

# INSTITUTE OF FUNDAMENTAL STUDIES

## ANNUAL SCIENCE CONFERENCE

29 - 30 January 1988

IFS AUDITORIUM

PROGRAMME

&

ABSTRACTS

Institute of Fundamental Studies  
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# TABLE OF CONTENTS

Programme

Abstracts

Personnel

Research Programmes

Calendar

Public Lectures

Research Colloquia

Visitors

Selected Press Reports

Publications



## PROGRAMME

## P R O G R A M M E

Friday, 29th January 1988

- 0930 hrs - Traditional lighting of the oil lamp
- 0935 hrs - "1987 in retrospect"  
Prof. Cyril Ponnampereuma
- 1000 hrs - Address by the Chief Guest  
Dr. Bhekh Thapa
- 1015 hrs - Visit to the laboratories  
&  
T E A

### **SESSION I - LIFE SCIENCES**

#### Progress Reports

- 1120 hrs - "Research on Biological Nitrogen Fixation"  
Ms. Malkanthi Gunatilaka
- 1140 hrs - "Ecology and Conservation"  
Prof. S. Balasubramaniam
- 1200 hrs - "The Tissue Culture Programme"  
Dr. K.G. Gunatileke
- 1220 hrs - "Arteriosclerosis and Atherosclerosis"  
Dr. Shanthi Mendis

#### Research Reports

- 1240 hrs - "Quantitative and Qualitative Analyses of  
Nitrogen-Fixing Cyanobacterial populations  
in rice soils"  
Ms. I.M. Samarakoon

- 1255 hrs - "Rhizospheric Nitrogen Fixation Associated with Wetland Rice"  
Ms. Y. Abhayawardhena
- 1310 hrs - "Distribution and economic uses of leguminous species Endemic to Sri Lanka"  
Mr. S.A.S. Pathmasiri
- 1325 hrs - L U N C H

**SESSION II - EARTH & SPACE SCIENCES**

Progress Reports

- 1430 hrs - "Research on Eppawela Phosphate"  
Prof. K. Dahanayake
- 1450 hrs - "Prospecting for Gems - The scientific way"  
Dr. M. Rupasinghe
- 1510 hrs - IFS-Ruhuna-Belgium Project  
Ir. Pol Deturck
- 1530 hrs - T E A
- 1600 hrs - "Soil Vegetation & Health"  
Dr. M.U. Jayasekara
- 1620 hrs - "Astronomy and Astrophysics"  
Dr. S.A. Leelananda

Research Reports

- 1640 hrs - "Serpentinite - a new way of controlling endemic fluorosis"  
Dr. R. Weerasooriya
- 1655 hrs - "Eppawela apatite - Muthurajawela peat mixture as P-fertilizer"  
Mr. Kapila de Silva

Saturday 30th January 1988

**SESSION III - PHYSICAL AND CHEMICAL SCIENCES**

Progress Reports

- 0930 hrs - "Photochemistry - 87"  
Prof. K. Tennakone
- 0950 hrs - "Search for Anticancer agents from  
Indigenous Plants"  
Prof. A.A.L. Gunatilaka
- 1010 hrs - "Oxidative Nitrogen Fixation Mechanistic  
Aspects"  
Dr. O.A. Ileperuma
- 1030 hrs - T E A
- 1100 hrs - "Studies on Superconductivity"  
Dr. M.A.K.L. Dissanayake

Research Reports

- 1120 hrs - "Photocatalytic Properties of Ferrocyanides"  
Mr. S. Wickramanayake
- 1135 hrs - "Efficiency of chemically treated Eppawela  
Phosphate as a source of phosphate for  
rice"  
Ms. S. Pathirana
- 1150 hrs - L U N C H

**SESSION IV- MATHEMATICS, PHILOSOPHY & SOCIAL SCIENCES**

Progress Reports

- 1330 hrs - "The IFS Archaeology Programme"  
Prof. S. Bandaranayake
- 1350 hrs - "Studies on Human emotion"  
Prof. Padmasiri de Silva

- 1410 hrs - "Primate Studies"  
Dr. W. Dittus
- 1430 hrs - "Ground water & Human Health"  
Prof. C.B. Dissanayake
- 1450 hrs - T E A

Research Reports

- 1530 hrs - "Statistics as a Tool"  
Dr. N. Yatawara
- 1545 hrs - "Deriving a Field Shear Strength  
Envelope for landslide prone soils"  
Mr. T. Kuruppuarachchi
- 1600 hrs - "The locational pattern of Early Historic  
sites in the plateau of Kandy"  
Ms. Chulani Rambukwella
- 1615 hrs - "Research in Indo-Lanka Relations"  
Mr. Rohan Gunaratna
- 1630 hrs - **END OF SESSIONS**

## ABSTRACTS

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**DIVISION OF LIFE SCIENCES**

## RESEARCH ON BIOLOGICAL NITROGEN FIXATION

Malkanthi Gunatilaka

Nitrogen is generally the major limiting factor in crop production. Agricultural production has always relied on nitrogen produced by nitrogen fixing organisms. The world requirement of nitrogen for crop production is estimated to be about  $125 \times 10^6$  metric tons per year and this is expected to increase to about  $245 \times 10^6$  metric tons by 200 A.D. Industrial production of nitrogenous fertilizer is quite expensive and the production costs are expected to escalate in the near future. Therefore, it is important to explore ways of biological processes as a partial substitute for the use of chemical fertilizer.

There are four well defined project areas in this programme, namely,

1. Data on nitrogen fixing plants endemic to Sri Lanka,
2. Resource centre for nitrogen fixing organisms,
3. Associative nitrogen fixation in rice, and
4. Efficiency of chemically treated Eppawala phosphate as a phosphorus fertilizer for rice cultivation.

The aim of the first project is to prepare a complete, scientific documentation of all the nitrogen fixing endemic plant species of Sri Lanka. The second project on resource centre for nitrogen fixing microorganisms is aimed at isolation, authentication and maintenance of nitrogen fixing microorganisms and different species of Azolla. In addition to the routine work on the culture collection, a phosphorus screening experiment on Azolla was performed. Some work on the rhizobiology of leucaena rhizobia was also undertaken.

The third project was aimed at improving rhizospheric, associative nitrogen fixing ability of rice. The rhizospheric, diazotrophic activity at different growth stages of the rice plant was also investigated.

In the last project the efficiency of chemically treated Eppawala phosphate on the growth and yield of a rice variety, Bg 450, was evaluated in a screen house pot experiment.

**ECOLOGY AND CONSERVATION OF RAIN FOREST  
MANGROVE ECOSYSTEMS OF SRI LANKA**

S. Balasubramaniam

Physiological strategies of tree species growing on nutrient poor soils or of plants subjected to salinity stress and soil biological processes of natural and man-made ecosystems are our main areas of research. There is a great need to identify new species of fast growing multipurpose trees for agro-silviculture and community forestry. There is also a need for tree species capable to growing in semi-arid and saline habitats. These searches along with a better understanding of soil biological processes sustaining the fertility levels of natural and anthropogenic ecosystems must be pursued, if we are to meet the challenges posed by environmental degradation and the ever increasing demands of fodder, fuel and timber of urban and rural people.

The following field surveys and laboratory studies were completed during 1987.

- (1) A survey of soil nutrient status and foliar nutrient contents of key tree species of wetzone and dryzone forests.
- (2) Floristic composition and zonation of lagoon fringing mangroves and riverine mangroves along the southeast coast of Sri Lanka.
- (3) Preliminary studies on salinity tolerances of propagules of some mangroves and the role of sugar alcohols in osmotic adaptation.

Besides the above studies a project on the cause of tree mortality in the montane cloud forests of Horton Plains Nature Reserve was initiated in November 1987. This project is being very enthusiastically carried out by our Junior Research Associate at the IFS.

A pilot project proposal to upgrade the derelict lands in the vicinity of IFS was prepared in June/July 1987. This project proposal has already been discussed with Senior administrators and scientists attached to the Land Use Division, the Forest Department, the National Housing Authority, the Government Agent, Kandy, the Plantation Sector (JEDB) and the Ministry of Health. So far the discussions have been positive and fruitful. We hope this project will gather more momentum during 1988. The scientific aim of this project is to investigate soil factors and soil biological processes likely to promote the establishment and development of a permanent tree cover on degraded grasslands. It is anticipated that the coarse, fire prone patana grasslands can be transformed into species rich, self sustaining permanent forests. The scientific and socioeconomic benefits of this project are enormous. In addition the beauty of the hills around Kandy will be greatly enhanced.

Besides these IFS based projects, we are actively engaged in collecting, identifying and documenting the herbaceous plants of the Sinharaja Man and Biosphere Reserve, the Wasgamuwa National Park and the Knuckles Area. Funds for the Sinharaja project are provided by the UNESCO supported MAB National Programme and for the National Parks from the Mahaweli Environmental Project.

## TISSUE CULTURE PROGRAMME

Dr. K.G. Gunatileke

### ABSTRACT :

The scientists involved in tissue culture research at various national research organizations, and one private sector organization met at IFS to have interactions with each other. Practically all were in the opinion that they will be fully occupied at their own organization engaged in developing protocol for the mass production of their specific crops. They felt that fundamental research which would have a significant impact on their technology have to be carried out at IFS, using the sophisticated equipment that is going to be available. Once the laboratories are set up, they wished to be associated with the research activities at IFS.

During the past year research was carried out on the proliferation of Papaya and Mango tissue in vitro. Shoot proliferation and rooting of proliferated. Papaya tissue were carried out successfully, obtaining as much as ten to twelve fold proliferation of shoots in four weeks. Fundamental research aimed at understanding somatic embryogenesis will be carried out during the year that just started.

TRACE ELEMENTS IN ATHEROSCLEROSIS

1.1 Analysis of trace elements in atherosclerotic lesions.

Magnesium, Calcium, Manganese and Zinc concentrations have been analysed in atherosclerotic lesions from aortas obtained at autopsy from accident victims. There was no significant difference in the concentration of calcium and magnesium and manganese concentrations in atherosclerotic lesions of different grades. However the mean zinc concentration of fibrous plaques ( $0.21 \pm .18$  ppm) was higher when compared with the mean concentration of zinc in ( $0.1 \pm .17$ ) normal tissue.

CORONARY HEART DISEASE AND RISK FACTORS IN THE GENERAL POPULATION

2.1 Prevalence of symptomatic coronary heart disease in a rural population

The prevalence of Coronary heart disease in a rural population in Sri Lanka has hitherto not been studied. A survey was carried out in Wargampaha village in Mahiyangana. 250 households were randomly selected from the electoral list. The participation rate was 78 percent. 290 males and 250 females between 30 and 70 years of age took part in the study. Standard procedures were used to assess the history of CHD and electrocardiogram. Symptomatic coronary heart disease was arbitrarily defined as anginal pectoris pain of possible myocardial infarction, with resting ECG changes of ischaemia. ECG abnormalities were defined as Minnesota code 1:1-2 (major Q/Qs), or 7:1 (left bundle branch block), or 1:3 (minor Q/QS) or 4:1-3 (ST depression), or 5:1-3 (T wave flattening/inversion).

The overall percentage prevalence of symptomatic coronary heart disease was 7.9, percent for males and 6.5 percent for females.

2.2 The relationship of reported parental history and relative risk of coronary heart disease.

The relationship of a reported parental history of coronary heart disease and relative risk of coronary heart disease and relative risk of coronary heart disease was determined retrospectively by comparing 168 individuals suffering from Coronary heart disease, with 150 age and sex matched healthy controls. They were interviewed for a positive family history of coronary heart disease which was defined as, having at least one first degree relative who suffered from heart disease morbidity and mortality.

Adjustment was made for the confounding effect of other risk factors found to be associated with the prevalence of parental history of coronary heart disease. This was done by excluding those with risk factors of Hypertension and/or diabetes mellitus, and/or hypercholesterolaemia and those with family histories of these conditions. Relative risk was analyzed by Mantel-Haenszel Chi-square analysis.

An odds ratio of 2.5 was observed for 29-49 year old individuals for those 50 years and above the odds ratio is 1.8. The overall odds ratio is 1.9.

2.3 Hypertension in a rural community in Central Province in Sri Lanka.

The results of a population survey of blood pressure in the adult residents of a village in the Central Province in Sri Lanka was completed. A total of 564 persons 273 males and 291 females aged 20 years and over were screened by visiting households. 80 percent of the total adult

village population was examined. 8.79 percent of males and 6.5 percent of females had a diastolic blood pressure 95-109 mm Hg. 2.9 percent of males and 2.75 percent of females had a diastolic blood pressure of 110 mm Hg or above. 43 percent of this population had never had their blood pressure measured previously. The overall prevalence of hypertension was 9.6 percent using the criterion 160/95 mm Hg.

## ATHEROSCLEROSIS OF THE AORTA

### 3.1 Extent of Atherosclerosis of the aorta in males.

Autopsy specimens of descending thoracic and abdominal aortas were collected from 108 male subjects dying of accidents. Over a 2 year period. The area of the intima covered by each type of atherosclerotic lesion was estimated as the percentage of the total intimal area of the artery and the sum of these figures was taken to represent the total extent of atherosclerosis.

Up to the age of 40 years fatty streaks occupied 12% of the surface. After 40 years it decreased gradually during the next 20 years. By 60 years of age it reached 4-5 percent and persisted at this level thereafter. The area occupied by fibrous plaque was small (less than 15%) until the age of 40 years. Then there was a swift increase up to 70 years of age. At 70 years of age the area occupied by fibrous plaque was 55%.

The extent of complicated lesions remained less than 1% up to 50 years of age. Between 50 and 70 years there was a rapid increase and the average area affected was 4 percent of the intimal surface. Lesions with calcifications appeared in the 4th decade and the extent involved increased rapidly after 60 years of age to an average of 5-8% by 70 years of age. The total extent of atherosclerosis increased slightly from 20-40 years of age within a range of 10-15 percent of the intimal surface. After 40 years

there was a steady increase amounting to 6-8% of the arterial surface per 10 years period. In the abdominal aorta the increase of atherosclerotic lesions by an early and the area occupied by all forms of lesions was greater than in the thoracic aorta.

## QUANTITATIVE AND QUALITATIVE ANALYSES OF NITROGEN FIXING CYANOBACTERIAL POPULATIONS IN RICE SOILS

Ms. I.M. Samarakoon

It has been reported that cyanobacterial populations from different localities differ qualitatively and quantitatively depending upon their microenvironments. In the present study cyanobacterial populations were examined in soils collected from different localities in Sri Lanka.

Air dried and sieved soil samples were sent by scientific collaborators participating in a project on Azolla co-ordinated by the Institute of Fundamental Studies. These samples came from Ambalantota, Kelaniya, Kirimatiyana, Mahailuppallama, Matara, Tammannagama and Waikkala. They were analysed quantitatively for nitrogen fixing cyanobacteria by the MPN method using dilution series prepared with a nitrogen-free selective medium. Qualitative analyses were done by direct microscopic examination of the dilution tubes and by plating, followed by microscopic observations. The samples were also analysed for pH, Olsen's P and total N.

Cyanobacterial densities varied from  $4.9 \times 10^3$  to  $5.4 \times 10^6$  colony forming units per gram of soil. The higher populations were generally associated with dry zone localities having higher soil pH and low N content, but no such correlation with Olsen's P could be observed. The dominant species from all the localities was Nostoc, with Anabaena and Calothrix as the sub dominants. Fisherella and Scytonema were found only in Tammannagama, Mahailuppallama and Ambalantota.

It can therefore be inferred that high pH and low N content favour the abundance of  $N_2$ -fixing cyanobacteria and that Nostoc is a cyanobacterium which is adapted to the widest range of soils.

RHIZOSPHERIC NITROGEN FIXATION ASSOCIATED WITH WETLAND RICE

Yamuna Abhayawardene

ABSTRACT :

The rhizosphere of rice is known to have nitrogen fixing activity, although it is quantitatively less pronounced than the activity attributed to cyanobacteria. This nitrogen fixing activity is attributed to rhizospheric diazotrophs.

Of the techniques so far reported for the detection and estimation of rhizosphere nitrogen fixation and isolation of diazotrophic bacteria from wetland rice, the most promising one involved an initial assay for nitrogenase activity by the cut plant soil method (Barraquio et, al., 1986) followed by a more specific method of isolation using a spermosphere model (Thomas-Bouson et.al., 1982).

In this investigation, field grown plants of a new improved short-age variety of rice, namely Bg 400-1 grown in two different localities under similar agronomic practices was used. The cut plant soil technique was employed to estimate the rates of biological nitrogen fixation at early flowering. Samples with the highest total rhizospheric nitrogen fixing activity were used for the isolation and characterization of the most prevalent diazotrophs in the rice rhizosphere. Several different aerobic media were used for isolation of these organisms. The most dominant population was recognized to be a single celled, coccoid organism forming transparent, slightly yellowish round colonies on Watanabe medium (Watanabe & Barraquio, 1979). This organism was tentatively identified as an enterobacteriaceae and will be used for further evaluation of rhizospheric nitrogen fixing activity.

It is known that the nitrogen fixing activity of the rhizosphere of wetland rice differs with the stage of maturity of the rice plant (Watanabe et.al., 1979). This was further examined with a short-age variety of rice, Bg 450, grown in the same locality with similar agronomic practices. The cut plant soil technique was used for the estimation of rhizospheric nitrogen fixing activity at selected growth stages of the rice plant. The highest nitrogen fixing activity was obtained at the nursery stage. There was a decline in activity at the stages of maximum tillering and an increase at the stage of maturity. The high activity in the nursery stage may be due to factors other than Soil nitrogen depletion such as high root biomass per unit area, root secretion favourable for  $N_2$  fixing bacteria etc. High activity at maturity is most likely to be due to soil nitrogen depletion, in addition to root secretions.

**THE OCCURRENCE AND UTILISATION OF LEGUMINOUS SPECIES  
ENDEMIC TO SRI LANKA**

S.A. Kulasooriya and S.A.S. Pathmasiri

The occurrence of leguminous species endemic to Sri Lanka were recorded during a long-term research project conducted by the Institute of Fundamental Studies. The data initially collected from the literature surveys and questionnaires were verified during field visits which included interviews with local people, visual observations and specimen collections.

The results so far obtained when mapped on a 10 x 10 km grid of the island shows that the distribution of the endemic species is highly limited. Non-adaptability to environmental situations, lack of utilisation and the availability of substitutes may be the major reasons for this restricted distribution.

The majority of these species are unknown to local people. Of the seven tree leguminous species studied, only Pericopsis mooniana (Nedun in Sinhala) was being used as timber, although there were three others which have potential value as utilisable timber.

Further basic studies such as seed germination, growth, nodulation, nitrogen-fixation etc., are required prior to the popularisation of these endemic leguminous species.

**DIVISION OF EARTH AND SPACE SCIENCES**

## ABSTRACT FOR IFS ANNUAL SCIENCE CONFERENCE 1987

Kapila Dahanayake, Senior Research Fellow, IFS

Several field visits were made to the Eppawala phosphate deposit during the year 1987. The purpose of the trips being to study the geological, petrological, and mineralogical relations of the Precambrian apatite marble to the overlying exploitable phosphate deposit. A comparable phosphate deposit at Ambakote in Kurunegala was also investigated. In both locations, the exposed weathering profiles, weathered rocks and the parent rock were studied macroscopically for varying compositions and texture. Laboratory studies were done with polarisation and scanning electronic microscopy. Chemical analyses were also carried out.

The deposits on the weathering profiles showed that the original parent rock had been weathered to give rise to various compositional textures. The resistant Precambrian apatite crystals now occur in fine grained groundmasses which consist of secondary phosphate minerals such as francolite and collophane. The secondary mineralization has been made possible by (i) the phosphate-rich solutions which have precipitated in the pre-existing cavities of the parent rocks (ii) a phenomenon of grain diminution which causes the corrosion of the grain boundaries of Precambrian apatite crystals thus resulting in recrystallization into fine crystals. Filamentous microorganisms appear to have played a role in both instances of secondary mineralization. The preliminary observations highlight the necessity of separately investigating the groundmasses and the larger apatite crystals of the phosphate deposits for exploitation purposes.

## PROSPECTIVE FOR GEMS - THE SCIENTIFIC WAY

Dr. M.S. Rupasinghe - Research Associate

### **ABSTRACT**

Fluorine - a gaseous reactive element is a good indicator of mineralization. Fluorine chemistry of granitic material is relevant, to economic prospecting in granitic terrains, since fluorine is associated with tin - tungsten - molybdenum deposits, the rare earth elements, zirconium-beryllium deposits and lithium-rubidium-caesium pegmatites. A number of researchers have suggested that other halogens, Cl and I may also have potential as pathfinder elements in geochemical prospecting programmes.

200 groundwater samples from a mineralized area around Rattota - Matale areas were studied for their fluoride concentrations, using an Orion model specific ion electrode. Fluoride concentrations, using an Orion model specific ion electrode. Fluoride contents ranged from 0.01 to 2.0 ppm, and showed dispersion patterns associated with mineralization, particularly in the topaz ( $\text{Al}_2\text{F}_2\text{SiO}_4$ ) bearing regions. This indicates the potential use of fluorine in mineral exploration in Sri Lanka.

## SOIL VEGETATION & HEALTH

M.U. Jayasekara

### ABSTRACT

The soil vegetation & health group is presently concerned with studying the corelationship between soil trace elements and endemic disease. .

The philosophy behind this exercise is that, in Sri Lanka most people depend on their immediate environment for a good portion of their food. So, any disparity of trace elements in the soil will be reflected in the plants and Later in Man. The fact that Sri Lanka has 9 of the 10 major soil groups in the world, makes it more important that these studies are conducted in Sri Lanka, so that any excesses or paucities of trace elements found in any group of soil in Sri Lanka may mimic the picture in the same soil group elsewhere in the globe.

Our assault on the problem is three pronged. Studies are directed in elucidating the corelationship between soil iodine and endemic goitre, soil selanium and malignant tumors, commonly reffered to as 'cancer' and soil fluoride and dental disease.

The study plan calls for the collection of 5000 soil samples from specified locations marked in a grid, so that each soil sample represents 5 square miles of surface land.

### STUDIES ON ENDEMIC GOITRE

The Sri Lankan figures for the  $I_2$  intake in the water soluble form is in excess of 100-150  $\mu$ g/day/adult. which is the WHO standard. Yet the  $I_2$  levels in the areas where goitre is endemic is lower than, those in the rest of the island.

This clearly indicate that Sri Lanka needs its own standards for I<sub>2</sub> intake.

In the laboratory testing of over 400 soil samples in 1987 obtained from areas with a high incidence of goitre and from those with a low incidence, indicated that higher levels of Cobolt and Manganese corelates well with low incidence of goitre. Our studies also showed that Cobolt forms a complex with thiocyanate, thus preventing the body utilising thiocyanate which is a goitrogen.

#### STUDIES ON "CANCER"

Our studies were confined to an area with a high incidence of gastric cancer as well as a area with no known cases of gastric cancer.

The soil-clay selenate complex was found to be highly stable in Nawalapitiya which has a very high incidence of gastric cancer. This was found to be so due to its peculiar clay mineralogy with a high proportion of gibbsite. Although the soil selenium levels in Nawalapitiya area compares well with areas of no known incidence of gastric cancer, the stable selenate complex seems to deprive the target population of available selenium which has a protective effect on the body against 'cancer'.

Our group has also observed that the high incidence of gastric cancer in Sri Lanka is directly corelated with a higher presence of soluble organic matter (fulvic acid). Although fulvic acid per se is not a carcinogen, it may act as a catalyst in the nitrosamine formation. In the laboratory, it was observed that the catalytic effect is dependent mainly on carboxyl groups in fulvic acid. Our experiments have indicated that selenate can convert the carboxyl groups into Co<sub>2</sub>, thus preventing the above catalytic effects. So the presence

of selenium may have a protective effect on 'cancer' induction by nitrosamines.

#### STUDIES ON DENTAL DISEASE

In 1987, we have directed our efforts on defluoridating the fluoride rich water in Sri Lanka of the two methods studied, one technique is already published while the other will be discussed today by a co-worker. Epidemiological data suggests that the incidence of dental caries is higher in industrial areas in Sri Lanka when compared with rural areas. When the tooth enamel was studied, an inverse relationship was found between the enamel content & the tooth lead content.

PUBLICATIONS FROM THE SVH GROUP

S.V.R. Weerasooriya, S. Bulumulle, S.A. Tilakaratne and M.U. Jayasekara (1987)

The reduction of selenate by fulvic acids in the soils of high gastric cancer risk area in Sri Lanka. Toxicol. Environ. Chemistry (accepted)

S.V.R. Weerasooriya, S.Bulumulla, M.U. Jayasekara, and C.B. Dissanayake (1987)

The medical geochemistry of Co and Mu in the etiology of endemic goitre. Environ. Geochem. and Health (under revision)

S.V.R. Weerasooriya, S. Bulumulla, S.A.Tilakaratne and M.U. Jayasekara (1987)

The selenate retention differences in soils of high and low gastric cancer areas in Sri Lanka. Intern. J. Environ Studies (submitted)

K.B.P.N. Jinadasa, S.V.R. Weerasooriya and C.B. Dissanayake (1987)  
A rapid method for defluoridating fluoride rich waters at a community level. Intern. J. Environ. Studies (in press)

C.B. Dissanayake, S.V.R. Weerasooriya, and M.U. Jayasekara (1987)  
The epidemiological distribution of gastric cancer in Sri Lanka. Proc. Environ. Life Element and Health Symposium China (accepted)

S.V.R. Weerasooriya, K.B.P.N. Jinadasa, C.B. Dissanayake and M.U. Jayasekara (1987)

A chemical process for serpentinite to enhance its fluoride uptake ability (in preparation)

## ASTRONOMY & ASTROPHYSICS PROGRAMME

Coordinator : S A Leelananda

The objective of the IFS Astronomy Programme is to promote and stimulate the study of Astronomy in Sri Lanka. However, its long term aim is to form a group of young astronomers engaged in Astronomical and Astrophysical research in Sri Lanka.

It is important to point out at this time that Astronomy is not and has not been an active area of research in Sri Lanka. It is neither taught at university or secondary school level on a regular basis although university courses have been offered occasionally.

Considering the importance of Astronomy as a fundamental science, the IFS is taking great effort and interest to promote the study of Astronomy in Sri Lanka with the hope that it will eventually become an active area of research in the future.

With these aims in mind the IFS has launched a programme to promote and stimulate the study of Astronomy. But the efforts are somewhat hampered by the unavailability of practicing Astronomers in Sri Lanka to take an active role although Sri Lanka has produced a few first Astronomers. The programme was reactivated when I joined the IFS in June 1987.

A three week residential National Workshop was held from 03 - 21 August 1987. Twenty young scientists selected to represent institutions throughout the Island participated in the workshop which was directed by Dr George V Coyne, Director of the Vatican Observatory. During the workshop, participants were exposed to basic concepts and theories in Astronomy and Astrophysics, and to some observational sessions using small telescopes. The workshop has been very successful and there had been useful interactions among the participants themselves and with Dr Coyne.

The success of the workshop can be better judged by the follow-up programme agreed upon at the end of the workshop and carried out to expectations. The follow-up programme consisted of four parts.

1. The formation of the IFS Astronomy Circle:

The Astronomy Circle has been meeting regularly every month for a day of activity of lectures and discussions. We are able to invite some interested school children to some of these meetings to stimulate their interest in Astronomy.

2. Donation of a telescope:

Dr Coyne has donated an eight-inch telescope to be used by the Astronomy Circle. The telescope is on its way and it is expected to organize observational sessions for interested groups and school children on its arrival

3. University course on Astronomy & Astrophysics:

A regular course on Astronomy and Astrophysics will be given by Dr S A Leelananda, Physics Department, University of Peradeniya, to physics major students starting from next academic year. Dr Coyne has kindly agreed to help in the organization of this course.

4. Regional Workshop:

A regional workshop has been tentatively planned for August 1988 to bring young Astronomers from neighbouring countries so that our young people will have an opportunity to interact with their counterparts. The second workshop that had been planned for December 1987 could not be held because Dr Asoka Mendis had to cancel his visit due to illness. We expect to continue these activities during 1988 to the best of our ability.

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## IFS - RUHUNA - K U LEUVEN PROJECT ON IRON TOXICITY

Ir. Pol Deturck

Summarizing the progress of the second year of the project the following can be concluded:

The main office and analytical laboratories of the project are now definitively installed at the Institute of Fundamental Studies. Actually, about 30 soil and  $\pm$  10 plant characters are determined on a semi-routine scale, illustrating that the objective to establish a soil fertility laboratory at the IFS and to provide IFS with better research conditions is fulfilled.

So far approximately 200 soil and about 100 iron toxic plant samples were analysed in triplicate on a wide range of chemical characteristics. Results of the analyses revealed strong deficiencies of exchangeable bases, so that iron toxicity should be considered as a problem caused by a low nutrient status rather than by a low pH or a high concentration of reducible iron.

The entering of the analytical data on the computer provides the necessary information to set up a data bank on the fertility status of paddy soil, which in turn could permit the funding of a soil advisory service.

Seven greenhouse experiments ranging from organic and inorganic fertilizer studies over investigations on varietal tolerance of the rice plant to simulation of interflow and drainage processes were started, so that 1987 could be considered as the "year of the greenhouse".

Fundamental research on the influence of potassium on redox potential, microbial activity and iron reduction in the rhizosphere of rice roots was started. In the laboratory, phosphate sorption characteristics of some

Sri Lankan rice soils were investigated and an attempt was made to find a suitable method to determine the microbiological characteristics of a paddy soil.

Besides the permanent staff, about a dozen of people were trained in analytical technique. With the compilation of "Soil and plant analysis - a laboratory guide" by Mr. J. De Coninck, it will in future even be more easy to train people.

Within the resources of the project, facilities were given to anybody who requested for them.

In 1987, three MSc students successfully submitted their thesis at the University of Leuven in July 1987. Besides 2 students of Ruhuna University and 2 students from University of Peradeniya obtained their BSc degree with a thesis made at the project.

## SUMMARY

### SERPENTINITE - A NEW WAY OF CONTROLLING DENTAL FLUOROSIS

S.V.R. Weerasooriya, K.B.P.N. Jinadasa, C.B. Dissanayake and  
M.U. Jayasekara.

(Institute of Fundamental Studies, Kandy, Sri Lanka)

Endemic dental fluorosis continues to be a public health problem of high magnitude in several parts of Sri Lanka, where drinking water contains excess quantities of naturally occurring fluoride. A simple and rapid method of defluoridating of these fluoride rich waters was required and it was found that the serpentinite forms a suitable starting material in the defluoridation. However it was shown that the efficiency of serpentinite in removing excess fluoride from fluoride water was limited, and it tends to become deactivate with repeated use. Here we present a method for chemical treatment of serpentinite to enhance the uptake of fluoride. In this way, under laboratory conditions, the concentrations of fluoride can be lowered from 10 mg/L to less than 1 mg/L, i.e. below the WHO permissible level in drinking water. A surface complex formation model was used to describe the removal of fluoride from chemically activated serpentinite.

**EPPAWELA APATITE-MUTHURAJAWELA PEAT  
MIXTURE AS A P-FERTILIZER**

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**ABSTRACT**

A peat reserve of nearly 50 million tons occurs at Muthurajawela. Since this material is acidic it is of interest to investigate the nature of this peat especially in view of its possible use as a raw material to produce a P-fertilizer from Eppawela apatite.

Peat samples were removed from three different locations at the Muthurajawela deposit and their pH, moisture content measurements and chemical analysis for C, S, N, P, K, Na, Fe, Ca, Mg and Zn have been made.

Powdered Eppawela rock phosphate was mixed with peat at different ratios and the available  $P_2O_5$  contents of these mixtures have been estimated at regular intervals up to 3 months.

pH of peat samples were in the range 4-5 while their total C was 26-29%. Acidity is mainly attributed to the presence of humic acid. Total N and S contents were 0.9 and 4.5% respectively. Its total P was 0.1% of which only about 1-6 ppm was in the available form. It also contains other plant nutrients in small quantities. Reaction of apatite with peat in the weight ratios 1:1 and 2:1 has been investigated. The reaction of 1:1 weight ratio was found to be fairly rapid initially,

and after 8 weeks conversion is rather slow. Percentage conversion doubles in 8 weeks and then increases very slowly resulting in the formation of a fertilizer containin about 12% available  $P_2O_5$ , 2% sulphur, 0.5% Nitrogen.

It is apparent from these studies that a P-fertilizer containing small amounts of N,S, K, Mg, Zn and Fe can be conveniently made by mixing apatite with peat and allowing the mixture to cure for 2-3 months. This product could easily be substituted for imported rock phosphate, which contain 10-12% available  $P_2O_5$ .

**DIVISION OF PHYSICAL AND CHEMICAL SCIENCES**

K. Tennakone

In the year 1987 Photophysics programme has touched almost all currently fashionable topics related to solar energy conversion. A significant progress was made in the following areas.

Photocleavage of Water

The work started in 1987 on two step photodecomposition of water was extended. Several new semiconductor materials (hydrous ferric oxide, cupric ferrocyanide, silver phosphate, cuprus chloride) having highly negative flat-band potentials were defected. It was demonstrated for the first time that there exists semiconductor catalysts capable of photogenerating hydrogen without the necessity of having electron and/or hole transfer catalysts.

Photofixation of Nitrogen

The hydrous ferric oxide system for photoreduction of nitrogen was studied in detail. Ammonia, oxygen and peroxide yields were estimated accurately. Hydrous ferric oxide deposited on clay or doped with hydrous titanium oxide was found to improve the performance of the catalyst. Attempts were made to elucidate the mechanism of catalysis and reaction kinetics.

Photoelectrochemical Cells

The quantum efficiencies of heterojunction photoelectrochemical cells based on CdS, CuS and CuCNS were measured. It was observed that in thin film heterojunction PECs new types of more efficient charge transfer processes are involved. The variation of the quantum efficiency of dye-sensitized PECs with the surface

concentration of the dye was determined. A charge separation process via exciton formation was suggested to explain the anomalies at higher surface concentrations. The influence of doping on the type of conductivity (n or p) of CuCNS was investigated and their photoelectrochemical properties determined.

#### Solid State Photovoltaic Cells

A dye-sensitized solid state solar cell was constructed to study the sensitization phenomena at the absence of an electrolyte. Quantum efficiencies were measured and compared with sensitized liquid junction cells. Photovoltaic cells based on p-CuCNS and n-CuCNS were studied.

#### Biomass Conversion

The work started in 1987 on biomass conversion was continued. Experiments were conducted to test the mathematical models. The optimum energy harvest efficiency of lemma and salvinia were measured.

#### Organic Photochemistry

It is well known that rosaniline type dyes undergo bleaching when treated with sulphur dioxide. We have noted that bleached solution (Shiff's Reagent) exhibits photochromism. Experiments were carried out to examine the phenomenon and reaction mechanisms were determined.

## SEARCH FOR ANTICANCER AGENTS FROM INDIGENOUS PLANTS

A.A. LESLIE GUNATILAKA

Thanks to its geographic situation and climatic conditions Sri Lanka has an abundant flora. The IFS research programme on Natural Product and Medicinal Chemistry intends exploiting medicinal plants and indigenous flora of Sri Lanka to produce useful pharmaceuticals.

Cancer is rated high as a killer disease. Drugs available today are highly specific and expensive and cannot be afforded by patients in developing countries. These justify the continued search for cheap and non-specific anticancer agents, both natural and synthetic.

There are some indigenous plants in Sri Lanka which are claimed to be useful in treating cancer; also plants of the family Annonaceae are well known to contain phytoconstituents exhibiting cytotoxic activity.

We have initiated a programme of biological screening of indigenous plants of Sri Lanka for their cytotoxic properties. Each plant part is successively and exhaustively extracted with hexane and 95% ethanol. The latter extract is separated into five fractions. A total of seven extracts/fractions obtained from each part is screened for cytotoxicity using Brine shrimp and potato disc assays. Those showing positive responses are subjected to further chemical fractionations in order to isolate phytoconstituents responsible for their activity.

## PHOTOOXIDATION OF AMMONIA MECHANISTIC ASPECTS

Dr. O.A. Ileperuma

The oxidation of  $\text{NH}_3$  to  $\text{HNO}_3$  is an important industrial process while the oxidation of ammonia fertilizers in soil to nitrites and nitrates has implications in Agriculture. The oxidation of  $\text{NH}_3$  in aqueous solutions under UV illumination to yield traces of nitrate has been reported in the older literature. However the mechanism of this interesting conversion has not been investigated.

The oxidation of ammonia was followed by irradiating solutions of  $\text{NH}_4\text{Cl}$  and  $\text{NaOH}$  with UV light followed by chemical analysis for  $\text{NH}_3$ , nitrite and nitrate. Changes in  $[\text{OH}^-]$  were determined by using a sensitive digital pH meter. All kinetic runs were carried out under pseudo-first order conditions with respect to  $[\text{OH}^-]$  and  $[\text{NH}_3]$ .

It was found that the photooxidation of  $\text{NH}_3$  proceeds only under neutral or alkaline pH values and for  $\lambda < 254 \text{ nm}$ . Pseudo-first order plots with respect to  $[\text{OH}^-]$  and  $[\text{NH}_3]$  indicated that the reaction is first order with respect to  $[\text{NH}_3]$ . The order with respect to  $[\text{OH}^-]$  was estimated to be Ca. 0.5. An overall rate constant of  $3.86 \times 10^{-6} \text{ mol}^{-\frac{1}{2}} \text{ dm}^{3/2} \text{ s}^{-1}$  has been estimated from the initial rate plots for the above reaction. The oxidation proceeds only to nitrite under normal conditions. With semiconductor suspension where  $\text{H}_2\text{O}_2$  is generated, the final product is  $\text{NO}_3^-$ . A free radical mechanism involving an  $\text{HNO}$  intermediate is proposed for this photooxidation.

## SOLID STATE PHYSICS

Dr. M.A.K.L. Dissanayake

The Solid State Physics programme of the IFS was initiated in early, 1987, with a project on Semiconductors. Under this project, optical and electrical properties of semiconducting copper-indium diselenide ( $\text{CuInSe}_2$ ) single crystals and thin films electrodeposited on titanium substrates have been investigated. We have observed that electrodeposited films can also be grown successfully on stainless steel substrates, which is less expensive than titanium. Present work concentrates on the possibility of using such films in solid state and photoelectrochemical solar cells.

The superconductivity project was initiated in May, 1987 as a direct follow up of the International Symposium on Solid State Physics held in April, 1987. Under this project, we have successfully prepared the new ceramic oxide type yttrium-barium-copper-oxide ( $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ ) superconductors and studied its electrical and magnetic properties. Initial studies were concentrated on understanding the annealing conditions for sample preparation and developing measuring techniques. An effort has been made to understand the mechanism of superconductivity in these materials, by doping them with  $\text{Al}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$ . Non-percolative nature and pair breaking effect by magnetic impurities appears to result from these additives. Search for new materials with higher superconducting transition temperature and setting up of laboratory facilities for sample preparation and characterization are under way.

### Publications

1. AC conductivity of  $\text{CuInSe}_2$  - K. Premaratne, S.H.S.P. Samarappuli and M.A.K.L. Dissanayake, Proc. Int. Symposium on Solid State Physics, Kandy, Sri Lanka, (1987) (to be published).

2. Effect of  $\text{Al}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$  on the superconducting transition temperature of Y-Ba-CuO (in preparation).

#### Other Activities

Following workshops/symposia have been organised at the IFS:

1. National Workshop on Solid State Physics - One day workshop was held in January 1987: about 30 participants and 5 speakers attended.
2. International Symposium on Solid State Physics was held in April, 1987 sponsored by the International Centre for Theoretical Physics, Trieste, Italy and the Third World Academy of Science, Trieste, Italy. 30 participants and 10 speakers from 9 different countries participated. The idea to initiate a superconductivity project at the IFS emerged as a follow up of this activity.
3. A National Symposium is planned for January, 1988 and an International one for January 1989. Sponsoring agencies and speakers have already been contacted.

## PHOTOCATALYTIC PROPERTIES OF FERROCYANIDES

S.W.M.S. Wickramanayake

### ABSTRACT

A number of heavy metal hexacyanides are tested for their ability to catalyse photo-oxidation of water with  $\text{Ru}^{2+}$  as the sensitizer and  $\text{K}_2\text{S}_2\text{O}_8$  as the sacrificial agent. Strongest catalytic activity is seen in  $\text{Zn}_3(\text{Fe}(\text{CN})_6)_2$ ,  $\text{Cd}_3(\text{Fe}(\text{CN})_6)_2$  and  $\text{Fe}_3(\text{Fe}(\text{CN})_6)_3$ . An aqueous suspension of cupric Ferrocyanide behaves differently photogenerating  $\text{H}_2$  and  $\text{O}_2$  with visible light under sacrificial conditions in the absence of electron or hole transfer agent. Semiconducting properties of Ferronoides and their relevance to catalytic activity are discussed.

" EFFICIENCY OF CHEMICALLY TREATED EPPAWELA PHOSPHATE AS A  
SOURCE OF PHOSPHATE FERTILIZER FOR RICE"

Ms. S.K. Pathirana.

ABSTRACT :

An inexpensive chemical conversion by a process of double decomposition is known to convert the insoluble Eppawala phosphates to a soluble form. Hence it was considered worthwhile to test the efficiency of this chemically converted Eppawala phosphate on the growth and yield of rice in comparison with the expensive, imported phosphorus fertilizer presently used in Sri Lanka. A pot experiment was conducted with a phosphorus deficient soil using a new-improved variety of rice, namely, Bg 450 in a randomized complete block design with four replications. A basal application of N & K was added to each pot. The controls received no phosphorus fertilizer, while the treatments received equivalent amounts of phosphate in the form of Eppawala phosphate, chemically treated Eppawala phosphate and triple super phosphate. Estimation of dry matter production and phosphate accumulation were carried out at 6 weeks after planting and at harvest. Yield component analysis were carried out at harvest. The results show that the chemically treated Eppawala phosphate is comparable to triple super phosphate in terms of efficiency.

**DIVISION OF PHILOSOPHY AND SOCIAL SCIENCES**

**THE IFS ARCHAEOLOGY PROGRAM AND THE STUDY OF  
HISTORICAL URBANIZATION IN SRI LANKA IN THE CONTEXT OF  
GLOBAL CYCLES OF DEVELOPMENT**

Senake Bandaranayake

Part I

Islands, we might well say are excellent laboratories for studying the dynamics historical change. The relative geographical isolation of Sri Lanka a small island at the southern most extremes of the civilized Old World, makes it a valuable field for basic research in archaeology. The IFS Archaeology program has developed into a multi-faceted, umbrella project linked with a number of other institutions such as the PGIAR, the Universities of Kelaniya and Peradeniya and the Cultural Triangle. It attempts to bring together some of the most important aspects of advanced guard, problem-oriented research in Archaeology, investigating specific Sri Lanka data in terms of general theoretical problematics in the historical and social sciences. The different subject areas being researched by the IFS Archaeology group and other associated specialists include : PHEH settlement patterns; ecozone, natural-resources and human environments; urbanization; history of science and technology; archaeo-metallurgical studies; prehistory and what is presented here is a broad review of the Sri Lankan data on urbanization in order to draw attention to generalized patterns of trans-Asian historical development. This study takes its place within the framework of two major theoretical problematics - one, a group of questions regarding urban genesis and urban function; two, the problem of why the technologically advanced, substantially-urbanized, substantially-mercantilist societies of Asia failed - in the period between the 11th and the 15th centuries -

to generate the dynamics and momentum that produced the modern transformation which took place in Europe from about the 15th and 16th century onwards.

Each one of the countries of the South Asian region has significant and unique contributions to make to the study of these problems. Looked at in a long-range perspective we are able to propose at least three global cycles of historical evolution relating to the phenomena of urbanization in South Asia and beyond. The first of these cycles is associated with the great chalcolithic bronze age transformation that took place in the 3rd and 2nd millenium B.C. in Africa (in the Nile Valley), in three key nuclear zones in Asia. (i.e. Mesopotamia, the Indus valley and the Yellow River valley) and in South-east Europe the second cycle begins with the generalized diffusion of iron technology in the Old World through the 1st millenium B.C., culminating in the emergence of a number of historical civilizations. The 'first' urbanization in Sri Lanka, represented by the mey site of Anuradhapura, is located within this time horizon.

The third cycle overlaps the second. It has its roots in the 7th century, with the end of the classical era in Europe and West Asia, the dynamic rise and expansion of Islam, the exponential developments of the civilizations of Post-Guptan South Asia and Tang China, and the emergence into the full light of history of Japan, Korea and South-east Asia. This third cycle has its culmination in the developments of the post-13th century period - that critical period which saw the dynamic rise of Europe.

The 11th/12th/13th century marks, a critical watershed in the Asian historical trajectory. In Sri Lanka, in particular, as in Sotheast Asia, this boundary is as or more important as that of the 7th/8th century.

Our hypothesis of the 'second urbanization' belongs to this time horizon.

The urban forms of the first urbanization in Sri Lanka are important for the evidence they provide with regard to the spatial morphology or urban centres, the social meaning and function of the urban form, the internal organization of space, general evidence of urban lifeways, and so on. The cities of the first urbanization were the great power centres of a dominantly centralised state. They are characterized by a geometricality of form and a monumentality of structures, reflecting the nature of their relationship with the other constituent elements of the society at whose centre they stand. The 'second' urbanization sees a fracturing and dispersing of this systemic-concentration of power. It is marked by the decentralization of polity, the emergence of multiple kingdoms and mini-and micro-polities associated with a variety of urban and port centres - all manifestations, in my estimation, of a new historical dynamism in which commerce, mercantilism and cosmopolitanism played a significant if as yet incalculable role. The long-range implications arising from our investigation involves the question why this dynamism failed to respond to the challenges that arose in a fourth cycle of global change that begins in the 15th and 16th century.

## EMOTION STUDIES

Padmasiri de Silva

(i) Research projects have been formulated within the framework of "Emotion Studies". The first project which emerged out of emotion studies is a project on suicide, "An epidemiological study of suicide and attempted suicide in Sri Lanka". A workshop held at the I.F.S. examined the conceptual and theoretical aspects of the notion of 'suicide'. This was followed by a review of literature on a limited number of studies on suicide in Sri Lanka. An interview guide was formulated for investigations. The first phase is being concentrated on a study of suicide in the Kandy district. To map out the distribution of suicide, data has been collected from 20 police stations. Once this data is analysed and processed an indepth study of suicide and attempted suicide will follow. It is expected that this study should be completed in about six months.

(ii) The second project is entitled "Emotions and Medicine". This project has already passed through three stages and three papers on this research area have been presented " (a) A study of emotions and emotion theories. After general introduction was presented at the I.F.S. "Philosophy Forum", a more detailed study was presented as a paper entitled, "Emotions and their Shadows" at 40th anniversary of "The Fullbright Programme" held in Colombo in June 1987 ; (b) A paper on "Ethical Values and Medicine" was presented at a seminar on "Medical Ethics" at the P.W.P.A. conference, December, 1987.

(c) A paper dealing with the place of emotions in medicine, entitled, "Understanding Human Emotions and their Relevance for Medical Ethics" was presented at

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the ICUS conference in Atlanta in November, 1987. This will form a chapter in book which is to be published by Paragon Publishers, New York. Two workshops on "Medical Ethics" and "Medicine and Emotions" are to be held at the I.F.S. this year.

(iii) The Philosophy Forum was formulated as an I.F.S. project for General Education open to academics as well as the general public. We had ten lectures and the response was excellent. We have built up a kind of "core group" of people who attend the lectures and participate in the discussion. The 1988 Philosophy Forum is being organised around the theme "LIVING IN COMPLEX TIMES". A selected number of these presentations will be revised, edited and prepared for publication as an I.F.S. project.

## PRIMATE STUDIES

Wolfgang Dittus, Ph. D.

The general objective of this research is to develop our understanding of the biological basis for social behavior in non-human primates. To this end, a number of studies have been carried out in the last year which address this aim from several interdisciplinary perspectives.

The study subject concerns a population of wild toque macaques (Macaca sinica), which live in their natural forest habitat at Polonnaruwa. In this population over 550 macaques from 25 different social groups have been individually identified, and their social behaviors, demographic fates and kinship lineages have been traced over the past 13 years. There is, therefore, a unique and invaluable resource of information available from this population that allow us to address many basic sociobiological questions.

The fundament to these studies concerns the long-term monitoring of individual life-histories (births, deaths, emigrations and immigrations), particularly as these are influenced by certain social behaviors and environmental changes. In the last year, as in all years, on the practical side, this involved the regular updating of individual identities for all macaques in the population, the monthly censusing of all macaques in all 25 social groups, regular testing of dominance rank relations among members within groups as well as between groups, and the weighing of macaques in order to define individual differences in physical growth.

These basic monitoring researches were supplemented with studies of a narrower focus. Thus, we trapped and biomedically processed nearly 200 macaques from several groups in order to take blood samples for genetic and immunological analyses. (All macaques were released unharmed hours after trapping). The aim of this set of studies is to define the genetic structure of the population, as well as to determine paternities for young macaques. The determination of paternities is unique for any wild vertebrate population, and this new information sets the stage for future research at very frontier of sociobiological science. The immunological assays serve to define individual differences in morbidity. All demographic, growth, genetic and immunological data are tied to identified individuals of known age, sex, matrilineal kinship, social rank and history. Therefore, we are able to test for statistically significant patterns among these various interrelationships.

A student project, examining the behaviors of old-aged and of injured animals, is in the final phase of dissertation writing. One major publication appeared in print in 1987 and two more are in press. One of these papers tests several hypotheses concerning the causes of social group division, and some of these results will be reviewed in the oral presentation of this year's progress. Finally, one film was produced concerning the primate research at Polonnaruwa. The film will be distributed internationally for television.

## GROUNDWATER AND HUMAN HEALTH

C.B. Dissanayake

The study of the effect of the physical environment in the epidemiology of human cancer, dental diseases and goitre in Sri Lanka forms one of the main objectives of the Soil, Vegetation and Health Group of the Institute of Fundamental Studies. In view of the fact the vast majority of the people of Sri Lanka live in very close contact with the physical environment, the health of the community depends to a marked degree, on the chemistry of the environment.

The link between iodine and goitre is one of the first associations recognized between a trace element in the environment and human health and nutrition. Eventhough iodine has long been recognized as an important element environmentally, the geochemical behaviour of iodine and its distribution in the environment has been poorly described and somewhat neglected in geochemical literature.

Endemic goitre is a health problem of national importance in Sri Lanka. The marked geographical variations as observed in Sri Lanka clearly point to the wide variation in the abundance of the element iodine and perhaps to other factors that control the geochemical mobility of iodine.

Previous epidemiological surveys in Sri Lanka revealed that goitre is endemic in the Central, Western, Sabaragamuwa and Southern provinces of Sri Lanka. Recent investigations show that the endemic belt should be enlarged to include the whole of Uva province and at-least a part of the Northwestern province.

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However, our studies reveal some interesting facts :

1. Endemic goitre regions are mostly restricted to villages and show extremely sharp boundaries.
2. Even in the goitre regions, the daily intake of iodine is well above the critical levels specified by the W.H.O. for endemic goitre. The levels in the 'non-goitre' regions however are higher.
3. The presence of pockets of goitre regions appear to indicate multifactorial causes closely linked to the geochemistry of trace and major elements in the soil and water of the regions concerned. Cobalt and Manganese for instance are two elements worthy of detailed study.
4. Even though iodine deficiency in the diet is the chief causative factor, other geochemical factors appear to exert a controlling effect on the iodine availability.

## STATISTICS AS A TOOL

Dr. N. Yatawara

It is well known that statistics is the method of extracting valuable information regarding hidden relationships existing between variables in experimental data. However, the analysis could lead to wrong conclusions if the data consists of spurious observations. These type of observations are fairly common in data and can come about due to various reasons such as a recording error, an operator error or due to the addition of a wrong amount of a catalyst etc., Isolating these so called "outliers" has become a challenging problem for statisticians today. Although some work has been done on outlier detection with regard to independant data, a literature survey revealed that very little has been done with respect to time series data. Part of my research was thus, to investigate efficient ways of handling this intriguing problem of outlier detection in time series data.

Research was conducted in this direction under three different topics, viz

- i. Off line outlier detection.
- ii. Robust Kalman Filtering
- iii. Industrial Quality Control

Under the first category I have extended some of my Ph.D work and a paper Co-authored with Bovas Abraham entitled "A score test for detection of time series outliers" was accepted for publication by the journal of the time series analysis in July 1987. Under two, I have again extended ch. 2 of my Ph.D thesis and a paper Co-authored with Bovas Abraham and John Macgreger entitled "A Robust Kalman Filter" was tentatively accepted by the journal of the American Statistical Association in November 1987. In this paper only the observational

outliers were considered and the robust filter was developed assuming that the measurement error may come from either one of two normal distributions with the transitions governed by a Markov Chain. The resulting filter comes out to be a weighted sum of two Kalman filters acting parallel to each other. Under three, Investigations are being carried out to devise newer techniques for industrial quality control based on event detection ideas and preliminary writing of a paper entitled "A Novel Approach to Industrial Quality Control", has just begun.

**DERIVING A FIELD SHEAR STRENGTH ENVELOPE  
FOR LANDSLIDE-PRONE SOILS**

T.A. Kuruppuarachchi

Measurement of shear strength parameters for a large number of samples is necessary for the aerial evaluation of slope stability for watershed management purposes in mountainous catchments. In the instances where facilities for shear strength measurement are dearth, it is possible that limit equilibrium slope stability techniques can be employed to establish failure envelopes for given soil categories under likely field conditions. A field shear strength relationship for the residual and colluvial soil mantles occurring in the Belihul Oya Catchment of the Maturata area was derived from back stability analysis techniques. It was evident that the shear strength of these soils is stress dependent at low stress conditions. However, it was considered that a conventional Terzaghi - Coulomb type failure criterion can still be approximated for the material for the purpose of rapid assessment of slope stability in this catchment.

## THE LOCATIONAL PATTERN OF EARLY HISTORIC SITES IN THE PLATEAU OF KANDY

Chulani Rambukwella

The main attempt in this study is to understand, factors responsible for the locational pattern of Early Historic sites. Our study falls within a chronological context of B.C. 3rd century to 3rd century A.D. Attention is focused on Brahmi inscription-bearing sites, drip-ledge caves and Early Historic temple sites.

This Plateau of Kandy is a link area for several other river valleys situated in hills. There are natural paths connecting these areas with each other. In the areas peripheral to the central valley, archaeological sites are situated along the banks of water courses. These routes were always used in history. The location of the ambalam (belonging to the Kandy period) often coincide with the same routes.

It is significant that these sites are situated near important economic mineral resources. Iron ore, copper, mica and mineral stones are such resources. The early inscriptions mention lapidary, metal smiths, merchants and guilds indicating craft and commercial activities in this region.

A study of the inscriptions indicate the existence of local chieftains who exercised their authority over resources and routes, and thereby had taken over the economic control associated with these settlements.

Some sites are situated near the narrow alluvial soil. Those settlements were obviously associated with agricultural activity to sustain other communities residing in less productive areas.

**INDO-LANKA RELATIONS - THE DEVELOPMENT OF  
NORTHERN AND SOUTHERN VIOLENCE IN SRI LANKA**

Rohan Gunaratna

In the historic decade of the 1970's Sri Lanka witnessed the emergence of violence both in the South (1971 insurrection) and in the North (beginning with the assassination of the Jaffna Mayor on July 27th 1975).

The Southern violence was militarily quelled and the militant leaders and their cadres were imprisoned. Unlike Southern militancy the northern militancy gathered wide public support and co-operation from the Tamil speaking people as their demand for equal opportunity in the spheres of education and employment was always at abeyance. In particular those who were victimised or witnessed the racial riots of 1956, 1958, 1961, 1974, 1977 and 1981 and in 1983 saw Samuel David's concept of Eelam (a creation in 1961) as the only alternative to the so called discrimination of the Tamils by the Sinhalese<sup>1</sup>.

Unfortunately to quell northern militancy which had transformed itself into ethnic terrorism, the decision makers and the policy makers ill advised the Government of Sri Lanka only to resort to a military option. A second major error was the absence of cordial relations between Madras and Colombo, and the tension over "US interests in Trincomalee" weakened the political and diplomatic dialogue between Delhi and Colombo. In addition

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<sup>1</sup> It is well known that for 150 years the colonial masters, the British favoured the minority Tamils as part of their divide and rule policy. Following independence, when equal education and employment opportunities were being created, the Tamils began to feel that they were being discriminated by the majority community.

the Central Government interests in Tamil Nadu which determined the political future of two Indian leaders catalysed the development of 36 ethnic militant organisations<sup>2</sup>. Post-Operation Liberation, an effort to capture the northern city and coast line on May 26th 1987 witnessed Indian airforce planes violating Sri-Lankan airspace and a crisis period in Indo-Lanka relations. Jayewardene-Gandhi agreement of July 29th 1987, an Accord proposed by India was acceptable with minor amendments and served as an alternative to an escalating conflict between Sri Lanka and India. India had ceased to be a mediator and had become a participant in Sri Lanka's ethnic crisis.

There are connections and aprallels between northern and southern militancy. In 1978 the Southern militants were pardoned and they were given an opportunity to enter the mainstream of Sri Lankan politics. Similarly with the signing of the Accord, the northern militants were given an amnesty. Both groups have today taken up for arms.

The question "Can a northern group of armed youth, misled by "Leaders" of their choice, and not necessarily of the masses ever enter and survive in the mainstream of a democratic politics? If and when the Indian peace makers return to India will the masses cut off their support to the Sinhala militant groups? If the Government sincerely impliment the Accord, will the militant groups continue to enjoy the support of the minority Tamils?

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<sup>2</sup> Recent studies indicates that the Research and the Analysis Wing (RAW) of the Indian Ministry of Defence and External Affairs too have supported the weapon training of some of the prominent Sri Lankan Tamil militant groups.

This paper will discuss some aspects of northern and southern militancy, the changing attitude, trends and thinking patterns of the masses, and a possible solution to the crisis that is facing Sri Lanka today.

## PERSONNEL

P E R S O N N E L

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<i>Dr. R. Attele</i>	<i>Senior Research Associate</i>
<i>Dr. M.A.K.L. Dissanayake</i>	<i>Senior Research Associate</i>
<i>Dr. O.A. Ileperuma</i>	<i>Senior Research Associate</i>
<i>Dr. S. Mendis</i>	<i>Senior Research Associate</i>
<i>Dr. S. Nadesan</i>	<i>Senior Research Associate</i>
<i>Professor P.de Silva</i>	<i>Senior Research Associate</i>
<i>Ms. M. Gunatilaka</i>	<i>Research Associate</i>
<i>Dr. S.A. Leelananda</i>	<i>Research Associate</i>
<i>Dr. S.J. Perera</i>	<i>Research Associate</i>
<i>Dr. M. Rupasinghe</i>	<i>Research Associate</i>
<i>Dr. R. Weerasooriya</i>	<i>Research Associate</i>

<i>Ms. Y. Abhayawardhana</i>	<i>Junior Research Associate</i>
<i>Mr. R. Gunaratne</i>	<i>Junior Research Associate</i>
<i>Mr. B. Kasturiarachchi</i>	<i>Junior Research Associate</i>
<i>Ms. S. Punchihewa</i>	<i>Junior Research Associate</i>
<i>Mr. R. Ranatunga</i>	<i>Junior Research Associate</i>
<i>Ms. I. Samarakoon</i>	<i>Junior Research Associate</i>
<i>Ms. C. Senanayake</i>	<i>Junior Research Associate</i>
<i>Mr. H.K. de Silva</i>	<i>Junior Research Associate</i>
<i>Mr. S. Wickremanayake</i>	<i>Junior Research Associate</i>
<i>Ms. R.A.R. Sndhya Kanthi</i>	<i>Laboratory Assistant</i>
<i>Ms. P. Armstrong</i>	<i>Secretary to the Director</i>
<i>Ms. S. Mirando</i>	<i>Liaison Officer</i>
<i>Ms. P. Perera</i>	<i>Steno/Typist</i>
<i>Ms. H. Pilapitiya</i>	<i>Secretary/Stenographer</i>
<i>Ms. W. Samarawickrema</i>	<i>Private Secretary to the Director</i>
<i>Ms. D. de Silva</i>	<i>Librarian</i>
<i>Ms. K.S. de Silva</i>	<i>Accountant</i>
<i>Mr. R. Thangiah</i>	<i>Development Officer</i>
<i>Ms. D. Wakista</i>	<i>Steno/Typist</i>
<i>Ms. M. Wickremasooriya</i>	<i>Secretary/Stenographer</i>
<i>Mr. G. Ariyaratne</i>	<i>Auxiliary Staff</i>
<i>Mr. A.D. Gunawardena</i>	<i>Auxiliary Staff</i>
<i>Mr. K.K. Karunadasa</i>	<i>Auxiliary Staff</i>
<i>Mr. H.M. Hennayake</i>	<i>Driver</i>
<i>Mr. N.G. Somapalaq</i>	<i>Driver</i>
<i>Mr. T. Senanayake</i>	<i>Driver</i>
<i>Mr. R.M. Ajith Bandara</i>	<i>Auxiliary Staff (Temporary)</i>
<i>Mr. H.D. Gamini</i>	<i>Auxiliary Staff (Temporary)</i>
<i>Mr. D.M. Ratnayake</i>	<i>Driver (Temporary)</i>

## RESEARCH PROGRAMMES

RESEARCH PROGRAMMES FOR 1987

Division: Life Sciences

PROGRAMME	COORDINATOR	PROJECT	SCIENTISTS	INSTITUTIONS INVOLVED
Biological Nitrogen Fixation	Prof. S.A. Kula-sooriya	Resource Centre for N <sub>2</sub> fixing Micro Organisms	Prof.S.A. Kula-sooriya Ms I.M. Samarakoon	IFS & Univ. of Peradeniya IFS
		Azolla in Rice Production	Prof. S.A. Kula-sooriya  Ms I.M. Samarakoon Ms S.W. Abeysekera Mr G. Seneviratne Mr C. Wijesundera Mr J.S. Fernando Mr W. Lankaputhra Ms B. Gunawardhana	IFS & Univ. of Peradeniya IFS Dept. of Agri. -do- -do- Univ. of Kelaniya -do- Univ. of Ruhuna
		Associative N <sub>2</sub> Fixing Plants	Prof. S.A. Kula-sooriya  Ms M. Gunatilaka Ms Y. Abhayawardhena	United Nations Univ. Tokyo IFS IFS
		Distribution of N <sub>2</sub> Fixing Plants	Prof.S.A. Kula-sooriya Mr S. Padmasiri	IFS & Univ. of Peradeniya IFS
Ecology & Conservation	Prof. S. Balasubramaniam	Biology of River systems & Estuaries of Sri Lanka	Prof. S. Balasubramaniam Dr. M. de Silva	IFS & Univ. of Peradeniya Univ. of Peradeniya
Biotechnology	Dr K.G. Gunatileke	Tissue culture for improvement and propagation of selected plants	Dr K.G. Gunatileke Ms N.D. Jayatilaka	IFS/CISIR IFS
Electrolytes in Medicine	Dr S. Nadesan	Electrolytes in infantile diarrhoea	Dr S. Nadesan Dr A. Jayasinghe	IFS/Peace Corps IFS & Univ. of Peradeniya
Arteriosclerosis	Dr S. Mendis	Effect of Coconut oil in Serum Lipid Profile of Sri Lankans	Dr S. Mendis Dr M.U. Jayasekera Prof. R.W. Wirslet	IFS & Univ. of Peradeniya IFS Univ. of Chicago

Division: Life Sciences

PROGRAMME	COORDINATOR	PROJECT	SCIENTISTS	INSTITUTIONS INVOLVED
Primate Studies	Dr W.P.J. Dittus	Primate Social Behaviour	Dr W.P.J. Dittus	IFS
		Monkey population Genetics	Dr W.P.J. Dittus Dr D. Mebrick	IFS Univ. of Columbia
		Monkey Dental Plate growth	Dr W.P.J. Dittus Dr r. Mendis	IFS Univ. of Peradeniya
		Monkey Morphometric studies	Dr W.P.J. Dittus Dr R. Thiranagam	IFS Univ. of Jaffna
		Monkey parasites	Dr W.P.J. Dittus Ms P. Amarasinghe	IFS Univ. of Peradeniya
		Monkey Viral Immunology	Dr W.P.J. Dittus Dr J.S.M. Peiris	IFS Univ. of Peradeniya

RESEARCH PROGRAMMES FOR 1987

Division: Earth and Space Sciences

PROGRAMME	COORDINATOR	PROJECT	SCIENTISTS	INSTITUTIONS INVOLVED
Soil Toxicity	Dr F. Ponnamparuma	Iron Toxicity in Paddy soils	Dr F. Ponnamparuma Mr P. Deturck Prof. K.K. Pathirana Ms N. Guna-wardhana Mr H.K. de Silva	IFS Univ. of Leuven Belgium & IFS Univ. of Ruhuna Univ. of Ruhuna IFS
Soil Vegetation and Health	Dr M.U. Jayasekera	Incidence of goitre, dental carries, cancer to geochemistry	Dr M.U. Jayasekera Prof. C.B. Dissanayake Dr F. Ponnamparuma Dr R. Weerasooriya	IFS IFS & Univ. of Peradeniya IFS IFS
Climate studies	Prof. K. Dahanayake	Rainfall Atlas	Prof. M. Domroes Mr R. Ranatunga	Univ. of Mainz Germany IFS
Economic Geology	Prof. C.B. Dissanayake	Exploration for Gem Stones	Prof. C.B. Dissanayake Prof. K. Dahanayake Dr M. Rupasinghe Mr K.K.M.W. Silva Mr G. Soysa	IFS & Univ. of Peradeniya IFS & Univ. of Peradeniya IFS Univ. of Peradeniya Gem Corp.
Petrology and Mineralogy	Prof. K. Dahanayake	Utilization of Eppawala Phosphate	Prof. K. Dahanayake Dr F. Ponnamparuma Dr N. Fernando Prof. B. Guna-wardhena Mr K.K.M.W. Silva	IFS & Univ. of Peradeniya IFS Univ. of Peradeniya Univ. of Peradeniya Univ. of Peradeniya

RESEARCH PROGRAMMES FOR 1987

DIVISION: Physical & Chemical Sciences

PROGRAMME	COORDINATOR	PROJECT	SCIENTISTS	INSTITUTIONS INVOLVED
Solar Energy Conversion	Prof. K. Tennakone	Electrochemical Photo Conduction Properties of Materials	Prof. K. Tennakone Ms S. Punchihewa Mr S. Wickramanayake	IFS & Univ.of Ruhuna IFS IFS
		Photochemical Fixation of N <sub>2</sub>	Prof. K. Tennakone Dr O.A. Ileperuma Ms S. Punchihewa	IFS & Univ. of Ruhuna IFS & Univ. of Peradeniya IFS
Solid State Physics	Dr M.A.K.L. Dissanayake	High Temperature superconductors	Dr M.A.K.L. Dissanayake Prof. K. Tennakone Dr O.A. Ileperuma Dr K. Premaratne Dr M.A. Kareem	IFS & Univ. of Peradeniya IFS & Univ. of Ruhuna IFS & Univ. of Peradeniya Univ. of Peradeniya Univ. of Peradeniya
Natural Products Products Chemistry	Prof. A.A.L. Gunatilaka	Isolation of Biologically Active Constituents from Herbs of Sri Lanka	Prof. A.A.L. Gunatilaka Mr K. Ponnampere	IFS & Univ. of Peradeniya IFS

RESEARCH PROGRAMMES FOR 1987

Division: Philosophy and Social Sciences

PROGRAMME	COORDINATOR	PROJECT	SCIENTISTS	INSTITUTIONS INVOLVED
Archaeology	Prof. S. Bandaranayake	Settlement Archaeology and Space Archaeology	Prof. S. Bandaranayake Ms C. Rambukwella	IFS & Univ of Kelaniya IFS
Mahaweli Studies	Prof. C.M. Madduma Bandara (on sabbatical leave)	Watershed Management in the catchment areas	Prof. C.M. Madduma Bandara Mr T. Kuruppuarachchi	IFS & Univ. of Peradeniya IFS
Philosophy	Prof. Padmasiri de Silva	1. Suicide 2. Emotion studies	Prof. P. de Silva Dr R. Abey-singhe	IFS & Univ. of Peradeniya Univ. of Peradeniya

RESEARCH PROGRAMMES FOR 1987

DIVISION: Mathematics

PROGRAMME	COORDINATOR	PROJECT	SCIENTISTS	INSTITUTIONS INVOLVED
Pure mathematics	Dr R. Attele	a) Mobious Variant Norm between EMD and Bloch Functions b) Hankel Operations Bergman Spaces c) Bounded theoplitiz Operators on Spaces	Dr R. Attele Dr S. Perera Mr B. Kasturiarachchi	IFS Univ. of Sri Jayawardenapura IFS

Annual Science Conference

29-30 Jan. 1988

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CALENDAR 1987

JANUARY 01		FEBRUARY 02		MARCH 03	
1	Th	S		S	
2	F	M	Action Committee	M	Action Committee
3	S	F		F	Dr V. Keudell (v), IFS Ayur. Col Sp. Res. Coll. Dr V. Kuehlmalz (v)
4	S	W	Independence Day	W	Research Colloquium/ IFS Prof. R.H. Wijanyake
5	M	Th	Prof. Ravi Ravindra (v)	Th	Mr Mansur Saidi (v)
6	T	F		F	
7	W	S	Senior Fellows Mtg. /IFS Philosophy Forum/IFS	S	School Science Prog/IFS
8	Th	S	Dr. J. Olsen (V)	S	
9	F	M	Action Committee	M	Action Committee
10	S	F	Dr McLucas (V)	F	
11	S	W	Research Colloquium/IFS Dr M.C.L. de Alwis	W	Research Colloquium/IFS Dr S. Nadesan
12	M	Th	ACC Awards/BMICH Dr Pride (V)	Th	
13	T	F	POYA* HOLIDAY	F	
14	W	S	ACC Dedication of New Bldg.	S	School Science Prog/IFS
15	Th	S	Dr A. Bruguieres (v)	S	PUBLIC HOLIDAY
16	F	M	Dr M. Singer (v) Action Committee	M	Action Committee
17	S	F	Iron Toxicity Pro. Mtg. Mr J. Guyer (v)	F	
18	S	W	Research Colloquium/IFS Prof. S. Widanapathirana	W	Research Colloquium/IFS Dr J.A.U.N. Gunatilaka
19	M	Th	Action Committee Biotechnology Mtg.	Th	
20	T	F	Prof. P. Wassermann (v)	F	Sp. Pub. Lecture/SLAAS Dr G. Kapitan
21	W	S	Research Colloquium/IFS	S	School Science Prog/IFS
22	Th	S	Sp. Research Colloquium/IFS Prof. H. Annersten	S	
23	F	M	Action Committee	M	Action Committee
24	S	F		F	
25	S	W	Public Lecture Prof. P. Wassermann	W	Public Lecture Prof. K.M. de Silva
26	M	Th	Action Committee Mtg.	Th	PUBLIC HOLIDAY
27	T	F	Maths Colloquium/IFS	F	Research Programme/IFS
28	W	S	Public Lecture Dr G. G. G. Corea	S	School Science Prog./Opening of New Wing IFS/Arch. Sem/IFS
29	Th	S	Group Lecture Nitrogen Fixation/IFS	S	Sem. Microbial Tech/IFS School Science Prog./IFS
30	F		Workshop/Solid State Physics/IFS	M	Action Committee Mtg.
31	S		Seminar/Tube Wells/IFS	F	Sp. Pub. Lecture/IFS, Kandy

CALENDAR 1987

	APRIL 04	MAY 05	JUNE 06	
1	W Philosophy Forum/IFS	F PUBLIC HOLIDAY	M Journal Club Mtg./IFS	1
2	Th	S School Science Prog/IFS (Fin) Award Ceremony	T	2
3	F	S	W Philosophy Forum/IFS Dr E.P. Fernando	3
4	S Sem. Phosphate Deposits School Science Prog./IFS	M Journal Club Mtg. /IFS	Th	4
5	S Dr J. Douek (v)	T	F Sem. "World Environment Day" in Colombo	5
6	M Journal Club Mtg./IFS	W Philosophy Forum/IFS Prof. J. Strong	S	6
7	T Dr G. Coyne (v)	Th	S	7
8	W Research Colloquium/IFS Prof. P.A.J. Perera	F Sem. Ecology	M Research Reports/IFS	8
9	Th	S Workshop "Azolla"/IFS	T	9
10	F	S Workshop "Suicide"	W Research Colloquium Dr F.P. Amarasinghe	10
11	S	M Research Reports/IFS	Th PUBLIC HOLIDAY	11
12	S	T	F	12
13	M PUBLIC HOLIDAY	W PUBLIC HOLIDAY	S	13
14	T PUBLIC HOLIDAY	Th PUBLIC HOLIDAY	S	14
15	W No Colloquium	F	M	15
16	Th	S	T	16
17	F PUBLIC HOLIDAY	S	W Research Colloquium Dr S. Somasiri	17
18	S	M	Th	18
19	S	T	F	19
20	M Research Fellows Mtg./IFS Int. Sem. on Solid State Phy.	W Research Colloquium J.M.Gunadasa	S Seminar "Karawila"	20
21	T Int. Sem./Solid State Phy.	Th	S	21
22	W Int. Sem/Solid State/Res.Col. Profs. Vlasek & Werrne(v)	F	M	22
23	Th Workshop-Writing a Res. Prop. Dr M. Greene(v)	S	T	23
24	F Workshop-Writing a Res. Prop/ Solid State Physics	S	W Public Lecture/SLAAS Asoka de Lanerolle	24
25	S Int. Sem. Solid State Phy.	M Senior Fellows Mtg./IFS	Th	25
26	S	T	F	26
27	M	W Public Lecture Dr O.P. Kulshreshtha	S Senior Fellows Mtg./IFS	27
28	T	Th	S	28
29	W Public Lecture/SLAAS Prof. K. Arudragasam	F Sem. "Environment" His Grace Ambrose De Paoli (v)	M	29
30	Th	S PUBLIC HOLIDAY	T	30
31		S		31

CALENDAR 1987

	JULY 07	AUGUST 08	SEPTEMBER 09	
1	W Research Colloquium/IFS Dr D.J. Weillgoma	S Sp. Pub. Lecture/IFS Prof. C.W. McKay	T	1
2	Th	S	W Research Colloquium/IFS	2
3	F	M Journal Club Mtg/IFS/ National Astronomy Workshop/IFS	Th	3
4	S	T Workshop "Astronomy"	F	4
5	S	W Workshop "Astronomy" Research Colloquium	S Seminar "Archeometallurgy"	5
6	M Journal Club Mtg./IFS Mr C. R. Lola (v)	Th Workshop "Astronomy"	S - do -	6
7	T Tea & Conversation/IFS	F Workshop "Astronomy"	M POYA HOLIDAY	7
8	W Philosophy Forum/IFS Dr D.C. Senaratne	S Sp. Workshop "Astronomy" for Astronomical Society (v)	T	8
9	Th	S Ceremonial Opening of Astronomy Ms C. Ranaraja (Chief Guest)	W Philosophy Forum /IFS	9
10	F POYA HOLIDAY	M Workshop "Astronomy" Research Mtg./IFS	Th	10
11	S	T Workshop "Astronomy"	F	11
12	S	W Workshop "Astronomy" Phil. Forum, Dr E.K. Rodrigo	S	12
13	M	Th Workshop "Astronomy"	S	13
14	T	F - do -	M	14
15	W Research Colloquium/IFS Dr J.S.M. Peiris	S - do -	T	15
16	Th	S - do - Maryland Group USA (v)	W Research Colloquium/IFS	16
17	F	M Workshop "Astronomy"/ Int. Sem. ICGB/IFS	Th	17
18	S	T Ws "Astronomy"/ Int. Sem. ICGB/ Sem. "Cosmos & Asian Art"/IFS	F	18
19	S	W Workshop "Astronomy" Research Colloquium /IFS Dr R.L. Pinto	S	19
20	M	Th Workshop "Astronomy"	S	20
21	T	F Sp. Public Lecture/SLAAS Dr G Coyne	M	21
22	W Research Colloquium/IFS. Prof T.B. Tennakone/Maryland Grp.USA (v)	S	T	22
23	Th Maryland Grp. USA (v)	S	W Research Colloquium/IFS	23
24	F	M Sp. Research Colloquium/IFS Dr L. Dissanayake	Th	24
25	S Senior Fellows Mtg./IFS Dr M. Greene (V)	T	F	25
26	S	W	S Senior Fellows Mtg.	26
27	M In-house Workshop - Dr M. Greene/ IFS	Th Sp. Public Lecture/IFS Prof. R.O.B. Wijesekera	S	27
28	T - do -	F	M	28
29	W Public Lecture/SLAAS Mr G. Gunatilleke	S	T	29
30	Th	S	W Public Lecture/SLAAS	30
31	F Dr G. Coyne (v)	M		31

CALENDAR 1987

	OCTOBER 10	NOVEMBER 11	DECEMBER 12	
1	Th	S	T	1
2	F	M	W Philosophy Forum/IFS	2
3	Follow up mtg./Astronomy & Astro- S physics/KSS- Astronomy Prog./IFS	T	Th	3
4	S	W Philosophy Forum/IFS	F PUBLIC HOLIDAY	4
5	M Journal Club /IFS	Th PUBLIC HOLIDAY	S	5
6	T POYA HOLIDAY	F	S	6
7	W Research Colloquium/IFS Dr S.A. Leelananda	S Kandy School of Science Astronomy Programme & Meeting	M	7
8	Th	S	T	8
9	F Prof. Dr. Hans Becker & Prof. Schimanke (v)	M	W SLAAS ANNUAL SESSIONS	9
10	S Kand School of Science/Maths Prog./IFS	T	Th Research Colloquium/IFS	10
11	S	W Research Colloquium/IFS	F Research Colloquium/IFS	11
12	M Research Meeting /IFS	Th	S Research Colloquium/IFS	12
13	T Philosophy Forum/IFS Dr Tudor Silva	F Seminar "Photochemistry"	S	13
14	W	S Kandy School of Science Mathematics Programme	M	14
15	Th	S	T	15
16	F	M	W Research colloquium/IFS	16
17	S Kandy School of Science/Science Prog./IFS	T	Th	17
18	S	W Research Colloquium/IFS	F	18
19	M	Th	S	19
20	T	F W/Shop on 'Fundamentals of Mathematical Modelling'	S	20
21	W PUBLIC HOLIDAY	S W/Shop on 'Fundamentals of Mathematical Modelling'	M	21
22	Th	S	T	22
23	F	M	W	23
24	S Kandy School of Science/Video prog./IFS	T	Th	24
25	S	W Research Colloquium/IFS	F PUBLIC HOLIDAY	25
26	M Prof. C.S. Seshadri (V)	Th	S	26
27	T Special Research Coll./IFS Prof. C.S. Seshadri	F	S	27
28	W Public Lecture/SLAAS Prof. A. Aluwihara	S Senior Fellows Mtg. Seminar "Soil Toxicity"	M International Seminar on "Number Theory"	28
29	Th	S	T - do -	29
30	F Special Public Lecture Prof. C.S. Seshadri	M	W - do -	30
31	S Senior Fellows mtg		Th - do -	31

**PUBLIC LECTURES**

THE INSTITUTE OF FUNDAMENTAL STUDIES

PUBLIC LECTURES 1987

- January 28 - Dr Gamani Corea  
Hon. Senior Fellow, Institute of Fundamental Studies  
& Chancellor, Open University, Nawala  
  
" NORTH SOUTH DIALOGUE: WHAT FUTURE?"
- February 25 - Professor Paul Wasserman  
Professor of Library Science,  
University of Maryland, USA  
  
" THE INFORMATION COMMUNICATION AND TRANSFER PROCESS  
IN SCIENCE AND TECHNOLOGY "
- March 25 - Professor K.M. de Silva  
Executive Director, International Centre for Ethnic  
Studies & Professor of Sri Lanka History, University  
of Peradeniya, Peradeniya  
  
" ETHNICITY AND POLITICAL CONFLICT - A COMPARATIVE  
PERSPECTIVE "
- April 29 - Professor K. Arudpragasam  
Vice Chancellor, The Eastern University, Batticaloa  
  
" THE ETHICS AND PHILOSOPHY OF CONTEMPORARY BIOLOGY"
- May 27 - Dr. O.P. Kulshreshtha  
Chief Technical Advisor & Advisor in Technical Education,  
Open University, Nawala  
(United Nations Development Programme)  
  
" DISTANCE EDUCATION "
- June 24 - Mr Asoka de Lanerolle  
Chairman, Export Development Board, Colombo  
  
" EXPORT DEVELOPMENT ESTABLISHING THE PATTERNS FOR THE  
21ST CENTURY "
- July 29 - Mr Godfrey Gunatilleke  
Vice Chairman, Marga Institute, Colombo 5  
  
" DEVELOPMENT AND THE QUALITY OF LIFE IN SRI LANKA "

- August 26 - Dr C.R. Panabokke  
Soil Scientist, International Irrigation Management  
Institute, Digana  
  
" SOME ASPECTS OF PEDOLOGY AND GEOMORPHOLOGY OF SRI LANKA'S  
SOILS AND RICE PLANTS "
- September 30 - Professor Ediriweera Sarachchandra  
Emeritus Professor  
University of Peradeniya, Peradeniya  
  
" DEVELOPMENT AND CULTURAL/AESTHETIC VALUES "
- October 28 - Professor A. Aluvihare  
Professor of Surgery  
Faculty of Medicine, University of Peradeniya  
Peradeniya  
  
" THE 1990s AND SURGICAL SKILLS "
- November 25 - Dr W Rasaputhra  
Governor, Central Bank of Sri Lanka, Colombo  
  
" ASSUALT ON POVERTY "

- January 07 Mr.K.K.M.W. Silva  
Department of Geology, University of Peradeniya  
"EPPAWALA PHOSPHATE DEPOSITS - PAST PRESENT & FUTURE"
- January 15 Professor G.A. Dissanayake  
Department of Physics, University of Peradeniya  
" TEACHING PHYSICS - ITS EXCITEMENT & ITS FASCINATION "
- January 21 Dr. Buddhi Weerasinghe  
Open University of Sri Lanka  
" RESOURCE CONSERVATION IN SRI LANKA - ANOTHER VIEW "
- January 22 Professor Hans Anersten  
Institute of Geology, University of Uppsala  
" KINETICS OF METAMORPHIC PROCESSES STUDIED BY  
MINERAL CHEMISTRY "
- January 29 Dr. G. Keerthisinghe  
Department of Agricultural Chemistry, University of Peradeniya  
" ASSESSMENT OF NUTRITIONAL STATUS IN SOILS "
- February 11 Dr. M.C.L. de Alwis  
Director, Veterinary Research Institute, Peradeniya  
" HAEMORRHAGIC SEPTICAEMIC-WORLD SITUATION WITH  
SPECIAL REFERENCE TO ASIA "
- February 12 Dr. Rohan Attele  
Coordinator/Mathematics Programme, IFS  
" A CASE FOR MATHEMATICAL AWARENESS IN SRI LANKA - THE  
MATHEMATICS PROGRAMME OF THE INSTITUTE OF FUNDAMENTAL STUDIES"
- February 18 Professor S. Widanapathirana  
Department of Botany, University of Kelaniya  
" SOME BASIC INFORMATION ON PHYSICAL CHEMICAL AND  
MICROBIOLOGICAL CHARACTERISTICS OF NATURAL FOREST SOILS  
IN SRI LANKA "

March 04

Professor R.H. Wijenayaka  
Department of Chemistry, University of Ruhuna

"UNDERSTANDING THE STRUCTURE OF CONCENTRATED  
ELECTROLYTE SOLUTIONS "

March 11

Dr. Sue Nadesan  
us Peace Corps and Senior Fellow, IFS

"LEAD POISONING \_ FACT OR FICTION "

March 18

Dr. I.A.U. Gunatilaka  
Department of Botany, University of Peradeniya

" A DECADE OF BOTANICAL RESEARCH AT SINHARAJA AND ITS  
CONTRIBUTIONS TO CONSERVATION AND UTILIZATION OF  
PLANT RESOURCES "

April 08

Professor P.A.J. Perera  
Department of Biochemistry, University of Peradeniya

" EFFECTS OF MICROWAVE PROCESSING OF FOOD "

May 20

Professor J.M. Gunadasa  
Department of Geogrphy, University of Peradeniya

" CROP DIVERSIFICATION IN SRI LANKA "

June 10

Dr. F.P. Amerasinghe  
Department of Zoology, University of Perdeniya

" MAN, MOSQUITO & MAHAWELI "

June 17

Dr. S. Somasiri  
Land & Water use Division, Department of Agriculture,  
Peradeniya

" AGRICULTURAL DEVELOPMENT IN THE DRY ZONE OF SRI LANKA "

July 01

Dr. D.J. Weligama  
Veterinary Research Institute, Peradeniya

" BOVINE BABESIOSIS (TICK FEVER) - THE DISEASE AND  
ITS CONTROL "

- July 15 Dr. J.S.M. Peiris  
Department of Microbiology, University of Peradeniya  
**" MONOCLONAL ANTIBODIES AND THEIR APPLICATIONS "**
- July 22 Professor D.T.B. Tennakone  
Department of Chemistry, University of Peradeniya  
**" CLAY BASED INDUSTRIAL CATALYSTS "**
- August 12 Dr.E.K. Rodrigo, Department of Psychiatry  
University of Peradeniya  
**"HUMAN SEXUALITY - CURRENT PERSPECTIVES"**
- August 19 Dr. L. Pinto  
Department of Zoology, Open University of Sri Lanka  
Colombo  
**"THE MANGROVE RESOURCE OF SRI LANKA"**
- September 02 Dr. Morley de Silva  
University of Ruhuna, Matara  
**" GLOBAL CO<sub>2</sub> PROBLEM"**
- September 09 Dr. Hans Oberdeick  
Department of Philosophy  
Swarthmore College, U.S.A.  
**" PROFESSIONAL ETHICS IN A CHANGING WORLD"**
- September 16 Dr. P. Sivapalan  
Director, Tea Research Institute  
**"INTEGRATED PEST MANAGEMENT"**
- September 23 Dr. N.D. Yatawara  
IFS & Faculty of Engineering  
University of Peradeniya  
**" QUALITY CONTROL IN INDUSTRY-A NOVEL APPROACH"**
- October 07 Dr. S.A. Leelananda  
IFS & Department of Physics  
University of Peradeniya  
**"ACOUSTIC ECHO SOUNDING OF THE ATMOSPHERIC BOUNDARY LAYER"**

- October 14 Dr. Tudor Silva  
Department of Psychology, University of Peradeniya  
"EQUALITY, EDUCATION AND URBAN POOR IN SRI LANKA"
- November 04 Dr. Jayanthi Edirisinghe  
Department of Zoology, University of Peradeniya  
"TRENDS IN BIOLOGICAL CONTROL USING INSECTS"
- November 11 Mr. Godwin Samararatne  
Meditation Centre, Nilambe  
"SOME ISSUES IN PARAPSYCHOLOGY"
- November 18 Mr. Jinapala Alles  
Consultant, National Institute of Education  
"FAMILY BACKGROUND AND PUPIL ACHIEVEMENT IN  
SRI LANKA"
- December 02 Professor K Vlassak  
Katholieke Universiteit of Leuven, Belgium  
"FIELD MEASUREMENT OF DINITRIFICATION AND AMMONIA  
LOSSES"
- December 09 Dr. Mirko Fryba  
Swiss Holistic Health Association  
"PSYCHODRAMA-A BRIDGE BETWEEN FANTASY & REALITY"

VISITORS TO THE IFS-1987

January 13 Professor William Bechhoefer,  
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University of Maryland, USA

January 13 Dr C. Von Keudell,  
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January 14 Professor Michael Green  
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January 15 Dr Alain Bruguières  
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January 19 Dr Athula Attygalle  
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January 19 Dr Gerhard Voll  
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FRG

January 19 Professor Herbert Kroll  
Institute of Mineralogy  
University of Munster  
FRG

January 20 Mr Bogoda Premaratna  
US Ed. Foundation  
Sri Lanka

January 20 Professor P. Wasserman  
University of Maryland,  
USA

January 22 Professor Hans Annersten  
Institute of Geology  
Uppsala University  
Sweden

February 05 Dr Nancy Yildiz  
Asia Foundation  
Colombo

February 07 Professor Ravi Ravindra  
Dalhousie University  
Halifax  
Canada

February 11 Dr John L. McLucas  
Executive Vice President & chief Strategic Officer  
Communications Satellite Corporation  
USA

February 14 Dr Colin Pride  
Programme Officer  
IDRC, Ottawa  
Canada

February 16 Professor Marshall R. Singer  
University of Pittsburgh  
USA

February 20 Dr Gerhard Kapitan  
Marine Archaeologist  
Sicily

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Mr Manzur Zaidi  
UNDP  
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Mr Mathew Kahane  
UNDP  
Sri Lanka

March 31 Professor Richard Litz  
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April 06 Dr J. Douek  
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April 07 Dr George Coyne  
Vatican Observatory  
Italy

April 22 Professor K. Vlassak  
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April 22 Dr. J. Werenne  
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August 19 Dr. Paul A Groves  
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August 19 Dr. J.M. Bjorkman  
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August 19 Dr. Robert Carroll  
Saugerties High School, New York  
U.S.A.

August 19 Dr. Paul Hanson  
California Lutheran College  
U.S.A.

August 19 Dr. Robert Hertig  
Fort Valley State College  
U.S.A.

August 19 Dr. David Hayano  
California State University  
U.S.A.

August 19 Dr. Ladd Johnson  
California State University  
U.S.A.

August 19 Dr. Judith Johnson  
Adelphi University, New York  
U.S.A.

August 19 Dr. Patricia Keith  
Iowa State University  
U.S.A.

August 19 Dr. Judith Owens  
Kimbell High School  
U.S.A.

August 19 Dr. Janet Rudolph  
Samuel Gompers High School, California  
U.S.A.

August 19 Dr. Robert Scull  
Shippensburg University  
U.S.A.

August 19 Dr. Robert Shelton  
Morgan Park Academy, Chicago  
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August 19 Dr. George Stoner  
University of Washington  
U.S.A.

August 19 Dr. Ingolf Vogeler  
University of Wisconsin  
U.S.A.

August 20 Dr. George V. Coyne  
Director, Vatican Observatory  
Italy

August 20 Mr. Roland Silva  
Commissioner of Archaeology  
Department of Archaeology  
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August 20 Dr. M. Prickett  
Archaeological Dept. Office  
Kotte

August 20 Prof. M. Domros  
Geographisches Institut  
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September 05 Dr. Karunakara T.M. Hegde  
M.S. University of Baroda  
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September 09 Dr. Hans Oberdiek  
Swarthmore College  
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October 08 Dr. Dieter Schimanke  
Universitat der Bundeswehr  
Institute fur Verwaltungswissenschaft  
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October 08 Prof. Dr. Hans Becker  
Universitat des Saarlandes  
West Germany

October 17 Dr. G.L. Springer  
Deutsche Gesellschaft Fiir Technische-  
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October 27 Mr & Mrs Edward Marks  
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December 15 Hon. Mohamed A Sherif  
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December 15 Mr. Bernard Pruniers  
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December 30 Mr. George Keyt & Ms. Kusum Keyt  
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## VISITORS

Thursday 8th January, 1987 THE ISLAND

## IFS map of Eppawala phosphate deposits

by Nalaka Gunawardene

The Institute of Fundamental Studies (IFS) plans to prepare a detailed map of the large phosphate deposit in Eppawala, to enhance prospects of using this valuable resource as a fertilizer.

There is an estimated 25 million tonnes of phosphate in the deposit, which would be able to provide our phosphate fertilizer needs for more than 100 years, said Dr. Felix Ponnampereuma, a soil scientist attached to the IFS.

"There are several kinds of phosphate in the Eppawala deposit and their relative distribution is not yet known. We intend to make a map, making out the area which have phosphate that can be used in the immediate future", he said.

At present, Sri Lanka

imports a large amount of phosphate fertilizer for many crops, although the tea and rubber plantation industries have been using Eppawala phosphate for some time. "The phosphate deposit as it is cannot be used as a general fertilizer". "It has to be chemically treated and processed. Then we can use it for rice, vegetables and a lot of other crops too", said Dr. Ponnampereuma.

The soil scientist added that the soft portions of the phosphate deposit could be utilized first. "The map we intend to prepare would pinpoint these areas. The value of rock phosphate depends on its softness", he said.

Meanwhile, Dr. Kapila Dahanayake, a geologist attached to the Peradeniya University who also acts as

a Deputy Director of the IFS, told *The Island* that the Eppawala phosphate deposit could be converted into single super-phosphate or triple super-phosphate to get maximum use of it as a fertilizer. "The IFS, along with the Dept. of Geological Survey and the Depts. of Geology and Chemistry at the Peradeniya University, plans to carry out this survey of the phosphate deposit. A complete geochemical and geological survey will be done", he said.

The IFS has organized a research colloquium on 'Eppawala Phosphate Deposit — Past, Present and Future' by Mr. K. K. M. W. Silva of the Dept. of Geology, University of Peradeniya today (Wednesday) at 5.00 p.m., at their headquarters in Hantane, Kandy.

## Heart Disease: early preventive measures necessary

(Senkadgala Special Correspondent)

The high incidence of Coronary Heart Disease (CHD) in Sri Lanka, could be greatly reduced by the adoption of primary preventive measures, according to Dr. (Mrs.) Shanti Mendis of the Faculty of Medicine, University of Peradeniya.

Dr. Mendis said this at a research colloquium held at the Institute of Fundamental Studies, presided over by its Director, Prof. Cyril Ponnamperuma recently.

The prevalence of Coronary Heart Disease (CHD), in 8.5% of those in the age group 40-70 years in Sri Lanka, is as high as that found in affluent western populations.

Enumerating the many Risk Factors of Coronary Heart Disease, Dr. Mendis identified three of them which were most relevant to the local situation. These were, High Blood Pressure, Smoking and excess of Cholesterol in the blood (hyper-cholesterolaemia).

A study of 10,000

people screened at the Teaching Hospital, Peradeniya, revealed that as much as 43% of the population suffered from high blood pressure of some severity. A diastolic blood pressure of 95 mm. of mercury was found in 21% of the age group 41-50 years while it rose to 31% in the case of those in the age group 51-60 years. It has been demonstrated that high blood pressure is a strong, graded and independent predictor of CHD risk.

It has been shown that even a small reduction in the dietary salt intake which is as high as 8.7gm. per day for Sri Lankans lowers the average blood pressure in a sample population. Even a small reduction in the blood pressure could bring about a large reduction in CHD of the population.

The second major risk factor, smoking tobacco is also in the increase, from 40% of the adult population (in Kandy) 20 years ago, to 65% today.

It has been shown in many studies that giving up smoking reduces the risk of developing CHD.

The third major risk factor is high cholesterol levels in the blood. Sri Lankans have a high mean cholesterol level of 216 mg/dl (milligrams per deciliter) in the blood. This relatively high value is comparable to that of many affluent cultures in various parts of the world.

Preventive measures against CHD should start early. A simple test such as blood pressure measurement and serum cholesterol estimation would enable the identification of individuals at special risk. Taking into consideration at the same time of several risk factors, among which a family history of CHD is very important, would strengthen the prediction. Such individuals can then be given the special preventive care they need.

Although CHD becomes manifest mostly in middle age or later, the underlying atherosclero-

tic process (hardening of the inner lining of the arteries) starts early in life. Studies conducted at the Faculty of Medicine, Peradeniya, of coronary arteries from autopsy material of children have shown evidence of arterosclerotic changes even during the first ten years of life.

The presence of fatty streaks increased from 3% in the first ten years to 56% in the 60's. Unfavourable food habits, smoking, and sedentary life styles are acquired early in life. Therefore it is not important that CHD preventive measures are introduced in childhood and adolescence as well.

More research to find a cure

# Treat the soil and beat cancer?

Cancer is the better known 'basket word' given to a whole lot of today's tumours, which if untreated or detected late, could be fatal. It has become a major health problem in the world and a big challenge to the medical researchers.

Discovering a cure for cancer is the ultimate dream of many a medical scientist, and the 'elusive cure' has already cost many of them their reputation — the price for haste. To solve the cancer problem, one has to understand how it occurs and what factors are responsible.

Now, a Lankan pathologist has started investigating yet another 'cancer-connection' that may one day bring hope to cancer patients.

## Establish

Dr. Upali Jayasekera, who is currently attached to the Institute of Fundamental Studies (IFS)

If a co-relation is established between cancer and the non-metallic element Selenium found in the soil, steps will be taken to introduce this element into areas where it is low. Laboratory tests on animals done in USA have proved that a high concentration of Selenium in the diet can reduce incidence of malignant tumours.

tried to establish the co-relation between the incidence of cancer and the element Selenium. He was inspired to take to this research by reports that a high concentration of selenium in the diet can reduce the incidence of tumours in laboratory animals.

Selenium, a non-metallic element which has some similar characteristics to sulphur, occurs in many food items in trace amounts.

In experiments done in the USA a group of scientists had exposed three sets of laboratory animals to carcinogenic (cancer-causing) agents Dr. Jayasekera said.

One set was given a

diet with a high concentration of selenium and another set with a particularly low concentration. The third set of animals were fed a normal selenium concentration.

by  
**Nalaka**

## Gunawardene

It was statistically proved that the animals who received a high selenium-diet had a less incidence of cancerous tumours than the other two groups.

"In Sri Lanka, it has been observed that certain types of cancer and tumours occur more in

some areas. We want to investigate whether this has anything to do with the varying Selenium concentrations in the soil," Dr. Jayasekera said.

## Malignant tumours

The IFS and Dr. Ralph Panabokke of the Peradeniya University have already done some research on this, he added.

"When referring to cancer, we must remember that it is a basket word — covering all kinds of malignant tumours. My research at the IFS will concern all these kinds of tumours," the pathologist explained.

He is hopeful that if a definite co-relation could be established between Selenium and cancer in human beings, it may help in preventing the tumours too. For instance, if the necessary Selenium could be introduced to the soil through fertilizer, that may reduce the incidence of cancer.

## Prevention

"Prevention is always better than cure" says an optimistic Dr. Jayasekera, and adds that is also less expensive.

The IFS will coordinate with the Ministry of Health and the Cancer Institute in Maharagama in carrying out this research.

"We have already done the pilot survey, and have enough facilities to do the testing of soil samples etc."

The research project is expected to cost about 125,000 US dollars and Belgium and Japan have pledged to give support.

# Science not magic can make poor country rich

by Nalaka Gunawardene

A poor country cannot be made a rich by magic. Science is necessary. But the process of implantation is a long and protracted one, and science must become part of our life, said Prof. Cyril Ponnampereuma, director of the Arthur C. Clarke Centre for Modern Technology on Saturday, after President J. R. Jayewardene declared open the new laboratory complex of the Centre in Katubedda, Moratuwa.

Prof. Ponnampereuma was referring to the euphoria and expectation that science might produce the utopia of the next decade. The spectacular advances of science and technology, like landing of a man on the Moon and splitting the atom, have given mankind confidence in science, he noted.

Referring to the concept of leap-frogging in to the 21st century, Prof. Ponnampereuma said: "To leapfrog implies the preparation of a solid under-base, a firm infrastructure. The under-pinning of science must be robust and comprehensive and extended to the very elementary system of education in the country. This is a goal of the Arthur Clarke Centre."

The director, who speculated that a working telephone will be everybody's birth right in the near future, said: "The Arthur Clarke Centre, which was established in honour of a man who rendered great service to human communications, is now exploring ways and means by which the nation could have the best possible communication system with the resources at our disposal. The Director of Telecommunications is on our board. Together with the communica-

tions group of the University of Moratuwa, the centre can provide the scientific underpinning for this immediate requirement of the nation. A Third World nation need not have a third class telephone system," he said.

Prof. Ponnampereuma said that communications and computers are the twin axes on which our future world will turn. "Our task is to carefully transfer these technologies to developing nations and not the creation or the invention," he added.

Dr. Arthur C. Clarke, patron of the Centre, said that he has been watching the Centre's progress with great interest, and thanked the director and the staff and the board of governors. He pledged that he would continue to assist the centre behind the scenes, by guiding personnel, equipment and money to the centre.

Although the Centre has several areas of interest, its chief concern will probably be with communications, said Dr. Clarke.

Prof. Willie Mendis, Vice-Chancellor of the University of Moratuwa said, that there was a great need for personnel trained in areas like computers and communications. The University of Moratuwa, through its own resources and through the symbiotic relationship with the Arthur Clarke Centre, has been able to expose its students to these vital areas of technology. "I can assure that no student passing out from our University would be without a working knowledge of computers, electronics and telecommunications," said Prof. Mendis.

However, noted Prof. Mendis, the Universities are understaffed and it was difficult to recruit competent teachers. "We are thankful for the recent salary revision, yet we may even need to recruit some teachers

from other countries to teach modern technologies. If such teachers are recruited for the next 5 years, the University can respond adequately to the needs of the nation" he said.

Dr. John McLucas, winner of the first Arthur Clarke Award, said that he was happy to be associated with the centre that was introducing modern technology to Sri Lanka. The Arthur Clarke Foundation in the U.S., of which he is the chairman, was planning to arrange some visiting professors for the Centre, he said.

Dr. W. Tissa Weera-

— Prof Cyril

koon Deputy Director of the Centre, in his vote of thanks said that the centre would carry forward the thinking of Arthur C. Clarke as well as help Sri Lanka leap-frog into the next Century. But the Centre has several more stages to be completed and it needed further support of all well-wishers, he said.

At a second ceremony held soon afterwards, Dr. Arthur C. Clarke and Prof. Cyril Ponnampereuma awarded certificates

and prizes to students who had excelled in two of their programmes.

The winners of the Halley's Comet competitions organized by the IFS and ACC received their awards while 40 students who had completed the 2nd 'Science for Youth' programme at the Centre also collected the certificates.

The students also formed a Young Scientists and Innovators Club to further their interests in science and technology.

Monday 16th February, 1987

THE ISLAND

Thursday 5th March, 1987

# IFS blazes new trails

The Institute of Fundamental Studies (IFS), which has now found a permanent home in the hills of Hantane in Kandy, is actively involved in trying out new concepts and methods of scientific research in this country.

To boost their multi-faceted research work, the Japanese government has pledged a grant of 5.4 million U.S. dollars (approximately 150 million rupees).

This is considered to be one of the biggest grants received by a scientific institution in Sri Lanka.

## Grant

The United Nations Development Programme (UNDP) has also decided to make a grant of 600,000 US dollars (nearly 17 million rupees) to the IFS to undertake new research projects.

The Japanese grant would be used mainly to set up a modern laboratory at the IFS headquarters in Hantane, Kandy.

IFS is also expected to get assistance from the government of Italy and Belgium.

This information was

revealed by IFS director Prof. Cyril Ponnampereuma at the house-warming ceremony held last Saturday to mark the acquiring of a new wing for the IFS.

The Institute, which was shifted to Kandy in December 1985, has now bought the entire building complex of what was formerly Hotel Hantane. This 100-room complex is now being transformed into a modern science laboratory complex.

## Concepts

Mr. Prem Sumanasekera, a local manufacturer of scientific equipment and laboratory apparatus, who is in charge of the setting up of IFS labs, has introduced some novel concepts, said director Ponnampereuma.

The work-benches at IFS labs would have mobile gas, water and electricity facilities.

"Hitherto, what we used to do was to have everything fixed and stationary. We found that certain facilities at certain points were hardly used or not used at all. So we decided to have them mobile. This

way, the researcher would have gas burners and water where he wants it. This will also cut down the cost by one third", Prof. Ponnampereuma explained.

Despite many hardships, limited resources criticism the IFS researchers have done some very good work in the past few years, he said. Seventy seven (77) research papers by IFS researchers have been published in internationally referred journals. With the new facilities, the IFS scientists would do even better, prophesied the optimistic director.

## Research

Dr. Arthur C. Clarke, who was the Chief Guest at the ceremony said that basic research was essential to scientific development, even though their benefits may not be obvious at the beginning. He cited several examples like the x-rays and the transistor which were extremely beneficial practical results of what was basically fundamental research.

In an interview with 'The Island' the IFS director said that the

institute will continue to emphasize on human resources in its activities.

"Science is people. All the valuable equipment would be useless without properly trained and qualified scientists to handle them," he said.

Hence, the IFS has set definite guidelines in utilizing its laboratory grant from Japan. Equipment would be imported only when there is a project that needs them, and when there are senior scientists to use them and junior researchers to be trained.

The IFS has also started a scheme where bright young students who finish the A.L. exam can work with IFS scientists as laboratory assistants. The first two post — A.L. fellows of

the IFS are already hard at work. — N.G.

# FUNDAMENTAL VS PRACTICAL RESEARCH

Dr. Arthur C. Clarke who was the chief guest at the opening of the new wing of the Institute of Fundamental Studies at Hantana, Mahanuwara, made use of the opportunity to clear up the confusion in the minds of most people about the difference between Fundamental and Practical research.

People who pay for projects like institutes like these, may well ask as to why Fundamental Studies? Why Fundamental Research? They can understand the use of practical research in some specific project like finding anew washing powder that washes whiter than the last one. But fundamental research is something that may not have any obvious application.

It is research for pure knowledge. Yet that is the type of research that pays off in the long run, in ways that no one can ever anticipate.

By D. G. A. Perera

To take an example, at the end of the last century, Roentgen, a physicist, was fiddling with vacuum tubes and high voltage supplies, when it occurred to him to see what would happen if you try to pass high voltage current through a vacuum tube.

Now what use would that be to any one? Any cost accountant may ask as to what justification would there be to use funds for such a purpose.

Even when Roentgen had discovered X-rays by his experiments, their use was not immediately obvious. No one would have even dreamed at that stage that X-ray would revolutionise medicine by making it possible to look inside the human body.

To look at it from the point of view of practical research, if anyone before Roentgen wanted to find out a way of looking into the human body, how would he set about it? Surely, no one could have imagined such a thing as X-ray! That illustrates the value of pure research - research for the sake of research.

To give another example, soon after the end of the war, the US Defence Dept. spent millions of dollars trying to find ways to make radio sets

smaller. Those were the days of the vacuum tubes - radio-valves they were called - that were at the heart of radio sets, with all those large large components like condensers etc. which made the radio sets very large.

After spending millions of dollars, they succeeded in making radio valves as small as acorns and radio sets as small as match boxes. Meanwhile, science had invented the transistor, making it possible to make radio sets thousands of times smaller.

Next came silicon chip technology, which made it possible to put hundreds of thousands of transistors and other components of a room-sized computer on a wafer of silicon, the size of a finger nail. This again was the result of pure research, all of which started with trying to find out how electric currents behaved in a vacuum, a question which was of interest to fundamental research only, to start with.

Quite recently, and quite surprisingly because of the problems in the US the White House agreed in principle to spend six Billion dollars on one of the most fundamental of research projects - building a nuclear accelerator almost as big as Sri Lanka, for it is to be about fifty miles across. It will be used for smashing fundamental particles of matter on each other. But no one has the faintest idea as to what the results, if any, would come out of that.

But scientists and philosophers agree that learning about the structure of the universe, about what makes up matter, is one of the most important things that is worthwhile to know. Even if no one knew what its practical application would be.

So there are two kinds of research, one of which is like research into properties of a plant (without any practical end in view,) and the other which is research with a specific objective - what may be called industrial research.

"Now if we had these industrial research organisations only - research that was only concerned with practical applications, back in the Stone Age, today we would only have some marvellous flint axes, but no one would have bothered to invent steel!" said Dr. Clarke.

# Natural sciences always influenced archaeology, says don

(Senkadagala special correspondent)

"During the historical period the Sri Lankans were amongst the most advanced hydraulic engineers in the world. They evolved a good command of surveying and planning-mathematics as seen in the creative use of a mathematical module in the laying-out the urban plan of Sigiriya," said Prof. Senaka Bandaranayake at a school science program held at the Institute of Fundamental Studies (IFS), Kandy.

"Archaeology," he said, "has always been profoundly influenced by the natural sciences. In trying to understand the past it uses many techniques and methodologies of the natural sciences, including aspects of geology and geomorphology, botany, zoology, physics and chemistry - and also like all other sciences, mathematics."

The life sciences contributed a knowledge of the plants and animals that were closely linked with man's life and his physical and cultural evolution.

They formed part of a general theory of evolution, helping us to understand the position gradually achieved by man in the entire life-system of our planet. They also helped us to examine the varying environments occupied by man through the ages and his creative interaction with different ecosystems.

Archaeologists, therefore have always been like astronomers, looking through their archaeological telescopes at the path followed by man through the past four million years or so of their evolutionary existence.

"While the Sri Lankan archaeology is not so fully developed as that in advanced countries, we have a long standing tradition of modern historical and studies starting more than hundred years ago. In recent years we have made important advances in our archaeological knowledge, approach and methodologies."

"We know for certain now, that man has lived for 25,000 to 50,000 years or more in Sri Lanka. Animals such as the dog seem to have been domesticated by Sri Lankan man in pre-historic times. Wet-rice cultivation seems to have developed in our country, probably during the period between 1000 and 500 B.C. or even a little earlier," he said.

"A new development in archaeology the world over is the emphasis laid on conservation - the attempt to preserve as far as possible environments, sites, monuments, objects and works of art from the distant and recent past.

"All this interest in the past is not just a form of entertainment or amusement for escape from the present. Our knowledge of the past - whether it is to do with the origins of the universe, the evolution of life or the development of human society and culture - is an important aspect of our knowledge of what we are today and of the world that is around us.

"It is a vital element of our scientific consciousness and of our resources of knowledge and experience for making a better future," he said.

Mr. Sudharshan Seneviratne, lecturer, Department of Archaeology of the University of Peradeniya spoke on The Beginning of Human Settlements in South Asia.

Prof. Cyril Ponnanperuma, Director, IFS and Program Director was in the audience while Prof. Kapila Dahanayake, Co-ordinator of the School Science Program presided.

Significant discovery by

# Beware of that

THE ISLAND Sunday 5th April, 1987

## Two Lankan scientists

# cooking pan

Several international publications have highlighted a recent discovery by two Sri Lankan scientists, which could have serious implications in the fields of medicine and food technology.

### University

Prof Kirthi Tennakone of the Institute of Fundamental Studies and the University of Ruhuna, and his associate Mr. Shantha Wickramanayake have found that water containing even the

minimum permitted level of fluoride releases a thousand times more aluminium from a cooking vessel than non-fluoridated water. Scientists believe that aluminium contamination of food and water is a possible cause of the Alzheimer's disease, the most common form of senile dementia (insanity and infirmity which comes with old age).

The discovery has been called a serendipity at the IFS, for Prof.

Tennakone, a physicist, was involved in a study related to photochemistry when he unexpectedly observed these results that may have great medical significance.

### Scientists

In a report published in the international science journal "Nature" (January 15, 1987), the two Lankan scientists say that water with 1 parts per million (ppm) of fluoride (ppm) of aluminium (ppm) of aluminium when boiled for 10

minutes in aluminium cooking pots. This is one thousand times the aluminium leached by non-fluoridated water. Prolonged boiling further raises the aluminium concentration to about 600 ppm, the scientists

present in cooking water, a chemical reaction causes a dramatic increase in aluminium release, has given a new twist to the issue, the Sunday Times said.

### Nature

### By Nalaka Gunawardene

reported: The rate of dissolution is affected by water and food acidity.

### Exposure

The London Sunday Times which highlighted the discovery by the Lankan scientists in its issue of February 22, quoted Professor James Edwardson, the director of the neuroendocrinology unit in Newcastle, as saying: "Now it would seem sensible to avoid chronic exposure to high levels of soluble aluminium."

### Experts

Previously experts had been of the opinion that the amounts of aluminium absorbed from cooking vessels was negligible. But research in Sri Lanka, which has found that when chloride is

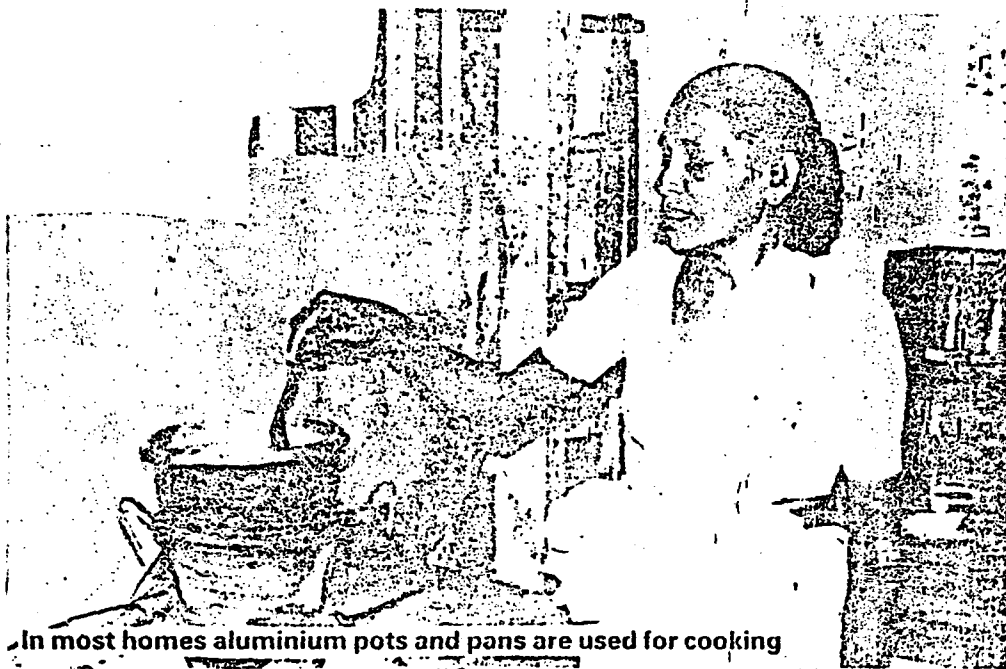
Soon after the article by the two researchers appeared in "Nature", the Sunday Times had commissioned a series of tests on aluminium saucepans by the Chemistry Department at the University of Surrey.

"They showed that adding a further 1 ppm of fluoride brought sharp increases in aluminium uptake," the paper reported.

The most striking increase, reaching 600 ppm and upwards (of aluminium), were in water adjusted with citric acid to mimic foods such as tomatoes or cabbages.

### Policy

Dr. Neil Ward, a chemistry lecturer



In most homes aluminium pots and pans are used for cooking

at the University of Surrey said the discovery raised questions about the policy followed by many water authorities of adding fluoride to drinking water.

This is being practised with the aim of strengthening children's

teeth, for moderate levels of fluoride are believed to be favourable for the teeth.

#### Magazine

Meanwhile the weekly magazine of "Science News" which highlights results in a variety of fields of science, has also referred to

the discovery by the Lankan scientists. In an article titled "Aluminium and Fluoride — Bad Mix for Cooks?", the magazine raised several issues related to the use of aluminium utensils in cooking and the practise of fluoridating drinking water.

# IFS aim is to promote public understanding of science

(Senkadagala special correspondent)

"One of the roles expected of the Institute of Fundamental Studies (IFS) by its charter is to promote public understanding of science", said Prof. Cyril Ponnampereuma, initiating the first seminar on Tissue Culture.

He said, "Unless we take science to the community, the general public and to the home, so that it becomes a part of our life, the process of development will not take place.

"The other aims of the IFS were to conduct research related to development; to bring together scientists of this country, as was being done on this occasion where those engaged in tissue culture in various departments and institutes were meeting to exchange their experiences and views".

The fourth role was to bring the scientists of this country into contact with scientists in other countries. This requirement was also being met by the presence of Prof. Richard E. Litz from the US to address the seminar, with Dr. Kovoor to follow.

"Unlike in fields like biotechnology, the tissue culture program of the IFS is problem-oriented rather than

discipline-oriented: What are some of the problems in tissue culture? What are the factors of importance in the whole process? What are the molecular requirements in the production of a callus? What are the factors that bind some of these cells to a surface? etc., so we can think in terms of surface chemistry, biochemistry, physical chemistry and caloritic activity."

It was also hoped to make this a continuing forum under the auspices of the IFS, for those engaged in tissue culture to meet regularly and exchange their ideas, said Prof. Ponnampereuma.

In giving an overview of tissue culture activities in plantation crops, Dr. R. L. de Silva said that those interested in tissue culture included many organisations like the research team at Gannoruwa, the Dept of Minor Export Crops, the Sugar Cane Institute, the CRI the TRI and the Depts of Botany of the Universities of Peradeniya and Sri Jayewardenepura.

Private sector organisations like the Ceylon Tobacco Company were also actively engaged in experimenting with tissue culture.

Having started about three years ago without even a laboratory for the purpose, a lot has been achieved by unofficial and friendly co-operation with each other and sharing each others, laboratory facilities on a very informal basis, he said.

Prof. Richard Litz, speaking on Somatic Embryogenesis of Tropical Trees dwelt on the importance of determining the best part of the plant from which tissue could be selected for propagation for optimum results.

Dr. K. G. Gunatileke (IFS and CISIR) outlined the work done so far by the CISIR on mass propagation of papaya plants.

While disease resistivity was the most important factor in this regard, other considerations included fruit and processing characteristics like colour and shelf life without spoilage, as well as the capacity for papain production.

Mr. Yapa Bandara from the Department of Minor Export crops explained the methods by which material from axillary buds in nutmeg and cloves were used in tissue culture.

Mrs. S. M. Karunaratne of the CRI spoke on the work done on stolon propagation as a method of tissue culture in palm trees where the axillary buds were not available for this purpose.

Mr. Robert Perera of the Research Wing of the Ceylon Tobacco Company spoke on the work done in the propagation of orchids and foliage plants by tissue culture methods. He also dwelt on the problem of controlling contamination in the production of basic seed potatoes.

Mr. P. V. Arulprakasam of the TRI explained the advantages of tissue culture in the propagation of selected planting stock in the tea plantation industry.

While a well-developed cloning process for the propagation of tea was now available, there was a time lag of 10 to 12 years before sufficient planting material to cover the whole industry could be made available by that process.

Tissue culture could provide millions of plants with the selected characteristics in a very short time, he said.

## Talk on underground wealth

(Senkadagala special correspondent)

It is often not realised how much we all depend on the wealth that is found underground, said Prof. Kapila Dahanayake, addressing the weekly school science program at the institute of fundamental studies (IFS) at Hantana, Mahanuwara.

Dr. Upali Jayasekara, Deputy Director of the IFS, introducing the speaker from the chair, said that Dr. Dahanayake hailed from the first batch of geology students at Peradeniya University and later became the professor of that department. He also held the rare honour of holding a Humboldt Fellowship and of being made a Knight Chevalier by the French government for his academic excellence and for the work he had done.

Continuing his speech on "Wealth Under the Ground" Prof. Dahanayake said that groundwater was the most valuable and critical of all earth resources, while a very high percentage of our energy requirements was also supplied by fossil fuels like petroleum, natural gas and coal.

"The mineral wealth of the earth also encompasses a wide spectrum of materials such as sand and gravel used in construction work and rare metals such as mercury, silver, gold, copper, nickel, zinc, platinum etc., abundant metals such as aluminium, iron manganese etc. and non-metals such as clays, gypsum, sulphates and phosphates.

"Although there are about 2,500 different kinds of minerals present in the earth's crust, only a few of these are of great economic importance. A still fewer number of minerals like quartz, feldspar, mica, hornblende, garnet, hypersthene and olivine are important as rock forming constituents.

"The most important minerals are silicates and carbonates; silicates because they constitute virtually all of the earth's crust; and carbonates because they are important in deciphering the history of the earth.

"Rocks can be described as aggregates of minerals which fall into three categories according to the processes by which they have come into being. Igneous rocks form when molten material crystallizes. Sedimentary rocks are formed by re-cementation of particles from older rocks, broken down due to processes of physical and chemical weathering.

"Metamorphic rocks are formed when igneous, sedimentary or other metamorphic rocks are altered by changes in temperature, pressure or chemical environment.

"After explaining the geologic processes that go to form the Rock Cycle which is something that is still

going on, in the earth, Prof. Dahanayake, turned his attention on a particular type of rock which is of economic potential for Sri Lanka, today.

"One of the most critical non-metallic minerals in terms of our well being is Apatite, which is the most important phosphorus bearing mineral", he said.

"Phosphorus is one of the three main mineral requirements in plant fertilizer. It is necessary to apply phosphates to crop land subjected to intensive cultivation, in order to replenish the original supply which is so necessary for plant growth.

"A large deposit of phosphate in the form of apatite extending over an area of about five square miles, was discovered in Eppawala, in 1971. Other areas where this mineral is found near the surface, are being mapped, and at present it is possible to say that we have enough deposits to last the phosphate requirements for the next 100 years.

"It is still not clear whether the Eppawala deposit is a carbonatite of metamorphic origin as claimed by the Geological Survey Department of Sri Lanka, or apatite of sedimentary origin such as the deposit in Morocco which provides 40% of the world's requirements," said Dr. Dahanayake.

"This apatite is ground into a fine powder (of 80 mesh) and applied to long term crops like coconut rubber etc. But this form of phosphate is not so useful for short term crops like paddy and vegetables, as the apatite is slow in dissolving and releasing the phosphorus required by the plants.

"The commercial methods available for conversion of apatite to soluble fertilizer are the acidulation and thermal methods. Research relevant to such conversion has been carried out by scientists from Peradeniya and the CISIR. But the studies carried out (for the exploitation of the apatite deposits) have been conducted haphazardly and without geological information available on the outcrops.

"The IFS has a project where the necessary interdisciplinary approach is expected to be made possible with the help of geologists, geochemists, chemists, agriculturists and chemical engineers drawn from various institutions of Sri Lanka, towards a meaningful exploitation of the Eppawala phosphate deposit," he said.

Research Associates of the IFS, Dr. M. Rupasinghe and Dr. S. V. R. Weerasooriya, spoke on Gemstones and Qualities of Water in Sri Lanka respectively.

There was also a film on gemstones, and a talk on Valuation of Gems, by Mr. S. Malawala, of Ratnapura.

# Alzheimer's disease traced to aluminium cooking pots

A discovery by two Ruhuna University researchers that the eating of fish, tomato or cabbage curry cooked in aluminium vessels with water containing fluoride could cause old age infirmity and insanity, has been deemed very valuable by scientists here and abroad.

Physics professor and Senior Fellow of the Institute of Fundamental Studies (IFS), Kirthi Tennakoon, and research assistants Sunil Wickramanayake and Nandana Fernando have also found that tea brewed in aluminium tumblers, curries with tamarind, "goraka" or baking powder cooked in aluminium utensils and fluoride-containing water boiled in aluminium kettles, could cause the dreaded old age disease called Alzheimer's dementia.

Alzheimer's dementia is caused by the accumu-

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By T. Sabaratnam

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lation of aluminium in the brain. The patient first develops forgetfulness, followed by loss of reason and the senses.

The silvery, light, aluminium, though known for its toxic effects, is harmless as a cooking utensil because of a thin film of aluminium oxide that covers its surface. The oxide does not react with the materials being cooked and also prevents the aluminium percolating into the food.

Tennakoon found that the protective oxide cover is disrupted when fluoride is present even in minute quantities in the water, or, the material being cooked. Water containing one part per million of fluoride (one ppm) the permissible limit of fluoridation, when boiled for ten minutes, has been found

to release 200 ppm of aluminium. Prolonged boiling releases upto 600 ppm. This worsens only when the cooking water is either acidic or basic.

Studies by scientists show that tea contains about 500 ppm of fluoride and fish up to 700 ppm. This high concentration of fluoride stimulates aluminium leaching. The storage of tea in aluminium foil could easily release over 100 ppm of aluminium.

The results, which appeared in the international journal *Nature* on January 15, immediately caught the eye of the world scientific community. "*Science News*", which carries the summary of important scientific discoveries, gave it huge play under the title: "Aluminium and Fluoride - Bad Mix for Cooks". London's *Sunday Times* took it up and commissioned a study which supported the Tennakoon discovery.

Friday 17th April, 1987

THE ISLAND

## Solid State Physics theme

From Cyril Wimalasurendre, our Kandy Special Correspondent

### of symposium

Vikram Kumar and Prof. L. Gopalakrishnan of India.

The first international symposium of the Kandy School of Sciences sponsored by the Institute of Fundamental Studies will be held at the IFS in Hantana shortly. The theme of the symposium will be Solid State Physics.

Solid State Physics is the branch of science that has led to the technological revolution which among other things, made the miniaturisation of electrical components and

circuitry possible. Equipment that once filled a fair sized room which had to be air-conditioned because of the heating due to the consumption of a large amount of power, can now be 'printed' on a silicon chip the size of a finger nail, the whole device able to operate with far less power than is needed to light up a "penlight" torch bulb.

The symposium will be open only to young researchers with at least a first degree in physics

selected from among local and foreign applicants from the Asian region, who wish to participate.

Among those who are expected to address this symposium are Prof. K. Tennakone of Sri Lanka, Prof. P. N. Butcher and Dr. B. L. Gallagher of England, Drs. Karl-Fredrick Berggren and Bengt-Erik Mellander of Sweden, Dr. S. Skaarup of Denmark, Professor R. Vihayaraghavan, Dr.

The Organising Committee consists of Dr. Rohan Attele (Coordinator) of the IFS, Kandy, Prof. K. Tennakone of the University of Ruhuna, Matara, Dr. Lakshman Dissanayake and Dr. M. A. Careem both of the University of Peradeniya.

# Science News highlights Lankan's discovery

The prestigious American science weekly *Science News* has recently highlighted a discovery by Ruhuna University and Institute of Fundamental Studies researcher, Prof. Kirthi Tennekone in a report titled: Aluminium plus fluoride equals bad mix for cooks?

The report refers to a letter the scientific reference journal *Nature* ran in its January 15 issue, in which Prof. Tennekone reported his finding about the release of aluminium from a utensil made of that metal if water containing fluoride is boiled in it.

The two-para report said: "Aluminium's known neurotoxic effects have put the metal on a list of suspicious characters. Furthermore, several studies last year found that aluminium compounds can be released from metal utensils during cooking. Now, experiments in Sri Lanka suggest that this leaching is 'dramatically enhanced' by water containing fluoride in levels normally used in municipal fluoridation.

"In a letter published in the Jan. 15 *Nature*, scientists at Hantana's Institute of Fundamental Studies and the University of Ruhuna say the water with one parts per million (ppm) of fluoride, frees nearly 200 ppm of aluminium when boiled 10 minutes in aluminium cooking pots. This is 1000 times the aluminium leached by non-fluoridated water. Prolonged boiling further raises the aluminium concentration to about 600 ppm. The rate of dissolution is affected by water and food acidity."

London's *Sunday Times* picked up the story from *Science News* and commissioned a series of tests on aluminium saucepans by the chemistry department of the University of Surrey. The paper published the results of those studies on February 22. It said: "They (studies) showed that adding a further one-ppm of fluoride brought sharp increases in aluminium uptake. The most striking increases, reaching 600 ppm and upwards, were in water adjusted to mimic conditions found when acidic foods, such as cabbage and tomatoes, were cooked. Dr. Neil Ward, a chemistry lecturer at Surrey, said the discovery raised questions about the policy followed by many water authorities of adding fluorides to strengthen children's teeth".

## Mathematical problem

First the question of reward. This was suggested by a university professor who volunteered to present a reward of Rs. 100 to a reader who sent the correct answer. I left it to the readers to decide whether to accept the kind offer. I received 29 letters of which 21 argued that this should not be turned into a competition.

They opine-cash prize will divert interest from mathematics to money; the pleasure readers now derive will be lost; since only one of the many who submit the correct answer will be rewarded, the others are bound to feel disappointed.



The eight readers who supported cash prizes feel it will motivate more students to participate.

I tend to agree with the reader who pleaded: 'Don't turn this into a lottery'.

I thank the professor for his offer, but would ask him to send us more questions.

Some readers are getting their answers certified by their maths teachers. That is not a requirement.

Answer to the question of April 7: Since Perera and Ramu walk at the speed of 4 kmph and 5 kmph towards each other, they will cover the 18 km in two hours. Perera's dog, White, is running these two hours at 10 kmph. Therefore it runs 20km.

I am pleased that many new students have sent in answers and sorry that I can publish only 18 names - 12 students and 6 others: D. Himalee Perera, Vissa Madhya Vidyalaya; T. Suresh, Jaffna Hindu College; P. Nelka Bernadette, De Mazenod College, Kaudana; T. Revathy, Chundukili Girl's College, Jaffna; Premal de Mel, St. Thomas' College, Mount Lavinia; Namiz Musafar, Madya Maha Vidyalaya, Badulla; R. Sriharan, Jaffna Central College; Najlin Fernando, Maris Stella College, Negombo; B. R. D. Joseph, St. Anthony's College, Kandy; Niloo H. Fernando, Holy Family Convent, Bambalapitiya; Nanthini Sivalingam, Vincent Girl's High School, Batticaloa; T. A. Kamuss, St. Thomas' Collegiate School, Bandarawela; Lakshitha de Silva, Colombo University; Ramya Dissanayake, Peradeniya; Mrs. Nirmala Goonewardene, Colombo 5; C. B. Herath, Colombo University; Lakshman Wijeyaratne, Pitakotte; Nuski Abubakr.

Another easy question aimed at holidaying students: The hands of a clock are together at 12 noon. At what time, exactly to the nearest second, would the hands be together again? Post the answer, before Saturday to 'World of Science', Daily News, Lake House, Colombo.

# WORLD CLASS SCHOOL OF SCIENCE IN KANDY

(Excerpts from the inaugural addresses at the Kandy School of Science).  
By Dr. A. Cyril Ponnamparumá, Director, Institute of Fundamental Studies.  
**BACKGROUND**

A little more than year ago, Professor Abdus Salam, Nobel Laureate, President of the Third World Academy of Science, Director of the International Centre for Theoretical Physics, Trieste, and Foreign Fellow of the Institute of Fundamental Studies visited us to discuss potential collaboration.

As we drove together from Colombo to Kandy, we discussed a number of possible areas in which this fledgling institute could provide an impetus for the development of science, and building an infrastructure so necessary to advance the country in Science and Technology.

We hit upon the idea that a series of workshops, national and regional, in the manner in which the International Centre for Theoretical Physics, Trieste has not become famous all the world over, could be organized in Sri Lanka. We had agreed on the format and the timing but, not the place.

He wondered why I wished to move from Colombo to Kandy. But as we alighted at Hantana, he stood on the balcony, gazed into the distance and told me: "do not say anything more, now I know why". His message to us on this occasion epitomizes his exuberant feelings about Kandy.

"I am delighted that the first meeting of the Kandy School of Science has materialized.

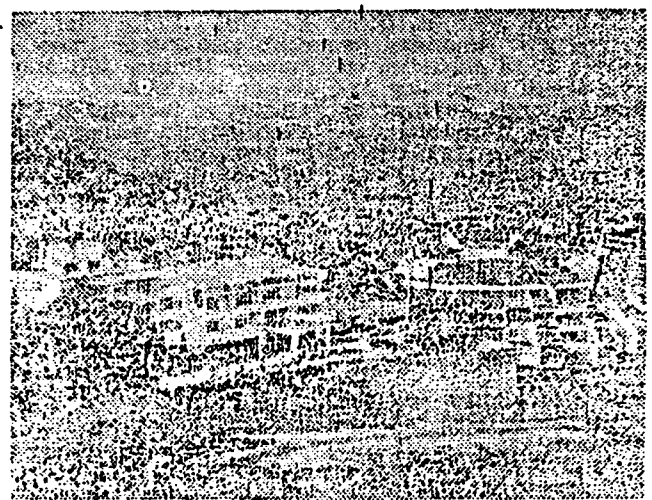
**KANDY BEAUTIFUL.**  
The sentiments about Kandy so aptly described by Professor

Abdus Salam, have been expressed by generations of visitors to this land of ours. The Papal Legate to China, Monsignor Pigorelli, stopped briefly in Sri Lanka a few centuries ago, was ushered into the court of the King of Kandy, and wrote to the Pontiff that "Twenty leagues from here, the sound of the waters of paradise could be heard".

After the British conquest John Davy, the brother of the celebrated Sir Humphrey Davy famous for his discovery of Sodium, accompanied Sir Robert Brownrigg, the Governor of Ceylon during the cruel years that followed the British occupation. In lucid prose he described the beauty of the surroundings. "No description, and I doubt any pencil could do justice to the scenery, the prospect of which was perfectly uninterrupted in every direction.

Later visitors have echoed the feelings of John Davy. Philip Brooks, an American divine in his first letter from Sri Lanka written from Kandy "I think it must be the most beautiful place in the world. I do not think there is one more beautiful". John Fletcher in 1980 spoke of "the serenity of the hill capital". "You find a calm and quiet, a freedom from strain and stress, a cluster of hillsides which throw down their beautiful faces into the mirroring lake at their feet, a sweetness in all the pulsations of the air, and a universal friendliness between all Nature and its Lord".

In truth, we do not have to rely on the crutch of descriptions given by foreign travelers. Which of us has not stood on the ridge of Dharmaraja hill and gazed on the Mahaweli flo-



The science school in Kandy

wing through the valley, a ten mile radius of glistening water, and been raptured with delight? This is the setting for the Kandy School of Science.

Centrally located the IFS becomes a catalyst in this major activity. The flow of the mighty Mahaweli from Peradeniya to Victoria is symbolic of the flow of knowledge.

### A CONCENTRATION OF SCIENCE

Apart from the beautiful setting of our Institute, ideal for scientific pursuits, we are also in the centre of a large concentration of scientific activity from Peradeniya to Digana. On the shores of the Mahaweli, extensive undertakings are in progress. From the University of Peradeniya to the International Irrigation Management Institute there are 15 research organisations with about 2500 scientists and 3000 supportive staff working on various problems of national importance.

### THE INSTITUTE

The Institute of Fundamental Studies which has the privilege of organizing this school, has as its main objective the moving of the country forward from the developing stage to one of greatly advanced productivity.

The spectacular achievements of Science and Technology, such as landing a man on the moon or the understanding of the basic processes of life itself, has given us a feeling of utter confidence in Science. There has been a rising expectation

all the world over, and a feeling of euphoria that science can solve all our problems. However, in the words of Lord Blackett in the Jawarhalal Nehru lecture of 1967 "Science is not a magic wand to wave over a poor country to make it a rich one". The science is necessary but the process of implantation cannot be instantaneous technology transfer. It is a long and protracted march. The science must become a part of the very fibre of life.

There is a paramount need to leapfrog or to make a quantum jump for survival if not for advancement. We have therefore in our institute undertaken a number of activities related to basic science.

Science will thrive in the face of adversity but the right environment and inspiration is necessary. We propose to achieve this by interaction with the Scientists in the Universities and the Institutes of this country. We propose to bring the leading minds of the world to the IFS. Our approach is a problem oriented one.

We will not work within the framework of a single subject. We approach our task in an interdisciplinary manner. We have chosen those problems that would have an immediate effect on the productivity of the nation and improve the quality of life.

It is a matter of great satisfaction that the Head of State has made a personal commitment to the scientific development of Sri Lanka and is the Chairman of the Board of Governors of this Institute. He presides at every meeting. I do not know of any other Institute in any nation that enjoys such a

privilege. We should be able to move ahead and have an impact on the scientific activity of Sri Lanka.

#### THE FIRST SYMPOSIUM

For the first symposium of the Kandy School of Science we have chosen the subject "Solid State Physics". This is an area of fundamental research which can have a major impact on modern life. Whether one looks at electron transport in semiconductors or the photoelectric properties of various substances, there will be a need to understand processes which affect the quality of life.

Nowhere else is the relationship between basic and applied research so clearly amplified.

#### FUTURE SYMPOSIA

We look forward to a series of activities under the umbrella of the Kandy School of Science. In August of this year will be a workshop on Astronomy, in December a programme in Mathematics to celebrate the Ramanujan centenary. Other activities in biotechnology are also in the cards. We are most grateful to our sponsors. The Third World Academy of Sciences, The International Centre for Theoretical Physics, Trieste, The International Seminar in Physics, Uppsala, and the British Council for their support.

Tentative plans for 1988 include the programmes of the Kandy School of Science. By 1990 there will be six regular annual sessions of this school. It is hopeful that the national impact will become regional and international. The Kandy School of Science will take its place among the many institutions in the world to which scientists flock for the contact with their peers an essential ingredient of scientific progress.

# IFS next steps into higher production

by D. G. A. Perera  
(Senkadagala special correspondent)

"The main objective of the Institute of Fundamental Studies (IFS) is moving the country from the developing stage to one of greatly advanced productivity," said Prof. Cyril Ponnampetuma at the opening of the First International Symposium on Solid State Physics of the Kandy School of Science at the IFS at its headquarters in Hantana, Kandy.

"Which of us has stood on the ridge of Dharmaraja Hill and gazed on the Mahaveli flowing across the valley, the ten-mile radius of glistening water, and not gone into raptures of delight. This is the setting for the Kandy School of Science. Apart from the beautiful setting of our institute, ideally suited for scientific pursuits, we are also in the centre of a large concentration of scientific activity.

"From Peradeniya to Digana, on the banks of the Mahaveli, extensive undertakings are in progress. From the University of Peradeniya to the International Irrigation Management Institute, there are fifteen research organisations with about 2500 scientific staff and 3000 supportive staff working on various problems of importance to the nation.

"Centrally located, the Institute of Fundamental Science becomes a catalyst in this major activity. The flow of the mighty Mahaveli from Peradeniya to Victoria is symbiotic of the flow of knowledge.

"The IFS which has the privilege of organising this School has as its main objective, the moving of the country forward from the developing stage to one of greatly advanced productivity.

"The spectacular achievements of science and technology, such as landing a man on the moon or understanding the basic processes of life itself, has given us a feeling of confidence in science. There has been a rising experience all the world over, and a feeling of euphoria, that science can solve all our problems.

"However, in the words of Lord Blackett in the first Jawaharlal Nehru Lecture of 1967, science is not a magic wand to wave over a poor country, to make it a rich one. Science is necessary, but the process of implantation cannot be instantaneous technology transfer. It is a long and protracted march. Science must become the very fibre of life.

"There is a paramount need to leapfrog, or to make a quantum jump for survival, if not for advancement. We have therefore in our institute, undertaken a number of activities related to basic science. Science will thrive in the face of adversity, but the right environment and inspiration is necessary. We propose to achieve this by interaction with the scientists in the universities and the institutes of this country.

"We propose to bring to the country the leading minds of the world. Our approach is a problem oriented one. We will not work within the frame-

work of a single subject. We approach our task in an interdisciplinary manner. We have chosen those problems that would have an immediate effect on the productivity of the nation and improve the quality of life.

"It is a matter of great satisfaction to us that the Head of State has made a personal commitment to the scientific development of Sri Lanka and is the Chairman of the Board of Governors of this institute. He presides at every meeting of the Board of Governors. I do not know of any other institute in any nation, that enjoys such a privilege. We should be able to move with it and hammer it back on the scientific activity of our nation.

"For the first symposium of the Kandy School of Science we have chosen the subject Solid State Physics. This is an area of Fundamental Research which can have a major impact on modern life. Whether one looks at electronic transport in semiconductors or the four electric properties of various substances, there will be a need to understand processes which affect and result in the improvement of the quality of life.

"Nowhere else is the relationship between basic and applied research so clearly exemplified. We have been fortunate to get together for this meeting some of the best authorities on the subject. We are most grateful to the scientists who have come from far and wide for this purpose.

"The Kandy School of Science Committee under its very active chairman Dr. Rohan Attelle has worked long in advance to prepare an occasion worthy of the scientists who have come from far and wide. If today's experiment is successful, we look forward to a series of activities under the umbrella of the Kandy School of Science.

"In August this year, there will be a workshop on astronomy. In December there will be a program in mathematics to celebrate the Ramanujan Centenary. Other activities on biotechnology are also on the cards.

"Tentative plans for 1988 include four programs of the Kandy School of Science. By 1990 there will be six regular sessions of this school. It is hoped that the national impact will become regional and international. The Kandy School of Science will take its place among the many institutions in the world to which scientists flock for contact with their peers, a factor so essential for the progress of Science.

"We are most grateful to our sponsors, the Third World Academy of Sciences, the International Centre for Theoretical Physics in Trieste, the International Seminar in Physics in Uppsala and the British Council for their support. We are also grateful to the mayor of Kandy for being with us on this occasion", said Prof. Ponnampetuma.

Other speakers included Prof. B. J. Panditharatne who represented the UGC, the Mayor of Kandy, Tilak Ratnayake and Dr. Rohan Attelle, Co-ordinator of the Kandy School of Science.

Also participating were Prof. Kirthi Tennakone, Dr. Laxman Dissanayake and Prof. P. N. Butcher (from UK).

Breakthrough in superconductor science

# Things are hotting up in solid state physics

Things are literally hotting up in solid state physics, and scientists are very excited about it. The rule of the game these days seem to be: "How great it is to get hotter!"

Of course, their excitement is justified and understandable. For the scientific world has just witnessed one of the most remarkable breakthroughs in modern physics — the creation of new types of 'superconductors', material through which electricity flows without resistance.

### Promise

Among other things, this breakthrough brings the promise of creating super magnets that could run trains as fast as planes, and the possibility of generating enormous amounts of electricity at low cost.

This breakthrough was a focal point discussed at the six-day international symposium on solid state physics, which was concluded at the Institute of Fundamental Studies (IFS) last week.

More than thirty five scientists and researchers — including world authorities on the subject — gathered in Kandy for this symposium, which was the first scientific meeting organized by the Kandy School of Science, the educational arm of the IFS.

### Transformed

In the past few months, superconductor science, a hitherto moribund field of physics, has suddenly been transformed into an area of feverish activity.

This new excitement was echoed at the symposium on solid state physics.

Superconductivity is a phenomenon known in certain metals and alloys where the resistance to the flow of electricity changes abruptly at a certain temperature, making resistance vanishingly small. (The electrical resistance of a metal or alloy is a function of temperature, decreasing as the temperature falls, and tending to a constant low value at absolute zero.) Superconductivity occurs in metals like lead, tin, vanadium etc., and the temperature at which it sets in is the transition temperature.

Until recently, this temperature was in the neighbourhood of a few degrees above absolute zero, i.e. more than 250 degrees below freezing point in the centigrade scale.

This is an extremely low temperature difficult to achieve and even more so to maintain.

### Restricted

Such cooling requires the use of liquid Helium, so expensive that it has restricted the use of superconductors to a handful of multinational research projects, such as nuclear particle accelerators.

Hence, though the superconductors were known since the 1930s, their use have been exclusive and rare.

A current induced by a magnetic field in a ring of superconducting material (at the critical temperature, of course) will continue to circulate after the magnetic field has been removed. This effect has been

used to produce large magnetic fields without the expenditure of appreciable quantities of electrical energy (except in maintaining the very low temperature — which was the stumbling-block until now.)

Last September, two Swiss physicists, Drs. Bednorz and Muller, sent a shock wave (or a 'heat' wave?) throughout the world of physics when they discovered a chemical that superconducted at slightly higher temperature. It was the first development in the field that both scientists had seen in their working lives.

by Nalaka Gunawardene

More important was the subsequent revelation that these new superconductors were cheap and easy to manufacture.

In a rush of activity unparalleled in modern science, physicists first repeated and then improved on the Swiss researchers' findings within a few days.

Superconductors have now been made that work at minus 170 degrees Centigrade — a cooling that can be achieved with liquid nitrogen, which is 30 times cheaper than liquid Helium.

The Chinese are believed to have achieved room temperature (which is 273 degrees above absolute zero) but this claim remains to be verified by scientists in other countries. Scientists all over the world have now set their eyes on this target.

"Everyday now, a laboratory is developing an even better super-

conductor, it seems", said Dr. Richard Greene, of IBM's Yorktown research laboratory, New York. "It was like the four-minute mile: once the barrier was broken, everyone began breaking records".

### Discovery

Already, direct applications of this discovery are being made. In March, IBM announced that it had begun trials using new superconductors to make Silicon chips that could run computers at ultra-fast speeds. This, scientists point out, is just a

glimpse of the things to come. Many believe that superconductors, released at last from the tyranny of temperature, will usher in a super revolution in electronics.

"The process (of making superconductors) has suddenly become so simple", said Dr. Paul Grant of IBM's San Jose laboratories in California, "that for a few dollars a school laboratory could recreate one of the scientific discoveries of the century".

Scientists, generally known to be rather skeptical and cautious, have turned emphoric over these events. Last month, five thousands physicists crammed into a 1,200-seat auditorium at the American physical society in New York recently, to hear the latest developments on superconductors.

The meeting began at

7 p.m., and finished at 4 a.m. the following morning.

### Changing

"At dawn we staggered into the bars downtown", said Dr. Grant, who could scarcely believe how rapidly the science of superconductors was changing, or what it might mean.

Predicting the potential uses of a major breakthrough in science is often difficult, but the prospects for this new generation of superconductors are fascinating. For instance, scientists believe that they could be used to make powerful electro-magnets, which are unaffected by resistance and heating. These could be used to power levitating trains running on magnetic fields instead of wheels. Eventually freed from friction, trains could travel as fast as aeroplanes.

Powerful magnets made from superconductors could also be used in fusion reactors to trap super-hot plasma that could generate enormous amounts of electricity.

Then there could be major benefits for the field of medical science. The super-magnets would drastically slash the cost of scanners which probe the soft tissues of the body. There sophisticated scanners are very expensive to run at present.

But, as it usually happens, the most remarkable consequences of this breakthrough may turn out to be over we cannot even imagine now. Time alone will show — and at the rate they are going, it won't take that long.

# Rs. 30 m Belgian grant for research

(by Nalaka Gunawardene)

The Belgian government has agreed to give Sri Lanka a research grant of 50 million Belgian francs (approx. Rs. 30 million) for a series of research projects in life sciences. The money which will be used mainly for research on biotechnology and biological nitrogen fixation, would be channelled through the Institute of Fundamental Studies (IFS).

A two-member delegation representing the scientific establishment of Belgium was in Sri Lanka recently to discuss and finalize the research grant.

Prof. K. Vlassak from the Katholieke University of Leuven, who headed the delegation, told 'The Island' that they have identified several areas of research that would be funded by the grant. These include one important project to find indigenous plants that may have the properties of nitrogen fixation.

Nitrogen, a vital element for all plants, comprises nearly 80 per cent of the atmosphere, but the green plants cannot use this form of nitrogen. Hence, the need for nitrogen fertilizer in farming. However, certain plants, especially legumes have some

micro-organisms residing in their root nodules

which can fix atmospheric nitrogen. The aim of this new project, to be initiated by the IFS group on biological nitrogen fixation (as the above process is called), in collaboration with the Universities, will try to find unknown indigenous plants which may have this special trait.

"There is a good possibility of finding a few such plants", Prof. Vlassak said. Another project would be to find out whether any micro-organism could help the rice plant to fix atmospheric nitrogen, he said.

Prof. John L. Werenne, from the University Libre de Bruxelles, who was the other member of the delegation, described some of the biotechnology projects identified for funding by Belgium. Among them are agricultural projects, especially those on in-vitro technologies and efforts to select and improve genetic characteristics in crops.

The Belgian scientists held several rounds of talks with IFS Director Prof. Cyril Ponnampereuma and some scientists at the IFS and Universities.

The research grant, which will be given over a period of four years, would commence with immediate effect, once the delegation reports back their government in Brussels.

## Discovery of fluoride as a catalyst in Aluminium leaching from utensils

by D. G. A. Perera

The light, white, metal Aluminium, has for long been considered an inert and safe substance for making household utensils, especially cooking pots and saucepans. Soon a dull white oxide covers the shiny surface, making it resistant to corrosion by mild acids and alkalines.

Unlike the heavy lead, aluminium has been considered non toxic to the human body until quite recently, when people suffering from a severe nervous disorder called Alzheimer's Dementia, were found to have a high concentration of aluminium in brain structures known as plaque.

Earlier researchers had pointed out that certain items of food like tea had a high aluminium content, while it was also suspected that the metal could also be released from aluminium utensils during cooking by some agent that altered its inert qualities.

The culprit behind this insidious leaching of aluminium appears to have been finally detected by two Sri Lankan scientists, Prof. Kirti Tennakone of the Dept. of Physics of the Ruhuna University and Mr. Shanta Wickramanayake, both members of the Institute of Fundamental Studies at Hanlana, Mahanuwara.

They have found that Fluoride, present even at the very low concentration of one part per million (1 p.p.m) in water, acts as the catalytic agent which liberates as much as 200 p.p.m. of aluminium from the surface of a vessel of that metal, during a period of 10 minutes of cooking.

This was found to happen only when the pH of the cooking fluid; came to be altered to plus or minus three, i.e. towards acidity or alkalinity.

Prolonged boiling under these conditions were found to increase the aluminium leaching to reach a saturation point of 600 p.p.m.

Now this raises another problem for public health. The absence of Fluoride in drinking water causes tooth decay while an excess of it (as in some localities in the NWP,) causes irreversible brown patches, leading to a condition called "mottled" teeth.

An dental cause is the more serious, of the two, advanced countries favour the addition of Fluoride to water, where it is normally absent, up to the permitted level of 1 p.p.m. to promote healthy teeth. In certain localities, however the level of Fluoride in ground water may be as high as 10 p.p.m. or more.

As a result of the latest discovery, even the lower level of fluoride, considered good for healthy teeth can lead to aluminium leaching, with neuro-toxic effects in the long run.

Certain foodstuffs are also known to contain fluoride, as tea (600 p.p.m.) and fish (up to 700 p.p.m.) Cooking or storage of these materials in Aluminium utensils could easily release more than 100 p.p.m. of the metal, according to our scientists.

As a trace of fluoride is essential in water for preventing dental caries, and aluminium utensils are likely to stay around for quite some time, the precaution to be observed for the time being seems to be to avoid cooking acidic food like tomato soup, or dishes with lemon soda added to them, in aluminium vessels.

Whether this new discovery has any bearing towards finding a method of replacing heavy lead storage batteries with light, accumulated cells using aluminium plates instead, is an interesting question.

## Students exposed to latest in science through IFS program

Senkadagala Special Correspondent

Ways of finding how the Institute of Fundamental Studies (IFS) could act as a catalytic agent in promoting science in Kandy schools, was the subject of discussion when Prof. Cyril Ponnampereuma, Director IFS, met the principals of Kandy schools for 'Tea and Conversation.'

Prof. Ponnampereuma said there was usually a time lapse of at least ten years between the announcement of the latest development in science and the time that it would take to reach the classroom, through text books. But the school science program of the IFS, conducted every Saturday over a period of eight weeks, had provided the opportunity to eliminate that time gap.

In this program, student participants and teachers who came as observers were brought into direct contact with scientists who were experts in their fields, so that the students' imagination would be fired by the latest developments in science.

Stimulating the young mind to enter into scientific inquiry on its own was one of the tasks that a good teacher should be able to achieve.

The professor recalled how as a young boy of four years his curiosity had been aroused by a visitor to his home who also happened to be a teacher from a

Kandy school.

This teacher had used the simplest of equipment to demonstrate that a crushed jak seed contained protein, with the help of a test tube and some lime from the 'bulath Tattuva' and a candle flame to heat the combination over, so that that it gave out the smell of ammonia.

But how many teachers were there today who could even show the night sky to their students and point out the constellations to them, he asked.

The Kandy principals, on their part, pointed out that the priorities in education had changed since the days that Prof. Ponnampereuma was speaking about, and that today the students and teachers were caught up in a race that was entirely examination oriented.

Prof. Ponnampereuma asked what would happen after students pass at their examinations. Getting into a job was also a difficult thing, and as a young man, even Einstein had to struggle as a clerk in a patent office because of it.

How much the world would have lost if Einstein's imagination had been restricted to what he had to imbibe by rote learning to pass his exams, he said.

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## BOSTID's goal is to promote research in third world

(Senkadagala special correspondent)

The art and procedure to be followed in writing a research proposal in applying for research grants from inter-national funding agencies was the theme of a two day workshop conducted by Dr. Michael Greene, Assoc. Director, Board on Science and Technology for International Development (BOSTID), of the National Research Council, Washington D.C., at the Institute of Fundamental Research, Kandy.

Dr. Greene not only illustrated how a good research proposal should be prepared but also how insufficient care in presenting the case may lead to losing the chance to obtain grants for an otherwise good project. (BOSTID) grants up to US \$ 150,000 for a single research project.

He said that the primary goal of the Bostid program is to promote high quality research directed at problems of development in the Third World. The CRG or Committee on Research Grants is composed of eminent scientists and scientific administrators of diverse backgrounds, including some from developing countries.

The criteria in selection of areas eligible for research support include the following: Their importance for international development, the particular interest and capability of BOSTID, the necessity for carrying out the research in the developing country itself and the possibility that significant advances in the field could be made in a relatively short time.

Dr. Greene outlined the general characteristics of the donor agencies and why they support research. He also sketched the principles and budgetting guidelines and how they are evaluated when the selection is made for research grants.

Example of research proposals made, how they had been evaluated by various reviewers, their weaknesses and strong points; suggestions made as to how they could be revised and re written, etc., were made clear to the participants in a simple and masterly fashion by Dr. Greene, who is no doubt an expert in this field.

Prof. Cyril Ponnampereuma, Director IFS and Mrs. Daya de Silva, co-ordinator, were associated in this workshop.

# Novel method to exploit Eppawala apatite reserves

Chemical fertilizers, whether you like them or not, are here to stay. For any country like Sri Lanka with an agrobased economy, fertilizers could be a vital factor — especially if it has to be imported. And that is precisely what we do, our annual fertilizer cost being a staggering 60 million US dollars — or Rs. 17,000 million.

## Irony

Twenty per cent of this chemical fertilizer is phosphates, and therein lies the irony: this precious mineral is available in great abundance in apatite deposits in the township of Eppawala in the Anuradhapura district.

Discovered in 1971 by the Geological Survey Department, the Eppawala apatite reserves have been estimated at 40 million tonnes — sufficient to last for more than five centuries at the present demand rate!

However, this apatite is currently exploited only as a phosphate fertilizer for tea and rubber plantations. Maximum use could be had if the apatite is to be converted to super-

phosphate or triple super-phosphate.

## Major

Sometime back, a major American industrial concern asked for half a billion US dollars to set up a super-phosphate plant. This, of course, did not come off as it was beyond our reach.

The standard methods used for production of super-phosphates involve the use of either sulphuric or phosphoric acids. This is one reason for the high cost of producing super-phosphate. Sulphur or sulphur-bearing ores used for making sulphuric acid being not found in Sri Lanka, it has to be imported and it is an expensive commodity in the world market.

Phosphoric acid, on the other hand, could be made from apatite itself, but the required high temperature technique is rather expensive. This would make the initial cost of setting up a plant and the expenditure on energy excessively high.

The only mineral acid that is produced in Sri Lanka is hydrochloric acid, which is also

cheaper than the above two acids.

The use of hydrochloric acid in the production of super-phosphate has never been considered as a reasonable process because of one draw-back: calcium chloride generated as a result of the reaction with this acid would be hygroscopic — that is, it will absorb water

by Nalaka Gunawardene

vapour in the air and tend to dissolve.

This makes such fertilizer unsuitable for storage.

## Method

Now, two Lankan scientists attached to the Institute of Fundamental Studies (IFS) have come up with an ingenious novel method to overcome this problem by adding ammonium sulphate to the process.

This addition would convert hygroscopic calcium chloride into calcium sulphate and will produce a fertilizer even superior to super-phosphate.

The discoverers of the new method, Prof. Kirthi Tennakone of the IFS (and also Professor of Physics at the University of Ruhuna) and Dr. Rohan Weerasuriya were recently awarded a patent for this process by the Registry of Patents and Trade Marks.

The IFS itself was also a recipient of the patent.

Phosphate fertilizer produced by using this method will contain between 21–26 per cent of phosphorous as compared to 16–20 per cent in the super-phosphate made by the conventional method using sulphuric acid.

The use of ammonium sulphate, which is a nitrogen-rich compound, provides an added advantage: the end-product also has about 10 per cent nitrogen.

Phosphorous and nitrogen, together with potassium are the three major elements most needed by all crops and plants.

The researchers believe that they could devise a way to add potassium too into this fertilizer, thus making it a real three-in-one fertilizer.

The new method would now have to go through a series of field tests to assess its commercial viability and economic feasibility. IFS sources said.

Dr. Felix Ponnampereuma, a soil scientist who is an honorary senior fellow of the IFS, is to carry out the field tests on several crops in the coming months.

## Trails

If these trials succeed, it could mark the beginning of a new era for agriculture in Sri Lanka and could well place the country on the threshold of self-sufficiency in phosphate.

The Earth Sciences division of the IFS is already engaged in a project to prepare a detailed map of the entire phosphate deposit at Eppawala.

This survey, undertaken in collaboration with the Department of Geological Survey and the Departments of Chemistry and Geological studies at the Peradeniya University, will enhance the prospects of using this valuable resource as a fertilizer, said Dr. Felix Ponnampereuma.

# The water factor and your heart

*It must be noted that whereas much emphasis is laid on the pollution of the physical environment by man, the effect of the chemistry of the natural environment on the health of a population is also of equal importance. What is required is therefore a much closer interaction between geochemists on the one hand and on the other, professionals such as medical practitioners, epidemiologists and ecologists working on joint projects.*

This article deals with the influence of geology and geochemistry on health. The International Association of Geochemistry and Cosmochemistry has recognized the research work now being carried out in this field in Sri Lanka and it is the aim of this article to highlight some of the significant research activities in Sri Lanka.

by Prof. C. B. Dissanayake

An awareness of the relationship between environmental geochemistry and the health of man, animals and plants is now being increasingly developed world-wide.

It is also realized that this is a complex problem requiring controlled interactive studies involving geochemists, epidemiologists, ecologists, medical and veterinary practitioners and others.

In a recent publication on Environmental Geochemistry and Health, by the Royal Society, it was stated that, "trace element toxicities and deficiencies in man are especially difficult to relate to the environment in developed countries. However, there are good expectations that direct evidence can be obtained more readily in developing countries and research in such territories is to be encouraged."

Sri Lanka affords an almost ideal opportunity for the researcher on environmental geochemistry and health in view of the fact that the vast majority of the population of Sri Lanka live in intimate association with the actual physical environment.

This is to say that most people depend on the soil, water, plants and air in the immediate environment for their sustenance. A person who has been drinking water from his garden well for over 60 years and eaten food from plants grown on the soil of his garden will surely have his general health and the trace element budget of his body be governed to a very great extent by the environmental chemistry of that particular water and soil.

This idea can be extended to larger geographical regions and the incidence of certain diseases can therefore be correlated with elemental distributions in the physical environment. Environmental geochemistry is therefore now developing into a very useful tool in investigating regional health problems.

It must be noted that whereas much emphasis is laid on the pollution of the physical environment by man, the effect of the chemistry of the natural environment on the health of a population is also of

equal importance. What is required is therefore a much closer interaction between geochemists on the one hand and on the other, professionals such as medical practitioners, epidemiologists and ecologists on the other, working on joint projects.

At the Royal Society meeting mentioned earlier, the clear need to differentiate between hazards due to the natural distribution of elements and due to those introduced by man's activities was noted.

It would for example, be useful to know if there is any risk in living on a serpentine mass with a few hundred micrograms of chromium, nickel or copper per gram or granite with 30 micrograms of uranium per gram or in a lead mining district with a few hundred micrograms of lead per gram in the soil.

## Water hardness

What level of lead could be expected to be taken up by plants grown on soils compared to the lead contents in plants grown in a market garden close to a major road?

In Sri Lanka there are many and interesting geochemical situations that need detailed investigations. A few case studies can be highlighted here.

A very interesting relationship that has been observed in many countries is the negative correlation of cardiovascular disease incidence with water hardness, of that area. Deficiencies or excesses in the content or availability of trace elements on rocks and soils, or in water flowing through them, is often considered to be a possible cause of certain diseases, including cardiovascular diseases.

Several investigations have revealed that higher cardiovascular pathology is almost consistently associated with environments (rocks, soils or water) that are generally deficient in trace elements.

In Sri Lanka, the Northern Province, underlaid mostly by sedimentary limestone formations, has the highest water hardness as well as the total dissolved solids (TDS). Interestingly, it is this area in Sri Lanka which has the lowest cardiovascular disease rate.

Areas in the Central Highlands, on the other hand, have soft water and low total dissolved solids contents. Some of the highest cardiovascular death rates, are also found in these mineral deficient groundwater regions. Even though hardwater itself may not be the factor controlling cardiovascular diseases, epidemiological studies have consistently shown that there is a 'water factor' associated with

hardwater the lack of which may be etiologically

CONTINUED ON PAGE 2

important.

The 'water factor' may well be a single trace element, a cluster or even, an indirect relationship. Looking for the water factor presents a special challenge to the geochemist and the epidemiologist. If the relation is causal and if the factor in the water can be determined and altered in a beneficial direction, a definite preventive health possibility could well be at hand.

### Alzheimer's disease

The relationship of aluminium with Alzheimer's disease is shrouded in controversy. At the second international symposium on geochemistry and health in London in April 1987, and which was attended by the author, many specialists from the medical profession showed definite evidence of aluminium accumulation on the senile plaque cores of the brain of those suffering from the dementia termed Alzheimer's disease.

In a well illustrated case study from Guam where the percentage of Alzheimer's disease is very high, Prof. Dan Perl from Mount Sinai Medical School, New York showed the abundance of aluminium as well as silicon in the senile plaque cores, using laser mass spectroscopy.

Even though one cannot yet attribute a causal effect to aluminium, the observations on aluminium accumulation has led to investigations on the possible role of aluminium in the etiology of Alzheimer's disease.

The recent work of Prof. Keerthi Tennakone and his team from Ruhuna University and IFS, published in the prestigious journal *Nature* was also

highlighted at the symposium and this brought in a whole new dimension to the problem of aluminium uptake by the human body. Prof. Tennakone and his team discovered that even trace quantities of fluoride ions can catalyse the dissolution of metallic aluminium from cooking utensils.

Their work showed that even one part per million of fluoride present in the water may help in extracting dangerous concentrations of aluminium.

This discovery has understandably caused concern among the general public and the environmental geochemists have now yet another intriguing problem before them, i.e. to probe the environmental geochemistry of aluminium and its relationship (if any) on the prevalence of Alzheimer's disease, bearing in mind that aluminium is one of the most abundant elements in the environment and that fluoride-rich waters are also abundant, particularly in the dry zone.

### Iodine and goitre

Recent work by Prof. Malcolm Fernando and his colleagues at the Faculty of Medicine, University of Peradeniya has shown that the prevalence of endemic goitre is extremely high in some parts of Sri Lanka. In Horana for example they observed rates as high as 44%.

The link between iodine and goitre was one of the first associations between a trace element in the environment and human health and nutrition. There are still large populations of the world afflicted by this disease which, in severe instances is extremely debilitating.

This provides a good reason why workers in the field of human health and nutrition need to be more aware of the geochemistry of iodine, in addition to the modern problem relating to nuclear accidents and radioactive iodine fall out.

The work of Prof. Fernando and his team has shown that:

● Endemic goitre in Sri Lanka is of relatively recent origin.

● Endemic goitre is mainly due to iodine deficiency even though many other factors may play a role.

● Western, Southern, Central, Sabaragamuwa and part of Uva provinces of Sri Lanka compose the endemic goitre belt with an estimated 10 million at risk.

Work now being carried out by the author and his colleagues at the Institute of Fundamental Studies shows that environmental chemistry of Co and Mn may also be related to the disease, indicating a multifactorial cause.

Another well known association between chemical element in the environment and human health is that of fluorine with dental and bone

diseases. The outer layer of the crown of a tooth is enamel, the hardest tissue in the body. Beneath it lies the dentine, the main tooth component. The principal component of enamel is microcrystalline hydroxyapatite set in a protein matrix.

When fluoride is present in excess in the water supply, some of the ingested fluoride ions are incorporated into the apatite crystal lattice of tooth enamel during its formation, causing the enamel to become harder and possibly discolour.

Even though food forms the main source for a large number of essential trace elements required by man, fluorides are mainly derived from water. The hydrogeochemical distribution of fluoride is therefore of great importance in delineating areas in which dental and bone diseases caused by deficiency or excess of fluoride are prevalent.

In Sri Lanka, work carried out by the author and his colleagues at the University of Peradeniya and at the Institute of Fundamental Studies has shown that certain areas have excess fluorides in the groundwater.

High fluoride concentrations lie in the North Central, Eastern and parts of the Southeastern sector of the Island.

As indicated by the presence of large concentrations of fluorides in some recently drilled tube wells, particularly in the Anuradhapura, Moneragala and Uda Walawe regions, dental fluorosis may well turn out to be an environmental disease worthy of serious investigation.

### Nitrates and cancer

Nitrates are often linked with cancer because nitrates on-reduction yield nitrites which can react with other substances, such as amines, in the stomach or lungs to yield N-nitrosoamines, which are now thought to be carcinogenic. Although nitrate in itself is relatively non-toxic, it can be reduced bacterially to nitrite in the intestines of new-born infants and may result in the disease methaemoglobinemia.

Prof. Ralph Panabokke of the University of Peradeniya in a five year study on the geographical pathology of malignant tumour in Sri Lanka presented data on investigations of 24,029 biopsy specimens. Accordingly, the Northern Province showed the highest incidence (184 per 100,000 population) of malignant tumours in biopsy material among the nine provinces of Sri Lanka. In the Southern province, the incidence was low (37 per 100,000) population.

The commonest sites from which malignant tumours arose were oesophagus (13.9 per 100,000 population, buccal region 12.2, and breast 10.58). Work carried out by the author and his co-workers has revealed the close correlation of the nitrate concentrations of groundwater with the incidence of cancer.

The Northern province for example has the highest nitrate levels in the ground water: Nitrate

concentrations in the groundwater of Sri Lanka appear to show a marked increase in areas of high population density, extensive fertilizer usage, and also in areas of the wet zone where atmospheric electric discharge are frequent.

The type of farming practice and fertilizer use is an important facet in any research study concerning the regional distribution of nitrates. Further, drinking water wells being located close to septic tanks also results in increase of nitrate levels in the drinking water.

Even though the relationship of nitrate levels to the geographical distribution of cancer is yet to be firmly established, the work now being carried out by the environmental geochemists and epidemiologists could well contribute to the further understanding of the etiology of human cancer.

*Prof. Dissanayake is Head, Department of Geology, University of Peradeniya, and Senior Fellow, Institute of Fundamental Studies, Hantane, Kandy.*

## Latest science equipment for IFS from Japan

The agreement for the supply of science equipment for the Institute of Fundamental Studies (IFS) by the Japanese firm C. Itoh and Co. Ltd. was signed at the Hotel Ceylon Intercontinental on Saturday.

IFS Director Prof. Cyril Ponnampereuma and Mr. J. Shimada, Director of C. Itoh, were the signatories.

The equipment is being supplied under a Rs. 175 million grant given by the Japanese government. The equipment, the most sophisticated to be supplied to a developing country, will be for the life sciences, physical and chemical sciences and earth sciences laboratories of the IFS.

University Grant Commission Chairman, Stanley Kalpage, member of the board of directors of the IFS, said the Kandy based institute is perhaps the only research institute in the world in which the Head of State presided. It was the only board where the Prime Minister, foreign minister, leader of the opposition and the chief justice were directors.

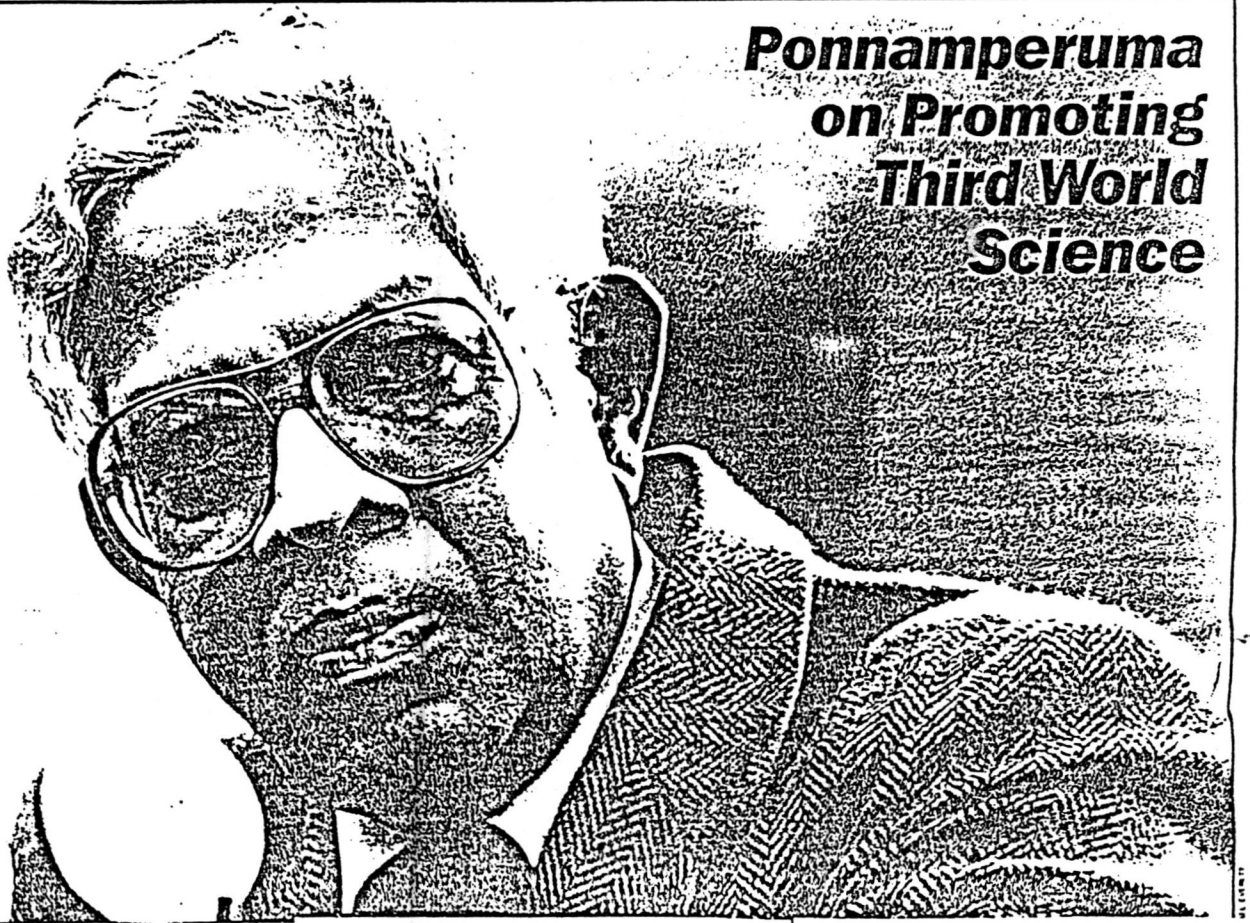
"The IFS enjoys the support of both the government and the opposition and would receive political patronage irrespective of which government comes to power," Prof. Kalpage said.

He said the Japanese government had been very generous with its help to Sri Lanka. Japan helped to update the engineering faculty of the Peradeniya university and equip the science and medical faculties of the Ruhuna university. It will assist in the setting up of the Institute of Computer Technology, and also help the Moratuwa university and the IFS.

"I appeal to Japanese generosity to help set up an engineering or agriculture faculty for the Jaffna university. It is the correct moment to help Jaffna", he said.

IFS Director Prof. Cyril Ponnampereuma said the IFS would be getting the most modern equipment and he had written into the agreement for the supply of equipment their maintenance also. The supplying firm C. Itoh would help maintain the equipment.

Mr. T. Urabe, the Japanese Embassy's Counsellor, said Japan developed because it laid stress in developing its human resources. "The help we are giving to IFS is also for the development of Sri Lanka's human resources. You have a very fine pool of scientists. If they are given the proper environment Sri Lanka's economic growth would be bolstered", he said.



## Ponnampereuma on Promoting Third World Science

Chemist and exobiologist Cyril Ponnampereuma was born in Ceylon (now Sri Lanka) and took a degree in philosophy at the University of Madras. He went on to study chemistry at Birkbeck College in London under crystallographer J.D. Bernal, a pioneer in studies of the origin of life. After receiving a Ph.D. in 1962 from the University of California, Berkeley, Ponnampereuma joined NASA's Exobiology Division and later became chief of its chemical evolution branch. Since 1971 he has directed the Laboratory of Chemical Evolution at the University of Maryland, which conducts research into the chemical path by which life appeared on Earth.

Although naturalized as a U.S. citizen in 1967, Ponnampereuma has maintained ties with his native country, where he serves as science adviser to President J.R. Jayewardene. He also directs both the Institute of Fundamental Studies there, which was formed in 1981 to promote and conduct research in the natural, physical and social sciences, and the Arthur C. Clarke Center for Modern Technologies in Sri Lanka.

Ponnampereuma was interviewed at his University of Maryland office by Tabitha M. Powlledge, editor of THE SCIENTIST, on April 14, before the recent wave of sectarian violence swept Sri Lanka. This is an edited version of their talk.

**Q:** How has exobiology fared in NASA's recent troubles?

**PONNAMPERUMA:** From a scientific point of view, I see exobiology as a jewel in NASA's crown. The prime goal of space biology is the search for extraterrestrial life. But NASA is essentially an agency responsible for launching spacecraft and so on, so the fundamental science tends to get buried. Exobiology in NASA has to ride piggyback on other missions. But with this new concept of trying to get a manned mission to Mars, maybe the exobiologists will come back into their own. And of course, exobiology is also the basis for the search for extraterrestrial intelligence. So if the SETI program gathers momentum, it would be far more important. But at the moment, exobiology is not what it was 10 years ago.

**Q:** Do you expect the SETI program to grow?

**PONNAMPERUMA:** I believe so. There was opposition to it earlier because politicians didn't understand what the scientists were after. They thought we were talking about little green men. But now it is a line item in the NASA budget. It's a small one, but with further development in radio astronomy it could become a strong part of the program.

**Q:** You're implying that exobiology funding depends in large measure on whether or not there is a manned Mars mission.

**PONNAMPERUMA:** NASA is not an agency involved in answering basic questions, so if it is tied up with a mission, then the chances are very much greater. What I'm saying is that if the interest in a manned mission to Mars grows, then one of its objectives would be to revive the search for life on Mars. We examined only two places. If we go back to look at more, then all the science that goes with that will have to be developed.

**Q:** How would you assess the chances for a manned mission to Mars?

**PONNAMPERUMA:** Right now there is interest. I'm hoping that the relations between the U.S. and U.S.S.R. improve, so that rather than spending money on Star Wars, the U.S. and the Soviet Union join together and do a manned mission to Mars. Wouldn't that be a fantastic objective for 2001? There is a body of scientists who feel that this just might solve political problems on Earth. But to answer your question directly, the chances may be small at the moment.

### SCIENCE IN SRI LANKA

**Q:** For the past several years you've been involved in science policy in developing countries, particularly Sri Lanka. What has that experience been like for you? You are from Sri Lanka, but you are a naturalized American. You have lived in this country for many years. How do you see the contrast?

cont'd

PONNAMPERUMA: It gives me feelings of great challenge, great excitement, great frustration. A curious mix. The president of Sri Lanka wanted me to come and help him develop science in the country. Now here is a head of state taking a personal interest in scientific development. That's very unusual for anywhere in the world, especially the Third World. The only other person I can think of who did that was Pandit Nehru, the prime minister of India. He looked upon science as the answer to India's problems, the key to its future.

One of the things I'm involved in right now is setting up an Institute of Fundamental Studies in Sri Lanka, something which today is what the Weizmann Institute was 45 years ago. We are starting very late, but this came up as a result of the president's own interest. He's chairman of the board of governors. He presides at every board meeting. Where else in the world do you have a head of state taking that kind of interest? The president says he wants to use science and technology to help Sri Lanka leapfrog into the 21st century. It's almost exhilarating, you know. Here is somebody who wants to take the country directly into the 21st century without going through the intermediate steps.

But there's such a big gap in what's possible there. The very able people are lost to the rest of the world; there's a big problem of brain drain. Salaries are so small. Today a scientist is an international commodity. A good chemist can go to Australia or the United States or Europe.

Q: In a way you are telling your own story when you say that, aren't you?

PONNAMPERUMA: Well, in a way. I wanted to go back when I finished my studies. But I had no opportunity then.

In Sri Lanka, the sciences are also thought of as something western—European, or at least Japanese. Korea was able to get over that and get science right into the hearts of the people. Sri Lanka is trying to do that now. So part of my task as science adviser is to get movement in a country where there is little interest in science.

There is no question in my mind that the difference between the North and the South, the haves and the have-nots, the First World and the Third World, is science and technology. It has made this country great. Take the great civilizations of the past: Egypt, China, Iran. They are in the Third World today. The countries that are in the forefront are the ones that have used the modern developments of science and technology. The man in the street must come to realize that science and technology is the answer. The young person who goes to school must be interested in doing science. You've got to build that infrastructure of science.

So how does one do that? The methods available are the newspapers, public lectures, radio, television. One of the tasks I have undertaken as science adviser to the president, and as director of the Institute of

Fundamental Studies, is to promote this. We have a public lecture every month that might be attended by 500 people. A weekly seminar for those who attend that lecture might be attended by 60 people. We have a group of science writers who got very interested. They will write, and the newspaper will be read by maybe a million people. Sri Lanka has a very high standard of literacy.

Q: Of Third World nations, it is among the most developed, isn't it?

PONNAMPERUMA: Most developed from the literacy point of view. Close to 90 percent. The life expectancy is very high, too, almost 70 years. Sri Lanka is pretty high up on that scale. But still, I think it can go very much further. We can do what Korea has done, what Taiwan has done, move from a colonial kind of economy to a productive one.

Q: What kinds of advice have you given the president of Sri Lanka?

PONNAMPERUMA: A number of subjects have come up constantly. One is formulating a science policy for the country, bringing the scientists of the country together to work on a policy.

### FUNDAMENTAL STUDIES INSTITUTE

Q: Is there a science budget?

PONNAMPERUMA: No, there is no specific science budget. But each ministry has some science. For example, the Ministry of Agriculture would have agricultural research and development. One of the problems in the developing world is the splintering of this activity. Perhaps there has to be a greater deal of centralization in the planning. Often one ministry does not know what the other ministry does. There is duplication. And with scarce resources, especially of manpower, we cannot afford duplication.

Then specific problems come up—perhaps an agricultural pest all of a sudden. I

don't carry all the answers in my head, but as science adviser I have access to scientists, at home and abroad, who will provide help.

In Sri Lanka my main task is science adviser to the president. Then I am director of the Institute of Fundamental Studies. I'm also involved in a program to develop the use of the winged bean, which I personally believe will be a solution to the lack of protein in the developing world. An amazing plant. You eat the leaf, you eat the flower, you eat the bean—the seed is more valuable than soya. It has a tuber. It improves the soil.

As for the Institute of Fundamental Studies, the moment you use the word fundamental, a question is raised: can Sri Lanka afford fundamental studies? My answer is it cannot not afford them. If primitive people did not think in terms of trying to answer questions, they would still be polishing stone tools. On the other hand, there is also a great misconception that fundamental studies is up in the clouds somewhere, that it has no relationship to life today. So whatever is done at the Institute of Fundamental Studies must affect the quality of life.

Q: Does the institute operate laboratories?  
PONNAMPERUMA: Yes. At the moment we have about 15 scientists involved with us. We also have a program of National Fellows. Maybe somebody at the university who works with us does not have good facilities; he does not have support, or even the right atmosphere. We provide that. So there is a two-way street. Whatever is done here is done at the institute and also maybe at the university.

We've been very fortunate. The Japanese government took very kindly to what we are doing, and undertook to equip the entire laboratory. We asked for \$2.5 million worth of equipment; they came back with \$5.7 million. The first grant that I requested was doubled!

Q: That's a highly successful grant proposal.

PONNAMPERUMA: Yes, very unusual. The Japanese are providing the equipment. The Sri Lanka government has provided the building and the recurrent expenses.

I'm trying to get the scientists out there to follow something we're doing here in the States. At this laboratory, if I don't get a grant, I have no research. I write a proposal and I get the money. It's survival of the fittest, kind of. To get a grant from the National Science Foundation or from NASA is not easy. I work terribly hard at my proposals. I'm trying to get that idea instilled among our scientists there. We compete for funds now. So we have submitted a number of programs to the Sri Lanka Board of Science and Technology of the National Academy, which has a competitive program. The U.N. has provided us with a certain amount of money. Italy and Belgium have pledged a certain amount of money. I'm confident that the money will be there.

But the people are a tremendous problem. Many of our younger scientists are abroad. They have been attracted by good salaries and good working conditions. What we can do immediately is to try to offset that. We have a scheme of fellowships and post-doctoral programs. For somebody who has finished a Ph.D., let us say at Maryland, we try to get him back immediately. We also have a program of pre-doctoral fellows. Anyone who is a research assistant at this institute must register for a higher degree.

### ARTHUR C. CLARKE CENTER

Q: What goes on at the Arthur C. Clarke Center?

PONNAMPERUMA: Arthur Clarke lives in Sri Lanka. He gave the world Comsat. So his friends thought that it would be very useful in the developing world to have a center where emphasis would be given to the very frontiers of scientific knowledge in communications, computer science and so on. What is going on there is an attempt to transfer the latest in communications, in information transfer, in computer science. These things may be ordinary here in the U.S., but are still very far out there.  
Q: Can you give me an example?

*'There is no question in my mind that the difference between the North and the South, the haves and the have-nots, the First World and the Third World, is science and technology. It has made this country great.'*

**PONNAMPERUMA:** Let us say computerizing your office.

**Q:** This place then acts as a resource, gives people advice?

**PONNAMPERUMA:** Advice, and trains people, and also will design equipment for local use. The hope is that it eventually could be a mini local Silicon Valley. We could train young people. Right now we have a lot of our young people going out, for instance, to the Middle East as bricklayers and carpenters and so on. We can train a generation of computer operators who can go out.

### ROLE AS SCIENCE ADVISER

**Q:** What's it like being a science adviser in a Third World country? Is it comparable to the position of science adviser in this country? Are you as political?

**PONNAMPERUMA:** No. I'm science adviser to the president of Sri Lanka. It is a one-to-one relationship. There is no office and organization. When the president has a problem, I give him advice. Or I can bring things to his attention—say, in science policy. It is nothing like the kind of organization that you have here, or that India has now. That is a bureaucratic apparatus, whereas in Sri Lanka it is simply that he wants somebody to turn to when things have to be done.

**Q:** Do you foresee that it will evolve into a larger structure?

**PONNAMPERUMA:** I do, as a matter of fact. That is very important for a country such as Sri Lanka. A lot of the aid money for various projects goes into different R&D programs. There should be somebody who understands that, who knows what is happening and can advise a head of state.

**Q:** It also sounds very much as if present interest in Sri Lanka's science is a function of the fact that the president is personally interested. If there were a different president who was less interested in science, might the situation be very different?

**PONNAMPERUMA:** It might be, but on the other hand, once an interest is created, then I foresee it becoming the pattern.

**Q:** We've noted that Sri Lanka is doing better than many Third World countries. That raises the question of whether science isn't something of a luxury. There are countries whose problems are so basic that they can't contemplate using resources for something that's essentially an intellectual endeavor. Is science only possible once a country has achieved a certain prosperity?

**PONNAMPERUMA:** No. Because even those basic problems need science. I mean science as a whole, the entire range. I mean the simple science of health: boil your water before drinking it, wash your hands before you eat, things of that sort. Without it—once again my analogy—we will be stuck with polishing stone tools. Take pesticides, for example. There's a tremendous use of pesticides in the developing countries. As a matter of fact, there is a certain amount of dumping, you know. But the farmer thinks that the more he sprays, the better it is for his vegetables. So we have to tell him to use pesticides carefully. All that will count only when there is an awareness, a consciousness of science.

### AIDING THIRD WORLD SCIENCE

**Q:** Is the science community in developed countries doing enough to give Third World science a helping hand?

**PONNAMPERUMA:** Probably not enough. Large amounts of money are spent in huge schemes, but to make those profitable, the small amount of research and development work that is needed is not often done. I'm talking about very impressive things like building dams, constructing huge waterways and roads. I often think that 1 percent of the total aid budget in countries like Sri Lanka, spent on R&D to make what they're doing better, would be a wonderful approach. But try to get that kind of thinking through. The resistance is so great!

**Q:** What are some things that scientists in those countries could do if they wanted to?

**PONNAMPERUMA:** One example is to introduce techniques of better food production. In a country like Sri Lanka today, there is a protein deficiency. Help with that. You can use a lot of the modern technology, biotechnology. My great fear is that the gap will widen unless things like this are done. It is not the immediate solution to the problem, but what about the year 2001?

At Expo '85, in Japan, I saw a single tomato plant that produced 16,000 tomatoes—more tomatoes than Sri Lanka can produce in a single acre. Of course it's very costly now because you need a closed environment, but soon the cost will go down. Wouldn't it be terrible if Sri Lanka had to depend on Japan for its tomatoes? The great fear I have is that, unless science is implanted in that country, this gap will widen.

I personally believe that the one-to-one relationship between institutes can do a lot. At the University of Maryland we have a relationship with the university system of Sri Lanka, so there is a continuous connection of people coming and going. That is far more important than one-shot deals.

**Q:** You're really concerned, then, with building permanent structures?

**PONNAMPERUMA:** Building the infrastructure of science, which is people. ■

## Dy. head of US Mission shows interest in IFS research

The Deputy Head of the US Mission in Sri Lanka, Mr. Edward Marks paid a visit to the Institute of Fundamental Studies (IFS) Kandy, recently and was greatly interested in the ongoing IFS research in finding ways to convert inert atmospheric nitrogen to ammonia and nitrite which could be directly used as plant fertilizer like urea which is based on expensive petroleum based byproducts, states a Press release by the IFS.

One approach was biological nitrogen fixation using micro-organism like rhizobia and also another bacterium that live on the root surface of grasses like paddy. Research in the latter instance is expected to

lead to the possibility that the rice plants may one day be made capable of producing their own nitrogen fertilizer. The other approach which excited the greater amount of interest in the visitor was a research experiment to convert atmospheric nitrogen directly to fertilizer using sunlight as the source of energy.

As explained by the Director of the IFS, Prof. Cyril Ponnamparuma, IFS scientists were developing a technique by which irrigation water leading into a paddy field is made to flow over a catalysing agent which uses sunlight to break up the water into hydrogen and oxygen and combines them with nitrogen dissolved in the

water, to form nitrites and nitrates which are easily absorbed by the roots of the paddy plants when these compounds are carried there by the same water. Positive results have been already achieved by this technique and it is only

left to improve the conversion rate to a satisfactory level.

On meeting the IFS personnel later on, Mr. Marks remarked: "You have a very exciting Institution here. I compliment you all on this work which seems so esoteric to me."

# They're leaving nothing to chance in search for gems

(Senkadagala special correspondent)

Finding a sure method of locating areas containing gem deposits would be a boon to the economy because a considerable revenue is accrued to the government by the auctioning of gemming rights and also by collecting customs duties on gem exports.

At present we have to rely on chance discoveries by prospectors for locating such areas, and much of it is illegally exploited before the government can move in to claim its legitimate rights.

It is suspected that traces of rare elements like Cerium, Thorium, Niobium, Tantalum, Yttrium etc. which are associated with gem deposits are also found in the soils of such areas. Conversely, the identification of such elements in the soil of a

particular area may turn out to be an indicator of the presence of gem deposits there.

To try out the effectiveness of this theory would require facilities for quick mineralogical analysis of soil samples. As it would be too expensive to set up such facilities here for experimental purposes only, Prof. Cyril Ponnampereuma, Director of the Institute of Fundamental Studies (IFS) has initiated a research project for which the funding will be from Canada.

A team of Canadian scientists with Dr. J. Davies and Dr. R. Whitehead from the Laurentian University and Dr. M. Tremblay who is the Director of the Cooperative Division of the IDRC (International Development Research Centre) of Canada, have already visited our gemming areas for this research, with their Sri Lankan counterparts, Prof. C. B. Dissanayake and Dr. M. S. Rupasinghe of the IFS.

DAILY NEWS, WEDNESDAY DECEMBER 2, 1987

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## **UNDP grants \$600,000 for IFS research**

(Senkadagala Special Correspondent)

The Institute of Fundamental Studies (IFS) has been assured of funding amounting to 600,000 US dollars for selected research activities over the next three years, by the United Nations Development Programme (UNDP). An agreement to this effect was signed last week, between the government of Sri Lanka and the UNDP.

The selected research areas have been identified through formal discussions, seminars and workshops held with reputed personnel in these

respective fields in Sri Lanka. They include Biotechnology, Earth Sciences, Ecology and Conservation, Natural Products and Medicinal Chemistry, Nitrogen Fixation and Solar Energy Conversion.

The UNDP has identified the IFS as a catalyst in promoting multidisciplinary research through scientists from the national universities and other research institutes. The UNESCO will act as the executive agency for this grant.

# Superconductors — Sri Lanka jumps bandwagon

A group of scientists from the University of Peradeniya and the Institute of Fundamental Studies, Kandy have successfully prepared what is believed to be the first superconductor in Sri Lanka. These superconducting material belong to the new oxide-ceramics family which in the past few months has revolutionized the science world and given rise to an avalanche of materials research.

Superconductors are materials with zero resistance to the flow of an electric current. They have the potential of radically altering electrical and electronic appliances used in everyday life, industry and scientific research.

Dr. Lakshman Disanayake, senior lecturer at the Department of Physics of the University of

Peradeniya and head of the IFS superconductor — solid state Physics Group, told "The Island" that it was highly exciting to see the zero resistance in these new materials.

"I think we have made superconductors in Sri Lanka for the first time. It's not so difficult, although we did it with the very limited equipment and (laboratory) facilities we have here," he said.

He continued — "It is rarely that scientists in the third world can join frontier research in Solid State Physics. We are continuing our work in order to understand these materials better and also to search for newer materials which would become superconducting at higher temperatures."

The current excitement in superconductors started in 1986, when Alex Muller and Georg Bednorz, two physicists at IBM Research Laboratories in Zurich announced the discovery of a new class of oxide-ceramics which became superconducting at higher temperatures than was known ever before. This discovery, which earned them the 1987 Nobel Prize for Physics, triggered a global search for new ceramic compounds superconducting at higher and higher temperatures.

A related compound, Yttrium — Barium — Copper Oxide, showing a superconductivity transition temperature minus 180 degrees Centigrade or 95 Kelvin as later prepared by Dr. Paul Chu, a physicist at the University of Houston,

USA. Because of the (relatively) higher temperatures required to make this material superconducting, it is possible to use liquid nitrogen for cooling, instead of liquid helium used so far, which is 30 times more expensive.

"The samples we prepared were in the same family as those prepared by Dr. Paul Chu," said Dr. Disanayake. "Now, we are trying out other compounds by varying the constituent atoms."

Already, a few different compositions of Yttrium — Barium — Copper Oxide have been prepared, and tested for zero electric resistivity. The samples became superconducting at 95 Kelvin or minus 180 degrees Celsius.

"We were able to

demonstrate the Meissner Effect — the ultimate test of true superconductivity — by allowing a small magnet to 'float' on a pellet of the material we prepared," said Dr. Disanayake.

The Peradeniya University — IFS Superconductor team has now joined the on-going global effort to produce a room-temperature superconductor. "Such superconductors would revolutionize the world in many areas such as transport, power transmission, medical diagnosis, lap-top computers and miniature home appliances."

The other members of this research team are Dr. O. A. Heperuma, Dr. K. Premaratne and Mr. Gamini Dharmasena.

— N.G.

DAILY NEWS, MONDAY DECEMBER 28, 1987

## Colloquium on 'number theory'

The international colloquium on 'number theory' will be held at Kandy from December 28 - January 1.

Ten well known experts on Srinivasa Ramanujan's life and work are scheduled to take part in this colloquium. It is being conducted by the Institute of Fundamental Studies in collaboration with the International Centre for Theoretical Physics, Trieste and the Third World Academy of Sciences, Trieste. The Tata Institute of Fundamental Research and the Institute of Mathematical Science, Madras are associated with the colloquium.

The colloquium is being held in memory of India's great number theorist Srinivasa Ramanujan.

The experts participating in the colloquium are: Bruce Berndt, USA; R. Ramachandra, India; D. Zagier, Federal Republic of Germany; R. A. Rankin, UK; C. R. Rao, USA; A. Selberg, USA; R. Balasubramanian, India; G. Sudarshan, USA; K. Srinivasa Rao, India and G. Bhamathi, India.

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DECEMBER 1987

BABU A.G.C., KULASOORIYA S.A. and GRANHALL U.

The use of nitrogen fixing trees for intensive fuel wood production in Sri Lanka.

BALASUBRAMANIAM S, DE SILVA K.H.G.M., DE SILVA P.K. and RANAWANA K.B.

A comparative study of a lagoon-fringing and a riverine mangrove on the South-East coast of Sri Lanka

BANDARA B.M.R., GUNATILAKA A.A.L., WIJERATNA E.M.K and ADIKARAM N.K.B.

Two antifungal compounds from the roots of *Feronia Limonia* (Rubaceae)

DE SILVA K.H., GUNAWARDANA R.P.

Eppawala appatite - Muthurajawela peat mixture as a P - fertilizer

DISSANAYAKE M.A.K.L., DHARMAWARDE P.A.G., ILEPERUMA O.A.

Discharge characteristics of a solid state cell with CuCl: CuCNS electrolyte and bi-metal electrodes

DISSANAYAKE W.D.D.P. and ILEPERUMA O.A.

Enhanced photoreduction of  $N_2$  on clay supported Iron oxide catalyts

KULASOORIYA S.A., ABHAYAWARDHANE Y., GUNATILAKA M.K. and WIJERATHNA BANDA W.M.

A field oriented laboratory evaluation of rhizosphere nitrogen fixation associated with wetland rice at different growth stages.

KULASOORIYA S.A., ABHAYAWARDHANA Y., GUNATILAKA M.K.

Studies on rhizobial cross inoculation with some species of Sesbania and a few selected food legumes.

KULASOORIYA S.A., ABHAYAWARDHANA Y., and GUNATILAKA M.K.

A laboratory evaluation of rhizosphere nitrogen fixation associated with wetland rice.

KULASOORIYA S.A. DE SILVA H.A.G.S., DE SILVA A.P.

Uptake of nitrogen by rice from different species of Azolla

KULASOORIYA S.A., PATHMASIRI S.A.S.

The occurrence and utilization of leguminous species endemic to Sri Lanka

KULASOORIYA S.A., SAMARAKOON I.M.

Nitrogen fixing cyanobacteria from rice fields of Sri Lanka

KURUPPUARACHCHI T.A.

Deriving a field shear strength envelope for landslide prone soils in the Belihul Oya catchment, Maturata area.

KURUPPUARACHCHI T.A., SENEVIRATNA Y.B.M.C.J., RANATUNGA E.R.

An enquiry into the antecedent precipitation conditions related to earthslip generation in the Belihul Oya catchment, Maturata area.

MENDIS S.

Prevalence of symptomatic coronary heart disease in a rural population

MENDIS S., ARIYARATNAM A.

The relationship of reported parental history and relative risk of coronary heart disease.

NUGEGOD D., BALASUBRAMANIAM S., DE ALWIS W.L.

Vegetation cover of the Uda Walawe National Park

PREMALA K.H.M.S., DISSANAYAKE M.A.K.L., DHARMASENA P.A.G.,  
ILEPERUMA O.A.

Opto electronic properties of n-Cde/p Cu phthalocyonine  
heterojunction solar cells

PUNCHIHEWA S., ILEPERUMA O.A., LEWKE BANDARA T.S.

Improved efficiency of nitrogen photo reduction of  
titanium doped ferric hydroxide via the possible seperation  
of active sites for hydrogen and oxygen evolution.

RUPASINGHE M.S., DHARMARATNA T., DISSANAYAKE C.B.

Fluorine as a tool in geochemical exploration

SUBASINGHE S.M.N.D., SILVA K.K.M.W., DAHANAYAKE K.

Secondary structure and variable compositional zones  
of the Eppawela phosphate deposit.

WEERAKKODY W.J.S.K., PARKINSON D., WIDANAPATHIRANA S.,  
BALASOORIYA I.

Analysis of litterfall in a montane rain forest  
of Sri Lanka

WICKREMASINGHE N.S.M.D., PONNAMPERUMA C., HOBLISH M.K.

Direct Interactions between homocodenic amino acids  
and nucleotides: a possible physio chemical basis for the  
origin of the genetic code.