PROCEEDINGS OF THE FIRST ANNUAL GENERAL MEETING OF THE CARIBBEAN ACADEMY OF SCIENCES

MAY 16, 1990

EDITED BY: Professor R. Saunders, Dr. H. Ramkissoon, Dr.E.C. Seaforth, Dr. D. Ali,

CONTENTS

FOREWORD

THE CARIBBEAN ACADEMY OF SCIENCES

The Caribbean Academy of Sciences was inaugrated at an International Seminar in Port of Spain on 16-17th May, 1988. At the end of this seminar a small working group was mandated to revise the draft constitution, produce the proceedings of the inaugural meeting, invite worthy scientists to membership and to arrange the first Annual General Meeting. The first Annual General Meeting was held on 16th May, 1990. At this meeting the first members and fellows were acclaimed and an executive chosen. This meeting therefore marked transition of the Academy from birth to infancy. This road ahead for the Academy will not be an easy one. However, the Academy has in its membership the leading scientists and technologists of the region and in addition has the good will of the leading Academies of the world. It is important that our membership recognises the difficulty of the task ahead and the need for each member to make a significant contribution to its development. Attending the A.G.M. is not enough. Our various committees must be fully activated and programmes initiated so that presence of the Academy is felt.

PROCEEDINGS OF THE FIRST ANNUAL GENERAL MEETING OF THE CARIBBEAN ACADEMY OF SCIENCES HELD IN THE CONFERENCE ROOM 101 OF THE FACULTY OF ENGINEERING ON MAY 16TH, 1990.

Present were:

Dr. D.A. Ali
Dr. N. Abedin
Dr. M.A. Angadi
Dr. F. Barrow
Dr. B.S. Bhatt
Prof. M.E. Cain
Mr. H. Charles
Prof. W.R. Chan
Prof. H. Coore
Prof. T.P. Dasgupta
Dr. E.J. Duncan
Dr. V.G. Hill
Dr. O. Headley
Prof. I. Imbert
Dr. T. Jackson
Dr. L. Kunar
Prof. G.C. Lalor
Prof. K.E. Magnus
Dr. L. Moseley
Prof. G.N. Melville
Mrs. L. Mair
Dr. B.S. Mootoo
Dr. C.R. McDavid
Prof. H. McFarlane
Dr. P.V. Devi Prasad
Prof. A.J. Parris
Prof. H.O. Phelps
Dr. H. Ramkissoon
Dr. F.J. Rosheuvel
Dr. W. Suite
Prof. J.A. Spence
Dr. C.E. Seaforth
Dr. E.B.A. St. Cyr
Prof. R. Saunders, Interim President (Chairperson)
Dr. A. Tang Kai

1. Call to Order

The First Annual General Meeting of the Caribbean Academy of Sciences was called to order by Professor G.M. Richards, Principal of the University of the West Indies, St. Augustine Campus.

Professor Richards welcomed delegates and invited the Interim President, Professor Ramsey Saunders to address the Meeting.

2. Address of Interim President

Prof. Saunders welcomed delegates on behalf of the Interim Committee of the Caribbean Academy of Sciences to the First Annual General Meeting of the Academy.

In his address he noted that some participants from Jamaica were unable to travel to Trinidad because they could not obtain Trinidad and Tobago visas.

The Interim President extended his sincerest apologies on behalf of the Academy, and expressed the hope that the Caribbean Academy of Sciences would in future be able to implement the necessary mechanism to avoid a recurrence of this incident.

3(1) Minutes of the Inaugural Meeting of 16 & 17 May, 1988

The Interim Chairman reminded delegates that it was exactly two years ago, May 16th, 1988 that the Caribbean Academy of Sciences was inaugurated. At this auspicious event the Academy was addressed by Senator Michael Williams, who officially opened the proceedings, while the Hon. Mr. Winston Dookeran, Minister of Planning and Mobilisation for Trinidad and Tobago, delivered the official address. The Rt. Hon. J.G.M. Compton, Prime Minister of St. Lucia, addressed the Academy on the Realisation of the Inauguration of the Caribbean Academy of Sciences.

The Keynote address entitled "Science Communication Development and Society" was delivered by Professor W.J. Whelan.

On that occasion Prof. G.M. Richards moved the Vote of Thanks. In his speech he stressed the importance of Science and Technology in the modern world.

In the academic session which followed, the assembly heard presentations from:

- Professor G. Lalor
- Professor Rolf Richards
- Professor H. Phelps
- Dr. C.H.D. Magadza
- Mr. Frank Barsotti
- Mr. H. Blades

Mandate to the Interim Committee

The Interim President recalled that at its inauguration the Interim Executive Committee was elected and mandated as follows:-

(a) To invite suitable persons for membership in the Academy.

(b) To prepare and publish the Proceedings of the Inaugural Meeting.

(c) To revise the Draft Constitution on the basis of reports of working groups.

(d) To organise and call the First Annual General Meeting.

3(ii) Matters Arising

Application for Membership to the Caribbean Academy of Sciences

The Interim President reported that at present the Interim Committee had some eighty scientists who have indicated their willingness to become first members of the Academy.

The Chairman noted that the Academy has to be very careful at 'start-up' to put in place individuals who were willing to spend some measure of time and effort at this initial stage.

The Meeting was asked to accept the list of (See Appendix II) persons applying for membership in the Caribbean Academy of Sciences.

3.(ii) Continued.

The Meeting enquired and was informed that in addition to Ordinary Members, the Annual General Meeting will also choose Executive and Regional Representatives. The Membership list was accepted.

Preparation and Publication of the Proceedings of the Inaugural Meeting

The Interim President, Prof. Saunders apologised for not having the entire proceedings for the commencement of the First Annual General Meeting, but it was hoped that it would be available as the proceedings progressed.

Revision of the Draft Constitution on the basis of Report of the Working Group

The Working Group on the Draft Constitution provided the final document. The Committee comprised persons from the disciplines of Agriculture, Engineering, Medicine, Natural Sciences and Social Sciences.

The Revised Constitution was tabled for consideration; during this session the following amendments were recommended.

Page 1, Article II Objective

1) "The advancement of Science in the Region", should become #1, or primary statement of the Caribbean Academy of Sciences.

2) Page 3, line 1 should read "meetings" not "memetings".

3) Page 3, line 5 replace "geographical areas" by "regions".

4) Page 3, 6 (b), add Belize.

5) Page 3 6(d), replace "Curacao, Aruba and Surinam" by "Netherland Antilles".

6) Page 3 6(e) add "including Barbados".

8) Page 3 line 14 should read "General Meeting by posted ballot; except for the first Annual General Meeting".

Page 7, line 5 insert Article XI, line 4 "Immediate Past-President" should read Secretary.

3(iii) Accounts of Caribbean Academy of Sciences

The Interim President reported that prior to the Annual General Meeting, the CAS had three accounts as follows:

Current Account (Republic U.W.I.)	TT $7,326.25
Fixed Deposit	TT$13,121.27
Foreign Account	US$ 5,000.00

He further stated that the Executive Committee had to draw down on these funds to offset expenses incurred in preparation of the First Annual General Meeting.

He noted that preparation of the Proceedings would cost some $10,500 and the Committee are in the process of raising funds to cover this cost.

The Academy's Banker's are Republic Bank Limited.

4. New Bank Signatories

At present the Academy has four signatories:

1. Dr. W. Suite
2. Dr. D. Ali
3. Dr. H. Ramkissoon
4. Prof. R. Saunders.

The Interim Chairman advised the Annual General Meeting that new signatories who should be members of the new Executive, would have to be chosen.

This item was deferred.

5. Membership Fees

Two issues were raised with respect to membership fees:

(i) On what currency, and
(ii) how much.

The Meeting considered these issues at length and noted the following:

1) The advantages of acquiring foreign currency;

2) The exchange control restriction vis-a-vis such transactions;

3) The range of US $50 - $100 as possible membership fees;

4) The special difficulties this will bring for members in Guyana and some other West Indian Islands;

5) Whether there were plans to produce a Journal and should membership include a journal.

The following proposals were put to the vote:

1) Proposal I US$50, or TT$200.

2) Proposal II US$10, across the board.

Proposal I was carried, but it was agreed that the matter of fees should be taken up by the Finance Committee.

The Meeting paused at 10:30 a.m. for a Coffee Break and resumed at 10:50 a.m.

The Interim President suggested that in the absence of the Inaugural Proceedings, the Annual General Meeting could proceed into the afternoon session of the Agenda, and that the Proceedings would be tabled for consideration when they become available.

The Meeting agreed.

6. Ratification of Nominations for Membership

The Interim Chairman informed the Meeting that the Interim Committee had received information on the Membership from which they have proposed a slate of Fellows to be approved. (See Appendix II to these proceedings).

He reminded the Meeting of the need to put in place at least, initially, people who have the time and can contribute to the Academy in its infant stage of Development. With this in mind he requested the meeting to accept this slate of candidates to carry the banner forward, to ensure the Academy's development into an association of which the region can be proud.

Dr. G.V. Taylor requested that Prof. Saunders be added to the slate.

This was unanimously agreed to.

Dr. L.L. Moseley noted the exclusion of Prof. Cadogan from the slate of Fellows.

The Chairman reiterated that this method of selection was only to facilitate 'start-up' and that this first group is only intended to get the organisation off the ground.

Dr. C.R. McDavid enquired whether the Curriculum Vitae as presented (in Appendix III) were to be published in that form. He thought they were too brief.

The Chairman agreed that some were indeed too abridged, and indicated that these would be expanded accordingly.

Dr. H. Ramkissoon's CV should be amended to read "Department of Mathematics" not Physics.

The Meeting was asked to approve the slate of Fellows of the Academy (listed in Appendix II).

The list of Fellows was approved.

7. Election of President, President Elect, Secretary, Treasurer

The Interim Committee suggested the Election of Dr. H. Ramkissoon for the position of Secretary of the Academy.

The motion was carried.

In the like method Dr. Compton Seaforth was suggested and accepted for the position of Treasurer to the Caribbean Academy of Sciences.

Dr. C.R. McDavid questioned the constitutionality of the method of election.

The consensus was that while the meeting was sympathetic to the reason given for the procedures, it should have been opened to the floor for suggestions.

This suggestion was carried.

Prof. Ramsey Saunders was nominated and unanimously elected to the position of President of the Caribbean Academy of Sciences.

President Elect

Prof. Lalor commented that he believed the influence of the University of the West Indies dominated the membership and suggested that in electing a President Elect, we should look outside the walls of the University of the West Indies.

Moreover, Mr. Hollis Charles noted that, the election of a 'President Elect' in reality limits the tenure of Office of the President to one (1) year, which contravenes Article IV '3' of the Constitution. The consensus was that the meeting should not proceed to elect a 'President Elect'.

8. Election of Divisional Representatives

Members of the Academy were divided into five divisions and the following Divisional Representatives have been elected:

1)	Agriculture	:	Prof. J. Spence
2)	Engineering	:	Prof. H. Phelps
3)	Natural Sciences	:	Prof. J.S. Kenny Prof. Lalor nominated by Dr. J. Duncan. He declined.
4)	Social Sciences	:	Dr. A. McIntyre (recommended) The Chairman suggested to hold this nomination pending a response from Dr. McIntyre.
5)	Medical Sciences	:	Prof. H. Coore

9. Election of Regional Representatives

The region was also divided in five geographical areas and a representative had been chosen for each as follows:

1)	Prof. Juan Bonnet	:	Puerto Rico, Santo Domingo and Haiti.
2)	Dr. G. Van Taylor	:	Jamaica, Bahamas and Belize.
3)	Dr. F. Rosheuvel	:	Netherland Antilles.
4)	Prof. R. Saunders Prof. C. Cadogan	:	Trinidad & Tobago, Guyana and the Eastern Caribbean.

The question was raised as to whether the Academy in its initial stages required Regional Representatives.

The consensus was that Regional Representation was indeed necessary to foster growth at this stage.

In the case of Region 4 above it was proposed that when the President is located in a given region, there would be no additional Representative for that given region.

The general view of the meeting was that there was still a need for a Regional Representative in the initial 'start-up' period to share the work-load.

It was therefore agreed that Prof. Saunders would preside over the area in question assisted by Prof. Cadogan.

10. Committees

Ethics Committee

Prof. Cain was proposed to Chair this Committee.

The Interim President stated that Prof. Cain had indicated her willingness to serve and has asked to be able to co-opt members as she deems fit.

This proposal was carried.

The President Elect declared this session closed.

Installation of New Officers and Addresses

The President Elect of the Caribbean Academy of Sciences invited Prof. Lalor of the Third World Academy of Sciences to install the new Executive and Fellows of the Caribbean Academy of Sciences.

Prof. G. Lalor

Prof. Lalor in his address brought greetings from T.W.A.S. and noted it was the first institution to congratulate the Caribbean Academy of Sciences and offered their support, which will not only help the Caribbean Academy of Sciences to achieve its aim in the Caribbean region but in the world.

He further stated that the Caribbean Academy of Sciences must not only be a success, but must be seen to be a success.

In closing he wished the Academy Luck in all its endeavours.

11. Short Address by Incoming President

Prof. Ramsey Saunders then asked members for their expressed confidence, confidence with which the Academy can move forward.

The President elect underscored the primary objective of the Caribbean Academy of Sciences as "to raise the level of scientific consciousness in the region and to increase the public understanding of the importance and potential of science and technology in human progress". This goal, the Caribbean Academy of Sciences hopes to fulfil by:

(i) Ensuring excellence is developed and recognised in the region;

(ii) Serving as an advisory body to regional governments in scientific and technological matters;

(iii) As a Scientific Body, speaking out on technological and scientific issues in such a way that Governments will take note;

(iv) Seeking funds both locally and externally to foster the working of the Academy;

(v) Working assiduously, so that within 1-2 years they begin to recognise the Caribbean Academy of Sciences, not only as a name but as a shining light in the interest of the region.

THE DYNAMIC EARTH AND THE ENVIRONMENT

PROF. G.C. LALOR

INTRODUCTION

Mr. Chairman, ladies and gentlemen, the inaugural meeting of an Academy of Sciences is an event of moment and solemn promise. In our region, where there has been no remarkable dedication to science, for the Caribbean Academy of Sciences to fulfill this promise it must become a key component in the infrastructure on which our science will be built. The time for an Academy is long past due, and those who recognised this and have played a major role in making this event possible, and none more so than Professor Saunders, deserve warm congratulations and the fullest support.

Today, Chairman, I bring greetings - on behalf of the distinguished President and Fellows - from the Third World Academy of Sciences and ask that you accept our best wishes for success. I feel sure that this new Academy will contribute to the well-being of the Caribbean and to the wider world of science. In this, work on the Caribbean environment must rank high.

My topic today - **THE DYNAMIC EARTH AND THE ENVIRONMENT** - deals with both the region and with the world; with science and with people; with the rich and the poor; with life and perhaps with catastrophe.

Everyone seems to agree to "protecting the environment", but actually doing this is a terribly complex business. It requires many compromises, more knowledge, much effort, and a new set of paradigms. Intensive agriculture, energy production and distribution, transportation, manufacture and industry, and recreation are all considered necessary; all are likely to affect the environment adversely.

There would be no alumina industry without red mud; no petroleum industry without some oil pollution; no intensive agriculture without the dangers of pesticides and fertiliser run off; and a last example, no cities without garbage and sewage problems. Unfortunately, what the thermodynamic would call our system and surroundings are inseparable as we operate on the present scale. We have to learn to minimise the adverse effects of those activities we consider necessary.

So it has become important to ask such questions as:

> "What kind of planet do we want? What kind can we get anyhow? How many people can Earth carry? How much poverty will be acceptable? How much change can the biosphere absorb without the extinction of mankind?"

To quote Lyn Marguelis and Edwin Dobb "The Sciences", January/February 1990, p48 there are two extreme views:

> "Those who would dominate nature care little

about the consequences of human action. Those who would preserve nature in some imagined pristine state pretend that it is possible for human action to have no consequence. Both speak from arrogance and seek refuge in certainty. And both are fundamentally mistaken."

The better our knowledge of origins and of historical changes and the more we understand the dynamics that form the environment, the better the answers will be. Much progress has been made on the knowledge base, and the dynamic nature of our everchanging world is beginning to be understood, but much remains to be done in basic and planetary research, on models and on applications. And as almost always knowledge of the distant past can be helpful.

Oxygen - One Man's Poison .....

The origin of the solar system some 4.6 billion years ago was the explosion of a supernova. Then condensation of primitive solar-nebula material - stardust really - and subsequent accretion of matter built up the primitive earth. Heating from radioactivity, which was very much greater then than now, impacts from infalling material and gravitational contraction, led to temperatures high enough to cause widespread melting and the differentiation into core, mantle and crust. The gravitational attraction of the newly formed planet was sufficient for it to hold those gases which with cooling formed the oceans and the atmosphere setting the stage for life.

After perhaps a billion years life appeared introducing an interaction between the organic and inorganic worlds which actually led to the non-equilibrium conditions which allow us to exist.

As long as three billion years ago when the atmosphere was composed largely of methane and carbon dioxide primitive life was well established. Then there emerged a group of single-celled marine organisms, called cyanobacteria because of their colour, which could synthesise carbohydrates using the sun's energy and the carbon dioxide dissolved in the oceans. Oxygen, a by-product of the photosynthesis, saturated the seas over time and became a major component of the atmosphere. It poisoned most other types of life on contact. Eventually new organisms, heterotrophic bacteria, which consumed photosynthesisers evolved. The cyanobacteria eventually led to algae and plants; the heterotrophic bacteria to animals. Together both groups have been remaking the face of Earth.

The action of this early pollutant, oxygen, shows how a stress can change an existing state. Oxygen was of course essential to our own evolution but next time we might suffer the fate of the ancient anaerobes three billion years ago - extinction.

The complex dynamics of the Earth shows up in many ways - continental drift, and the creation and erosion of mountains are impressive but though less grand the biogeochemical cycles are the chemical basis of life as these recycle and make available the materials on which life depends.

Biogeochemical Cycles

The Earth is a dynamic system undergoing extremely complex sets of biogeochemical cycles. Materials flow from one reservoir to another allowing elements which are key to life e.g. carbon, oxygen, nitrogen, phosphorus - to circulate through the lithosphere, the oceans and the atmosphere. These cycles maintain a steady state biosphere within the narrow limits necessary for life. The Carbon cycle is a good example.

Photosynthesis converts carbon dioxide and water to oxygen and carbohydrates thus providing the earth's entire supply of organic carbon. Carbon is immobilised in dead plant and animal matter and the calcium carbonate shells of various organisms. These are eventually buried as sediment and incorporated into the earth's crust. Without this storage there would be no net source of oxygen which would then be a trace constituent in the atmosphere. Oxidative decay of organic matter, respiration, acid dissolution of carbonates, some formation of methane, the uplift of carbon sediments during the formation of mountains and subsequent weathering returns carbon to the cycle. The time scales involved for the different links vary enormously but overall a more or less steady, or at least a slowly varying state, has been maintained.

Similarly, cycles can be constructed for all the elements and, with the energy balance, help provide and maintain the conditions necessary for life. Obviously, there can be severe fluctuations and, as mentioned, life itself has already altered the environment fundamentally with catastrophic consequences for some species, through the generation of large quantities of oxygen. Man may well be initiating other large-scale disturbances.

The global flows of major elements such as sulfur and nitrogen consequent on human activity now often exceeds natural flows. Emissions of lead; cadmium and zinc exceed the natural flow by factors of 18, 5, and 3 respectively; for arsenic, mercury, nickel, and vanadium the factor is about 2. Over 70,000 chemicals which do not exist in nature have been synthesised and several of these, as varied as mercury compounds and the chlorofluorocarbons, are now known to have powerful and unexpected effects on the global environment some at remarkably low concentrations. The future magnitude of the releases will be largely determined by the global populations and the extent of resources they consume.

Population and Poverty

For the first 2 million years of his existence when man was hunter, scavenger, and herbivore his food resources could have supported a population of about 10 million. Primitive man's activities hardly affected the global environment. If the local game were killed off or the productivity of fields destroyed people could find new lands. For those who reached beyond the far horizon there was always a new world.

Then, about 10,000 years ago, man learnt to domesticate plants and animals and began to alter the environment to his own ends. The dynamics changed and population began its exponential growth. Since the eighteenth century population has increased eight times and life span has doubled raising world population levels above 5 billion. Man has become more aggressive in his impact on the natural world, and increasingly he has sought to fill every available niche on the planet. Consequently global demand is now huge, and people now, for example:-

- use over 40% of the organic material fixed by photosynthesis on land;
- produce energy at the rate of over 12 billion tons of coal equivalent per year;

Consumption is highly skewed. The 26% of the global population who live in developed countries have per capita consumption of paper, steel, and commercial energy which are respectively 15, 11, and 12 times those of the developing world. Data like these are now readily available so I want only to point out that Los Angeles has three times as many cars as India, and that there the use of barbecue lighter-fluid adds as much hydrocarbon pollution as a quarter million cars or one oil refinery.

Although there is no monopoly on concerns about pollution, poor countries are likely to differ from rich ones in their perspectives on environmental protection. Also the likely consequences of achieving the standards of living of developed countries for Asia, Africa and Latin America can generate sobering thoughts.

The environment is what supports poor countries. Natural resources are the main assets. Typically farming, forestry, fishing, and mining account for a third of the GNP, and in the Caribbean tourism is a major earner. If environmental calamity strikes, the Third World has everything to lose and the Third World is approaching real danger. The huge urban centres are already environmental disasters and worsening. Population increases will stress the rural environment even more than now. More land, much of it unsuitable for intensive agriculture, will be cleared, more animals driven to extinction, rivers and seas polluted, etc., if we follow the "normal" course of development.

Bruntland writes that "Poverty is a major cause and also

a major effect of global environmental problems. It is futile to seek solutions to environmental disturbances without considering them from a broad perspective that encompasses the factors underlining world poverty and the inequalities within and among nations. For developing countries poverty lies at the heart of all issues.

Poverty is a terrible contaminant and its removal may be necessary to save the environment. Unfortunately, this will involve concepts of equity between the countries of the world and between the present and the future. Not an easy matter as topical discussions on the possibility of climate changes due to the greenhouse effect are making clear. Here both the rich and poor will be involved in affecting climate and in sharing the consequences.

The Greenhouse Effect

Without the thermal blanket provided by the atmosphere Earth would be as cold and dead as the moon and life would never have developed. Incoming visible and near-ultraviolet radiation penetrate the atmosphere, is absorbed by rocks, soil and water and is re-irradiated in the infrared. The tri- and poly-atomic gases which are minor atmospheric constituents have low lying vibrational modes which absorb in the infrared; and the subsequent re-emission returns much of the energy to the earth rather as a greenhouse does.

The gases contributing directly to the greenhouse effect are carbon dioxide, methane, nitrous oxide, and the chlorofluorocarbons. Global warming is expected to increase as more of these enter the atmosphere. Carbon dioxide is now the main greenhouse gas.

The first major source of anthropogenic carbon dioxide was the coal furnace of the industrial revolution. In 1800 the atmospheric carbon dioxide concentration was .028%, it is now .035%. Industry, electricity generation and transportation are adding carbon dioxide to the atmosphere at the rate of over 5 billion tons yearly, an increase of about 1% per year. The industrialised world accounts for more than half this output; but the output from developing world is already large and likely to increase greatly. Another billion tons of carbon dioxide are being added yearly from the burning of tropical rain forests, which are being cleared at the rate of forty thousand square miles annually.

Methane levels are growing more rapidly than those of carbon dioxide. Sources include anaerobic fermentation of biomass in swamps, rain forests and rice paddies; bacteria in landfill sites, leakage from the mining and transportation of coal, oil and natural gas, and animals. Cattle generate up to half a pound per day per animal due to the metabolism of cellulose; even termites appear to be a considerable source of methane. The major sink for methane is its reaction with hydroxyl radicals obtained from the reaction of photochemically generated atomic oxygen (with water).

$$CH_4 + OH = CH_3 + H_2$$

The methyl radicals undergo further reaction, one product being carbon monoxide some of which is oxidised to carbon dioxide by hydroxyl. This is but one example of the cycles of thermal and photochemical reactions which occur in the atmosphere. There is some still fascinating chemistry here but it is an area that has not been attractive to Caribbean researchers.

As the demand for more energy, meat products and rice grows the atmospheric concentration of methane could well double during the next century. The climatic warming due to methane and other trace gases could be as much as that caused by carbon dioxide whose concentration is expected to double by 2050.

Climate Models

Climate is the result of extremely complex interactions. Supercomputers are used to model how and why the global climate may change. The inputs are equations derived from the various laws which describe the properties and circulation of the atmosphere and the oceans, and the kinetics of the reactions of the various species. The main models all predict that a doubling of carbon dioxide concentrations in the atmosphere will produce significant warming 1-5°C late in the next century with the greatest temperature changes in the higher latitudes. The icesheets could melt and ocean levels rise. If this rise is large enough to dislodge the West Antarctic ice sheet, within a matter of decades the ocean levels might rise by as much as 5 metres. Coastal cities would be flooded.

The hydrological cycle may be particularly sensitive to global warming. Precipitation will increase and the distribution will shift changing the global pattern of agriculture. Some countries will benefit, others will suffer droughts. In the tropics and middle latitudes storms will be more numerous and much more severe with hurricanes probably achieving wind speeds in excess of two hundred miles per hour. As a friend joked - buildings will have to be aerodynamically designed.

The many uncertainties in the feedback loops include: removal of carbon dioxide; possible, increased photosynthesis by algae, plankton and other microorganisms; reduction of incident energy by reflection due to increased cloud formation and cloud cover; and many others. These uncertainties, concerns about the high cost of reducing the production of greenhouse gases, which include effects on national economies, are used by many to postpone immediate action, and to call for more research before decisions are made. The U.S. government has taken that view but at least it has budgeted one billion dollars for such research in the present year.

Yet by the time there are sure answers, if the predictions

are correct, it might be too late to avoid global upheavals.

What can be done?

There is now a fair amount of relevant knowledge. We know a lot about the chemical and physical dynamics of the biosphere; the causes of atmospheric pollution; how to reduce erosion; how to clean up toxified lakes and seas, and the nature and modes of action of toxic pollutants. There are analytical techniques of remarkable sensitivity for environmental monitoring and statellite reconnaissance is another powerful tool.

And there are hopeful signs: the population explosion seems to be slowing in almost all countries though there still could be a doubling of global population in the latter half of the next century with most of the increase occurring in the poorer countries. The emission rates of sulfur, lead, and radioisotopes are decelerating and there is the increasing awareness of the need to protect the biosphere.

Assessments of the carrying capacity of the Earth at various levels of population and life styles, the extent and quality of the arable land under different agricultural practices, mineral and energy resources, ocean upwellings and their productivity are among the studies which will prove valuable. Hopefully, the rapprochement between the superpowers will release money to speedily generate enough knowledge and action to make a difference.

But while lots of answers are needed, it is sensible to do things now that promise highly desirable social benefits regardless of worries about the accuracy of the predictions. This includes conservation, increasing energy and manufacturing efficiency; reducing waste and pollution, recycling, reforestation, population control, etc., all matters which will lead to significant improvements whatever happens.

There must also be a commitment to environmental education. Even now the bottleneck is the way people think and do, and the things they want, rather than the knowledge base.

Caribbean

The Caribbean faces in some measure many of the global environmental problems. Deforestation, erosion and sedimentation, overfishing and the destruction of nursery areas, damage to coral beds, habitat loss and species extinction, oil spills, garbage and sewage disposal, industrial effluents, leachates from disposal sites entering ground water, saline intrusions, fertiliser and pesticide contamination, all contribute to the situation.

Deterioration of an ecosystem can take place quickly. As late as the fifties Kingston Harbour was a productive unit for fishing and recreation. Now it is reeling under severe insults.

The beaches for swimming have almost disappeared, certainly only the brave and foolhardy use those remaining; there is algal growth, few fish, and even seen from the air the damage is obvious. The discharge of raw, or improperly treated sewage is perhaps the major contributor to the decay. Copper, cadmium, chromium, lead, zinc, and mercury have been reported in the harbour sediments. These form a reservoir of possible contamination of the food chain.

Nor is the harbour the only sufferer, the atmosphere of Kingston is now frequently smoky, dusty, and shows signs of what might well be photochemical smog. The condition of the water table of the Liguanea plains reflects the large number of septic pits needed in the absence of better waste disposal. Proper disposal of sewage is probably the major problem but industrial effluent also requires attention.

And Kingston is not alone: UNEP publications include Havana, San Juan, Veracruz, Cartagena, Puerto Cabella, and Port-of-Spain as suffering major pollution. Obviously much needs to be done; more data would be useful but there is enough for many curative actions to begin.

The University of the West Indies

Environmental research is hardly new to the University of the West Indies but there is presently a much greater emphasis on this area. A number of important programmes are underway and ALCAN has endowed a Chair in Sustainable Development with special reference to the Caribbean. This has been advertised and it is likely that the person appointed will be expected to direct a Centre which can serve as focus and catalyst for a great deal of additional work.

Not long ago I began to prepare an inventory on environmentally related work in UWI. The responses reported a considerable effort as follows:

Mona

The programmes at Mona include:

> environmental mapping of soils, sediments, water and air particulates; pesticides in the environment; water recycling; measurements of ozone, sulfur dioxide, and carbon dioxide fluxes in the Blue Mountain range; atmospheric pollution; pollen abundance and dispersal; the reef environments; heavy metal and nutrient cycling; biological diversity; effects of chemical industries; landslides; development of monitoring systems.

Cave Hill

> Environmental research in Cave Hill concentrates on biology. The topics include: ecotoxic effects of agrochemicals; population dynamics and conservation; pollution in recreational waters.

St. Augustine

Research in St. Augustine depends a great deal on analytical chemistry. It includes:

> lead levels in blood, hair and respirable dust; phthalate esters in potable water storage tanks; fingerprinting of oils; leachates from toxic waste disposal sites; carbon dioxide as a propellant for aerosols.

I would like to say a little more about the mapping programme which is being executed by the Centre for Nuclear Sciences. This involves the measurement and mapping of background levels of some thirty elements in soils and sediments, surface and ground waters throughout Jamaica. Pesticide residues, microbial contamination and air particulates will be included as appropriate. The analytical methods include neutron activation analysis, x-ray fluorescence, atomic absorption spectrophotometry and ion chromatography.

The data, including sample locations, are being entered into a computer readable database, and after transformation are the basis for detailed concentration maps. These will be displayed, analysed and compared using the GRASS geographical information system. The programme has several collaborators including the Scientific Research Council, the NDRC, the National Water Commission, the Underground Water Authority, the Ministry of Agriculture, and the Ministry of Health. These are providing access to their own data, and assisting with the execution of the work and interpretation of the results.

The programme will produce detailed information on the chemistry of the Jamaican environment, train a number of scientists and technicians and provide recommendations for a permanent monitoring system. Funding is provided mainly by the Inter-American Development Bank.

Conclusion

In 1948 the British astrophysicist Fred Hoyle predicted that:

> "Once a photograph of the Earth, taken from the outside, is available - once the sheer isolation of the Earth becomes plain - a new

idea as powerful as any in history will be let loose."

The beauty and fragility of the Earth have been best seen by the astronauts and cosmonauts. They have brought back the pictures and as Archibald MacLeish puts it:

> "to see the Earth as it truly is, small and blue and beautiful in that eternal silence where it floats, is to see ourselves as riders on the Earth together, brothers on that bright loveliness in the eternal cold - brothers who know now that they are truly brothers."

To be more prosaic: In 1981 the cosmonaut Vladimir Kovalyonok reported a dust cloud originating in a Sahara storm. He watched as it traveled over Africa, over the Indian ocean, and was dumped in rain on the Philippine Islands seven thousand miles from its start. He says "I understood for the first time that we are sailing in the same boat."

Humans are subject to selection like any other species and if the historical record be the measure, the cards are stacked against us in the long run. If we overwhelm our food and energy resources and foul our environment sufficiently the species will, like any of the many shown in the fossil record, join the line for extinction. But we may have the means if there is the will to maintain the environment in a state not inimical to mankind.

We had better because there is no life boat. Earth is unique, certainly within the solar system so if we value our children and the future of mankind it must be insane not to protect it to the very limit of our ability.

It is true that the Caribbean is small; it is true also that we are unlikely to have any major effect on what the world does or suffers; but we are important to ourselves and the Caribbean environment is ours. If we understand its dynamics, and protect and preserve it we are preserving the quality of our own lives life and our children's children's existence.

Inventory of Environmental Projects

Mona

1. Environmental mapping and the development of a monitoring system for key environmental parameters
   (Prof. G.C. Lalor and Dr. H. Robotham, CNS)

2. Measurements of ozone, sulphur dioxide, and carbon dioxide fluxes in the Blue Mountain range
   (Dr. A. Chen, Physics and Dr. W. Pinnock, Chemistry)

3. Atmospheric pollution in Kingston
   (Dr. A.M. Greenaway, Chemistry and Dr. W. Pinnock, Chemistry)

4. Pollen abundance and dispersal in the Kingston Metropolitan area
   (Dr. W. Bailey, Geography)

5. Environmental changes in the Jamaica reef environments since the last interglacial years
   (Dr. S. Donovan, Geology)

8. Studies on pesticide residues in ground water
   (Prof. T.P. Dasgupta, Chemistry)

9. Degradation of pesticides in tropical condition
   (Prof. T.P. Dasgupta, Chemistry)

10. Encapsulation of pesticides - slow foundation
    (Prof. T.P. Dasgupta, Chemistry)

12. Heavy metal and nutrient cycling in polluted environment
    (Dr. A.M. Greenaway, Chemistry)

13. Monitoring of biological diversity (terrestrial land) in the Hope Valley region, and of the water sediments for B.O.D. sedimentation, pesticide diversity and variation elements
    (Dr. A. Mansingh, Zoology)

14. Monitoring of pesticide residues.
    (Dr. A. Mansingh, Zoology)

16. The chemical industries of Jamaica and their environmental effects
    (Dr. A.M. Greenaway, Chemistry)

19. A national landslide monitoring and research programme for Jamaica
    (Geology and Geography Departments)

20. A study of landslides in the western section of the parish of St. Andrew and their impact on people and lifeline structures

and

Development of landslide loss reduction techniques for the parish of St. Andrew
(Mr. R. Ahmad, Geology)

22. Engineering-geologic and environmental-geologic maps of Jamaica: a framework for the national land development plan
(Mr. R. Ahmad, Geology and Ms. Y. Drakapoulos, Geology)

Cave Hill

1. Ecotoxic effects of selected agrochemicals
(Dr. E.A. Moore, CERMES)

2. Population dynamics and stock structure of sea urchins in the Eastern Caribbean
(Dr. W. Hunte, Biology)

3. Eastern Caribbean flying-fish project
(Dr. W. Hunte, Biology)

5. Conservation of the hawksbill turtle
(Dr. J. Horrocks, Biology)

8. Monitoring faecal pollution in recreational waters
(Prof. G. Mathison, Biology)

St. Augustine

1. Monitoring of lead levels in blood and hair in the Trinidad and Tobago population
(Dr. J. Addae, Medical Sciences, Dr. D.E. Bratt, Medical Sciences, Dr. V.A. Stoute, Chemistry, and Dr. L.A. Hall, Chemistry)

3. Investigation of phthalate esters in potable water storage tanks in Trinidad and Tobago
(Dr. I. Chang-Yen, Chemistry)

4. Development of systems for fingerprinting of crude oils and spilt oils in the environment using a multianalytical approach and computerized patter recognition
(Dr. I. Chang-Yen, Chemistry)

5. Investigation of lead levels in respirable dust along roadways in automobiles and primary school atmospheres in Trinidad and Tobago
(Dr. I. Chang-Yen, Chemistry)

6. Assessment of leachate patterns from toxic waste disposal sites in Trinidad and Tobago with regard to environmental contamination
(Dr. I. Chang-Yen, Chemistry)

7. Utilization of carbon dioxide as a propellant for aerosols formulations in place of chlorinated fluorocarbons
(Dr. I Chang-Yen, Chemistry)

CARIBBEAN ACADEMY OF SCIENCES

ANNUAL GENERAL MEETING, PORT OF SPAIN, 16 MAY 1990

ENVIRONMENT AND DEVELOPMENT: THE CHALLENGE FOR CARIBBEAN SCIENCE

Yves Renard

I start by thanking the conveners of this first Annual Meeting of the Caribbean Academy of Sciences for giving me the honour to address such an important gathering. I particularly appreciate this invitation because it gives me the opportunity to express my admiration for the initiative taken in constituting this Academy, and my conviction that this institution has an essential role to play in the shaping of a better future for the Caribbean.

And of course, if there is to be such a future, it will be because we would have taken better care of a dimension of our development which has been often neglected in the past, namely the environment, which constitutes the theme of this evening's discussions. The environment indeed has become a new and unavoidable buzzword in the discourse of many, including the political leaders of today's world. It is a theme which has attracted the attention of the media, which rallies political forces and mobilises the energies of communities and institutions all around the globe. Within a few years, the concern for environmental quality and integrity has moved to the top of the world's agenda.

But please, do not worry. I have not come before you with my own perception of these issues, with my own scenario of an ecological crisis, with a long litany of problems and concerns. I think we are here today because you know, better than anyone else, that these problems exist, that these problems are serious, that under the rethoric and beyond the fashion, there are real and complex issues which are important, relevant and urgent. There is therefore no need for us to expand any further on the description of these issues, but there is probably need to summarise briefly what these issues are, and how they relate to our common concern for Caribbean social, cultural and economic development. In this regard, I think environmental issues can be placed in four distinct categories.

When talking about the environment, what we are talking about, first of all, is the quantitative loss of important natural and environmental resources, a growing disparity between demand and supply. We are all familiar with the long list of resources - the forests and the soils, the fish and the wildlife, the water and the land - which are progressively being depleted, exhausted, exploited beyond sustainability. We are also familiar with the dramatic figures - millions of hectares of tropical forests lost every year, so many species threatened by extinction by the year 2000. For the Caribbean, the figures can be similarly dramatic, as it is estimated that over 2 million hectares are being deforested in the Wider Caribbean every year, with over 10,000 hectares for the CARICOM sub-region alone.

The second set of issues relates to the impact of human activities on the quality of our environment, on the quality of the natural resource base upon which we depend. We are familiar with the issues of pollution and environmental contamination, which affect the quality of the air, the water and the soils, reduce the productivity of the environment and impact on human health. In this regard, we can only stress the extreme seriousness and urgency of such issues, noting the frequent abuse and misues of agrochemicals in the region, the inadequacy of most of our solid waste management and sewerage systems, the insufficient investments in the infrastructure required to prevent and minimize the impacts of our activities.

But "environmental problems", as we may call them, are not limited to this negative list, as there is another side to the coin. In this day and age, while our concerns for the negative impacts of environmental degradation and contamination are certainly legitimate, we must stress that it is similarly valid to be concerned with the underutilisation of our environment. In this last decade of the century, our limited use of marine resources, our inability to tap certain renewable sources of energy or the absence of meaningful linkages between environmental conservation and tourism development should concern us as much as the pollution of our harbours and the deforestation of our slopes.

The fourth dimension of the environmental problems which we now face is the cultural dimension. It is the degradation of the quality of the relationship between people and their environment, it is the destruction of the intimate knowledge of the milieu, it is the loss of the harmony which can exist between people and the system of which they are part. As we discuss our responses to the challenges of environmental management, it is essential that we do not lose sight of this important cultural dimension.

Analysis of the issues

But as we discuss our responses, it is even more important to realise that these problems, as we have summarised them very succinctly, are merely the symptoms of more profound and more serious causes. Indeed, it is important to note that some efforts towards improved environmental management may have failed because they focused on the symptom while ignoring the root cause. We must therefore ask ourselves: what are these profound causes? If the deforested slopes, the polluted waters, the eroded beaches and the garbage piled up at the street corner are merely the symptoms, what then is the illness - or rather, what are the illnesses - from which our patient suffers?

The first illness is poverty. In a sense, poverty is both a symptom and a cause. It is a cause because hunger and needs force one to destroy the environment in order to survive, because rural poverty provokes migration and urban congestion, because the scarcity of public funds makes it impossible for a government to invest in environmental management.

But poverty is itself a symptom of inequality. The inequality in the access to resources, which forces the landless farmer to deforest important watershed areas, the inequality in the sharing of wealth, which creates poverty, the inequality among countries, which makes the developing world the first victim of environmental degradation. In the Caribbean, these inequalities are the product of a peculiar history which has determined the patterns of resource allocation and the terms of the exchange with other parts of the world.

Another illness is found in our structures, in the way decisions are made, in the inadequacy of many of our institutions, in the prevalence of short-term needs over long-term interests. We are organised to exploit resources to meet immediate needs, not to manage resources for present and future benefits.

The real illness, therefore, is probably in a form of development that has not only failed to meet the needs of the majority, but has also in the process created the impacts that jeopardize the chances to meet these needs in the future. It is the failure of instruments which gave absolute priority to growth rates over the satisfaction of needs, which ignored the long-term consequences of human action.

It is therefore clear that our response to the environmental issues of these times is part of our response to issues of development, to the challenge of meeting people's needs and aspirations, now and in the future. It is clear that what we need is not a set of remedies to get rid of the symptoms, but a new vision of development, a redefinition of development that will prevent the occurence of the illnesses.

A redefinition of development

It is indeed one of the most valuable products of the recent wave of official interest in the environment-culminating with the release of the Report of the World Commission on Environment and Development in 1987 - that there is now a consensus on the need for a new approach to development. With the release of the Commission's report, entitled Our Common Future, the concept of sustainable development has been popularised. It is defined as a form of development that "meets the needs of present generations without compromising the ability of future generations to meet their own needs".

I must confess that I have slight difficulties with the use - and abuse-of this expression "sustainable development". In a recent address. Prof. Norman Girvan asked: "Is development becoming a dirty word?" We could also ask: "Has development become an empty word, so empty that it now requires permanent adjectives to ensure that is is properly qualified?" I have difficulties with the expression because development should, by definition, be sustainable, and because a definition of development, or rather a qualification of development, should explicitly incorporate a number of principles.

The first of these principles is peace, both as a goal and as an instrument of human development.

The second principle is equity; equity among and within nations, equity in the access to and benefit from natural and environmental resources, equity in the distribution of these benefits.

The third principle is sovereignty; the sovereignty of nations, communities and institutions; the respect of one's fundamental right to shape one's destiny, in harmony with others, without being forced by others.

The fourth principle is cultural integrity, as a precondition of development and progress. History has indeed demonstrated that culture is the source of development, the foundation without which development has no meaning, no goal, no spirit. Culture is not the ornament that one places on a finished building, it is the structure and the foundation of the building, without which it could not resist the hurricanes and the earthquakes of human life.

And the fifth principle is, of course, sustainability, which implies that development must preserve and indeed enhance the productivity of the ecosystem, that it must permit the renewal of the resource base and that it must assume inter-generational responsibility.

The role of an Academy of Sciences

It is obvious that an Academy of Sciences has an important, indeed a central role to play in this quest for more harmonious and more sustainable forms of development. This, in essence, is what I have come to discuss with you today, convinced as I am that your Academy will be in the forefront of that urgent search.

In the growth of your institution, you will benefit from experiences from other parts of the world, where organisations such as yours are engaged in pioneering work to save and manage the environment. In Poland, for example, the Institute for Conservation of Nature and Natural Resources is a part of the Polish Academy of Sciences. In several other countries, Academies of Sciences have created specialised institutions, such as Botanical Institutes, Institutes for Landscape Ecology or Nature Conservation Commissions. In some cases, such as in the USSR, Academies are involved in the actual management of nature reserves, and run important research and training facilities.

With this reference to other Academies, I should also mention the role of the Third World Academy of Sciences, which has already been presented to us, as well the important work of the International Council of Scientific Unions (ICSU), carried out by its Scientific Committee on Problems of the Environment (SCOPE). The mandates of SCOPE, as stated in its constitution, are:

- to advance knowledge of the influence of humans on their environment, as well as the effects of these environmental changes upon people, their health and their welfare-with particular attention to those influences and effects which are either global or shared by several nations; and
- to serve as a non-governmental, interdisciplinary and international council of scientists and as a source of advice for the benefit of governments and inter-governmental and non-governmental bodies with respect to environmental problems.

SCOPE's activities fall within four main areas, namely: sustainable development, biogeochemical cycles, global change and ecosystems, and health and ecotoxicology. Under these headings, some twenty-three projects are presently carried out, most of which having direct relevance to our region.

Another global organisation which should be mentioned here is the IUCN-the world Conservation Union. Founded in 1948 and based in Switzerland, IUCN is a grouping of governments, research institutions, non-governmental organisations and professionals concerned with the preservation and sustainable use of natural resources. As part of IUCN's structure, there are six commissions, including the Commission on Ecology,

the Commission on Environmental Law and the Commission on National Parks, which provide the mechanism for the participation of scientists and professionals involved in these domains. At present, the participation of Caribbean scientists in the work of IUCN's commissions is regrettably limited, and your Academy can certainly assist in developing useful linkages there.

In the regional context, your Academy will become a key partner to several institutions and programmes, which your perspectives and experiences will no doubt strengthen and expand. In this regard, I wish to note the role of the following organisations:

- at the governmental level, a very significant development is the establishment of the Caribbean Environment Programme, sponsored by the United Nations Environment Programme, and coordinated out of Jamaica. As you know, the legal framework for this programme, which encompasses the Wider Caribbean region, is provided by the Convention for the Protection and Development of the Coastal and Marine Environment of the Caribbean Region, better known as the Cartagena Convention. The CEP carries out important programmes in pollution monitoring and control, coastal zone management, information, institutional development and environmental legislation;

- the Caribbean Conservation Association (CCA) is a non-governmental organisation which has the particularity of having governments, non-governmental organisations and individuals within its members. It is particularly active in the field of environmental education and public awareness, and also facilitates networking and provides technical assistance to its members in the fields of environmental planning, environmental impact assessment, etc. CCA's membership includes countries and organisations from the Spanish, English, French and Dutch-speaking Caribbean;

- within the framework of the Caribbean Community, one key institution is the Caribbean Environmental Health Institute (CEHI), based in St. Lucia. The institute carries out important training, research and technical assistance programmes, notably in the fields of solid waste management, water quality, toxic substances management, agro-chemicals and environmental impact assessment.

Several other regional, sub-regional and national institutions are active in the field of environmental management, and you are of course familiar with most of these. Among them, a recent initiative which deserves particular mention here is the creation of the Consortium of Caribbean Universities for Resource Management, which is a grouping of fourteen institutions of higher learning in the region. The objectives of the Consortium include all aspects of cooperation, notably the sharing of expertise among universities and the development of joint programmes. The secretariat of the Consortium is presently located at the University of the Virgin Islands in St. Thomas.

All this is to say that there are a number of institutions which are anxious to collaborate with your Academy and to benefit from your collective wisdom and experience. Indeed, in the existing regional framework of cooperation and action for environmental management, there is need for expanded collaboration among scientific disciplines, as well as between science and other elements of management.

Let us therefore examine briefly the role of science in environmental management.

Monitoring the environment and evaluating impacts

There can be no effective environmental management, there can be no solution to the problems identified earlier without a good knowledge of elements and processes- this is most obvious-and without an ability to monitor the status of the environment and the impact human activities may have on the resource base. What we need to do, therefore, is to improve and effectively use the scientific, technical, and legal instruments that will allow us to monitor and evaluate such changes. Environmental monitoring is a vast domain, and I wish to limit myself to three observations:

- firstly, I would like to note the urgency of developing and enforcing truly regional environmental standards, suitable to our ecological, economic and institutional conditions, capable of providing us with instruments to enforce measures and improve management;

- secondly, I wish to highlight the relevance of developing simple and adapted monitoring techniques. Our resource management and environmental agencies around the region are at the same time frightened and seduced by the sophisticated instruments that science- or rather aid agencies- offer. The reality is that some of our needs - such as beach, coral reef, water quality or forest cover monitoring - could also be met by simpler - and more indigenous - techniques;

- thirdly, I should stress the need to develop adequate human and institutional capabilities to carry out effective monitoring. The reality is simple: in the region, it is much easier to carry out an extensive three-month survey than to have regular data collection exercises once a week over a few years. We now lack data because we lack people and institutions who accumulate that data.

Diagnosing the causes of the impacts

As was said earlier, we need to go beyond the identification of the symptoms - what environmental monitoring reveals - to understand the real causes of environmental degradation. Of course, such understanding requires the mobilization of a broad range of disciplines, and among these, I would like to highlight three important domains:

- the first domain is the relatively new and generally unexplored field of environmental history. It is the necessary understanding and articulation of the relationship between people and resources at various periods of time, and the understanding of the impact of past resource use patterns on present situations; we have much more to learn from an examination of that relationship in Caribbean history;

- the second domain is the examination of human values, attitudes and behaviour, an understanding of the phenomena that link social and cultural causes with ecological change, an appreciation of the basis upon which new development patterns can emerge;

- the third domain concerns the study of land and resource use patterns, as an indispensable prerequisite for improvements and reform.

Achieving sustainability

But the main role of science is probably to provide the instruments to achieve sustainability, and its first task, here, is to define, in operational terms, what sustainability is. It is to give flesh to a relatively new concept.

We also need to carry out a more systematic exploration and evaluation of resources for development. We have identified the underexploitation of certain resources as an environmental issue, and we recognize that the achievement of sustainability requires the full mobilization of available resources. Because of our peculiar history, and because of the legacy of past patterns of development, this is a task that remains to be done. It begins

with an inventory and assessment of terrestrial and marine plant and animal resources, and includes a more systematic exploration of local renewable sources of energy. It is a task that will inform us better of what our capital is, and how much of it is available for investment in development.

Another set of tasks relates to an improved understanding of what we could term "critical ecosystems and processes". Among these, I could note certain areas where knowledge is particularly needed:

- forestry;
- hydrology, and water catchments;
- coastal dynamics and erosion; and
- mangroves, seagrass beds and coral reefs.

Lastly what science provides is the actual instrument of resource management, the instrument that puts the concept of sustainability into practice. Among these instruments, those that we need as a matter of priority include the following:

- diversification of energy sources and energy efficiency;
- sustainable agriculture;
- rehabilitation of degraded ecosystems and resource enhancement;
- environmental and resource economics.

Science as an ingredient of management

It is obvious that what we need, as well, is a new approach to natural resource and environmental management. We need to move away from a simplistic top-down approach and to design more appropriate management strategies that integrate science, planning and popular participation.

Community participation is indeed one of the frequently missing ingredients in management, and it is therefore useful to remind ourselves of the need and justification for such participation:

- first, community participation is justified because of the local knowledge of natural resources, their extent and the trends affecting them. It is obvious that such popular knowledge, often accumulated over decades of intimate relationship between people and their environment, is presently under-utilized in the region. Community participation recognizes such knowledge and places it at the disposal of new and improved management regimes and procedures;

- second, community participation must be recognized as the only mechanism to understand, respect and build upon traditional management practices. There are many such practices in the region, which are too often ignored and indeed combatted by modern management systems;

- the third justification for community participation is that it helps to guarantee the feasibility of new conservation and resource management procedures, and to ensure that such procedures are adequately integrated into local development frameworks;

- the last justification is a rather obvious one: that it is in the nature of human beings to show greater commitment to decisions which they have helped to make.

The implications of adopting such an approach to management are numerous, especially for our institutional arrangements.

First of all, we need, within our governments, the mechanisms that permit the coordination of activities and the prevention of impacts. Many of our problems indeed come from the fact that the right hand does not know what the left hand is doing. We must therefore put in place the appropriate coordinating mechanisms that allow for the integration of environmental concerns into all aspects of development planning and implementation. Scientific information and expertise is of course required to assist in this process of coordination.

Secondly, we need a more active involvement of citizens' organisations, non-governmental orgainzations. We certainly do not need to imitate the environmental movement in other parts of the world, but to find our own way of ensuring that popular views are expressed and taken into account. This, I feel, could be done, not so much with the constitution of more environmental groups, but with the integration of environmental concerns on the agenda of genuine and representative development institutions. Farmers' organizations, chambers of commerce, development foundations and similar established institutions have a central role to play in addressing environmental issues in their respective sectors. What science must do, in this case, is to provide expertise and to contribute, within such organizations, to the linkage between development and environmental concerns.

Lastly, new institutional arrangements are needed to permit -or restore the responsibility of communities over the resources upon which their livelihood depends. This is indeed a relatively new area that the region must now explore more systematically It is the recognition that in the field of the environment as indeed for any other aspect of development - nothing meaningful and durable can be achieved without community responsibility. In

recent times we have acted as if governments could do it all. Not only did it not work, but it created negative effects on communities which have perceived the increase in public responsibility as an alienation, a dispossession of the resources which they had used for generations. What we need therefore is to strengthen the role of community organizations and to find concrete ways for such groups - the fishermen's cooperatives, the farmers' organizations, the village councils, etc - to assume some of the responsibility over the management of natural resources and the environment.

Conclusion

It is obvious that modern science - we should probably say western science - is partly responsible for the crisis we now face. Modern science has seen nature - or the environment - as something "out there", an object of study and mastery, separated from man. Today, one of the greatest challenges is to restore harmony, to discover a new relationship between people and the environment of which we are part.

The challenge is to forge a new ethics of development, a new vision of our place on Earth. The Caribbean is fortunate in having an Academy of Sciences to help shape, indeed to lead the search for that new vision.

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Yves Renard is Director of the Caribbean Natural Resources Institute, St. Lucia, and President of the Caribbean Conservation Association. He is also Regional Councillor of IUCN - the World Conservation Union.

APPENDIX I

CARIBBEAN ACADEMY OF SCIENCES

MEMBERSHIP

Dr. N. Abedin
Dr. N. Ahmad
Prof. M.C. Alleyne
Dr. D. Ali
Dr. M.A. Angadi
Dr. P.R. Bacon
Dr. R. Barrow
Dr. D. Basu
Dr. B.S. Bhatt
Prof. J. Bonnet
Prof. C. Bourne
Dr. R.A.I. Braithwaite
Prof. F.J. Brouers
Prof. B.A. Butler
Prof. C. Cadogan
Prof. M.E. Cain
Prof. W. Chan
Mr. Hollis Charles
Dr. M. Wing-Sang Chin
Mr. T. Clarke
Prof. H. Coore
Dr. G. Dann
Prof. T.P. Dasgupta
Dr. E.J. Duncan
Dr. E.J. Farrel
Prof. I. Goodbody
Dr. A.M. Greenaway
Prof. J.E. Greene
Prof. W. Grell
Dr. S.M. Griffith
Dr. O.St.C. Headley
Dr. V.G. Hill
Dr. C. Hudson
Dr. D. Irvine
Dr. G. Nwachukwa Isitor
Dr. T.A. Jackson
Dr. J.S. Kaminjolo
Prof. J.S. Kenny
Dr. J. Khan
Dr. O. Khan
Dr. L. Kunar
P.V.C.G.C. Lalor
Mr. T.M. Lewis
Dr. J. Lodenquai
Prof. K.E. Magnus
Mrs. L. Mair
Mr. F.E. Martinus
Dr. C. McDavid
Prof. H. McFarlane
Prof. M.A. McIntyre
Dr. W.A. Mellowes
Prof. G. Melville
Dr. B. Mootoo
Dr. E.Y. St.A. Morrison
Dr. L.L. Mosely
Dr. V. Naraynsingh
Prof. A.J. Parris
Dr. K. Persad
Prof. H.O. Phelps
Dr. T. Poon-King
Mrs. D.L. Powell
Dr. P.V. Devi Prasad
Dr. A. Ramkissoon
Dr. W.A. Ramsahoye
Prof. S.D. Reid
Prof. G.M. Richards
Prof. R. Richards
Prof. G.W. Roberts
Dr. F.J. Rosheuvel
Prof. R. Saunders
Dr. C.E. Seaforth
Dr. J.B. Shepherd
Prof. J.A. Spence
Dr. E.B.A. St. Cyr
Prof. V. St. Omer
Dr. W. Suite
Dr. A. Tang Kai
Dr. G.V. Taylor
Prof. H.E. Williams

APPENDIX II

LIST OF FELLOWS

Prof. J. Bonnet
Bayamon Tech. Univ. College
University of Puerto Rico
Bayamon, P.R. 00619-1919

Prof. H. Coore
University of the West Indies
c/o Plant Sciences & Biochem.
St. Augustine, Trinidad

Prof. I. Goodbody
Department of Zoology
University of the West Indies
Mona, Kingston 7, Jamaica

Dr. O. Headley
Department of Chemistry
University of the West Indies
St. Augustine, Trinidad

Prof. J.S. Kenny
Department of Zoology
University of the West Indies
St. Augustine, Trinidad

Prof. G.C. Lalor
c/o Faculty of Natural Scs.
University of the West Indies
Mona, Kingston 7, Jamaica

Prof. H. McFarlane
Prof. of Chemical Pathology
General Hospital
Charlotte Street
Port of Spain, Trinidad

Prof. M.A. McIntyre
Vice Chancellor
University of the West Indies
Mona, Kingston 7, Jamaica

Prof. G. Melville
Faculty of Medical Sciences
Eric Williams Medical Complex
Uriah Butler Highway, Mt. Hope,
Trinidad.

Prof. H.O. Phelps
Department of Engineering
University of the West Indies
St. Augustine,Trinidad

Dr. H. Ramkissoon
Department of Mathematics
University of the West Indies
St. Augustine, Trinidad

Prof. R. Saunders
Dean Faculty of Natural Scs.
University of the West Indies
St. Augustine, Trinidad

Prof. J. Spence
Dept. of Plant Scs. & Biochemistry
University of the West Indies
St. Augustine, Trinidad

APPENDIX III

CURRICULUM VITAE

1. NAME: Ramsey Mc Donald Saunders

2. PROFESSION: Professor of Physics

3. EDUCATIONAL & SCIENTIFIC:

   a) B.Sc. First Class - UWI 1968

   b) Commonwealth Scholar (UK) 1968-1971

   c) DIC - Imperial College of Science and Technology - 1971

   d) Ph.D - Imperial College of Science and Technology - 1971

   e) Alexander Von Humboldt Postdoctoral Fellow - Freie Universitat Berlin under Professor O.J. Grusser 1971 - 1973

   f) Senior Research Scientist Physiologische Institute, Berlin 1973 - 1978

   g) Professor of Physics and Head, Department of Physics, U.W.I. 1978 - present.

4. SCIENTIFIC PUBLICATIONS

   Over Thirty publications in Refereed Physics Journals.

5. RESEARCHES UNDERTAKEN

   a) Processing of Optical Signals by the Brain - Imperial College of Science and Technology.

   b) Cybernetics: Processing of information by single neuron
      i) Optic tract, lateral geniculate, cortex
      ii) Optic tectum.
      Freie Universitat Berlin and U.W.I. Trinidad

   c) Timber - Built timber lab and undertook work on hysteresis properties of timber to increase use of local timber
      - dimensional Stabilisation of Timber.

   d) Asphalt - Development of Asphalt Lab in the Physics Department (U.W.I.). A variety of new products have been produced by blowing and blending asphalt.

   e) Audiometry - Development of system and testing of hearing capabilities of 1000 children in the Curepe/St. Joseph area.

   f) Scoliosis - Development of machine to detect curvature of the spine using Moire topography.

6. INVENTIONS

   a) Equal energy machine. This machine was produced for research purposes and using any optical source produces an equal energy spectrum. This instrument is in use at the Freie Universitat, Berlin, Germany.

   b) Reflection/Transmission Meter. Instrument produced locally to measure the reflectance and transmittance of tints and coatings used on motorcar windscreens.

7. APPLICATIONS OF LOCAL MATERIALS

   a) Process developed to produce brushes for motors/alternators using waste graphite at ISCOTT.

   b) Technology developed to produce all-graphite based lubricants used in Trinidad and Tobago. Already special lubricant blocks have been designed and fabricated for TCL to replace units supplied by Voest Alpine (Austria).

   c) Production of components for dry cells.

   d) Production of components for lead pencils.

   e) Application of slag from steel industry for heat storage device in large scale solar system.

8. PRESENT DEVELOPMENTAL PROJECTS

   a) For T&TEC and TELCO - use of pine poles instead of Wallaba poles.
      This project will save these state corporations $2M per year as well as an additional $4M per year in foreign exchange.

b) **For private company - production of polymer for laminate.**

c) **Seven reflectance/transmittance meters are being built for the Transport Division.**

d) **Computerisation of instrument built for the detection scoliosis.**

9. INTERNATIONAL RECOGNITION/HONOURS

Honoured by the Nobel Committee for Physics 1983 and invited to make nominations for the Nobel Prize in Physics.

SELECTED LIST OF PUBLICATIONS

1. Saunders, R. and Kishto B.N. (1970). Variation of visual threshold with retinal location II. Vis. Res. (Pergamon, Press), 10, 762.

2. Saunders, R. McD. (1971). Subjective brightness of a flashing light as a function of stimulus size, F1. Lights, Adam Hilgers London, 1, 17.

3. Saunders, R. McD. (1977). Eigenvectors of the sensitivity variation across the human central fovea, Vis. Res., 13, 1823.

4. Saunders, R. McD. (1974). Contribution of spatial and border interaction to the Westheimer effect, Vis. Res., 141, 379.

5. Saunders, R. McD. (1975). The critical duration of temporal summation in the human central fovea, Vis. Res., 15, 699.

6. Saunders, R. McD. and Grussner-Cornehls (1976). The spectral properties of Class 1, 2, 3 and 4 neuron of the frog optic tectum, Pflagers Archiv, 359, 202.

7. Saunders, R. McD. (1977). The spectral responsiveness and the temporal frequency response (TFR) of cat optic tract and lateral geniculate neurons: Sinusoidal stimulation studies. Vis. Res., 17, 285.

8. Saunders, R. McD. and Grussner-Cornehls U (1980). Chromatic Subclasses of frog retinal ganglion cells: Studies using black stimulus moving on a monochromatic background. Vis. Res. 21, 469.

9. Saunders, R. McD. and Grussner-Cornehls U (1981). Response of frog retina ganglion cells to moving monochromatic spots under photopic conditions. Vis. Res. 21, 1620.

10. Saunders, R. McD. (1982). Non-linearities in the velocity response function of Classes 1, 2, and 3 Neurons of Rana esculenta, Neur. Lett, 10, 431.

CURRICULUM VITAE

RESUME

Name : Harry Orville Phelps

Nationality : Citizen of Trinidad and Tobago

Profession : Professor Phelps is a Chartered Civil Engineer, University teacher and researcher, specialising in Water Resources Eng., Environmental Eng., Hydrology and Engineering Education. He has published over thirty papers in conference proceedings, local and international journals, one of which was awarded a Bronze Medal by the Institution of Civil Engineers (UK). Over the past years he has served on several Boards of Government Statutory Authorities, as Deputy Chairman of the Water and Sewerage Authority (Trinidad and Tobago), Chairman of the Board of the Institute of Marine Affairs, Chairman of the Trinidad and Tobago Bureau of Standards, and Board Member, Trinidad and Tobago Electricity Commission.

Education : 1953 - BSc (Wales) - First Class Honours in Civil Engineering

1958 - Diploma, Imperial College (London) in Hydraulic Engineering and Fluid Mechanics

1967 - PhD (Manchester) in Fluid Mechanics

Professional Qualifications: Fellow, Association of Professional Engineers (Trinidad and Tobago)

Fellow, Institution of Civil Engineers (United Kingdom)

Chartered Civil Engineer (United Kingdom)

Employment Record: 1953 - 55 Asst. Engineer, Ministry of Works (T&T)

1955 - 58 Drainage Engineer, Ministry of Works (T&T)

1958 - 61 Chief Drainage Engineer, Ministry of Works (T&T)

1961 - 70 Lecturer in Civil Engineering, UWI

1970 - 74 Senior Lecturer, UWI

1974 - 86 Professor and Head, Department of Civil Engineering, UWI

1986 Professor of Civil Engineering

Experience :

- Design, construction, operation and maintenance of works for drainage, irrigation, flood control, water supply and environmental engineering.
- Chairman, Study Group for Piarco Airport Development traffic forecasting, financial and economic analysis, drainage and sewage disposal, critical path scheduling - Report to Government of T & T, 1972.
- University: teaching and research in Water Resources Engineering, Hydrology, Environmental Engineering, Engineering Project Economics.
- Specialist Consultant on a variety of projects in Water Resources and Environmental Engineering, including:
  * Hydraulic Model, Navet Dam Extension Labyrinth Spillway
  * Hydraulic Model, Caroni/Arena Dam Spillway
  * Hydrology E-W Corridor
  * Hydrology Flood Protection, Barbados
  * Feasibility Study, Orange Grove Food Project: irrigation, drainage, water supply, flood control
  * System Design for home Construction Ltd: drainage, sewage disposal, flood control

Awards and Honours:	Cooper Hill Bronze Medal, Institution of Civil Engineers (UK)
	Chaconia Medal (Gold), Trinidad and Tobago.

CURRICULUM VITAE

NAME	:	Harold Ramkissoon
EDUCATION	:	B.Sc. Honours in Mathematics, U.W.I., Jamaica (1966) M.Sc. in Mathematics, University of Toronto, Canada (1969) Ph.D. in Applied Mathematics, University of Calgary, Canada (1975)
POSITIONS HELD	:	Lecturer in Mathematics at the University of the West Indies, Cave Hill, Barbados (1975-76). Lecturer in Mathematics at the University of the West Indies, St. Augustine, Trinidad (1976-1982) Alexander Von Humboldt Fellow at Technische Hochuschule, Darmstadt, West Germany (1981-1982). Senior Lecturer in Mathematics at the University of the West Indies, St. Augustine, Trinidad (1982-1990). Senior Fullbright Fellow at the University of Pittsburgh, U.S.A. (June-September 1988). Reader in the Mathematics Department at the University of the West Indies (1990 -). Third World Academy of Sciences Fellow at the Chinese Academy of Sciences, People's Republic of China (June - August, 1990).
AWARDS	:	Recipient of the following three fellowships: Alexander Von Humboldt Fellowship (West Germany, 1981-82). Senior Fullbright Fellowship (U.S.A., 1988). Third World Academy of Science Fellowship (China, 1990).

PROFESSIONAL ACTIVITIES : Serving on the panel of Reviewers for:

(i) Zentralblatt fur Mathematik (Germany)

(ii) Mathematical Reviews (U.S.A.).

Referee for the following journals:

(i) International Journal of Engineering Science

(ii) Journal of Mathematical and Physical Sciences

(iii) Acta Mechanica

Associate Editor of the Caribbean Journal of Dynamics.

INVITED LECTURES : Invited Lectures were delivered at:

Centre of Advanced Study in Applied Mathematics, Calcutta University (Calcutta)

Indian Institute of Technology (Kanpur)

Indian Institute of Technology (Bombay)

Regional Engineering College (Warangal)

Indian Institute of Science (Bangalore)

Technische Hochschule, Darmstadt (West Germany)

University of Karlsruhe (West Germany)

University of Essen (West Germany)

Hochschule der Bundeswehr Hamburg (West Germany)

Max-Planck Institute at Gottingen jointly with DFVLR - Institute for Experimentelle Stromungsmechanik (West Germany)

Technical University, Vienna (Austria)

Czechoslovak Academy of Sciences at Prague (Czechoslovakia).

The 32nd Congress of the Indian Society of Theoretical and Applied Mechanics at Bombay, December 17-20, 1987.

The First Latin American Workshop in Fluid Mechanics in Brazil, February 19-23, 1990.

SCIENTIFIC PUBLICATIONS : Over fifty five papers published in international journals.

SELECTED LIST OF PUBLICATIONS

1. H. Ramkissoon and S.R. Majumdar, "Drag on an Axiallay Symmetric Body in the Stokes" Flow of Micropolar Fluids", Physics of Fluids, 19, pp. 16-21 (1976).

2. H. Ramkissoon, "Drag in Couple Stress Fluids". Zeitschrift fur Angewandte Mathematik und Physik (Z.A.M.P.), 29, pp. 341-346 (1978).

3. H. Ramkissoon, "Slow Steady Rotation of an Axiallay Symmetric Body in a Micropolar Fluid", Applied Scientific Research, 33, pp. 243-257 (1977).

4. H. Ramkissoon, and M.E. O.Neil, "Stokes Force in Microcontinuum Fluid Mechanics", Acta Mechanica 46, pp. 255-263 (1983).

5. H. Ramkissoon, E. Becker and U. Akbay, "Three-Dimensional Disturbances of Planar Viscometric Flow", rheologica Acta 22, pp. 284-290 (1983).

6. H. Ramkissoon, "On a Planar Exterior Problem in Elasticity", quarterly Applied Mathematics, 43, pp. 135-141 (1985).

7. H. Ramkissoon, "On a System of Equations in Visco-Elastic Fluid Theory", Zeitschrift fur Angewandte Mathematik und Mechanik (Z.A.M.M.), 67, pp. 197-203, 1987.

8. H. Ramkissoon, "On an Exterior Planar Problem in Microcontinuum Fluid Mechanics", J. de Mecanique Theorique et Appliquee, 5, pp. 897-909 (1986).

9. H. Ramkissoon, C.V. Easwaran and S.R. Majumdar, "Unsteady Flow of an Elastico Viscous Fluid in Tubes of Uniform Cross-Section", Int. J. Non-Linear Mechanics, 24, pp. 585-597 (1989).

10. H. Ramkissoon, and S.R. Majumdar, "Flow due to the Longitudinal and Torsional Oscillation of a Cylinder", Zeitschrift fur Angewandte Mathematik und Physik, (Z.A.M.P.), 41, pp. 200-206 (1990).

CURRICULUM VITAE

NAME : Oliver St. Clair Headley

ACADEMIC AND SCIENTIFIC : Harrison College, Barbados

University of the West Indies, Mona, Jamaica 1961-64. B.Sc. (Special) Chemistry, Class IIA Honours 1964.

University College, London, 1964-67. Ph.D. (Inorganic Chem.), 1967.

1967-68: Assistant Lecturer in Chemistry, U.W.I., St. Augustine, Trinidad.

1968-1977: Lecturer in Chemistry, St. Augustine.

1977-1988: Senior Lecturer in Chemistry, U.W.I., St. Augustine.

1979-1980 Sabbatical year, spent visiting Caribbean countries giving assistance with Solar Energy programmes.

1989 - present, Reader in Chemistry.

RESEARCH INTEREST : Inorganic Chemistry
Solar Energy

PROFESSIONAL ACTIVITIES : 1968-72 Local examiner for University of London, G.C.E. "A" level chemistry Examinations.

Organization of American States consultant to Ministry of Agriculture, Barbados - design and constructing a solar drier, March 1976.

OAS visiting Research Fellow at College of Arts, Science & Technology, Jamaica Nov.-Dec. 1979.

Jan. 1980 Inter American Development Bank Consultant to ICAITI, Guatemala.

March 1980 Advisor to Ministry of Agriculture, Grenada.

OAS visiting Research Fellow at CAST, Jamaica.

Visiting Research Scientist at Golden, Colorado, U.S.A.

Aug.-Sept. 1982: Sponsored by UNESCO, UNIDO and Habital to lecture at summer school on Thermal Solar Engineering at Dubrovnik, Yugoslavia.

Jan. 1982-Jan. 1983: Secretary of Organizing Committee for the Tenth Caribbean Conference of Chemistry and Chemical Engineering.

Sept. 1983: Advisor to Ministry of Agriculture, Dominica Workshop on design and construction of simple solar crop driers.

Jul.-Aug. 1984: Visiting Research Fellow at Brace Research Institute, McGill University.

June 1986: Resource person for one week workshop on Solar Crop Driers in Antigua sponsored by O.A.S.- U.W.I.

Jul. - Aug. 1986: Visited Solar Energy Research Centres in Britain, France, Holland and Germany on a study tour sponsored by European Development Fund.

Appointed referee for International Foundation for Science to assess projects in Alternative Energy.

MEMBERSHIP OF PROFESSIONAL SOCIETIES : Member of the American Chemical Society Member of the international Solar Energy Society.

HONOURS AND RECOGNITION : Barbados Scholar 1961
Commonwealth Scholar 1966
Guinness Award for Scientific Achievement 1982.

SCIENTIFIC PUBLICATIONS : Over thirty seven publications in international journals.

SELECTED LIST OF PUBLICATIONS

1. "Preparation and Spectroscopic properties of some low spin trigonal bipyramidal d^8 metal complexes" (with Sir Ronald Nyholm et al.) Inorg. Chim. Acta., Vol. 4, pp. 93-96 (1970).

2. O. Headley and B. Springer, "Distilled Water from Solar Stills", J. Chem. Ed., Vol. 48, pp. 49-51.

3. O. Headley, "Cascade Solar Still for Distilled Water Production", Solar Energy, Vol. 15, pp. 245-258. (1973).

4. O. Headley, "Remarks on Cascade Solar Still for Distilled Water Production". Solar Energy, Vol. 18, p. 75 (1976).

5. O. Headley and J. Morris, "The Design, Construction and Operation of Solar Stills for Producing Distilled Water". Proceedings of the International Conference on Solar Building Technology, Vol. 2, pp. 612-623; held in London, England from July 25 to 29, 1977 under the sponsorship of UNESCO and the North East London Polytechnic.

6. O. Headley and J. Morris, "Solar Stills for production of distilled water", The International Journal of Ambient Energy, Vol. 1, No. 4, pp. 209-218, October 1980.

7. O. Headley, "Solar distillation of saline water, solar stills; Thermal Solar Engineering for Developing Countries". Edited by C.J. Hoogendoorn, International Centre for Heat and Mass Transfer, Belgrade, Yugoslavia, 1982, (16 pages).

8. O. Headley and L. Hall, "Complexing properties of 1, 2-dihydroxy-3-4-diketocyclobutene with iron and nickel in ethanol". Polyhedron, Vol. 4, No. 10, pp. 1697-1700, (1985).

9. O. Headley and I.A. McDoom, "Producing distilled water with Solar Stills", Advances in Solar Energy Technology, Edited by W.H. Bloss and F. Pfisterer, Vol. 3, pp. 2804-2808, Pergamon, Oxford (1988).

10. O. Headley, D.R. McGaw and C.K. Sankat, "Mixed mode solar driers for the tropics", Drying '88, Edited by A.S. Majumdar, Vol. 2, pp. 93-97. Hemisphere Publishing Corp. Washington D.C. (1988).

CURRICULIM VITAE

NAME	:	Julian Stanley Kenny
EDUCATION AND SCIENTIFIC	:	B.A. University of Toronto, 1951
		Ph.D. University of London, 1963
		Summer employment, Dept. of Lands and Forests, Ontario, Canada, 1948-1951.
		Fish Culturists Ministry of Agriculture, Trinidad and Tobago, 1952-1959.
		Senior Fisheries Officer, Ministry of Agriculture, Trinidad & Tobago 1959-1961.
		Research Associate, Zoological Society of London, 1961-1963.
		Lecturer in Zoology, University of the West Indies, St. Augustine 1963-1967.
		Exchange Lecturer, University of Reading, United Kingdom 1967-1968.
		Senior Lecturer in Zoology, University of the West Indies, St. Augustine 1968-1970.
		Professor of Zoology, Head, Department of Zoology, University of the West Indies, St. Augustine 1970- present.
RESEARCH ACTIVITIES	:	Generally in the area of Aquatic Sciences and particularly Fisheries Science, Aquaculture, Fish Biology, Marine Biology, Marine Ecology and Vetebrate Biology. Subsidiary interests in natural history, especially in field Botany, and of native Araceae, Bromliaceae and Orchidaceae of Trinidad.
RESEARCH SUPERVISION	:	20 higher Degree Candidates supervised. 10 at Doctoral level, 3 at Doctoral Candidates currently and 3 M.Phil currently.
MEMBERSHIP IN SOCIETIES	:	Gulf and Caribbean Fisheries Institute. Miami Zoological Society of London. Trinidad & Tobago Field Naturalists' club.

ADMINISTRATIVE	:	Various University Chairmanships including Head of Departments, Associate Deanship, Faculty of Agriculture, Vice Deanship, Faculty of Natural Sciences.
		International Co-ordinator for CICAR.
		Chairman, WECAFC
		Chairman, Committee of Enquiry into the shrimp industry.
		Membership Inter-Ministerial Committee on the law of the sea.
		Board member, National Fisheries Co. Ltd.
		Executive Chairman, Institute of Marine Affairs.
SCIENTIFIC PUBLICATIONS	:	Over fifty five publications in international journals.

SELECTED LIST OF PUBLICATIONS

1. 1951 - Preliminary trials with the Toronto Plankton Sampler, Ontario Research Council.

2. 1960 - The effect of sexual maturity on the length/weight relationship in Tilapia mossambica. W.I. Fish. Bulletin 1960, No. 3, 1-15.

3. 1966 - Behaviour of Pseudis paradoxa tadpoles. Biol. J. 1, 11-14.

4. 1969 - Pharyngeal mucous secreting epithelia of anuran larvae. Acta Zoologica 50, 143-153.

5. 1973 - The Guyana Shelf Fisheries: A special case. Sierra Club Seminar, Caracas, Venezuela International Series No. 4, 2 pp.

6. 1974 - A Guide to the Shallow Water Corals of Trinidad. Department of Biological Sciences - U.W.I., Trinidad. 89 pp. plus figures (with Ramsaroop, Field, Alick and Alkins).

7. 1976 - Buccoo Reef: A problem in Coastal Zone Management - Second OAS Seminar Science Policy and Planning. Studies on the Scientific and Technological Development. No. 28, 9-18.

8. 1977 - Historical, Sociological, Nutritional and Economic Importance of Fisheries to Countries of the Caribbean: An Overview. Proc. Gulf Carib. Fish. Inst. 30, 122-129. Invited lecture at 30th meeting of Gulf and Caribbean Fisheries Institute, Cartagena.

9. 1980 - Biological Conservation: Management of our Natural Resources. West Indian Science and Technology. Vol. 4 No. 2, 10-13.

10. 1983 - Development Strategies for Fisheries in the Eastern Caribbean.
Proc. Gulf Carib. Fish. Inst. 34, 56-61.

		Agricultural Research Council Grant (1978-81) (with N.J. Kuhn) Glucose Transport into Lactating Rat mammary cells.
		Wellcome Trust Grant (1981-84) Regulation of Insulin Receptors.
OTHER ACTIVITIES	:	Supervised successfully the work of six (6) Ph.D. students.
SCIENTIFIC PUBLICATIONS	:	Over forty five (45) publications in international journals.

CURRICULUM VITAE

NAME : Haldane G. Coore

EDUCATIONAL AND SCIENTIFIC :

B.Sc. Physiology, 1st Class Honours, 1956. Edinburgh.

MB., Ch.B. (with distinction), Edinburgh 1959.

Ph.D. Biochemistry, Cambridge, England, 1964.

Elmore Research Student, Cambridge University, 1960-1963.

Lecturer in Physiology, University of the West Indies, Mona, Jamaica 1964-1968.

Wellcome Research Fellow, Bristol University, Department of Biochemistry, 1968-1970.

Lecturer, Bristol University, Department of Biochemistry, 1970-1971.

Lecturer, Birmingham University, Department of Biochemistry, 1971-1974.

Senior Lecturer, Birmingham University, Department of Biochemistry, 1974-1979.

Professor of Biochemistry, University of the West Indies, Mona, Jamaica 1979-1985.

Professor of Biochemistry, The University of the West Indies, Eric Williams Medical Sciences Complex, 1985 - present.

RESEARCH GRANTS : Recipient of several research grants including:

Wellcome Trust Grant (1971-74) Pyruvate Dehydrogenase in Lactating Rat Mammary Gland.

Medical Research Council Grant (1975-78) Metabolic Regulation of a Mult'-Enzyme Complex.

SELECTED LIST OF PUBLICATIONS

1. Coore, H.G. & Randle, P.J. (1962) Secretion of insulin by rabbit pancreas in vitro. Biochem. J. 84, 78.

2. Coore, H.G., & Randle, P.J. (1964) Insulin secretion form rabbit pancreas in vitro. In: Structure & Metabolism of Pancreatic Islets. Eds. Brolin, Hellman & Knutson, Pergamon Press, p. 295.

3. Coore, H.G., Hellman, B., Pihl, E & Taljedal, I-B. (1969) Physicochemical characteristics of insulin secretion granules. Biochem. J. 111, 197.

4. Denton, R., Coore, H.G., Martin, B.R. & Randle, P.J., (1971) Insulin activates pyruvate dehydrogenase in rat epididymal adipose tissue. Nature, New Biology, 231, 115.

5. Walsh, C.W., Wright, A.D. & Coore, H.G., (1975) Hypoglycaemia associated with intrathoraicic fibrosarcoma. Clin. Endocrinology, 4, 395.

6. Titheradge, M.A. & Coore, H.G., (1977) Preparation and properties of mitochondria from lactating rat mammary gland in particular relation to lipogenesis. Int. J. Biochem., 8, 433.

7. Baxter, M.A. & Coore, H.G., (1978) Persistent effects of starvation on pyruvate dehydrogenase kinase and phosphatase of lactating rat mammary gland. Biochem. Soc. Trans., 6, 154-157.

8. Baxter, M.A. & Coore, H.G. (1979) Starvation of lactating rats leads to alterations in the behavious of pyruvate dehydrogenase kinase which persist in the semi-purified pyruvate dehydrogenase complex of the mammary gland but are partly reversible in vitro. FEBS Letts. 98, 195.

9. Hutchinson, C. & Coore, H.G. (1980) Halothane anaesthesia can block insulin stimulation of pyruvate dehydrogenase activity in mammary glands of 24h starved, lactating rats. Br. J. of Anaesthesis. 52, 573.

10. Coore, H.G. (1987) Counterion considerations. trends Biochem. Sci. 12, 424.

CURRICULUM VITAE

NAME	:	Meredith Alister McIntyre
EDUCATION	:	B.Sc., London School of Economics and Political Science, 1957.
		B. Litt., Oxford University, 1960.
CAREER	:	Director, ISER, The University of the West Indies 1967-1974.
		Deputy Secretary-General of UNCTAD, 1985-1986.
		Vice Chancellor, The University of the West Indies from 1988.
ACTIVITIES	:	Served on several regional and international Bodies including Commonwealth Caribbean Regional Secretariat. UNCTAD, U.N. Committee in Development Planning, Third World Forum.
AWARDS	:	Fullbright-Hays Fellow, 1963.
		Commander of the Order of Distinction, Jamaica.
		Cacique's Crown of Honour, Guyana.
		Doctor of Laws, The University of the West Indies.
SCIENTIFIC PUBLICATIONS	:	Over thirty five (35) papers, articles, monographs and books published.

SELECTED LIST OF PUBLICATIONS

1. "Aspects of Development and Trade in the Commonwealth Caribbean", Economic Commission for Latin America, 1964. (Printed in Economic Bulletin for Latin America, October 1965).

2. "Canada-West Indies Economic Relations", Mutual Press, Toronto, 1967. (With K. Levitt).

3. "The Effects of Reverse Preferences on Trade Among Developing Countries", United Nations, 1974.

4. "The Political Economy of Federation", Pelican, 1961. (With L. Best).

5. "Reflections on the Problem of Unemployment in the Commonwealth Caribbean". ("The Commonwealth Caribbean in the Seventies".) Proceedings of a Conference held in September 1973, Howard University, Washington.

6. "The Role of the Economic Integration Process in Regional Development: The Caribbean Experience", Institute of Latin American Studies, University of London, 1976.

7. "The Current State of International Commodity Negotiations" in G. Goodwin and J. Mayall (ed). "A New International Commodity Regime", Croon Helm, London, 1979.

8. "South-South Trade: a growing dimension of UNCTAD's work" Twentieth Anniversary Special Issue, UNCTAD Bulletin, No, 205, September 1984.

9. "Marketing of Commodities: Approaches and Arrangements for Development Countries", in "Crisis and Response: The Challenge to South-South Co-operation" edited by N. Sopiee, B.A. Hamzah and Leong Choon Heng, Institute of Strategic and International Studies, Malaysia, 1988.

10. "The World economy in the 1980's": Some Issues and Challenge. Keynote Address to the International Congress of AIESEC, Boston, Mass., February 1988.

CURRICULUM VITAE

NAME	:	**Juan Bonnet**
ACADEMIC AND SCIENTIFIC	:	**B.Sc., Chemical Engineering, University of Michigan, 1960.**
		Ph.D., Nuclear Engineering, University of Michigan, 1971.
OTHER ACTIVITIES	:	**Director, Center for Energy and Environment Research, University of Puerto Rico, 1977-1988.**
		Professor, Engineering Department and Head, Chemistry and Physics Departments from 1988.
		Served and continues to serve on several Committees including Inter-goverment Biomass Committee, Engineering Committee of the World Federation of Engineering Societies, Advisory Board, Puerto Rico Medical Center Administration. Inter-American Alcohol for Fuel Commission.
SOCIETIES	:	**Member of American Association for the Advancement of Science, Pan American Association of Engineering Societies. American Nuclear Society.**
AWARDS	:	**Most distinguished Chemist Award, Puerto Rico Association of Chemists, 1984 and 1988.**
		Mobil Award for outstanding scientific accomplishment in Puerto Rico, 1981.
SCIENTIFIC PUBLICATIONS	:	**Over seventy (70) publications in international journals.**

SELECTED LIST OF PUBLICATIONS

1. Latest Development in Biomass Energy (coauthored) - Proceedings of the 1986 International Congress on Renewable Energy Sources, Madrid, Espana-Volume 1. 1987.

2. Enmienda Propuesta a la Ley 399, Dimension, Year 1, Vol. 3, Oct.-Dec.1 1986.

3. "Small Power Production in the Caribbean Basin", (Coauthored) Cogeneration World, Vol. 4 No. 4. July/August 1985, pp. 9-11.

4. "Energia Oceano-Termica para Puerto Rico y el Caribe", (Coauthored) Interciencia, Vol. 10, No. 3, May-June, 1985.

5. "Renewable Energy Sources for Puerto Rico and the Virgin Islands", (Coauthored) Revista/Review Interamericana, Vol. X11 No. 2.

6. "The Caribbean Region- - -A Challenge for Alternative Energy Technology Transfer and Development", (Coauthored) Fifth International Scientific Forum on changes in Energy, No. 9-14, 1981, Ciudad de Mexico (CEER X-124).

7. "The Energy Crisis and its Impact on Puerto Rico's Petrochemical Industry", Science-Ciencia, Vol. 6, No. 1, Fall 1978.

8. "Optical Detection of Boiling in Pressurized Water Reactors", Nucl. Sci. Eng. 45, 1971.

9. "Incipient Boiling Detection in Sodium Cooled Fast Reactors", Transaction ANS, June, 1971.

10. "On the Use of Acoustic Waves in Nuclear Power Reactors to Determine Average Void Fractions", Nucl. Sci. Eng. 43, January, 1971.

CURRICULUM VITAE

NAME	:	John Spence
EDUCATION AND SCIENTIFIC	:	B.Sc., University of Bristol, 1951. Ph.D., University of Bristol, 1961. Appointed Lecturer in the Department of Botany at The University of the West Indies, St. Augustine in 1963. Promoted to Senior Lecturer in 1967. Appointed Professor of Botany in 1974.
OTHER ACTIVITIES	:	Served as Dean of the Faculty of Agriculture and on several National and International Bodies including International Center for Tropical Agriculture, Commonwealth Science Council, United States Academy of Sciences Committee on Global Genetic Resources, International Board for Plant Genetic Resources, Commonwealth Agriculture Bureaux and Director, United Nations Economic Commission for Latin America.
AWARDS	:	John Simon Guzzenheim Fellowship, 1970 Chaconia Medal (Gold) for Education and Public Service, Trinidad, 1980.
SCIENTIFIC PUBLICATIONS	:	Over thirty (30) publications in international journals.

SELECTED LIST OF PUBLICATIONS

1. Spence, J.A., Ferguson, T.U. and Haynes, P.M. Tropical Agriculture. "Distribution of dry matter and mineral nutrients in tubers of two cultivars" Dioscorea alata L. Vol. 57, No. 1, Jan. 1980.

2. Spence, J.A. and Taitt, E.G. Agricultural Meteorology, "TheMicrometerology of a Pigeon Pea Stand", Vol. 17, Pt. 3, pp. 205-210 (1976).

3. Spence, J.A., Soffee, R.W. and Humphries, E.C. Planta "Rooted Leaved for Physiological Experiments", 104, 352-356 (1972).

4. Spence, J.A. and Humphries, E.C. Annals of Botany, "Effect of Moisture Supply, Root Temperature and Growth Regulators on Photosynthesis in Isolated Rooted Leaves of Sweet Potato", (Ipomoea batatas), 36, 115-121 (1971).

5. Spence, J.A., Haynes, P.H. and Walter, C.J. Proceedings of the 1st International Symposium on Tropical Root Crops (Trinidad), "The use of Crop Physiological Studies in Root Crop Agronomy", 1 (3), 1-17, 1969.

6. Spece, J.A., Ahmad, N. Agronomy Journal, "Plant Nutrient Deficiencies and Related Tissue Composition of the Sweet Potato", 59, 59-62 (1967).

7. Spence, J.A., Arlett, C.F., Barnes, R.F. and Iton, E.F. Proceedings of the Neo-Tropical Botanical Conference, "Gaps in our Knowledge of Micro-organisms in the Neo-Tropics", Bulletin No. 1 of the Association for Tropical Biology (1962).

8. Spence, J.A. Annals of Applied Biology, "Black Pod Disease of Cocoa I, Comparison of Isolates of Phytophthora palmivora 49, 717-722 (1961).

9. Spence, J.A. Nature (London), "Probable Mechanism of Resistance of Varieties of Cocoa to Black Pod Disease by Phytophthora palmivora, 192, 278 (1961).

10. Spence, J.A., Sugar Bulleting (British Guiana/Guyana), "Sugarcane Diseases in British Guiana", 22, 73-75 (1954).

CURRICULUM VITAE

NAME	:	Hylton McFarlane
EDUCATION AND SCIENTIFIC	:	B.Sc. 1956
		M.Sc. 1959 (Manitoba)
		Ph.D. 1961 (Edinburgh)
		M.R.C. path. 1969 (London)
		F.R.C. Path. 1970 (London)
		Lecturer in Chemical Pathology, The University of the West Indies, 1961-1964.
		Senior Lecturer, then Professor of Chemical Pathology, University of Ibadan, Nigeria, 1964-1970.
		Senior Lecturer in Chemical Pathology, Medical School University of Manchester, England, 1970-1977.
		Professor of Chemical Pathology, The University of the West Indies, Trinidad, - Present.
OTHER ACTIVITIES	:	Supervised seventeen Postgraduate Students.
		Negotiated the award of 10 Fellowships in Immunology allocated to Trinidad and Tobago by Dutch Government (1979).
		Negotiated the Grant of 12 Fellowships from the University of Glasgow, Scotland for Trinidadians to study Forensic Science in Britian.
MEMBERSHIP IN SCIENTIFIC	:	British Association of Clinical Biochemistry.
		Commission of World Standards of the World Association of Pathology and International Quality Control.
		Nigerian Science Association.

		British Society of Immunology.
		Royal Society of Tropical Medicine and Hygiene.
		Royal College of Pathology of Great Britain.
		British Society of Nutrition.
		British Transplantation Society.
		Trinidad & Tobago Medical Association.
		American Science Association.
		Association of American Clinical Pathologists.
INTERNATIONAL RECOGNITION/ HONOURS	:	Awarded the Swiss International Prize for Modern Nutrition for Research on Immunity and Nutrition, 1976.
		Elected to U.S.A. Academy of Science Sub-Committee on Food & Immunology, 1975.
SCIENTIFIC PUBLICATIONS	:	Over eighty five (85) papers published in international journals.

SELECTED LIST OF PUBLICATIONS

1. An improved Electrophoretic Technique. W. Ind. Med. J. 7 (1963) 171.

2. Waldenstrom Type Macroglobulinaemia in a Nigerian with Rheumatoid Arthritis. J. Clin. Path. 19 (1966) 603.

3. Plasma Amino-Acids in the Nigerian Nutritional Ataxic Neuropathy. Brit. Med. J. 3 (1968) 647.

4. Immunoglobulins in Jamaicans and Nigerians with Immunogenetic Typing of Myeloma and Lymphoma in Jamaicans. J. Clin. Path. 23 (1970) 124.

5. Excretion of Immunoglobulins in Burkitt's Lymphomas. Brit. J. Cancer. 24 (1970) 258.

6. Differential protein Clearance in Benign and Malignant Diseases. Amer. J. Clin. Pathology 62 373 (1974).

7. The SIGA System and Hypersensitivity in Patients with Cystic Fibrosis. Journal of Clinical Allergy 6 (1976) pp. 349-358.

8. Effects of Early Protein-calorie Malnutrition on the Immune Response. Paediatric Research 10 (1976), 707.

9. Detection, Significance and Treatment of Paraprotein in Patients Presenting with Idiopathic Proteinuria without Myeloma. Quarterly Journal of Medicine, XI, VII (1978) pp. 145-175.

10. Blood and alcohol concentrations of motor vehicular accident victims at the Port of Spain General Hospital. West Indian Med. J. 35 (1986) page 40.

CURRICULUM VITAE

NAME	:	Gerry Norris Melville
EDUCATIONAL AND SCIENTIFIC	:	B.Sc., University of Manitoba, Canada 1966.
		M.Sc., Dalhousie University, Canada, 1968.
		Ph.D., University of the West Indies, Jamaica, 1972.
		M.D., Essen University, West Germany, 1977.
		Assistant Lecturer, Physiology Department, University of the West Indies, Jamaica, 1969.
		Lecturer, Physiology Department, University of the West Indies, Jamaica, 1970.
		Professor Physiology Department, University of the West Indies, Jamaica, 1978.
		Professor, Department of Physiology, University of the West Indies, Trinidad, 1985.
OTHER ACTIVITIES	:	Served on several Boards and Committees at the University of the West Indies.
		Successfully supervised five (5) Ph.D's and two (2) M.Sc.'s.
AWARDS	:	Dalhousie Graduate award 1966/68.
SCIENTIFIC PUBLICATIONS	:	Over one hundred and fifteen (115) papers published in international journals.

SELECTED LIST OF PUBLICATIONS

1. The effect of facial cold stimulation on airway conductance in healthy man. Can. J. Physiol. Pharmacol. 47, 453 (1969) (with W.T. Josenhans and W.T. Ulmer).

2. Pulmonary Function Testing, II: Respiratory exchange function: A review. Stethoscope 7, 29 (1971).

3. Potentiation of water content induced airway resistance by facial cold. Respiration 31, 1 (1974) (with J. Iravani).

4. Ability of single breath Nitrogen closing volume to detect early airway obstruction. Thorax 30, 220 (1975) (with A. Funahashi and L.H. Hamilton).

5. Closing and opening pressures in the intrapulmonary airways of rats. Respiration 35, 22 (1978) (with J. Iravani and H.G. Ritcher).

6. Mechanism of decreased ciliary beat in bronchitis. Progress in Respiration Research II, 127 (1979) (with J. Iravani).

7. Relationship between separation age of offspring and level of arousal as an indication of behavioural disturbance. West Indian Med. J. 31 (1), 38 (1982) (with S.R. Wray).

8. Pulmonary function in humans and rats after smoking marijuana. In: PERSPECTIVES IN DIFFERENTIATION AND HYPERTROPHY. Ed. W. Anderson. Publishers, Elsevier, N. Holland (1982) (with M. Kumar; S.R. Wray and M. West).

9. Effects of parenteral smoking on ventilatory function in children. Amer. Rev. Resp. Dis. 127 (4) 187 (1983) (with M. Kumar).

10. Effect of Nicotine and cigarette smoke on insulin release in diabetic and non-diabetic animals. Biochem. Arch. 2: 165, 1986 (with Bennett, Mills and A. Castro).

NAME : Gerald Cecil Lalor

EDUCATION : C.D., M.Sc. (London) Ph.D. (London), F.J.S.S.T.

Graduate of the University College of the West Indies in 1953 and joined the West Indies Chemical Works Limited, then the world's largest manufacturer of natural dyes. While employed there, received an M.Sc. for research on logwood and the prestigious Leverhulme Colonial Scholarship for research in the University of Cambridge.

Joined the University College of the West Indies as Assistant Lecturer in 1960 and was promoted successively Lecturer, Senior Lecturer, Reader and Professor of Chemistry by 1969. During this period research was concentrated on the rates and mechanisms of reactions of transition metal ions, a field in which he received the Ph.D. (London) in 1963.

PROFESSIONAL EXPERIENCE : Pro-Vice Chancellor at the University of the West Indies, Director of the Centre for Nuclear Sciences, which operates the only nuclear research reactor in the Caribbean; and also Director of UWIDITE, the University's programme for distance education by use of telecommunications.

Made numerous contributions to national, regional and international committees, task forces and boards. These include: the Scientific Research Council, the inter-governmental UN expert group on the Financing of Science and Technology, advisory groups to the Director-General of UNESCO on science and society programmes and at the Vienna Conference on Science and Technology.

MEMBERSHIPS : The Royal Society of Chemistry; the American Association for the Advancement of Science, the New York Academy of Sciences; the Governing Council of the International Energy Society.

AWARDS AND DISTINCTIONS	:	The Commander of the Order of Distinction; Fellowship of the Jamaica Society of Scientists and Technologists; Fellowship of the Third World Academy of Sciences, Special Award by the Jamaica Society of Scientists and Technologists for contributions to the development of science and technology; the Centenary Medal of the Institute of Jamaica, the Gleaner's Annual Honour award for UWIDITE; and the Jamaican Society of Scientists and Technologists' Award for the application of Science to Education (also for UWIDITE).
OTHER SERVICES	:	Chairman of the only pre-school for deaf children in Jamaica during its developing years, Chairman of the Jamaica Council for the handicapped, and Chairman of the Private Voluntary Organisations Ltd., member of the Boards of the Jamaica Association in Aid of the deaf, United Way of Jamaica; and the ICWI Group Foundation.
RESEARCH INTERESTS	:	Applications of nuclear science in agriculture, science and technology, medicine and industry; geochemical mapping and trace element/environment relationships; science and technology in development.
SCIENTIFIC PUBLICATIONS	:	Over sixty (60) publications in international journals.

SELECTED LIST OF PUBLICATIONS

1. G.C. Lalor and S.L. Martin, "Studies on Haematoxylin and Haematein, the Colouring Principles of Logwoos", Part I, Journ. Soc. Dyers and Colourists, 75, 517-521 (1959).

2. G.C. Lalor and J. Lang, "The Kinetics of the Reaction between Nitropentamminecobalt (III) Perchlorate and the Hydroxide Ion", J. Chem. Soc., 5620-5625 (1963).

3. G.C. Lalor and G.W. Bushnell, "The Kinetics of the Reaction between Sodium Hydroxide and Chloropentamminecobalt (III) Perchlorate in Aqueous Solution", Journ. Inorg. Nucl. Chem. 30, 219-223 (1968).

4. G.C. Lalor and G.W. Bushnell, "Kinetic Studies on 4d and 5d Transition-metal Complexes", Part IV. Kinetic Studies on the Chloropenta-amminerhodium (III) - Aquopenta-amminerhodium (III) System. J. Chem. Soc., (A), 2520-2522, (1968).

5. G.C. Lalor, G.A. Neita and A.M. Newton, "The Kinetics of the Reaction between the Thiosulphatopenta-Amminecobalt (III) Cation and Hydroxide Ions, Revista Latinoamer", quim, 2, 149-154 (1972).

6. S.A. Bajue, G.C. Lalor and K.L. Stuart, "The Reactions of Cobalt Properties of some Co (III) Complexes of the 2-Nitroso-1-Naphtol-4 Sulphonate Nucl. Chem., 37, 51-54 (1975).

7. G.C. Lalor and H. Miller, "The Silver Ion Induced Aquation of Thiocyanatopenta-amminechromium (III) Perchlorate", Journ. Inorg. Nucl. Chem., 40, 305-308 (1978).

8. S.A. Bajue, T.P. Dasgupta and G.C. Lalor, "Reactions of Nickel Ions with Nitroso-Naphthols-IV. Formation Kinetics of Nickel (1-Nitroso-2-Naphthol-6- Sulphonate)", Polyhedron, 2, 431-433. (1983).

9. H. Robotham, G.C. Lalor, A. Mattis, R. Rattray and C. Thompson, "Trace Elements in Jamaican Soils", 1. The Parishes of Clarendon, St. Catherine, Portland, and St. Elizabeth", Journ. Radioanalytical and Nuclear Chemistry, articles, 116(1), 27-34 (1987).

10. G.C. Lalor, J. Miller, Hilary Robotham, P.R. Simpson, "Gamma radiometric survey of Jamaica". Trans. Instn. Min. Metall. (Sect. B: Appl. earth si.), 98, 34-37, (1989).

CURRICULUM VITAE

NAME : Ivan Miles Goodbody

EDUCATION & SCIENTIFIC :

B.A. (Mod) First Class Honours in Zoology, T.C.D. 1949. M.A. 1959.

Ph.D. Aberdeen, 1954

Research Scholar, Edward Grey Institute of Ornithology, University of Oxford, 1949-1950.

Assistant Lecturer in Zoology, University of Aberdeen, 1950-55.

Lecturer in Zoology, University College of the West Indies, 1955-1962.

Senior Lecturer in Zoology, University of the West Indies, 1962-1964.

Professor and Head of the Department of Zoology, University of the West Indies 1964-1986.

Director, Port Royal Marine Laboratory 1972 - Present.

Vice-Dean, Faculty of Natural Sciences, U.W.I., Mona Campus, 1973-1975.

Dean, Faculty of Natural Sciences, U.W.I., 1975-1977.

Chairman, Discovery Marine Laboratory (U.W.I.) Management Committee, 1970-1977.

OTHER ACTIVITIES :

Chairman, Commission of ecology, UNESCO/Government of Jamaica Cultura and Conservation Conference, Jamaica July/August, 1970.

Member, Editorial Board, Bulletin of Marine Science 1974 - present.

Member, Steering Committee, CICAR 11 Symposium (UNESCO) Caracas, 1976.

Occasional reviewer in Biological Oceanography for the United States Natural Science Foundation.

President, Association of Island Marine Laboratories of the Caribbean, 1979-1980.

Guest Lecturer on Caribbean Oceanography, International Ocean Institute Training Course in Ocean Management, Trinidad, October 1984.

IOC Consultant to prepare a draft Technical Assistance Project for the Development of Marine Science in CARICOM States of the Caribbean, 1988.

MEMBERSHIP IN SCIENTIFIC SOCIETIES :

American Association for the Advancement of Science (Fellow).
Zoology Society of London (Sceintific Fellow).
Marine Biological Association of the United Kingdom.
British Ecological Society.
American Ecological Society.
British Ornithologists' Union.
American Ornithologists' Union.
Association for Tropical Biology.

DISTINCTIONS RECOGNITION/ HONOURS :

Commander of the Order of Distinction (Awarded in Jamaica). National Honours 1979, for Marine Biology.

Institute of Jamaica, Silver Musgrave Medal, 1974 - Contributions to Science in Jamaica.

Institute of Jamaica - Centenary Medal, 1980.

Dublin University Experimental Science Association Silver medalist, 1949.

SCIENTIFIC PUBLICATIONS :

Over thirty five (35) publications in international journals.

SELECTED LIST OF PUBLICATIONS

1. The Tunicata of Dublin Bay. Irish Naturalists' Journal 10: 77-80, 1950.

2. The post-fledging dispersal of juvenile titmice, British Birds 45: 279-285, 1952.

3. Abbreviated development in a pinnotherid crab. Nature 185: 704-705, 19601.

4. Continuous breeding in three species of tropical ascidian. Proc. Zool. Soc. 136: 403-409, 1961.

5. The biology of Ascidia nigra (Savigny) 3. The annual pattern of colonisation. Biol. Bull. 129: 129-133, 1965.

6. Continuous breeding in populations of two tropical crustaceans. Ecology 46: 195-197, 1965.

7. The Tunicata. Encyclopaedia Brittanica. 1974.

8. "Tunicata". In Parker, S.P. et al (eds.). Taxonomy and Classification of Living Organisms. McGraw-Hill, Vol. 2, pp. 823-829, 1982.

9. The Ascidian Fauna of two contrasting lagoons in the Netherlands Antilles: Piscadera Baai, Curacao and the Lac of Bonaire Studies on the Fauna of Curacao and other Caribbean Islands 67: 21-61, 1984.

10. A new species of Perophora (Ascidiacea) from the Western Atlantic, including observations on muscle action in related species. In Press: Bulletin of Marine Science, Vol. 40, No. 2, March 1987. (with Linda Cole).