

CHEMISTRY

IN SRI LANKA



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The Tri Annual Publication of
the Institute of Chemistry Ceylon
ISSN 1012-8999



29th Batch of 83 Graduate Chemists (with officials) at Eighth Convocation on 16.02.2012 at Waters Edge



Chief Guest at the Convocation was Mr. Ronnie Peiris, Chairman, Nations Trust Bank and Group Director, John Keels Holdings Ltd.

Principal Award Winners with Chief Guest, Officers & Officials at Eighth Convocation 16.02.2012



Chemistry in Sri Lanka

ISSN 1012 - 8999

The Tri-Annual Publication of the Institute of Chemistry Ceylon

Founded in 1971, Incorporated by Act of Parliament No. 15 of 1972

Successor to the Chemical Society of Ceylon, founded on 25th January 1941

Vol. 29 No. 2

May 2012

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"Role of Chemistry Research in National Development"

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Outline of our Institute

The Institute of Chemistry Ceylon is a professional body and a learned society founded in 1971 and incorporated by act of Parliament No. 15 of 1972. It is the successor to the Chemical Society of Ceylon which was founded in 1941. Over 50 years of existence in Sri Lanka makes it the oldest scientific body in the country.

The Institute has been established for the general advancement of the science and practice of Chemistry and for the enhancement of the status of the profession of Chemistry in Sri Lanka. The Institute represents all branches of the profession and its membership is accepted by the government of Sri Lanka (by establishment circular 234 of 9-3-77) for purposes of recruitment and promotion of chemists.

Corporate Membership

Full membership is referred to as corporate membership and consists of two grades: **Fellow (F.I.Chem.C.)** and **Member (M.I.Chem.C.)**

Application for non-corporate membership is entertained for four grades: **Associate (former Graduate) (A.I.Chem.C.)**, **Licentiate (L.I.Chem.C.)**, **Technician (Tech.I.Chem.C.)** and **Affiliate Member**.

Revision of Membership Regulation

All Special Degree Chemists can now apply directly to obtain **Associate (Graduate) Membership**. Three year B. Sc. Graduates (with an acceptable standard of Chemistry) can

- directly become **Licentiate**
- obtain corporate membership in a lesser number of years.

Tech.I.Chem.C.

Those who have passed the DLTC examination or LTCC examination or have obtained equivalent qualification and are engaged in the practice of Chemistry (or chemical sciences) acceptable to the Council are entitled to the designation **Tech.I.Chem.C.**

Members/Fellows are entitled to the designation of **Chartered Chemist (C.Chem.)** on establishment of a high level of competence and professionalism in the practice of chemistry and showing their commitment to maintain their expertise.

All corporate members (Members / Fellows) are entitled to vote and become Council/ Committee members whether Chartered Chemists or not.

Membership Applications

Any application for admission to the appropriate class of membership or for transfer should be made on the prescribed form available from the Institute Office.

Current Subscription Rates

Fees should be paid on 1st of July every year and will be in respect of the year commencing from 1st July to 30th June

Fellow	Rs. 1200
Member	Rs. 1200
Associate	Rs. 900
Licentiate	Rs. 750
Technician	Rs. 500
Affiliate	Rs. 500
Membership for Life	Rs. 10000

Entrance Fee

All the grades	Rs. 500
Processing Fees*	Rs. 200
Processing Fee for Chartered Chemist designation	Rs. 1000
Institutional Members	Rs. 2500

*per application for admission/transfer to any grade

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CHEMISTRY IN SRI LANKA

Chemistry in Sri Lanka is a tri-annual publication of the Institute of Chemistry Ceylon and is published in January, May and September of each year. It is circulated among the members of the Institute of Chemistry and students of the Graduateship/DLTC course and libraries. The publication has a wide circulation and more than 1500 copies are published. Award winning lectures, abstracts of communications to be presented at the annual sessions, review papers, activities of the institute, membership news are some of the items included in the magazine.

The editor invites from the membership the following items for publication in the next issue of the Chemistry in Sri Lanka which is due to be released in September 2012.

- Personal news of the members
- Brief articles of topical interests
- Forthcoming conferences, seminars and workshops
- Latest text books and monographs of interest to chemists

All publications will be subjected to approval of the 'Editorial and Publicity Committee' and the Council of the Institute of Chemistry Ceylon.

Further, prospective career opportunities for chemists, could be advertised in Chemistry in Sri Lanka at a nominal payment. The editor welcomes from the members suggestions for improvement of the publication.

Sri Lanka Institute of Nanotechnology on a Viable Path

Professor Veranja Karunaratne, *FRSC*

Science Team Leader, Sri Lanka Institute of Nanotechnology (SLINTEC)



The Nanotechnology Initiative (NNI) in Sri Lanka launched through the Sri Lanka Institute of Nanotechnology (SLINTEC) in 2006, is unique among many such initiatives worldwide, by being a public private partnership. The vision of NNI is to facilitate development and make Sri Lanka an industrial power in order to enable the country to emerge from poverty by infusing nanotechnology based innovations through research and development utilizing local raw materials, resources and talent. Therefore, SLINTEC, aims to provide platform research solutions based on nanotechnology to the Sri Lankan industries.

In order to fast-track the NNI, the Government proposed the setting up of SLINTEC, the first ever Government funded start-up research company. SLINTEC is a Rs. 420 million venture with the Government investing 50% and five joint venture partners, namely, Hayleys, MAS Holdings, Brandix, Loadstar and Dialog equally investing the rest. The Ministry of Science and Technology is the focal point of the Government's investment which will oversee its responsibilities through the National Science Foundation. Under its mandate, SLINTEC will provide an value added industrial platform, based on nanotechnology research solutions, to the product line up of these companies thus enhancing their global competitiveness. In this simple yet profoundly logical model, SLINTEC will strengthen and support Sri Lankan companies to enhance their export earnings thus contributing to the national economy. In other words, this is the first time that scientists have been embedded as close as possible to the industry to carry out research relevant to them. Significantly, the World Bank in its 2009 review of the NNI in Sri Lanka hailed the SLINTEC model as a practical way to carry out scientific research in nanotechnology relevant to a country such as Sri Lanka.

SLINTEC which started research in August 2009, thus far, has applied for five patents at the United States Patent Office to cover the innovations for its joint venture partners. It is noteworthy that two of the patents pertaining to slow release nanofertilizer formulations which releases nitrogen to the soil in a slow and sustained manner attracted the attention of Nagarjuna Fertilizer and Chemicals Limited (NFCL) a global leader in the manufacture of fertilizer.

Specifically, in a landmark scientific development, SLINTEC entered into a strategic collaboration with NFCL of Hyderabad, India, to develop the next generation of nanotechnology based plant fertilizer solutions. These nanofertilizer products are aimed at increasing productivity and income for farmers and creating a sustainable business for all the stakeholders engaged in agri-business. These nanofertilizer systems achieve this task by slowing down the loss of urea in soil – due to leaching and volatilization- which had remained an age old problem in agriculture.

As part of this strategic partnership, SLINTEC is selling two patents covering their first generation nano plant fertilizer products, taking it from proof of concept to proof of value for commercialization. In addition, SLINTEC will enter into a long-term strategic technology development program for the second and third generation nano plant nutrition products. For SLINTEC, this is an opportunity to work with a global partner to take the product development journey from lab to field. NFCL aims at establishing a long-term business partnership with SLINTEC as an exclusive nanotechnology research facility for its nano plant nutrition products. In this strategic research programme over the next three years, a total investment to be made by Nagarjuna is projected to be US\$3M. However, SLINTEC has reserved the rights for Sri Lanka to exploit this technology on its own. Sri Lanka is known only for selling commodities and this deal between SLINTEC and NFCL heralds a new era in technology development in Sri Lanka.

In the area of value addition to Sri Lankan natural resources, SLINTEC entered into an agreement with Laughs Gas (pvt) Ltd. to build a pilot plant to convert Ilmenite to Titanium Dioxide and nano-Titanium Dioxide. This agreement paves the way to the commercial production of Titanium Dioxide from the high purity Ilmenite ore whose value addition had remained elusive during the past decades while Sri Lanka exported sand to foreign countries.

SLINTEC within a short period of three years has proved that given facilities and an enabling research environment, Sri Lankan scientists can rise to task and contribute to national development. On the other hand, by investing in nanotechnology “technopreneurship”, the Government has recognized that scientists can make a big difference in national development by helping to exploit good technologies.

Institute of Chemistry Ceylon

Forty First Annual Sessions and Seventy First Anniversary Celebrations 2012



Chief Guest
Professor Tina Overton
University of Hull, UK



Guest of Honour
Professor John Dyke
University of Southampton, UK

Inauguration of the 41st Annual Sessions, Institute of Chemistry Ceylon & the International Conference on Chemical Sciences

Wednesday, June 20th 2012

Venue: Waters Edge, Capital City

- | | |
|----------------|--|
| 8.00 – 8.45 am | Arrival of Members and Guests.
(Refreshments will be served) |
| 8.45 am | Ceremonial Procession of the Council Members and Past Presidents. |
| 8.50 am | Inauguration by the lighting of the Traditional oil lamp and playing the National Anthem. |
| 8.55 am | Welcome Address by Professor S. Sotheeswaran
(President, Institute of Chemistry Ceylon) |
| 9.00 am | Presidential Address: <i>"Role of Chemistry Research in National Development"</i> . |
| 9.30 am | Address by the Chief Guest, Professor Tina Overton
(Deputy Head of Department, Department of Physical Sciences, University of Hull, UK).
<i>"The Role of Chemistry Education Research in developing Graduates for the 21st Century"</i> . |
| 10.00 am | Presentation of Awards, Prizes and Certificates
Distinguished Services Award - Professor W S Fernando
Kandiah Memorial Award - Miss Pathira Kankanange Vinitha Ranji
Graduateship Examinations in Chemistry, Scholarships, Prizes and Awards
All Island Interschool Chemistry Quiz Contest |
| 10.15 am | Kandiah Award Lecture by Ms P K V Ranji
(The Open University of Sri Lanka)
<i>"Bioactivity Directed Chemical Investigation of Fungal Extracts : Citriquinones A & B from Penicillium citrinum and Butyrolactone I & (+)- Geodin from Aspergillus terreus"</i> . |
| 10.45 am | Vote of Thanks by Professor S. Mohandas (President Elect). |
| 10.55 am | Close of Ceremony. |
| From 11 am | Annual General Meeting (AGM): (for corporate members only; associate members can be present as observers). |
| 11.00 am | Registration of International Conference Participants. |

INTERNATIONAL CONFERENCE ON CHEMICAL SCIENCES 20-22 JUNE 2012

PLENARY, KEYNOTE AND INVITED LECTURES

Day 1 - Wednesday, June 20, 2012 at Waters Edge

Plenary Lectures

PL 1 9.00am - 9.30am

Role of Chemistry Research in National Development

S. Sotheeswaran

PL 2 9.30am - 10.00am

The Role of Chemistry Education Research in developing Graduates for the 21ST Century

Tina Overton

PL 3 1.30pm - 2.00pm

Atmospheric Chemistry and Climate Change

John Dyke

PL 4 2.00pm - 2.30pm

Global Food Trade and Laboratory Accreditation

Upali Samarajeewa

PL 5 2.30pm - 3.00pm

Harnessing Natural Products for National Development: Some Innovative Strategies

A. A. Leslie Gunatilaka

PL 6 3.00pm - 3.30pm

An Outstanding Contribution to Tertiary Chemical Education (over Four Decades) by the Institute of Chemistry Ceylon

JN O Fernando

Day 2 - Thursday, June 21, 2012 at Sri Lanka Foundation Institute

NATURAL PRODUCTS

Plenary Lecture

PL 7 8.30 am - 9.00am

Molecular Approach towards the Treatment of Ulcers, and MDR-Infections

M. Iqbal Choudhary and Atta-ur-Rahman

Invited Lecture

NPIL 1 9.00 am - 9.30am

Synthesis of Alkaloids Using a Chiral Auxiliary Cleavable by Metathesis

Claude Spino, David Gagnon, François Tremblay, Mélissa Arbour, and Sophie Lauzon.

Day 2 - Thursday, June 21, 2012 at Sri Lanka Foundation Institute Parallel Sessions

ENVIRONMENTAL CHEMISTRY

Keynote Lecture

KL 1 8.30am - 9.00am

Natural Toxins in the Environment and Human Health Implications

Wasantha A Wickramasinghe

Day 2 - Thursday, June 21, 2012 at Sri Lanka Foundation Institute Parallel Sessions

FOOD SCIENCE

Keynote Lecture

KL 2 8.30am - 9.00am

Innovations in Food Chemistry-Food Science for a Healthy Life Now and Beyond

Navam Hettiarachchy

(PTO)

Invited Lecture

FSIL 1 9.00am - 9.30am
The Food Processing Industry in National Development in Sri Lanka and the Role of Food Regulations
Malini Mallawaratchie

**Day 2 - Thursday, June 21, 2012 at Sri Lanka Foundation Institute
Parallel Sessions**

Keynote Lectures

KL 3 10.00am – 10.30am
Implication of some Research Findings for Teaching and Learning of Chemistry: Language, Visualization and 'Reality'
Robert (Bob) Bucat

KL 4 10.30am – 11.00am
Diagnostic Assessment in Chemistry Education
Mei-Hung Chiu

Workshop: 11.00 am – 1.00 pm
Some non-standard ways of developing deep Understandings, and of assessing understandings of students of chemistry
Lead by Professors Mei-Hung Chiu and Bob Bucat

**Day 3 - Friday, June 22, 2012
At Sri Lanka Foundation Institute**

NATURAL PRODUCTS

Invited Lecture

NPIL 2 8.30am - 9.00am
Oligomeric Proanthocyanidins from Tea Leaves – Separation, Structures and Biological Properties
N. Savitri Kumar

**Day 3 - Friday, June 22, 2012 at Sri Lanka Foundation Institute
Parallel Sessions**

NEW TECHNOLOGICAL DEVELOPMENTS

Keynote Lectures

KL 5 8.30am - 9.00am
Lanthanide-Based Nanomaterials for Biomedical Imaging and Therapy
Channa R. De Silva

KL 6 9.00am - 9.30am
Role of Micro Chemical Analysis in the Characterization of Materials and Understanding the Performance of the Material.
Vaidehi Ganesan

KL 7 9.30am – 10.00am
Scaling Up for Realizing Potential – Industrial R&D for Green Industrialization
Ajith de Alwis

Cover Page

The cover page shows the Graduate Chemists after the graduation at the 8th Convocation of the College of Chemical Sciences at Waters Edge. The photograph was taken by Mr. M Y R Perera, Graduate Chemist (2011). More formal photographs of the Convocation are on page 24.

PLENARY, KEYNOTE AND INVITED SPEAKERS

Professor S. Sotheeswaran



Professor Sotheeswaran is currently the Dean of the College of Chemical Sciences of the Institute of Chemistry Ceylon. He is also an adjunct professor at the Fiji National University. Professor Sotheeswaran has a Ph.D degree (1967) in the area of physical organic chemistry and a D. Sc degree (1987) in the area of Natural Products. Both degrees were awarded by the University of Hull, UK. He graduated with a B. Sc Honours degree from the then University of Ceylon, Colombo and served the University of Peradeniya during the period 1967-1985. He then moved to the University of the South Pacific and served as the Professor of Organic Chemistry and since 2009, he is an Emeritus Professor of the University of the South Pacific.

Professor Tina Overton



Tina Overton is Professor of Chemistry Education at the University of Hull. She worked in industry and in the National Health Service whilst completing her first degree by part time study. She then completed a PhD and postdoctoral work in heterogeneous catalysis. She joined the chemistry department at the University of Hull in 1992, first as a teaching fellow, then as lecturer, senior lecturer, and then as Professor. She has published on the topics of critical thinking, context and problem-based learning and their role in developing conceptual understanding and cognitive skills and the development of problem solving skills. She has published learning resources which have been adopted in many institutions and has co-authored several textbooks in inorganic chemistry. She was Director of the national Higher Education Academy UK Physical Sciences Centre which supported teaching and learning across chemistry, physics and astronomy. She has been awarded the Royal Society of Chemistry's HE Teaching Award, Tertiary Education Award and Nyholm Prize and is a National Teaching Fellow and Senior Fellow of the Higher Education Academy.

Professor John Dyke



John Dyke is an expert on the electronic structure and reactivity of reactive intermediates in the gas-phase. His research focuses on the role of reactive intermediates in atmospheric chemistry as studied experimentally using spectroscopy and kinetics, and supported computationally by electronic structure calculations.

He was an undergraduate at University College Wales Cardiff, and graduated with a first class honours degree. He won the Isaac Roberts Award for the best science student in the University of Wales.

He studied for a PhD under the supervision of Dr Noel Hush in Bristol University. The topic of this research was the study of electron transfer reactions with spectroscopic methods. He then worked as a research chemist for Ciba-Geigy on the development of a new colour film and process.

He was then appointed as a post-doctoral fellow with Professor Neville Jonathan at Southampton University. He was later appointed as a lecturer in Physical Chemistry at Southampton and in 1988 he was appointed to a Chair in Physical Chemistry.

He is a visiting Professor at Manchester, Lisbon, Rome, Hong Kong and Herbei Universities. He is a member of the project assessment panel at the Elettra synchrotron (Trieste), and chair of the management committee of the EPSRC National Service in Computational Chemistry.

Professor Upali Samarajeewa



Professor Upali Samarajeewa is a Professor Emeritus in Food Science & Technology, University of Peradeniya, Sri Lanka. He obtained a B.Sc. in Chemistry and a Ph.D in Microbiology from the University of Sri Lanka, Peradeniya. He was a Professor in Food & Science Technology at the University of Peradeniya. He is a Fellow of the Institute of Chemistry Ceylon; Institute of Biology Sri Lanka and National Academy of Sciences Sri Lanka. He worked as a Consultant to UNIDO and ADB on Food Safety & Inspection and in Food Processing. He received the General Research Committee Award of the Sri Lanka Association for the Advancement of Science (1992), Gold Medal of the Institute of Chemistry Ceylon (1993) for the Outstanding Research contribution to Sri Lankan

Science, Research Merit Award of the National Foundation of Science 1999, National Award for Agriculture Research, Council for Agricultural Research Policy of the Ministry of Agriculture (1999). He has published over 100 publications in reputed journals on aflatoxins & polycyclic aromatic hydrocarbons in foods, histamine in fish and coconut sap products. He was a member of the Board of Management of the Postgraduate Institute of Agriculture and a member of the advisory committees of Ministry of Health, Ministry of Science & Technology and Ministry of Plan Implementation (Nutrition division). He was also a member of the Editorial Board of the Journal, Food Microbiology (1986-1996) and co-opted member of the Mycotoxin Working Group in the Food Chemistry Commission of the International Union of Pure and Applied Chemistry (1990-1992).

Professor Leslie Gunatilaka



Leslie Gunatilaka is Professor, School of Natural Resources and the Environment and Director of the Natural Products Center of the University of Arizona (UA). He earned his B.Sc. in Chemistry from University of Sri Lanka, Peradeniya, and Ph.D. in Organic Chemistry from Imperial College, University of London, under the guidance of the Nobel Laureate, Professor Sir Derek Barton, FRS, and has carried out postdoctoral research at Imperial College (UK), Stanford University (USA), and Virginia Tech (USA). He is a Fellow of the Academy of Sciences for the Developing World (TWAS), National Academy of Sciences, Sri Lanka, and the Institute of Chemistry Ceylon. Dr. Gunatilaka has to his credit over 200 peer-reviewed research publications and book chapters and over 150 communications in natural product science. He is a recipient of the Institute of Chemistry Ceylon Gold Medal (1983), Sri Lankan Presidents Award for “creating a center of excellence in natural products research at the University of Peradeniya, Sri Lanka” (1987), CaPCURE award for “dedication to ending prostate cancer as a risk for all men and their families” (2000), Research Faculty of the Year Award of the UA College of Agriculture & Life Sciences (2003), UA Asian American Faculty, Staff & Alumni Association Outstanding Faculty Award (2005), and UA Leading Edge Researcher Award for Innovative Research (2012). He has delivered over 100 invited lectures worldwide and was the Keynote Speaker and the Guest of Honor at Chemtech-2007, an International Conference organized by the Institute of Chemistry Ceylon.

Emeritus Professor J N Oleap Fernando



Professor JN Oleap Fernando presently serves as the First Honorary Rector of the College of Chemical Sciences of the Institute of Chemistry Ceylon after serving as the First Honorary Dean since its establishment in 2001. He retired from the University service in 2009 having served the Sri Lankan University system over 43 years at the Universities of Peradeniya and Colombo for 18 years and as the Chair in Chemistry for over 25 years at the Open University of Sri Lanka. He served as the Dean of the Faculty of Sciences at the Open University of Sri Lanka for 6 years. He has been actively involved in the activities of the Institute of Chemistry Ceylon over the past four decades in numerous capacities. These include: President (1984-1986), General Secretary (1978-1983), Council Member (35 years), Chairman of Admissions and Ethical Practices Committee; House and Finance Committee; Educational and Academic Board. He has also functioned as the Lecturer/Coordinator of the Diploma in Laboratory Technology Programme and Graduateship Programme in Chemistry over the past four decades. He was also the Founder Coordinator of the Australian National Quiz Competition in Sri Lanka. He initiated the publication of the Chemistry in Sri Lanka magazine (now in 28th year) and Inter School Chemistry Quiz (now in 26th year) when he was the President of the Institute of Chemistry. He has represented the Institute of Chemistry at the Federation of Chemical Societies for 20 years and has served on its Executive Committee and as the Director of the Asian Chemical Education Network. Professor Fernando also served on the first independent Public Service Commission in Sri Lanka from 2002 to 2005.

Professor Muhammad Iqbal Choudhary



Dr. M. Iqbal Choudhary is a Professor of Organic Chemistry and Director at International Center for Chemical and Biological Sciences (H. E. J. Research Institute of Chemistry and Dr. Panjwani Center for Molecular Medicine and Drug Research). He is among the most prominent scientists of Pakistan, recognized for his original contributions in the fields of natural products and bioorganic chemistry. He has written and edited 24 books. He is also the author of over 670 *research papers* and chapters in reputed international science journals. He has served as a visiting faculty in many prestigious universities. Dr. Choudhary is instrumental in the discovery of a large number of fascinating molecules with potential therapeutic applications. More specifically his research group has

discovered and studied new inhibitors of clinically important enzymes. Prof. Choudhary has won several national and international awards such as *Hilal-e-Imtiaz*, *Sitara-e-Imtiaz* and *Tamgha-e-Imtiaz* by the President of Pakistan, Pakistan Academy of Sciences Gold Medal and the Third World Academy of Sciences Young Scientist Prize. He received the prestigious title of “Distinguish National Processor” from the Higher Education Commission in 2004. He is a member and fellow of many prestigious societies including Fellow of the Third World Academy of Sciences, Islamic Academy of Sciences, Chemical Society of Pakistan, Royal Society of Chemistry (London) and LEAD-International.

Professor Claude Spino



Prof. Spino graduated from the Université de Montréal (Montréal, QC, Canada) in 1983 and then joined the University of British Columbia (Vancouver, BC, Canada) for his doctoral studies (1983-1988) where he carried out the synthesis of the C16-C32 fragment of the polyether ionophore antibiotic ionomycin under the supervision of the late Prof. Larry Weiler. Claude Spino then joined the group of Prof. Pierre Deslongchamps for his post-doctoral fellowship. There, he helped to develop the anionic polycyclisation methodology towards triterpene natural products. He started his academic career at the University of Victoria, BC, in 1990 where he engineered a Diene-Transmissive Diels-Alder synthetic route to the anti-cancer triterpenes 'quassinoids'. In 1995, The Université de Sherbrooke lured him back and he rose to the rank of Full professor (professeur titulaire) in 2000. He is the principal author of more than 50 publications, a book, a book chapter, and 3 patents. His research interests include target oriented syntheses of natural products, the development of synthetic methodologies, mechanistic studies of reactions, and the isolation and characterisation of natural products.

Dr. Wasantha A Wickramasinghe



Dr Wasantha Wickramasinghe (Wasa) is a Senior Research Fellow at the National Research centre for Environmental Toxicology, at University of Queensland. Wasa graduated from the University of Peradeniya in 1976 with honours in Chemistry and completed his doctoral studies at Concordia University in Montreal, Canada. After completing a post doctoral training program at the Research School of Chemistry of the Australian National University on structural studies of hydrido metal complexes, Wasa joined the Bond University for a short period. In 1992 moved to the Centre for Drug Design and Development of the University of Queensland to study drug-protein interactions at atomic resolution. In 1997 Wasa moved to the National Research centre for Environmental Toxicology. Wasa's main research interests are natural toxins and their interactions with biological systems.

Dr. Navam Hettiarachchy



Dr. Navam Hettiarachchy, a Fellow of the Institute of Food Technology, is a University Professor of Food Chemistry in the Department of Food Science and Institute of Food Science and Engineering at the University of Arkansas, USA. Professor Hettiarachchy earned her B.S in Chemistry (Madras University), M.S in Biochemistry (Edinburgh Medical School, Scotland), Ph.D in Molecular Biochemistry (University of Hull, England) and Postgraduate Diploma in Human Nutrition (Indian Council for Medical Research). Professor Hettiarachchy heads an integrated protein, bioactives, nutraceuticals and functional foods, and food safety research program. Her research focus is on both fundamental (Chemistry and mechanisms) and applied aspects and she is recognized globally as an outstanding researcher in the areas of her expertise including cancer (stem cell research), diabetes, obesity and Alzheimers. Her research efforts led to the creation of a start-up company, Nutraceutical Innovations LLC in 2007. She has published over 120 peer reviewed journal articles, delivered over 260 presentations including 65 invited presentations and over 280 abstracts. Dr. Hettiarachchy's original research resulted in having patents with international and US scientists. She is an invited advisor to Chinese government and to the Asian Productivity Organization (APO) to train scientists in developing countries. She has received several prestigious research, teaching and service awards including the John White Outstanding Research Award in 2008.

Mrs. Malini Mallawaratchie



Malini Mallawaratchie obtained a First Class Honours degree in Food Technology from the FAO Food Technology Training Centre, Central Food Technological Research Institute (CFTRI), Mysore, India affiliated to the University of Mysore in 1975 on a Colombo Plan Scholarship after completing her Bachelors Degree in Natural Sciences at the University of Colombo in 1971. She also has a Diploma (with Distinction) in Food Sector Technology and Management from the Netherlands International Institute of Management, Delft, Netherlands in 1989. She is an Emeritus Professional Member of the Institute of Food Technologists, USA. She is a Chartered Chemist and Member of the Institute of Chemistry, Ceylon since 1980.

After a few years industrial experience at a major fruit and vegetable processing industry, she served for 24 years as a Research Officer at the Food Technology Section of the Industrial Technology Institute (ITI).

Since 1998 to date, on invitation, she is the Food Technologist of the Food Advisory Committee (FAC) of the Ministry of Health which is the National Committee responsible for Food Safety in Sri Lanka. She also served on the Panel which reviewed and redrafted the Sri Lanka Food Act and its regulations. She is involved in the committees formulating National Food Standards at the Sri Lanka Standards Institute and also served as a Technical Expert for high risk foods in Quality Audits for ISO 9000 and 22000.

Mrs Mallawaratchie is a visiting lecturer at post graduate and undergraduate level at many Sri Lankan Universities in various fields of Food Technology for over 35 years. She also lectures in Food Technology at the Graduateship Course of the College of Chemical Sciences, Institute of Chemistry while having lectured in the Institute's Laboratory Technician Certificate Course for nearly 20 years.

Professor Robert (Bob) Bucat



Professor Robert (Bob) Bucat, BSc, BEd, PhD is a physical chemist whose current research interests are in the challenges of teaching and learning chemistry. With a focus on education at the tertiary level, his interests include (i) the complexity of the task of learning (and teaching) chemistry, (ii) content-specific pedagogical knowledge, (iii) the importance of visual imagery in understanding chemistry concepts, and (iv) issues of language and communication. He has supervised numerous PhD students, and is a textbook author and co-editor of the *Australian Journal of Education in Chemistry*. He was a titular member of the Committee on Chemical Education of IUPAC, inaugural winner (2010) of the Fensham Medal of the Royal Australian Chemical Institute for outstanding contribution to education in chemistry, and was declared a "Living Luminary of Australian Chemistry" in 2011 by *Chemistry in Australia*.

Professor Mei-Hung Chiu



Mei-Hung Chiu is a Professor of Science Education at Graduate Institute of Science Education (GISE) of the National Taiwan Normal University (NTNU). She has a BS in Chemistry (National Taiwan Normal University), Ed.M. and Ed.D. from Harvard University. She taught as a physical science and chemistry teacher in secondary schools for three years before serving as a science education researcher and professor at the university level. She has published articles about diagnosing students' conceptual understanding and changes as well as mental models in science learning in international reputed journals. She was the President of the Association of Science Education in Taiwan (2008-2010), International Coordinator for National Association for Research in Science Teaching (NARST) in the US (2008-2010), and Project Director of Asian Chemical Education Network (ACEN) of Federation of Asian Chemical Societies (FACS) (2009-2011). Currently, she is an Associate Editor of *Journal of Research in Science Teaching* (JRST, SSCI journal), Chair of Committee on Chemistry Education (CCE) of International Union of Pure and Applied Chemistry (IUPAC), and Chairperson of Committee on Education Affairs of Chemical Society in Taipei (CSLT), Taiwan. She is also engaged in international projects on Young Ambassadors for Chemistry (YAC) to promote public understanding of chemistry, visualization in chemistry and Flying Chemists Program (FCP) sponsored by CCE of IUPAC. She was a recipient of the Distinguished Contribution to Chemical Education Award from the Federation of Asian Chemical Societies (FACS) in 2009.

Professor Savitri Kumar



Prof. Savitri Kumar is a Research Professor working with the Natural Product Research Group at the Institute of Fundamental Studies, Kandy. She retired from the University of Peradeniya in 2008 after 43 years of teaching and research. She was appointed an Emeritus Professor, Faculty of Science, University of Peradeniya in 2009.

Savitri Kumar, Ph. D. Birkbeck College University of London (1971), and B.Sc. Chemistry Special University of Ceylon (1965), was the recipient of several research grants – from the National Science Foundation of Sri Lanka, International Foundation for Science, Stockholm and the International Program in Chemical Sciences (IPICS), Uppsala University. She was elected a Fellow of the National Academy of Sciences Sri Lanka in 1991. She has also been awarded the Sri

Lanka Presidential awards on several occasions and the Institute of Chemistry Gold Medal in 1994. She was a Council Member, National Research Council of Sri Lanka during 1999-2004. She has 47 publications in peer reviewed scholarly journals and more than 70 research communications presented at International/National symposia. She continues to be actively involved in Natural Product research at the IFS, Kandy.

Dr. Vaidehi Ganesan



Dr. Vaidehi Ganesan is working as a senior scientist/ engineer at Indira Gandhi Centre for Atomic Research, Department of Atomic Energy, Kalpakkam. She was invited to work as a guest scientist in a European project (University of Vienna, 1995-96). Dr. Vaidehi Ganesan has extensively used electron optics techniques and contributed to the fields of diffusion, phase transformations, structure-property correlations and corrosion of structural materials and surface treatments to improve the performance etc. Her current interests include high burn up issues of nuclear materials (Irradiation damage, phase stability, fuel/clad interactions etc), design and development of new alloys, failure analysis and structural integrity assessment of components using NDE techniques, stress

& strain analysis, real time and online nanosensor development for defect and strain measurements on engineering components etc. She is collaborating with Mechanical/ Design Engineers of IGCAR on the projects related to structural integrity & damage assessment of engineering components.

Dr. Channa R. De Silva



Dr. Channa R. De Silva is an Assistant Professor of Chemistry at Western Carolina University, Cullowhee, North Carolina, USA. He obtained his PhD in Chemistry at University of Arizona, Tucson, Arizona, USA in 2007. Dr. De Silva completed his Post-doctoral studies in the Pacific Northwest National Laboratory (PNNL), Richland, Washington, USA and the Bio5 Institute, University of Arizona, Tucson, Arizona, USA. His research expertise includes inorganic, bioinorganic, and bioanalytical chemistry, nanotechnology, lanthanide chemistry, material syntheses, computational chemistry, and nuclear medicinal chemistry. His current research is focused on developing lanthanide-based luminescence chelators and nanomaterials for biomedical imaging applications including cancer imaging. Dr. De Silva's hobbies include

playing musical instruments and conducting chemistry magic shows.

Professor Ajith de Alwis



Prof. Ajith de Alwis focuses upon research areas that include 'Triple Bottom Line approach for the Process Industry', Bioenergy systems, Industrial Biotechnology, Integrated Solid Waste Management, Food Processing Systems and Cleaner Production. He completed his Ph.D. at the University of Cambridge, UK following his B.Sc. (Eng) degree at the University of Moratuwa, Sri Lanka. He also has a MBA from Postgraduate Institute of Management, University of Sri Jayewardenepura, Sri Lanka and elected as a Fellow of the National Academy of Sciences Sri Lanka in 2010. A Professor at the Department of Chemical and Process Engineering at the University of Moratuwa, he is also the Director of the UOM-Cargills Food Process Development Incubator. Prof. de Alwis is a member of

Cambridge Philosophical and Commonwealth Societies, the American Institute of Chemical Engineers, the Editorial Board of the European Journal of Food & Bioproducts and the Lanka Biogas Association – of which he is the founding President. He was a Post doctoral research fellow at the University of Reading and a Visiting Scientist at the Indian Institute of Science in Bangalore. He serves in many national committees including the CEA's

committee on Implementation of Basel Convention, NSF's National Nanotechnology Committee and SLSI Management Committee on Standards. He served as a Science Team Leader at Sri Lanka Institute of Nanotechnology from inception to 2011 and is the project team leader on establishing a regulatory framework for Nanotechnology in Sri Lanka and IDRC Project covering India, Pakistan and Sri Lanka.

As a guest columnist to DailyFT writes on every other thursday on his thoughts and ideas on science, technology and national development (www.ft.lk).

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Distinguished Service Award, 2012 - Professor W S Fernando, *C.Chem., F.I.Chem.C*



Professor W S Fernando obtained B.Sc. Hon. In Chemistry from the University of Ceylon (1967) and PhD in Chemistry from the University of Leicester UK (1972). Since then he has continued his career in teaching as a lecturer, Senior Lecturer, Associate Professor, Professor and Senior Professor to the date of his retirement (2010-Feb). In addition to his academic work, Prof. Fernando was also involved in administration work in the University. He was the Head, Department of Chemistry (1990 – 1998), Dean Faculty of Applied sciences (1998 – 2004), the first Deputy Vice-Chancellor (student affairs) and also served as the acting Vice-Chancellor on several occasions. Considering his dedicated service to the University as a whole, University honored him with “Professor Emeritus” status on February 2012.

He joined the Institute of Chemistry as a visiting lecturer in 1984 and has continued his service as a lecturer in Physical, Inorganic and Mathematics courses since then. He served as a member of the council for eight consecutive years, member of the academic board, Chairman of Royal Society of Chemistry (Sri Lanka) and was also the President of the Institute of Chemistry (2002/2003).

Prof. Fernando has been awarded the long service award by the Royal Society of Chemistry, UK in recognition of the continuous and dedicated service for 20 years and as the chairman for three consecutive years. He was also awarded a certificate of appreciation by the Sri Lanka United Nations Friendship Organization (SUNFO) for excellent service rendered as a Human Resource and Membership Development.

In recognition of the yeoman service rendered towards the activities of the institute in an honorary capacity the Council unanimously decided to award Prof. W S Fernando the “Distinguished Service Award”.

Benevolent Fund Benefits for Members

- **Long life** Benefits: Rs. 10,000 (over 70)/ Rs. 15,000 (over 75)/Rs. 20,000 (over 80)
- **Critical illness** benefits (upto Rs. 50,000)
- **International travel** for conferences (upto Rs. 50,000)
- **Balance 50% of Tuition fees** of any member's child following the Graduateship Programme (Since 50% concession is already by CCS, this will amount to a 100% waiver)

Any member who has paid membership fees for life (after 3 years of such payment) is entitled for these benefits.

All members are advised to pay the membership fee for life and become beneficiaries.

Graduate Chemists Welfare Fund

This fund has been established with effect from 1-1-2012. The principal benefits towards CCS Graduate Chemists would be,

- a) To provide partial assistance towards international travel of those proceeding abroad for PG degrees (once a life time)
- b) To provide partial assistance towards registration fees in respect of IChemC/CCS events such as International Conferences (Preference for those presenting papers)
- c) To provide assistance towards registration fees for IChemC/CCS training seminars etc.
- d) To provide partial assistance towards activities of the Alumni Association.

Note: Depending on the demand, Graduate Chemists who maintain positive content and participate in IChemC/Alumni activities will get preference for the above mentioned benefits.

Role of Chemistry Research in National Development

Professor S. Sotheeswaran

President, Institute of Chemistry Ceylon, Rajagiriya

National development means economic growth, with job opportunities for those who seek employment and a sufficient income for all families in the country. It also means a satisfactory standard of living—in other words, satisfactory levels of food, clothing, shelter, healthcare, education and recreation for all.

The most important factor here is education. We cannot have all the good things in life without education—either formal or informal, or both. And we cannot have quality education for the young, if unemployment, anxiety and insecurity are the lot of parents and guardians. And we cannot have quality education, if malnutrition and ill health are the lot of the young.

The theme of this conference is: Chemistry Research in National Development. Can Chemistry Research in Sri Lanka contribute to the betterment of life for its people? I hope to persuade you that it has done so in the past, and can do more in the future.

Before we can have quality Chemistry Research, there must be quality Chemical Education. Research is built slowly and steadily, by researchers, upon research work already done by earlier researchers. No less a person than Isaac Newton said that he was able to see far because he stood on the shoulders of giants. If Newton, himself a giant, acknowledged his debt to his predecessors we too should be aware of our indebtedness to our forerunners.

We know that much Chemistry Research has already been done, and that there is already a great store of discoveries, information and knowledge that is available in the field of Chemistry. This has to be imbibed by prospective researchers, through Chemical Education, before they can undertake original/innovative research.

We Sri Lankans can take pride in the fact that Chemical Education, in schools, state universities and private institutions of higher education, is of a high standard in our country. The Institute of Chemistry Ceylon, has been imparting Chemical Education, in Sri Lanka, since 1980, and has produced more than 800 Graduate Chemists, many of whom have been involved in Chemistry Research in the last 25 years or so.

We also know that, in Sri Lanka, much Chemistry Research has already been done, and continues to be done, mainly at the postgraduate level, at Universities, in Research Institutions, and in Industries.

In addition, we have a fund—a veritable treasure trove—of traditional knowledge in the field of

Chemistry. Some of this age-old knowledge is unique to Sri Lanka. The rest of it, we share with our neighbours, particularly with India.

How do we, today, build on the past instead of resting on our laurels? How do we pay obeisance to the past, yet break away and become innovative? I believe that a chain of Chemists working in series (rather than in isolation or in competition) can contribute a great deal to the Chemistry Research-Technological Application Chain:

- (1) INITIAL STAGE - conception (of new approach); bench-work; patenting
- (2) INTERMEDIATE STAGE - application of findings; product development; quality control; market research;
- (3) FINAL STAGE - follow up by monitoring and assessing effect of application on health, environment etc.
- The Final Stage is not the End! The Next Chain will commence with the conception of yet another novel idea / modification / innovation / improvement.

Let us now consider Chemistry Research and human development in the global context. Throughout the modern period of its development, Chemistry Research has contributed enormously both to broad improvements in human wellbeing and to the wealth of nations and individuals. A few landmark examples are worth discussing briefly.

Discoveries in Electrochemistry provided the foundation for the industrial transformation of many materials and, in particular, for the production of metals such as aluminum, and also important industrial starting materials such as caustic soda and chlorine. This is a good example of fundamental research in electrochemistry having applications that could not have been known to, or predicted by, the original fundamental researchers.

Let us consider aluminium in some detail. Students of Chemistry know that aluminium is an abundant element—the third most abundant on earth, after oxygen and silicon. Aluminium is found almost everywhere and in everything including that familiar, common substance, clay (*matti* in Sinhala; *kalimunn* in Tamil.)

Today, aluminium is a useful, versatile and widely used element. But the world had to wait till the 19th Century, until Charles Martin Hall in USA and H. T. Heroult in France, independently discovered the

electrolytic method of extracting aluminium from its ore, alumina (aluminium oxide).

Humans extracted, and used, iron and copper and tin and silver and other metals centuries ago, mainly by smelting the ores of these metals. I will not go into the Chemical reasons why aluminium could not be extracted in a pure, uncontaminated state, through smelting, by our distant and ancient ancestors.

Aluminium had to wait till electricity was harnessed. Aluminium had to wait, dormant in the earth and bound to other elements, until it was released by the electrolytic method. The extraction of aluminium is a good example of interdisciplinary cooperation contributing to scientific advancement.

The electrochemical extraction of aluminium is also an excellent example of a chemical discovery contributing to an explosion of applications in hundreds of fields. This has brought wealth to individuals and to nations and employment and prosperity to untold numbers of people.

The electrochemical extraction of aluminium may be “foreign chemistry”, or “imported chemistry”, but we in Sri Lanka have benefited by it. To cite just one single, simple example: the so called “rubber dishes” are “aluminium dishes” used by our very own rubber industry to coagulate rubber latex. For this use, the lightweight, yet sturdy, aluminum dish has been found to be unrivalled by any substitute.



Figure 1: Aluminium Dish for coagulating rubber latex

We Chemists are good at concocting slogans. Maybe I should concoct one and broadcast it right here: **“Chemistry is Without Borders—Chemistry is International”**

Aluminium is not the only superstar in International Chemistry Research; there are numerous other superstars that shine brilliantly in International Chemistry Research. These others too have led to individual, then national, and then international development.

Some of this International Chemistry Research and some of the Chemical discoveries are ancient—we don't even know who the first researchers were, but the improvements and developments and innovations are modern and new.

The following is an example of Chemistry Research that is ancient, has had an international impact, and a long history of innovation.

Eye-sight itself, as well as colour perception, is Chemistry. Humans have been fascinated by the colours of nature from very ancient times. Instead of merely admiring the colours in nature, they have tried to impart colour to their lips, their nails, their skin, their clothes, their walls, their drawings and so on.



Figure 2: TATTOO (the word is of Polynesian origin) on the backs of a man & a woman and other examples of painting

Who first transferred colour from a likely source to a drab surface? We do not know. Archaeologists can give us evidence of unique usage from every culture.



Figure 3: coloured paintings

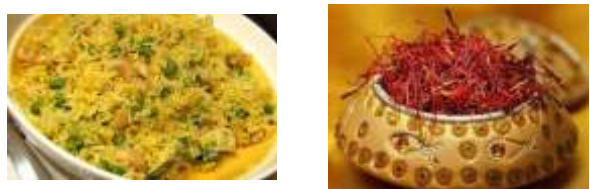


Figure 4: FOOD COLOUR-Saffron

(According to the bible, saffron was used to dye cloth. Saffron has imparted a yellow colour to the rice in the bowl; the strands of saffron are red.)



Figure 5: COLOURFUL CLOTHES

Dyes and pigments (or paints) are called colourants. Archaeologists tell us that dyeing was a widespread industry in the Egyptian, Mesopotamian and Indus Valley Civilizations, more than 5,000 years ago. Even at that ancient time, the processes used were complex. The colorants were of mainly vegetable and mineral sources—that is, organic and inorganic sources.

Two of the ancient dyes, indigo (blue) and alizarin (red), once obtained from the indigo and madder plants respectively, are still in commercial use. However, today, we use synthetic indigo and synthetic alizarin, which Organic Chemists have synthesized from chemicals derived from coal tar. The methods inherited from those ancient civilizations remained in use until the mid 19th century.

The first synthetic organic colourant was produced by P. Woulfe (Germany), who produced picric acid (yellow) in 1771. At first it was used to colour glass, and then as a mordant to fix dyes and also as a dye. In 1856,

William Henry Perkin (Britain) produced a synthetic organic dye that imparted a purple (mauve) colour to textiles.

1856 was the beginning of the end for natural dyes. Natural dyes were soon displaced by synthetic organic dyes. Inorganic dyes were abandoned altogether. In 1856, only a dozen or so synthetic dyes were available. By the 1960's, there were several thousand chemically distinct dyes. Colours and shades not found in nature were created by Synthetic Organic Chemists.

I am reluctant to take leave of the subject of dyes without mentioning a dye derived from an insect and discovered by the ancient Phoenicians. The insect is cochineal; The colour is purple—not a soft purple but a reddish purple that is more scarlet than purple; and the name is “ROYAL PURPLE”.

This purple (or scarlet) was very expensive. It was also a jealously guarded trade secret. Only kings and queens and their children could afford to wear this colour, and so, to this day, it is called “ROYAL PURPLE”. However, Synthetic Organic Chemists have produced royal purple (or scarlet) out of laboratory chemicals; we can all wear royal purple now if we wish to (even though Phoenicia and the Phoenicians are no more).

What I am trying to say (with these very few examples) is that there is no end to Chemistry Research and no borders to it. Today, it is customary to talk of traditional, or indigenous, knowledge and of patenting it. This is a good thing. However, at the same time, all people are the inheritors of the fruits of Chemistry Research anywhere and at any time—it is our birthright.

At this point, I must say that many of our (Sri Lankan) chemists working in foreign laboratories in foreign countries have been involved in Chemistry Research that has had a worldwide impact.

Today, we are in the age of rational drug design, drugs that target specific organs and drugs that block the damage done by chemicals produced during metabolic disorders in the body. At present, this kind of sophisticated Chemistry Research is possible only overseas.

Recently, the Institute organized what turned out to be a very exciting and illuminating symposium on “DRUG DISCOVERY”; it was organized by the alumni of the College of Chemical Sciences and The University of Texas, at Arlington, to felicitate the Honorary Rector of the College of Chemical Sciences, Prof. JNO Fernando.

The title of the symposium says it all: The Drug Discovery Process and Research Opportunities for Sri Lankan Scientists.

Sri Lankan Chemists working for foreign multinational pharmaceutical companies, overseas, and in

University Chemistry Departments, overseas, with links to the pharmaceutical industry, shared their experiences with Chemistry students.

If I may pick out just one speaker out of the many distinguished speakers, I would like to tell you that Dr. Anura Dantanarayana worked for the pharmaceutical giant Alcon and had a hand in designing drugs. One particular eye ointment made by Alcon, namely Azopt, is one of the many Alcon products sold worldwide, and is prescribed and used in Sri Lanka as well. This is an example of Chemistry Research done by our own Chemists in foreign countries that has benefitted the world and us.

In passing, and very briefly and sadly, I must say that there have been accidents and disasters in Chemical Research, and the Industrial Application thereof. I have only to mention the name of the synthetic chemical tranquilizer “Thalidomide” to create a shudder. Such disasters mean that we (chemists, industrialists, governing authorities and consumers) have to be more alert, more careful, more demanding, more stringent and more responsible in future.

Now let me get back from international roaming to Chemistry Research in Sri Lanka and its Role in National (that is, in Sri Lankan,) Development.

It is well known that essential oils and perfumes have been produced in almost all countries from very ancient times. Techniques such as expressing, distillation and solvent extraction have been used for centuries with skillfully designed, and ingeniously constructed, equipment. Essential oils—a gift of nature found mainly in plants—have been used in food and in medicines down the ages.

Today, the essential oil and perfumery business is huge; and it contributes to the prosperity of individuals and nations. Business houses carry out their own research continuously in order to find new sources, to create synthetic versions of natural aromatic compounds, to improve products and to remain competitive.

As an example of Chemistry Research and its link with National Development in Sri Lanka, I would like to draw your attention to a company called “Link Natural Products” founded in 1982. The goal of the company is to manufacture (using hygienic and effective modern technology) essential oils and herbal preparations from local raw materials—in other words, the industrial utilization of medicinal plants and essential oils. The founders are a scientist turned technocrat and industrialist, Dr. Devapriya Nugawela, and his engineer friends, Siripala Jayasinghe and Wimuw Jayawardhane.

The firm was helped by Prof. R.O.B Wijesekera, distinguished world-renowned scientist [former Head/Natural Products at the Ceylon Institute of

Scientific and Industrial Research (CISIR), later a member of the World Health Organization (WHO) staff, and then Special Technical Adviser to the Chemical Industries Branch, Department of Industrial Operations of the United Nations Industrial Development Organization (UNIDO)], and advised by Dr. Lakshman Jayewardhane, a knowledgeable expert in Natural Products Chemistry, who was attached, at that time, to the Ceylon Institute of Scientific and Industrial Research.

I would like to mention the fact that the first export of “Link Natural Products” was a 200kg consignment of nutmeg oil to an essential oil buyer in Germany. Dr. Nugawela has described the difficult beginnings of “Link Natural Products”. Today, one of its popular herbal pharmaceuticals, “Samahan”, is a household name in Sri Lanka.

“Link Natural Products” is just one example of an industrial chemical organization in Sri Lanka that plays a part in Chemistry Research, and also provides employment, improves healthcare with herbal pharmaceuticals based on indigenous knowledge, and contributes to individual and national prosperity.

There are many other examples of small and large firms that do the same thing in various ways and in various degrees.

The political and economic climate in Sri Lanka today is conducive to motivated and adventurous young Chemists participating in Chemistry Research and in National Development. Those who have endeavoured and succeeded in the past are proof that Chemistry Research has played a role in National Development in Sri Lanka; and they are role models for young Chemists, who I hope will continue this tradition.

At this point, I would like to publicize the fact that His Excellency The President honours innovators and inventors through the annual Presidential Awards for Inventions. The Sri Lanka Inventors' Commission, under the aegis of the Ministry of Technology and Research, oversees the selection of winners. This is encouraging news for all potential achievers in our country.

I will be failing in my duty if I do not devote some time to one of our most valuable crops and profitable exports—TEA.

The Tea Research Institute (TRI) at Talawakele, established in 1925, is a leading research institution in Sri Lanka. The Biochemistry Division of TRI conducts studies on the Chemical and Biochemical aspects of tea. A few of the contributions of TRI scientists in the areas of NOVEL CONSUMER PRODUCTS, ENHANCED PRODUCTS AND NATIONAL DEVELOPMENT are given below:

- Obtained patent for the preparation of tea-wine.
- Obtained patent for the discovery of anti-fungal

activity of black tea components, catechins and theaflavins, against the fungi - *Candida albicans*, *C. parapsilosis*, *C. tropicalis*, *C. Krusei* and *C. glabrata*

- Extraction of protein from spent and refuse tea by membrane filtration technique. This is a commendable way of solving a waste disposal problem. Not yet commercially applied.
- Established new medicinal uses of tea and validated claims of medicinal uses, thus boosting the reputation of “Ceylon Tea”.

A remarkable achievement of TRI Chemists is safeguarding the reputation of “Ceylon Tea” by estimating and regulating the pesticide residue levels in tea. On the one hand, we need pesticides for better crops and for better crop yields; on the other hand, we need to ensure that residues are absent or present well below hazardous levels in the consumer product. Every Sri Lankan expects TRI scientists to fiercely guard the worldwide reputation of “Ceylon Tea”. And we should be grateful every time they do it. In this connection I would like to add that TRI scientists are always alert, and they detect and report additives and adulterants, even if these are not hazardous to health. For example, beetroot flakes, added to tea, enhance the bulk and enrich the colour, and are not a health hazard. However, they are hazardous to the reputation of “Ceylon Tea”, and TRI scientists have discouraged the practice. We should be thankful to them.

I shall not discuss research in the RUBBER and COCONUT industries in detail. I will merely indicate past achievements and future possibilities by emphasizing what is well known:

Authorities and scientists established the Rubber Research Institute (RRI), at Agalawatte, to promote all categories of rubber research, including Chemistry Research. The RRI emerged from a casual and informal engagement, in 1909, by a group of rubber planters in Kalutara, of a Chemist, to study the coagulation of rubber latex.

Researchers at the Coconut Research Institute (CRI), established in 1928, have served the coconut industry in its heyday, and are continuing to serve, though the coconut export industry has seen better days and is struggling to survive now. The way forward is to develop non-traditional exports derived from the bounteous coconut tree.

For example coconut shell is a good source of polyphenols (such as Lignin). These can be converted to Vanillin. One of the Graduate Chemists from the Institute is planning to work on the commercial use of coconut shells to produce synthetic vanillin. The world demand for this flavouring substance is very great and only 10% can be supplied by natural vanilla.

I have highlighted Tea-Rubber-and-Coconut

Research at TRI, RRI and CRI, because, as every Sri Lankan knows, our prosperity depended heavily on these three crops in the past.

Today, in Sri Lanka, there are many new industries and non-traditional exports; I am justified in saying that the number of researchers, the number of areas of study, and the number of findings that end in practical applications are numerous.

However, I must mention the following: The Ceylon Institute of Scientific and Industrial Research known as CISIR (now the Industrial and Technological Institute, known as ITI) has always fostered research that is focused on applications in commerce and in industry, so that the ultimate outcome is economic development and prosperity.

WASTE DISPOSAL → USE OF “WASTE” AS RAW MATERIAL

We, at the Institute, have isolated varying yields of vegetable oils from several inedible and “useless” local seeds (this work was made possible by foreign grants). Mention must be made of the substantial amounts of citrus seeds (orange, lime, lemon, cumquat, mandarin, grapefruit) that are disposed of as “waste” every day in Sri Lanka. We have shown that a “healthier” cooking oil (with a higher percentage of poly-unsaturated fatty acids) can be manufactured from citrus seeds. “Citrus Cooking Oil” awaits an enterprising producer.

PINEAPPLE WASTE → ALCOHOL

In Sri Lanka, pineapples are abundant and popular. The fruit is used to make jam and juice. Studies at the Institute have shown that the peel and core, which are discarded as waste, are a possible source for the commercial preparation of alcohol (ethanol).

RICE PADDY HUSK (Agricultural Waste) → WATER PURIFIER

Ammonia is a common water pollutant. Ammonia is often converted, in natural water systems, to more harmful pollutants. It can also contribute to oxygen depletion. Activated carbon is used to remove these and other contaminants in water. However, activated carbon is expensive. Institute researchers will present a paper on preparing low cost activated carbon from rice husk, which is itself a pollutant of the environment when it is dumped as an agricultural waste.

BIO-FUELS—Research and Commercial Utilization. The world is ravenous for cheap, renewable fuels. Physicists and Engineers are looking at solar, power, wind power, geothermal power and so on. Chemists are looking at bio-fuels.

BIO-FUELS Research at the Institute of Chemistry, Ceylon

At the Institute, we have estimated the yields of bio-fuel that can be obtained by converting "citrus vegetable oil" to bio-diesel. The next step will be to test these fuels in small engines (eg. power generators) in collaboration with Engineers. Studies by Indian Chemists, on *Jatropha* seeds, confirm and support our optimism.

For health reasons that are also chemical reasons, unsaturated vegetable oils should not be repeatedly used for frying. We have shown that *trans* fats, which are harmful to health, are found in foods fried in re-used oil as well as in many baked products and margarine spreads. An enterprising entrepreneur could buy once-or twice-used cooking oil, which ought to be thrown away, from hotels and restaurants, and transform waste oil into bio-fuel. Chemists at the Institute have done the Chemistry that can make bio-diesel from used cooking oil. The problem of waste disposal in the above instances is solved by the following measures: WASTE → CHEMISTRY RESEARCH → RECYCLING WASTE → NOVEL UTILIZATION

ANTIOXIDANT STUDIES

Oxidation reactions in the body are vital for life; paradoxically, they can also be damaging. Low levels of antioxidants and the inhibition of antioxidant enzymes cause oxidative stress, and this may damage or kill cells. Hence the diet should contain antioxidants.

Pomegranate has emerged as a popular health food in the 21st century. Pomegranate juice contains antioxidant polyphenols and is said to have numerous health benefits. This recognition of pomegranate is overdue. The pomegranate tree has been prized in traditional medicine in Asia from ancient times. In Sri Lanka, at least one pomegranate plant used to be carefully cultivated in many home gardens both in villages and towns. All parts of the plant are used to prepare remedies for various diseases.

A research paper is being presented on the levels of antioxidants in pomegranate at this conference. Indigenous use has been supported by research because it is claimed by researchers that pomegranates can help in the prevention, cure or management of:

- prostate cancer
- diabetes
- menopause symptoms
- cholesterol levels
- periodontal inflammation

Many natural product chemists in Sri Lanka have studied many plants that are reportedly used in Ayurveda Medicine (Traditional Medicine).

One example out of several is the herb *Gymnema* (*kurinja* in both Sinhalese and Tamil) traditionally used for its ability to block sweet tastes and to maintain blood sugar balance. Sri Lankan natural products chemists along with biochemists and pharmacologists have studied *Gymnema* on many occasions. Animal studies have indeed confirmed the efficacy of this plant in managing diabetes. Plant extracts of *Gymnema* are now being marketed in Canada and other western countries. Traditional knowledge validated by science has led to the commercialization of this and many other traditional remedies.

A WORD ABOUT COMPUTERS & CAI (computer aided instruction)

We have gone from a computer that took up a whole air-conditioned room to desktops to laptops to hand-held computers. Our grandchildren are holding the world in the palms of their hands.

I am used to reading about say 'cell division' and then I have to visualize the process in my mind. Our own biochemistry students now desultorily watch 'cell division' happening on the screen and listen to a lecturer, describing the process in words. This is Computer Aided Chemistry Instruction, and it has invaded Sri Lanka.

I mentioned computers only because emerging, cutting edge technologies affect all of us—including Chemists. Chemical education should incorporate these novel ways of learning. And I can't resist the temptation to add that the silicon chip in your computer is Chemistry in the Computer.

CONCLUSION

I hope I have convinced you that Chemistry Research has played a worthy role in National Development in Sri Lanka. The partnership, which already exists between Chemistry research groups in our institutions of Higher Education on the one hand, that is, between Academia on the one hand, and Industry on the other hand, could be strengthened. Such strengthening would be mutually beneficial. We look to intrepid, resourceful and creative young Chemists to make these dreams come true in the future.



Figure 6: CHEMISTRY IN STREET ART

Kandiah Memorial Awards - 2012

Three Kandiah Memorial Awards are made annually to commemorate Prof. A Kandiah, the first President of the Chemical Society of Ceylon. Professor Kandiah served in the University of Ceylon from 1933 and was the Professor of Chemistry at the University of Ceylon from 1934 until his death in 1951.

The Kandiah Memorial Awards for Basic Chemistry and Applied Chemistry are awarded for the best research contribution in Chemistry carried out by a postgraduate student registered at a Higher Education Institute and for work carried out in Sri Lanka with the exception of special analysis (less than 20% of findings) that cannot be done in the country.

- The Kandiah Award for Basic Chemistry is made for research predominantly in Basic Chemistry (Organic, Inorganic, Physical & Analytical).
- The Kandiah Award for Applied Chemistry is made annually for research in related areas such as polymer, food, biochemistry, biotechnology etc. where interdisciplinary research is involved, provided that chemistry has a central role & comprises at least 50% of the content.
- The Kandiah Memorial Graduateship Award is awarded to the best piece of research in the chemical sciences carried out by a Graduate Chemist of the Institute of Chemistry Ceylon registered with a Higher Educational Institute for a postgraduate degree.

Kandiah Award for Basic Chemistry - 2012



Ms. Pathira Kankanamge Vinitha Ranji from the Open University of Sri Lanka has been awarded the Kandiah Award for Basic Chemistry in recognition of her research on "*Bioactivity Directed Chemical Investigation of Fungal Extracts : Citriquinones A & B from *Penicillium citrinum* and Butyrolactone I & (+)- Geodin from *Aspergillus terreus**". The research was carried out under the supervision of Prof. G.M.K.B. Gunaherath, Dept of Chemistry, The Open University of Sri Lanka, Prof. S.C. Wijeyaratne, Dept. of Botany, University of Sri Jayawardenapura and Dr K.H. Jayawardena, Dept of Zoology, The Open University of Sri Lanka.

Miss P.K.V. Ranji is an old girl of Sanghamitta Girls College, Galle and is currently reading for her MPhil degree in Natural Products Chemistry at the Open University of Sri Lanka. She is also a member of the Sri Lanka Association for the Advancement of Science.

Abstract of Kandiah Award for Basic Chemistry - 2012

Bioactivity Directed Chemical Investigation of Fungal Extracts: Citriquinones A and B from *Penicillium citrinum* and Butyrolactone I and (+)-Geodin from *Aspergillus terreus*

Pathira Kankanamge Vinitha Ranji

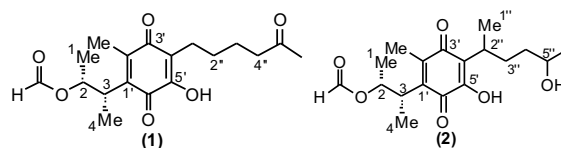
Department of Chemistry, The Open University of Sri Lanka, Nawala, Nugegoda.

Fungal metabolites are an obvious choice for drug discovery today. As an initiation of research in this area, chemical investigation of two terrestrial fungal isolates, namely *Penicillium citrinum* and *Aspergillus terreus* was carried out as both have shown a significant antibacterial activity against gram positive bacteria.

The fungus *Penicillium citrinum* was isolated from a soil sample collected from the garden of Botany Department of Sri Jayawardenepura University, and *Aspergillus terreus* was isolated from the rhizosphere of *Suveda maritima* plant collected from Puttalam District. Each fungal culture grown on Potato dextrose agar (PDA), were separately extracted into MeOH and each MeOH extract after concentrating was subjected to a series of solvent-solvent partitioning using EtOAc, hexane and CH₂Cl₂ respectively. CH₂Cl₂ fraction of both fungal extracts showed antibacterial activity; hence were subjected to bioassay guided fractionation to

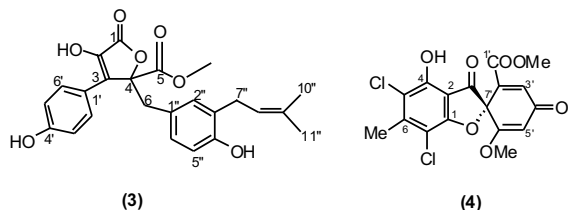
isolate the bioactive compounds.

P. citrinum yielded two new 1, 4- benzoquinone derivatives Citriquinone A (**1**) and Citriquinone B (**2**). Structures of these novel metabolites were established as 3-(5-hydroxy-2-methyl-3,6-dioxo-4-(5-oxohexyl)cyclohexa-1,4-dienyl)butan-2-yl formate and 3-(5-hydroxy-4-(5-hydroxyhexan-2-yl)-2-methyl-3,6-dioxocyclohexa-1,4-dien-1-yl)butan-2-yl formate respectively on the basis of detailed spectroscopic analysis.



A. terreus yielded two known compounds Butyrolactone I (**3**) and (+)-geodin (**4**). Their structures were confirmed by extensive usage of spectral

characteristics.



Antibacterial assay, carried out on the isolated compounds revealed that citriquinone A is active against *Bacillus sp.* giving an average clear zone of 16 mm at a dose of 250 µg/ disc while amoxicillin (positive control) gave a clear zone of 12 mm at a dose of 25 µg/ disc. Both Butyrolactone I and (+)-geodin found to be antibacterially active against *Bacillus* species tested. A dose of 150 µg of Butyrolactone I

could give the same activity of 25 µg of Amoxicillin while (+)-geodin showed a higher activity than an equal dose of Amoxicillin could.

Cell migration inhibition assay was carried out using human cancer cell line, HEp 2 (Epidermoid carcinoma, larynx, adherent, monolayer) maintained *in-vitro* to evaluate the efficacy of Citriquinone A in the retardation of cancer cell migration. In this assay, citriquinone A has shown a significant retardation of cancer cell growth at a concentration of 0.5 mg/ mL revealing that it is having a potential anticancer activity thus signifying that further studies relating to the evaluation of the anticancer properties of citriquinones would be much beneficial in searching for an anticancer drug lead with lesser cytotoxicity.



Professor Stanley Wijesundera Gold Medal Lecture 2012

Continuing with the practice of recognizing **Chemistry Greats**, the Council has decided to commemorate **Prof Stanley Wijesundera**, Past President of the Chemical Society of Ceylon (1966) and the first Chairman of the Graduateship Examination Board (1978-1980). He was the Vice-Chancellor, University of Colombo (1979-1988). Chemistry Greats recognised earlier were Professors P P G L Siriwardene, R S Ramakrishna, M U S Sultanbawa & Pearlyn Pereira and Dr. M A V Devanathan.

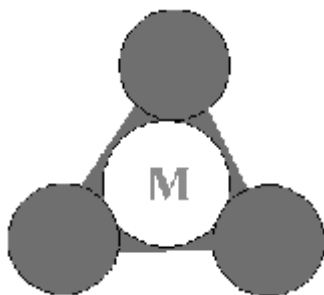
IUPAC Sponsored Chemical Education Workshop

Professors **Bob Bucat** (Australia) and **Mei-Hung Chiu** (Taiwan) will co-ordinate the workshop on Chemical Education to present results of their attempts to identify student misconceptions/ misunderstandings and other non-scientific approaches to problem solving etc. The workshop would be held at SLFI on **June 21st** from 8.30 am to 12 noon, as a part of the International Conference on Chemical Sciences. The workshop is aimed at University/School teachers and students.

Telephone Services at Adamantane House

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Ms. Dulanjalee Attanayake	200	Mr. J M Ranasinghe Banda	200
Prof. J N O Fernando	208	Ms. Dilini Gunawardene	212
Prof. H D Gunawardhana	220	Mr. A M Jayasekera	207
Dr. R Kandiah	214	Dr. B S Lankage	211
Ms. Midha Masood	200	Mr. N I N S Nadarasa	201
Dr. R Parthipan	214	Prof. K A S Pathiratne	219
Prof. S Sotheeswaran	206	Dr. C Udawatte	218
Dr. Sisira Weliwegama	209	Ms. Anoma Wijesuriya	202
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Avurudu Asiriya - 2012

'Avurudu Asiriya-2012' Cultural Programme, jointly organized by the Ministry of National Heritage and the Institute of Chemistry Ceylon with a view to celebrate Sinhala and Tamil New Year 2012 concluded successfully on 21st April 2012 at the Folk Art Centre (Janakala Kendraya), Battaramulla. It was held for the third consecutive year by the Institute of Chemistry Ceylon, based on a concept of Professor JNO Fernando, Rector of the Institute. It is estimated that over 600 persons consisting of members of the staff of the Ministry of National Heritage, members of the Institute of Chemistry Ceylon, students of Janakala Kendraya and College of Chemical Sciences, participated at the event. Opportunities gained for participation and enjoying together by members of all the three major communities was of special significance.

The events organized by the Institute of Chemistry Ceylon and the Ministry of National Heritage depicting the cultural heritage of both communities consisted of a number of attractive traditional dances, Raban play, drum beating and musical programmes, *Avurudu Kumari* and *Avurudu Kumara* contests. Models of Tamil and Sinhala traditional homes, displaying their traditional foods and sweetmeats provided a real village atmosphere.

The activities were commenced at 9.30 am by lighting the Traditional Oil Lamp. Mrs. Kanthi Wijethunga, Secretary to the Ministry of National Heritage welcomed the invitees and participants and stressed the importance of promoting cultural programmes such as Avurudu Asiriya to impart knowledge and experience on age old traditions and the highly valued national heritage to our younger generation. She thanked the staff of the Institute of Chemistry Ceylon and her staff of the Ministry of National Heritage for the efforts taken to bring the event a reality, through their hard work and dedication. Professor JNO Fernando, Rector of the College of Chemical Sciences stated that, it was the third consecutive year that Sinhala and Tamil *Avurudu* Celebration was being organized by the Institute of Chemistry and thanked the Secretary Ministry of National Heritage for collaborating with the Institute and providing the facilities at *Janakala Kendraya* for the event. Mr. GD Samarasinghe, Addl. Secretary, Senior Asst Secretaries and other staff of the Ministry

of National Heritage, Mr. GSK Kannangara, Director of *Janakala Kendraya*, Professor. MDP De Costa and Mr. NMS Hettigedera Chairman of the Steering Committee, Prof.(Ms.) Sujatha Hewage, Dr. (Ms) L S R Arambawela, Mr. NINS Nadarasa Registrar of IChemC, and Mr. AM. Jayasekara, Consultant, along with other senior staff of the Institute of Chemistry Ceylon attended the occasion. Mr. KD. Dayananda, Chairman of the Social Services Committee and Dr. AAP Keerthi, joint Secretary, I.Chem.C and Dr. R. Parthipan, Senior Lecturer CCS, organized the student activities. Mr. Chathuraka Jayasingha from the Ministry of National Heritage and Mr. AM. Jayasekara from the Institute of Chemistry Ceylon coordinated the overall programme.

The events included, various traditional Avurudu Sports such as *Banis Kema* (below 12 years), *Lime and Spoon*, *Egg Passing*, *Kiri Kema*, *Needle and String*, *Avurudu Kumara* open contest, *Avurudu Kumari* open contest, *Water Filling*, *Badhaka Diweema*, racing, *Suuppuwen Beema*, Fancy Dress Competition and many more activities such as Racing competitions, *Kamba Edeema* and Sinhala and Tamil traditional dances.

The events presented by the Janakala Kendraya consisted of *Suurya namaskaraya*, *Visitng Sinhala and Tamil Model Homes*, Tambourine Dance, *Kamath puranaya*, Tamil Cultural Dance, *Paththini Narthanaya*, *Yak Thun Padaya*, *Keligee*, *Dance'N Song* and several other attractive presentations. Presents were distributed by the Secretary Ministry of National Heritage, Chairman of the National Secretariat and Senior staff of the Ministry and the Institute of Chemistry Ceylon.

The success of the *Avurudu Asiriya* 2012 Programme was mainly due to the efforts of the dedicated staff of the Ministry of National Heritage, Institute of Chemistry Ceylon, College of Chemical Sciences and students of both *Janakala Kendraya* and the College of Chemical Sciences. Students from both Institutions had no doubt gained an excellent experience in Sinhala and Tamil traditional cultural activities and traditional *Avurudu* Sports, while enlivening themselves and fostering national consciousness in preserving our great national cultural heritage.

Avurudu Asiriya - 2012



Eighth CCS Convocation at Waters Edge, 16.02.2012



Academic Procession



Graduate Chemists in Procession



Mr. Ronnie Peiris delivers the Convocation Address



Shireen Jayasuriya Gold Medallist

Ms. P A M K Erangi



Graduate Chemists in Audience



DLTC Diplomates & Guests

Awards for Yeoman Service for Educational Activities in an honorary capacity



Ms. Kumudinee Goonetillake

Mr. K Sivarajah

Eighth Convocation of the College of Chemical Sciences

Convocation Address

Mr. J Ronnie F Peiris

*MBA (Cape Town), FCMA (UK) FCCA (UK), FSCMA, FZICA
Executive Director & Group Finance Director John Keels Holdings Group,
Chairman, Nations Trust Bank,
President, Sri Lanka Institute of Directors*



I am honored to be the Chief Guest at the 8th Convocation of the College of Chemical Sciences.

While congratulating the Graduates, Licentiates and Diplomates, I applaud the Honorary Rector and the Academic Board of the College for the meticulous manner in which this event has been organised. The event has now established itself as a “red letter day” in the annual calendar of the College of Chemical Sciences of the Institute of Chemistry Ceylon.

This message is primarily for you, the Women and Men, who are elevating to Graduates, Licentiates and Diplomates and it serves to give you pointers/guides in your onward journey. I will draw from my own experiences in verbalizing these pointers. I started my working life as an Accounts Clerk, at the lowest possible level, and I attribute my success, everything is relative no doubt, in my career to my unwavering belief in, and the practicing of, the Values of **Integrity**, **Caring**, **Innovation** and **Excellence**.

Integrity, to me, is doing the right thing when no one is watching. As many behavioural psychologists have often indicated, integrity sprouts from a combination of “nature” and “nurture”. Our parents, our teachers, our religious leaders and our role models have been, by and large, the shapers of our intrinsic integrity. Admittedly, the road to integrity is not an easy path. Very often, you will have to make the unpopular choice or even go against the norm. However, as my experiences have taught me, the rewards of integrity are endless. Ultimately, you feel no guilt and you radiate a peace that only a clear conscience can give.

Caring is another Value that has enabled me to derive immense satisfaction in life, both spiritually and materially. It is easy to say “I care”. However, it is your actual behaviour which demonstrates whether or not you mean it. I have found that sincere caring, and empathy, engenders credibility and reliability which, in turn inspires trust. This results in your subordinates, peers, superiors, your family and your loved ones supporting you whole heartedly and willingly in your pursuance of your personal and organisational objectives.

Innovation, in my view, is not limited to “Edison”

like mega inventions but includes the incremental improvements and enhancements we make to the status-quo of a product or a process. The problem that we face is that many people are not into the idea of continuous improvement. We, as human beings, are slow to adapt to the changes required by the emerging needs of a new global economy. The old methods which were appropriate for the old times become obsolete and if you do not adapt, and adopt, you will be left behind as individuals, organisations, societies and countries.

I am reminded of the words of *General Eric Shinseki*, US Army Chief of Staff, who said “if you don't like change you are going to like irrelevance even less” Yes:- you have to invest in continuous learning, growing and reinventing if you are to avoid making yourselves irrelevant.

Lastly, I would beseech you to pursue **Excellence** in everything that you do. Excellence to me is the relentless pursuance of perfection in everything we do and doing so with passion and enthusiasm. Excellence to me is the giving of your individual attention to the person that you serve, at that moment of time, whether such person is a customer, employee, employer or just an ordinary member of the society that you live in. Excellence to me is giving your one hundred per cent to any task that has been entrusted to you.

As you plan your future, I encourage you to reflect deeply on the Values which I have described above. They may not be in your “nature”. However, I believe you can attain them by proactive, and deliberate, “nurture”.

In closing, I urge you to continue with the wonderful work that you have done, and are doing, and never to be put off by the set-backs you are bound to experience from time to time. Success comes to those who persevere. Let us take courage from some of the great artists of the past. To mention only a few;- *August Rodin* grew up in absolute poverty, - three times his application to be admitted as a student in sculpture was turned down. He spent many years earning a meager living, making ornamental decorations for buildings. *Vincent van Gogh* wrote to a friend on one occasion saying that his main meal comprised of dry bread and chestnuts. Today his paintings are worth millions. *Leonardo da Vinci*, the illegitimate child of a peasant girl, was poor, hungry and homeless, - yet he became one of the greatest artists that ever lived. *Johann*

Sebastian Bach, again, was as poor as a church mouse and without education. He developed into one of the principal composers in the world. We all enjoy his music. *Ludwig von Beethoven* left school at the age of 13 to become the family's breadwinner because his father was an alcoholic. *Mendelssohn* was born in a ghetto in the worst possible conditions and *Haydn* started his life as a singer;- lost his voice at the age of 18 and lived a miserable existence while composing his masterpieces late at night.

The one thing that all these artists had in common was their belief in themselves and their professional skills. Ultimately, their integrity towards their work gave them fame and fortune. We, like them, must not be put off by disappointments. When people of character have their backs to the wall, they fight. Every one of you is an artist in your own way and you have experienced, and will experience, difficult times.

Creating a beautiful painting, a symphony or doing the work that you do is very similar. It requires the same dedication, the same integrity, the same enthusiasm, the same creativity and the same excellence. In the Road Not Taken – Robert Frost says ;-

*I shall be telling this with a sigh, Somewhere ages and ages hence,
Two roads diverged in a wood, and I took the one less travelled by,
And that has made all the difference.*

You have the choice to take one of two roads in life. The broad, and more frequently sought-after, road to mediocrity or the narrow, and less-travelled, road to greatness and distinction. You choose!!!

Good luck and best wishes!

(The report of the Honorary Rector/CCS presented at the 8th Convocation held at Waters Edge on 16.02.2012)

Exponential Rate of Progress by the College of Chemical Sciences (CCS) in Human Resource Development in the International Year of Chemistry



It is indeed with a continuing sense of accomplishment and satisfaction but in great humility that I present to you this Annual Report of the activities of the College of Chemical Sciences over the past years.

Major events connected with the International Year of Chemistry (IYC)

2011 commenced with a big bang with the heralding of IYC through a mammoth CHEMEX-1 Exhibition & Trade Fair held over a four day period (Jan 27-30, 2011) at the BMICH. The staff & students of the College played a magnificent role in the organization, presentation of numerous topics in many stalls and the conduct of numerous other activities. Formal academic work of the College was suspended for a 3-4 week period in January 2011 in order to enable the staff & students to participate with full vigour and enthusiasm in this mammoth activity, which attracted a very large number of school children and considerable number of the general public. The activities of the Institute and the College received a big boost as a result of this event.

The Inter University Debating Competition

This was conducted for the **third** consecutive year during the CHEMEX Exhibition & Trade Fair and attracted all the six universities (Colombo, Peradeniya, Jaffna, Sri Jayawarcanapura, Kelaniya & Ruhuna) which are conducting special degree programmes in

Chemistry. The competition was once again conducted for the **fourth** consecutive year on 28th January, 2012, at Adamantane House.

The College authorities conducted a IYC Raffle (that was drawn during the CHEMEX Exhibition) which enabled a sum of rupees 3.8million to be credited to the IYC funds of the Institute.

Emboldened by the success and popularity of CHEMEX-1, the College conducted another exhibition CHEMEX-2 that was held at the Adamantane House premises from November 24-26, 2011. On account of the lack of adequate space, the exhibition was conducted on a more modest scale and was geared largely towards the interests of school children.

As a part of CHEMEX-2, a **National School Titration Competition** was also conducted from November 14-16, 2011, amongst school children to encourage the conduct of much neglected practical work at the Advanced level.

In conclusion, I cannot fail to place on record the magnificent contribution made by our own Graduate Chemist, Mr. N M S Hettigedara, who provided the leadership for IYC activities in his capacity as the Chairman of the IYC Steering Committee. The support of more CCS Alumni is solicited and is essential for such innovative as well as recurrent activities of the Institute & the College.

Graduateship Programme in Chemistry

The 29th Batch of 83 Graduate Chemists receiving their certificates today really comprise the 30th intake as well since we admitted two batches in

2007/8 in order to accommodate those who qualified at the A/L Examination 2007 which was suddenly postponed from April to August 2007. It is the third batch of Graduate Chemists who were admitted subsequent to the completion of Adamantane House, which also coincided with a drastic change of course structure and curricula. Our average annual output from amongst those admitted to Adamantane House in 2005 (2009-2011) now exceeds 80 in contrast to an average annual output over the three previous years (2006-2008) of 45. This increase in numbers passing out has however not been at any expense of quality and standards and we note that our current output after moving into Adamantane House constitutes over 40% of Sri Lanka's total production of Chemistry Special Graduates- a situation which the Institute of Chemistry can be justly proud about.

The total number of 822 Graduate Chemists produced over the past 33 years constitutes an unexpected and unpredicted human resource development at a very low personal cost to students of about Rs. 2 ½ lakhs over 4 years which surely must be the cheapest of such programmes in any part of the world. Since it costs the Government of Sri Lanka over one million rupees to produce one such graduate from a Sri Lankan University, the contributions of our Institute toward human resource development can thus be estimated at an equivalent of well over one billion rupees at no expense whatsoever to the national exchequer. It is no doubt an achievement our Institute and the College can be very satisfied and proud about and corresponds to a remarkable achievement of a professional body of Chemists.

If only we had been provided by now with a modest block of land in close proximity to Adamantane House, as promised, we could have carried out this task much more effectively and efficiently and provided a much more complete and useful service to Sri Lankan students. Since our current demands for space are very acute, we have therefore been compelled to take steps to construct a five/six storey building on the balance strip of land in the car park area surrounding Adamantane House. The building construction will commence soon & hopefully the extended building will be ready for occupation next year. Until then, we are compelled to manage with the limited space available at present. We are glad to note and it speaks very well for our programme that the biggest advertisement for our educational programmes now comes from Graduate Chemists and our current students.

Diploma in Laboratory Technology Programme in Chemistry (DLTC)

Our pioneering formal educational programme which commenced in 1973 continues

without interruption & is approaching its fortieth year. The 37th batch of 56 will receive their Diplomas today. The total number of technicians produced up to date totals 832 and they are providing a notable and noble service in numerous medical, scientific and other institutions. The programme remains the only such programme producing Chemistry technicians at middle level. The foresight and forethought that enabled our predecessors to even think of such a technician programme in the early seventies in order to meet a serious need at middle level in Sri Lanka is remembered with great respect and gratitude. The spirit of service & need fulfilment espoused by them was so sincere that no fee was charged for even issuing the Certificate by the Institute during the first decade. We are glad to note that increasing numbers of DLTC Diplomates are now registering to follow the Graduateship Programme.

Fifth Research Session

The fifth Research Session of the College was held on 10th November 2011 with Dr. A M Mubarak, Director, Industrial Technology Institute as Chief Guest. 29 Graduate Chemists passing out today presented the results of their research/study as this occasion as part of their examination process.

Change of administrative designations in the College

By an amendment approved at the Institute AGM last June, a new post of Honorary Rector and that of a full time Dean were created with effect from 1st July 2011. It is hoped that these changes will result in more efficient & productive educational programmes.

Full time Academic Staff of the College

Two of our own Graduate Chemists – **Dr. Chandani Udawatte & Dr. Buddhie Lankage** – were recruited on contract for one year from September 2011. This increased the total number of our own Graduate Chemists working with us to 4.

Dr. Vinitha Thadhani who had been with us as a Senior Lecturer for nearly 4 years resigned from the end of 2011 in order to accept an appointment at the University of Sri Jayewardenepura.

The total number of regular academics at CCS will once again increase to 8 with the appointment of **Professor. K A S Pathiratne** as Professor for a period of one year on contract with effect from 1st March 2012.

Seminars/Symposium organized by CCS during the past year

- (1) Training Seminar on **Nanotechnology** was held on 30th September 2011 and was co-ordinated by Dr. Sisira Weliwegama.
- (2) One of our Graduate Chemists, Professor Roshan Perera, who is an Assistant Professor at the University

of Texas in Arlington, organized the Professor J N O Fernando Felicitation Symposium on “**Drug Discovery Process and Research Opportunities for Sri Lankan Scientists**” on 8th January 2012. This symposium was co-sponsored by the Alumni Association of the College.

Recognition of two Chartered Chemists for rendering yeoman service in an honorary capacity and richly contributing to the success of the Educational programmes in an exemplary & noteworthy manner.

Continuing with the practice of recognizing those who have rendered invaluable honorary services, we are recognizing today **Mr. K Sivarajah**, who *inter alia*, served as Co-coordinator of the DLTC programme for many years & **Ms. M N Kumudunee de Zoysa Goonetilleke**, who, *inter alia*, served as Assistant Secretary for Educational Affairs for many years. Ms. Goonetilleke is the second of our own Graduate chemists to be recognized in this manner. Let us hope that this type of formal recognition annually will serve as an inspiration to other members and in particular Graduate Chemists to come forward & contribute more & more of their expertise, talents and time towards the success of our educational activities.

Acknowledgements

I wish to acknowledge with grateful thanks the receipt of an increasing number of scholarships & prizes at various levels of study in our Graduateship Programme. The following have been received after the last Convocation:-

- (1) The **Council of the Institute of Chemistry Ceylon** has created the **Institute of Chemistry Ceylon President's Scholarship** to be awarded to a level 4 student who has demonstrated the best performance in levels 1,2 and 3 (theory) with a minimum GPA of 3.5
- (2) **Professor & Mrs. H W Dias** created an endowment to award three prizes in memory of their parents. These are:
Professor and Mrs. H.W. Dias Prize for the Second best overall (theory) performance in Levels 3 & 4.
Mr. and Mrs. H.G. Dias Memorial Prize for Geochemistry
Mr. and Mrs. E. Gajanayaka Prize for Atomic

Absorption Spectrophotometry

- (3) **Dr. Senthe Shanmuganathan & family** have created an endowment to award a prize for Levels 3 & 4 in memory of their parents. (**Mr. Amd Mrs. Suppiah and Seethadevi Prize**) for Analytical Industrial Biochemistry
 Dr. Senthe Shammuganathan, who now resides in Canada, is the founder Co-ordinator of the Technician Programme (now DLTC).
- (4) **Mr. P. L. A. Soysa** created an endowment which enabled the award of a scholarship for the fourth best performance at the Level 1 Examination titled **Dr. Dilanjan & Mrs. Gowri Soysa Scholarship**
- (5) **Dr. Rohan Perera** has donated the prize for **Chemical & Molecular Toxicology** at Levels 3/4

Conclusion

We go forward with confidence, enthusiasm & a sense of fulfilment that the Institute of Chemistry Ceylon through its College of Chemical Sciences has been able over the past four decades to make an immense contribution towards human resource development of Graduate Chemists in Sri Lanka. From very small beginnings the increasing income generated from the two educational programmes has been used very carefully and meticulously towards further strengthening alternate avenues of education in the Chemical Sciences in Sri Lanka. Savings have been used to improve the human resources available for all work of the Institute and to improve and enhance the College infrastructure, 64% of the membership of the Institute now constitutes our own Graduate Chemists. It is therefore quite clear that the future progress and development of the Institute & the College will increasingly devolve to our own alumni who as Institute members are also collectively shareholders and stakeholders. It is our fervent hope and expectation that this responsibility will be more fully taken over by our alumni who should regard the Institute and the College as their “Academic Parent” as was eloquently emphasized by the Chief Guest at our Third Convocation (Professor Arjuna Aluwihare) in 2007. With that fervent hope and expressing my earnest expectation that this will be achieved, I conclude this Annual Report of the College.

A glimpse into the history, structure and therapeutic applications of proanthocyanidins

Dr. Chayanika Padumadasa

Department of Chemistry, University of Sri Jayewardenepura

In 1534, Jacques Cartier, a French explorer, and his crew were on a winter expedition up the St. Lawrence River in New York. During this exploratory journey, the group found themselves trapped by ice. They had to survive on salted meat and biscuits and with time began to show symptoms of scurvy, a disease resulting from a deficiency of vitamin C, although at that time the cause was not known. However, they were saved from this disease when a Native American suggested that they drink tea made out of the bark of a local pine tree. Over 400 years later, Masquelier, of the University of Bordeaux, France came across this story and was intrigued to know the constituents of the bark of pine trees. Thus, he began a thorough investigation in to the phytochemicals present in French maritime pine bark. In 1951, Masquelier was able to extract a class of compounds that he named as pycnogenols, which he postulated to possess ascorbate-like effects. Later, Masquelier confirmed the structure, effects and lack of toxicity of this class of compounds. Encouraged by this work many scientists began to investigate this fascinating class of compounds and at present structures of many of these compounds and their therapeutic applications have been established.

This class of natural products was called as proanthocyanidins by Freudenberg and Weinges in 1960. According to Haslam, they are the condensed tannins, recorded in the earlier chemical and botanical literature. Attempts have been made by many scientists to define the term 'proanthocyanidins' and the first successful definition was put forward by Freudenberg and Weinges also in 1960. They defined all colourless substances isolated from plants which yield anthocyanidins when heated with acid as proanthocyanidins. In 1969, Weinges et al. reserved the term leucoanthocyanidin for the monomeric proanthocyanidins and the term condensed proanthocyanidins for dimers and higher oligomers of proanthocyanidins.

Phytochemical studies carried out on proanthocyanidins over the last few decades have revealed that they occur widely in fruits, vegetables, nuts, seeds, flowers, and bark of a diverse range of plants. Studies have also shown that they occur in monomeric, dimeric, higher oligomeric or polymeric forms. Now, it is well established that they belong to a specific class of polyphenolic compounds, the flavonoids which are important secondary metabolites

found in plants. Flavonoids are based on the heterocyclic ring system shown in Figure 1. Thus the proanthocyanidins are also based on the same heterocyclic ring system.

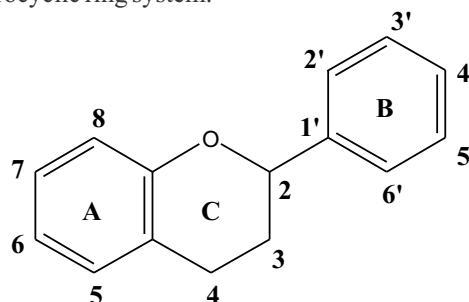
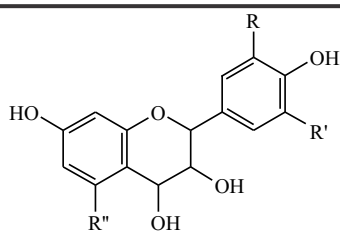


Figure 1: Basic heterocyclic ring structure and numbering system of flavonoids.

As mentioned before, leucoanthocyanidins are the monomeric proanthocyanidins. They are based on flavan-3,4-diols and Figure 2 gives several such compounds encountered commonly in nature. In addition, there are other flavan-3,4-diols of natural origin that have been encountered much less commonly. The building blocks of condensed proanthocyanidins are the flavan-3-ol units. Depending on the number of flavan-3-ol units the condensed proanthocyanidin will be a dimer or a higher oligomer. The principal flavan-3-ols found in plants are (+)-catechin, (-)-epicatechin, (+)-gallocatechin, and (-)-epigallocatechin (Figure 3) of which (+)-catechin and (-)-epicatechin are the most common. There are other flavan-3-ols that have been found in plants but rarely. Phytochemical studies of a wide variety of plants have revealed that the most common dimeric condensed proanthocyanidins* are B-1, B-2, B-3 and B-4 (Figure 4). Related dimers with other linkages have also been scarcely isolated.

Higher oligomers are based on a polyflavan-3-ol structure and two such examples are given in Figure 5.

Up to now the discussion has been based on leucoanthocyanidins and condensed proanthocyanidins, however, polymeric proanthocyanidins that are based on a polyflavan-3-ol structure are also found in plants. Of which some according to Shen et al. are bound to a carbohydrate or other polymer matrix within the plant cell thus making them insoluble in water and usual organic solvents although soluble proanthocyanidin polymers have been extracted from plants.



R=H, R'=OH, R''=H - leucofisetinidin
R=H, R'=H, R''=OH - leucopelargonidin
R=H, R'=OH, R''=OH- leucocyanidin
R=OH, R'=OH, R''=OH- leucodelphinidin

Figure 2: Principal naturally occurring flavan-3,4-diols.

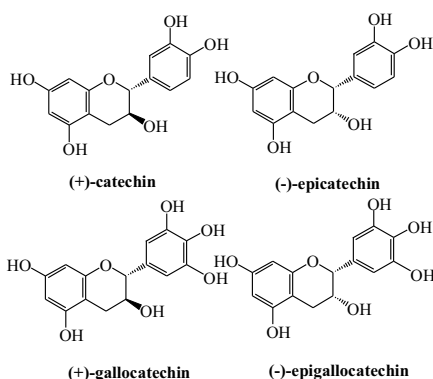


Figure 3: The most commonly reported naturally occurring flavan-3-ols.

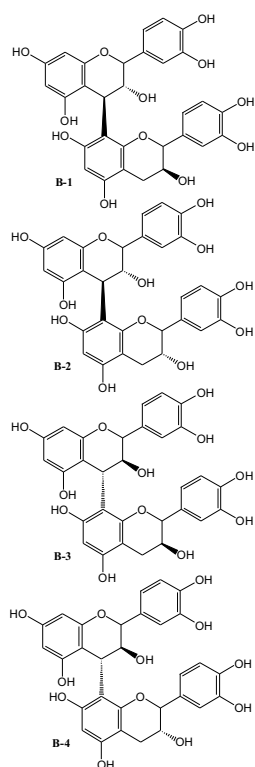


Figure 4: The most common dimeric condensed proanthocyanidins.

B-1 = epicatechin-(4 β →8)-catechin
 B-2 = epicatechin-(4 β →8)-epicatechin
 B-3 = catechin-(4 α →8)-catechin
 B-4 = catechin-(4 α →8)-epicatechin

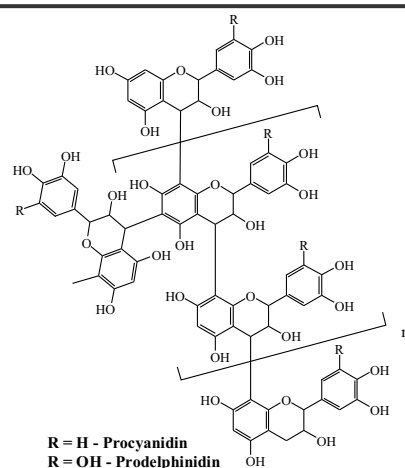


Figure 5: Oligomeric condensed proanthocyanidins.

Studies carried out on proanthocyanidins over the past quarter of a century have revealed that they possess free radical scavenging and antioxidant activity typical of polyphenolic compounds. In addition, they have been linked to many health benefits. There is evidence that suggests proanthocyanidins reduce the discomfort and swelling of varicose veins, reduce the fluid retention and swelling that can occur in premenstrual syndrome (PMS) and reduce the symptoms of menopause. Proanthocyanidins have shown to possess anti-cancer and anti-tumour activity. There is proof to show that they help to prevent heart disease, diabetic neuropathy and retinopathy and that they revitalize aging skin. Preliminary studies have also found evidence to show that proanthocyanidins alone or with arginine, may be helpful for impotence. Today, nutritional supplements containing proanthocyanidin extracts from various plant sources are available, alone or in combination with other nutrients, as herbal extracts, capsules, or tablets.

Proanthocyanidins are a very interesting class of natural products to study, no doubt, with so much more to explore and discover and as Bate Smith quoted "it is important to study in breadth and in depth, so that the whole is not lost while a part is being examined".

*In 1982, Porter and his co-workers proposed that proanthocyanidins be named in an analogous manner to that of carbohydrates. According to this proposition, the C-4 of the flavan-3-ol unit of proanthocyanidins is the same as the C-1 anomeric centre of the sugar unit in carbohydrates. The interflavonoid bond and its direction is indicated by parentheses (4→) just the same way as the linkage between sugars in carbohydrates.

Acknowledgement

I am very grateful to Prof. A. M. Abeysekera at the Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura for giving me the opportunity to carry out research

alongside him on this class of natural products.

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Smart Polymers

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Being smart means having a perceptive intelligence. Can a piece of plastic be smart enough to be categorized under intelligence? Over the years we have heard about such stories and predictions only in science fiction. These fictions have turned into a reality today with the introduction of “smart polymers” – the polymers that can exhibit or have inherent ability to learn and self-correct over time. Smart polymers or stimuli responsive polymers can adapt themselves in a remarkable way to immediate environmental changes.

Significant advances have been made in stimuli-sensitive materials in recent years. Such substances can respond in a specific way to external stimuli such as light, heat, pH, ionic strength, magnetic or electric field, biological molecules and solvent composition.^{1,2}

By incorporating a stimuli responsive receptor into a polymer system, microscopic deformations of the receptor efficiently transfer into macroscopic deformations of the polymer. Having control of these significant changes in structure and properties of the material triggered by external stimuli has created very promising applications. Stimuli responsive polymers are becoming increasingly more prevalent in highly specialized applications such as biomedical engineering and day-to-day practice as in biodegradable packaging.^{3,4}

This article is focused on different strategies that have been developed in the field of light and temperature sensitive polymers. A few selected examples have been encompassed to emphasize certain points.

Photoresponsive materials have been of wide interest. The major advantage of using light as a trigger is that light can be applied without disturbing the

surroundings. As a consequence, numerous experimental and theoretical studies suggest a high potential for photoresponsive applications such as in smart materials, devices, actuators for micro-scale or nano-scale applications, optical sensors, for controlled release, and as separators.⁵⁻⁹ Incorporating a photoresponsive chromophore into a polymer network, which can thereby undergo photocontractions, is a well-established strategy to convert light energy to mechanical energy.¹⁰ Numerous photosensitive compounds have been used in this regard. Functionalized azobenzene compounds, leucodye derivatives, cinnamic acids, and spirobenzopyran derivatives are of particular interest.¹¹⁻¹³

The isomerization of azobenzenes is well known, extensively studied and widely used. Azobenzenes undergo reversible photoisomerization. The more stable *trans* isomer converts photochemically to the less stable *cis* isomer, and the latter may subsequently revert to the *trans* either thermally or photochemically.

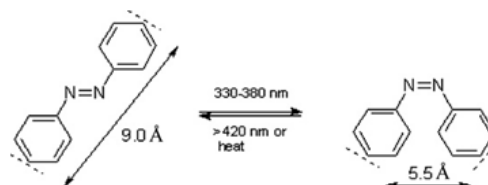


Figure 1: *Trans* - *cis* photoisomerization of azobenzene

Isomers, by definition, have different molecular and structural properties. *Trans*-to-*cis* photoisomerization changes the molecular dimensions in that the distance between the 4- and 4'-carbons of the

aromatic rings is reduced from 9.0 to 5.5 Å (**Figure 1**).¹⁴ Therefore, introducing azobenzene groups substituted at the 4- and 4'-positions, and connecting them to a polymer network can be used to cause a macroscopic volume change in the polymer upon photoisomerization.

Water-absorbing superabsorbent polymer (SAP) that is thoroughly surface cross-linked with functionalized azobenzenes is an excellent example which uses this strategy.^{15,16} Upon light absorption, *trans* isomerization to the *cis* form induces contractions of the polymer network. Contractions of the polymer force water molecules to move out from the polymer network mimicking the squeezing of a swollen sponge. The mechanical energy needed to squeeze the hydrogel is gained from light energy through the photoresponsive azobenzenes (**Figure 2**).

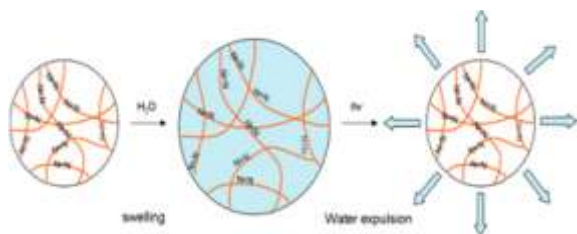


Figure 2: Schematic illustration of water removal of swollen photoresponsive superabsorbent polymer following light absorption.

“Photochromism” is a reversible change of color caused by light which even dates back to the era of Alexander the Great.¹⁷ It can be defined as a reversible transformation between two different chemical species in which reaction in one or both directions can be induced by the absorption of light.¹⁸ In most organic photochromic compounds, absorption in the UV region induces coloration or darkening and this may fade or discolor on exposure to visible light or upon heating. Optoelectronic devices can be prepared by incorporating the photoreactive chromophore into a polymer network.¹⁹⁻²⁵ Photochromic changes at the molecular level can lead to the global changes in bulk materials.

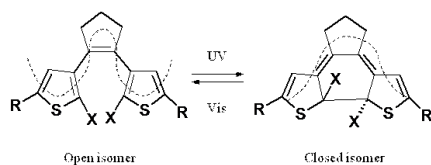


Figure 3: Open and closed dithienylethenes. The dashed lines show the π -electron conjugation paths.

Dithienylethenes are the most promising candidates among various photoresponsive compounds for optoelectronic devices because of their outstanding chemical and physical properties.

These properties exist in solution as well as in solid phase. Thus many studies have been reported regarding the fabrication of photochromic dyes dispersed, impregnated or bound in to polymer networks.

The potential applications of dithienylethene incorporated photochromic films are in erasable photon-mode recording. The recording is possible with UV light on colorless films or with visible light on previously exposed to UV colored films. Writing can be done through a mask on the films.



Figure 4: Photochromic recorded image.

Dual-stimuli-responsive materials have gained high attention due to their many potential applications. These materials can be fabricated by incorporating two receptors which can be triggered by different stimuli. Controlled drug delivery, bio-separations, viscosity modulations, surface modifications, memory elements, and water remediations are some of the applications.²⁶

A dual-stimuli responsive hydrogel with a thermoresponsive backbone and photochromic pendant group is an excellent example.²⁷ The polymer synthesized to be dual responsive, in that poly(*N*-isopropylacrylamide) [PNIPAAm] responds to temperature changes while the pendant spironaphthoxazines respond to light (**Figure 5**).²⁸

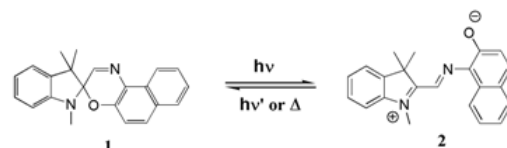


Figure 5: Photoisomerization of 1,3,3-trimethylspiro[indoline-2,3'-[3H]naphtha[2,1b][1,4]oxazines.

The photochromic pendant group exists as the stable closed isomer under ambient conditions. Upon irradiation at UV, closed isomer rearranges to a charge separated form capable of being stabilized by polar solvents including water. This enables more water molecules to diffuse into the polymer and the irradiated polymer material absorbs more water than the non-irradiated polymer. The polymer backbone - poly(*N*-isopropylacrylamide) responds to changes in temperature. Its lower critical solution temperature (LCST) is around 32-33 °C. Therefore, the polymer material absorbs water below the LCST and above LCST, the polymer undergoes a phase transition becoming insoluble and water repellent (**Figure 6**).

Irradiation enhanced the water absorption of the polymers while increases in temperature decreased it.

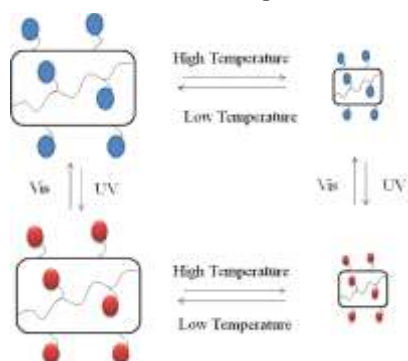


Figure 6: Schematic representation of the dual responsiveness of the PNIPAAm-MSp hydrogel. The circles represent the spironaphthoxazine pendant groups.

Development of smart polymer-based materials has gained attention over the past few years. This significance has been sparked by their fundamental and commercial interest. However, tremendous challenges remain to be explored in this creative field of science.

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Ion Selective Electrodes

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Ion selective electrodes (ISEs) remain the oldest class of chemical sensors, with the discovery of pH response of thin glass membranes by Cremer in 1906. Today ISEs are used in variety of applications including biomedical, environmental and industrial fields. Determination of biologically relevant analytes in physiological fluids is one of the key areas where ISEs are used extensively over other analytical techniques. Its capability to detect analytes in the

presence of an interfering matrix makes it a better candidate over other analytical techniques. Further unlike other techniques ISEs respond to the activity of the analyte instead of the concentration. As a result it is convenient to use ISEs as most health disorders are correlated to activity.

Measurements conducted using ISEs are performed in an electrochemical cell, as shown below in Figure 1.

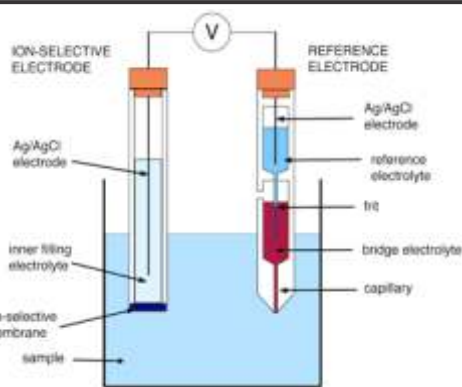


Figure 1: Typical electrochemical cell used in ISE measurement

The potential measured across the cell is a sum of the potential contributions from each electrode. Under ideal conditions all possible potential contributions can be kept constant except for the membrane potential (E_M). The E_M is determined using the Nernst equation, which states that E_M is dependent on the activity of the analyte ion, I^+ in solution, assuming the activity of the analyte ion in the membrane is constant

$$\text{Nernst equation} \quad E_M = E^0 + \frac{RT}{z_I F} \ln \frac{a_{I^+,pb}}{[I^+]_{pb}}$$

where R is the ideal gas constant, T is the temperature, F is the Faraday constant, z_I is the charge of the analyte ion, $a_{I^+,pb}$ is the activity of I^+ in the sample, and $[I^+]_{pb}$ is the concentration of I^+ in the membrane phase. According to the Nernst equation, if the activity of a monovalent analyte changes by a factor of 10, a potential change of 59 mV will be observed.

Selectivity and the detection limit are two main characteristics of an ISE. Nernst equation can predict E_M in ideal conditions where only analyte ions are present in the sample. However in real samples not only analyte ion but interfering ions are present and contribute to E_M . This contribution is accounted for in the Nikolski Eisenman formalism. Activity term in the Nernst equation is replaced by a sum of selectivity weighted activities.

Nikolski Eisenman formalism

$$E_M = E^0 + \frac{RT}{z_I F} \ln(a_{I^+,pb} + K_{I,J}^{pot} a_{J,pb}^{z_I/z_J})$$

where $a_{I^+,pb}$ and $a_{J,pb}$ are the activities of ions I and J in the mixed sample and $K_{I,J}^{pot}$ is the Nikolski selectivity coefficient. The selectivity coefficient gives the relative response of the electrode to interfering ion and the analyte ion. Smaller the selectivity coefficient less the interference by the interfering ion.

Intercepts of the linear ranges of sensor response shown in the figure 2 below define the lower and

higher detection limits. It is the selectivity that generally determines the lower detection limit (LDL) of a sensor, as background interferences may influence the electrode potential at low activities.

The performance of the best glass pH membrane remains unsurpassed in terms of selectivity and the detection limit thus far. However chemical versatility of this material is limited, which imposes restrictions on the range of available analytes. As a result extensive research is carried out even today to find membrane material selective for various analytes.

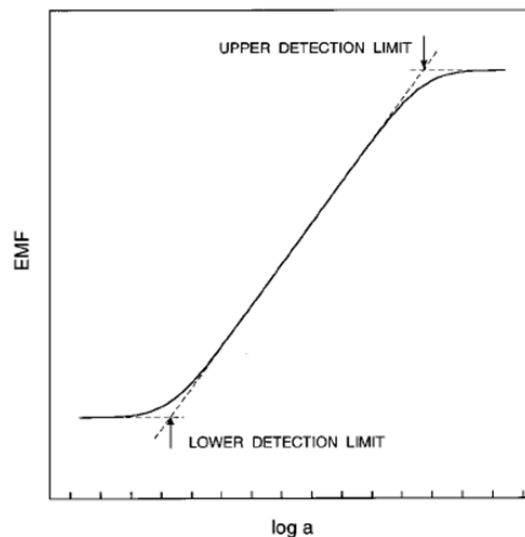


Figure 2: Upper and lower detection limits of an ISE¹

Research that led eventually to today's modern ISEs began in the late 1960s. The solvent polymeric membranes based on the polymer poly (vinyl chloride) were introduced.² Further a neutral carrier (ionophore) which offers improved selectivity to a certain analyte was discovered in 1966.³ Since then numerous research groups focused on the development of highly selective ionophores for a variety of analytes. Search for novel ionophores has been quite successful and by the 1980s, ISEs had been incorporated into routine clinical analysis to monitor the activities of various blood electrolytes such as K^+ , Na^+ , Cl^- , and Ca^{2+} .^{4,5}

In 1992 a new direction for ISE was established with the introduction of the first ISE capable of detecting the polyion heparin.⁶ Heparin has a charge of approximately -70. This charge would result in a response of less than 1 mV per decade according to the Nernst equation. The potential response of the non-classical sensor was larger than what was expected. This "super-Nernstian" response was attributed to a non-equilibrium change in the E_M at the sample-membrane interface. In short, initially the ISE acts as a Na sensor equilibrated using a NaCl solution. Once heparin is introduced to the sample solution, ion-pair interactions with an ion-exchanger

in the membrane create a steady-state flux of heparin molecules into the membrane. The resultant change in the EM, is proportional to the concentration of the analyte in the sample bulk.⁷

Unfortunately, because the extraction of polyions is an irreversible process, strong potential drifts are normally observed and sensor loses its response after relatively short exposure times. Further, when the sensor is exposed to the polyion for extended period of time, the sample-membrane interface will reach equilibrium. Then the subsequent changes in the polyion concentration would yield Nernstian response at the membrane.

A new transduction principle with instrumental control over the ion flux to and from the membrane has been introduced by Bakker *et al.* in 2003.⁸ These pulsed galvanostatic control of the ionophore based polymeric sensors has no intrinsic ion exchange properties. The experimental cell includes a three electrode electrochemical cell and ion extraction/stripping is electrochemically controlled by an alternating galvanostatic/ potentiostatic mode. This method can be applied not only for polyion detection but also for the detection of small ions.^{8,9,10} An attractive feature of the pulstrobe response is that it mimics the traditional ISE behavior. Therefore, its response can be elucidated through well studied ISE theory. Furthermore, the pulstrobe results can be compared against the published potentiometric results.

Sensors based on electrode capacitance

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Electrochemical sensors based on faradic process have become a hot topic for the past few decades. These sensors depend on one or more electrochemical processes that can produce a faradic current. Sensors based on faradic processes have some practical difficulties when they are used with biological samples. Competitive side reactions based on other electro-active species that are found in these biological systems have been identified as the major hurdle to use faradic sensors for biological systems. In addition to this, physiological conditions found inside cells are not the ideal condition for many electrochemical processes. These practical difficulties forced scientists to find alternative biological sensors that can be used under physiological conditions.

Sensors based on electrode capacitance are capable of operating under normal physiological conditions, and they have less complicated instrumentation compared to their faradic counterparts. Capacitance (C) of an electrode can be

ISEs, 100 years after its emergence have still not reached a mature and stagnant age. On the contrary it is at a quite exciting stage for research. With novel directions in the field, it has the opportunity to give rise to many new bioanalytical measurement tools that may be truly useful in practical chemical analysis.

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defined as follows:

$$C = \frac{\epsilon_0 \epsilon_r A}{d} \quad (1.1)$$

Where, ϵ_r are ϵ_0 the dielectric constant of the medium and the dielectric constant of the vacuum (8.85419 pF/m), respectively. A is the effective area of overlap between the conducting plates, and d is the distance between two charged layers in the capacitor. An electrode modified with a thin layer of recognition elements can be used as a simple capacitive sensor. As the analyte binds with the modified layer, it causes the electrode double-layer capacitance to change, which can be measured as an impedance change. This article is focused on the theoretical aspects of these sensors based on electrode-capacitance.

Electrodes modified with affinity-based molecules can be used as sensors. This modified layer on the electrode tip acts as a barrier to the electrode double layer, and this blocking ability changes the electrode double-layer capacitance. This wall of molecules (modified layer) pushes the solvent and solvated ions farther away from the

electrode surface. Additionally, replacing water as the filling medium in the double layer capacitor with a lower dielectric medium such as organic molecules will decrease the double-layer capacitance. For a modified electrode, C_{Hm} is the total capacitance between the modified electrode surface and the outer Helmholtz plane (OHP). C_{Dm} , the capacitance generated beyond the OHP to the bulk solution, represents the diffuse layer capacitance in the modified electrode. The modified electrode tip capacitance (C_{tot}) can be defined (equation 1.2) as follows:

$$\frac{1}{C_{tot}} = \frac{1}{C_{Hm}} + \frac{1}{C_{dm}}$$

Removal of the modified layer or interactions with the analyte will change the C_{Dm} and this will affect the total capacitance (C_{tot}). In addition to the capacitance on the electrode surface, solution resistance (R_s) and the redox reaction kinetics play major roles in the final electrochemical properties of the electrode. A Randles equivalent circuit can be used to explain the impedance response of the electrode. Depending on the availability of a redox reaction, a redox charge-transfer resistance R_{CT} can be added to the equivalent circuit. The Warburg impedance/resistance (Z_w) is a second electrode surface-based resistance parameter that represents the resistance for any charged ion diffusion across the OHP (i.e. electrochemical reactions controlled by diffusional mass transport). Figure 1 shows the Randles equivalent circuit for a modified electrode without a redox mediator and this eliminates R_{CT} and Z_w due to the absence of a redox reaction. The Randles equivalent circuit for a modified electrode with a redox mediator is shown in Figure 2.



Figure 1: Randles equivalent circuit for a modified electrode without a redox mediator.

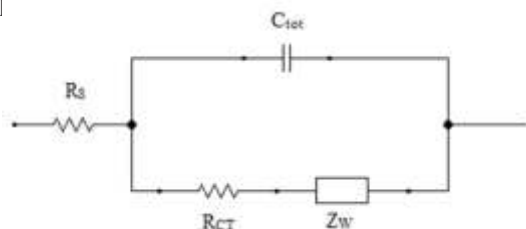


Figure 2: Randles equivalent circuit for a modified electrode with a redox mediator present.

Chemical or physical changes to the electrode

modified layer can alter the electrode double-layer impedance. Impedance spectroscopy is a typical method to detect electrode impedance. In addition to expensive impedance spectroscopic approach, simple cyclic voltammetric measurements can be used to evaluate the impedance change. A sinusoidal signal with a small amplitude also can be used to monitor the impedance ($|Z|$) and this technique is frequently used with electrochemical surface scanning techniques.

Mathematical expressions for the imaginary and real impedance $Z_{im}(\omega) = \frac{1}{\omega C} = X_c$ are given in equations 1.3 and 1.4, respectively.

$$Z_{real}(\omega) = R \quad (1.4)$$

Based on these two components, the impedance magnitude $|Z| = \sqrt{Z_{real}^2 + Z_{im}^2}$ as follows, equation 1.5):

Substituting $Z_{im}(\omega)$ and $Z_{real}(\omega)$ to equation 1.5 gives the imaginary part $|Z| = \sqrt{R^2 + (1/2\pi f C)^2}$ (equation 1.6), where f is frequency.

Sensors based on electrode-capacitance have been developed to detect many biologically active molecules and microbes. First mode of using these capacitive-sensors is to produce selective interactions with the analyte. In this approach, electrode tip impedance will increase with the analyte interactions. Recently, Owino et al. developed an immunosensor based on electrode impedance to detect Aflatoxin B1. A Pt electrode modified with polyamine immobilized with Aflatoxin B1 antibodies was used as the working electrode in this detection. This simple, but effective capacitance-based detection method was used successfully to detect Aflatoxin B1 compared to conventional methods. This same detection technique can be possibly developed to detect other biologically found toxins. A second way of using these modified electrodes as capacitive sensors is as a sacrificial sensor. In this approach, modified layer on the electrode acts as a sacrificial layer to detect reactive chemical species. These reactive species may strip of the modified layer on the electrode which can increase the electrode-tip impedance. Detection of radicals and mapping localized reactive chemical species can be successfully performed using an electrode modified with an organic layer.

Sensors and detection methods based on electrode capacitance are getting popular due to many advantages. This type of detection can be performed without any redox active species. In

addition to this, interferences from other possible redox species are negligible to electrode tip impedance.

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International Symposium on Polymer Science and Technology 2012 in Collaboration with Industries, Institutions and Universities (IIU PST 2012)

Organized by the Department of Chemistry, Faculty of Applied Sciences,
University of Sri Jayewardenepura

As the pioneers of producing polymer scientists and technologists, we, the polymer group, in the Department of Chemistry, University of Sri Jayewardenepura are poised to initiate an annual symposium, **“International Symposium on Polymer Science and Technology 2012 in Collaboration with Industries, Institutions and Universities”** to be held on 2nd, 3rd and 4th November 2012.

We are proud to initiate such a collaborative event on Polymer Science and Technology in Sri Lanka. We strongly believe that the symposium will merge academia, scientists, technologists, polymer industrialists and planters on a common platform to exchange information and novel ideas to enhance research and development and inspire and prepare the younger generation in meeting global challenges with social responsibilities.

We have a strong collaborative team of *eminent professionals* and experienced specialists *with* wide-ranging areas of expertise *in the field of Polymer Science and Technology*. Our institutional collaborators are Industrial Technology Institute, Department of Chemical and Processing Engineering, University of Moratuwa, Department of Textile and Clothing Technology, University of Moratuwa, Department of Materials Science and Engineering, University of Moratuwa, **Sri Lanka Institute of Nanotechnology (SLINTEC) Pvt. Ltd, Industrial Development Board of Ceylon**, Rubber Research Institute of Sri Lanka, Sri Lanka Atomic Energy Authority, and Plastics & Rubber Institute of Sri Lanka. *We have also taken the initiative in collaborating with* Ministry of Higher Education, **Ministry of Industry and Commerce**, Ministry of Technology and Research, Ministry of Plantation Industries and University Grants Commission. We believe that together with our collaborators we will be able to open a new chapter in the polymer science community through IIUPST 2012.

The symposium will be a 3 day event, with an inauguration on the first day evening at the Galle Face Hotel, Colombo followed by two full days of technical sessions at the University of Sri Jayewardenepura. The technical sessions will offer a great opportunity for the national and international polymer community to emphasize their research work and to discuss the latest ideas, discoveries, challenges and innovations with a broad spectrum of professionals. The themes for **IIU PST 2012** symposium have been selected to envelop the industry and academia and to address the novel technological challenges.

Your participation at IIU PST 2012 will be greatly appreciated to make this event a success.

Dr. Chayanika Padumadasa

Dr. Thilini Gunasekara

ALL ISLAND INTERSCHOOL CHEMISTRY QUIZ CONTEST-2011/2012

The preliminary written paper of the All Island Interschool Chemistry Quiz contest 2011/2012 was held on 14th November 2011 for year 13 students. On the basis of the results of the preliminary written paper the final contest (oral) was held on 30th March 2012 at Adamantane House.

The results of the All Island Interschool Chemistry Quiz contest are as follows. The Prizes and trophies for winners will be awarded at the 41st Annual Sessions of the Institute of Chemistry Ceylon which will be held on 20th June 2012 at the Waters Edge.

Best Student in Each Province (Based on Preliminary Written Paper)

Province	Name	School
Western Province	Shamaali Gunawardana	Devi Balika Vidyalaya, Colombo 08
Eastern Province	V. Rishikesh	KM/ Carmel Fathima College, Kalmunai
Uva Province	D.M.V.S. Dissanayake	B/ Bandarawela M.M.V., Kinigama, Bandarawela
Sabaragamuwa Province	B.P.M.P. Kulathilake	B/ Bandarawela M.M.V., Kinigama, Bandarawela
	J.A. Samankumari	Kg/Dehi/Rajasinghe M. M. Vidyalaya, Ruwanwella
North Central Province	M.K. Thilini Darshika	R/Ferguson High School, Ratnapura
	Sivasubramaniam Pavithiran	V/ Vavuniya Tamil M.M.V., Vavuniya
Southern Province	M.K. Weerathna	G/Richmond College, Galle
Central Province	T.I. Kodikaraarachchi	Mahamaya Girls School, Kandy
	D.M.M.H. Dissanayaka	St. Sylvester's College, Kandy
North Western Province	A.A.K. Wijerathna	Ibbagamuwa Central College, Ibbagamuwa
	W.R.S. Dilushika Weerakkody	Maliyadeva Balika Vidyalaya, Kurunegala
North Province	S. Jasothakrishna	St. John's College, Jaffna
	S. Kethri	St. John's College, Jaffna
	M. Mikunthan	J/Vembadi Girls High School, Jaffna
	S. Sivasubramaniam	J/Vembadi Girls High School, Jaffna

Best Individual Performances (Based on Preliminary Written Paper)

First	Sivasubramaniam Pavithiran	V/ Vavuniya Tamil M.M.V., Vavuniya
Second	V. Rishikesh	KM/ Carmel Fathima College, Kalmunai
Third	M.K. Weerathna	G/Richmond College, Galle
Fourth	A.A.K. Wijerathna	Ibbagamuwa Central College, Ibbagamuwa
	W.R. Sachini Dilushika Weerakkody	Maliyadeva Balika Vidyalaya, Kurunegala
	P.G.A. Madura Pankaja	Rahula College, Matara
Seventh	Shamaali Gunawardana	Devi Balika Vidyalaya, Colombo 08
	T.I. Kodikaraarachchi	Mahamaya Girls School, Kandy
	D.M.M.H. Dissanayaka	St. Sylvester's College, Kandy
	Thisari Athukorala	G/Southland College, Galle

Winners :	Challenge Shield Donated by Mr N M S Hettigedara	V/Vavuniya Tamil M.M.V, Vavuniya,
	Sivasubramaniam Pavithiran	Thanabalasingam Tharshan
	Packkiyakumaran Arunkumar	Kathirgamaththornby
	Kugathasan Ganapparasanna Muththukumar	Rajakulasingam Thesigan

1st Runners up:	Challenge Shield Donated by Link Natural Products Ltd	Nalanda College, Colombo
	Jayan Chathuranga Widanapathirana	KA Ranasinghe
	NS Wijayabandara	KK Kahatapitiya
	J M Dissanayake	W M P M Wijerathne

PUBLICATIONS OF THE INSTITUTE OF CHEMISTRY CEYLON

Monograph	Title	Author	Price
01	Textile Fibers	Mr T Rajasekeram	Rs.50/-
02	Principles of Food Preservation	Prof U Samarajeewa	Rs.75/-
03	Biotechnology	Prof C P D W Mathew	Rs.75/-
04	Recombinant DNA Technology	Prof J Welihinda	Rs.75/-
05	Natural Toxins in Foodstuffs	Prof E R Jansz & Ms A S Perera	Rs.50/-
06	Fat Soluble Vitamins	Prof E R Jansz & Ms S Malavidana	Rs.50/-
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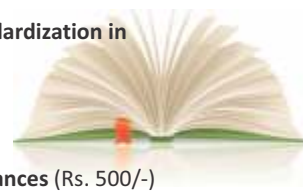
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01	Functional Group Analysis in Organic Chemistry	Prof A A L Gunatilake	Rs. 175/-
02	Zinc Metalloproteins	Prof (Ms) R D Wijesekera	Rs. 175/-

General Publications

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- ★ **Infrastructure Support Services for Industrial Development** (Rs.200/-)
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- ★ **Proceedings of the Workshop on the Technological aspects of the Production & Processing of Essential oils in Sri Lanka** (Rs.100/-)
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- ★ **A-Level Chemistry Facts, Patterns & Principles by Dr. Seetha I Rodrigo** (Rs.1500/-)
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RSC NEWS

THE ROYAL SOCIETY OF CHEMISTRY SRI LANKA SECTION

1. Membership

According to the records sent to us from the parent body, a breakdown of the membership is as follows:-

Category	Abbreviation	Number
Fellow Life Member.	F E L	05
Fellow C Chem.	F C C	09
Member	M E M	26
Associate Member	A M E	12
Affiliate Member	A F F	01
Affiliate /Under Graduate. A F U		<u>02</u>
Total Membership as at March 2011		<u>55</u>

2. Committee of Management

The following were elected to the Committee at the 50th Annual General Meeting held on 15th July 2011.

Chairman	- Prof. Sudantha Liyanage
Vice Chairman	- Mr. W J P D Jayalath
Chairman Elect	- Dr. M P Deeyamulla
Hony. Secretary	- Mr. I M S Herath
Hony. Treasurer	- Prof. W S Fernando
Committee Members -	Dr. Positha Premaratne
	Mr. W A P Silva
	Mr. S Perasiriyan
	Mr. R M G B Rajanayake
	Prof. L G Chandrasena
	Mr. Sulith Liyanage

3. Committee Meetings

There were 12 Committee Meetings held during the period, July 2010 to July 2011. The venue of these meetings was the office of the Royal Society of Chemistry SL Section at the S L A A S Headquarters. These meetings were held to discuss the R S C SL Section's, new plans and strategies with regard to organizing the activities for the year 2010/2011 and thereafter.

4. Activities

4.1 Contributions to Activities of the Institute of Chemistry Ceylon

(a) Full page advertisement of "Chemistry in Sri Lanka".

(b) Annual Dinner

(c) Award for the Best Performance at the Graduate ship Examination in Chemistry Part II Theory Examination

(d) Contributions for the International Conference

4.2 All - Island Inter School Chemistry Essay Competition.

4.3 Inter - University Chemistry Competition.

4.4 Teacher training program.

4.5 Advanced Level chemistry seminar.

4.6 Donation of teaching and learning resources for Chemical Society of selected University.

4.7 Book donation program.

4.8 Popular Lectures.

4.9 Industrial Visit.

4.10 Writing Monographs by few committee members.

4.11 Newton A. Dias Weerasinha Memorial Scholarship 2011/2012

5. Web Site

The members are reminded of the web site of our Section, the address of which is as follows:-

[www.rsc.org/Membership/Networking/InternationalSections/Sri Lanka/ index. asp](http://www.rsc.org/Membership/Networking/InternationalSections/SriLanka/index.asp).

I M S Herath
Hony Secretary



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