the questions which previously were unrealistic even to ask are now in the process of actually being answered. All we require now is teamwork, dedication and time. Indeed some of my own undergraduate students have been participating in answering some of these questions.

The main thrust of our work is thus to lay down the fundamental background endocrinology of the *Tilapia* gonad and how it responds to the equatorial environment. It is true that the primary motivation for this work is J. Arthur Thomson's "intellectual curiosity, a self-preservation dislike of obscurities, a desire for unity and continuity of outlook." Equally, however, we must confess that we have been spiritually sustained and nourished by J. Arthur Thomson's other observations: namely, "the great majority of important practical discoveries have behind them a long labour of theoretical research pursued for its own sake." This can be illustrated by our 16-month study of the reproductive patterns of Lake Naivasha *Tilapia*. The information we have should enable us to predict the periods and some of the
sites of breeding in an equatorial lake — Lake Naivasha. We also have established the size at which reproduction occurs in the major species of *Tilapia* in Lake Naivasha. Such information is directly useful to the Fisheries Department in the formulation of regulations to govern the fishing activity in this lake. Recently there have been disturbing reports of a serious decline of *Tilapia* in Lake Naivasha. The evidence we have is that the fishermen are cutting their own throats by failing to cooperate with the government by removing immature fish as well as fish in breeding areas. A strict enforcement of the fishing regulations is urgently needed in this lake if the *Tilapia* fishery is to recover. I notice that the Minister has indeed acted swiftly in the last few days.

Our work on the reproductive physiology of *Tilapia* is not complete. As Professor J. Arthur Thomson says:

“No doubt that for any wonder Science dissipates, she gives us twain; but they are not the old homely wonders. No doubt, though Science is ever pushing the curtain back a little further, so that half-wonders disappear, the wonder remains.”

It might even be said that I am over-specializing. There is a well-known zoological myth that the penalty of such over-specialization is a metamorphosis resulting in a physical identity of the zoologist with his animal of study. I appeal to you to disregard such superstition as is represented by Terry Hirst (Fig. 4).
But given the background work we have achieved so far, I can confidently predict some major discoveries in the next few years. It is no longer impossible to hope for a life-time reversal or, at least, interception of sex in *Tilapia* by adequate manipulation of the reproductive tendencies of young fish. Since male *Tilapia* in general grow faster and become bigger anyway, the implications of the artificial sex-reversal of females to males are obvious in terms of the pond culture of *Tilapia*. A central "Laboratory" could produce such artificial "bull" *Tilapia* for dam and pond stocking throughout the country free of the fear of breeding leading to stunted growth.

Another possibility is the use of techniques for artificial fertilization and artificial mouth-brooding we have already developed to raise sterile hybrids which could also be centrally bred and distributed.

There are a number of such exciting possibilities that lie ahead of us. The truth however is that we cannot look to the University alone to conduct such investigations. The *Tilapia* Research Unit in the Department of Zoology consists basically of only one academic member of staff — myself. Yet there are many pressing questions that require answering to enable the full exploitation of our fish resource on a sustained yield basis. Let us just take Lake Naivasha as an example. One can ask the following questions:

1. What is the present fish population in this Lake and how does it relate to the fishing intensity?
2. What is the growth rate and natural mortality?
3. What is the principal food source of the *Tilapia* and what determines its availability?
4. What is the relationship of the food availability and growth rate to the "natural" rain recruitment of chemicals into the lake?
5. Is there a serious seepage of chemicals through the agricultural and urban developments in the surrounding areas? How does this affect the fish growth and fertility of the lake?
6. What effective measures can be taken to control the plant parasites — e.g. *Salvinia* — without polluting the lake?
7. What is the life history of the *Tilapia* parasites — particularly *Centrocaecum*? How do they affect growth and food suitability of the *Tilapia*? How can they be controlled?
(8) How do all these factors affect the reproductive activity of Tilapia which governs, after all, the degree of resource renewal?

(9) What migration patterns of the fish are evident in the lake and how does this relate to the survival and maintenance of the fish?

(10) What hydrobiological phenomena are operational in this lake and to what extent do they affect the nutrient circulation?

These are some of the key questions that could be asked of this lake alone. Clearly the University neither has, nor is it likely to have for a long time, the necessary manpower to make a simultaneous attack on a problem of this nature. Equally clearly, it will take the Fisheries Department (or even the East African Freshwater Fisheries Research Organization at Jinja) many many years to create a team of this nature even were it desirable to establish such a separate team within the Fisheries Department. What I am implying therefore, is that a new concept in the solution of such problems is called for urgently. I suggest that a Cooperative Freshwater Biology Research Unit be created in the University. Such a Cooperative Research Unit should be supported jointly by the University, the East African Community and the Government. The University would contribute the participation of those staff and facilities as already exist in its relevant scientific department and might also consider sympathetically a modest increase in staff to be recruited with the clear objective of their participation in such a programme in addition to teaching. At the moment, for instance, the Departments of Zoology and Botany could provide between them at least four members of staff who could participate in such a programme. In the next triennium, this number could rise to six with planned recruitment in the Departments of Zoology and Botany alone. The Community and the Government through separate direct grants could provide the four or so members of staff required to complement the existing University staff. Through research grants from the Government (via the Ministry of Tourism and Wildlife?) and the Community the financial requirements for undertaking the investigation would be assured.

Such a Unit could do several things:

(a) Bring a team spirit to bear on major problems of crucial significance to the understanding and exploitation of the freshwater biological resources of the country. Thus a simultaneous attack could be mounted on, say, the problems of Lake Naivasha and Lake Baringo — both facing an
acute decline of *Tilapia* fisheries forcing the closure of the currently (?) operating filleting enterprises.

(b) Mount a postgraduate programme in Freshwater Biology with coursework and research components to train future expertise for the Community, the Fisheries Departments of Kenya and sister countries, and, indeed, for the University itself.

(c) Help break down the current artificial interdepartmental barriers by providing the essential catalyst — financial assistance conditional upon inter-departmental cooperation. In practice such inter-departmental cooperation is potentially here if given the right incentives.

(d) In a very significant way, help re-orientate our undergraduate teaching by inevitably bringing the fruits of such investigations to our undergraduate courses.

The creation of such Cooperative Research Units is not only cheaper in the long run but also an effective way of bringing the full University responsiveness to the developmental needs of the country.

Naturally the Government might wish to assure itself that such funds as it invests in such a Unit as we have proposed would indeed facilitate genuine University responsiveness to priority developmental problems. Various methods could be devised to reassure the Government of this. Thus there could be a Coordinating Committee consisting of the Permanent Secretary, Ministry of Tourism and Wildlife, the Director of Fisheries, the Director of the Community's East African Freshwater Fisheries Research Organization, the Heads of the participating University Departments and the Director of the Research Unit where he is not a Head of Department. This committee would in the first place define the areas of investigation, prepare the initial financial estimates and receive either quarterly, half-yearly or annual progress reports of the research. The Government would thus not only be involved with the University in establishing research priorities but also be kept continually in touch with the results of the investigations. There could be other suggestions of reassuring the Government of a desirable hearing being given to developmental priorities. These could be explored provided the will to cooperate is there.

At the beginning of this Inaugural Lecture I said that in thinking about it, I became increasingly convinced that the present series presents a unique opportunity to provoke some hard think-
ing and perhaps create an atmosphere of understanding, dialogue and cooperation within the Trinity: the University, the Government and the Public. I expressed my belief that we all three share the destiny of this country and that there is a considerable area where concerted action is not only possible but, the only way of shaping the future of this country. I further stressed that I have deliberately sought in this Inaugural Lecture an excuse for self-examination rather than of self-justification. I have also said:

“If I am challenged to pronounce an overall objective of the science of Zoology in Kenya it would be as follows: to give as accurate and as detailed an understanding of the animal world in this tropical environment bearing in mind the utilization of such understanding for the physical and spiritual welfare of Man in Kenya and the world. Such knowledge and understanding of the animal world in this tropical environment is really the cornerstone of any attack of the biological problems that confront Man in this country.”

I hope I have shown you that while we in the University might individually seek to live to the motto of “Excellence with Relevance”, our search for that understanding and knowledge of our basic resources could be harnessed more effectively by a cooperative involvement of the University and Government together with the understanding and goodwill of the Public. We should, in my submission, use every means of gathering such knowledge because through it, we would not only become better, more effective and more relevant teachers but also most important of all, because ultimately the only effective way of being, in the full sense of the term, masters of our own environment and our destinies is through knowledge. I commend to you these words of wisdom: “Knowledge is foresight, and Foresight is Power.”
REFERENCES


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