

# INTERNATIONAL CENTRE FOR ENVIRONMENTAL AND NUCLEAR SCIENCES (ICENS)

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## WORK OF THE CENTRE

**I**CENS is the only institution in the Caribbean that is dedicated to the application of nuclear techniques to research and development in the environmental sciences; these affect national development and population health. ICENS is a node of the network centres of the Commission on Sciences and Technology of the Countries of the South established by the Heads of Government of the G-77, and the Trace Element Institute for UNESCO. It is increasingly supporting the government of Jamaica in its nuclear accounting responsibilities consequent on the additional responsibilities acquired as a signatory to the Additional Safeguards protocol.

The main programmes pursued during this reporting period have been in environmental geochemistry and health. The present priority is on the transfer of heavy metals through the chain: Soil  $\rightarrow$  Food  $\rightarrow$  Humans.

Lead and cadmium, both highly toxic elements, and other elements thatacerbate or mitigate the toxic effects of these two heavy metals, are the main topics of present investigations. This work has led to emergency medical treatment of several children; successful environmental mitigation and the raising of public awareness that has led the government of Jamaica to begin to attempt to remove old lead acid batteries from circulation. ICENS is a technical advisor and cooperates with this programme. The cadmium research is very complex. The remarkable levels of cadmium that exist naturally in some Jamaican soils are often orders of magnitude higher than commonly found.

Figure 1: Cadmium content of Jamaican soils.

The grey values are nearly 20X higher than, for example, the Danish critical limits and in many areas the values reported are similar to what is held to be contaminated soils. Since the target organ for humans is the kidney, links are being sought between cadmium intake of the populace and the high

incidence of kidney diseases. These studies include elements known to be antagonists or synergists to cadmium. Collaborations include the Ministries of Agriculture, Health, Land and Environment; the Faculty of Medical Sciences, and the Faculty of Social Sciences at Mona; CFNI; and the Rural Agricultural Development Agency (RADA) as well as overseas institutions.

Much effort is being made to obtain a change of the SLOWPOKE core from high enrichment uranium to a low enrichment one. It appears that success in this is likely.

During the coming year ICENS will focus on the following:

1. ***Essential and Potential Hazardous Elements in the Jamaican diet and soil/food transfers***

Research data will allow a better understanding of the bioavailability of heavy metals and plant/soil relationships of selected elements.

2. ***The Health Effects of Cadmium and other Heavy Metals***

This project consists of: (a) analysis of mortality statistics, (b) autopsy and possibly biopsy studies (c) analysis of urine and other samples from diseased persons, (d) a survey of urine samples for cadmium and the small proteins known to be indicative of kidney disease.

If funds become available:

3. ***Health Implications and Mitigation of contamination from backyard smelting of lead recovered from used Lead-Acid Batteries***

150 known sites at which lead-acid battery recycling and smelting activities were previously done or are presently being conducted have been identified. An assessment will be made of present risk levels and resultant health effects on the residents.

4. The re-introduction of the *Undergraduate Training Programme* which provides “hands on” high-level training and research summer opportunities for undergraduate students of great promise.

## RESEARCH IN PROGRESS

The two main projects during the reporting period were:

### 1. Island wide blood lead project

A total of 1081 basic-level school children have been screened island-wide at the locations shown in Figure 2. The results are summarised in Table 1

**Table 1.** Summary of blood lead analysis results obtained to date.

No of Children	No. of Schools	Children with BLL <10 µg/dl	Children with BLL 10-19 µg/dl	Children with BLL 20-44 µg/dl	Children with BLL >45 µg/dl
1081	32	908	93	61	19

Eighty-four percent of the children had blood lead levels below the CDC limit of 10 µg/dl, and on the presently agreed limits require no further action. All children with blood lead values above these, and their parents/guardians, received lead-safe educational materials; environmental assessments

were done for 58 children and in the 10 cases found necessary environmental mitigations were provided for their homes; 18 received medical attention and treatment. Of this group, six were very severely lead poisoned and required emergency chelation treatment. Lead poisoning in Jamaica is mainly an urban problem caused by backyard lead smelting. It is entirely preventable.

## 2. Elemental Contents of Jamaican Soils and Foods

The general features of the cadmium contents of Jamaican soils are well established and the resulting data and maps are suitable for land use determinations if this is thought necessary. Likewise, a great deal of data has been collected on the elemental contents of foods. These data are presently being analysed and, for at least one crop, yams, it is possible to predict with good accuracy those locations that would produce products with cadmium levels that are acceptable internationally.

Much of the thrust in this programme has shifted to health effects, including an examination of the geographical distributions of mortality data for the years 1996-2004. These data are being examined in detail to see whether there are geographical patterns for relevant deaths especially from renal disease, diabetes, hypertension and cancers.

## PAPERS PRESENTED

- C.N. Grant, G.C. Lalor and J. Preston, "Utilization and Refueling of the JAMAICA SLOWPOKE", IAEA Technical Meeting on the Conversion of SLOWPOKE-2 and MNSR Reactors, IAEA Headquarters, Vienna International Centre, May 23 -25, 2005, 15 pgs

## PUBLICATIONS

### Refereed Journal Articles

- .\* C.N. Grant, G.C. Lalor, M.K. Vutchkov, 2004. In situ Gamma Spectroscopy Measurement of <sup>41</sup>Ar during Neutron Activation Analysis with the SLOWPOKE II Reactor in Jamaica. *Health Physics*, 87 (Supplement 2) S6 8 S72.
- .\* Andrea Howe, Leslie Hoo Fung, Gerald Lalor, Robin Rattray, Mitko Vutchkov, 2005. Elemental composition of Jamaican foods 1: A survey of five food crop categories. *Environmental Geochemistry and Health*, 27(1), 19 -30.
  - \* Laura Ogle and Hugh Harries, 2005. Introducing the Vector: How coconut lethal yellowing disease may have reached the Caribbean. *Ethnobotany Research & Applications* 3: 139 -142
- .\* Robert G. Garrett and Gerald C. Lalor, 2005. The Fe/Na ratio, a framework for modelling trace element distributions in Jamaican soils. *Geochemistry: Exploration, Environment, Analysis* 5, 147 - 157 (2005)

### Book Chapter:

- \* Mitko Vutchkov, Gerald Lalor, Stephen Macko, 2005. Inorganic and Organic Geochemistry Techniques. Essentials of Medical Geology. Elsevier, Chapter 29, 695 723.

### Technical reports

- \* Vincent Campbell, Gerald C Lalor, 2004. Dryland Farming: Jamaica. UNDP, Sharing Innovative Experiences 9, 54 -59.

## **PUBLIC SERVICE**

### **Professor Gerald Lalor**

- .- Director of Gleaner Company; Insurance Company of the West Indies Group; Member of the Board of Governors of the ICWI Group Foundation;
- .- Member: Third World Academy of Sciences (TWAS); Commission on Science and Technology for Sustainable Development in the South (COMSATS); National Commission for Science and Technology (NCST); Technical Committee of the Scientific Research Council.
- .- Member of Editorial Boards: Environmental Geochemistry & Health; and Jamaica Journal of Science & Technology; The Science of the Total Environment; Revista Latino-Americano Quimica.

### **Dr. Robin Rattray**

- .- Member, Air and Water Quality Subcommittees, National Environment and Planning Agency
- .- Recording Secretary, Laboratories Association of Jamaica
- .- Member, Lions Club of Mona

### **Dr. Mitko Vutchkov**

- Member, Product Research & Development Committee, Scientific Research Council.

### **Dr. Gladstone Taylor**

- Member: Executive Council, Inter-American Institute for Global Change Research.

### **Mr. John Preston**

- .- Member, Land Information Council of Jamaica
- .- Member, Telecommunications Appeals Tribunal.

### **Mrs. Joan Thomas**

- .- Member, Radiation Protection Advisory Committee of Jamaica.
- .- Member, Inner Wheel Club of Kingston.

## **STUDENT AND STAFF TRAINING**

Lack of funds prevented the Centre from implementing its Undergraduate Training Programme which provides opportunities for excellent undergraduate students to gain experience and an appreciation of multidisciplinary work likely to benefit small countries. Nevertheless, the Centre provided funding and training for one student in the Chemistry Department Work Study Programme.

Ms. Andrea Howe, Scientific Officer, completed a ten-month traineeship with the International Atomic Energy Agency in Vienna, Austria provided by the Safeguards Traineeship Programme.

Mr. Samuel Thompson, a Scientific Officer in the Solutions Laboratory went on a two-week training program in July in the Analytical Lab at Brandon Agricultural Research Center, Manitoba Canada, to obtain valuable experience in special techniques and some familiarity with newer items of instrumentation.

## **INCOME GENERATION**

### **Grants Obtained**

(CAN)\$448,000 over two years from the International Development Research Centre of Canada (IDRC) for a project entitled: "Environmental Risks of Cadmium in Jamaica".

J\$25,000,000 over 5 years to support a research fellow at the professorial level to strengthen ICENS' capability to examine essential and potentially substances in the Jamaican diet and investigate possible links between the high levels of heavy metals in Jamaican soils and the high incidences in Jamaica of diabetes, renal disease and prostate cancer.

