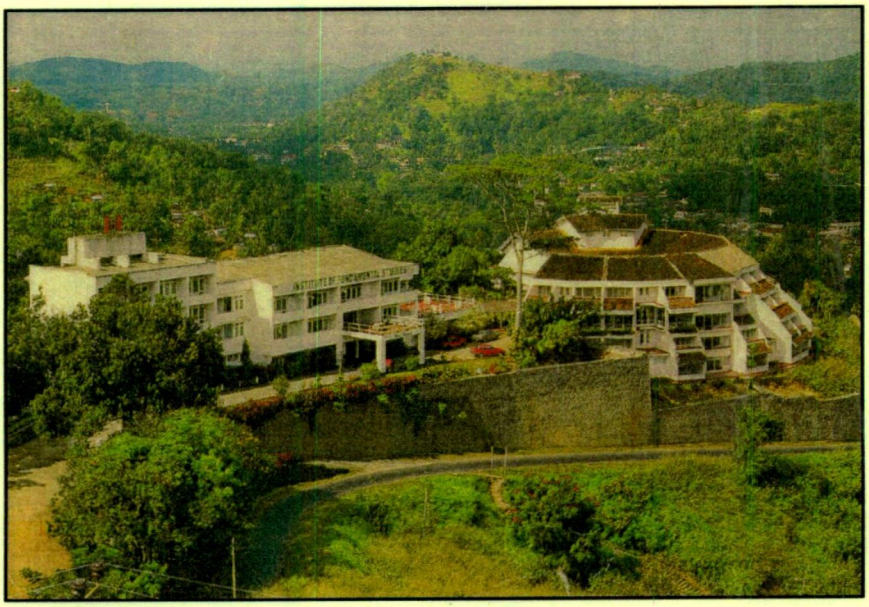
ANNUAL RESEARCH REPORT 2005



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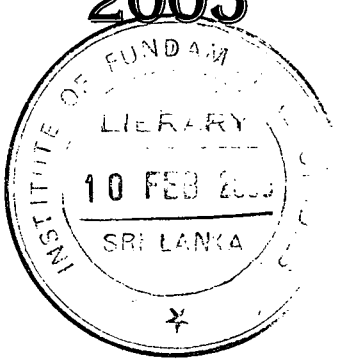

Compiled by
Science Dissemination unit

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CONTENTS

PUBLICATIONS IN REFEREED JOURNALS IN 2005

1. Agyeman B.O., Kaneko S., Kumara G.R.A., Okuya M., Murakami K., Konno A., and **Tennakone K.** Sensitization of Nanocrystalline SnO_2 Films with Indoline Dyes. ***Japanese Journal of Applied Physics*, 44:** L731-L733 (2005)[2].

2. **Bandara J.**, Guasaquillo I., Bowen P., Soare L., Jardim W.F., and Kiwi J. Photocatalytic Storing of O_2 as H_2O_2 Mediated by High Surface Area CuO. Evidence for a Reductive-Oxidative Interfacial Mechanism. ***Langmuir*, 21:** 8554-8559 (2005)[1,2].

3.* **Bandara J.**, Pradeep U.W., and Bandara R.G.S.J. The role of n–p junction electrodes in minimizing the charge recombination and enhancement of photocurrent and photo-voltage in dye sensitized solar cells. ***Journal of Photochemistry and Photobiology, A: Chemistry,* 170**: 273-278 (2005)[1,2].

4.* **Bandara J.** and Weerasinghe H. Employing NiO as a hole collector in Solid-state dye-sensitized solar cell. ***Institute of Physics Sri Lanka,* 5:** 11-16 (2004).

5.* **Bandara J.** and Weerasinghe H. Efficient Solid-state dye sensitized solar cells fabricated on a compact TiO_2 barrier layer preventing short-circuit current. ***Institute of Physics Sri Lanka,* 5:** 27-35 (2004).

6.* **Bandara J.** and Weerasinghe H.C. Enhancement of photovoltage of dye-sensitized solid-state solar cells by introducing high-band-gap oxide layers. ***Solar Energy Materials and Solar Cells,* 88:** 341-350 (2005)[1,2].

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9.* **Dharmaratne H.R.W.**, Tennakoon S.B., and **Piyasena K.G.N.P.** A Geranylated biphenyl derivative from *Garcinia mangostana*. ***Natural Product Research,*** 239-243 (2005)[2].

10. * **Dias H.V.R.**, Richey S.A., Diyabalanage H.V.K., and Thankamani J. Copper(I) Complexes Supported by a Heavily Fluorinated Bis(pyrazolyl)borate: Syntheses and Characterization of $[H_2B(3,5\text{-}(CF_3)_2Pz)_2]CuL$ (Where L = PPh_3, $N{\equiv}CCH_3$, $HC{\equiv}CPh$, $H_2C{=}CHPh$) and $\{[H_2B(3,5\text{-}(CF_3)_2Pz)_2]Cu\}_2(1,5\text{-COD})$. ***Journal of Organometallic Chemistry*, 690:** 1913-1922 (2005)[1,2].

11. **Dias H.V.R.**, Wang X., and Diyabalanage H.V.K. Fluorinated Tris(pyrazolyl)borate Ligands without the Problematic Hydride Moiety: Isolation of Copper(I)-Ethylene and Copper(I)-Tin(II) Complexes using $[MeB(3\text{-}(CF_3)Pz)_3$ ***Inorganic Chemistry*, 44**: 7322-7324 (2005)[1,2].

12. **Dias H.V.R.** and Diyabalanage H.V.K Trimeric silver(I) pyrazolates with isopropyl, bromo and nitro substituents: Synthesis and characterization of $\{[3,5\text{-}(i\text{-}Pr)_2Pz]Ag\}_3$, $\{[3,5\text{-}(i\text{-}Pr)_2,4\text{-}(Br)Pz]Ag\}_3$, and $\{[3,5\text{-}(i\text{-}Pr)_2,4\text{-}(NO_2)Pz]Ag\}_3$. ***Polyhedron***, 2005 (in press) [1,2].

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14. **Ellepola S.K.W.,** Choi S.M., and Phillips D.L. Raman Spectroscopic study of rice globulin. ***Journal of Cereal Science,*** 2005 (in press) [1,2].

15. **Ellepola S.W.** and Ma C.Y. Thermal Properties of globulin from Rice (*Oryza sativa*) seeds. ***Food Research International,*** 2005 (in press) [1,2].

16. * Hoch M. and **Weerasooriya R.** Modeling interactions of kaolinite-tributyl tin interface. ***Chemosphere,*** **59:**743-752 (2005)[1,2].

17. * Hoch M. and **Weerasooriya R.** New model calculations of pH depending tributyltin (TBT) adsorption onto monmorillonite and monmorillonite-rich sediment. ***Environmental Science and Technology,*** **39:**844-849 (2005)[1,2].

18. * **Jayasinghe U.L.B.**, Balasooriya B.A.I.S., Hara N., and Fujimoto Y. Steroidal and triterpenoidal saponins from the fruits of *Diploclisia glaucescens.* ***Natural Product Research,*** **19:** 245-251 (2005) [2].

19. **Jayasinghe U.L.B.**, Hara N., and Fujimoto Y. (2-Nitro Ethyl) Phenyl and cyanophenyl glycosides from the fruits of *Diploclisia glaucescens*, ***Natural Product Research,*** 2005 (in press) [2].

20. **Jayasinghe U.L.B.,** Samarakoon T.B., Kumarihamy B.M.M., Hara N., and Fujimoto Y. Prenylated flavonoids and xanthones with radical scavenging properties from the root bark of *Artocarpus nobilis.* ***Natural Product Research,*** 2005 (in press) [2].

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22. Jayasinghearachchi H.S. and **Seneviratne G.** Fungal solubilization of rock phosphate is enhanced by forming fungal-rhizobial biofilms. ***Soil Biology and Biochemistry,*** 2005 (in press) [1,2].

23. Jayatissa L.P., **Silva E.I.L.**, McElhiney J., and Lawton L.A. Risk of toxigenic cyanobacterial blooms in freshwaters of Sri Lanka. ***Systematic and Applied Microbiology,*** 2005 (in press)[1,2].

24. Jayaweera P.M., Rajapakse R.M.S.D., and **Tennakone K.** TiO_2 nano-porous photoelectrochemical cells (PECs) sensitized with mixed cationic/anionic dye systems: Role of the second cationic fluorescent dye on the photocurrent enhancement. ***Chemical Physics Letters*, 412:** 29-34 (2005) [1,2].

25. * **Jayaweera P.V.V., Perera A.G.U., Seneviratne M.K.I., Pitigala P.K.D.D.P.,** and **Tennakone K.** Dye-sensitized near-infrared room temperature photovoltaic photon detectors. ***Applied Physics Letters*, 85:** 5754-5756 (2005)[1,2].

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32. Kumara G.R.A., Kaneko S., Konno A., Okuya M., and **Tennakone K.** Dye-sensitized solar cell sensitized with the Shiso leaf pigment. ***Solar Energy Materials and Solar Cells***, 2005 (in press) [1,2].

33. Kumara G.R.A., Kaneko S., Konno A., Okuya M., Murakami K., Onwona – agyeman B., and **Tennakone K.** Large area dye-sensitized solar cells: Material Aspects of Fabrication. ***Progress in Photovoltaics***, 2005 (in press) [1,2].

34. * **Nanayakkara A.** New Semiclassical and Numerical approaches to locate zeros of wave functions. ***Communications in Theoritical Physics*, 42:** 693(2005)[1,2].

35. * **Nanayakkara A.** Semiclassical Chaos in a 2-D Exactly Solvable system. ***SriLanka Journal of Physics*, 5:** 1 (2004).

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38. * **Perera V.P.S., Seneviratne M.K.I., Pitigala P.K.D.D.P.,** and **Tennakone K.** Doping CuSCN Films for Enhancement of conductivity: Application in Dye-sensitized Solid-state solar cells. ***Solar Energy Materials and Solar Cells*, 86**: 443-450. (2005)[1,2].

39. Raja P., **Bandara J.**, Giordano P., and Kiwi J. Innovative Supported Composite Photocatalyst for the Oxidation of Phenolic Waters in Reactor Processes. ***Industrial and Engineering Chemistry Research*, 44:** 8959-8967 (2005)[1,2].

40. * Sakagami Y., Iinuma M., **Piyasena K.G.N.P.,** and **Dharmaratne H.R.W.** Antibacterial activity of α-Mangostin against Vancomycin Resistant *Enterococci* (VRE) and Synergism with Antibiotics. ***Phytomedicine,*** 203-208 (2005)[2].

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55. **Silva E.I.L.**, Jennerjahan T.C., and Ittekkot V. Nutrient fluxes into coastal waters via Sri Lankan rivers: a comparison with other Asian rivers. ***International Journal of Ecology and Environmental Science,*** **31(3):**34-40 (2005).

56. **Silva E.I.L.** and Samaradiwakara S.R.M.S.Limnology of Kandy Lake Before the Outbreak of Cyanaobacteria Bloom III. Phytoplankton composition and succession. ***Sri Lanka Journal of Aquatic Sciences,*** **10**:55-71 (2005).

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67. **Wijayasinghe A.**, Bergman B., and Lagergren C. LiFeO2-LiCoO2-NiO materials for Molten Carbonate Fuel Cell cathodes Part II: Fabrication and characterization of porous gas diffusion cathodes. ***Solid State Ionics,*** 2005 (in press) [1,2].

68. **Wijayasinghe A.**, Bergman B., and Lagergren C. LiFeO2-LiCoO2-NiO materials for Molten Carbonate Fuel Cell cathodes Part I: Powder synthesis and material characterization. ***Solid State Ionics,*** 2005 (in press) [1,2].

Total number of publications for year 2005 - 44
Twenty four articles appeared as "in press" in the Annual Research Report 2004

Names of the IFS staff members are in bold letters
* *Reported as 'in press' in Annual Report 2004*
[1] *Listed in the Science Citation Index in 2005*
[2] *Listed in the Science Citation Index-expanded in 2005*

IMPACT FACTORS OF JOURNALS IN WHICH, THE ARTICLES ARE PUBLISHED

(Impact factors are computed to an accuracy of three decimal places, X: Impact Factor not computed for the year 2005)

JOURNAL	IMPACT FACTOR
American Journal of Tropical Medicine and Hygiene	*2.013*
Applied Catalysis B: Environmental	*4.042*
Applied Physics Letters	*4.308*
Bulletin of Material Sciences	*0.554*
Chemical Communications Royal Society of Chemistry	*4.000*
Chemical Physics Letters	*2.438*
Chemistry Letters	*1.650*
Chemosphere	*2.359*
Chinese Journal of Physics	*0.289*
Colloids and Surfaces	*1.513*
Communications in Theoritical Physics	*0.871*
Current Applied Physics	*1.117*
Current Science	*0.688*
Environmental Science and Technology	*3.557*
Food Research International	*1.332*
Forest Ecology and Management	*1.522*
Industrial and Engineering Chemistry Research	*1.424*
Inorganic Chemistry	*3.454*
Institute of Physics, Sri Lanka	*X*
International Journal of Ecology and Environmental Science	*X*
Japanese Journal of Applied Physics	*1.142*
Journal of Asian Earth Sciences	*1.095*
Journal of Cereal Science	*2.173*
Journal of Colloid and Interface Science	*1.784*
Journal of Magnetism and Magnetic Materials	*1.031*
Journal of Organometallic Chemistry	*3.462*
Journal of Photochemistry and Photobiology: A Chemistry	*2.235*
Journal of Physical Chemistry B, American Physical Society	*3.834*
Journal of Solid State Chemistry	*1.815*
Langmuir	*3.295*
Natural Product Research	*0.529*
Photochemical and Photobiological Sciences	*2.235*
Physics Letters A	*1.454*
Phytomedicine	*1.201*
Polyhedron	*1.586*
Progress in Photovoltaics	*1.196*
Research Journal of Microbiology	*X*
Science of the Total Environment	*1.925*
Semiconductor Science and Technology	*2.152*
Soil Biology and Biochemistry	*2.234*
Soil Science Society of America Journal	*1.561*
Solar Energy Materials and Solar Cells	*1.432*
Solid State Ionics	**1.862**

JOURNAL	IMPACT FACTOR
Sri Lankan Journal of Physics	X
Sri Lanka Journal of Aquatic Sciences	X
Systematic and Applied Microbiology	1.933
Tropical Agricultural Research and Extension	X

PROJECT: **COMPUTATIONAL MATHEMATICS AND PHYSICS**
(I) QUANTUM CHAOS

COMMENCEMENT: 2000

INVESTIGATORS (2005):

Nanayakkara A., *Associate Research Professor* **(Project Leader)**
Kumari H.K.J.S., *Research Assistant*

PROGRESS ACHIEVED (*Since inception*):

In recent years, the manifestation of chaos in quantum mechanics have been of great interest. In particular, quantum systems which are classically chaotic have been investigated intensively. In order to study signature of chaos in quantum mechanics, we have been developing various theoretical and computational methods for multidimensional systems which bridge classical mechanics with quantum mechanics in a transparent manner. Also we have been investigating quantum mechanical quantities which contain information on chaos in the corresponding classical system. Major achievements of this project since its inception (till end of the year 2004) can be summarized as follows:

(1) A new powerful asymptotic energy expansion method was developed for 1-D systems. This method is based on power series expansion of the quantum action variable J in energy and can be applied to a wide range of potentials. Contour integrals involved in the method are much simpler than that in WKB methods.

(2) A new quantization condition was developed for 1-D systems. This new method is a computational method which can be applied to large number of 1-D systems.

(3) The semi-classical concepts and methods which are normally used for studying semi-classical chaos in real phase-space were extended to complex phase-space for studying both PT-symmetric and pseudo Hermitian systems. It is found that most of the semi-classical methods which have been developed for quantizing multi-dimensional real Hermitian Hamiltonian systems can be successfully employed for complex non-Hermitian PT-symmetric systems with suitable extensions

(4) Several 1-D and 2-D pseudo Hermitian Hamiltonian systems have been studied. The Lyapunov exponents and classical phase space trajectories were used to distinguish regular motion from chaotic ones. The quantum energy level statistics were used to identify quantum signatures of classically chaotic motion.

(5) A new analytical method was developed for locating zeros of wave functions. In this method locating zeros of the wave function is converted to finding roots of a polynomial whose coefficients are obtained as analytical expressions.

(6) Distribution of zeros of quantum wave functions and second differences of energy at avoided crossings were investigated. We developed new approximation and numerical methods for locating zeros of wave functions. Hermitian systems have been studied to establish a connection between classical chaos and behavior of quantum eigen states at avoided crossings. Applicability of very high order non-degenerate perturbation theory for studying energy levels of multidimensional systems near avoided crossings were also investigated.

PROJECT OUTPUT 2005:

In 2005, non-PT symmetric systems were studied with non-perturbative action angle theoretical methods. Semiclassical Lie transformation methods were modified for complex non-Hermitian systems. Results were surprisingly good. Before publishing results of this work, thorough and deep investigation on why the quantum mechanical methods based on periodic trajectories in the real phase space are still valid in non-periodic trajectories in complex phase space will be carried out.

This project has produced 20 research papers and 3 research communications during last five years.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

*1.**	*Title:*	Level spacing distributions and quantum chaos in Hermitian and non Hermitian systems
	Authors:	**Nanayakkara A.** and **Wickramarachchi P.**
	Journal:	***Communications in Theoritical Physics,* 44:** 31 (2005)[1,2]
2.*	*Title:*	Comparison of quantal and classical behavior of *PT*-symmetric systems at avoided crossings
	Author:	**Nanayakkara A.**
	Journal:	***Physics Letters A,* 334:** 144 (2005)[1,2]
3.*	*Title:*	New Semiclassical and Numerical approaches to locate zeros of wave functions
	Author:	**Nanayakkara A.**
	Journal:	***Communications in Theoritical Physics,* 42:** 693 (2004)[1,2]
4*.	*Title:*	Semiclassical Chaos in a 2-D Exactly Solvable system
	Author:	**Nanayakkara A.**
	Journal:	***Sri Lanka Journal of Physics,* 5:** 1 (2004)

* ***Reported as 'in press' in Annual Report 2004***
[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

OTHER CONTRIBUTIONS:

Tilakaratne C.T.K. and **Nanayakkara A.**

Contributed an article on Time, Space, You and Me (කාලයයි, අවකාශයයි, මමයි මමයි), World Year of Physics, Institute of Physics, Sri Lanka, Vol. 3(1), 2005.

PROJECT: **COMPUTATIONAL MATHEMATICS AND PHYSICS**
(II) COMPUTER SIMULATION OF ELECTROPHYSIOLOGICAL ACTIVITIES IN HUMAN BRAIN

COMMENCEMENT: 2002 (August)

INVESTIGATORS (2005):

Nanayakkara A., *Associate Research Professor* **(Project Leader)**
Selvarajan S., *Lecturer, University of Jaffna*

PROGRESS ACHIEVED (*Since inception*):

As the first project in the area of computer simulation of electrophysiological activities in human brain, we investigated epilepsy. Epilepsy is a chronic medical condition produced by temporary changes in the electrical function of the brain, causing seizures which affect awareness, movement, or sensation. One of the signatures of the human epileptic brain during periods of time in between seizures is the presence of brief burst of focal neuronal activity known as interictal spikes. Often such spikes emanate from the same region of the brain from which the seizures are generated but the relationship between the spikes patterns and seizure onset remains unclear.

In this project we simulated some experiments using neural network models with chemical kindling and investigated how to control the chaotic nature of the network. We developed and investigated several neural network models. We simulated both the normal and the epileptic brains with discrete and continues models. External stimuli to the neural work and the inclusion of additional Calcium and Potassium currents were studied in detail.

PROJECT OUTPUT 2005:

Mr. Selvarajan was awarded an MPhil degree for his research work on this project. **Several Manuscripts based on this research work have been submitted for publication in appropriate journals.**

POSTGRADUATE DEGREES COMPLETED IN 2005:

1. *Name :* S. Selvarajan
   Thesis title: Modeling Epileptic Brain using discrete and continuous neural network models
   Degree: MPhil.
   Awarded by the University of Sri Jayawardenepura

PROJECT: **COMPUTATIONAL MATHEMATICS AND PHYSICS**

(III) **COMPUTER AIDED DESIGNING OF NEW MATERIALS**

COMMENCEMENT: 2004

INVESTIGATORS (2005):

Nanayakkara A., *Associate Research Professor* **(Project Leader)**
Senadeera G.K.R., *Senior Research Fellow*
Seneviratne S.B.M.S., *Research Assistant*
Udathasan T., Research Student *(NSF funded)*

PROGRESS ACHIEVED (*Since inception*):

Aim of this project is to design new materials with desirable electronic and physical properties using *ab initio* and semi-empirical computational methods. In this long term project, we are addressing the problem of calculating electronic structure properties of materials from three different fronts. They are

(1) Calculation of electronic structure properties using molecular based Density Functional theory and other electronic structure methods.

(2) Calculation of electronic structure properties using Crystal molecular orbital based methods.

(3) Development of new theoretical methods to incorporate electronic exchange and correlation effects more accurately in Density Functional Theory.

Preliminary calculations based on Molecular Density Functional Theory were carried out for several conducting polymers and calculated both electronic band gaps and band positions of them. The calculated values are in fairly good agreement with the experimental values. We also predicted electronic band gaps and band positions of few new conducting polymers which have not yet been studied experimentally. The manuscripts based on these results have been submitted for publication in appropriate journals.

PROJECT OUTPUT 2005:

In order to test our new theoretical methods, two software packages are being developed. One package (called **MOLDF**) is based on Density Functional Theory and new exchange correlational functionals. Most of the coding has been completed. Now it is in the testing stage.

The second package is based on Crystal Molecular Orbital theory. It is specially developed for studing conducting polymers. A three year **NSF** grant was received for

hiring a research student to assist the development of this Crystal Molecular Orbital based electronic structure code. NSF research student joined the research team in October 2005

New method was developed for predicting band gaps of polymers using HOMO-LUMO gaps of finite size oligomer chains. Various types of conducting polymers were investigated using the above method.

We have developed a method to calculate band positions theoretically using nearly free electron model. Development of **MOLDF** software code started in October 2005.

PROJECT : CONDENSED MATTER PHYSICS

COMMENCEMENT : 1987

INVESTIGATORS (2005):

Tennakone, K., *Senior Research Professor* **(Project Leader)**
Wijayantha K.G.U., *Visiting Senior Research Fellow*
Perera V.P.S., *Visiting Scientist*
Bandaranayake K.M.P., *Research Assistant*
Jayaweera P.V.V., *Research Assistant*
Pitigala P.K.D.D.P., *Research Assistant*
Seneviratne M.K.I., *Research Assistant*
Premalal E.V.A., *Research Assistant*

PROGRESS ACHIEVED (*Since inception*):

This project was initiated around mid nineteen eighties to conduct original research in major areas of Condensed Matter Physics depending on the existing trends and the facilities available. In the first few years, a considerable effort was diverted towards high temperature superconductivity, a fashionable theme at that time. Subsequently, the project moved in the direction of semiconductor physics and fundamental research in the area of solar energy conversion. The project continues to conduct investigations on semiconductor films and nanostructures and dye-sensitization covering both experimental and theoretical aspects. Dye-sensitized solid-state solar cells and dye-sensitized nanostructure photoelectrochemical cells based on composite materials are important innovations of the project which receive international recognition. The work conducted has given rise to nearly 170 publications in international journals. The project has gained acclaim as a focus of activity in this field and some of the papers published are widely cited.

PROJECT OUTPUT 2005:

The work conducted in the previous year in the area of dye-sensitized semiconductor nanostructures was continued. Another model system was demonstrated to illustrate the applicability of molecular rectification as means of suppressing recombination in sensitized carrier injection. A new concept of achieving panchromatic sensitization by linking chromopores to conducting polymer chains was introduced and a model cell fabricated to explain the principle. A series of experiments were conducted in collaboration with Center for Innovations, Shizuoka University, Japan to understand the nature of surface recombination in dye-sensitized solar cells and the influence of dye in mitigation of recombination. With the same collaboration methods were developed to improve the efficiencies of large area cells. Studies on 1/f noise in semiconductor nanostructures were continued as a collaboration with the Department of Physics, Georgia State University.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1.* *Title:* Water photoreduction with Cu_2O Quantum Dots on TiO_2 Nano-Particles
Authors: **Seneviratne M.K.I., Pitigala P.K.D.D.P.,** and **Tennakone K.**
Journal: ***Journal of Photochemistry and Photobiology,A: Chemistry,*** **171:** 257- 259 (2005) [1,2]

2.* *Title:* Photocatalysis of CFC degradation by titanium dioxide
Authors: **Tennakone K.** and **Wijayantha K.G.U.**
Journal: ***Applied Catalysis B: Environmental,*** **57:** 9-12 (2005) [1,2]

3.* † *Title:* Dye-sensitized near-infrared room temperature photovoltaic photon detectors
Authors: **Jayaweera P.V.V., Perera A.G.U., Seneviratne M.K.I., Pitigala P.K.D.D.P.,** and **Tennakone K.**
Journal: ***Applied Physics Letters,*** **85:** 5754-5756 (2005) [1,2]

4.* *Title:* Doping CuSCN Films for Enhancement of conductivity: Application in Dye-sensitized Solid-state solar cells
Authors: **Perera V.P.S., Seneviratne M.K.I., Pitigala P.K.D.D.P.,** and **Tennakone K.**
Journal: ***Solar Energy Materials and Solar Cells,*** **86**: 443-450. (2005) [1,2]

5. *Title*: Molecular Rectification: Application in Dye-Sensitized Solar Cells
Authors: **Seneviratne M.K.I., Pitigala P.K.D.D.P., Perera V.P.S.,** and **Tennakone K.**
Journal: ***Langmuir,*** **21**: 2997-3001(2005) [1,2]

6. *Title*: Dye-sensitized solar cell with an extremely thin liquid film as the redox mediator
Authors: Kumara G.R.A., Kaneko S., Konno A., Okuya M., and **Tennakone K.**
Journal: ***Chemistry Letters***, **34**: 572-573 (2005) [1,2]

7. *Title*: Sensitization of Nanocrystalline SnO_2 Films with Indoline Dyes
Authors: Agyeman B.O., Kaneko S., Kumara G.R.A., Okuya M., Murakami K., Konno A., and **Tennakone K.**
Journal: ***Japanese Journal of Applied Physics***, **44:** L731-L733 (2005) [2]

8. *Title*: Chromopore linked conducting polymers attached semiconductor surfaces: A Strategy for development of dye-sensitized solar cells
Authors: **Seneviratne M.K.I., Pitigala P.K.D.D.P.,** and **Tennakone K.**
Journal: ***Journal of Physical Chemistry B, American Physical Society,*** **109:**16030-16033 (2005) [1,2]

9. *Title*: 1/*f* Noise and Dye-sensitized solar cells
Authors: **Jayaweera P.V.V., Perera A.G.U.**, and **Tennakone K.**
Journal: ***Semiconductor Science and Technology*, 20:** L1-L3 (2005) [1,2]

10. *Title*: TiO_2 nano-porous photoelectrochemical cells (PECs) sensitized with mixed cationic/anionic dye systems: Role of the second cationic fluorescent dye on the photocurrent enhancement
Authors: Jayaweera P.M., Rajapakse R.M.S.D., and **Tennakone K.**
Journal: ***Chemical Physics Letters*, 412:** 29-34 (2005) [1,2]

11. *Title*: The effect of the partical size and the conductivity of CuI layer on the performance of solid-state dye sensitized solar cells
Authors: Konno A., Kitagawa T., Kida H., Kumara G.R.A., and **Tennakone K.**
Journal: ***Current Applied Physics*, 5:** 149-151 (2005)[2]

12.†† *Title*: An enhancement of photoproperties of solid-state TiO_2/dye/CuI type cells by coupling mercurochrome with natural juice extracted from pomegranate fruits
Authors: **Sirimanne P.M., Senevirathna I.**, and **Tennakone K.**
Journal: ***Chemistry Letters*, 34(11):** 1568-1569 (2005) [1,2]

13. *Title*: Dye-sensitized solar cell sensitized with the Shiso leaf pigment
Authors: Kumara G.R.A., Kaneko S., Konno A., Okuya M., and **Tennakone K.**
Journal: ***Solar Energy Materials and Solar Cells***, 2005 (in press) [1,2]

14. *Title*: Large area dye-sensitized solar cells: Material Aspects of Fabrication
Authors: Kumara G.R.A., Kaneko S., Konno A., Okuya M., Murakami K., Onwona–agyeman B., and **Tennakone K.**
Journal: ***Progress in Photovoltaics***, 2005 (in press) [1,2]

† ***This publication is included in the publication list of the project Semiconductor Optoelectronics***
†† ***This publication is included in the publication list of the project Nano Science (chemistry and physics)***

* ***Reported as 'in press' in Annual Report 2004***
[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Pitigala P.K.D.D.P., Senevirathna M.K.I.,** Liyanage L.S.G. and **Perera V.P.S.**
   Deposition of quantum dot shell on semiconductor particles: A strategy to suppress recombination in dye-sensitized solar cells based on ZnO
   Proceedings of the Sri Lanka Association of the Advancement of Science, Part I, 63 pp., 61st annual session, 2005. Sri Lanka Association of the Advancement of Science, Colombo.

2. Kumara G.R.R.A., Konno A., Agyeman B.O., Okuya M., Kaneko S., and **Tennakone K.**
   Indoline dyes for Dye-sensitized Solid-State Solar Cells using Copper Iodide as the Hole Collector
   The 11th Asian Chemical Congress, August 24-26, 2004, Korea National University.

3. Konno A., Kumara G.R.R.A., and **Tennakone K.**
   Recent development in dye-sensitized solid-state cells based on metal-free organic dyes
   The 52nd Annual Meeting of the International Society for Electrochemistry, September 25-30, 2005, Busan, Korea.

4. Konno A., Kumara G.R.R.A., Kawaguchi T., Katoh Y., and **Tennakone K.**
   Dye-sensitized solid-state solar cell sensitized with coumarin derivatives
   Pacific Chemistry Congress, December 15-20, 2005, Honolulu, Hawaii, USA.

INVITED LECTURES/CONFERENCES ATTENDED IN 2005:

1. **Tennakone K.**
   Dye-sensitized Solar Cells: Problems and Possible Solutions, Shizuoka, University, Japan , March 2005 (*Presentation)*

2. **Tennakone K.**
   Fundamental (Basic) vs Applied Research, University Grants Commission Seminar on Curriculum Revision, May 2005 (*Invited lecture*)

3. **Tennakone K.**
   Pigment based mesoscopic solar cells: Some insights into their mode of operation and possibilities of improvement , Institute of Physics /Institute of Technical Physics and Chemistry, Chinese Academy of Sciences,September,2005(*Invited lecture)*

4. **Tennakone, K.**
   Ball Lightning, Workshop on Lightning, its physics, chemistry and hazards, Institute of Fundamental Studies , October 2005

5. **Tennakone K.**
   Nanoscience and Nanotechnology: An Overview, Workshop on Nanoscience and Nanotechnology, National Science Foundation, Sri Lanka, October,2005 (*Invited lecture*)

6. **Tennakone K.**
   Human Creativity from Physics to Music, University of Peradeniya Research Sessions, November 2005 (*Guest Lecture*)

7. **Tennakone K.**
   Albert Einstein and What He Did , The World Year of Physics Program, Institute of Fundamental Studies, November 2005 (*Presentation)*

8. **Tennakone K.**
   Reformers of knowledge: From Aristotle to Einstein and lessons for all of us, Convocation, University of Ruhuna, 10th December 2005 (*Convocation Address)*

OTHER CONTRIBUTIONS:

1. **Tennakone K.**
   The World Year of Physics: 2005 the Centennial Anniversary of Albert Einstein's Miraculous Year , Daily News,11 April 2005

2. **Tennakone K.**
   Physics of the Diyaluma Falls, Island, 07 June 2005

3. **Tennakone K.**
   Albert was not only abstract: Physics of Kome Pittu, Pragna, World Year of Physics Issue, October 2005.

4. **Tennakone K.**
   Theoretical Physics: Its History and the Current Status, Pragna, World Year of Physics Issue, October 2005.

PROJECT : PHOTOCHEMISTRY

COMMENCEMENT : 1999

INVESTIGATORS (2005):

Bandara J., *Senior Research Fellow* **(Project Leader)**
Maligaspe E.C., *Research Assistant*
Yasomanee S., *Research Assistant (NSF funded)*
Wansapura P.T., *Volunteer Student*

PROGRESS ACHIEVED (*Since inception*):

Interfacial electron-transfer dynamics are fundamental to solar cells applications and optimization of these interfacial dynamics is a key issue in achieving improvement in device performance. The project successfully demonstrated use of n-p junction electrode for the control of charge recombination in dye-sensitized solar cells. The photochemistry project also successfully demonstrated how the barrier layer could increase the photocatalytic activity by coating thin insulating layers on photocatalysts.

The project leader has the highest "Hit factor"* (7.67) among the IFS scientists. (*Hit factor is calculated dividing number of total citations by number of publications and it has been considered as the latest research performance evaluation factor)

Worked as an invited professor at Swiss Federal Institue of Technology from Nov 2004 to March 2005.

Number of Publications during 1999 - 2005 in refereed international journals: 20

PROJECT OUTPUT 2005:

The research on preparation and characterization of p-type oxide semiconductors to be used as hole conductors in solid-state dye-sensitized solar cells was continued. New research on photocatalytic conversion of solar energy into chemical energy (water splitting and photodegradation of pollutants) was re-initiated.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1.* *Title:* Enhancement of photovoltage of dye-sensitized solid-state solar cells by introducing high-band-gap oxide layers
Authors: **Bandara J.** and Weerasinghe H.C.
Journal: ***Solar Energy Materials and Solar Cells*, 88:** 341-350 (2005)[1,2]

(This article has been selected as the most downloaded article of the journal in 2005)

2.* *Title:* Solid-state dye-sensitized solar cell with p-type NiO as a hole collector

Authors: **Bandara J.** and Weerasinghe H.

Journal: ***Solar Energy Materials and Solar Cells,*** **85:** 385-390 (2005)[1,2]

3.* *Title:* The role of n–p junction electrodes in minimizing the charge recombination and enhancement of photocurrent and photo-voltage in dye sensitized solar cells

Authors: **Bandara J.**, Pradeep U.W., and Bandara R.G.S.J

Journal: ***Journal of Photochemistry and Photobiology, A: Chemistry,*** **170**: 273-278 (2005) [1,2]

(This article was among the most downloaded articles of the journal in 2005.)

4.* *Title:* Employing NiO as a hole collector in Solid-state dye-sensitized solar cell

Authors: **Bandara J.** and Weerasinghe H.

Journal: ***Institute of Physics Sri Lanka,*** **5:** 11-16 (2004)

5.* *Title:* Efficient Solid-state dye sensitized solar cells fabricated on a compact TiO_2 barrier layer preventing short-circuit current

Authors: **Bandara J.** and Weerasinghe H.

Journal: ***Institute of Physics Sri Lanka,*** **5:** 27-35 (2004)

6. *Title:* Innovative Supported Composite Photocatalyst for the Oxidation of Phenolic Waters in Reactor Processes

Authors: Raja P., **Bandara J.**, Giordano P., and Kiwi J.

Journal: ***Industrial and Engineering Chemistry Research,*** **44:** 8959-8967 (2005) [1,2]

7. *Title:* Photocatalytic Storing of O_2 as H_2O_2 Mediated by High Surface Area CuO. Evidence for a Reductive-Oxidative Interfacial Mechanism

Authors: **Bandara J.**, Guasaquillo I., Bowen P., Soare L., Jardim W. F., and Kiwi J.

Journal: ***Langmuir,*** **21:** 8554-8559 (2005) [1,2]

8. *Title:* Highly stable CuO incorporated TiO_2 catalyst for photocatalytic hydrogen production from H_2O

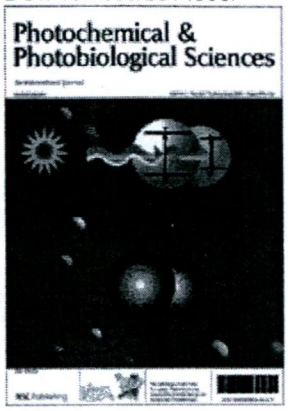
Authors: **Bandara J.**, Udawatta C.P.K., and Rajapakse C.S.K.

Journal: ***Photochemical and Photobiological Sciences,*** **4**: 857-861 (2005)[2]

(This article has been selected as the cover page of the issue 11, 2005 of the journal)

Front cover: *Photochem. Photobiol. Sci.*, 2005, **4**(11), 849

DOI: 10.1039/b514506f



* ***Reported as 'in press' in Annual Report 2004***

[1] ***Listed in the Science Citation Index in 2005***

[2] ***Listed in the Science Citation Index-expanded in 2005***

PROJECT : **SOLID STATE CHEMISTRY**
(Chemistry, preparation and characterization of semiconducting materials, conducting organic solids and polymers)

COMMENCEMENT : 1999

INVESTIGATORS (2005):

Senadeera G.K.R., *Senior Research Fellow* **(Project Leader)**
De Silva N., *Research Assistant*
Fernando J.M.R.C., *Research Assistant(NSF funded)*

PROGRESS ACHIEVED (*Since inception*):

This Project was initiated in 1999 and mainly directed towards the understanding of fundamental physico-chemical aspects that are centered to electrically conducting polymers and conventional semiconductors, which have been the object of increasing academic and technological interest during the last 10-15 years. Cyclic voltametry (CV), SEM, TEM, XPS, FTIR, AC impedance and photocurrent measurements were used to characterized the materials synthesized and used in the investigations.

Some of the major achievements are:
(a)The identification of complexes of Cu(I) bromide with sulfides *(Sri Lankan Patent No. 11982)* and Pentacene as promising materials suitable for positive charge collection in solid-state dye sensitized photo cells.

(b)Discovery of a new method for deposition of CuSCN on dye coated TiO_2 films and a simple model system, where the broadening of the spectral response, enhanced charge separation and the consequent increase in the energy and incident photon to current efficiencies in photoelectrochemical cells by ionic linkage of some complexes of dyes.

(c)Construction of a fully automated spray pyrolysis unit (equipment) to prepare homogenous nanocrystalline oxide semiconducting thin films.

(d) In order to explore the possibilities of the use of new regioreguler conducting polymers suitable in photovoltaic applications as alternatives to the expensive Ruthenium based dyes, poly (3-thiophenemalonic acid), poly(3-thiophenylacetic acid) (P3TAA) and one of it's regioregular polymer Poly(3 thiophenylacetic acid)-Poly(Hexyl thiophene) (P3TAA-PHT) having carboxylic groups were synthesized, characterized and tested their photoresponses by fabricating both the solid sate and liquid electrolytic photocells comprising TiO_2 electrodes and obtained higher efficiencies than the reported devices with conducting polymers so far. In these investigations, a simple, efficient and rapid- microwave assisted method has been introduced in synthesis of P3TAA in which the total synthesis consists of esterification of 3-thiophenyl acetic acid and hydrolysis of poly (3-methyl acetate) in aqueous alkaline media.

Total No. of articles published (since inception, 1999)

(a) ***In refereed journals cited in Science Citation Index = 16***

(b) ***In other refereed journals (including Science Citation index expanded) = 4***

(c) ***Abstracts and conference proceedings: 15***

(d) ***Conference proceedings full papers: 7***

(e) ***Hit factor*** *= (Total No. of citations of the papers/No. of papers) = 7.25 (3rd Highest among the IFS scientists)*

(f) **Patents:** *International Patent No.* NKS 2624-2003-36805, *: Sri Lankan Patent No. 11982*

(g) ***Presidential Awards for Research Publications in Science Citation Index-1999, 2000, and 2001***

PROJECT OUTPUT 2005:

1. For the first time in the field of polymer sensitized solid sate solar cells, novel, volatile solvent free, solar cells were fabricated with mesoporous TiO_2 electrodes sensitized using thiophene derivatives containing carboxyl groups and in situ electropolymerized poly(3,4-ethylenedioxythiophene) as a holetransporting material together with the ionic liquid 1-ethyl-3- methylimidazolium bis(trifluoromethylsulfonyl)amide and lithium bis(trifluoromethanesulfone)imide as additives for charge transport promotion.

2. Photovoltaic devices were assembled using synthesizing a conducting polymer having two carboxcilic groups; poly (3-thiophenemalonicacid). Significant photo-responses were obtained with the solar cells comprising with TiO_2.

3. Nano-structured TiO_2 electrodes, suitable for dye sensitized solid-state solar cells were prepared by a new simple spraying technique (SPT). Physical properties of these electrodes were compared with the electrodes prepared by the 'doctor blade' technique (typical sliding method, DB).

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1.* *Title*: Microwave assisted steps in the synthesis of poly(3-thiophenyl acetic acid)
Author: **Senadeera G.K.R.**
Journal: ***Current Science*, 88(1):** 145-148 (2005) [1,2]

2.* *Title:* Photoresponses of electrodes prepared by CuSCN with electro-deposited C_{60} on mesoporous TiO_2
Authors: **Senadeera G.K.R.** and **Perera V.P.S.**
Journal: ***Chinese Journal of Physics*, 43(2):** 384-390 (2005)[1,2]

3.* *Title:* A new crystal structure for $(BEDT\text{-}TTF)_2SbF_6$ and some of its physical properties
Authors: **Senadeera G.K.R.** and Mori T.
Journal: ***Bulletin of Material Science*, 28(1):** 25–29 (2005)[2]

4.* *Title:* Spray–painted nanostructured TiO_2 electrodes for solid-state dye sensitized photocells
Author: **Senadeera G.K.R.**
Journal: ***Sri Lankan Journal of Physics*, 5:**17-25 (2004)

5. *Title*: Volatile solvent-free solid-state polymer-sensitized TiO_2 solar cells with poly(3,4-ethylenedioxythiophene) as a hole-transporting medium
Authors: **Senadeera R.**, Fukuri N., Saito Y., Kitamura T., Wada Y., and Yanagida S.
Journal: ***Chemical Communications (Royal Society of Chemistry, UK)*, 17:** 2259–2261 (2005) [1,2]

6. *Title:* Photosensitization of nanocrystalline TiO_2 films by a polymer with two carboxylic groups, Poly (3-thiophenemalonic acid)
Authors: **Senadeera G.K.R.** , Kitamura T., Wada Y., and Yanagida S.
Journal: ***Solar Energy Materials and Solar cells*, 88(3):** 315-322 (2005)[1,2]

7. *Title:* Versatile preparation method for Mesoporous TiO_2 electrodes suitable for solid-state dye sensitized photocells
Authors: **Senadeera G.K.R.**, Kobayashi S., Kitamura T., Wada Y., and Yanagida S.
Journal: ***Bulletin of Material Science*, 28(6):** 635-641(2005)[2]

8. *Title*: Synthesis of Triphenylamine Trisazo dye and its uses in dye sensitized solar cells
Authors: **Senadeera G.K.R.** and Jiang K-J.
Journal: ***Sri Lankan Journal of Physics*, 6:** 43 (2005)

* ***Reported as 'in press' in Annual Report 2004***
[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **de Silva N.** and **Senadeera G.K.R.**

   Dye sensitized solar cells employing molten salt electrolyte
   Proceedings of the Sri Lanka Association for the Advancement of Science, Part I, 62 pp., 61st annual session, 2005. Sri Lanka Association for the Advancement of Science, Colombo

2. **Fernando J.M.R.C** and **Senadeera G.K.R.**

   Photovoltaic cells using regioregular thiophenes and TiO_2
   Proceedings of the Sri Lanka Association for the Advancement of Science, Part I, 65 pp., 61st annual session, 2005. Sri Lanka Association for the Advancement of Science, Colombo

PROJECT : NANO SCIENCE(CHEMISTRY AND PHYSICS)

COMMENCEMENT : 2005

INVESTIGATORS (2005):

Sirimanne P.M., *Senior Research Fellow* **(Project Leader)**

PROGRESS ACHIEVED (*Since inception*):

This project was initiated in year 2005. Properties of nano-structured oxide films and their applications in dye-sensitized solid-state and photoelectrochemical cells were studied. The work conducted has raised 03 publications in international journals.

The project leader won a JSPS post-doctoral fellowship from Japanese Government for a period of two years.

Number of Publications during this year in refereed international journals: 03

PROJECT OUTPUT 2005:

A natural pigment (Cyanadin 3-glucoside) is extracted from pomegranate fruits, organic polymer [2-methoxy-5-(2-ethyl-hexyloxy)-p-phenylene vinylene], (MEH-PPV) and metal free organic dye mercurochrome were used as sensitizers in dye sensitized solid-state cells. Coupling of Cyanadin 3-glucoside with mercurochrome is found to increase the performance of TiO_2|dye|p-semiconductor solid state cells compare to that of them in along in similar systems. A metal centered dye cis-dithiocyanate-bis (2-2′ bipyridyl-4-4′-dicarboxylate) ruthenium (II) exhibited the highest performance in this type of dye sensitized solid-state cells. Photo-properties of TiO_2|mercurochrome|Cyanadin 3-glucoside|CuI system are found comparable with the cells sensitized with cis-dithiocyanate-bis (2-2′ bipyridyl-4-4′-dicarboxylate) ruthenium (II).

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1. *Title:* Observation of microwave conductivity in copper iodide films and relay effect in the dye molecules attached to CuI photocathode
   Authors: **Sirimanne P.M.**, Soga T., and Kunts M.
   Journal: ***Journal of Solid State Chemistry,*** **178**: 3010 (2005)[1,2]

2.†† *Title:* An enhancement of photoproperties of solid-state TiO_2|dye|CuI type cells by coupling mercurochrome with natural juice extracted from pomegranate fruits
   Authors: **Sirimanne P.M., Senevirathna I.,** and **Tennakone K.**
   Journal: ***Chemistry Letters,*** 34(11): 1568 (2005)[1,2]

3. *Title:* Utilization of natural pigment extracted from pomegranate fruits as sensitizer in solid-state Solar Cells

Authors: **Sirimanne P.M., Senevirathna M.K.I., Premalal E.V.A., Pitigala P.K.D.D.P., Sivakumar V.,** and **Tennakone K.**

Journal: ***Journal of Photochemistry and Photobiology,A:Chemistry,*** 2005 (in press) [1,2]

†† ***This publication is included in the publication list of the project Condensed Matter Physics***

[1] ***Listed in the Science Citation Index in 2005***

[2] ***Listed in the Science Citation Index-expanded in 2005***

AWARDS:

1. **Sirimanne P.M.**

JSPS post-doctoral fellowship from Japanese Government for a period of two years.

PROJECT : **ELECTROCHEMICAL MATERIALS**

COMMENCEMENT : April 2005

INVESTIGATORS (2005):

Wijayasinghe A., *Research Fellow* **(Project Leader)**
Samarasinghe P.B., *Research Assistant*

PROGRESS ACHIEVED (*Since inception*):

This project mainly emphasizes the synthesis and characterization of technologically important materials for the electrochemical energy conversion applications. Synthesis of new materials using different chemical and solid-state routes is being investigated. The electrochemical characterizations of the synthesized materials are performed employing a.c. impedance spectroscopy, d.c. 4-probe, Seebeck and polarization techniques, followed by in-cell testing in laboratory cells. Furthermore, XRD, SEM, EDX, FTIR, DSC, BET, Porosimetry, and Pycnometry techniques are employed for material characterizations depending on the requirements.

Some of the achievements;

(a) The study performed on NiO:$LiCoO_2$-$LiFeO_2$ materials, which are viable alternatives for the electrode material of carbonate fuel cells, reveals the ability of improving electrical conductivity and stability of the materials significantly, by careful control of Co and Fe contents. The electrochemical performance studies show very promising characteristics for these materials.

(b) Work on Li-Co-Ni-Mn based oxides, which are potential candidates for modern Li-ion batteries, is being carried out. The synthesis studies show promising characteristics for further electrochemical investigations.

(c) Materials study on Sr and Mg doped lanthanum galates, which are promising candidates for the electrolyte material of low temperature solid oxide fuel cells, has been started with the collaboration of Royal Institute of Technology (KTH), Sweden. The preliminary studies show the possibility of enhancing electrical conductivity while preserving the crystal structure of the material.

(d) Preliminary investigations on fast-ion-conductors (Ag-ion conductors in the form of glass) have been initiated with the collaboration of KTH, Sweden.

(e) Under the material characterization work, a new high temperature 4-probe specimen holder, which can be used to measure electrical conductivity and Seebeck coefficient of bulk materials, has been designed and fabricated at IFS.

Total number of articles published:

(a). In refereed journals cited in Science Citation Index = 2

(b). Conference proceedings (full papers) = 1

PROJECT OUTPUT 2005:

The materials investigated under this project can be divided into two main groups, as *electronic conductors* and *ionic conductors*.

Initially, the work on Li-Fe-Co-Ni-Mn based electronically conducting oxides was started. These new materials were synthesized by employing the conventional solid-state sintering technique as well via novel wet-chemical routes (Pechini, glycine-nitrate and stearic-entrapment methods). Calcinations and sintering studies were performed in order to find the optimum conditions for calcinations and sintering of these new materials. A number of new compositions have so far been synthesized under NiO-$LiCoO_2$, $LiCoO_2$-$LiFeO_2$ and $LiFeO_2$-NiO binary systems and, NiO-$LiCoO_2$-$LiFeO_2$ and $LiNiO_2$-$LiCoO_2$-$LiMnO_2$ ternary systems. The outcome of the study shows promising characteristics of these materials for the applications as electrode materials of carbonate fuel cells and modern Li-ion batteries. Specially, this study reveals the ability of improving the electrochemical properties and the stability of the material while preserving the desired crystal and microstructure.

A research collaboration has been initiated with Prof. Bill Bergman's group at the Department of Materials Science and Engineering in Royal Institute of Technology (KTH) Sweden. Accordingly, some of the advanced characterizations on the above mentioned electronically conducting materials and preliminary work on novel ionic conductors have been performed at KTH, during a three months research fellowship given to Dr. Wijayasinghe in autumn 2005. Under the work on ionic conductors, studies on oxygen-ion conducting, lanthanum galates, and Ag-ion conducting fast-ion-conductors have been initiated and are in progress now.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1. *Title:* $LiFeO_2$-$LiCoO_2$-NiO materials for Molten Carbonate Fuel Cell cathodes Part I: Powder synthesis and material characterization
   Authors: **Wijayasinghe A.**, Bergman B., and Lagergren C.
   Journal: ***Solid State Ionics,*** 2005 (in press) [1,2]

2. *Title:* $LiFeO_2$-$LiCoO_2$-NiO materials for Molten Carbonate Fuel Cell cathodes Part II: Fabrication and characterization of porous gas diffusion cathodes
   Authors: **Wijayasinghe A.**, Bergman B., and Lagergren C.
   Journal: ***Solid State Ionics,*** 2005 (in press) [1,2]

[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Wijayasinghe A.**, Lagergren C., and Bergman B.
   $LiFeO_2$-$LiCoO_2$-NiO cathodes for Molten Carbonate Fuel Cells (***full paper***)
   Proceedings of 7th International Symposium on Molten Salts Chemistry and Technology (MS7), Toulouse, France, 2005, 425-429

INVITED LECTURES/CONFERENCES ATTENDED IN 2005:

1. **Wijayasinghe A.**
   $LiFeO_2$-$LiCoO_2$-NiO cathodes for Molten Carbonate Fuel Cells (***Oral presentation)*** 7th International Symposium on Molten Salts Chemistry and Technology (MS7), Toulouse, France, 28th August – 2nd September 2005.

PROJECT: **METAL COORDINATION CHEMISTRY**

COMMENCEMENT: 1999

INVESTIGATORS:

Dias H.V.R., *Visiting Research Professor* **(Project Leader)**

PROJECT OUTPUT 2004:

Metal complexes are widely used in a variety of applications ranging from catalysis, materials chemistry to medicine. Properties of metal complexes are directly related to the nature of ligands around the metal site. Thus the development of new ligands with useful steric/electronic properties is of particular interest. Current efforts are focused on the design, synthesis and applications of nitrogen and oxygen based ligands such as tris(pyrazolyl)borates, pyrazolates, triazapentadienyl systems, and aminotroponimines. We are using these new ligands to prepare metal catalysts for small molecule activation, isolate reaction intermediates, develop transition metal containing drugs, and to control photochemical processes of metal coordination compounds.

We have investigated the coordination chemistry and catalytic properties and antimicrobial properties of metal adducts obtained using fluorinated tris(pyrazolyl)borate and triazapentadienyl ligands. Metal ions bonded to these ligands are highly electron deficient as evident from the spectroscopic data of the carbonyl groups. Some of the metal adducts of tris(pyrazolyl)borates also facilitate the catalytic oxidative polymerization of aromatic amines. We have also explored the photophysical properties of copper, silver, and gold pyrazolyl adducts. They show bright luminescence under a variety of conditions.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1.* *Title:* Copper(I) Complexes Supported by a Heavily Fluorinated Bis(pyrazolyl)borate: Syntheses and Characterization of $[H_2B(3,5\text{-}(CF_3)_2Pz)_2]CuL$ (Where L = PPh_3, $N{\equiv}CCH_3$, $HC{\equiv}CPh$, $H_2C{=}CHPh$) and $\{[H_2B(3,5\text{-}(CF_3)_2Pz)_2]Cu\}_2(1,5\text{-COD})$

Authors: **Dias H.V.R.**, Richey S.A., Diyabalanage H.V.K., and Thankamani J. *J*

Journal: ***Journal of Organometallic Chemistry*, 690**: 1913-1922 (2005)[1,2]

2. *Title:* Fluorinated Tris(pyrazolyl)borate Ligands without the Problematic Hydride Moiety: Isolation of Copper(I)-Ethylene and Copper(I)-Tin(II) Complexes using $[MeB(3\text{-}(CF_3)Pz)_3]$

Authors: **Dias H.V.R.**, Wang X., Diyabalanage H.V.K.,

Journal: ***Inorganic Chemistry*, 44**: 7322-7324 (2005) [1,2]

3. *Title:* Trimeric silver(I) pyrazolates with isopropyl, bromo and nitro substituents: Synthesis and characterization of {[3,5-(*i*-Pr)$_2$Pz]Ag}$_3$, {[3,5-(*i*-Pr)$_2$,4-(Br)Pz]Ag}$_3$, and {[3,5-(*i*-Pr)$_2$,4-(NO_2)Pz]Ag}$_3$

Authors: **Dias H.V.R.** and Diyabalanage H.V.K.

Journal: ***Polyhedron***, 2005 (in press) [1,2]

* ***Reported as 'in press' in Annual Report 2004***

[1] ***Listed in the Science Citation Index in 2005***

[2] ***Listed in the Science Citation Index-expanded in 2005***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Dias H.V.R.**
The chemistry of highly fluorinated pyrazolates and poly(pyrazolyl)borates
ACS National Meeting, San Diego, California, March 2005

2. **Dias H.V.R.**
Coinage Metal Complexes of Polyfluorinated Ligands, and their Catalytic and Photophysical Properties
NSF-Inorganic Chemistry Workshop; Landsdowne, Virginia, June 2005

3. Wang X. and **Dias H.V.R.**
Coinage metal complexes of polyfluorinated B-methylated tris(pyrazolyl)borates
229th ACS National Meeting, San Diego, California, March 2005

4. Diyabalanage H.V.K. and **Dias H.V.R.**
Divalent group 14 derivatives of aminotroponiminates: Potential alternatives for phosphines and nucleophilic carbenes
229th ACS National Meeting, San Diego, California, March 2005

5. Cross J.L., Baker R.T., Kubas G.J., Diyabalanage H.V.K., and **Dias H.V.R.**
Special delivery: Reactions of cationic NHC-main group adducts with transition metal complexes
229th ACS National Meeting, San Diego, California, March 2005

6. Rudkevich D.M., Organo V.G., Leontiev A.V., Sgarlata V., **Dias H.V.R.**
Supramolecular features of synthetic nanotubes
230th ACS National Meeting, Washington, DC, August 2005

PROJECT: **NATURAL PRODUCTS CHEMISTRY**

I. Chemistry, biological activity and structure- activity relationship studies of natural products and plant extracts of Sri Lankan flora

COMMENCEMENT: 1994

INVESTIGATORS (2005):

Dharmaratne H.R.W., *Associate Research Professor* **(Project Leader)**
Napagoda M.T., *Research Assistant*
Piyasena K.G.N.P., *Research Assistant*
Premaratne S.R., *Research Assistant*
Haroon M.H., *Lecturer, South Eastern University*
Jayaweera D.S., *Technician*

PROGRESS ACHIEVED *(since inception):*

Anti HIV, antibacterial [anti methicillin-resistant *Staphylococcus aureus* (MRSA) and anti vancomycin-resistant *Entrococci* (VRE)], anti fungal and antioxidant natural products have been isolated from Sri Lankan plants and their chemical structures were elucidated using spectroscopic methods and partial synthesis. Further, their structure activity relationship studies were investigated. Some of the structures of biologically active compounds and their activities are given below. Other than the biologically active compounds, a number of new natural products have been isolated and their structures were elucidated.

Above research findings and other collaborative research work paved the way to twenty-two international publications, thirty-eight research communications, four national awards including prestigious Institute of Chemistry Gold Medal (2004) and following postgraduate degrees.

Piyasena K.G.N.P. - Chemistry and Bioactivity Studies of *Garcinia Mangostana.* M. Phil, University of Peradeniya (2005).

Napagoda M.T. - Chemistry and Bioactivity Studies of some Sri Lankan flora and isolation of bioactive xanthones from *Calophyllum thwaitesii* M. Phil, University of Peradeniya (2005).

Marasinghe G.P.K. - Chemistry and antiviral/anti-HIV activity of family Clusiaceae. M. Phil, University of Peradeniya (2000).

Wijesinghe W.M.N. - Chemistry and antimicrobail activity of *Calophyllum moonii* M. Phil, University of Colombo (1999).

Wanigasekera W.M.A.P. - Chemistry and search for antiviral/anti-HIV activity of some Sri Lankan *Calophyllum* species. M. Phil, University of Peradeniya (1996).

As recognization of our work, following awards have been received by members of our research group.

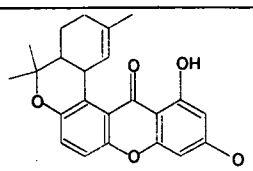
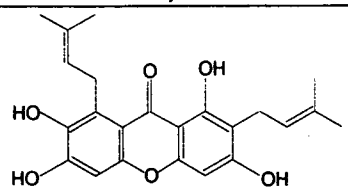
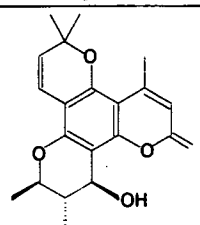
1. Institute of Chemistry **Gold Medal 2004**, for outstanding contribution in the use of Chemical Sciences for the development or innovation in industry or for national development in Sri Lanka. **Dharmaratne H.R.W.**

2. Visiting Scholar, National Center for Natural Products Research University of Mississippi, University, MS, USA 2000/2001 - **Dharmaratne H.R.W.**

3. **Kandiah Memorial Award** (11) for the best piece of research carried out by a postgraduate student in Sri Lanka 1999 - **Wijesinghe W.M.N.M**

4. **Kandiah Memorial Award** (11) for the best piece of research carried out by a postgraduate student in Sri Lanka 1997 - **Wanigasekera W.M.A.P.**

5. **TWAS/NARESA award** for the best young scientist of the year 1996 (Chemistry Award) - **Wanigasekera W.M.A.P.**

 calozeyloxanthone	Anti MRSA and anti VRE
 γ-mangostin	Anti MRSA and Anti VRE
 cordatolide A	Anti HIV 1 RT

PROJECT OUTPUT 2005:

Allelopathic activity: Lettuce seed germination assay is widely used in the detection of allelochemicals, throughout the world. However, there are no previous reports on this type of study in Sri Lanka. Hence the present study was carried out to detect potential germination inhibitory activity of Sri Lankan plants. In this study, the normal lettuce seed germination assay was slightly modified to suit our needs and initially16 crude plant extracts were screened. Our observations suggested that

Cardiospermum halicacabum (Penela) water extract has shown seed germination inhibitory activity which might be due to the presence of allelopathic agents that could be used as a source of natural herbicides in the future. Even though other extracts have not inhibited the lettuce seed germination at a considerable level, the reduced root lengths observed for all the extracts except the water extract of leaves of *Ipomoea aquatica*, might increase the chance of desiccation in seedlings before establishment and delay growth. Further studies are in progress to detect the possible allelopathic effect of the *C. halicacabum* and other plant extracts.

Structure-activity: Structure-activity studies of antibacterial active xanthones from *Garcinia mangostana* and other plant species were investigated.

Seaweeds: Sea weeds are commercially important as a source of alginates, agar and carrageenan. Further marine algae (seaweeds) are well known to produce an incredible diversity of secondary metabolites having potent anticancer, antimicrobial, anti-inflammatory, antiviral, anthelmintic, and insecticidal activities. However, a limited attention has paid on Sri Lankan sea weeds. Therefore, a project on Chemistry and Biological activity studies of Sri Lankan sea weeds was initiated.

Thirtyfive seaweeds species were collected from different locations from the coastal line of Pottuvil (Eastern Province), Tengalle, Hambantota and Kirinda. Specimens were preserved by fixing them in 3-5% buffered Formalin at the Natural Product Laboratory. Seaweeds were cleaned, washed, thoroughly air-dried and powdered using a grinder. Chemistry and biological activity studies of above extracts are in progress.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1.* *Title:* A Geranylated biphenyl derivative from *Garcinia mangostana*
Authors: **Dharmaratne H.R.W.**, Tennakoon S.B., and **Piyasena K.G.N.P.**
Journal: ***Natural Product Research,*** 239-243 (2005)[2]

2.* *Title:* Antibacterial activity of α-Mangostin against Vancomycin Resistant *Enterococci* (VRE) and Synergism with Antibiotics
Authors: Sakagami Y., Iinuma M., **Piyasena K.G.N.P.**, and **Dharmaratne H.R.W.**
Journal: ***Phytomedicine,*** 203-208 (2005)[2]

* ***Reported as 'in press' in Annual Report 2004***
[2] ***Listed in the Science Citation Index-expanded in 2005***

INVITED LECTURES/CONFERENCES ATTENDED IN 2005:

1. **Dharmaratne H.R.W.**
   Lecture conducted on Plant Chemistry at Vijaya College, Matale on Science Day (14.10.2005).

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Napagoda M. T., Balasuriya B.M.G.K.** and **Dharmaratne H.R.W.**
   Inhibitory activities of some plant extracts upon germination of Lettuce
   Proceedings of Sri Lanka Association for the Advancement of Science, 61st annual session, 2005, 46 p.p

2. **Dharmaratne H.R.W.** and **Piyasena K.G.N.P.**
   Structure-activity relationship studies of antibacterial (MRSA and VRE) active xanthones from *Garcinia mangostana*
   Proceedings of Sri Lanka Association for the Advancement of Science, 61st annual session, 2005, 71 p.p

POSTGRADUATE DEGREES COMPLETED IN 2005:

1. *Name:* **Piyasena K.G.N.P.**
   Thesis Title: Chemistry and Bioactivity Studies of *Garcinia Mangostana*
   Degree: M.Phil.
   Degree awarded by the University of Peradeniya .

2. *Name:* **Napagoda M. T.**
   Thesis Title: Chemistry and Bioactivity Studies of some Sri Lankan flora and isolation of bioactive xanthones from *Calophyllum thwaitesii*
   Degree: M.Phil.
   Degree awarded by the University of Peradeniya .

PROJECT : **NATURAL PRODUCTS CHEMISTRY**

II. Search for bioactive compounds from Sri Lankan plants as potential resources for treatment and control of diseases

COMMENCEMENT: 1992

INVESTIGATORS (2005):

Jayasinghe U.L.B., *Associate Research Professor* **(Project Leader)**
Amarasinghe N.R., *Research Assistant*

PROGRESS ACHIEVED *(since inception)*:

During the past twelve years we have been doing research on various parts of following plants: *Pometia eximia* and *Filicium decipiens* (Sapindaceae), *Sarcococca brevifolia* (Buxaceae), *Uncaria elliptica* (Rubiaceae), *Terminalia catappa* (Combretaceae), *Diploclisia glaucescens* (Menispermaceae), *Bridelia retusa* and *Ageratum conyzoides*(Euphorbiaceae). This work led to the isolation and structure elucidation of hederagenin saponins, quinovic acid saponins, phytolaccagenic acid saponins, serjanic acid saponins, oleanolic acid saponins, norneohopane ester of caffeic acids, flavonoid glycosides, flavone C-glycosides, steroidal alkaloids, indole alkaloids, ecdysteroids, bisabolane sesquiterpenes and phenolic compounds etc. Some of these isolates showed strong antibacterial, antifungal, molluscicidal and insecticidal activity. Further we have revised the previous structure assignments of uncaric acid, diketouncaric acid and diacetouncaric acid which were reported from *Uncaria elliptica* (Rubiaceae). In addition, we have identified a number of antifungal, antibacterial, nematicidal and antifeedant active extracts from some Sri Lankan plants. All these results led to 29 publications, 45 communications, 03 book chapters and and 02 M. Phil. Degrees.

PROJECT OUTPUT 2005:

Preliminary investigations indicated the presence of antifungal active compounds (against *Cladosporium cladosporioides*) in both ethyl acetate and methanol extracts of the whole fruits of *Artocarpus altilis*. Chromatographic separation of the combined extracts gave ten compounds. Seven of them were identified as (*E*)-4-(3-methyl-E-but-1-enyl)-3,5,2',4'-tetrahydroxystilbene, (*E*)-3,5,2',4'-tetrahydroxystilbene, 2-(2,4-dihydroxyphenyl)-5,7-dihydroxychroman-4-one, 2-(3,5-dihydroxyphenyl)-benzo furan-4,6-diol, (*E*)-4-isopentenyl)-3,5,2', 4'-tetrahydroxy stilbene, 5,7,2',4'-tetrahydroxyflavone and β-sitosterol by detailed analysis of ^{1}H, ^{13}C NMR, mass spectral data. All these compounds except β-sitosterol showed radical scavenging properties towards 2,2'-diphenyl-1-picrylhydrazyl (DPPH) radical by TLC bio-autography method.

Chemical investigation of the dichloromethane extract of the leaves of *Syzygium jambos* furnished three rare dihydrochalcones, phloretin 4'-O-methyl ether (2',6'-dihydroxy-4'-methoxydihydrochalcone, myrigalone G (2',6'-dihydroxy-4'-methoxy-3'-methyldihydrochalcone) and myrigalone B (2',6'-dihydroxy-4'-methoxy-3',5'-dimethyldihydrochalcone with radical scavenging properties towards the DPPH radical by spectrophotometric method.

Following paper has been selected as most downloaded papers from 2004 in Natural Product Research.
Jayasinghe U.L.B., Balasooriya B.A.I.S., Bandara A.G.D., and Fujimoto Y. Glycosides from *Grewia damine* and *Filicium decipiens, **Natural Product Research,*** 18, 499-502 (2004).

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1.* *Title:* Steroidal and triterpenoidal saponins from the fruits of *Diploclisia glaucescens*
Authors: **Jayasinghe U.L.B.**, Balasooriya B.A.I.S., Hara N., and Fujimoto Y.
Journal: ***Natural Product Research,*** **19:** 245-251 (2005) [2]

2. *Title:* Prenylated flavonoids and xanthones with radical scavenging properties from the root bark of *Artocarpus nobilis*
Authors: **Jayasinghe U.L.B.,** Samarakoon T.B., Kumarihamy B.M.M., Hara N., and Fujimoto Y.
Journal: ***Natural Product Research,*** 2005 (in press) [2]

3. *Title:* (2-Nitro Ethyl) Phenyl and cyanophenyl glycosides from the fruits of *Diploclisia glaucescens*
Authors: **Jayasinghe U.L.B.,** Hara N., and Fujimoto Y.
Journal: ***Natural Product Research,*** 2005 (in press) [2]

* ***Reported as 'in press' in Annual Report 2004***
[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

BOOKS AND MONOGRAPHS:

1. *Title:* Search for biologically active compounds from Sri Lankan Plants
Authors: **Jayasinghe U.L.B.** and Fuimoto Y.
In the book: Frontiers in Natural Product Chemistry, vol. 1
Publisher: Benthum Science Publishers, 193– 200 (2005).

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Jayasinghe L.,** Nanayakkara N.P.D., Melissa R.J., and Abbas H.K
   Antimicrobial compounds from *Fusarium polyphialidicum Proceedings, Friontiers in Bioorganic and Natural Products Chemistry, American Society of Pharmacognosy, 46th Annual Meeting, Oregon State University, Corvalis, USA*, P.48 (2005)

2. Nanayakkara N.P.D., **Jayasinghe L.**, Melissa R.J., and Abbas H.K.
   Antimicrobial compounds from *Alternaria alternate*
   Proceedings, Friontiers in Bioorganic and Natural Products Chemistry, American Society of Pharmacognosy, 46th Annual Meeting, Oregon State University, Corvalis, USA P.48 (2005)

AWARDS:

1. **Jayasinghe U.L.B.**
   Visiting Scholar, National Center for Natural Products Research, University of Mississippi, USA, 2004/2005.

PROJECT: **BIOCHEMISTRY**

COMMENCEMENT: **1997**

INVESTIGATORS (2005):

Dharmaratne H.R.W., *Associate Research Professor* **(Project Leader)**
Balasuriya B.M.G.K., *Research Assistant*
Fernando W.I.T., *Research Assistant*
Perera S.M., *Technician*

PROGRESS ACHIEVED *(since inception)*:

Two acid proteinases from the juice of *Nepenthes distillatoria* pitcher were purified to near homogeneity and their partial amino terminal amino acid sequences were determined, and compared with reported sequences of known plant aspartic proteinases from rice, barley and cardoon. Proteolytic action of above *Nepenthes* major acid proteinase, on dhal and other proteins at acidic as well as neutral pH levels were found to be remarkable. Enzymic and structural characterization of nepenthesin, a unique member of a novel subfamily of aspartic proteinases was completed.

Under the project on efficacy and toxicological studies on herbal remedies in veterinary practice in Sri Lanka, our *in-vitro* and *in-vivo* studies showed that crude extracts of *Areca catechu* (areca-nut) unripe fruit kernel and *Adhatoda vasica* (Pavatta) leaves are highly active against gastrointestinal nematodiasis in goats. Further, our toxicological studies and field trials (short term and long term) showed above extract can be used to control gastrointestinal nematodiasis in goats in Sri Lankan farms.

Under the project on toxicity and pharmacological activity studies of vegetable greens consumed in Sri Lanka, water extract of *Alternanthera sessilis* (Mukunuwenna), showed a significant cytotoxicity. Therefore, above cytotoxic extract was subjected to a mice toxicity study and results showed that oral administration of water extract of *A. sessilis* in high doses leads to histopathological changes in the liver and kidney tissues of Swiss mice. Above observed changes in the liver and kidney must be due to the cytotoxic substance/s in *A. sessilis*.
Our findings paved the way to one publication, eleven research communications, a M.Phil. degree and an award.

Postgraduate Degrees:
Rajapakse R.G.S.C. Purification and characterization of Acid Proteinases from *Nepenthes distillatoria* L., M.Phil., University of Peradeniya (2002).

Awards:
The abstract titled "*In vitro* anthelmintic activity of some indigenous plant extracts against caprine gastrointestinal parasites" was awarded as a Commendable presentation at the Proceedings of University of Peradeniya (2003).

PROJECT OUTPUT 2005:

Toxicity of vegetable greens: *Alternanthera sessilis* commonly known as "Mukunuwenna" is a popular leafy vegetable among Sri Lankans. Although, its nutritive values are well established, the toxic properties of the plant are not completely understood. A histopathological study was, therefore, carried out to investigate into the cytotoxic effect of water extract of *A. sessilis* in Swiss mice. Six-weeks-old Swiss mice weighing 35 ± 10g were separated into four experimental groups (T1, T2, T3 and T4) each comprising of 3 males and 2 females. All the animals were provided with a regular diet of commercial feed and water *ad libitum* throughout the experiment. In addition to their regular diet, the animals of T1, T2 and T3 were given an oral dose of water extract of *A. sessilis* at the rate of 16.9 mg, 33.8 mg and 67.6 mg per animal per day respectively. The fourth group (T4) of mice were kept as the Control. On the 15th day, study animals were euthanised and subjected to post-mortem examination. Micro sections of 5 μm cut from the formalin fixed tissues embedded in paraffin wax were stained with haematoxylin and eosin (H & E) and examined under light microscope for histopathological changes.

The study animals did not show severe clinical signs suggestive of toxicity during the experiment. However, histopathological changes were found in the liver and kidney specimens of the mice fed with the plant extract. The lesions found in the mice fed with higher doses of *A. sessilis* (T3) were comparatively severe and characterised by hepatocyte degeneration and necrosis in centrilobular area associated with wide spread sinusoidal congestion. Degeneration and necrosis of renal tubular cells accompanied by hyperaemia and congestion were seen in the kidney specimens. These pathological changes were not observed in the mice of the control group. No biochemical tests were carried out on the mice of this experiment, but in progress with an experiment using Wistar Rats. Findings of the present study indicate that the water extract of *A. sessilis* contains cytotoxic substance/s consumption of which in high doses lead to histopathological changes in the liver and kidney tissues of Swiss mice. However, further investigations are necessary in order to understand the long-term effects of the consumption of *A. sessilis*, particularly the cooked preparations in smaller quantities.

ABSTRACTS /CONFERENCE PROCEEDINGS IN 2005:

1. **Fernando W.I.T.**, Rajapakse R.P.V.J., Fazi M.A.M., and **Dharmaratne H.R.W.**
   Areca catechu and *Adathoda vasica* extracts against gastrointestinal nematodes in goats
   Proceedings of the International Symposium on Herbal Medicine, Phytopharmaceuticals and other Natural Products. Colombo, Sri Lanka (2005) B-4, 37

2. **Fernando W.I.T.**, Rajapakse R.P.V.J., Sumathipala R.H., and **Dharmaratne H.R.W.**

   Anthelmintic efficacy of long term treatment with plant extracts in naturally infected goats

   57th Annual Convention, Sri Lanka Veterinary Association, 2005, p 14

3. **Balasuriya B.M.G.K.**, Gunawardena G.S.P. de S., Rajapakse R.P.V.J., and **Dharmaratne H.R.W.**

   Histopathological changes caused by oral administration of Water extracts of *Alternanthera sessilis* in Swiss mice

   Proceedings of Sri Lanka Association for the Advancement of Science, 61st annual session, 2005, 10 p.p.

PROJECT: **PLANT BIOTECHNOLOGY**

COMMENCEMENT: 1988

INVESTIGATORS (2005):

Ramanayake S.M.S.D., *Senior Research Fellow* **(Project Leader)**
Kovoor A., *Honorary Research Professor*
Maddegoda M., *Research Assistant*
Vitarana M., *Research Assistant*

PROGRESS ACHIEVED *(since inception)*:

Problems associated with the recalcitrance to in vitro responses in selected woody perennials were investigated.

Bamboo: These belong to the family of grasses but unlike other grasses are woody, and different from other woody trees. Unlike other flowering plants their flowering and seeding rhythm are unpredictable and some flower after long intervals of many years. With all these unorthodox characteristics they are valuable. The objective of this project is to use tissue culture techniques to investigate the unique behavior in bamboos, develop protocols for propagule production and taxonomically identify different Sri Lankan species.

Different plant parts from field grown clumps of the two species, *Dendrocalamus giganteus* and *Bambusa vulgaris* were used to study their responses to in vitro manipulations. The phenology and development of selected clumps of these species were studied to correlate the in vitro responses of plant parts of mother clumps with developmental stages and phenology.

Plantlets were produced from seedling explants that responded to axillary shoot proliferation in the species *D. giganteus* (M. C. Rajapakse, M.Phil. thesis) and in *D. asper*.

The axillary shoot proliferation for plantlet production with the use of explants from 6 – year old and a 70-year old field grown clumps was achieved. In vitro flowering was also induced in these axillary shoots. The factors that may have contributed to in vitro flowering were studied. Callus, which exhibited an embryogenic potential, was also induced from explants of the adult clump. It was possible to regenerate a few plantlets. Although seedlings are reported to respond to such behaviour in vitro, this is the first time an adult bamboo of over 70-years behaved in this manner.

The problems that have led to recalcitrance in rhizogenesis in *D.giganteus* were identified and overcome by the use of certain treatments.

Axillary shoots of *Bambusa atra* , *B. vulgaris and D. hookeri* were proliferated continuously. Rooting of the axillary shoots yielded plantlets that were acclimatized to field conditions. This could be used for large-scale plantlet production in this species.

It is now possible to apply these findings in the commercial applications for propagule production in these species. We have given away over 1000 plantlets which were produced during experiments in these four species. The field performance of these show that they grow faster than plants raised by classical methods due to early rhizome development.

Genetic distances computed and dendrograms developed using the RAPD markers that were generated from 130 individuals of *D. giganteus* and 25 related species of bamboo. The data have been analyzed and will be used in identification and characterization of species. Most of these Sri Lankan species have not been taxonomically defined.

Interestingly, *Melocanna baccifera*, a species of bamboo introduced from India, in the Botanic gardens, Peradeniya flowered in synchrony with the impended flowering of this species in Mizoram India. The event was used to study the flowering behaviour and taxonomy of this species.

The species *Mormodica dioica* (thumbakarawila) was used in studying callogenesis and regeneration of shoots and rooting. This is a perennial climber that responded well to plant regeneration from callus unlike bamboo and therefore possibly be utilized in studies in bamboo.

Commercial application of the findings related to bamboo: I was released to the Riverine Bamboo Project, under the Mahaweli Authority, to micropropagate giant bamboo and other related species of bamboo using the findings generated by the Plant Biotechnology Project, for one year commencing February 2004. Due to financial constraints and other bureaucratic problems it was not possible to successfully carry out the intended work. However I was able to design and develop the tissue culture laboratory in a building allocated to the Project in Mawatura, Kotmale. Although the other essential chemicals and minor equipment were identified, they could not be purchased due to lack of funds. I also maintained some shoots of giant bamboo under in vitro conditions at the IFS laboratory, in order to use them for propagation once the lab was developed. These were used to train a technician in the project in tissue culture techniques. I gave my resignation in November 2004, as the Mahaweli Authority was unable to sustain the Project further. At the same period a private tissue culture laboratory, Ceylinco Biotech Pvt Ltd., was able to apply the findings developed by us, to produce over 100,000 bamboo plants, *D. hookeri and B. vulgaris*, when Ms. Vindya Meemaduma, who was a research Assistant at the IFS joined this laboratory at the end of her contract at the IFS. Therefore there is practical evidence that IFS findings are commercially feasible.

Rattan: In vitro requirements for a high germination percentage of excised embryos of four species of rattan, *Calamus zeylanicus, C. ovoideus, C. rotang* and *C. thwaitesii* were determined. It was also possible to induce multiple shoots in all four species. *C.*

zeylanicus and *C. thwaitesii* showed rapid and continuous shoot proliferation while it was slow in the other two species. The origin of these shoots was studied. Root induction in the proliferated shoots of *C. thwaitesii* was possible and plants have been established in the nursery. The rooting response of *C. zeylanicus* was slow and sufficient plant were not available to carry out rooting experiments in these species due to accidental contamination of cultures. Excised embryos of *Calamus thwaitesii* and *C. rotang* were cultured to study their responses under limited growth conditions either in encapsulated form or as naked embryos.

The study on bamboo and rattan received funding from NORAD for the period October 1993 – May 1994 (Rs. 160, 000/-) and from May 1994 – October 1997 (Rs 1,406,650/-). These funds were utilized to purchase chemicals and for purchase of equipment and improving the laboratories.

In vitro micrografting and compatibility studies: This study was suspended in 1994 and revived in 1997. Culture conditions for the establishment of in vitro cultures required for grafting were determined for selected species, *Anacardium occidentale, A.microcarpum, Garcinia mangostana, Pentadesma butyracea, Durio zebethius* and *Adansonia digitata.* A technique of in vitro micrografting cashew was determined. It was also possible to achieve multiple shoot proliferation and rooting of cashew and establishment of plantlets in the nursery. After revival of this study in 1997 seeds of *Loranthus* were cultured in vitro for inducing germination but complete plant development did not take place. Mangosteen seeds were induced to produce multiple shoots. Seeds of *Feronia, Citrus, Adansonia digitata* and *Camellia sinensis* were germinated in vitro. Various plant parts of these in vitro plantlets as well as from field grown plants *of Pentadesma* and *Loranthus* were cultured to induce callus that will be used to study the compatibility between selected scion and root stock species.

PROJECT OUTPUT 2005:

In vitro shoot cultures were established this year in *D. giganteus* and a variegated mutant of this species raised by tissue culture, *D. hookeri, B. atra, B. vulgaris* and *Gigantocloa atroviolacea.* These are presently used to study the exogenous and endogenous auxin patterns in the rooting zone, related to various chemical and physical treatments. Studies on induction of in vitro flowering in these species have commenced. Shoot cultures of *D. hookeri* have started to flower. This will be used for taxonomic studies in the species.

Cutures were also established from seeds of giant bamboo collected from three clumps that flowered in Kandy, Pilimatatawa and Daulagala. Studies in callus induction and somatic embryogenesios have commenced.

A green house was constructed with funds received from the National Agribusiness Council estimated for Rs.490,000/-. This is an essential requirement for studies related to plants which was lacking in the IFS.

INVITED LECTURES/CONFERENCES ATTENDED IN 2005:

1. **Ramanayake S.M.S.D.**
   Flowering behaviour and propagation of bamboo. Presentation at the **Seminar on Current Issues in Bamboo**, Organized by the Section D, Sri Lanka Association for the Advancement of Science and Sri Lanka Network for Bamboo and Rattan, 26th August 2005, NSF, Colombo

RESEARCH GRANTS:

A project proposal 'Development of protocols for the micropropagation of four selected bamboo species (*Bambusa vulgaris, B. ventricosa. Gigantocloa atroviolacea and Dendrocalamus giganteus*) of promising ornamental value' was approved for a budget estimate of Rs. 1,737,430/- of which Rs. 1,023,310/- (58.9%) was from the National Agribusiness Council (NAC), which received funding for research from the Perennial Crop Development Project.

OTHER CONTRIBUTIONS:

1. **Ramanayake S.M.S.D.**
   Flowering in bamboo- facts and myths. Sri Lanka Horticulturist. ***(Journal of the Horticultural and flora conservation Society - Sri Lanka)*** Jan-June 2004, July -Dec.2004, Jan - June 2005. pp32 - 37.

2. **Ramanayake S.M.S.D.**
   Melocanna baccifera is flowering in Sri Lanka too! Newsletter of Network for Bamboo and Rattan, Sri Lanka (SRINBAR).

3. Reviewed manuscripts submitted to the following international journals:

   - Annals of Botany
   - Scientia Horticulture
   - Hortscience

PROJECT: PLANT REPRODUCTIVE BIOLOGY

COMMENCEMENT: 1997

INVESTIGATORS (2005):

Iqbal M.C.M., *Senior Research Fellow* **(Project Leader)**
Kovoor A., *Honorary Research Professor*
Wijesekara K.B., *Research Assistant*
Wijesekera T.P., *Research Assistant*
Kulasekara L., *Research Assistant (NSF funded)*

PROGRESS ACHIEVED *(Since inception):*

Androgenesis: In *Datura metel,* androgenesis was increased by applying a temperature shock in the form of a heat gradient. A combination of warm and cool temperatures in quick succession, for a total duration of 1 min, significantly enhanced androgenesis.

Pollen development: In *Gordonia* species, we observed the differentiation of parenchyma cells in the connective tissue of anthers into sterile pseudopollen. They are large pollen like cells with a distinct surface architecture and migrated into the pollen sacs. Their role in reproductive biology remains speculative. They have been reported in some members of the Theaceae family.

Primary and secondary embryogenesis: The basic embryo body organization was studied using abnormal haploid embryos of *D. metel,* which manifested deletion patterns, and were characterized histologically. The absence of meristems were associated with secondary embryogenesis. This was confirmed by excising meristems from normal embryos.

Secondary metabolism: Glucosinolates, a secondary metabolite accumulated in the seeds of Brassica species, was shown to be transported against a concentration gradient into the embryos as an active process (with Dr. C. Möllers, University of Göttingen).
Lipid emulsions were formulated from the oil of *Adenanthera pavonina,* which indicate a potential use in pharmaceutical and medical fields as carriers for active ingredients of drugs and cosmetics (with Dr. Zarnowski, Poland).

Antifungal activity was observed in vitro in common weed species. A bioactive compound against plant pathogenic fungi was isolated from the weed *Ageratum conyzoides*. The compound was identified as precocene II inhibiting the growth of some fungi at 80 – 100 ppm. (with Dr. L. Jayasinghe, IFS).

Aquatic plants: *Cryptocoryne wendtii* is a popular plant in the aquatic export industry. Indiscriminate harvesting from the wild has accorded it a Threatened Status in the IUCN2000 Red list. We developed a protocol for in vitro propagation for this species.

PROJECT OUTPUT 2005:

Fatty acid composition in mustard: Sri Lanka has over sixty accessions of mustard *Brassica juncea*. Their fatty acid composition is undesirable for human composition as an oil. The fatty acid composition of a sample of the accessions were determined. Interspecific hybridization between *B. juncea* and *B. napus* showed the desirable fatty acid composition of the latter could be transferred to mustard. In vitro embryo rescue was necessary to recover the hybrid embryos.

Heavy metal uptake by plants: The ability of certain plants species to absorb and accumulate heavy metals is utilized to remediate metal contaminated soils. Mustard is known tolerate high levels of Pb; accessions of local mustard are screened to determine their capacity to uptake Pb.

Serpentine ecology: Serpentine soils originate from serpentinite and ultra-mafic rocks and have a high concentration of heavy metals. The flora on such soils are unique having adapted to the toxic concentrations of metals. There are five serpentine sites in Sri Lanka along a pre-cambrian suture zone between the Highland and Vijayan series of rocks. Our investigations of the flora at Ussangoda site showed species hyperaccumulating heavy metals.

In vitro regeneration of rice: A protocol to rapidly regenerate shoots from in vitro cultures was developed. This reduces the exposure of rice tissues to plant hormones and possible somaclonal variation. Improved and traditional rice varieties are being screened.

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Wijesekara T.** and **Iqbal M.C.M.**
   Rapid regeneration in vitro from four local rice varieties (*Oryza sativa* ssp. *indica*)
   Proceedings of the Sri Lanka Association for the Advancement of Science, Part I, 24 pp., 61st annual session, 2005. Sri Lanka Association for the Advancement of Science, Colombo

2. Weerakoon S.R., **Iqbal M.C.M.**, and Pieris P.K.D.
   Towards improving the fatty acid profile in local mustard by interspecific hybridization
   Proceedings of the Sri Lanka Association for the Advancement of Science, Part I, 46 pp., 61st annual session, 2005. Sri Lanka Association for the Advancement of Science, Colombo

PROJECT: **PLANT CELL BIOLOGY**

COMMENCEMENT: 2001

INVESTIGATORS (2005):

Magana-Arachchi D.N, *Research Fellow* **(Project Leader)**
Kovoor A., *Honorary Research Professor*
Jeyanandarajah P., *Former Research Fellow*
Gnanakkan D.T., *Research Assistant*
Lal M.A., *Work Assistant*

Scope of the project:

- Isolation and identification of cyanobacteria to ascertain their biodiversity; investigation of the biological activities terrestrial and aquatic cyanobacterial forms.
- Development of assays for water-borne toxicants; identification of microorganisms capable of degrading toxins; characterisation of microbes present in bio films in aquatic systems.
- Study of aspects of mycotrophy and formulation of methodologies for the introduction of microorganisms, including mycorrhizal fungi, for optimisation of plant growth.
- Investigation of mechanism of antagonism, synergism and toxicity of rhizoplane and spermoplane microorganisms.

PROGRESS ACHIEVED *(since inception)*:

Phytoplankton:
Several members of Chlorophyceae, Cyanophyceae and Bacillariophyceae were detected in the samples collected from fresh water expanses/bodies. Several members of toxigenic cyanobacteria were detected in the samples collected from Beira Lake, Colombo. The microorganism prevalent in the surface scum and water were *Microcystis*. Thin layer chromatography and high performance liquid chromatography were employed for separation and identification of toxins. Microcystin-LR, known to be heptatoxic cyclic heptapeptide, was detected in the samples of surface water and cells of the scum.

Mycotrophy:
A fungus was isolated from snake gourd (*Trichosanthes cucumerina*) by plating plant tissue onto potato dextrose agar (PDA) medium. Based on the morphological characteristics, it was identified as *Didymella bryoniae*. Three isolates from different locations were studied further.

Phylloplane fungi were isolated from leafy vegetables by plating leaf tissues onto PDA. Fungi identified are *Alternaria alternata, Aspergillus flavus, Aspergillus niger, Cladosporium cladosporioides, Fusarium pallidoroseum, Fusarium solani, Fusarium*

equiseti, Myrothecium roridum, Myrothecium verrucaria, Penicillium spp., Rhizoctonia solani, Trichoderma spp.. Isolations from the rhizosphere samples of leafy vegetable plot were done by dilution plate methods and wet sieving methods. In dilution plate method: *Alternaria tenuis, Aspergillus* spp., *Chaetomium globossum, Cladosporium* sp., *Fusarium solani, Fusarium oxysporum, Mucor* sp., *Penicillium* spp., *Rhizopus stolonifer, Sordaria fimicola* and *Trichoderma* spp were identified and wet sieving revealed *Glomus* and *Gigaspora* in plots where *Centella asiatica* was growing. In dual culture studies, isolate TPJ5' showed prominent antagonistic properties against a number of fungi.

PROJECT OUTPUT 2005:

In year 2005, project focused mainly on first two objectives. On the basis of published 16S rRNA sequences a PCR procedure was developed for the selective retrieval of cyanobacterial rRNA gene fragments from a variety of natural and artificial settings.

In many eutrophic fresh water lakes, cyanobacteria frequently form toxic mass occurrences. Due to human and animal poisonings and the results of toxicological studies, which have shown the adverse effects of microcystins to some mammals, many countries have started to monitor cyanobacterial cell densities and microcystin concentrations in raw water sources and recreational waters. A PCR procedure was optimised to identify the microcystin producing genera with the Genus specific *mcyE* primers.

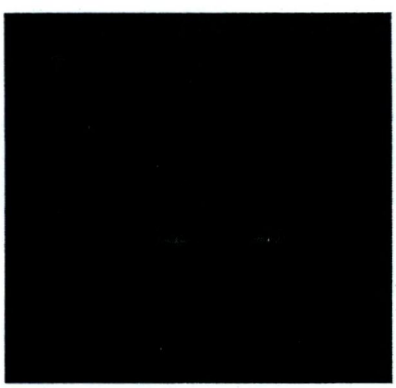


Figure 1: PCR amplification of 16SrRNA gene fragments from DNA extracted from environmental samples

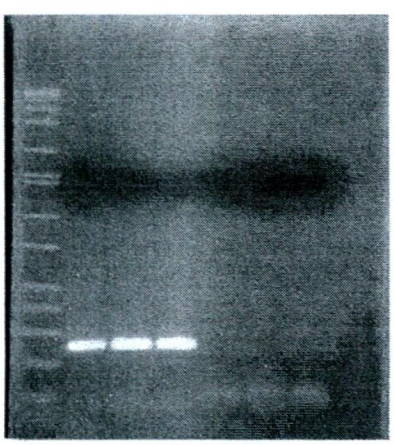


Figure 2: PCR amplification of *mcyE* gene fragments from DNA extracted from freeze dried samples collected from Beira Lake, Colombo

In order to study the microbial diversity with the tsunami natural disaster, water and soil samples were collected from southwestern, southern and southeastern areas of Sri Lanka. The samples have been inoculated into standard and modified culture media. Based on microscopic observation, morphology and cultural characteristics the isolates showed a diverse mixed population with mostly algae and cyanobacteria (tentatively identified as *Synechococcus, Nostoc, Schizothrix, Anabaena, Gloeocapsa, Microcystis and Aphanizomenon*).

Currently studies are being carried out with more fresh and marine water samples to isolate cyanobacterial species and to determine the phylogenetic relationship using the 16S rDNA sequences.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1.* *Title:* Rice diseases - problems and progress
Authors: Seneviratne S.N.de S. and Jeyanandarajah P.
Journal: ***Tropical Agricultural Research and Extension,*** 7: 30-48 (2004).

* ***Reported as 'in press' in Annual Report 2004***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Gnanakkan D.T., Magana-Arachchi D.N.**, and Jeyanandarajah P.
Identifcation of cyanobacteria using 16S rRNA genes – A preliminary study
Proceedings of the Sri Lanka Association for the Advancement of Science 61st Annual Session, 2005, 129; 247/D

PROJECT: **BASIC FOOD CHEMISTRY**
(Chemistry, structure and function of food proteins)

COMMENCEMENT: 2005

INVESTIGATORS (2005):

Ellepola S., *Research Fellow* **(Project Leader)**

PROGRESS ACHIEVED *(since inception)*:

Identification and characterization of rice proteins

Rice protein is an important source of nutrition and energy for approximately 50% of the world's population, for whom rice has long been a staple diet. Although the protein content of rice has been relatively low (~10%) compared with that of other cereal grains, the amount of rice protein potentially available is considerable because of the huge quantity of rice produced worldwide (approximately 400 million metric tons annually). On the other hand, rice protein has a significant influence on the structural, functional, and nutritional properties of rice. Protein is a major factor in determining the texture (e.g., stickiness), pasting capacity, and sensory characteristics of rice. In recent years, rice seed proteins have been recognized to be uniquely nutritious and hypoallergenic which makes rice an increasingly popular food source for use all over the world.

Studies on protein component of rice have not been extensively studied compared with that of starch component. The aim of this investigation is to identify and characterize proteins from different varieties of rice. The work is being conducted in collaboration with Department of Food Science, University of Hong Kong, Hong Kong SAR, China.

Major achievements:

i. The major protein fractions (globulin, glutelin, albumin and prolamin) were isolated from milled rice following the method of Osborne fractionation. Protein fractions were purified by using ion-exchange chromatographic techniques.

ii. Determination of chemical composition of rice proteins: Carbohydrate content, protein content, fat content, ash content, moisture content and disulphide contents were determined.

iii. Determination of thermal properties: Thermal properties of rice proteins were determined by Differential scanning calorimetry.

iii. Determination of the secondary structure (conformation) of rice proteins: A detailed structural analysis of rice proteins is being conducted by various spectroscopic techniques (Fourier-transform Raman spectroscopy, Fourier-transform infrared spectroscopy and Circular Dichroism spectroscopy).

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1. *Title:* Raman Spectroscopic study of rice globulin
   Authors: **Ellepola S.K.W.,** Choi S.M., and Phillips D.L.
   Journal: ***Journal of Cereal Science,*** 2005 (in press)[1,2]

2. *Title:* Thermal Properties of globulin from Rice (*Oryza sativa*) seeds
   Authors: **Ellepola S.W.** and Ma C.Y.
   Journal: ***Food Research International,*** 2005 (in press) [1,2]

[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

PROJECT: **BIOLOGICAL NITROGEN FIXATION**

COMMENCEMENT: 1986

INVESTIGATORS (2005):

Seneviratne G., *Senior Research Fellow* **(Project Leader)**
Bandara W.M.M.S., *Research Assistant*
Ratnayake R., *Research Assistant*
Weerasekara M.L.M.A.W., *Research Assistant*
Zavahir J.S., *Research Assistant*

PROGRESS ACHIEVED *(Since inception)*:

The original aim of the project was to improve livelihood of rural Sri Lankan farmers through improved soil fertility by biological nitrogen fixation and balanced nutrient application. A variety of research programs were conducted during this period. However, present objective is to conduct basic research on biological nitrogen fixation and related topics.

a) A *rhizobium* inoculant (bacterial fertilizer) was produced for grain legumes and leguminous trees, based on a substrate made of a special mixture of organic waste materials. The inoculant could increase soybean yield by at least 26%, even up to over 100% under different soil conditions in the dry zone of Sri Lanka. A similar inoculant increased plant growth of *Albizia,* a nitrogen fixing leguminous tree by 84% on tea estates. This inoculant is now used for grain legumes in Sri Lanka, and is also being tested in Bangladesh.

b) Thirteen leaf isozymes were assessed by gel electrophoresis for identification of elite trees in a heterogeneous population of *Pericopsis mooniana* (Nadun). Such an identification is important in efficient management of reforestation programmes with slow growing, high quality timber species like the tree under consideration. Out of the isozymes tested, formate dehydrogenate showed promising results.

c) Foliar application of chelated micronutrients to rice and tea showed potential for increasing their yields. A mixture of micronutrients when applied to farmers' fields in the dry zone increased panicle and grain formation of rice by 25% and 32%, respectively. Hundred seed weight was increased by 18%. The same mixtures increased tea yields by about 30% in tea estates over a year with a net extra benefit of around 30,000 Rs/ha.

d) Polyphenols are known as disinfectants and act as bactericides. Soil polyphenols therefore affect the growth and activity of rhizobia in soils, threatening their survival. In a study of polyphenolic inhibition of rhizobia, a method for fractionation and identification of polyphenols in soils was

developed using One Dimensional Sodium Dodecyl Sulphate Polyacrylamide Gel Electrophoresis (1 D SDS PAGE).

e) Interactions between phenolic compounds and rhizobia, and the effect of phenolic acid affected rhizobia on rhizobial-legume symbiosis were studied. Phenolic acids were found to be possible agents of modifying N_2 fixing symbiosis through rhizobial alteration. A paper was published.

f) Studies on litter turnover in ecosystems led to discover that soil surface mulch application mitigates soil N_2O emission. This was published and established now. Underlying mechanisms of this mitigation were also identified.

g) A study on rhizobial-fungal biofilms was completed, where the effects of the biofilm formation on the survival and effectiveness of rhizobia under adverse conditions were examined. The biofilms were successfully developed *in vitro*, observed and reported in a research paper. This is the first observation of such biofilms.

h) Different biofilms were developed for various applications. A rhizobial-fungal biofilm was developed for rock phosphate solubilization. A *Pseudomonas* spp.-*Pleurotus* spp. biofilm was formed for the transfer of *Pseudomonas fluorescens* to tomato plant tissues. A *Bacillus* spp.-*Penicillium* spp. biofilm was formulated to degrade polythene biologically. Biological nitrogen fixation in mushrooms was tested and understood. These findings were published in refereed journals.

i) Soil organic matter decomposition was studied under different land-use patterns of Sri Lanka. Soils were collected and analyzed for a number of soil parameters and soil respiration, CH_4 and N_2O emissions. Soil organic carbon contents of the land-use patterns were predicted using artificial neural network (ANN) analysis and a paper was published in a refereed journal.

NUMBER OF PUBLICATIONS IN REFEREED JOURNALS: 22

PROJECT OUTPUT 2005:

1. An experiment was conducted to examine soil carbohydrate controls on nutrient dynamics. Soil samples were collected from different agroclimetic zones of the country. They were analysed for basic soil parameters and macro and micronutrients. Soil extracts are now being analysed for carbohydrates using gas chromatography. A manuscript was sent for publication to a refereed journal.

2. Studies were conducted to examine associative nitrogen fixation in the rice rhizosphere, with special reference to *Azorhizobium caulinodans*, an efficient nitrogen fixer in the rhizosphere. The effect of *A. caulinodans* as a monoculture on rice was evaluated and found that there is no significant effect on growth etc.

Studies are now being carried on to examine its effect when it is in microbial communities or biofilms. Further, endophytic microbes of rice plant were also isolated and are being tested in the biofilm formation. The goal of this study is to develop a microbial fertilizer technique for rice.

3. A study was started to investigate the survival and ecological function of nodule forming rhizobia before the emergence of nodulating legumes in the life history. Literature survey is under way for developing a hypothesis for this. Laboratory studies will then be started.

4. A study was started to examine the potential of the use of microbial biofilms for enhanced monosaccharide production for the monosaccharide-based drug production. Microbial cultures were grown and exudates were isolated for the chemical analysis.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1. *Title:* Prediction of soil organic carbon across different land-use patterns: A neural network approach
   Authors: Somaratne S., **Seneviratne G.**, and Coomaraswamy U.
   Journal: ***Soil Science Society of America Journal*, 69:** 1580 (2005) [1,2]

2. *Title:* A rhizobial biofilm with nitrogenase activity alters nutrient availability in a soil
   Authors: **Seneviratne G.** and Jayasinghearachchi H.S.
   Journal: ***Soil Biology and Biochemistry*, 37:** 1975 (2005) [1,2]

3. *Title:* Ectomycorrhizal colonization and seedling growth of Shorea (Dipterocarpaceae) species in simulated shade environments of a Sri Lankan rain forest
   Authors: Tennakoon M.M.D., Gunatilleke I.A.U.N., Hafeel K.M., **Seneviratne G.**, Gunatilleke C.V.S., and Ashton P.M.S.
   Journal: ***Forest Ecology and Management*, 208:** 399 (2005) [1,2]

4. *Title:* A mushroom-fungus helps improve endophytic colonization of tomato by *Pseudomonas fluorescens* through biofilm formation
   Authors: Jayasinghearachchi H.S. and **Seneviratne G.**
   Journal: ***Research Journal of Microbiology*,** 2005 (in press)

5. *Title:* Polyethylene biodegradation by a developed *Penicillium-Bacillus* biofilm
   Authors: **Seneviratne G.**, Tennakoon N.S., Weerasekara M.L.M.A.W., and Nandasena K.A.
   Journal: ***Current Science*,** 2005 (in press) [1,2]

6. *Title*: Fungal solubilization of rock phosphate is enhanced by forming fungal-rhizobial biofilms
Authors: Jayasinghearachchi H.S. and **Seneviratne G.**
Journal: ***Soil Biology and Biochemistry,***2005 (in press) [1,2]

[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

TECHNICAL ASSISTANCE:

1. R.C.K. Karunaratne
2. K.K. Karunadasa

PROJECT: PRIMATE BIOLOGY

COMMENCEMENT: 1983

INVESTIGATORS:

Dittus W., *Visiting Scientist* **(Project Leader)**

PROGRESS ACHIEVED *(Since inception)*:

The overall aim of the program is to establish new knowledge concerning the biological foundations for social behaviour in non-human primates (and by inference, man). This aim has interdisciplinary ramifications. Hence, past research and publications have addressed the interrelationships among factors concerning social organization, matrilineal kinship, ecology, environmental change and their effects on demography (Darwinian fitness). For example, our research was the first to establish an actuarial life-table for primates and showed that social behaviour influences individual differences in survival, breeding success, and morphological development. Our aims and data collection protocols require consistency over many years.

In practice, to investigate such phenomena we have identified more than three thousand macaque individuals (living plus dead), distributed among 34 different social groups at our dry evergreen forest study site, at Polonnaruwa. For each macaque, we have traced its behavioural, genealogical, ecological and demographic history. Such large samples are required to assure statistical soundness.

It was not clear by which physiological and similar mechanisms behaviour affected mortality. Therefore, the research was expanded (with the aid of collaborators from a variety of institutions) to investigate the potential role of disease (parasitism) and physiology (milk composition, blood chemistry, hormone levels) in relation to behaviour and demography. Different aspects of physiology and disease have been more intensively investigated in the primates at Polonnaruwa particularly in association with the Faculty of Veterinary Medicine, University of Peradeniya. In addition, we have assumed a greater role in aspects of nature conservation.

PROJECT OUTPUT 2005:

(a) ***Routine demographic, ecological and behavioral monitoring:*** The entire population of over 1,100 identified macaques was censused on a monthly basis. New recruits (newborns & immigrants) were identified. The hierarchical relationships within groups was tested and documented. Intergroup relations, shifts in ranging pattern, and diets were recorded.

(b) ***Ecology of three sympatric primates***: On a regular monthly schedule we sampled the diets, home ranges and interspecific interactions among the toque macaque, and the two langur species *Semnopithecus entellus* and *Trachypithecus. vetulus*. The aim of this study is to clarify the ecological relations that allow these three potentially competing species to co-exist in sympatry.

(c) ***Parasitism and microbiology:*** In order to clarify the transmission dynamics of *Cryptosporidium* infection among the three species of primate at Polonnaruwa (as identified earlier – see Publications), we performed a phylogenetic analysis of the hyper variable region of 18S rRna gene of *Cryptosporidium* isolates from these monkey species. It showed that the macaque and grey langur harbor *C. parvum* infections similar to genotype 2 type A and B, but in the purple-faced langur the isolate was similar to genotype 1. These results, done in collaboration with the Global infectious Disease Program at Woods Hole, USA, are being prepared for publication.

(d) ***Professional activities:*** (i) I reviewed manuscripts for international peer reviewed journals. (ii). I facilitated collaborative research on captive elephants between the Smithsonian Institution, the Pinnawala Elephant Orphanage and the University of Peradeniya. (iii) I guided the undergraduate thesis research of students from the Open University of Sri Lanka. (iv) I sponsored two students N. Kanthilatha (Univ. Sri Jayewardenepura) and P. de Silva on two week fellowships to participate on Earthwatch workshops. (v) I visited and conferred with several supportive or collaborating institutions in the USA.

(e) ***Nature Conservation***: (i) I participated in meetings as a member of the National Species Advisory Group to the Ministry of Environment and Natural Resources. (iii) As part of our mission for educational outreach, we donated binoculars, posters, and reading material and verbal presentations to a local schools (Nikawewa, Nilumwewa, Lakxyauyana, Nagranuchvidiyala) and for monks at Gal Vihara at Polonnaruwa, as well as presentations to students from 13 schools at a Nature Photographic exhibit.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1. *Title:* Prevalence of Cryptosporidium and other enteric parasites among wild non-human primates in Polonnaruwa, Sri Lanka
   Authors: Ekanayake D.K., Arulkanthan A., Horadagoda, N.U., Sanjeevani G.K.M., Kieft R., Gunatilake S., and **Dittus W.P.J.**
   Journal: ***American Journal of Tropical Medicine and Hygiene***, 2005 (in press)[1,2]

[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Dittus W. P. J.**
Life history of a population of Toque macaques at Polonnaruwa, Sri Lanka (1968-2005).
Conference on Primate Life History Databank: 23-25 Sept 2005, Wenner-Gren Foundation, New York, USA.

PROJECT: **ECOLOGY AND ENVIRONMENTAL BIOLOGY**

COMMENCEMENT: 1989

INVESTIGATORS(2005):

Silva E.I.L., *Associate Research Professor* **(Project Leader)**
Karunathilake K.M.B.C., *Research Assistant*
Weerasinghe W.M.D, *Research Assistant*
Kangara K.M.W.S.B., Research Assistant *(Project funded)*
Thumpela I., *Technician*
Athukorale N., *Technician*

PROGRESS ACHIEVED *(Since inception)*:

The project initiated as Ecology and Conservation in 1989, was renamed in 1992 as Ecosystem Analysis and Impact Assessment. The name was changed again in 1996 as Ecology and Environmental Biology with a view to restructuring the studies towards fundamental aspects of ecological studies in aquatic science. Although this project is broadly named as Ecology and Environmental Biology with an intention of future expansion, studies were primarily focused on aquatic environment with special emphasis on aquatic ecology of inland and coastal marine ecosystems.

At the beginning, a study was carried out on the limnological aspects and the fisheries of the Mahaweli river basin. Since 1989 with special emphasis on colonization of exotic fish species in the Victoria Reservoir, water chemistry of the Nilambe Oya, nutrient loading into Kotmale Reservoir, trophic characteristics reservoirs in the Mahaweli basin. Limnology and water quality of the Kandalama tank were studied during pre-construction, construction and operational phases of the hotel complex to determine whether it has effects on ecosystem processes and functions of the tank environment. A study was also carried out to determine the rainwater chemistry and buffer intensities of surface water in Sri Lanka. Further, commercially important fresh water fish species were analyzed for bio-accumulation of trace elements while several species of pelagic blood fishes were analyzed for the levels of histamine. A study was also launched to determine the impact of operational activities of shrimp farms in the north western province on brackish water ecosystem including Mundel Lake. In 1995, an intensive study was carried out to determine the levels of organic and inorganic pollution along course of the Meda Ela in Kandy.

Towards the end of 1996, a systemic limnological study was launched in the Kandy Lake with view to identifying the eutrophic process of a tropical urban water body. This study was intensified from May 1999, with the emergence of a cyanobacteria bloom (*Microcystis aeruginosa*) in Kandy Lake. A parallel study was also started in the Hulu Ganga, the major tributary of the Mahaweli River in the central Mahaweli Valley to determine the ecological processes and functioning of a tropical stream draining and intensively exploited watershed. A broad limnological study was

commenced in August 1998 to compare the primary productivity and nutrient dynamics of three morphologically and functionally different reservoirs namely Victoria, Minneriya and Udawalawe. This was a component of the research project launched to determine the ecological processes and dynamics of Asian reservoirs and lakes funded by the European Union. In addition, studies were conducted on retention of silica behind the dams of Sri Lankan reservoirs, which is currently being considered as an important issue of land-ocean nutrient fluxes. In 2003, detail studies on material fluxes in three adjacent river basins namely Maha Oya, Deduru Oya and Mi Oya was carried out. This study was extended to Kala Oya, Malwathu Oya and Mahaweli basins. Intensive investigations on Kandy Lake was conducted on daily basis from August to December, 2003. Studies conducted on Rekawa lagoon under European Union funded project on Mangrove Resilience in Coastal Zones in East India and Southwest Sri Lanka were completed for a period of two years. Investigation on nutrient loading into the Kandy Lake via perennial and seasonal inflows was commenced in January 2004 while Heen Ganga which drains the northeast slope of the Knuckles Range was examined monthly to determine aspects of its ecology since May 2004. An intensive survey was conducted during August-September 2004 on phytoplankton systematic in 34 major reservoirs in Sri Lanka.

Investigations on nutrient loading into Kandy Lake via perennial and seasonal inflows were continued till December 2005. Studies on Heenganga tributaries in the knuckles range were also continued till December 2005. The field studies conducted on Kalaoya basin were completed in July 2005. A study was initiated to determine water chemistry of Rajangana irrigation scheme on a request made by Irrigation Secretariat. On a request made by Water Supply and Drainage Board, several reservoirs (Kurunegala, Unachchai, Nallachchiya, Eppawela, Kekirawa tanks and Nuwarawewa, Kalawewa and Parakrama Samudra) were examined for toxigenic phytoplankton. The results of the above studies that are ecologically significant and scientifically important were published in refereed journals and monographs and in the proceedings of local, regional and international meetings.

PROJECT OUTPUT 2005:

Major emphasis was paid on preparation of several manuscripts during the year 2005. In addition a bibliographic compilation of fisheries and aquatic sciences in Sri Lanka was compiled on a request made by Sri Lanka Association for Fisheries and Aquatic Resources. Further, presentations were made at SCOPE General Assembly held in New Delhi, India, other international meetings held in Chennai, and Kerala in India and LOIZ International Workshop on River Basins in South and Southeast Asia, held in Waikkala in Sri Lanka. Four papers were published in refereed journals and two manuscripts were submitted to monographs. In addition a bibliographic compilation on fisheries and aquatic resources in Sri Lanka was produced towards the end of year 2005.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1. *Title:* Risk of toxigenic cyanobacterial blooms in freshwaters of Sri Lanka
   Authors: Jayatissa L.P., **Silva E.I.L.**, McElhiney J., and Lawton L.A.
   Journal: ***Systematic and Applied Microbiology,*** 2005 (in press) [1,2]

2. *Title:* Nutrient fluxes into coastal waters via Sri Lankan rivers: a comparison with other Asian rivers
   Authors: **Silva E.I.L.**, Jennerjahan T.C., and Ittekkot V.
   Journal: ***International Journal of Ecology and Environmental Science,*** **31 (3):** 34-40 (2005)

3. *Title:* Limnology of Kandy Lake Before the Outbreak of Cyanaobacteria Bloom III. Phytoplankton composition and succession
   Authors: **Silva E.I.L.** and Samaradiwakara S.R.M.S.
   Journal: ***Sri Lanka Journal of Aquatic Sciences,*** **10**:55-71 (2005)

[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Silva E.I.L.**
   Water Resources Developments in Sri Lanka – Successes and Failures. In: V. Sharma (ed.)
   Proceedings of SCOPE General Assembly Symposium on Water Sources Management in Asia held in New Delhi, Feb 2005 (in press)

2. **Weerasinghe W.M.D.** and **Silva E.I.L.**
   An Ecological study of physical and chemical parameters of Heen Ganga in the Knuckles region
   Proceedings of 11th annual sessions of Sri Lanka Association for Fisheries and Aquatic Resources (2005)

3. **Weerasinghe W.M.D., Silva E.I.L.,** and Dias R.K.S.
   Community composition of benthic insects of the Heen Ganga tributaries in the Knuckles region
   Annual Research Symposium-2005, Faculty of Graduate Studies, University of Kelaniya

4. Kangara K.M.W.S.B. and **Silva E.I.L.**
   Water quality of waste water inflows draining into Kandy Lake
   Proceedings of 11th annual sessions of Sri Lanka Association for Fisheries and Aquatic Resources (2005)

5. **Karunathilake K.M.B.C. and Silva E.I.L.**
Seasonal variation of nutrient and other physico-chemical characteristics of a dry zone river, Kala Oya
Proceedings of 11th annual sessions of Sri Lanka Association for Fisheries and Aquatic Resources (2005)

INVITED LECTURES/CONFERENCES ATTENDED IN 2005:

1. **Silva E.I.L.**
Lecture conducted on Water Resources in Sri Lanka in general and water quality of drinking water at Vijaya College, Matale on Science Day (14.10.2005).

BOOKS AND MONOGRAPHS 2005:

1. *Title:* Macro and micro chemical constituents in groundwater of Sri Lanka –an over view
Authors: **Silva E.I.L.**
In the Book: Status of Groundwater in South and Southeast Asia
Editor: Ramanathan L.
Publishers: Capital Publishing Company, New Delhi (in press).

2. *Title:* Current status of taxonomy and ecology of freshwater phytoplankton in Sri Lanka
Authors: **Silva E.I.L.**, Rott E., and Thumpela I.
In the Book: Low plants in Sri Lanka
Editor: Wijesundara C.
Publishers: Ministry of Environment of Sri Lanka (in press).

3. *Title:* Bibliography of Scientific Research on Fisheries and Aquatic Sciences in Sri Lanka, 1900-2004
Author **Silva E.I.L.**
Publisher: Sri Lanka Association for Fisheries and Aquatic Resource (in press).

PROJECT: **CHEMICAL MODELING OF AQUATIC SYSTEMS**

COMMENCEMENT: 1992

INVESTIGATORS (2005):

Weerasooriya R., *Research Professor* **(Project Leader)**
Nanayakkara A., *Associate Research Professor*
Senevirathna H.R.W.U., *Research Assistant*
Vitanage M.S., *Research Assistant*
Aluthpatabendi D., *Technician*
Wickramasinghe M., *M.Sc. Student*
Illangasinghe, J., *Volunteer Research Student*
Makehelwala M., *Volunteer Research Student*

Collaborating laboratories:

X-ray spectroscopy and Molecular modeling
Tobschall H.J. (School of Applied Geology) University of Erlangen, ***Germany (1995 to to-date)***

Vibration spectroscopy
Bandara, Atula (Dept of Chemistry) University of Peradeniya, ***Sri Lanka (1999 – to date)***

Anode stripping voltametry
Liyanage, Janitha (Dept of Chemistry) University of Kelaniya, ***Sri Lanka (1998- to date)***

Electron microscopy
Ng, J. Dept of Environmental Engineering National University of Singapore ***Singapore***
(2004 – to date)

PROGRESS ACHIEVED *(Since inception)*:

Overall aim: Mechanistic, spectroscopic and molecular definition of solid-solution interfacial interactions.

1. Modeling interactions of trubutyl-Sn (TBT) onto clay surfaces
2. Quantification of As(V) and As(III) retention mechanism of gibbsite with the aid of mechanistic modeling and vibration spectroscopy.
3. Quantification of the activation state of monochlorophenol (MCP)/ pyrite surface complexes.

4. Calculation of essential therodynamic parameters of MCP/pyrite surface complexes.
5. Reaction path modeling of 4-chlorophenol/pyrite interactions.
6. Detection of reactivity sites of kaolinite for of tributyl tin (TBT) from molecular modeling methods.
7. Calibration of TBT – kaolinite interactions using mechanistic and molecular modeling methods.
8. Retention of lead, cadmium and arsenic on gibbsite was quantified mechanistically.
9. Experimental evidence for site heterogeneity was obtained for gibbsite using a chemical method.
10. In order to account for the finite size of ions, the newly developed charge distribution multi-site surface complexation model (CD-MUSIC) was used to quantify chromium binding on goethite.
11. Chemical characterization of the kaolinite-water interfacial processes was completed. The proton, halide ion binding on kaolinite based on surface complexation was completed.
12. Chemical kinetic modeling for the complexation of copper-organic polymer systems was developed. Kinetic modeling of Fe-F system under acidic conditions was completed.
13. A direct method for the quantification of copper –fulvate complexation was developed.
14. SEM of Cd(II) adsorbtion on model minerals at different experimental conditions was completed.
15. Determination of near-surface solid composition of the goethite-copper system to elucidate Cu-inter-particle diffusion from surface precipitation on external surfaces was completed. X-ray photon spectroscopy was used to achieve these results.
16. Essential unit processes of drinking water treatment for fluoride, nitrate, and selected organic-Cl were completed. These processes have also been modeled with ENVIRONPRO software (Project objectives were revised to meet with the current IFS reorientation towards themes of basic science).
17. A precise mechanistic model was developed to understand the formation of N-nitrosation (project objectives were revised to meet the current IFS reorientation towards basic science)

Number of publications in refereed journals: 41

PROJECT OUTPUT 2005:

Arsenic and red earth interactions: Red earth is a natural substrate, which has Fe in +2 and +3 oxidation states. In this research we devised a method to utilize the iron phase – As(III) data to define the fate of As species over a range of pH. The data were modeled mechanistically using 2-pK double layer theory. Arsenic retention on Natural Red Earth (hereafter NRE) was examined as a function of pH, ionic strength and initial arsenic loading using both macroscopic and spectroscopic methods. Proton binding sites on NRE were characterized by potentiometric titrations yielding an average pH_{zpc} around 8.5. Both As(III) and As(V) – NRE surface configurations were postulated by vibration spectroscopy. According to spectroscopic data it is envisaged

that arsenite form monodendate complexes and arsenate forms bidendate complexes with NRE surface sites. When 4 < pH < 8 and [total arsenic as As(III) or As (V)] = 0.385 μmol/L both arsenite and arsenate exhibit near 100 % adsorption for a 1000-fold variation of ionic strength that is ascribed to inner-sphere complexation of surface bonding. Arsenite exhibits apparent bond switching mechanism from inner-sphere to outer-sphere at excess As(III) loading. Competitive effect of arsenate on arsenite adsorption sites was observed when [initial As] = 0.385 μmol/L. In dual adsorbate systems the adsorption density was reduced over 50% showing a competition of arsenite for arsenate (or vice versa) binding sites. All experimental data were quantified with 2-pK generalized diffused layer model considering two site types for both protons and anions.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1.* *Title:* Modeling interactions of kaolinite-tributyl tin interface
Authors: Hoch M. and **Weerasooriya R.**
Journal: ***Chemosphere***, **59**:743-752 (2005)[1,2]

2.* *Title:* New model calculations of pH depending tributyltin (TBT) adsorption onto monmorillonite and monmorillonite -rich sediment
Authors: Hoch M. and **Weerasooriya R.**
Journal: ***Environmental Science and Technology***, **39**:844-849 (2005)[1,2]

3. *Title:* Pyrite-water interactions: effects of pH and pFe on surface charge
Authors: **Weerasooriya R.** and Tobshcall H.J.
Journal: ***Colloids and Surfaces***, 2005 (in press)[1,2]

4. *Title:* Thermodynamics of monochlorophenol-pyrite complexes at activation state
Authors: **Weerasooriya R.**, Makehelwela M., Mieander M.M., and Tobschall H.J.
Journal: ***Journal of Colloid and Interface Science,*** 2005 (in press)[1,2]

5. *Title:* Mechanistic Modelling of arsenic retention on natural red earth in simulated environmental systems
Authors: **Vithanage M.,** Chandrajith R., Bandara A., and **Weerasooriya R.**
Journal: ***Journal of Colloid and Interface Science,*** 2005(in press)[1,2]

6. *Title:* Arsenic binding mechanisms on natural red earth; A potential substrate for pollution control
Authors: **Vithanage M., Senevirathna W.,** Chandrajith R., Bandara A., and **Weerasooriya R.**
Journal: ***Science of the Total Environment,*** 2005(in press) [1,2]

** **Reported as 'in press' in Annual Report 2004***
*[1] **Listed in the Science Citation Index in 2005***
*[2] **Listed in the Science Citation Index-expanded in 2005***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Weerasooriya R.** and Tobschall H.J.
Pyrite-organic halide interactions-a new pathway for abiotic degradation of 4-CP
Conference Geochemistry Nov. 25th – 28 th 2005, University of Erlangen, Germany

BOOKS AND MONOGRAPHS 2005:

1. *Title:* 1-pK modeling strategies for the adsorption of some trace elements onto gibbsite
In the book: Surface Complexation Modeling Series Interface Science and Technology
Authors: Mieander M.M., **Weerasooriya R.**, and Tobschall H.J.
Editors: Lutzenkirchen J.
Publisher: Elsevier Publications (in press)

PROJECT: **STRUCTURAL GEOLOGY**

COMMENCEMENT: 1995

INVESTIGATORS (2005):

Kehelpannala K.V.W., *Senior Research Fellow* **(Project Leader)**
Kröner A., *Honorary Research Professor*
Yoshida M., *Honorary Visiting Research Professor*
Kleinschrodt R., *Honorary Visiting Associate Research Professor*
Ranaweera L.V., *Research Assistant*

PROGRESS ACHIEVED *(Since inception)*:

The Structural Geology project was started in 1995 with a view to study (i) the origin of structures and mineral deposits in the lower crust, (ii) the behaviour of lower crustal rocks during ductile deformation, (iii) the mechanisms of plate movements during Proterozoic, (iv) possible mechanisms of assembly and break-up of supercontinents, (v) deformation- and fluid-controlled lower crustal processes, such as migmatization, charnockitization, retrogression and metasomatism, (vi) vein graphite mineralization, and (vii) brittle deformation, neotectonics and seismic activities in an exhumed section of the lower crust exposed in Sri Lanka.

During the last eight years, the Structural Geology project contributed to the structural evolution of the lower crust exposed in Sri Lanka and to understanding the significance of mantle-derived fluids on the precipitation of post-metamorphic vein graphite. The data so far gathered led us to established that the middle to lower crust exposed in Sri Lanka has been formed by the amalgamation of three different plates collided at two separate stages during the final assembly of the Gondwana supercontinent at about 610-550 Ma. The most intensely developed and easily visible ductile structures in the basement rocks of Sri Lanka have been formed by the above two collisions. We have been able to recognize some structures formed even before the above collisions, probably related to the accretion and break-up of the supercontinent Rodinia that existed before 750 Ma ago. Some results obtained in relation to deformation-controlled migmatization and sheared-controlled charnockitization, retrogression and metasomatism are important in understanding these lower crustal processes. In addition, the project made a valuable contribution to understand neotectonics and seismic activity in Sri Lanka that makes part of the exhumed lower crust. With limited resources, important results obtained during the last 10 years were published in refereed journals (20 papers), in the Second Edition of the National Atlas of Sri Lanka (three chapters), in proceeding volumes (14 papers) and in the form of abstracts (27).

In recognition of our work, the Project Leader has been honoured by awarding two DAAD Invitation Research Fellowships from the German Academic Exchange Service to carry out research in Germany and a JSPS Invitation Research Fellowship from the Japan Society for Promotion of Science to Japan. The Project Leader was

invited by international organizations to participate in about eleven international symposia and workshops held in India, China, Singapore, Japan and Sri Lanka to present some of the results of the project. Since 1995, the Project Leader has delivered about 47 invited/public/special lectures in Sri Lanka, India, Singapore, Hong Kong, China and Japan. Further, the Project Leader has been appointed as a Fellow of the Geological Society of India and as a member of the Steering Committee of the International Association for Gondwana Research, Japan and has been the Sri Lankan convenor/researcher of the following international projects:

1. UNESCO-International Geological Correlation Programme (IGCP 368) project on "Proterozoic Events in East Gondwana".

2. UNESCO- International Geological Correlation Programme (IGCP 440) project on "Rodinia Assembly and Break-up".

3. International project on "Structure, Composition and Evolution of the South Indian and Sri Lankan Granulite Terrains from Deep Seismic Profiling and other Geophysical and Geological Investigations: A LEGENDS Initiative".

In addition, the Project Leader edited a special issue on "The role of Sri Lanka and Associated Continental Blocks in the Assembly and Break-up of Rodinia and Gondwana" of the Journal of Asian Earth Sciences (Elsevier) (In press).

The Project Leader's work on seismic activity in Sri Lanka and in the Indian Ocean led him to predict violent tsunamis in the Indian Ocean affecting Sri Lanka. The Project Leader is the only person who had previously predicted Indian Ocean violent tsunamis striking Sri Lanka. In his news feature article appeared in Midweek Mirror of 21 April 1999 and in the article on "Seismicity & Earthquakes" submitted in November 2004 to the Second Edition of the National Atlas of Sri Lanka (in press) he predicted violent tsunamis striking Sri Lanka.

After the devastating tsunami of 26th December 2004, the Project Leader was invited by both state as well as private media institutions to conduct awareness programmes on tsunamis and earthquakes. He conducted about 16 television programmes and nine radio programmes. He also published several news paper articles on natural disasters such as tsunamis, earthquakes and landslides.

PROJECT OUTPUT 2005:

The work started in the previous year was continued. In addition the following studies were carried out in the year 2005.

1. Geological and structural studies along the boundary shear zones of the major crustal blocks in Sri Lanka were continued. This work is being continued.

2. A detailed work on the Indian Ocean tsunami of 26th December 2004 was undertaken. The effect of the tsunami on the coastal areas of Sri Lanka, coastal erosion, the nature of the tsunami waves, their wave heights, arrival times and

evidence for palaeotsunamis were studied. The work is being continued, and the data will be published in international journals.

3. Th-U-Pb isotopic system of the mineral monazite in metamorphic rocks of Sri Lanka was studied at the University of Cologne, Germany. Monazite in thin sections taken from some important rocks across the boundary between the Wanni Complex and the Highland Complex of Sri Lanka was studied using Electron Probe Micro Analyser at the above university. In situ dating of monazite based on the Th-U-Pb system was also carried out. A large number of back-scattered electron (BSE) images taken led to the identification of new type of monazite. This work is being continued.

4. The cracks developed along the Kotmale rock-filled dam were investigated.

5. Preliminary studies along some brittle faults in Sri Lanka were commenced, and samples from fault rocks were collected for further studies. This work is funded by the NSF and is being continued.

PUBLICATIONS IN REFEREED JOURNALS IN 2005:

1. *Title:* The role of Sri Lanka and Associated Continental Blocks in the Assembly and Break-up of Rodinia and Gondwana
   Authors: **Kehelpannala K.V.W** and Collins A.
   Journal: ***Journal of Asian Earth Sciences,*** Special Issue,2005 (in press)[2]

2. *Title:* The role of Sri Lanka and associated continental blocks in the assembly and break-up of Rodinia and Gondwana. Introduction
   Authors: **Kehelpannala K.V.W** and Collins A.
   Journal: ***Journal of Asian Earth Sciences,*** Special Issue, 2005 (in press)[2]

[1] ***Listed in the Science Citation Index in 2005***
[2] ***Listed in the Science Citation Index-expanded in 2005***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2005:

1. **Kehelpannala K.V.W.**
   Tectonics and Seismicity in the Indian Ocean
   Proceedings of the Seminar on "Natural Disasters and the Role of Geoscientists", 21st Annual Technical Sessions, Geological Society of Sri Lanka, 25th February 2005, 2-3

2. **Kehelpannala K.V.W.**
   Geological natural disasters. Seminar on "Designing to Withstand Natural Disasters: Are you ready?" of the Continuing Professional Development Programme, Sri Lanka Institute of Architects, 29th April 2005, Colombo, 1-2.

3. Jackson K.L., Amelung F., Andres M.S., Eberli G., Jayasena H.A.H., **Kehelpannala K.V.W.**, Peterson L., and Rankey E.C.
Comparative study of the sediment record of coastal lagoons, Sri Lanka: Implications for paleotsunamis. EOS Transactions. American Geophysical Union, 86(52), 2005. Fall Meeting, U.S.A.

INVITED LECTURES/CONFERENCES ATTENDED IN 2005:

1.* Public lecture on "Earthquakes, Tsunamis and Damages: Where we went wrong?" organized by the Institute of Fundamental Studies, Hantana Road, Kandy, 31st December 2004.

2. Invited lecture on "Neotectonics, Seismicity and Deformation of the Lithosphere" delivered at the Seminar on Earthquakes and Tsunamis – Geological Conditions" organized by the Postgraduate Institute of Science (PGIS), University of Peradeniya, Peradeniya, 20th January 2005.

3. Invited lecture on "Earthquakes and Tsunamis" at the Faculty of Applied Sciences, University of Rajarata, Polgolla, 26th January 2005.

4. Invited lecture for engineers on "Earthquakes with Special Reference to Tsunami Conditions" organized by the Institute of Engineers, Sri Lanka, Wayamba Centre, at the Industrial Services Bureau, Kurunegala, 27th January 2005.

5. Invited lecture for parents on "Natural Disasters with Special Reference to Earthquakes and Tsunamis" organized by the Girls' High School, Kandy, 30th January 2005.

6. Invited lecture on "The Tsunami: what we know and what we do not" at the seminar on "The Tsunami: A Scientific Description" – A Series on the Tsunami and its Consequences – Panel Discussion 1. Organised by the Sections D and F of the Sri Lanka Association for the Advancements of Sciences (SLAAS), 22nd February 2005, Colombo. (One of the best lectures attended by many scientists).

7. Invited lecture on "Can earthquakes strike Sri Lanka?" at the seminar organised by the National Science Foundation of Sri Lanka and Sri Lanka Association for the Advancements of Sciences (SLAAS), 24th March 2005, Colombo.

8. Invited lecture on "Tectonics and Seismicity in the Indian Ocean" at the Seminar on Natural Disasters and the Role of Geoscientists, 21st Annual Technical Sessions, Geological Society of Sri Lanka, 25th February 2005.

9. Invited lecture on "The effects of the tsunami waves on the coastal features" at the seminar on the Effects of the tsunami on the Cultural Heritage" organised by ICOMOS, Sri Lanka, 25th March 2005.

10. Presentation on "Earthquakes in Sri Lanka" at the Parliamentary Select Committee on Natural Disasters, Sri Lanka Parliament, 30th March 2005.

11. Presentation on "The Effect of the Tsunami on Coastal Features, Tsunami Water Heights and the 100 m Buffer Zone" at the Parliamentary Select Committee on Natural Disasters, Sri Lanka Parliament, 30th March 2005.

12. Invited lecture on "Geological Natural Disasters", Seminar on "Design to Withstand Disasters: Are You Ready?" Withstand Disasters: Are You Ready?" under the "Continuing Professional Development Programme (CPD) of the Sri Lanka Institute of Architects (SLIA), at the Bandaranayake Memorial Hall, Colombo, 29th April 2005.

13. Invited lecture on "Earthquakes and Tsunamis", Seminar/Panel Discussion on Natural Disasters organized by the National Science Foundation of Sri Lanka, Colombo, 10th May 2005.

14. Invited lecture on "Coastal Erosion Caused by the Indian Ocean Tsunami of 26 December 2004 and 100 m Buffer Zone" at the Office of the President of Sri Lanka, Colombo, 24th June 2005.

15. Invited lecture on "Natural Disasters affecting Sri Lanka" at the Commission for Justice, Peace Human Development and Human Right Secretariat, Kandy, 27th July 2005.

16. Invited lecture on "Natural Disasters of Sri Lanka" for Catholic Priests of Kandy District, Kandy, 29th August 2005.

17. Invited lecture on "Plate Tectonics and Related Natural Disasters" for school children, Gothami Girls' School, Kandy, 13th September 2005.

* This was not included in Annual Research Report 2004.

AWARDS:

1. **Kehelpannala K.V.W.**
   Re-Invitation Fellowship to Germany from the German Academic Exchange Service (DAAD).

RESEARCH GRANTS:

"Brittle deformation, neotectonics and seismicity of Sri Lanka" (Amount of the Grant: Rs. 3.4 million) - NSF Research Grant No. RG/2005/DMM/01.

OTHER CONTRIBUTIONS:

a) WORKSHOPS CONDUCTED IN 2005:

1. Conducted a workshop on "Effects of the tsunami, what happened and what will happen?" for people in the affected area of North Payagala, Western Coast. Organised by the Sri Lanka Association for the Advancement of Science 2nd April 2005, Payagala.

b) TELEVISION PROGRAMMES ON NATURAL DISASTERS

1. About one hour and 30 minutes live TV programme on "the Great Sumatra Earthquake and the Tsunami" – on Independence Television Network (ITN) – A Government owned television channel, on the 30th of December 2004. **(This programme was repeated many times).**

2. 30 minutes educational TV programme on "Tsunamis" – on Rupavahini (Government) – The major national television channel in Sri Lanka, on the 14th of January 2005.

3. Two-hour live TV programme on "Earthquake, tsunamis, what happened on 26th December 2004 and what will happen in the future" – on Independence Television Network (ITN) – A Government owned television channel (the first television channel in Sri Lanka), on the 06th of March 2005. **(This programme was repeated on 09 March 2005).**

4. News item in television news on my discovery of an old human settlement in the Yala National Park, which has been exposed by the tsunami of 26.12.2004. In 8.00 p.m. Rupavahini News (Government) – The major national television channel in Sri Lanka, on 10th March 2005.

5. News item in television news on the frequent sea water flooding in tsunami affected areas (my own findings). In 12.00 noon Rupavahini News (Government) – The major national television channel in Sri Lanka, on 11th March 2005.

6. 30 minutes live TV programme on "what has happened to the coast after the tsunami?" on Rupavahini (Government) – The major national television channel in Sri Lanka, on 16th March 2005.

7. About 15 minutes live discussion in a special TV news programme after the great Sumatra earthquake of 28.03.2005. On Rupavahini (Government) – The major national television channel in Sri Lanka, on 28th March 2005.

8. Two-hour live TV programme on "The 100 m Buffer Zone and What Happened on 28th March 2005" - On Rupavahini (Government) – The major national television channel in Sri Lanka, on 29th March 2005.

9. 30 minutes live TV programme on "Why the 28.03.2005 Sumatra Earthquake did not triggered a big tsunami?" and on "Earthquakes in Sri Lanka" - On Rupavahini (Government) – The national major television channel in Sri Lanka, on 04th April 2005.

10. A programme in TV news on "The earthquake belt that crosses Sri Lanka" (This is my own finding) – "Live at 8.00" – Swarnavahini, a private TV channel, 07th April 2005.

11. 30 minutes live TV programme on "The effects of the tsunami on the coastal areas" - On Rupavahini (Government) – The major national television channel in Sri Lanka, on 11th April 2005.

12. 30 minutes live TV programme on "What will happen near Sumatra after the 28.03.2005 great earthquake?" - On Rupavahini (Government) – The major nationa television channel in Sri Lanka, on 18th April 2005.

13. 30 minutes live TV programme on "Tsunamis and Seiches?" - On Rupavahini (Government) – The major national television channel in Sri Lanka, on 02nd May 2005.

14. A programme in TV news on "Frequent inland sea water flow" (This is my own finding) – "Live at 8.00" – Swarnavahini, a private TV channel, 28th May 2005.

15. 30 minutes live TV programme on "Frequent sea water flooding in the tsunami affected areas" - On Rupavahini (Government) – The major national television channel in Sri Lanka, on 8th June 2005.

16. 30 minutes TV programme on "Tsunamis" – On TLN Television, on 15th September 2005.

c) RADIO PROGRAMMES ON NATURAL DISASTERS

1.* One and half hour live radio programme on "The Tsunami of the 26th of December 2004" – Lak Handa Radio, a Government owned radio channel. Conducted 29th December 2004.

2. One hour live radio programme on "Earthquakes and Tsunamis" – Lak Handa Radio, a Government owned radio channel. Conducted on 03rd March 2005.

3. Short live radio programme on "Emission of an unknown gas from a hole near the Kotmale Reservior" - Lak Handa Radio, a Government owned radio channel. Conducted on 16th March 2005.

4. 15 minutes live radio programme on "Possible Future Tsunamis" - Lak Handa Radio, a Government owned radio channel. Conducted on 21st March 2005.

5. Discussions on earthquakes and tsunamis in radio news - three times in Hiru FM Radio - a private radio channel.

6. A discussion on coastal erosion by the tsunami in radio news – Sun FM Radio - a private English radio channel.

7. A discussion on "Future tsunamis", special live radio programme – RNN Radio - a Government radio channel, 20th May 2005.

8. A discussion on "Landslides in the Hill Country", special two-hour live radio programme – Asura Radio - a private radio channel, 6th June 2005.

9. A two-hour live Radio discussion on "Earthquakes, Volcanic Eruptions, Tsunamis and Landslides" – Sirasa FM Radio, a private radio channel, 31st July 2005.

* This was not included in Annual Research Report 2004.

d) **NEWS PAPER ARTICLES ON NATURAL DISASTERS:**

1. "Sri Lanka is located in a possible earthquake zone" in Sinhalese), "Divaina" News paper, 01st January 2005.

2. "An earthquake with a magnitude of 6.5 on the Richter scale occurred in Sri Lanka during the Portuguese period" (in Sinhalese), "Lakbima" News paper, 9th January 2005.

3. "Study on early tsunami sediments deposited in the coast" (in Sinhalese), "Lakbima" News paper, 2nd February 2005.

4. "Possible evidence for the effect of early tsunamis in the Yala National Park area" (in Sinhalese), "Lakbima" News paper, 4th March 2005.

5. "Fractures and faults occur throughout Sri Lanka - could the hydropower reservoirs in the hill country be affected?", (in Sinhalese), "Lakbima" News paper, 19th March 2005.

6. "Minor tremors can occur in the future", (in Sinhalese), "Lakbima" News paper, 04th April 2005.

7. "Corals in the south-western and eastern areas were caused by an earthquake?" (in Sinhalese), "Lakbima" News paper, 11th April 2005

8. "Another tsunami caused by an earthquake – Sri Lanka could be affected? (in Sinhalese), "Lakbima" News paper, 18th April 2005.

9. "What are the scientific reasons for inland sea water flow? – an investigation by the Institute of Fundamental Studies" (in Sinhalese), "Lakbima" News paper, 21st April 2005.

10. "Great earthquake can occur in the future", (in Sinhalese), "Lakbima" News paper, 5th May 2005.

11. "Tsunami severely erodes country's coastal belt", "Sunday Island", 10th July 2005.

12. "Landslide threats with heavy rain" (in Sinhalese), "Lakbima" News paper, 13th September 2005.

e) OTHER ARTICLES

1. **Kehelpannala K.V.W.**, 2005.
Earthquakes in Sri Lanka. Report of a presentation at the Parliamentary Select Committee on Natural Disasters, Sri Lanka Parliament, 30th March 2005.

2. **Kehelpannala K.V.W.**, 2005.
The Effect of the tsunami on coastal features, tsunami water heights and the 100 m buffer zone. Report of a presentation at the Parliamentary Select Committee on Natural Disasters, Sri Lanka Parliament, 30th March 2005. **(This was quoted in the Parliamentary debates on the 05th April 2005 by the Hon. Dinesh Gunawardena, Minister of Urban Development and Water Supply and Deputy Minister of Education, Hansard of 5th April 2005).**

3. **Kehelpannala K.V.W.**, 2005.
Coastal Erosion Caused by the Indian Ocean Tsunami of 26 December 2004 and 100 m Buffer Zone" Report of the Invited Lecture Delivered at the Office of the President of Sri Lanka, Colombo, 24th June 2005.

4. Contribution to the final report of the Parliamentary Select Committee on Natural Disasters, Sri Lanka Parliament.

SCIENCE DISSEMINATION

Tilakaratne C.T.K. and Sellam S.

Research colloquia, public lectures, research meetings and the science popularization programme for schools were conducted as in the previous years in keeping with the IFS commitment to fundamental science.

(A) Research meetings, research colloquia, special lectures, and public lectures

Research meetings were conducted by the research assistants of the IFS. These meetings provide a platform to present their research findings and discuss their research problems with the peers. Scientists with expertise in their fields of research were invited to talk to their colleagues at research colloquia. Special lectures are arranged to expose researchers in the IFS and other institutions, to visitors who come to IFS. In addition, public lectures were organised to promote the public understanding of science.

(B) Awareness and educational programmes for students

(i) School Science Programme: (SSP)

The School Science Program (SSP) is one of the most important annually conducted programs for the dissemination of science among the younger generation. The Year 2005 has been declared as the "World Year of Physics" to motivate younger generation to take up physics and also to make the general public aware of the importance of physics. Therefore the School Science Program Year 2005 emphasized on Physics.

(ii) Special lectures were delivered on Science Day at Vijaya College, Matale

a) Water Resources in Sri Lanka in general and water quality of drinking water
Prof. E.I.L. Silva

b) Plant Chemistry
Prof. H.R.W. Dharmaratne

(iii) Programme on "World Year of Physics" for school children and Physics teachers in Kandy schools

Problems of Physics Education in Sri Lanka
Prof. Lakshman Dissanayake, Director, PGIS

Physics in Day to Day Life
Prof. K. Premaratne, Department of Physics, University of Peradeniya

Albert Einstein and What he Did
Prof. K. Tennakone, Director/IFS

(iv) Visits: Lab visits were organised for

Postgraduate students
Undergraduate students
Students from other institutions
School children and teachers

Special lecture on IFS and its activities were prepared in advance to enable these students to understand the IFS activities better.

(C) Preparation of Scientific reports/bulletins:

Annual Research Report 2004 was compiled. Mid year report and four quarterly research reports were prepared. Scientific part of the Administrative Report 2004 was prepared in English, Sinhala and Tamil.

On request, Statistical and Scientific Reports about IFS were prepared for other institutions (National Science Foundation, National Library etc.).

Pragñā- IFS Science Bulletin: Two volumes of the Bulletin were published this year. These were distributed to schools , research institutes, universities and scientists.

(D) Science and Technology Promotion

Development of English-Tamil glossary is in progress. Data files for Botany, Zoology, Chemistry and Mathematics were completed and remaining data files are in preparation.

(E) Auditorium was rented out for outsiders on five occasions.

RESEARCH MEETINGS, RESEARCH COLLOQUIA, PUBLIC LECTURES, AND SPECIAL LECTURES

RESEARCH MEETINGS

11.01.2005 **Hydrochemical characteristics of tributary streams of Heen Ganga in the Knuckles region**
Ms. W.M.D. Weerasinghe, Research Assistant, IFS

16.02.2005 **Potential use of herbal anthelmintics in controlling gastrointestinal nematodes in goats**
Dr. (Ms). W.I.T. Fernando, Research Assistant, IFS

09.03.2005 **Mechanistic modelling of arsenic retention on natural red earth in simulated environmental system**
Ms. M.S. Vithanage, Research Assistant, IFS

16.03.2005 **Preliminary studies on theoretical band gaps of some conducting polymers**
Ms. S.B.M.S. Senevirathne, Research Assistant, IFS

18.05.2005 **Copper-kaolinite interactions: an application of diffuse layer surface complexation model**
Mr. P.M. Wickramasinghe, M.Sc. candidate

01.06.2005 **Plant Regeneration from rice *in vitro***
Ms. T.P. Wijesekera, Research Assistant, IFS

22.06.2005 **Axillary shoot proliferation for the induction of *in vitro* rooting and flowering in Bamboo**
Ms. M.C. Vitarana, Research Assistant, IFS

06.07.2005 **Somatic Embryogenesis and Artificial Seeds Production of Bamboo**
Ms. K.M.M.N. Meddegoda, Research Assistant, IFS

03.08.2005 **Application of molecular rectification in a dye-sensitized solar cell**
Mr. P.K.D.D.P. Pitigala, Research Assistant, IFS

17.08.2005 **Geological and Structural Evolution of a root zone of a plate boundary in Sri Lanka**
Mr. L.V. Ranaweera, Research Assistant, IFS

07.09.2005 **Utilization of MEH-PPV as a sensitizer in titana based photovoltaic cells**
Mr. E.V.A. Premalal, Research Assistant, IFS

21.09.2005 **Comparison of surface complexation models with mineral-water interfacial data**
Ms. H.R.W.U. Seneviratne , Research Assistant, IFS

12.10.2005 **Some aspects of limnological characteristics of lentic and lotic habitats of Kala Oya river basin**
Ms. K.M.B.C. Karunathilake, Research Assistant, IFS

20.10.2005 **Pharmacological and toxicity studies of vegetable greens consumed in Sri Lanka**
Ms. B.M.G.K. Balasuriya, Research Assistant, IFS

03.11.2005 **Polymer sensitized solid-state photovoltaic devices based on substituted polythiophenes**
Mr. J.M.R.C. Fernando, Research Assistant

23.11.2005 **Efficient quasi-solid dye sensitized solar cells employing molten salt electrolyte**
Ms. N.de Silva, Research Assistant, IFS

30.11.2005 **Chemistry and Bioactivity studies of *Garciniam Mangostana***
Ms. K.G.N.P. Piyasena, Research Assistant, IFS

07.12.2005 **Photoproperties of dye-sensitized solid-state solar cell sensitized by coupling mercurochrome with a natural stain extracted from pomegranate fruits**
Ms. M.K.I. Seneviratne, Research Assistant, IFS

28.12.2005 **The action of $CuAlo_2$ as a hole conductor on Dye Sensitized Solar Cells**
Ms. J.P. Yasomanee, Research Assistant, IFS

RESEARCH COLLOQUIA

22.12.2005 **Structural characterization of globulin from rice (*Oryza sativa*) seeds**
Dr. S.K.W. Ellepola, Research Fellow, IFS

PUBLIC LECTURES

30.03.2005 **Technical Writing with a purpose - Thesis Vs. Dissertation**
Prof. S.V.R. Weerasooriya, Research Professor, IFS

02.06.2005 **Scientific Deductions and Logical Reality**
Prof. A. Nanayakkara, Associate Research Professor, IFS

11.10.2005 **The Selection of Nobel Prize Winners in Physics**
Prof. Sune Svanberg, Chairman Nobel Prize Committee

SPECIAL LECTURES

05.01.2005 **Marine Natural Products from the South Pacific**
Prof. S. Sotheeswaran, Professor of Organic Chemistry, The University of the South Pacific, Fiji Islands

25.01.2005 **FTIR study on secondary electron acceptor in photosystem-1(PSI)**
Dr. V. Sivakumar, Visiting Scientist, IFS and Lecturer, Department of Physics, University of Peradeniya

WORKSHOPS AND SEMINARS

15.08.2005 Workshop on "Lightning: its Physics, Chemistry and impact on life".

21.10.2005 Demonstration on "Analytical techniques" for students from Postgraduate Institute of Agriculture, Peradeniya at IFS.

02.11.2005 Programme on Instrumentation for final year students from Faculty of Agriculture, Rajarata University.

26.11.2005 One day short course on Computer Modeling conducted by Prof. S.V.R. Weerasooriya, IFS for M.Sc. students in Industrial and Environmental Chemistry from Department of Chemistry, University of Kelaniya.

EDUCATIONAL VISIT

09.03.2005 Undergraduate students from Department of Botany, University of Peradeniya.

11.03.2005 Students from Balangoda Ananada Maithri M.M.V., Balangoda.

18.03.2005 Students from Kahawatta Central College, Kahawatta.

13.06.2005 Undergraduates from Sabaragamuwa University of Sri Lanka.

25.06.2005 M.Sc. students of Postgraduate Institute of Science, Peradeniya.

19.07.2005 Students from G/All Saints M.M.V., Galle

19.07.2005 Students from Technical College, Matara

14.10.2005 Students from Wariyapola Sri Sumangala Vidyalaya , Kandy.

24.11.2005 A/L Biology students from Trinity College, Kandy.

25.11.2005 Undergraduate students from Buttala Campus.

02.12.2005 Undergraduate students from Buttala Campus.

SPECIAL PROGRAMME FOR SCHOOL CHILDREN

14.10.2005 **Lectures on Science Day** at Vijaya College, Kandy

a) Water Resources in Sri Lanka in general and water quality of drinking water
Prof. E.I.L. Silva

b) Plant Chemistry
Prof. H.R.W. Dharmaratne

07.11.2005 **Programme on "World Year of Physics"** for school children and Physics teachers in Kandy schools

Problems of Physics Education in Sri Lanka
Prof. Lakshman Dissanayake, Director, PGIS

Physics in Day to Day Life
Prof. K. Premaratne, Department of Physics, University of Peradeniya

Albert Einstein and What he Did
Prof. K. Tennakone, Director/ IFS

SCHOOL SCIENCE PROGRAMME
29th June to 1st July, 2005

29th June **Planck - Einstein Photon Hypothesis: Birth of Quantum Mechanics**
Prof. K. Tennakone

Photovoltaic solar cells
Dr. P.M. Sirimanne

30th June	**Physics in Medicine** *Dr. V. Sivakumar*
	Application of Physics in Molecular Biology *Dr. D.N. Magana-Arachchi*
1st July	**On SETI and the search for extra solar planets** *Prof. W. Stuiver*

RESEARCH STAFF 2005

The period mentioned within brackets shows their stay at IFS

Senior Research Professor

Director/IFS - Tennakone K. *(1988-todate)*

Research Professor

Weerasooriya S.V.R. *(1986-todate)*

Associate Research Professor

Dharmaratne H.R.W. *(1992-todate)*
Jayasinghe J.H.M.U.L.B. *(1992-todate)*
Nanayakkara A. *(2000-todate)*
Silva E.I.L. *(1988-todate)*

Senior Research Fellow

Bandara J. *(1999-todate)*
Iqbal M.C.M. *(1997-todate)*
Kehelpannala K.V.W. *(1994-todate)*
Ramanayake S.M.S.D. *(1988-todate)*
Senadeera G.K.R. *(1998-todate)*
Senevirathne P.R.G. *(1993-todate)*
Sirimanne P.M. (2005-todate)

Research Fellow

S. Ellepola *(January 2005-todate)*
Maganaarachchi D.M. *(2004-todate)*
Wijayasinghe A. *(April 2005-todate)*

Visiting Research Staff

Honorary Research Professor

Kovoor A. *(2001-todate)*
Kröner A. *(2001-todate)*

Distinguished Visiting Research Professor

Queisser H.J. *(2003-todate)*

Honorary Visiting Research Professor

Yoshida M.	*(2000-todate)*

Visiting Research Professor

Dias H.V.R.	*(1999-todate)*
Fernando G.W.	*(1997-todate)*
Gunaratne G.H.	*(1997-todate)*
Perera U.	*(2000-todate)*
Wijewardena L.C.R.	*(1997-todate)*

Honorary Visiting Associate Research Professor

Kleinschrodt R.	*(2000-todate)*

Honorary Senior Research Fellow

Dittus W.P.J.	*(1983-todate)*

Visiting Senior Research Fellow

Wijayantha K.G.U.	*(2004-todate)*

Visiting Scientist

Perera V.P.S.	*(2004-todate)*
Sivakumar V.	*(2004-todate)*

RESEARCH ASSISTANTS 2005

The period mentioned within brackets shows their stay at IFS

Research Assistants (Grade I)

Jayaweera P.V.V	*(03.04.2000-todate)*
Premaratne S.R.	*(01.09.2005-todate)*
Rathnayake R.R.	*(15.01.2001-todate)*
Wijesekara K.B.	*(16.06.2003-todate)*
Wijesekera T.P.	*(01.05.2004-todate)*
Zavahir J.S.	*(01.09.2005-todate)*

***Research Assistants* (Grade II)**

Amarasinghe N.R.	*(17.11.2003-todate)*
Balasuriya B.M.G.K	*(03.11.2003-todate)*
Bandara W.M.M.S.	*(17.03.2005-todate)*
Bandaranayake K.M.P.	*(17.04.2000-todate)*
de Silva N.	*(15.07.2002-todate)*
Fernando W.I.T.	*(15.07.2002-todate)*
Gnanakkan D.T.	*(01.02.2005-todate)*
Karunathilake K.M.B.C.	*(15.07.2002-24.10.2005))*
Kumari H.K.J.S.	*(01.12.2004-12.08.2005)*
Maligaspe E.C.	*(01.11.2004-31.07.2005)*
Maddegoda K.M.M.N.	*(03.01.2005-todate)*
Napagoda M.T.	*(01.07.2002-31.05.2005)*
Pitigala P.K.D.D.P.	*(01.07.2002-todate)*
Piyasena K.G.N.P.	*(01.06.2002-todate)*
Premalal E.V.A.	*(20.05.2004-todate)*
Ranaweera L.V.	*(03.11.2003-todate)*
Samarasinghe P.B.	*(01.12.2005-todate)*
Seneviratne M.K.I.	*(01.09.2003-todate)*
Senevirathne S.B.M.S.	*(15.12.2003-todate)*
Senevirathna H.R.W.U.	*(20.12.2004-todate)*
Vithanage M.S.	*(15.12.2004-10.08.2005)*
Vitharana M.C.	*(03.01.2005-todate)*
Weerasinghe W.M.D.	*(01.01.2004-todate)*
Weerasekara M.L.M.A.W.	*(01.09.2005-todate)*
Yasomanee J.P.	*(01.12.2005-todate)*

Project Leaders are responsible for authenticity of reports they have submitted.