ANNUAL RESEARCH REPORT 2007

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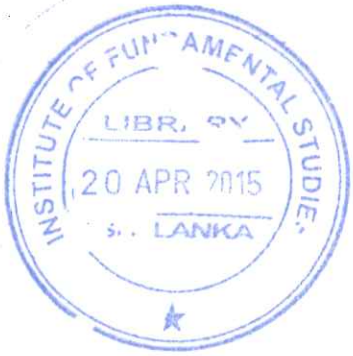

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CONTENTS

PUBLICATIONS IN REFEREED JOURNALS IN 2007

1. **Amarasinghe N.R., Jayasinghe L.,** Hara N., and Fujimoto Y. Chemical constituents of the fruits of *Artocarpus altilis*. ***Biochemical Systematics and Ecology***, 2007 (in press) [1,2].

2. ***Amarasinghe N.R., Jayasinghe L.**, Hara N., and Fujimoto Y. Flacourside, a new 4-oxo-2-cyclopentenylmethyl glucoside from the fruit juice of *Flacourtia indica*. ***Food Chemistry***, **102**, 95-97 (2007) [1,2].

3. Arnoldi A., Dallavalle S., Merlini L., Musso L., Farina G., Moretti M., and **Jayasinghe L**. Synthesis and antifungal activity of a series of a *N*-substituted [2-(2,4-dichlorophenyl)-3-(1,2,4-triazol-1-yl)]-propylamines. ***Journal of Agricultural and Food Chemistry***, **55:** 8187–8192 (2007) [1,2].

4. **Balasuriya B.M.G.K**. and **Dharmaratne H.R.W**. Cytotoxicity and antioxidant activity studies of traditional green leafy vegetables consumed in Sri Lanka. ***Journal of National Science Foundation***, **35(4):** 255-258 (2007).

5. **Bandara J.** and Ranasinghe R.A.S.S. The effect of MgO coating on photo-catalytic activity of SnO_2 for the degradation of chlorophenol and textile colorants; the correlation between the photocatalytic activity and the negative shift of flatband potential of SnO_2. ***Applied Catalysis A-General,*** **319:** 58-63 (2007) [1,2].

6. **Bandara J**. and Klehm U., and Kiwi J. Raschig rings-Fe_2O_3 composite photocatalyst activate in the degradation of 4-chlorophenol and Orange II under daylight irradiation. ***Applied Catalysis B: Environemental,*** **76:** 73-81 (2007) [1,2].

7. **Bandara J.** and **Yasomanee J.P**. p-type oxide semiconductors as hole collectors in dye-sensitized solid-state solar cells. ***Semiconductor Science and Technology,*** **22**: 20-24 (2007) [1,2].

8. **Bandara J.**, Jayathilaka S.P.B., and Wansapura P.T. Indium tin oxide coated conducting glass electrode for electrochemical destruction of textile colorants. ***Electrochimica Acta,*** **52 (12):** 4161-4166 (2007) [1,2].

9. ***Dharmaratne H. R.W.,** Tennakoon S.B. and Napagoda M.T. Xanthones from root bark of *Calophyllum thwaitesii* and their Bioactivity. ***Natural Product Research,*** 2007 (in press) [2].

10. ***Dharmaratne H.R.W.** and Marasinghe G.P.K. New methylethers of cordatolides from *Calophyllum cordato-oblongum* and their synthesis. ***Natural Product Research,*** 2007 (in press) [2].

11. Dissanayake C.M. Hettiarachchi and **Iqbal** M.C.M. Sustainable use of *Crytocoryne wendtii* de Wit and *Echinodorus cordifolius* in the aquaculture industry of Sri Lanka by micropropagation. ***Sri Lanka Journal of Aquatic Sciences*** **,12:** 89-101 (2007).

12. Ekanayake D., Welch D., Kieft R., Hajduk S., and **Dittus W.** Transmission dynamics of cryptosporidium infection in a natural population of non-human primates at Polonnaruwa, Sri Lanka. ***American Journal of Tropical Medicine and Hygiene,*** **77(5):** 818-822 (2007) [1,2].

13. ***Ellepola S.W.**, and Ma C.Y. Conformational study of globulin from rice (*Oryza sativa*) seeds by Fourier-transform infrared spectroscopy. ***International Journal of Biological Macromolecules,*** **37:** 20- 22 (2007) [1,2].

14. *Fernando J.M.R.C. and **Senadeera G.K.R.** Photorsponses of copolymers based on derivatives of thiophene units. ***Ceylon Journal of Science (Physical Sciences),*** **12:** 37-46 (2007).

15. Fernando J.M.R.C. and **Senadeera G.K.R.** Synthesis and characterization of carboxylated thiophene co-polymers and their uses in photovoltaic cells. ***Current Science***, 2007 (in press) [1,2].

16. **Iqbal M.C.M.** and **Wijesekara K.B**. A brief temperature pulse enhances the competency of microspores for androgenesis in *Datura metel*. ***Plant Cell, Tissue and Organ Culture,*** **89:**141-149 (2007) [1,2].

17. **Iqbal M.C.M.** Falsifiability of theories in the Biological Sciences. ***Ceylon Journal of Science,*** 2007 (in press).

18. ***Jayasinghe U.L.B.**, Hara N., and Fujimoto Y. (2-Nitroethyl) Phenyl and cyanophenyl glycosides from the fruits of *Diploclisia glaucescens*. ***Natural Product Research***, **21:** 260-264 (2007) [2].

19. ***Jayasinghe U.L.B.**, Ratnayake R.M.S., Medawala W., and Fujimto Y. Dihydrochalcones with radical scavenging properties from the leaves of *Syzygium jambos*. ***Natural Product Research***, **21**, 551-554. (2007) [2].

20. **Jayasinghe U.L.B.,** Samarakoon T.B., Kumarihamy B.M.M., Hara N., and Fujimoto Y. Four new prenylated flavonoids and xanthones from the root bark of *Artocarpus nobilis*. ***Fitoterapia***, 2007 (in press) [2].

21. **Jayaweera P.V.V.,** Mastik S.G., **Tennakone K., Perera A.G.U.**, Liu H.C., and Krishna S. Spin split-off transition based IR detectors operating at high temperatures. ***Infrared Physics and Technology,*** **50:** 279 (2007) [1,2].

22. **Jayaweera P.V.V. , Perera A.G.U.,** and **Tennakone K.** Why Gratzel cell works so well. ***Inorganica Chemica Acta*** (available online www.science direct.com 2007) [1,2].

23. **Jayaweera P.V.V., Perera A.G.U.,** and **Tennakone K.** Displacement currents in semiconductor quantum dots embedded in dielectric media. ***Applied Physics Letters,*** **91:** 063114-1 – 063114-3 (2007) [1,2].

24. **Jayaweera P.V.V.,** Pitigala P.K.D.P.P., **Seneviratne M.K.I.,** and **Tennakone K.** 1/f Noise in dye-sensitized solar cells and NIR photon detectors. ***Infrared Physics and Technology,*** 50: 270 (2007) [1,2].

25. Konno A., Kumara, G.R.A., Kaneko S., Agyeman B.O., and **Tennakone K.** Dye-sensitized solid-state solar cell sensitized with indoline dye. ***Chemistry Letters*, 36:** 716 (2007) [1,2].

26. Matsuura Y., **Kehelpannala K.V.W.**, and Wada H. Differential thermal analysis of Sri Lankan-type vein graphite. ***Geoscience Reports of Shizuoka University*, 34:** 7-18 (2007).

27. Milligan L.A., Rapoport S.I., Cranfield M.R., **Dittus W.,** Glander K.E., Oftedal O.T., Power M.L., Whittier C.A., and Bazinet R.P. Fatty acid composition of wild anthropoid primate milks. ***Comparative Biochemistry and Physiology, Part B,***2007 (in press) [1,2].

28. **Nanayakkara A.** Asymptotic behavior of eigen energies of Non-Hermitian cubic polynomial systems. ***Canadian Journal of Physics,* 85:** 1473 (2007) [1,2].

29. **Nanayakkara A.** Semiclassical quantization of non-Hermitian Multidimensional Systems using Hamilton-Jacobi Equation. ***Canadian Journal of Physics,* 85:** 1481 (2007) [1,2].

30. *Nath U.K., **Iqbal M.C.M.,** and Möllers C. Early, non-destructive selection of microspore derived embryo genotypes in oilseed rape (*Brassica napus* L.) by molecular markers and oil quality analysis. ***Molecular Breeding,* 19**: 285-289 (2007)[1,2].

31. ****Ramanayake S.M.S.D.**, Meemaduma V.N., and Weerawardene T.E. Genetic diversity and relationships within populations of *Dendrocalamus giganteus* Wall. ex Munro and *Ochlandra stridula* Moon ex Thwaites in Sri Lanka using RAPDs. ***Journal of Bamboo and Rattan,* 5: (3 & 4):** 141-149 (2006).

32. **Ramanayake S.M.S.D.,** Meemaduma V.N., and Weerawardene T.E. Genetic diversity in a population of *Dendrocalamus giganteus* Wall. ex Munro in the Royal Botanic Gardens, Sri Lanka. ***Journal of the National Science Foundation of Sri Lanka*, 35(3):** 207-210 (2007).

33. **Ramanayake S.M.S.D.,** Meemaduma V.N., and Weerawardene T.E.. Genetic diversity and relationships between nine species of bamboo in Sri Lanka, using Random Amplified Polymorphic DNA. ***Plant Systematics and Evolution*, 269 (1-2):** 55-61 (2007) [1,2].

34. **Ratnayake R.R., Seneviratne G.,** and Kulasooriya S.A. A modified method of weight loss on ignition to evaluate soil organic matter fractions. ***International Journal of Soil Science*, 2**: 69 (2007).

35. Selvarajan S., **Nanayakkara A.**, and Malmini Ranasinghe R.P.K.C. Effect of external current on spiking Neuron. ***Journal of the National Science Foundation***,2007 (in press).

36. ***Senadeera G.K.R.** and **de Silva N.** Efficient quasi –solid dye sensitized solar cells employing molten salt electrolyte. ***Sri Lankan Journal of Physics,* 7**: 15-22 (2007)

37. ***Senevirathna M.K.I.**, Pitigala P.K.D.D.P., **Premalal E.V.A.**, **Tennakone K.**, Kumara G.R.A., and Konno A. Stability of the SnO_2/MgO Dye-sensitized Photoelectrochemical Solar Cell. ***Solar Energy Materials and Solar Cells,* 91:** 544-547 (2007) [1,2].

38. **Seneviratne G.** Two-thirds law of nitrogen mineralization under undisturbed soil conditions: a new theory. ***Pedosphere*** (in press)[2].

39. Sepperumal M., **Wijayasinghe A.,** and Bergman B. Preparation and Characterization of CuI-doped Silver Borovanadate Superionic System. ***Solid State Ionics*, 178:** 779 – 783 (2007) [1,2].

40. Sepperumal M., **Wijayasinghe A.,** and Bergman B. Ion Transport Studies in CuI doped Silver Borovanadata Glassy System. ***Journal of Non-Crystalline Solids,*** 2007 (in press) [1,2].

41. Siddique I., Gutjahr C., **Seneviratne G.,** Breckling B., Ranwala S.W., and Alexander I.J. Changes in soil chemistry associated with the establishment of forest gardens on eroded, acidified grassland soils in Sri Lanka. ***Biology and Fertility of Soils*, 44:** 163 (2007) [1,2].

42. **Silva E.I.L.** Ecology of Phytoplankton in Tropical Waters: Introduction to the Topic and Ecosystem. ***Asian Journal of water, Environment and Pollution*, 4(1):** 25-35 (2007).

43. ***Silva, E.I.L.** Hypertrophic-eutrophic alteration in an urban water body, following an outbreak of a Microcystis Bloom. ***Sri Lanka Journal of Aquatic Sciences*, 12:** 115-120 (2007).

44. **Silva E.I.L.,** Singappuli M.S., Jayatissa L.P., Hettiarachchi S., and Dehairs F. Photosynthetic characteristics and primary production of phytoplankton and sea grasses in Rekewa, a coastal lagoon in Sri Lanka. ***Indian Journal of Marine Sciences,*** 2007 (in press)[2].

45. **Sirimanne P.M.** and **Premalal E.V.A.** Optical properties of Poly-[2-methoxy-5-(2-ethyl-hexyloxy)-phenylene vinylene and its application in photovoltaic cells. ***Ceylon Journal of Physics,*** 2007 (in press).

46. **Sirimanne P.M.** Contribution of H-aggregated pyrogallol red molecules in the photocurrent generation of solid state TiO2|dye|CuI cells. ***Renewable Energy,*** 2007 (in press) [1,2].

47. ***Sirimanne P.M.** and Tributsch H. Generation of inhomogeneous photocurrent in solid-state TiO_2|dye|CuI cells and effect of ligands attached to the surfactant on the morphology of CuI films. ***Solar Energy,* 81:** 535-539 (2007) [1,2].

48. **Sirimanne P.M., Premalal E.V.A.,** and Soga T. Optical and electronic properties of poly[2-methoxy-5-(2-ethyl-hexyloxy)-p- phenylene vinylene and its applications in solid state cells. ***Current Science,* 93:** 132-133 (2007) [1,2].

49. *Sirimanne P.M., Senevirathna M.K.I., Premalal E.V.A., Pitigala P.K.D.D.P., Sivakumar V., and Tennakone K. Utilization of cyanadin 3-glucoside as a sensitizer in a solid-state solar cell and enhancement of photo-effects of TiO_2|cyanidin 3-glucoside|CuI cell coupling by mercurochrome with cyanidin 3-glucoside. ***Ceylon Journal of Chemistry***, 2007 (in press).

50. **Tennakone K.**, **Senaviratne M.K.I.**, and **Kehelpannala K.V.W.** Extraction of pure metallic nickel from ores and plants at Ussangoda, Sri Lanka. ***Journal of the National Science Foundation***, **35:** 245-250 (2007).

51. *Vithanage M., Seneviratna W., Chandarjith R., and **Weerasooriya R.** Arsenic binding mechanism on natural red earth: a potential substrate for pollution control. ***Science of the Total Environment***, **379:** 244 (2007) [1,2]

52. Weerasinghe A.P., Ariyawansa S., and **Weerasooriya R.** Phyo-remediation potential of I aquatica for Cr(VI) mitigation. ***Chemosphere,*** 2007 (in press) [1,2].

53. **Weerasooriya R.,** Tobschall H.J., and Bandara A. Modeling Interactions of Hg(II) and Natural Soils Using Physico-chemical Parameters of Synthetic Gibbsite. ***Chemosphere,*** 2007 (in press) [1,2].

54. ***Weerasooriya R.**, Senevirathne W., Kasthuriaarachi H.A., and Tobschall H.J. Thermodynamic assessment of Hg(II)-gibbsite interactions. ***Journal of Colloid and Interface Science***, 301: 452 (2006)[1,2]

55. **Weerasooriya R.,** Tobschall H.J., Seneviratne W., and Bandara A. Transition state kinetics of Hg(II) adsorption at gibbste-water interface. ***Journal of Hazardous Materials***, 2007 (in press) [1,2].

56. **Wijesekara T.P.**, **Iqbal M.C.M.,** and Bandara D.C. Plant regeneration *in vitro* by organogenesis on callus induced from mature embryos of three rice varieties (*Oryza sativa* ssp. *indica*). ***Tropical Agricultural Research,*** **19**: 25-35 (2007).

57. **Wijesekara T.P.**, Jayasena M.K.A.S., Medagoda M.N.and **Iqbal M.C.M.**. Callusing and regeneration of three genotypes of *Oryza sativa* ssp. *indica* by 2,4 dichlorophenoxy acetic acid (2,4-D). ***Journal of the National Science Foundation,*** **35(2):** 139-14 (2007).

58. **Zavahir J.S.** and **Seneviratne G.** Potential of developed microbial biofilms in generating novel bioactive compounds. ***Research Journal of Microbiology***, 2: 397 (2007)

* ***Reported as "in press" in Annual Report 2006***
** ***Not included in Annual Report 2006***

[1] ***Listed in the Science Citation Index in 2007***
[2] ***Listed in the Science Citation Index-expanded in 2007***

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 2006)

JOURNAL	*IMPACT FACTOR*
American Journal of Tropical Medicine and Hygiene	*2.546*
Applied Catalysis A-General	*2.630*
Applied Catalysis B: Environemental	*3.942*
Applied Physics Letters	*3.977*
Asian Journal of water, Environment and Pollution	*X*
Biochemical Systematics and Ecology	*0.906*
Biology and Fertility of Soils	*1.405*
Canadian Journal of Physics	*0.756*
Ceylon Journal of Chemistry	*X*
Ceylon Journal of Physics	*X*
Ceylon Journal of Science (Physical Sciences)	*X*
Chemistry Letters	*1.734*
Chemosphere	*2.442*
Comparative Biochemistry and Physiology, Part B	*1.532*
Current Science	*0.737*
Electrochimica Acta	*2.955*
Fitoterapia	*0.908*
Food Chemistry	*2.433*
Geoscience Reports of Shizuoka University	*X*
Indian Journal of Marine Sciences	*0.209*
Infrared Physics and Technology	*0.970*
Inorganica Chemica Acta	*1.674*
International Journal of Biological Macromolecules	*1.323*
International Journal of Soil Science	*X*
Journal of Colloid and Interface Science	*2.233*
Journal of National Science Foundation	*X*
Journal of Agricultural and Food Chemistry	*2.322*
Journal of Bamboo and Rattan	*X*
Journal of Hazardous Materials	*1.855*
Journal of Non-Crystalline Solids	*1.362*
Molecular Breeding	*2.135*
Natural Products Research	*0.798*
Pedosphere	*1.817*
Plant Cell, Tissue and Organ Culture	*0.957*
Plant Systematics and Evolution	*1.239*
Renewable Energy	*0.850*
Research Journal of Microbiology	*X*
Science of the Total Environment	*2.359*
Semiconductor Science and Technology	*1.586*

Solar Energy	*1.431*
Solar Energy Materials and Solar Cells	*2.321*
Solid State Ionics	*2.190*
Sri Lanka Journal of Aquatic Sciences	*X*
Sri Lanka Journal of Fisheries and Aquatic Sciences	*X*
Sri Lankan Journal of Physics	*X*
Tropical Agricultural Research	*X*

PROJECT: **COMPUTATIONAL MATHEMATICS AND PHYSICS**

(I) BRAIN COMPUTER INTERFACE

COMMENCEMENT: 2006

Nanayakkara A., *Associate Research Professor* **(Project Leader)**
Zahmeeth Sakkaff, *Research Assistant*

PROGRESS ACHIEVED (*Since inception*):

Scope of the Project:

This project is aiming at building a Brain Computer Interface (BCI) system, which provides communication link between the human brain and a computer, especially for patients who suffer from severe motor impairments (late stage of Amyothrophic Lateral Sclerosis (ALS), severe cerebral palsy, head trauma and spinal injuries). This way, the patients who are with severe physical disabilities can control equipments such as Wheel chairs, TVs, etc. and communicate with computer voice in his or her native language (in Sinhala, Tamil or English).

Overview:

For many years, several research laboratories around the world and various research groups in Europe and USA have been working on systems, which allow for a direct dialog between man and machine. One of the outcomes of these efforts is "Brain Computer Interface" (BCI). A brain-computer interface (BCI) or direct neural interface is literally a direct technological interface between a brain and a computer not requiring any motor output from the user. That is, neural impulses in the brain are intercepted and used to control an electronic device such as computer.

The Electroencephalogram (EEG)-based Brain Computer Interface is one of the methods used in BCI, which measures the brain activity in order to control a device just by thoughts. EEG - based Brain-Computer Interface (BCI) system is a an alternative communication software channel, which allows people to use scalp-recorded EEG activity to control a device such as a computer cursor to give paralyzed patients greater ability to interact with their environment.

In the first part of this project, we will develop a BCI by monitoring thoughts of individuals through Electroencephalographic (EEG) signals, and then translate them into a digital data stream, which can be understood by a computer.
The project is carried out in two stages:

- Collect EEG signals from human subjects.
- Process and analyze EEG signals, to identify features, which are corresponding to specific thoughts. Processing and analyzing of data are achieved by using signal processing and other computational methods.

Since we haven't had access to a EEG recording system until November 2007, we have been mainly working in the signal processing part of the project. The existing signal processing methods developed for EEG were studied. Also we developed software for analyzing EEG data with Short time Fourier transforms and Linear predicting coding techniques. From the internet, large amount of event specific EEG data has been down loaded and used for testing the software which we are developing.

Our aim here is to find new computational methods for identifying features in EEG signals correctly and efficiently and hence developing a working BCI system for Sri Lankan community.

PROJECT OUTPUT 2007:

Since July 2007, the Project Leader is on sabbatical leave at Uva Wellassa University, Badulla and he is mainly involved in curriculum development for Science and Computer science and technology degree programs. (Detail is given at the end of this project description under the title *other contributions*)

As part of Brain Computer system, a new nonlinear method has been implemented for removing EOG artifacts from EEG signals. The method was tested with data down loaded from Artificial Intelligence Group, Department of Computer Science, University of Colorado, USA. It was found that quadratic regression method which we developed performed the best among many methods tested. EEG hardware arrived in November 2007 and presently, EEG lab is being constructed. By the end of January 2008, the EEG lab will be completed and signal processing software which we developed during 2007 will be tested with this new EEG Hardware.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1. *Title:* Effect of external current on spiking Neuron
   Authors: Selvarajan S., **Nanayakkara A.**, and Malmini Ranasinghe R.P.K.C.
   Journal: ***Journal of the National Science Foundation,*** 2007 (in press)

   The major part of this work has been carried out under the project titled "COMPUTER SIMULATION OF ELECTROPHYSIOLOGICAL ACTIVITIES IN HUMAN BRAIN "

INVITED LECTURES/CONFERENCES ATTENDED IN 2007:

1. **Nanayakkara A.** and Selvarajan S.
   Modeling of Electrical Activities of Epileptic Brain Using Continuous Neural Network Models
   (Talk given at Brain Interest Group at University of Peradeniya on 26-06-2007)
   The major part of this work has been carried out under the project titled "COMPUTER SIMULATION OF ELECTROPHYSIOLOGICAL ACTIVITIES IN HUMAN BRAIN "

OTHER CONTRIBUTIONS IN 2007:

Since July 2007 the project leader is working as Course Director at Uva Wellassa University (UWU) on sabbatical leave. Major work carried out at UWU is

(a) Development of new courses for Computer Science and Technology degree program.
(b) Development of Courses in Quantum Mechanics and Computational Material Science.
(c) Lectured Calculus and structured programming classes and supervised students projects on computer science and technology.
(d) Involved in development of new research program for junior lecturers

PROJECT: **COMPUTATIONAL MATHEMATICS AND PHYSICS**

(II) COMPUTER AIDED DESIGNING OF NEW MATERIALS

COMMENCEMENT: 2004

INVESTIGATORS (2007):

Nanayakkara A., *Associate Research Professor* **(Project Leader)**
Seneviratne S.B.M.S., *Research Assistant*
Udathasan T., *Research Student (NSF funded)*

PROGRESS ACHIEVED (*Since inception*):

Scope of the Project:
Aim of this project is to use computer aided techniques to design new materials with desirable electronic and physical properties which can be used for practical applications.

Overview:
As the first step we are concentrating on materials which are useful in solar cell development. We use ab initio and semi-empirical methods for obtaining electronic band structures. 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.

A 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.

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.

In order to test our new theoretical methods, a software package, **MOLDF** is being developed. This package is based on Density Functional Theory and new exchange

correlational functionals. We have completed the Major part of the MOLDF code and currently we are introducing efficient and accurate numerical algorithms to the package.

We have developed a method to calculate band positions theoretically using nearly free electron model based on electrostatic potentials along the double bond and single bond pairs of polymer chains. These electrostatic potentials are calculated using Density functional based ab initio molecular structure methods.

PROJECT OUTPUT 2007:

The electrostatic potential method was implemented and tested with few conducting polymers. Preliminary results were presented at the Material science conference at University of Peradeniya

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2007:

1. **Senevirathne M.S.**, **Nanayakkara A.**, and **Senadeera G.K.R.**
   A theoretical investigation of band gaps of conducing polymers - polythiophene, polypyrrole and polyfuran (full paper)
   Proceedings of the 23rd Technical Session, Institute of Physics, Sri Lanka, March 2007

2. **Senevirathne M.S.**, **Nanayakkara A.**and **Senadeera G.K.R.**
   A new extrapolation method for estimating band gaps of heterocyclic conducting polymers (abstract)
   National Conference on Materials for Emerging Technologies, p 51, 21-22 July 2007

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

COMMENCEMENT: 2000

INVESTIGATORS (2007):

Nanayakkara A., *Associate Research Professor* **(Project Leader)**

PROGRESS ACHIEVED (*Since inception*):

Scope of the Project:
This is purely a theoretical project to investigate the peculiar behavior of multi dimensional systems in the semiclassical limit. (i.e. limit between quantum mechanics and classical mechanics)

Overview:
In recent years, the manifestation of chaos in quantum mechanics has 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 2005) 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.

(7) Non-PT symmetric systems were studied with non-perturbative action angle theoretical methods. Semiclassical Lie transformation methods were modified for complex non-Hermitian systems.

(8) Asymptotic energy expansions of general cubic polynomial complex potentials were derived using new integration techniques. Both complex and real eigen values of the above system are obtained using the asymptotic energy expansion. Quantum eigen energies obtained by the above method are found to be in excellent agreement with the exact eigen values.

PROJECT OUTPUT 2007:

Complex simplectic structure of phase space of non-Hermitian Hamiltonian systems were studied and for several systems Birkhoff normal forms were derived and reality of constants of motion of multidimensional systems was studied with Birkhoff normal forms and Lie Transform methods.

This project has produced 22 research papers and 3 research communications during last six years.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1. *Title:* Asymptotic behavior of eigen energies of Non-Hermitian cubic polynomial systems
   Author: **Nanayakkara A.**
   Journal: ***Canadian Journal of Physics*, 85:** 1473 (2007)[1,2]

2. *Title:* Semiclassical quantization of non-Hermitian Multidimensional Systems using Hamilton-Jacobi Equation
   Author: **Nanayakkara A.**
   Journal: ***Canadian Journal of Physics*, 85:** 1481 (2007) [1,2]

[1] ***Listed in the Science Citation Index in 2007***
[2] ***Listed in the Science Citation Index-expanded in 2007***

PROJECT : CONDENSED MATTER PHYSICS

COMMENCEMENT: 1987

INVESTIGATORS (2007):

Tennakone K. *Senior Research Professor* **(Project Leader)**
Ariyasinghe Y.P.Y.P., *Research Assistant*
Bandaranayake K.M.P., *Research Assistant*
Jayaweera P.V.V., *Research Assistant*
Premalal E.V.A., *Research Assistant*
Seneviratne M.K.I., *Research Assistant*
Wijayaratne T.R.C.K., *Research Assistant*

PROGRESS ACHIEVED (*Since inception*):

The project was established in mid nineteen eighties to initiate original research in Condensed Matter Physics. The choice of topics depended on resources available, popular fashions and the sustainability of the selected themes in the local context. In the first few years since inception of the project, much effort was diverted to high temperature superconductivity, an exciting new development pursued in many laboratories at that time. Thereafter, the project shifted more towards semiconductor physics interacting closely with project on photochemistry at the Institute. Currently, the project conducts investigations in semiconductor nanostructures and dye-sensitization covering both experimental and theoretical aspects. Following are some of the major highlights of the project.

(1) Discovery of CuSCN as a high band-gap p-type semiconductor and developing methods of its deposition
(2) The concept of the dye-sensitized solid-state solar and its first experimental demonstration.
(3) The concept of the solar cell based on thin light harvesting semiconductor thin film deposited on a high band-gap semiconductor nanocrystalline film and its experimental demonstration.
(4) Dye-sensitized solar cell based on a nanocomposite of zinc and tin oxides
(5) Use of ultra-thin insulating barriers for suppression of recombination in dye-sensitied solar cells based on tin oxide and theoretical understanding of the mechanism involved.
(6) The technique of using crystal growth inhibitors to improve nanocrystallinity of hole collecting materials.
(7) Development of model system to illustrate the utility of molecular rectification in dye-sensitized solar cells.
(8) Illustration of the possibility panchromatic sensitization in nanocrystalline solar cells.
(9) Application of 1/f noise for elucidating mechanisms of recombination in semiconductor nanostructures.

Project has given rise to more than 180 publications in international journals and some of the papers are highly cited. The project has acclaim as a focus of activity in this field and facilitated post-graduate training of 18 students.

PROJECT OUTPUT 2007:

The first phase of the assessment of the stability of tin oxide based dye-sensitized solar cells was completed and the results published. Experiments were conducted to determine influence of the dye and nature of the oxide surface on recombination kinetics in dye-sensitized solar cells and an important conclusion arrived was that suitable ligands in the dye molecule could passivate recombination centers on the oxide surface. Indolines with rhodanine rings were examined in great detail with the view of developing more efficient organic sensitizers. Heterostructures of the configuration, nano-TiO_2/nano-gold particles/dye were experimented to explore the plasmonic and rectification properties of these systems. Work conducted during the year 2007 overlapped with the project on Semiconductor Optoelectronics pursued in collaboration the Department of Physics, Georgia State University. An important outcome of this collaborative program has been experiments and calculations carried out for designing photon detectors utilizing displacement currents in quantum dots and carbon nanotubes embedded in dielectric media. Results were published in a prestigious journal.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1.* *Title* : Stability of the SnO_2/MgO Dye-sensitized Photoelectrochemical Solar Cell
Authors: **Senevirathna M.K.I.** , Pitigala P.K.D.D.P., **Premalal E.V.A., Tennakone K.,** Kumara G.R.A., and Konno A.
Journal: ***Solar Energy Materials and Solar Cells,* 91:** 544-547 (2007)[1,2]

2. *Title:* 1/f Noise in dye-sensitized solar cells and NIR photon detectors
Authors: **Jayaweera P.V.V.,** Pitigala P.K.D.P.P., **Seneviratne M.K.I.,** and **Tennakone K.**
Journal: ***Infrared Physics and Technology,* 50:** 270 (2007) [1,2]

3. *Title:* Spin split-off transition based IR detectors operating at high temperatures
Authors: **Jayaweera P.V.V**, Mastik S.G, **Tennakone K., Perera A.G.U.,** Liu H.C., and Krishna S.
Journal: ***Infrared Physics and Technology,* 50:** 279 (2007) [1,2]

4. *Title:* Dye-sensitized solid-state solar cell sensitized with indoline dye
Authors: Konno A., Kumara, G.R.A, Kaneko S., Agyeman B.O., and **Tennakone K.**
Journal: ***Chemistry Letters*, 36:** 716 (2007) [1,2]

5. *Title:* Why Gratzel cell works so well
Authors: **Jayaweera P.V.V. , Perera A.G.U.,** and **Tennakone K.**
Journal : ***Inorganica Chemica Acta*** (available online www.science direct.com 2007) [1,2]

6. *Title:* Displacement currents in semiconductor quantum dots embedded in dielectric media
Authors: **Jayaweera P.V.V., Perera A.G.U.,** and **Tennakone K.**
Journal: ***Applied Physics Letters,* 91:** 063114-1 – 063114-3 (2007) [1,2]

7.† *Title :* Extraction of Nickel from Ores and Plants at Ussangoda, Sri Lanka
Authors: **Tennakone K., Seneviratne M.K.I.,** and **Kehelpannala W.**
Journal: ***Journal of the National Science Foundation of Sri Lanka*, 35:** 245-250 (2007)

† This publication is included in the publication list of Structural Geology
** Reported as "in press" in Annual Report 2006*
[1] Listed in the Science Citation Index in 2007
[2] Listed in the Science Citation Index-expanded in 2007

INVITED LECTURES/CONFERENCES ATTENDED IN 2007:

1. **Tennakone K.**
Dye-sensitization: A viable route for conversion of solar energy (Invited Lecture)
Eastern Regional Conference in Photosynthesis, Woods Hole, Boston MA ,May 2007

2. **Tennakone K.**
Semiconductor Photochemistry
Second International Conference, The Robert Gordon University, Aberdeen, 23rd-25th July, 2007

3. Sivakumar V., Husain F.M., **Senevirathna M.K.I.,** and **Tennakone K.**
Diffuse-Reflectance Infrared Fourier Transform (DRIFT) Spectroscopy in Combination with Hybrid Hartree-Fock/Density Functional Calculation for the Study of Structure of Natural Pigments Used as Sensitizer in Dye-sensitized Solar Cells

POSTGRADUATE DEGREES COMPLETED IN 2007:

1. *Name:* **Seneviratne M.K.I .**
Title of Thesis: Strategies of improving the efficiencies of dye-sensitized solar cells and quantum yields in photoreduction of water
Degree: M.Phil.
Degree awarded by University of Ruhuna

2. *Name:* **Pitigala P.K.D.D.**
Title of Thesise: Investigation of electron transport in nanostructured semiconductor heterojunctions by using dye-sensitized solid-state solar cells
Degree: M.Phil.
Degree awarded by University of Jayewardenapura

3. *Name:* **Premalal E.V.A.**
Title of Thesis : Sensitization of titania with natural and moderated flavylium pigments and MEH-PPV polymer for photovoltaic devices
Degree: M.Phil.
Degree awarded by University of Peradeniya

OTHER CONTRIBUTIONS IN 2007:

1. **Tennakone K.**
Basic Knowledge: Its impact on science, technology, education and the society in general, Convocation Address, 33rd Convocation, University of Sri Jayewardenepura, 31st January 2007. The lecture delivered on occasion of award of Doctor of Science Degree by the University of Jayewardenepura. *(honoris causa)*

2. **Tennakone K.**
Ball Lightning, Seminar Conducted at the Department of Physics, University of Cincinnati, and Cincinnati, USA.

PROJECT: **PHOTOCHEMISTRY**

COMMENCEMENT: 1999

INVESTIGATORS (2007):

Bandara J., *Senior Research Fellow* **(Project Leader)**
Yasomanee J.P., *Research Assistant*
Senevirathne S.., *Research Assistant (NSF funded)*

PROGRESS ACHIEVED (*Since inception*):

Dye sensitized photoelectrochemical cells (PEC) constructed using nano-porous films are gaining recognition as promising photovoltaic devices for conversion of solar energy. The efficient sensitizations of semiconductor nanocrystallites with inorganic and organic dyes have been demonstrated. The attempts have been made to increase the solar power efficiency minimizing the charge recombination processes. The Photochemistry project successfully demonstrated use of n-p junction electrodes for the control of charge recombination in dye-sensitized solar cells. As in nanocrystalline semiconductor films an ideal Schottky barrier is absent, the driving force for charge separation is absent and hence by introducing a of n-p junction across the film, a better charge separation was achieved. In such a way, the introduction of a n–p junction in DSC would suppress the dark current arising from the reduction of the redox electrolyte at the semiconductor surface, improving the photovoltage. The advantage of such a n–p junction is, that less scattering of electrons is expected when electrons are tunneled through p-type oxide as electrons are the minority carriers.

In the dye-sensitized solid-state solar cells (DSSC) using p-type semiconductors often met problems of short-circuit and mass transport limitations of the ions resulting in low conversion efficiencies compared with the liquid version.. Only a few types of p-type semiconductors have been tested as solid hole collectors because of the difficulty of identification of a suitable hole collector and its deposition. Finding a suitable hole collector with required properties is a great challenge, i.e. appropriate band gap, band positions and method for its deposition preserving the properties of the adsorbed dye layer. It is also needed to have proper contacts between dye and the p-type materials. The use of p-type oxide semiconductors as hole-collectors in dye-sensitized solar cells was successfully demonstrated and the problems encountered in p-type oxide as hole conductors were investigated by the photochemistry group.

The use of semiconductor oxide particles as photocatalysts is well established and has shown great utility in the complete mineralization of organic pollutants. One of the most important factors that control the high photocatalytic activity is the kinetics of recombination process and a wide charge separation is a prerequisite for better photocatalytic activity. Photochemisty project is actively involved in photochemical and photoelectrochemical purification of water. We have demonstrated ways to increase the catalytic activity by introducing an insulating layer

on the active semiconductor photocatalysts and shown how the insulating barrier layer could increase the photocatalytic activity. The mechanistic aspects of these processes were established.

NSF research grant RG/2004/P/02 was successfully completed in 2007. J. P. Yasomanee is pursuing her PhD studies in USA from August 2007.

Number of Publications during 1999 - 2007 in refereed international journals: 27

PROJECT OUTPUT 2007:

Work on solid-state dye-sensitized solar cells with p-type oxide semiconductors as hole conductors were continued. Photosplitting of water using dye sensitized solar cells with tandem structure was initiated. Preparation and catalytic activity of new catalysts for photochemical degradation of pollutants was investigated.

PUBLICATIONS IN REFEREED JOURNALS IN 2006:

1. *Title:* p-type oxide semiconductors as hole collectors in dye-sensitized solid-state solar cells
   Authors: **Bandara J.** and **Yasomanee J.P.**
   Journal: ***Semiconductor Science and Technology,* 22:** 20-24 (2007) [1,2]

2. *Title:* The effect of MgO coating on the photocatalytic activity of SnO_2 for the degradation of chlorophenol and textile colorants; the correlation between the photocatalytic activity and the negative shift of the flatband potential of SnO_2
   Authors: **Bandara, J.**, and . Ranasinghe R.A.S.S.
   Journal: ***Applied Catalysis A: General,* 319:** 58-63 (2007) [1,2]

3. *Title:* Raschig rings-Fe_2O_3 composite photocatalyst activate in the degradation of 4-chlorophenol and Orange II under daylight irradiation
   Authors: **Bandara J.**, Klehm U., and Kiwi J.
   Journal: ***Applied Catalysis B: Environemental* , 76:** 73-81 (2007) [1,2]

4. *Title:* Indium Tin Oxide coated conducting glass electrode for electrochemical destruction of textile colorants
   Authors: **Bandara J**, Jayatilake S.P.B., and Wansapura P.T.
   Journal: ***Electrochimica Acta*, 52:** 4161-4166 (2007) [1,2]

[1] ***Listed in the Science Citation Index in 2007***
[2] ***Listed in the Science Citation Index-expanded in 2007***

AWARDS IN 2007:

1. **Bandara J.**

   Awarded a Humboldt Fellowship in 2007.

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

COMMENCEMENT: 1999

INVESTIGATORS (2007):

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

PROGRESS ACHIEVED *(since inception):*

Solid-state chemistry by its nature, with its interdisciplinary history, has the ability to prepare and educate its graduates to excel in a wide variety of industries including the fields of energy, pharmaceuticals, optical materials, electronic devices, nano technology and biotechnology. Since these emerging technologies depend on the discovery of new materials and their properties, the Solid-State Chemistry project at IFS, which was initiated in 1999, deals with the investigations on the determination of fundamental physico-chemical aspects that are centered to polymeric/organic materials and conventional semiconductors, which have been the object of increasing academic and technological interest during the last 10-15 years. The chemical aspects of the project specifically targeted at novel ways of synthesising, new organic, inorganic, layered or porous semiconducing solids, and hybrid organic–inorganic compounds which were synthesized either in the bulk or as thin films or nano particles. The structural and the surface properties will be addressed both from *in situ and ex situ* experimental methods in the physical aspects of the project. A particular emphasis is paid on electrical (metallic or semiconductors, ionic and mixed conductors) features associated with the microstructures of these solids. The Standard characterization methods such as (CV) cyclic voltametry, SEM, TEM, XPS, FTIR, AC impedance and photocurrent techniques are being used to characterize the materials involved in these investigations.

Research and development achievements to use in industry:

1. The identification of complexes of Cu(I) bromide with sulfides which could be used as a novel hole conducting material in low cost solid state solar cells ***(Sri Lankan Patent No. 11982).***

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

3. Successfully fabricated efficient solar photovoltaic device comprising with chemically attached poly 3-thiopnenyl acetic acid as the sensitizer for several nanocrystaline semiconductors, ***(An international patent No. NKS 2624-2003-36805).***

NIPPON KAYAKU CO.,LTD. Functional Chemical Res. Lab. 26-8,Shimo 3-Chome,Kita-Ku, Tokyo, Japan Tel:03-3598-5101(direct) Fax:03-3598-5431

4. For the first time in the field of polymer sensitized solid state 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.(***Chem.Com. Royal Society of Chemistry UK, 2005,17,2259).***

5. Discovery of a new method for deposition of CuSCN on dye coated TiO_2 films.

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

(a) In refereed journals cited in Science Citation Index + expanded = 22
(b) In other refereed journals = 5
(c) Abstracts and conference proceedings: 23
(d) ***Conference proceedings full papers: 10***
(e) ***Patents : (1) Sri Lankan Patent No. 11982,***
(2) International Patent No. **NKS 2624-2003-36805**
(f) ***Presidential Awards for Research Publications in Science Citation Index- 1999, 2000, 2001 and 2002***
(g) Research Grants :
(i) National Science Foundation, Sri Lanka
(ii) National Science Foundation, Sri Lanka (for spare parts)
(iii) TWAS (The academy of sciences for the developing world) Trieste, Italy

PROJECT OUTPUT 2007:

(a) Due to their high absorption coefficients in the visible part of the spectrum and the high mobilities of charge carriers, conjugated conducting polymers, have attracted considerable interest in use of active component (sensitizer) in solar cells. The ideal sensitizer for a single junction photocell should be firmly grafted to the semiconductor oxide surface and inject electrons to the conduction band of the semiconductor. Therefore, to use these polymeric materials effectively as sensitizers in these devices, rigid bondings, such as carboxylic moieties in ruthenium based dyes with inorganic semiconductors are required. In order to introduce suitable conducting polymers for solar devices with aforementioned properties, several 3-substituted thiophene and pyrole bearing polymers were synthesized. ^{1}H NMR, Cyclic Voltametry, IR and UV-Absorption techniques were used to characterize these polymers. Solar cell performances were tested using Current-Voltage and incident photon to current conversion efficiency (IPCE) techniques.

(i) **Polymers with directly attaching COOH groups.**
Poly (pyrrole-3,4-dicarboxylic acid)- PP34DCA, poly (N-pyrrolecarboxylic acid) and poly (3-thiophenecarboxylic acid).

(ii) **Synthesis of poly(3-pyrroleacetic acid)**
Poly(3-hydroxy-3-thiophen-3-yl-propionic acid)- **P3H3TPA** and Poly(3-furan-3-yl-3-hydroxypropionic acid)-**P3F3HPA** both containing two functional groups; carboxylic acid and hydroxyl.

(iii) **Co-Polymers**

(1) P3TAA-P3PT – Poly (3- thiophene acetic acid – co-poly (3-Phenylthiophene)
(2) P3TMA-P3PT – Poly(3 –thiophene malonic acid) – co- poly (3- Phenaylthiophene)
(3) P3TAA- PPNCA - Poly (3- thiophene acetic acid – co-poly (pyrrole-N—Carboxylix acid)
(4) P3TMA-PPNCA - Poly(3 –thiophene malonic acid) – co- poly (pyrrole – N – Carboxylic acid)
(5) P3TAA-P3MT - Poly (3 –thiopheneacetic acid)- poly 3 methyl thiophene)
(6) P3TAA-P3AT - Poly (3 –thiopheneacetic acid)- poly 3 acetyl thiophene)

(b) Organic solar cells show great promise as a low cost alternative to inorganic semiconductor-based photovoltaic devises. Though they give very small currents these too come in handy for devices such as small calculators, clocks, thermometers etc., where the only obstacle will be the lifetime. In this contest studies were carried out on polymer photovoltaics based on blends composed of poly[(2-methoxy-5-ethylhexyloxy)-1,4-phenylenevinylene] (MEH-PPV) and [6,6]-phenyl-C_{61}-butyric acid methyl ester (PCBM), poly(3-hexylthiophene) (P3HT) and PCBM bulk-heterojunction cells sandwiched between a polymer electrolyte made of either Polyacrylonitrile (PAN), or Polyethylene oxide (PEO), having different compositions together with a Pt counter electrode. Changes in device performance with the addition of acetonitrile to the electrolyte have also been studied.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1.* *Title:* Photorsponses of copolymers based on derivatives of thiophene units
Authors: Fernando J.M.R.C. and **Senadeera G.K.R.**
Journal: ***Ceylon Journal of Science (Physical Sciences),*** **12:** 37-46 (2007)

2.* *Title:* Efficient quasi –solid dye sensitized solar cells employing molten salt electrolyte
Authors: **Senadeera G.K.R.** and **de Silva N.**
Journal: ***Sri Lankan Journal of Physics,*** 7: 15-22 (2007)

3. *Title:* Synthesis and characterization of carboxylated thiophene co-polymers and their uses in photovoltaic cells
Authors: Fernando J.M.R.C. and **Senadeera G.K.R.**
Journal: ***Current science***, 2007 (in press)[1,2]

* ***Reported as "in press" in Annual Report 2006***
[1] ***Listed in the Science Citation Index in 2007***
[2] ***Listed in the Science Citation Index-expanded in 2007***

ABSTRACTS/CONFERENCE PROCEEDINGS: (full papers)

1. **Senevirathne M.S., Nanayakkara A.**, and **Senadeera G.K.R.**
A theoretical investigation of band gaps of conducing polymers - polythiophene, polypyrrole and polyfuran (full paper)
Proceedings of the 23rd Technical Session, Institute of Physics, Sri Lanka, March 2007

2. Fernando J.M.R.C., **de Silva N** and **Senadeera G.K.R.**
Soluble Thiophene and Furan based functionalized conducting polymers for sensitization of TiO_2 in dye sensitized solar cells (abstract)
Proceedings of the 63rd Annual Session of Sri Lanka Association for the Advancement of Science, pp 104, 2007

3. **de Silva N** and **Senadeera G.K.R.**
Polymer photovoltaic devices by blending with ionic solid electrolyte (abstract)
Proceedings of the 63rd Annual Session of Sri Lanka Association for the Advancement of Science, pp 104-105, 2007

4. **Senevirathne M.S., Nanayakkara A.**and **Senadeera G.K.R.**
A new extrapolation method for estimating band gaps of heterocyclic conducting polymers (abstract)
National Conference on Materials for Emerging Technologies, p 51, 21-22 July 2007

PROJECT: **NANO-SCIENCE (CHEMISTRY AND PHYSICS)**

COMMENCEMENT: **2005**

INVESTIGATORS (2007) :

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

PROGRESS ACHIEVED (*Since inception*):

This project was initiated in year 2005. Properties of nano-structured films and their applications in solid-state electronic devices were studied. The project leader won a post-doctoral fellowship from Japanese Government for a period of two years, in year 2005. The work conducted has given rise to 11 publications in referred journals (09 in international journals and 02 in local journal) and 03 proceedings in local and international symposiums.

PROJECT OUTPUT 2007:

A conjugated polymer poly[2-methoxy-5-(2-ethyl-hexyloxy)-phenylene vinylene] (MEH- PPV) exhibits a high degree of absorption in visible region, sufficiently fast carrier mobility and conductivity at room temperature. An attempt was made to fabricate photovoltaic cells using MEH-PPV as a hole-conductor. A feeble photo-response was observed for solid-state TiO_2|dye|MEH-PPV cell, under illumination. An enhancement in photovoltage with a weaker photocurrent was observed by doping iodine in MEH-PPV film. However, an efficient collection of photo-induced electrons toward the counter electrode and there by significantly enhanced photocurrent are observed by applying a thin graphite layer on iodine doped MEH-PPV film. Phot-effects of TiO_2|dye|MEH-PPV|I_2|graphite cell studied.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1*. *Title:* Generation of inhomogeneous photocurrent in solid-state TiO_2|dye|CuI cells and effect of ligands attached to the surfactant on the morphology of CuI films
Authors: **Sirimanne P.M.** and Tributsch H.
Journal: ***Solar Energy,*** **81**: 535-539 (2007) [1,2]

2. *Title:* Optical and electronic properties of poly[2-methoxy-5-(2-ethyl-hexyloxy)-p- phenylene vinylene and its applications in solid state cells
Authors: **Sirimanne P.M., Premalal E.V.A.,** and Soga T.
Journal: ***Current Science,*** **93**: 132-133(2007) [1,2]

3. *Title:* Contribution of H-aggregated pyrogallol red molecules in the photocurrent generation of solid state TiO_2|dye|CuI cells
Authors: **Sirimanne P.M.**
Journal: ***Renewable Energy,*** 2007 (in press) [1,2]

4. *Title:* Optical properties of Poly-[2-methoxy-5-(2-ethyl-hexyloxy)-phenylene vinylene and its application in photovoltaic cells
Authors: **Sirimanne P.M.,** and **Premalal E.V.A.**
Journal: ***Ceylon Journal of Physics,*** 2007 (in press)

5.* *Title:* Utilization of cyanadin 3-glucoside as a sensitizer in a solid-state solar cell and enhancement of photo-effects of TiO_2|cyanidin 3-glucoside|CuI cell coupling by mercurochrome with cyanidin 3-glucoside
Authors: **Sirimanne P.M., Senevirathna M.K.I, Premalal E.V.A.,** Pitigala P.K.D.D.P., **Sivakumar V.** and **Tennakone K.**
Journal: ***Ceylon Journal of Chemistry,***2007 (in press)

* ***Reported as "in press" in Annual Report 2006***
[1] ***Listed in the Science Citation Index in 2007***
[2] ***Listed in the Science Citation Index-expanded in 2007***

PROJECT: **ELECTROCHEMICAL MATERIALS**

COMMENCEMENT: 2005

INVESTIGATORS (2007):

Wijayasinghe H.W.M.A.C., *Research Fellow* **(Project Leader)**
Samarasingha P.B., *Research Assistant*

PROGRESS ACHIEVED:

Synthesis and characterization of low-cost materials for electrochemical energy conversion applications are being mainly carried out under this project. At present, this project conducts research on three types of fuel cells and two types of batteries. Feasibility studies on Sri Lankan minerals for these potential high tech applications and investigations on applying nano-technology to enhance performance of these materials have recently being initiated. For the material characterization and cell component fabrication work, a new high temperature 4-probe specimen holder and a tape-caster have been designed and fabricated at IFS.

PROJECT OUTPUT 2007:

Research on new materials for Fuel cells

1. The electrode development work based on $NiO\text{-}LiCoO_2\text{-}LiFeO_2$ for the Molten Carbonate Fuel Cell (MCFC) resulted in materials fulfilling the electrochemical and stability requirements for the MCFC cathode.
2. Development of novel solid electrolyte materials for the Intermediate Temperature Solid Oxide Fuel Cell (ITSOFC) revealed the promising characteristics of the investigated system of La-Sr-Ga-Mg-Ni oxides.
3. A novel idea of devising a biological fuel cell has being initiated with the microbes developed at IFS by the Biological Nitrogen Fixation (BNF) project. The preliminary work of assembling this Microbial Fuel Cell (MBFC) has shown promising results.

Research on new materials for batteries

1. The investigations carried out on $Li(Co_{1-2x}Ni_x\ Mn_x)O_2$ materials using novel low-cost synthesis techniques resulted in a very promising electrode materials for rechargeable Li-ion batteries (LIB). A novel idea of devising a "Sri Lankan Li-ion battery" has been initiated with the electrodes developed at IFS and the electrolytes developed at Solid State Ionics (SSI) Research Group, University of Peradeniya. Feasibility studies on Sri Lankan minerals (Mica, graphite, clay, Phosphate ..etc) for these applications have been started with the aim to find the ways to upgrade our mineral resources for these potential high tech applications. Further, the preliminary investigations performed on synthesis and application of nano particles have shown promising results.

2. The work performed on super-ionic conductors based on CuI-doped Silver Borate-Vanadate Glassy System resulted in very promising materials with high silver-ionic conductivity.

Total number of articles published;

(a). In refereed journals cited in Science Citation Index = 2
(b). Conference proceedings = 03

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1. *Title:* Preparation and Characterization of CuI-doped Silver Borovanadate Superionic System
   Authors: Sepperumal M., **Wijayasinghe A.**, and Bergman B.
   Journal: ***Solid State Ionics,* 178**: 779 – 783 (2007) [1,2]

2. *Title:* Ion Transport Studies in CuI doped Silver Borovanadata Glassy System
   Authors: Sepperumal M., **Wijayasinghe A.**, and Bergman B.
   Journal: ***Journal of Non-Crystalline Solids,*** 2007 (in press)[1,2]

[1] ***Listed in the Science Citation Index in 2007***
[2] ***Listed in the Science Citation Index-expanded in 2007***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2007:

1. **Samarasingha P.** and **Wijayasinghe A.**
   Synthesis and electrical characterization of Li-transition metal oxides for lithium ion rechargeable battery cathodes
   National Conference on Advanced Materials for Emerging Technologies (NCAMET 2007), University of Peradeniya, July 2007

2. **Samarasingha P.** and **Wijayasinghe A.**
   Synthesis and electrical characterization of Fe and Al doped $Li(Ni_{1/3}Co_{1/3}Mn_{1/3})O_2$ for lithium ion rechargeable battery cathodes
   Proceedings of the 63rd Annual Sessions of the Sri Lanka Association for the Advancement of Science, p103, December 2007

3. **Wijayasinghe A.**
   Synthesis and characterization of lanthanum gallate electrolyte materials for the intermediate temperature solid oxide fuel cell
   Proceedings of the 63rd Annual Sessions of the Sri Lanka Association for the Advancement of Science, p102, December 2007

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 (2007):

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

PROGRESS ACHIEVED *(since inception)*

Out of five Post Graduate students who have completed their research training under the IFS Natural Products Chemistry I Research Project, two students have been hired by Sri Lankan National Universities as permanent lecturers in Biochemistry.

Anti HIV, antibacterial [anti methicillin-resistant *Staphylococcus aureus* (MRSA) and anti vancomycin-resistant *Entrococci* (VRE)], anti fungal, antioxidant and allelopathic active natural products have been isolated from Sri Lankan plants including seaweeds and their endophytic microorganisms. Chemical structures of isolates were elucidated using spectroscopic methods and partial synthesis. Further, their structure activity relationship studies were investigated. 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 **25** international publications, **44** research communications, **9** national awards including the prestigious Institute of Chemistry Gold Medal (2004) and **5** postgraduate degrees.

Postgraduate Degrees:

Piyasena K.G.N.P. - Chemistry and Bioactivity Studies of *Garcinia Mangostana.*
M. Phil, University of Peradeniya (2006).

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

Awards:

1. **Kandiah Memorial Award (Basic Chemistry) 2006,** for the best piece of post graduate research in Basic Chemistry, carried out by a postgraduate student in Sri Lanka. **K. G. N. P. Piyasena**

2. **Kandiah Memorial Award** (III) 2005, for the best piece of post graduate research carried out by a postgraduate student in Sri Lanka. **Napagoda M. T.**

3. The presentation titled "*Xanthones from roots of Calophyllum thwaitesi and their biological activities*" was awarded as **the best scientific paper in Medicine** at the Proceedings of University of Ruhuna Annual sessions(2005).

4. Visiting Scholar, Institute for Molecular Bio-organic Chemistry, George-August University, Gottingen, Germany (2006, July – August) - **Dharmaratne H.R.W.**

5. 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.**

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

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

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

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

PROJECT OUTPUT 2007:

Column chromatography of the methanol extract of the common seaweed *Ulva lactuca* extract gave a diterpenoid 3,7,12,16-tetramethylheptadec-2-enol having molecular formula $C_{21}H_{42}O$. Literature reveals that this is a new diterpenoid, and named as Arugambenol.

A number of plant species have been tested for their allelopathic activity using Lettuce seed germination inhibition bioassay. Of them *Mikania scandens* showed 100% activity and activity guided fractionation led to the isolation of a highly active

compound. As above isolate has shown 100% allelopathic activity, it has a great potential as a natural weedicide and field trials are in progress.

The project on Chemistry and biological activity studies of endophytic fungal strains isolated from seaweeds and terrestrial plants is in progress. A number of compounds including several napthopyrones have been isolated from an endophytic fungal strain isolated from the seaweed *Sargassum nightii.*

In December 2007, on request of the Dean, Faculty of Medicine, University of Peradeniya, a selective/elective course (three weeks) on "Herbal Medicine and Natural Products Chemistry" was conducted for a group of first year Medical students.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1*. *Title:* Xanthones from root bark of *Calophyllum thwaitesii* and their Bioactivity
Authors: **Dharmaratne H.R.W.**, Tennakoon S.B and Napagoda M.T.
Journal: ***Natural Product Research***, 2007 (in press)[2]

2*. *Title:* New methylethers of cordatolides from *Calophyllum cordato-oblongum* and their synthesis.
Authors: **Dharmaratne H.R.W.** and Marasinghe G.P.K.
Journal: ***Natural Product Research,*** 2007 (in press)[2]

****Reported as "in press" in Annual Report 2006***
[2] Listed in the Science Citation Index-expanded in 2007

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2007:

1. Haroon M.H. and **Dharmaratne H.R.W.**
Arugambinol, a new acyclic diterpenoid from green alga *Ulva lactuca* L.
Proceedings of the 63rd Annual Session of Sri Lanka Association for the Advancement of Science, pp 117-118, 2007

2. **Dharmaratne H.R.W.** and Piyasena K.G.N.P.
Allelopathic activity studies of Sri Lankan flora
Proceedings of the 63rd Annual Session of Sri Lanka Association for the Advancement of Science, p.p 201-202, 2007

3. **Dharmaratne H.R.W., Premaratne S.R.**, Haroon M.H., and Laatsch H.
Chemistry of endophytic microorganisms from seaweeds
Proceedings of the 63rd Annual Session of Sri Lanka Association for the Advancement of Science, p.p 200-201, 2007

INVITED LECTURES IN 2007:

1. **Dharmaratne H.R.W.**
   Parisara dushanaya saha eya walakwa gatahaki karma on 12-10-2007 at Mahaweli Authority, Victoria Power House Auditorium, Adikarigama

AWARDS IN 2007:

1. **Piyasena K. G. N. P.**
   Kandiah Memorial Award (Basic Chemistry) 2006, for the best piece of post graduate research carried out by a postgraduate student in Sri Lanka.

PROJECT: **NATURAL PRODUCT CHEMISTRY II**

Search for bioactive compounds from Sri Lankan plants as potential resources for treatment and control of diseases in agricultural crops and humans

COMMENCEMENT : 1992

INVESTIGATORS (2007):

Jayasinghe U.L.B., *Associate Research Professor* **(Project Leader)**
Amarasinghe N.R., *Research Assistant*
Ariyaratna R.A.Y.K., *Research Assistant*
Gunawardena D.C., *Research Assistant*
Ariyawansa J.K., *Research Assistant*
Silva W.C.De., *Research Assistant*

PROGRESS ACHIEVED (*Since inception*):

During the past few years we have been conducting investigations on different tissues 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) etc.. 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. In addition, we have identified a number of antifungal, antibacterial, nematicidal and antifeedant active extracts from some Sri Lankan plants. All the important results led to 37 publications, 60 communications, 03 book chapters and 03 M. Phil. Degrees.

PROJECT OUTPUT 2007:

Flacourtia inermis: Chemical investigation of the fruit juice of *Flacourtia inermis* (sinh. Lovi) furnished a rare phenolic glucoside (*rel*)-(6α-benzoyloxy-1α, 2α - dihydroxy-5-oxocyclohex-3-ene carboxylic acid 2-(6-*O*-benzoyl-β-D-glucopyranosyloxy)-5-hydroxybenzyl ester, five chlorogenic acid esters methyl 5-*O*-caffeoylquinate, methyl 3-*O*-caffeoyl quinate, methyl 4-*O*-caffeoylquinate, *n*-butyl 5-*O*-caffeoylquinate, *n*-butyl 3-*O*-caffeoylquinate, together with quinic acid and malic acid. Some of these compounds showed strong radical scavenging properties towards the DPPH radical.

Careya arborea: Chemical investigation of the fruits *Careya arborea* (sinh. kahata) furnished phenolic compounds 3,4-dihydroxybenzoic acid, gallic acid, kaempferol 3-O-β-D-glucopyranoside, quercetin 3-O-β-D-glucopyranoside, qurcetin 3-O-(6-O-glucopyranosyl)-glucopyranoside. All these compounds showed high antioxidant

activity. Medicinal properties reported for *C. arborea* fruits may be directly related to the presence of highly antioxidant active compounds in the edible fruits of this plant.

Averrhoa carambola: Preliminary investigations indicated the presence of strong phytotoxic activity and antioxidant activity in organic solvent extracts of the fruits of *A. carambola* of the family Oxalidiaceae. Chemical investigation of the fruit juice of *A. carambola* furnished a new natural product *cis*-abscisic alcohol β-D-gluopyranoside together with known *cis*-abscisic acid, *trans*-abscisic acid, abscisic acid β-D-glucopyranosyl ester, abscisic alcohol, *trans*-abscisic alcohol β-D-gluopyranoside, vomifoliol, roseoside and epicatechin. Six of these compounds showed strong phytotoxicity against lettuce seeds germination. The antioxidant compound was identified as epicatechin.

Further we have identified some plant extracts with phytotoxic, antioxidant and antifungal properties. Chemical and bioassay investigations of these plants collected from IFS – Popham arboretum in Dambulla are in progress.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1. *Title:* Four new prenylated flavonoids and xanthones from the root bark of *Artocarpus nobilis*
   Authors: **Jayasinghe U.L.B.,** Samarakoon T.B., Kumarihamy B.M.M., Hara N., and FujimotoY.
   Journal: ***Fitoterapia,*** 2007 (in press)[2]

2. *Title:* Chemical constituents of the fruits of *Artocarpus altilis*
   Authors: **Amarasinghe N.R., Jayasinghe L.,** Hara N., and Fujimoto Y.
   Journal: ***Biochemical Systematics and Ecology,*** 2007 (in press)[1,2]

3. *Title:* Synthesis and antifungal activity of a series of a *N*-substituted [2-(2,4-dichlorophenyl)-3-(1,2,4-triazol-1-yl)]-propylamines
   Authors: Arnoldi A., Dallavalle S., Merlini L., Musso L., Farina G., Moretti M., and **Jayasinghe L.**
   Journal: ***Journal of Agricultural and Food Chemistry*, 55**: 8187–8192 (2007) [1,2]

4*. *Title:* (2-Nitroethyl) Phenyl and cyanophenyl glycosides from the fruits of *Diploclisia glaucescens*
   Authors: **Jayasinghe U.L.B.**, Hara N., and Fujimoto Y.
   Journal: ***Natural Product Research*, 21:** 260-264 (2007) [2]

5*. *Title:* Dihydrochalcones with radical scavenging properties from the leaves of *Syzygium jambos*
   Authors: **Jayasinghe U.L.B.,** Ratnayake R.M.S., Medawala M.M.W.S., and Fujimto Y.
   Journal: ***Natural Product Research*, 21**: 551-554 (2007) [2]

6*. *Title:* Flacourside, a new 4-oxo-2-cyclopentenylmethyl glucoside from the fruit juice of *Flacourtia indica*
Authors: **Amarasinghe N.R., Jayasinghe L.**, Hara N., and Fujimoto Y.
Journal: ***Food Chemistry*, 102**: 95-97. (2007) [1,2]

** Reported as "in press" in Annual Report 2006*
[1] Listed in the Science Citation Index in 2007
[2] Listed in the Science Citation Index-expanded in 2007

ABSTRACTS/PROCEEDINGS OF CONFERENCES

1. **Amarasinghe N.R.** and **Jayasinghe U.L.B.**
Chemotaxonomlc significance of the fruit constituents of *Artocarpus altilis*
Proceedings of the Peradeniya University Research Sessions, November, p.92-93 ,PURSE -2007

2. **Gunawardena D.C.** and **Jayasinghe U.L.B.**
Phytotoxic constituents from the fruit juice of *Averrhoa carambola. Proceedings of the Peradeniya University Research Sessions, November, p. 96-97, PURSE -2007*

3. **Jayaweera D.S.** and **Jayasinghe U.L.B.**
Comparison of antifungal, Phytotoxicity and cytotoxicity of seeds of *Dolichos biflorus*
Proceedings of the Peradeniya University Research Sessions, November, p.107-109, PURSE -2007

4. **Ariyaratne R.A.Y.K., Amarasinghe N.R., Gunawardena D.C.,** and **Jayasinghe U.L.B.**
Antioxidant phenolic constituents from the fruits of *Careya arborea. Proceedings of the Peradeniya University Research Sessions, November, p. 103-104, PURSE -2007*

5. Rodrigo S.K., **Jayasinghe U.L.B.** and Bandara B.M.R. (2007):
Antifungal, antioxidant and cytotoxic activity of *Acronychia pedunculata* and *Adenanthera pavonina*
Proceedings of the Peradeniya University Research Sessions, November, p. 94-95, PURSE -2007

6. **Jayasinghe U.L.B.**
Search for biologically active compounds from Sri Lankan plants, Humboldt-Kolleg on "Aquatic Sciences cum Enhancement of the Agro Industry"
Universiti Sains Malaysia, Penang, Malaysia, 25th-29th October Malaysia, 2007

7. **Jayasinghe U.L.B.**
   Search for biologically active compounds from Sri Lankan plants, "Colloquium for Humboldt Fellows and Awardees in Thailand and neighboring countries"
   Chiang-Mai, Thailand, 23rd-26th November, 2007

8. **Gunawardene D.C.** and **Jayasinghe, U.L.B.**
   Chemical constituents of the fruit juice of *Averrhoa carambola*
   Proceedings of the 63rd Annual sessions of Sri Lanka Association for the Advancement of Science, December, 2007

9. Lakdusinghe M. and **Jayasinghe, U.L.B.**
   Antioxidant phenolic compounds from the fruits of *Flacourtia inermis*
   Proceedings of the 63rd Annual sessions of Sri Lanka Association for the Advancement of Science, December, 2007

10. **Jayasinghe L.**, Nanayakkara N.P.D., Herath W.H.M.W., Duke S.O. and Abbas H.K.
    Phytotoxins from Diaporthe phaseolorum f. sp. Meridionalis, the casual agent of northern stem canker and dieback in soybean
    Proceedings, Frontiers in Bioorganic and Natural Products Chemistry, American Society of Pharmacognosy, 48th Annual Meeting, Portland Main,USA, 2007

11. **Jayasinghe L.**, Nanayakkara N.P.D., Herath W.H.M.W., Duke S.O. and Abbas H.K.
    Phytotoxins from *Diaporthe phaseolorum f. sp. Caulivora*, the casual agent of northern stem canker and dieback in soybean
    Proceedings, Frontiers in Bioorganic and Natural Products Chemistry, American Society of Pharmacognosy, 48th Annual Meeting, Portland Main, USA, 2007

POSTGRADUATE DEGREES COMPLETED IN 2007:

1. *Name:* **Amarasinghe N.R.**
   Title of the Thesis Chemistry and bioactivity of fruits of *Artocarpus altilis* and *Flacourtia indica*
   Degree: M.Phil.
   Degree awarded by University of Peradeniya

AWARDS IN 2007:

1. **Jayasinghe U.L.B.**
   Presidential Awards for Research 2002
   (Date of award ceremony to be announced)

PROJECT: **BIOCHEMISTRY**

COMMENCEMENT: 1997

INVESTIGATORS (2007):

Dharmaratne H.R.W., *Associate Research Professor* **(Project Leader)**
Balasuriya B.M.G.K., *Research Assistant*
Priyanwada, N., *Research Assistant*

PROGRESS ACHIEVED *(since inception)*:

Out of three Post Graduate students who have completed their research training under IFS Biochemistry Project, two students have been hired by National Universities as permanent lecturers.

Nepenthesin, a unique member of a novel subfamily of aspartic proteinases from the juice of *Nepenthes distillatoria* pitcher was isolated and characterized. *In-vitro* and *in-vivo* bioassays showed that the crude methanol extracts of *Areca catechu* unripe fruit kernel and *Adhatoda vasica* leaves are highly active against gastrointestinal nematodiasis in goats. Toxicological studies and field trials showed above extract can be used to control gastrointestinal nematodiasis in goats, in Sri Lankan farms.

Toxiccological and pharmacological activity studies of vegetable greens consumed in Sri Lanka were investigated, and the water extract of *Alternanthera sessilis*, showed a significant cytotoxicity. Further studies using Wistar rats, showed that oral administration of water extract of *A. sessilis* in different doses lead to hepato and renal toxicities which are dose and duration of exposure dependent. Therefore, it can be stated that frequent consumption of larger quantities of *A. sessilis* could leads to hepatic and renal toxicities, especially for patients with chronic hepatic and renal diseases. However, further investigations are necessary in order to understand the long-term effects of the consumption of cooked *A. sessilis* in lesser quantities.

Research project on search for nutritive and economical alternatives from plants, as farm animal feed is in progress.

Our findings paved the way to four research publications, fourteen research communications, two M.Phil. degrees and two awards.

Postgraduate Degrees:

B.M.G.K. Balasuriya, Toxicity and biological activity studies of green leafy vegetables consumed in Sri Lanka, M. Phil., University of Peradeniya (2007).

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 "*A*nthelmintic efficacy of long term treatment with plant extracts in naturally infected goats" was awarded **the best presentation** at the 57th annual scientific session of the Sri Lanka Veterinary Association (2005)

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 2007:

Oral glucose tolerance of some medicinally important plants on glucose induced hyperglycemic rats:
In Sri Lanka there are more than 40 plants, which are reported to be used in herbal medicine for the treatment of diabetes. However, hypoglycemic activity of some of those plants have not been scientifically evaluated. Therefore, present investigation was initiated with the aim of identifying potential hypoglycemic plants. In our experiment water extracts of *Argyreia populifolia, Benincasa hispida, Morinda citrifolia, Languas galanga* and *Careya arborea* were tested for their glucose tolerance ability on glucose induced hyperglycemic rats. It was noted that the positive control Glibenclamide and the water extract of *L. galanga* have significantly ($p<0.001$) reduced the blood glucose levels after glucose loading. Therefore *L. galanga* should be further tested for its potential hypoglycemic effect using a chemically induced diabetic animal models.

Experimental evaluation of essential fatty acid, linoleic acid (LA) rich plants to increase the conjugated linoleic acid(CLA) acid content in animal products, by feeding them.
Among the reported health benefits of CLA are reducing body fat, increasing lean muscle tissue, contribution to the body's ability to metabolize existing fat deposits, modifying serum total lipids and decreasing whole body glucose uptake. Further, CLA protect the body against cancers, diabetic mellitus, inflammatory diseases such as rheumatoid arthritis, inflammatory bowel diseases, and ulcerative colitis and also act as an antioxidant.

Animal tissues and animal products (ruminant meat, poultry, eggs, dairy products; cheese, milk and youghart) are rich sources of CLA while vegetable fats are poor in CLA. However plants are the main source of the LA to animals. LA was found in many plant sources such as peanuts, rapeseeds, palm, canola and sunflower. Unfortunately, LA cannot be sufficiently converted into conjugated CLA in human body, when taken as LA itself. As directly consuming LA is not very useful to human, it is essential to have CLA in human food for the utilization in the body. Therefore LA rich plant sources can be fed to Livestock (mainly ruminants) to increase CLA in their products (meat and milk). Then the above CLA rich animal products can be consumed by human for their benefit.

Even though peanuts, palm, canola, and sunflower are found to be rich sources of LA, due to their high cost, Sri Lankan farmers are not in a position to use them as farm animal feed. Therefore, it is important to search for cheaper LA rich sources such as grasses and legumes in Sri Lanka to be used as farm animal feed. If we can identify

such LA rich local plants, they can be fed to farm animals and CLA rich quality meat and milk can be obtained for the benefit of Sri Lankans.

In our search for LA rich Sri Lankan plants, oils and fats of seeds from 36 plant were extracted, methylated and checked for LA using Gas Chromatography, and 10 plant seeds were identified as LA rich. Of them promising plants/seeds will be fed to ruminants and their CLA content in milk will be checked, with the hope of introducing them to farms of Sri Lanka.

Ethanol as a fuel from plant waste

A new research project was initiated with the aim of producing ethanol from cellulose, as a substitute for fossil fuel. Under this project, search for cellulytic microorganisms from cellulose consuming animals is in progress.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1. *Title:* Cytotoxicity and antioxidant activity studies of traditional green leafy vegetables consumed in Sri Lanka.
   Authors: **Balasuriya B.M.G.K.** and **Dharmaratne H.R.W.**
   Journal: ***Journal of National Science Foundation,*** **35(4):** 255-258 (2007).

ABSTRACTS /CONFERENCE PROCEEDINGS IN 2007:

1. **Balasuriya B.M.G.K.**, **Priyanwada N.H.N.**, de S. Gunawardena G.S.P., **Dharmaratne H.R.W.**
   Oral glucose tolerance of some medicinally important plants on glucose induced hyperglycemic rats.
   Proceedings of the 63rd Annual Sessions of Sri Lanka Association for the Advancement of Science, p.p 125, 2007.

POSTGRADUATE DEGREES COMPLETED IN 2007:

1. *Name:* **Balasuriya B.M.G.K.**
   Title of Thesis: Toxicity and biological activity studies of green leafy vegetables consumed in Sri Lanka
   Degree: M.Phil.
   Degree awarded by University of Peradeniya

PROJECT: **PLANT BIOTECHNOLOGY**

COMMENCEMENT: 1988

INVESTIGATORS (2007):

Ramanayake S.M.S.D., *Senior Research Fellow* **(Project Leader)**
Chaturani G.D.G., *Research Assistant*
Maddegoda 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 rhythms 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 and molecular 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 their plant parts with developmental stages and phenology.

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

Plantlets were produced from field plants of *D. giganteus,* even from a 70-year-old field plant, *D. hookeri*, *B. vulgaris*, *B. atra* and *B. ventricosa*. The factors that contribute to shoot proliferation and in vitro rooing were identified. In vitro flowering was also induced in axillary shoots of *D. giganteus, D. hookeri* and *B. atra*.

Callus, which exhibited an embryogenic potential, was also induced from explants of the adult clumps of *D. giganteus* of 70-years age. 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.
Cultures were also established from seeds of giant bamboo collected from three clumps that flowered in Kandy, Pilimatalawa and Daulagala. Studies in callus induction and somatic embryogenesis have commenced.

It is now possible to develop continuously proliferating shoots from many species of bamboo of different ages. Induction of axillary shoots in other species such as

Giganticloa atroviolacea, D. asper and *Schizostachium brachyladum* field plants were also attempted.

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

It is now possible to apply these findings in the commercial applications for propagule production by axillary shoot proliferation followed by rooting in the species mentioned above. We have given away over 2000 plantlets of all species, which were produced during experiments. The field performance of these shows that they grow faster than plants raised by classical methods due to early rhizome development.

DNA was isolated from 130 individuals of *D.giganteus* and 25 related species of bamboo with RAPD technique genetic distances were computed and dendrograms developed. The data have been analyzed and used in identification and characterization and determining relationships within and between species. Most of these Sri Lankan species have not been taxonomically defined.

Flowering in bamboo in nature were studied with close observations in *D. giganteus* and those in the bamboo collection in the Royal Botanic Gardens, Peradeniya. 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 present the Riverine Bamboo Project seeks my advice on propagation of bamboo due to problems they have encountered.

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.

National Agribusiness Council provided funds for studies in bamboo during the period January – December 2005 (Rs. 1,023,310/-). A green house was constructed with funds received for Rs.490,000/-. This is an essential requirement for studies related to plants which was lacking in the IFS.

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 2007:

Somatic embryogenesis in *D. giganteus* has been possible but further improvements for consistent embryogenic callus proliferation are under investigation. A few plants that were regenerated were soil established. Histological studies on development of somatic embryos are ongoing. The clonal fidelity of somatic embryo derived plants and those from axillary shoot proliferation was confirmed with the use of RAPD technique.

An investigation to develop SCAR markers for identification of a few bamboo species have commenced. However, a -80^{0}C freezer is required to continue these studies.

Induction of flowering in *B. atra* is now consistent. Histological studies on transition of the shoot apical meristem from a vegetative to a reproductive state are ongoing.

Short term storage of axillary shoots of *D. giganteus, D. hookeri* and *B. atra* are under investigation. This will facilitate the availability of stock cultures to be used at times required. At present stocks are maintained by continuous shoot proliferation at short intervals. Short term storage will prolong the subculture intervals, therby reducing cost of culture maintenance.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1.** *Title:* Genetic diversity and relationships within populations of *Dendrocalamus giganteus* Wall. ex Munro and *Ochlandra stridula* Moon ex Thwaites in Sri Lanka using RAPDs
Authors: **Ramanayake S.M.S.D.**, Meemaduma V.N. and Weerawardene T.E.
Journal: ***Journal of Bamboo and Rattan,* 5: (3 & 4):** 141 – 149 (2006)

2. *Title:* Genetic diversity in a population of *Dendrocalamus giganteus* Wall. ex Munro in the Royal Botanic Gardens, Sri Lanka
Authors: **Ramanayake S.M.S.D.,** Meemaduma V.N. and Weerawardene T.E.
Journal ***Journal of the National Science Foundation of Sri Lanka,* 35(3):** 207 – 210 (2007)

3. *Title:* Genetic diversity and relationships between nine species of bamboo in Sri Lanka, using Random Amplified Polymorphic DNA
Authors: **Ramanayake S.M.S.D.**, Meemaduma V.N. and Weerawardene T.E.
Journal: ***Plant Systematics and Evolution*, 269 (1-2):** 55-61 (2007)[1,2]

*** Not included in Annual Report 2006*

[1] ***Listed in the Science Citation Index in 2007***
[2] ***Listed in the Science Citation Index-expanded in 2007***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2007:

Ramanayake S.M.S.D. and **Maddegoda K. M. M. N.**
Micropropagation of an ornamental bamboo by axillary shoot proliferation. Abstracts.
17th Biennial Meeting of the NewZealand branch of the International Association for Plant Tissue Culture and Biotechnology, 25th –28th February 2007. Rotorua, New Zealand.

PROJECT: **PLANT REPRODUCTIVE BIOLOGY**

COMMENCEMENT: 1997

INVESTIGATORS (2007):

Iqbal M.C.M., *Senior Research Fellow* **(Project Leader)**
Weerasinghe H.A.S., *Research Assistant*
Wijesekera K.B., *Research Assistant*
Wijesekara T., *Research Assistant*
Geethanjalie H.D.N. *(NSF grant)*
Samithri Y.A.S. *(NSF grant)*
Perera R.S.M., *Technical Officer*

PROGRESS ACHIEVED (*Since inception*):

Androgenesis: Haploids were induced in *Datura metel,* by alternating a short temperature pulse to the anthers before culture. A combination of warm and cool temperatures in immediate succession, for a total duration of 1 min, significantly enhanced androgenesis.

Pollen development: In *Gordonia* species, the differentiation of parenchyma cells was observed 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 was 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.

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 IUCN 2000 Red list. We developed a protocol for *in vitro* propagation for this species.

The indica sub-species of rice *O. sativa* is recalcitrant to *in vitro* culture, which is a prerequisite for biotechnological applications such as transformation. Callus induction and plant regeneration was achieved in local indica rice genotypes by changes in amino-acid composition of nutrient media, and physical stress of the calli.

PROJECT OUTPUT 2007:

Interspecific hybridization of Brassica species.
(with, Dr. Shyama Weerakoon, Open University, Sri Lanka)

The objective is to transfer the canola quality fatty acids from *Brassica napus* to mustard *B. juncea*, the latter having a high content of the undesirable erucic acid. Hybrid embryos from the two species were rescued *in vitro* and raised to plants. Gas chromatographic analysis of fatty acids of the hybrids showed a fatty acid profile towards canola quality.

Biodiversity and ecology of plants on a serpentine site: Serpentine soils originate from serpentinite and ultra-mafic rocks and have a high concentration of heavy metals. The serpentine site in Ussangoda (in Hambantota) was studied to determine the soil physical and chemical characteristics and the diversity of plant families and species. Metal hyperaccumulating species were identified.

Heavy metal accumulation by selected plant species was determined under experimental conditions towards identifying potential species to remove heavy metals from contaminated soil.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1.* *Title:* Early, non-destructive selection of microspore derived embryo genotypes in oilseed rape (*Brassica napus* L.) by molecular markers and oil quality analysis
Authors: Nath U.K., **Iqbal M.C.M.,** and Möllers C.
Journal: ***Molecular Breeding,* 19:** 285-289 (2007)[1,2]

2. *Title:* A brief temperature pulse enhances the competency of microspores for androgenesis in *Datura metel*
Authors: **Iqbal M.C.M.**, and **Wijesekara K.B.**
Journal: ***Plant Cell, Tissue and Organ Culture*, 89:** 141-149 (2007) [1,2]

3. *Title:* Callusing and regeneration of three genotypes of *Oryza sativa* ssp. *indica* by 2,4 dichlorophenoxy acetic acid (2,4-D)
Authors: **Wijesekara T.P.**, Jayasena M.K.A.S., Medagoda M.N., **Iqbal M.C.M.**.
Journal: ***Journal of the National Science Foundation,* 35(2):** 139-141 (2007)

4. *Title:* Sustainable use of *Crytocoryne wendtii* de Wit and *Echinodorus cordifolius* in the aquaculture industry of Sri Lanka by micropropagation
Authors: Dissanayake C., Hettiarachchi M., and **IQBAL M.C.M.**
Journal: ***Sri Lanka Journal of Aquatic Sciences,*** **12:** 89-101 (2007)

5. *Title:* Plant regeneration *in vitro* by organogenesis on callus induced from mature embryos of three rice varieties (*Oryza sativa* ssp. *indica*)
Authors: **Wijesekara T.P., Iqbal M.C.M.,** and Bandara D.C.
Journal: ***Tropical Agricultural Research,*** **19:** 25-35 (2007)

6. *Title:* Falsifiability of theories in the Biological Sciences
Author: **Iqbal M.C.M.**
Journal: ***Ceylon Journal of Science,*** 2007 (in press).

****Reported as "in press" in Annual Report 2006***
*[1] **Listed in the Science Citation Index in 2007***
*[2] **Listed in the Science Citation Index-expanded in 2007***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2007:

1. Somarathna S., Weerakoon S.R. and **Iqbal M.C.M.**
Agro-Morphological characters in classification of mustard accessions (*Brassica juncea* L.) in Sri Lanka: A Classification Tree Approach
Fourth Annual Academic Sessions, Open University of Sri Lanka, 28-29 June, 2007, p. 77-80

2. Weerakoon S.R., **Iqbal M.C.M.,** Somarathna S., Pieris P.K.D., and Wimalasuriya W.S.R.
Delimitation of local mustard (*Brassica juncea*) germplasm in Sri Lanka and improvement of their nutritive quality
Proceedings of the 12th International Rapeseed Congress, Wuhan, China March 26-30, 2007 p. 75-78

3. Nath U.K., **Iqbal M.C.M.,** and Möllers C.
In vitro selection of microspore derived embryo genotypes based on molecular marker and oil quality analysis in oilseed rape (*Brassica napus* L.).
Proceedings of the 12th International Rapeseed Congress, Wuhan, China March 26-30, 2007, p. 20-23

4. Samithri Y.A.S., Wijesundera D.S.A. and **Iqbal M.C.M.**.
A preliminary study of the Ussangoda Serpentine Flora
12th International Forestry and Environment Symposium 2007, Kalutara Sri Lanka, 30th November - 1st December 2007, p. 29

5. **Weerasinghe H.A.S.** and **Iqbal M.C.M.**.
Soil nutrient contents in the Ussangoda serpentine soil
Proceedings of the 63rd Annual Session of Sri Lanka Association for the Advancement of Science, Part I, pp 117-118, 2007

BOOKS AND MONOGRAPHS:

1. *Title:* Doubled Haploids in Breeding Winter Oilseed Rape
In the Book: Advances in haploid production in Higher Plants
Authors: Möllers C.and **Iqbal M.C.M.**
Editors: Touraev A., Forster B.P., and Mohan Jain S.
Publisher: Kluwer Academic Publishers (submitted)

AWARDS IN 2007:

1. **Iqbal M.C.M.**
Presidential Research Awards – 2002 for publications in Science Citation Indexed Journals.

POSTGRADUATE DEGREES COMPLETED IN 2007:

1. *Name:* **Wijesekara K.B.**
Title of thesis: Development of a haploid transformation system and overexpression of phytochrome B gene in *Brassica napus* L.
Degree: Ph.D
Degree awarded by Faculty of Agricultural Sciences, Georg-August-University, Göttingen, Germany.

2. *Name:* **Subhajini R.**
Title of thesis: Uptake of Cadmium and Nickel by selected plant species under laboratory conditions.
Degree: M.Sc.
Degree awarded by Postgraduate Institute of Science, University of Peradeniya.

PROJECT: **PLANT CELL BIOLOGY**

COMMENCEMENT: 2001

INVESTIGATORS (2007):

Magana-Arachchi D.N, *Research Fellow* **(Project Leader)**
Wanigatunge R.P., *Research Assistant*
Meegahakumbura M.K.M, *Research Assistant (NSF Grant)*
Lal M.A., *Work Assistant*

PROGRESS ACHIEVED *(Since inception):*

Microorganisms are the most numerous and important organisms on Earth which are of great importance in biological systems.During the past three years the thrust of this project was to combine the molecular-genetic approaches with state-of-the-art microscopy to determine the role of microbes in nature. The principle objective of the research carried was to isolate cyanobacterial and archaeal species in Sri Lankan waters both fresh and marine, and to determine the phylogenetic relationship using the 16S rDNA sequences.

In addition, investigation on bacteria, both from environmental and clinical samples were carried out.

Scope of the project;

a. Isolation and identification of cyanobacteria to ascertain their biodiversity
b. Development of assays for water –borne toxicants.
c. Study on *Mycobacterium tuberculosis* strains
d. Study of aspects of bio control and formulation of methodologies for the isolation of *cry* genes in *Bacillus thuringiensis*
e. Innovation of methods to isolate genomic DNA

PROJECT OUTPUT 2007:

The studies started in previous year were continued. In water and soil samples collected from different areas of Sri Lanka revealed the presence of more than twenty genera of cyanobacteria. Based on culture characteristics and microscopic observations on morphology, they were tentatively identified as *Chroococcus, Synechococcus, Nostoc, Gleotheca, Phormidium, Microcoleus, Cylindrospermum, Oscillatoria, Merismopedia, Lyngbya, Schizothrix, Anabaena, Gloeocapsa, Microcystis, Westiellopsis, Fischerella, Aphanizomenon, Xenococcus, Spirulina* and *Gomphosphaeria/Coelosphaerium.*

A PCR procedure was developed for the selective retrieval of cyanobacterial rRNA gene fragments from a variety of natural and artificial settings. DNA extractions and amplifications to determine the phylogenetic relationship using the 16S rDNA sequences were completed from the tentatively identified cultured cyanobacterial

species and the 23 nucleotide sequences obtained from Gene Sequencing were deposited in GenBank under accession numbers, EU 276382, EU276383, EU 283865, EU283866, EU283867, EU283868, EU 310417, EU 310418, EU 310419, EU 310420, EU 310421, EU 310422, EU 310423, EU 310424, EU 310425, EU 310426, EU 310427, EU 310428, EU 310429, EU 310430, EU 310431, EU 310432, EU 310433.

Life in extreme environments has been studied intensively focusing attention on the diversity, molecular and metabolism of the organism. A major incentive that has driven extensive and intensive research efforts on extremophiles during the last decades is the potential biotechnological applications associated with these organisms and their products. A study was initiated to determine the cyanobacterial and archaeal diversity in the Mahapelessa hot springs, Sri Lanka. By combining morphological characterization and molecular characterization to ascertain the diversity in environmental samples and the cultures derived from the field material, we were able to isolate 3 new cyanobacterial species belonging to the order Oscillatoriales. The 3 nucleotide sequences obtained from Gene Sequencing were deposited in GenBank under accession numbers, EU 276384, EU 276385 and EU 276386.

Study on *Mycobacterium tuberculosis* strains - 2007

Tuberculosis (TB) had been a dreaded disease in Sri Lanka for centuries. Multidrug-resistant (MDR) *M. tuberculosis* is an emerging problem of great importance to public health, with higher mortality rates than drug-sensitive TB. Mycobacterial strain typing by means of molecular methods has become an important instrument for tuberculosis surveillance, control and prevention. Among DNA fingerprinting methods which restriction fragment length polymorphism (RFLP) typing is the most common method used which, has permitted novel investigations of the epidemiology and pathogenesis of tuberculosis.

Project 1; Rapid Detection of multidrug – resistant *Mycobacterium tuberculosis* strains using PCR assays.

Project 2; Restriction Fragment Length Polymorphism (RFLP) analysis and Spoligotyping on *Mycobacterium tuberculosis* strains isolated from patients attending the Central Chest Clinic Kandy

Ethical Clearance was granted to the projects by the Faculty of Medicine University of Peradeniya. During this study period (February 2007 – November 2007) around 125 clinical specimens were processed and 85 culture positive isolates were identified /notified to the relevant chest physician, Chest Clinic, Kandy.

GRANTS IN 2007:

Research Grants

Grant No; RG/2006/HS/07 –National Science Foundation – Rs 1,616,387.00

Project titled "Restriction Fragment Length Polymorphism (RFLP) analysis and Spoligotyping on *Mycobacterium tuberculosis* strains isolated from patients attending the Central Chest Clinic Kandy".

OTHER CONTRIBUTIONS IN 2007:

(1) Resource person to the School Science program of the IFS, prepared course notes, conducted laboratory demonstrations and delivered a lecture on "Molecular Medicine for better Health".

(2) Workshop on "Training on trainers in Science Communication – Taking Science to the General public" organized by the National Science Foundation, Sri Lanka.

PROJECT: **BASIC FOOD CHEMISTRY**

COMMENCEMENT: 2005

INVESTIGATORS (2007):

Ellepola S.K.W., *Research Fellow* **(Project Leader)**
Bannehaka N.M.S., *Research Assistant*

PROGRESS ACHIEVED *(Since inception):*

This project was initiated in 2005. The project was mainly directed towards the fundamental studies of structure, chemistry and properties of plant food constituents. In the past two years, the project mainly concentrated on properties and characterization of rice grain constituents. Studies on identification and characterization of rice seed proteins, antioxidant properties of red rice, cooking properties of different rice varieties and the influence of cooking methods on cooked rice grain properties have been investigated. The aforementioned work resulted in 04 publications in international journals. Subsequently, the project was extended towards the understanding of some unique properties of underutilized plants in Sri Lanka. Under this study, the antioxidant activity of *Dan* (*Syzygium caryophyllatum)*, a rare indigenous fruit of Sri Lanka has been investigated.

Received the NRC grant No: 06-71 for the project titled "*Identification and characterization of seed proteins from rice varieties*".

PROJECT OUTPUT 2007:

1. Antioxidant properties of red rice (*Oryza sativa* L.) in relation to interaction with soluble iron

The objective of this study was to determine the antioxidant properties and iron binding properties of red rice pigment (proanthocyanidin). Free radical scavenging activity, reducing power, and ferrous ion chelating ability of red and white rice varieties were compared with synthetic antioxidants, L-ascorbic acid and ethylenediaminetetraacetic acid (EDTA). The findings of the study revealed that red raw rice possessed greater antioxidant activity than white raw rice and its Fe^{+2} binding ability was not significant in the acidic medium. The manuscript relevant to this study has been submitted for publication in SCI journal, *Food Chemistry* (2007).

2. Antioxidant activity of *Syzygium caryophyllatum (*Dan*)*

Antioxidant activity of *Syzygium caryophyllatum (*Dan*)* was investigated by measuring free radical scavenging activity, reducing power, and ferrous ion chelating ability. The study revealed that *Syzygium caryophyllatum (*Dan*)* has good antioxidant potencies.

3. Effect of cooking and methods of cooking on physicochemical properties of different varieties of rice *(Oryza sativa* L.)

Five rice varieties; Bg-250, Bg-350, raw-Bg-94-1, parboiled-Bg-94-1 and *Basmati* were cooked by four commonly used rice-cooking methods. Carbohydrate loss was greater in milled-raw rice than red-bran and parboiled rice. Losses of protein, fiber and total minerals were comparatively higher in red rice. Parboiled rice exhibited higher retention of chemical nutrients and was less influenced by cooking. Pressure-cooking and microwave cooking showed least losses of chemical constituents and shorter cooking time. Our study revealed that cooking influences chemical and physical properties of rice seeds and these changes vary according to variety, type, structural characteristics of rice and method of cooking.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1.* *Title:* Conformational study of globulin from rice (*Oryza sativa*) seeds by Fourier-transform infrared spectroscopy.
Authors: **Ellepola S.W**. and Ma C.Y.
Journal: ***International Journal of Biological Macromolecules***, **37**: 20-22 (2007) [1,2]

* ***Reported as "in press" in Annual Report 2006***
[1]***Listed in the Science Citation Index in 2007***
[2]***Listed in the Science Citation Index-expanded in 2007***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2007:

1. **Ellepola S.K.W. and Bannehaka N.**
Effect of cooking and cooking-methods on chemical/nutrient composition and physical properties of five rice types in Sri Lanka
Proceedings of Aries Kovoor Memorial Symposium. Innovations in Plant Sciences through multidisciplinary Research (2008)

2. **Ellepola S.K.W.**
Study of secondary structure of rice seed globulin by Fourier-transform infrared Spectroscopy
National Conference on Advanced Materials for Emerging Technology (NCAMET 2007).

PROJECT: **BIOLOGICAL NITROGEN FIXATION**

COMMENCEMENT: 1986

INVESTIGATORS (2007):

Seneviratne G., *Senior Research Fellow* **(Project Leader)**
Bandara W.M.M.S., *Research Assistant*
Padmathilake K.R.E., *Research Assistant*
Ratnayake R., *Research Assistant*
Sandamali H.A.J., *Research Assistant*
Thilakaratne R.M.M.S., *Research Assistant*
Weerasekara M.L.M.A.W., *Research Assistant*
Zavahir J.S., *Research Assistant*
Kuruppuarachchi K.A.J.M., *Lecturer, Open University of Sri Lanka*
Liyanarachchi, L.A.W., *Lecturer, Sri Lanka Institute of Advanced Technological Education*

PROGRESS ACHIEVED:

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, replacing the use of urea completely. A similar inoculant increased plant growth of *Albizia,* a nitrogen fixing leguminous tree by 84% on tea estates. This inoculant is now used for about 5,000 acres of annual soybean and mung bean production 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.

j) An experiment was conducted to examine soil carbohydrate controls on nutrient dynamics. Soil litter and clay-bound organic matter were found to control soil carbohydrates, which govern the availability of some macro and micronutrients. Manuscripts were sent for publication to refereed journals.

k) A study was conducted 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 and analysed. A manuscript was published in a refereed journal.

NUMBER OF PUBLICATIONS IN REFEREED JOURNALS: 36

PROJECT OUTPUT 2007:

1. A microbial biofertilizer produced by the IFS in mid nineties is now used for about 5,000 acres of annual soybean and green gram production in Sri Lanka, replacing the use of urea completely. Studies are being carried on to examine effects of N_2 fixers and other effective microbes when they are in microbial communities or biofilms, to be used as biofertilizers for rice. The goal of this study is to develop a microbial fertilizer technique for rice. The microbes are now being screened, while the selected microbes are being tested with rice in greenhouse and field experiments.

2. 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.

3. In the study on bioactive compound production by biofilms, various biofilms are now being screened for the production of novel compounds, using FTIR spectroscopy.

4. A study was started to examine the potential of the use of microbial biofilms for biofuel production, based on cellulose waste materials. Microbes are now being tested to select potential candidates.

5. A study was started to examine the potential of the use of microbial biofilms as a microbial fertilizer technology for tea, in collaboration with the Tea Research Institute (TRI). Microbes are now being tested with tea for improved plant growth. One biofilmed inoculant showed about 3-fold increase in plant growth, compared to recommended chemical fertilizer application in tea nurseries.

6. A study was conducted to develop an improved rice production system using present and past cultural practices. *Nawakekulama,* a low cost organic farming system was compared with intensive rice production for ecological and economic benefits. Data of the first season are being analysed. This is funded by the NSF, Sri Lanka.

7. A study was started to examine the potential of the use of microbial biofilms in improving the performance of microbial fuel cells. Microbes are now being screened in a fuel cell to select efficient ones.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1. *Title:* Changes in soil chemistry associated with the establishment of forest gardens on eroded, acidified grassland soils in Sri Lanka
   Authors: Siddique I., Gutjahr C., **Seneviratne G.**, Breckling B., Ranwala S.W. and Alexander I. J.
   Journal: ***Biology and Fertility of Soils*, 44**: 163 (2007)[1,2]

2. *Title*: Potential of developed microbial biofilms in generating novel bioactive compounds
   Authors: **Zavahir J. S.** and **Seneviratne G.**
   Journal: ***Research Journal of Microbiology*, 2**: 397 (2007)

3. *Title:* A modified method of weight loss on ignition to evaluate soil organic matter fractions
   Authors: **Ratnayake R.R.**, **Seneviratne G.** and Kulasooriya S. A.
   Journal: ***International Journal of Soil Science*, 2**: 69 (2007)

4. *Title:* Two-thirds law of nitrogen mineralization under undisturbed soil conditions: a new theory
   Authors: **Seneviratne G.**
   Journal: ***Pedosphere,*** 2007 (in press)[2]

[1]***Listed in the Science Citation Index in 2007***
[2]***Listed in the Science Citation Index-expanded in 2007***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2007:

1. **Ratnayake R.R., Seneviratne G.**, and Kulasooriya S.A.
   Relationship between soil carbohydrates and nutrient availability in forests and cultivated lands
   International Symposium on Organic Matter Dynamics in Agro-Ecosystems, Poitiers, France, 16-19 July 2007, 241-242

2. Ambagahaduwa I.M., Gunatilleke I.A.U.N., **Seneviratne G.**, and Gunatilleke C.V.S.
   Estimating aboveground biomass of *Pinus caribaea* stand in lower Hantana
   Twelfth International Forestry and Environmental Symposium 2007, Kalutara, Sri Lanka, 30 November-1December 2007, 17

INVITED LECTURES IN 2007:

1. Invited lecture on "Biofilmed Biofertilizers: Novel Inoculants for Efficient Nutrient Use in Plants" at ACIAR Project Workshop on Efficient Nutrient Use in Rice Production in Vietnam Achieved Using Inoculant Biofertilizers, **Hanoi University College of Science, Hanoi, Vietnam,** 12-13 October 2007.

2. Invited lecture on "The Introduction on Bio-degradable Polythene" at **Sri Lanka Association for the Advancement of Science**, on 15th February 2007.

FELLOWSHIPS AND AWARDS IN 2007:

1. **Seneviratne G.**
   Short-term Visiting Collaborative Research Fellowship at University of Sydney, Australia (April-June 2007).

TECHNICAL ASSISTANCE:

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

PROJECT: **PRIMATE BIOLOGY**

COMMENCEMENT: 1983

INVESTIGATORS:

Dittus W., *Senior 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 four 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 of the Faculty of Veterinary Medicine, University of Peradeniya. In addition, we have become more active in aspects of nature conservation and in outreach educational programs to local communities to assist in mitigating the human-monkey conflict.

PROJECT OUTPUT 2007:

(a) ***Routine demographic, ecological and behavioral monitoring.*** The entire population of over 1,100 identified macaques was censused on a nearly 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, microbiology and physiology.*** With collaborators from eleven different international institutions I participated in the completion of data analyses and two manuscripts. They dealt with the microbiological aspects (DNA) of parasitism in Sri Lankan primates, particularly as this pertains to human health issues. Secondy, we completed a comparisons in primate milk physiology across several taxonomic levels of primates, respectively (see publications).

(d) ***Professional activities:*** (i) I reviewed manuscripts for international peer reviewed journals. (ii). I supervised two graduate students, Kerstin Becker of Germany and Rasika Kumaratunga (Univ Peradeniya) in their dissertation research (iii) I visited and conferred with collaborating institutions in Germany and the USA. (iv) I assisted in the making of a brief documentary film about our primate research at Polonnaruwa. (v) I wrote an invited article (interview format) to a leading Indian newspaper on the how to deal with the growing menace of monkeys in urban areas.

(e) ***Student Sponsorship***: I provided the airfare and organized other financial support for Ms. Rasika Kumaratunga (Univ. Peradeniya) for her 8 months of graduate biotechnical training (genetic analyses) at the Cologne Centre of Genomics, Germany.

(f) ***Nature Conservation***: (i) Our project did education programs in rural schools in and around Polonnaruwa, (ii) In collaboration with Richard Pieris Co Ltd., we designed and distributed educational pamphlets to the general public for how best to deal with monkey-human conflict.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1. *Title:* Transmission dynamics of cryptosporidium infection in a natural population of non-human primates at Polonnaruwa, Sri Lanka
   Authors: Ekanayake D., Welch D., Kieft R., Hajduk S., and **Dittus W.**
   Journal: ***American Journal of Tropical Medicine and Hygiene,*** **77(5):** 818-822 (2007)[1,2]

2. *Title:* Fatty acid composition of wild anthropoid primate milks
   Authors: Milligan L.A, Rapoport S.I., Cranfield M.R.,**Dittus W.,** Glander K.E., Oftedal O.T., Power M.L, Whittier C.A, Bazinet R.P.
   Journal: ***Comparative Biochemistry and Physiology, Part B,***2007 (in press) [1,2]

[1]***Listed in the Science Citation Index in 2007***
[2]***Listed in the Science Citation Index-expanded in 2007***

PROJECT: **ECOLOGY AND ENVIRONMENTAL BIOLOGY**

COMMENCEMENT: 1989

INVESTIGATORS (2007):

Silva E.I.L., *Associate Research Professor* **(Project Leader)**
Weerasinghe W.M.D, *Research Assistant*
Thumpela I., *Staff Technical officer*
Athukorale N., *Technical officer*

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 Kala Oya 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, Parakrama Samudra, Kantale, Senanayake Samudra, Konduwatuwana and Himadurawa tanks in Amapara distric) 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. Detail studies on Gal Oya system was started in August 2007, under a grant given by Finland Government. This study was conducted only for four months and immediately stopped by the donors due to some misunderstanding on prevailing political situation of the country. In 2007, studies continued on Kurunegala and Unnichchai tank and north central reservoirs.

PROJECT OUTPUT 2007:

Emphasis was paid mainly on compilation of data and correction of a Ph.D. thesis and final proof reading of four papers appeared in FISHSTRAT monograph. In addition, a two manuscripts were submitted to SCI journals on primary productivity of Rekawa lagoon and Impact of Rajangana irrigation scheme on Kala Oya source water.

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1. *Title:* Ecology of Phytoplankton in Tropical Waters: Introduction to the Topic and Ecosystem
   Authors: **Silva E.I.L**
   Journal: ***Asian Journal of Water, Environment and Pollution,*** **4(1):** 25-35 (2007)

2.* *Title:* Hypertrophic-eutrophic alteration in an urban water body, following an outbreak of a *Microcystis* Bloom
   Authors: **Silva E.I.L.**
   Journal: ***Sri Lanka Journal of Aquatic Sciences***, 12: 115-120 (2007)

3. *Title:* Photosynthetic characteristics and primary production of phytoplankton and sea grasses in Rekewa, a coastal lagoon in Sri Lanka
   Authors: **Silva E.I.L.,** Singappuli M.S., Jayatissa L.P., Hettiarachchi S., and Dehairs F.
   Journal: ***Indian Journal of Marine Sciences,*** 2007 (in press)[2]

* ***Reported as "in press" in Annual Report 2006***
[2] ***Listed in the Science Citation Index-expanded in 2007***

ABSTRACTS/CONFERENCE PROCEEDINGS IN 2007:

1. **Silva E.I.L.**, Kangara W., and Thirunavukkarasu T.
   Trophic alteration in reservoirs of Sri Lanka – an outcome of monsoon driven seasonal hydrology
   Proceedings of the International Conference on Humid Tropical Ecosystems: Challenges and opportunities – Water in the Humid Tropics December 4-9, Kandy, Sri Lanka, 2007, *27-33 pp.*

INVITED LECTURES/CONFERENCES ATTENDED IN 2007:

1. **Silva E.I.L.**
   Key note speaker, World Water Day organized by NWS& DB, Dharmaraja College, (05.06.2007).

2. **Silva E.I.L.**
   Evaluation of habitat heterogeneity, resource exploitation and functional resource units in Mundel Division, NW coast of Sri Lanka: a novel approach of coastal zone management at the international conference on Coastal Zone Environment and Sustainable Development-Vulnerability, Adaptation and Beyond to be held in New Delhi, India between 12-14 February, 2007

BOOKS AND MONOGRAPHS 2007:

1. *Title:* Catchment Characteristics, Hydrology Limonology and Socioeconomic Features of Three Reservoirs in Sri Lanka
   In the Book: In: Aquatic Ecosystems and Development: Comparative Asian Perspectives - Biology of Inland Water, 23-34 pp. (2007)
   Authors: **Silva E.I.L.,** Simon D. and Schimer F.
   Publishers: Bakhyus Publishers, Lieden, The Netherlands

2. *Title:* Regulation of Primary Productivity in Sri Lankan Reservoirs.
   In the Book: Aquatic Ecosystems and Development: Comparative Asian Perspectives - Biology of Inland Water, 74-89 pp, (2007)
   Authors: **Silva E.I.L.** and Schiemer F.
   Publishers: Bakhyus Publishers, Lieden, The Netherlands

3. *Title:* Phytoplankton community-structure (species composition, diversity, chlorophyll, key variables) in five SE Asian water bodies
   Authors: Rott E., **Silva E.I.L.,** Enriquez E. and Ingthamjitr S.
   In the Book: Aquatic Ecosystems and Development: Comparative Asian Perspectives - Biology of Inland Water, 123-141 pp. (2007)
   Publishers: Bakhyus Publishers, Lieden, The Netherlands

4. *Title:* Structure of microcrustacean zooplankton communities in five south-east Asian water bodies
   Authors: Vijverberg J., Amarasinghe P.B., Chittapalapong T., Pagulayan R.C., Ariyaratne M.G., Pamanian E.R., **Silva E.I.L.** and Nagelkerke L.A.J.
   In the Book: Aquatic Ecosystems and Development: Comparative Asian Perspectives- Biology of Inland Water, 149-161 pp. (2007)
   Publishers: Bakhyus Publishers, Lieden, The Netherlands

PROJECT: **CHEMICAL MODELING OF ENVIRONMENTAL SYSTEMS**

COMMENCEMENT: 1992

INVESTIGATORS (2007):

Weerasooriya R., *Research Professor* **(Project Leader)**
Nanayakkara A. *Associate Research Professor*
Bandara A., *Visiting Scientist*
Jayarathna I.P.L., *Research Assistant*
Kumara I.G.C.K., *Research Assistant*
Aluthpatabendi D., *Technical Officer*
Makehelwala M., *Volunteer Post Graduate Candidate*

Collaborating Laboratories (2006)

X-ray spectroscopy and molecular modeling (1995 – to date)
Heniz J. Tobschall, University of Erlangen (Germany)
M.M. Mieander University of Mainz, Germany

Scanning Electron Microscopy/ Scanning Tunneling Microscopy
N. Ng National University of Singapore

FTIR Spectroscopy (1999-to date)
Atula Bandara, University of Peradeniya

PROGRESS ACHIEVED (*Since inception)*:

Overall aim Mechanistic, spectroscopic and molecular definition of solid-water interfacial interactions

1. The Hg(II) adsorption on gibbsite was endothermic and spontaneous. The Hg(II) adsorption data were quantified with the Langmuir or Hill, and Dublin-Radushkevick (D-R) isotherms at all exp conditions.
2. Modeling interactions of tributyl-Sn (TBT) onto clays
3. Quantification of As(V) and As(III) retention mechanism of gibbsite with the aid of mechanistic and molecular modeling
4. Quantification of the activation state of monochlorophenol – pyrite interface
5. Calculations of essential thermodynamic parameters of MCP/pyrite interface
6. Reaction pathway modeling of 4-CP/pyrite interactions
7. Reactive site determination of kaolintie-TBT interface by molecular modeling methods
8. Retention mechanism of lead, cadmium, and arsenic on gibbsite
9. Site heterogeneity assessment of gibbsite by macroscopic methods

10. Mechanistic model development for quantification of chromate-goethite interfacial processes
11. Characterization of kaolintite – water interface probing with fluoride
12. Kinetic modeling of copper-fulvate complexation
13. Kinetic modeling of copper-organic polymer complexes
14. Determination of near surface solid composition of goethite copper system with X-ray photon spectroscopy
15. Development of novel unit processes of drinking water treatment for fluoride, nitrate, and selected organic-Cl (Project objectives were revised to meet the current IFS focus)
16. Development of N-nitrosoamine formation pathways in natural systems (Project objectives were revised to meet current IFS focus)

PROJECT OUTPUT 2007:

Metal ions adsorption in aqueous solutions to mineral surfaces can be described in terms of surface complexation models. The primary objective of our research was to validate model calculations by measuring free metal ion in chemically heterogeneous systems using ion selective electrodes. Specifically we selected Cu(II) – kaolinite system in this work to illustrate the validity of the proposed method. The free metal ion activities of Cu^{2+}/kaolinite system was determined experimentally to validate model calculations performed under surface complex formation theory. The copper ion selective electrode (CuISE) was used for free metal ion activity determinations after calibrating it in Cu(II)/TRIEN metal buffer systems to enhance its Nerstian behavior at low concentration limits (below 10^{-7}M Cu^{2+}). The generalized diffused layer model (DLM) was used to quantify both H^+ and Cu^{2+} adsorption on kaolinite using following reaction stoichiometries:

$\equiv AlOH + H^+ = \equiv AlOH_2^+$	log K = 4.13 (3.55)
$\equiv AlOH = \equiv AlO^- + H^+$	log K = -3.52(-2.99),
$\equiv SiOH = \equiv SiO^- + H^+$	log K = -6.61 (-6.11)
$\equiv XNa + H^+ = \equiv XH + Na^+$	log K = (3.27)
$2(\equiv AlOH) + Cu^{2+} = (\equiv AlO)_2Cu + 2H^+$	log K = 2.57(2.09),
$2(\equiv SiOH) + Cu^{2+} = (\equiv SiO)_2Cu + 2H^+$	log K = -3.75(-3.74),
$2(\equiv XNa) + Cu^{2+} = (\equiv X)_2 Cu + 2Na^+$	log K = (5.04).

The log K values in parentheses are calculated assuming no fixed charged sites. The experimentally measured free Cu^{2+} values agree well with the model calculations up to pH 8, afterwards they deviate. The $CuOH^+$ seems to compete for Cu^{2+} exchange sites on CuISE due to comparable ionic radii. This competing effect was resolved partially by subtracting $CuOH^+$ activities.

Number of Publications: 45

PUBLICATIONS IN REFEREED JOURNALS 2007:

1. *Title:* Transition state kinetics of Hg(II) adsorption at gibbste-water interface
   Authors: **Weerasooriya R.,** Tobschall H.J., Seneviratne W., and Bandara A.
   Journal: ***Journal of Hazardous Materials,*** 2007 (in press)[1,2]

2. *Title:* Modeling Interactions of Hg(II) and Natural Soils Using Physico-chemical Parameters of Synthetic Gibbsite
   Authors: **Weerasooriya R.,** Tobschall H.J., and Bandara A.
   Journal: ***Chemosphere,*** 2007 (in press) [1,2]

3. *Title:* Phyo-remediation potential of I aquatica for Cr(VI) mitigation
   Authors: Weerasinghe A.P., Ariyawansa S., **Weerasooriya R.**
   Journal: ***Chemosphere,*** 2007 (in press) [1,2]

4.* *Title:* Arsenic binding mechanisms on natural red earth; A potential substrate for pollution control
   Authors: Vithanage M., **Senevirathne W.**, Chandrajith R., Bandara A., and **Weerasooriya R.**
   Journal: ***Science of the Total Environment,*** **379:** 244 (2007) [1,2]

5.* *Title:* Thermodynamic assessment of Hg(II)-gibbsite interactions
   Authors: **Weerasooriya R.**, Senevirathne W, Kasthuriaarachi H.A., and Tobschall H.J.
   Journal: ***Journal of Colloid and Interface Science,*** **301**: 452 (2006)[1,2]

**** Reported as "in press" in Annual Research Report 2006***
[1] Listed in the Science Citation Index in 2007
[2] Listed in the Science Citation Index-expanded in 2007

BOOKS AND MONOGRAPHS 2007:

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, **11:** 469-490 (2006)
   Authors: Mieander M.M., **Weerasooriya R.**, and Tobschall H.J.
   Editors: Lutzenkirchen J.
   Publisher: Elsevier Publications, (in press)

2.* *Title:* Role of natural red earth in arsenic removal from drinking water-comparison with synthetic gibbsite and goethite
   In the book: Trace Elements and Other Contaminants, **9:** 587-602 (2007)
   Authors: Vithanage M., Chandrajith R., and **Weerasooriya R.**
   Editors: Series editor: J.O. Nriagu
   Publisher: Elsevier Publ., Netherlands (in press)

**** Reported as "in press" in Annual Research Report 2006***

POSTGRADUATE DEGREES COMPLETED IN 2007:

1. *Name:* **Wijesekara D.**
   Title of the Thesis: Mechanistic Spectroscopic and Molecular Model Probing of Arsenic Gibbsite Interactions
   Degree: Ph.D
   Degree awarded by University of Peradeniya

OTHER CONTRIBUTIONS IN 2007:

1. **M.Phil.– Examiner**

   WDK Mahathantila (2007)
   Water quality variation of tank cascade system, PGIS Univ. Peradeniya

2. **New Courses Offered (2007):**
   1. Physical Chemistry (2 credits)
      Uva Wellassa University of Sri Lanka
   2. Chemistry Laboratory (4 credits-shared)
      Uva Wellassa University of Sri Lanka
   3. Thermodynamics (1 credit)
      Uva Wellassa University of Sri Lanka
   4. Soil Environmental Chemistry (3 credits shared)
      University of Peradeniya

PROJECT: **STRUCTURAL GEOLOGY**

COMMENCEMENT: 1995

INVESTIGATORS (2007):

Kehelpannala K.V.W., *Senior Research Fellow* **(Project Leader)**
Prof. A. Kröner, *Visiting Senior 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 eleven 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. The main amphibolite-granulite facies metamorphism in the western (Wanni Complex) and central (Highland Complex) crustal units was related to the first collision, while the amphibolite facies metamorphism of the eastern crustal unit (Vijayan Complex) was resulted from the second collision. Geological and structural studies carried out along the boundary shear zones of the major crustal blocks in Sri Lanka led us to identify them as parts of major suture zones. EPMA study of Th-U-Pb isotopic system of the mineral monazite in metamorphic rocks of Sri Lanka, especially taken from some important rocks across the boundary between the Wanni Complex and the Highland Complex, led to identification of new type of monazite. 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 twelve years were published in refereed journals, in the Second Edition of the National Atlas of Sri Lanka (three chapters), in international and local proceeding volumes and in the form of

abstracts. The Project Leader co-edited a special issue of the international Elsevier Journal of Asian Earth Sciences (Issue 1 of Volume 28, 2006) on "The role of Sri Lanka and Associated Continental Blocks in the Assembly and Break-up of Rodinia and Gondwana".

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 a Visiting Professor at the Shizuoka University, Japan during January-March 2006 under a JSPS programme. The Project Leader had been invited by foreign universities and international organizations to participate in about nineteen international symposia and workshops held in India, China, Singapore, Japan, Hong Kong, USA and in Sri Lanka to present some of the results of the project. Since 1995, the Project Leader has delivered about 70 keynote/invited/public/special lectures in Sri Lanka, India, Singapore, Hong Kong, China, Japan and in the USA. Out of these, about 33 invited lectures are at international levels. 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".

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, and he 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 great earthquakes of 26.12.2004 and 28.03.2005 near Sumatra, the Project Leader analysed the seismicity in the entire area and predicted a big earthquake in the area west of southern Sumatra within about 30 years, which could trigger a tsunami. He has given the requirement that should be fulfilled for generating an ocean-wide tsunami and made public these findings in newspapers published in April, May and December 2005. As predicted, a big earthquake (Magnitude 8.4) occurred in the same area as was predicted by the Project Leader on 12.09.2007. Moreover, as we have predicted some earth tremors occurred in Sri Lanka during 2007.

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 natural disasters, especially landslides, tsunamis and earthquakes. He has conducted over 45 television programmes and as many as 30 radio programmes on natural disasters. He also published several news paper articles on natural disasters such as tsunamis,

earthquakes and landslides. Immediately after the Indian Ocean tsunami of 26th December 2004, a detailed work 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 also studied. We have already identified some evidence for palaeostunamis, and radio carbon dating carried out at the Shizuoka and Nagoya universities by the Project Leader and his collaborators in these universities suggests the a possible tsunami has struck Sri Lanka about some 1000 years ago.

The Structural Geology Project intervened in finding scientific solutions to problems related to some natural disasters and other nationally important geological problems. Under this, causes and mechanisms of major landslides occurred in Sri Lanka were studied, and several public awareness programmes were conducted by the Project Leader to help the people in affected areas. The studies on landslides led the Project Leader to make aware the public on potential landslides, especially along some of the major roads, before their occurrence. Potential landslides areas in the Kotmale region and along the Kandy-Nuwara Eliya, Kandy-Colombo and Teldeniya-Hasalaka roads were identified and predicted their occurrence. Although the public was made aware of some of these landslides through the media, no series attention was paid. Several such identified areas underwent landslides, killing people and destroying property. The best example of such predicted landslide was the one occurred on 10.11.2006 at Paradeka, which killed 6 people, along the Kandy-Nuwara Eliya road. Landslides that occurred in January 2007 in the Walapane, Randenigala, Maturata, Rikillagaskada and Niladandahinna areas were also studied.

The cracks developed along the Kotmale rock-filled dam were investigated, and the relevant authorities were informed about the measures that should be taken. The project was able to find the reasons for developing cracks in the walls and floors of a large number of houses in Sri Lanka, especially in the Matale, Kengalla, Menikhinna and Kotmale areas. Models developed for understanding the development of cracks indicate that they are not caused by any natural disasters, but mainly due to the following reasons.

(i) Poor preparation of the ground,
(ii) Settling of the filled up ground,
(iii) Poor construction of foundations and walls,
(iv) Contraction of the clayey soil under the floors of the houses during dry seasons
(v) Poor drainage system
(vi) Low quality building materials
(vii) Slope failures

PROJECT OUTPUT 2007:

1. Carried out a detailed study of landslides in the Walapane, Maturata and Randenigala areas (This work is being continued).

2. A detailed study of the structure along the boundary between the Wanni Complex and the Highland Complex of Sri Lanka was carried out. (This work is being continued)..

3. The seismic activity in the Indian Ocean around Sri Lanka was monitored by studying earthquakes reported in the USGS website. Several moderate earthquakes occurred in the Indian Ocean east, southeast and southwest off Sri Lanka. As we had predicted, some tremors occurred within Sri Lanka during July 2007. Although these earthquakes had no effects on Sri Lanka, two events were academically important. The earthquake that occurred on 18.07.2007 east off Sri Lanka in the Bay of Bengal falls in the earthquake belt that crosses the country, which is a finding of our project. I had predicted occurrence of earthquakes in this belt. The other earthquake is the one that occurred on 12.09.2007 west off Sumatra with a magnitude of 8.4 (M_w). This was the big event that I had predicted in the region ("Lakbima" Newspapers of 18.04.2005, 04.05.2005 and 29.12.2005). (This work is being continued).

4. Some brittle fracture and fault zones in the central and southeastern sectors of Sri Lanka were analysed from satellite images provided by Google Earth (http://earth.google.com). (This work is being continued).

PUBLICATIONS IN REFEREED JOURNALS IN 2007:

1.† *Title:* Extraction of pure metallic nickel from ores and plants at Ussangoda, Sri Lanka
Authors: **Tennakone K., Senaviratne M.K.I.** and **Kehelpannala K.V.W.**
Journal: ***Journal of the National Science Foundation,*** **35:** 245-250 (2007)

2. *Title:* Differential thermal analysis of Sri Lankan-type vein graphite
Authors: Matsuura Y., **Kehelpannala K.V.W.**, and Wada H.
Journal: ***Geoscience Reports of Shizuoka University***, **34:** 7-18 (2007)

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

ABSTRACTS/CONFERNECE PROCEEDINGS IN 2007:

1. Nakagawa M., Santosh M., **Kehelpannala K.V.W.**, Mathew K.J., Matsuura K. and Kuwada Y.
Gemstones of central Gondwana in south India and Sri Lanka. In: Nakano, N., Osanai, Y., Miyamoto, T. and Santosh, M. (Eds.), 4th International Symposium on Gondwana to Asia and IAGR Annual Convention. International Association for Gondwana Research Conference Series 4, pp. 112-113, 2007

2. Jackson K.L., Rankey E.C., Eberli G.P., Amelung F., Andres M.S., Peterson L.P., Swart P.K., Jayasena H.A.H., and **Kehelpannala K.V.W.**
Are Tsunamis Always Sedimentologically Important Events? A Case Study of Sedimentological and Geochemical Analyses of Coastal Lagoons, Sri Lanka: American Association of Petroleum Geologists Abstracts with Programs, Annual Meeting, Long Beach, CA., USA,2007

3. Jackson K.L., Amelung F., Eberli G.P., Jayasena H.A.H., **Kehelpannala K.V.W.,** Moore A.L., Peterson L.C., Rankey E.C. and Swart. P.K.
Comparative Sedimentology of Recent and Ancient Tsunami Deposits in Sri Lanka. American Geophysical Union Fall Meeting, San Francisco, 2007

INVITED LECTURES/CONFERENCES ATTENDED IN 2007:

1. **Kehelpannala K.V.W.** and **Ranaweera L.**
Structural and kinematic evolution of a possible Pan-African suture zone in Sri Lanka. In: Nakano, N., Osanai, Y., Miyamoto, T. and Santosh, M. (Eds.), 4th International Symposium on Gondwana to Asia and IAGR Annual Convention. International Association for Gondwana Research Conference Series 4, pp. 83-88, 2007. **This is an invited keynote lecture**

2. **Kehelpannala K.V.W..**
Participated as an invitee to **deliver the keynote address** at the 4th International Symposium on Gondwana to Asia and IAGR Annual Convention and the connected Field Workshop held in Fukuoka, Kyushu, Japan

3. **Kehelpannala K.V.W..**
Invited lecture on "Landslides in the Central Hill Country and Subsidence in the Matale Area" organized by the Commission for Justice, Peace, Human Development and Human Rights Secretariat, Kandy, 22 March 2007

4. **Kehelpannala K.V.W..**
Popular Lecture on "Landslides and After Effects of Heavy Rains" organized by the German Alumni Association of Sri Lanka in Association with the German Cultural Centre, Geothe Institute, Colombo, 30th March 2007

5. **Kehelpannala K.V.W..**
Invited Guest Lecture on "Science of Geological Natural Disasters" at the Kaikawala Central College, Kaikawala for school teachers and children of the Kaikawala Educational Division, 12th June 2007

6. **Kehelpannala K.V.W.**
Invited lecture on "Earthquakes and Tsunamis" at the Poramadulla Central College, Rikillagaskada for school teachers and children, 27th September 2007

7. **Kehelpannala K.V.W.**
Invited Guest lecture on "The Theory of Plate Tectonics and Earthquakes" at the Science Day, St. Anthony's College, Kandy for school children, 26th October 2007.

OTHER CONTRIBUTIONS IN 2007:

a) IMPORTANT MEETINGS ATTENDED:

1. Attended several meetings of the National Advisory Committee at the office of the Hon. Minister of Natural Disasters & Human Rights.

2. Attended as an invitee at the Cabinet of Ministers held on 20.06.2007 at Temple Trees to participate in a discussion on recent landslides and subsidence in the Nuwara Eliya district.

b) WORKSHOP CONDUCTED IN 2007:

1. Conducted a one day workshop on "Disasters in Sri Lankan Perspective including South Asia Region" and "Disasters in Central Province" organized by the National Christian Council of Sri Lanka at Sathyodaya, Kandy, 01st June 2007

2. Conducted a one-day workshop on "Disasters Preparedness and Managements" organized by the National Christian Council of Sri Lanka at the Institute of Fundamental Studies, Kandy, 20th September 2007

c) TV PROGRAMMES

1. Live discussion on "Landslides" in the main News Bulletin, Rupavahini, Government TV Channel, 15th January 2007.

2. 30 minutes live programme on "Landslides", Derana Television, 16th January 2007.

3. A short discussion on "the earthquake of 18.07.2007" in the "Hatha" (Seven) News Bulletin Rupavahini, Government TV Channel, 18th July 2007.

4. A short discussion on "the earthquakes that occurred from 18.07.2007 to 20.07.2007" in the "Derana Today" News Bulletin, Derana Television Channel, 20th July 2007.

5. A short discussion on the earthquakes that occurred from 18.07.2007 to 20.07.2007 in the "Live at 8" News Bulletin, Swarnavahini Television Channel, 20th July 2007.

6. A short TV presentation on "Subsurface Water Channels at Uduwela" in the News Bulletin at 10 p.m., Rupavahini Government TV Channel, 24th July 2007.

7. A short discussion on "the cracks appeared in the Teldeniya area" in the "Live at 8" News Bulletin, Swarnavahini Television Channel, 02nd August 2007.

8. One hour TV discussion on "Earthquakes in and Around Sri Lanka", Swarnavahini Television Channel, 05th August 2007.

9. A short discussion on "the Sumatra earthquake of 12.09.2007" in the "Hatha" (Seven) News Bulletin Rupavahini, Government TV Channel, 12th September 2007.

10. A short TV discussion on "What will happen after the Sumatra earthquake of 12.09.2007" in the News Bulletin at 10 p.m., Rupavahini Government TV Channel, 12th September 2007.

11. A short discussion on "the Sumatra earthquake of 12.09.2007" in the main News Bulletin, Sirisa TV, 13th September 2007.

12. A live TV programme on "the Sumatra earthquake of 12.09.2007 and what will happen", Swarnavahini Television Channel, 15th September 2007.

13. A short TV discussion on "What will happen after the Sumatra earthquake of 12.09.2007" in the "Live at 8" News Bulletin, Swarnavahini Television Channel, 16th September 2007.

14. One hour live TV discussion on "The situation after the Sumatra earthquake of 12.09.2007", Swarnavahini Television Channel, 21st September 2007.

15. One hour live TV discussion on "Causes of development of cracks in walls and floors of houses in Sri Lanka", Swarnavahini Television Channel, 08th October 2007.

16. A short programme on "Possible landslides in the Gampola and Weligalla areas" in the News Bulletin, Swarnavahini Television Channel, 24th November 2007.

17. A short programme on "Possible landslides in the Gampola and Weligalla areas" in the Main News Bulletin, Sirasa TV Television Channel, 25th November 2007.

18. A short programme on "Possible landslides in the Gampola and Udunuwara areas" in the News Bulletin, Rupavahini Government TV Channel, 08th December 2007. This was repeated in the English News.

d) RADIO PROGRAMMES

1. A short programme on "Landslides", BBC World Service, Sandesaya Programme, 18 January 2007.

2. A 30 minutes live radio programme on "Earthquakes in Sri Lanka", Sri Lanka Broadcasting Corporation (SLBC), the Government National Radio Channel, 26th July 2007.
3. A live radio discussion on "Earthquakes in Sri Lanka" – Sirasa FM Radio, a private radio channel, 30th July 2007.

4. Two-hour live radio discussion on "Possible Earthquakes in Sri Lanka", Max Radio Channel, 07th August 2007.

5. A discussion on "The Sumatra earthquake of 12 September 2007" in radio news – Neth FM Radio - a private radio channel, 13th September 2007.

6. A discussion on "The Sumatra earthquake of 12 September 2007" in radio news – Max Radio - a private radio channel, 13th September 2007.

7. A discussion on "The Sumatra earthquake of 12 September 2007" in radio news – Sri Lanka Broadcasting Corporation (SLBC) - the Government National Radio Channel, 13th September 2007.

8. A discussion on "The Sumatra earthquake of 12 September 2007" in radio news – TNL English Radio - a private radio channel, 14th September 2007.

9. A discussion on "The Sumatra earthquake of 12 September 2007" – Neth FM Radio - a private radio channel, 14th September 2007.

10. A discussion on "The Sumatra earthquake of 12 September 2007" in radio news – V-FM Radio, a private radio channel, 14th September 2007.

11. A live discussion on "The Sumatra earthquake of 12 September 2007" – Max Radio - a private radio channel, 14th September 2007.

12. A live discussion on "The Sumatra earthquake of 12 September 2007 and future problems", special programme – Kandy Service, Sri Lanka Broadcasting Corporation (SLBC) - the Government National Radio Channel, 14th September 2007.

13. One hour live radio programme on "Floods and landslides" – "Subarathi" Programme, Sri Lanka Broadcasting Corporation (SLBC) - the Government National Radio Channel, 25th October 2007.

e) **INTERVIEWS/NEWS PAPER ARTICLES:**

1. "Attentions should be paid to the situation if a landslide strikes a dam" (in Sinhalese), "Rawaya" Newspaper, 28th January 2007.

2. "Powerhouses in the hill country under landslides threats" (in Sinhalese), "Lakbima" Newspaper, 23rd March 2007.

3. "An earthquake threat to Sri Lanka" (in Sinhalese) (The lead news item of the Newspaper), "Lakbima" Newspaper, 22nd July 2007.

4. "Now Sri Lanka too is an earthquake zone" (in Sinhalese), "Lakbima" Newspaper, 25th July 2007.
5. "Earthquake: The next disaster" in "Daily Mirror" Newspaper, 27th July 2007.

6. "Earthquake belt running from East to West" in "Lakbimanews" Newspaper, 29th July 2007.

7. "Earthquake threat to Sri Lanka" (in Sinhalese) in "Lakbima" Newspaper, 29th July 2007.

8. "Predicting a tsunami" in "Daily Mirror" Newspaper, 15th September 2007.

9. "More quakes are expected: Another tsunami lees likely" in "Lakbimanews" Newspaper, 16th September 2007.

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.

(ii) 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 2006 was compiled. Mid year report and four quarterly research reports were prepared.

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

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

(D) Science and Technology Promotion

i. In the view of giving a better understanding to the general public/students about the IFS activities, preparation of video presentations were initiatiated. As an initial project, **video clips on instrumental analysis method** is under construction. Presentations will be in Sinhala and Tamil languages.

ii. Free Electronic version of the **English-Sinhala Chemistry dictionary with an intelligent** search engine was prepared by C.T.K. Thilakaratna with the help of Prof. A. Nanayakkara and CDs were distributed among the School science programme participants.

iii. **Electronic English-Tamil Science Glossary** – (Vinghana Padangal "விஞ்ஞானபதங்கள்) with an intelligent search engine was developed and published in compact disk form jointly with Prof. A. Nanayakkara. This contains 45,000 words in the fields of Biology, Chemistry, Computer Science, Physics, and Mathematics. This glossary was published in end of 2006. The CDs were distributed among the School Science Programme participants and to the others who are interested.

(E) Auditorium was rented out for outsiders on two occasions and services were rendered on four occasions for government institutions.

RESEARCH MEETINGS AND SPECIAL LECTURES

RESEARCH MEETINGS

01.01.2007 **Multi-electron storage of photoenergy using Cu_2O-TiO_2 thin film photocatalyst**
Ms. J.P. Yasomanee, Research Assistant, IFS

21.03.2007 **Toxicity studies of green leafy vegetables consumed in Sri Lanka**
Ms. B.M.G.K. Balasuriya, Research Assistant, IFS

20.06.2007 **Plant and soil characteristics at the Ussangoda Serpentine Site**
Mr. A.S. Weerasinghe, Research Assistant, IFS

27.06.2007 **In vitro flower induction, floral morphology and molecular studies in some bamboos**
Ms. G.D.G. Chaturani, Research Assistant, IFS

04.07.2007 **Antioxidant Activity of Red Rice Pigment (Proanthocyanidin)**
Ms. N. Banneheka, Research Assistant, IFS

06.09.2007 **Utilization of poly[2-methoxy-5-(2-ethyl-hexyloxy)-phenylene vinylene (MEH-PPV) as a hole-conductor in Dye-sensitized solid-state solar cells**
Mr. E.V.A. Premalal, Research Assistant, IFS

SPECIAL LECTURE

13.03.2007 **Mapping genes in man and beast**
Professor Peter Nuernberg, Professor of Genomics, Acting Director of the Cologne Center for Genomics (CCG), University of Cologne

WORKSHOPS AND SEMINARS

02.08.2007 Sri Lanka Science and Engineering Fair (SLSEF) – Introductory Workshop jointly organized by National Science Foundation and IFS.

EDUCATIONAL VISITS

02.02.2007 School children from Saint Aloysius' College, Galle

02.02.2007 Undergraduate students from Department of Agricultural Engineering, University of Peradeniya

06.03.2007 Students from K/Kurugoda Boys Muslim Vidyalaya, Akurana

28.03.2007 Students fromm K/Iddamalpana Maha Vidyalaya, Attale

21.06.2007	Students from Al Ashraq Maha Vidyalaya, Ambakote
17.07.2007	Students from Sabaragamuwa University of Sri Lanka.
24.07.2007	Students from Alsaints Maha Vidyalaya, Galle.
27.07.2007	Students from Ananda Madhya Maha Vidyalaya, Elpitiya
17.08.2007	Students from Mohamadhia Maha Vidyalaya, Nilaveli
02.10.2007	Students (Grade 13 H Science Stream) from Dharmaraja College, Kandy

SCHOOL SCIENCE PROGRAMME
06-08 AUGUST, 2007

06th August

Physice of Toys
Prof. K. Tennakone

IFS activities and Science Dissemination
Dr. C.T.K. Tilakaratne

Brain Computer Interfacing
Prof. A. Nanayakkara

07th August

Molecular Medicine for Better Health
Dr. D.N. Maganaarachchi

What does Research mean to us?
Mr. P.B. Samarasingha
Ms. N de Silva
Ms. G. Balasuriya

Persistent Organic Pollutants
Prof. H.R.W. Dharmaratne

08th August

Primate Behavior, Ecology and Conservation
Dr. W.P.J. Dittus

Galaxies, Nebulae, SETI.....
Prof. W. Stuiver

RESEARCH STAFF 2007

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

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

RESEARCH ASSISTANTS 2007

The period mentioned within brackets shows their stay at IFS

Research Assistants (Grade I)

Balasuriya B.M.G.K	*(03.11.2003-todate)*
Bandara W.M.M.S.	*(17.03.2005-01.08.2007)*
Jayaweera P.V.V	*(03.04.2000-19.03.2007)*
Padmathilake K.R.E.	*(03.09.2007-todate)*
Piyasena K.G.N.P.	*(01.06.2002-todate)*
Premalal E.V.A.	*(20.05.2004-todate)*
Premaratne S.R.	*(01.09.2005-todate)*
Rathnayake R.R.	*(15.01.2001-23.10.2007)*
Sandamali H.A.J.	*(03.09.2007-todate)*
Thilakaratne R.M.M.S.	*(03.09.2007-todate)*
Wijesekara K.B.	*(16.06.2003-todate)*
Wijesekera T.P.	*(01.05.2004-12.12.2007)*
Zavahir J.S.	*(01.09.2005-25.06.2007)*

Research Assistants (Grade II)

Amarasinghe N.R.	*(17.11.2003-30.06.2007)*
Ariyaratne R.A.Y.K.	*(15.03.2006-20.07.2007)*
Ariyasinghe Y.P.Y.P.	*(01.11.2006-todate)*
Ariyawansa J.K.	*(03.09.2007-todate)*
Bandaranayake K.M.P.	*(17.04.2000-19.03.2007)*
Banneheka B.M.N.M.S.	*(08.05.2006-todate)*
Chaturani G.D.G.	*(03.04.2006-todate)*
de Silva N.	*(15.07.2002-31.08.2007)*
de Silva W.C.	*(03.09.2007-todate)*
Gunawardene D.C.	*(01.03.2006-todate)*
Jayarathna I.P.L.	*(01.12.2006-todate)*
Kumara I.G.C.K.	*(03.07.2006-todate)*
Maddegoda K.M.M.N.	*(03.01.2005-todate)*
Priyanwada N.H.N.	*(03.07.2006-todate)*
Ranaweera L.V.	*(03.11.2003-todate)*
Ranwala S.N.P.	*(01.10.2007-todate)*
Samarasinghe P.B.	*(01.12.2005-todate)*
Seneviratne M.K.I.	*(01.09.2003-19.07.2007)*
Senevirathne S.B.M.S.	*(15.12.2003-15.06.2007)*
Siriwardana C.L.	*(11.06.2007-10.08.2007)*
Wanigatunga R.P.	*(03.04.2006-todate)*
Weerasinghe W.M.D.	*(01.01.2004-todate)*
Weerasinghe H.A.S.	*(15.03.2006-todate)*
Weerasekara M.L.M.A.W.	*(01.09.2005-01.09.2007)*
Wijayaratne T.R.C.K.	*(15.08.2007-todate)*
Yasomanee J.P.	*(01.12.2005-03.08.2007)*
Zahmeeth S.S.	*(01.06.2006-todate)*

Project Leaders are responsible for authenticity of reports they have submitted