

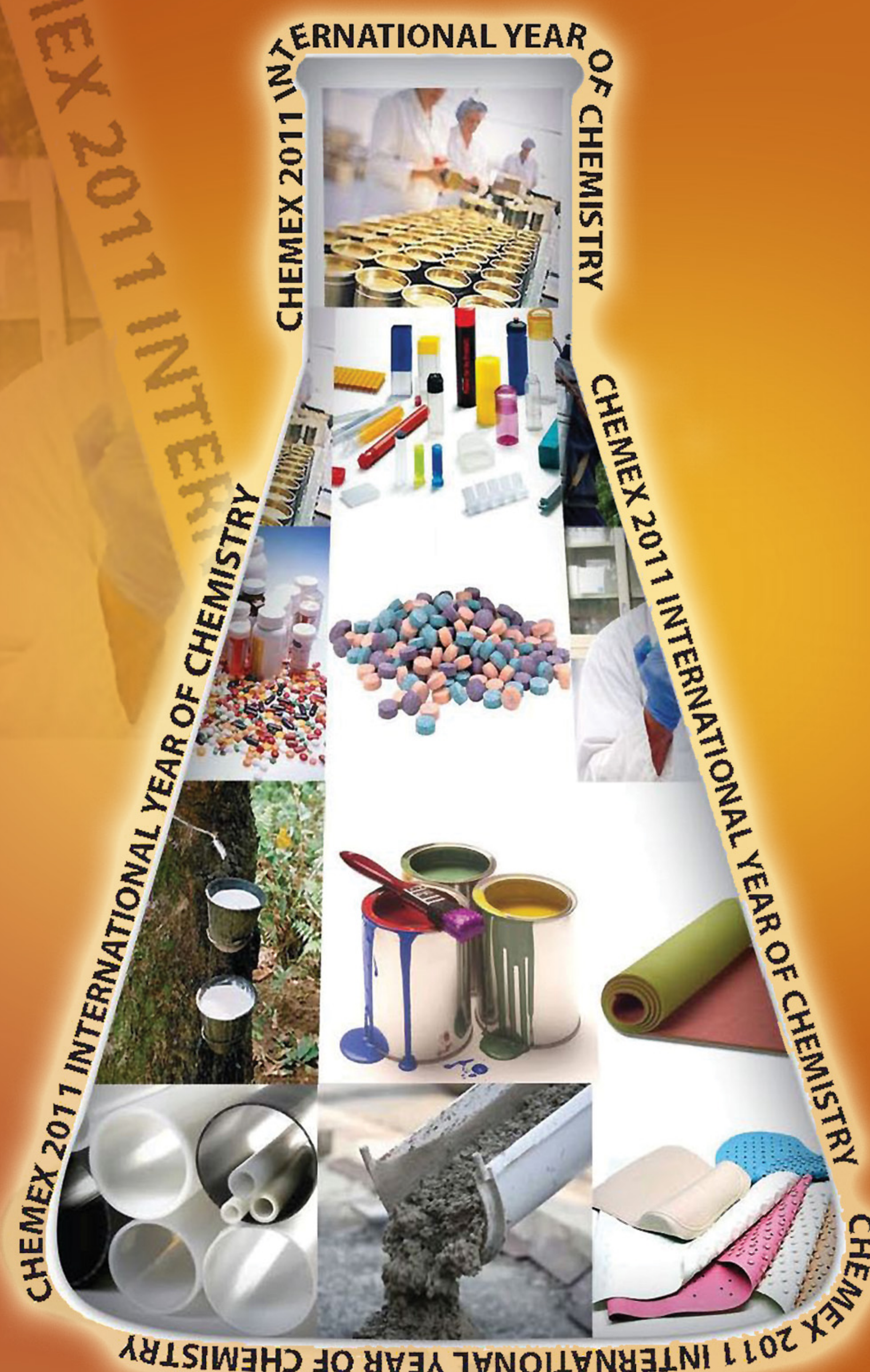
INTERNATIONAL YEAR

OF CHEMISTRY

CHEMISTRY

IN SRI LANKA

CHEMEX 2011 INTERNATIONAL YEAR OF CHEMISTRY



SEPTEMBER 2010 VOLUME 27 - NO. 3



**2011 will be the International Year of Chemistry
- a unique declaration by the United Nations**



College of Chemical Sciences Institute of Chemistry Ceylon

(founded 1971; Incorporated by Act of Parliament No. 15 of 1972)



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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

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"Chemistry Education for the Well Being of Society"

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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. 750
Member	Rs. 750
Associate	Rs. 600
Licentiate	Rs. 500
Technician	Rs. 400
Membership for Life	Rs. 7500

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 January 2010.

- 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.

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Cover Page

One of the major events organized by the National IYC Secretariat is the “Chemistry exhibition – Wonders in Chemistry” at the BMICH from 27th to 30th January 2011 with the participation of the Universities, Research Institutes and Industry. In each day a different theme is highlighted to show the contributions made by Chemistry for the benefit of the humanity.

See page 30

Research and National Development

Professor S Sotheeswaran



Universities are tertiary educational institutions engaged not only in teaching/learning but are also centres of research. The total research output of universities all over the world is vast and Sri Lankan universities contribute a reasonable amount to this total.

It is well known that industrial establishments invest large sums of money and effort in research; but they do not stop there. Research is coupled with development and the two are usually inextricably linked in the term Research and Development, often referred to as R & D. Usually research is directed towards creating inventions and products that have useful applications. These are rigorously tested, patented, mass produced and marketed-in brief, they are commercialised. In other words, research does not stop with investigation and the presentation of the results at a conference or in a publication as is often the case with research conducted at universities. The term 'development', in R & D, denotes the practical application of the fruits of research. Naturally it leads to the economic development of the business house and shares in the development of the community at large.

Many countries, especially those in the West, have realised that it is wasteful to duplicate the research work done in universities and in industrial establishments. Links have been forged between researchers in universities and R & D departments in industry whereby the former concentrate on research and the latter focus their attention on product development. The relationship is mutually advantageous—the universities receive research grants from industry and industrial organisations benefit by obtaining all rights to the utilisation of the results of the research funded by them. University researchers may feel somewhat hedged in by confidentiality clauses in the agreements made with industry; however, they are freed from anxiety about finances.

It would be desirable for links of the above kind to be encouraged in Sri Lanka.

According to one recent news report, the Engineering Faculty at Ruhuna University has successfully concluded research on manufacturing paper using invasive aquatic plant species as raw materials. These plants are weeds that clog waterways and are a threat to the environment. The work of the

student who carried out this research, S.H.C.S. Gunawardena is highly commendable. He has found a way to control a weed by harvesting and using it and, at the same, time found a substitute for valuable trees that need to be felled to make paper.

According to another news report, an undergraduate has produced bio-fuel from algae. This report also indicated that it is feasible to substitute petrol and diesel from both fresh water and marine algae for petrol and diesel from petroleum, which is neither inexhaustible nor cheap.

The College of Chemical Sciences at the Institute of Chemistry, Ceylon, has been actively pursuing research in the area of bio-fuels from plant seeds that are not edible.

Research in the area of bio-fuels should not be conducted in isolation in various places in Sri Lanka as we see it is happening today but there should be an effort on the part of some national body such as the National Science Foundation to see that the current research efforts are coordinated, and the results patented and commercialised. The research results should not be confined to academic presentations.

Innovative ideas should be protected by patents. We should learn a lesson from what happened in the case of *Kothala himbutu*. Sri Lankan chemists published their research data in journals but did not obtain patents for *Kothala himbutu* products, whereas the Japanese have done just that.

Indian scientists confirmed, through research, the insecticidal properties of *neem* products which have been well known to traditional Indian healers for centuries. However, Americans obtained the first patent for a *neem* product.

Our Universities and Institutes such as the Institute of Chemistry Ceylon, Institute of Fundamental Studies (IFS) and Industrial Technology Institute (ITI) should combine forces to do more research in the area of applied sciences. One of the obstacles for research in Sri Lanka is the lack of modern research equipment in good working condition. A Central Science laboratory should be established in Sri Lanka to house modern research equipment with appropriate technical help at hand.

It is heartening that the Ministry of Science and Technology has been renamed as the Ministry of Technology and Research. There is hope that researchers will receive increasing support to conduct research and help in the development of their findings.

Message from the President, Institute of Chemistry Ceylon

The theme chosen for the year is "Chemistry Education for the well being of the society". Any theme on education is a hot topic in Sri Lanka and at present with wide ranging discussions at various levels and forums being continued. Our country which has been having free education since 1948 and has seen a high literary rate among Sri Lankan population is facing a major problem with the employability of our graduates and other categories of students. Generally the belief is that foreign graduates are better placed to be selected for employment than our own graduates in Sri Lanka. Then the question arises why our own graduates are not suitable for the types of jobs available in Sri Lanka. Is there a mismatch between the availability of jobs and products from the Sri Lankan universities? Should our youth live in an environment where the future is uncertain? Majority of the students who do not enter the Universities is another huge problem and to find appropriate employment for them is the biggest headache for any government.

What role can the Institute of chemistry play to help in some way in facing this problem by the youth? The theme of the year has been decided at the correct juncture so that the Institute of Chemistry can work out a plan of work for the common benefit at all levels in educating the young generation of this country. Institute of Chemistry already conducts several courses, The Graduateship in Chemistry and DLTC programmes. We also conduct training programmes in Chemistry for Advanced Level teachers and seminars on relevant topics to many industries in Sri Lanka. In addition we also conduct programmes to Popularize chemistry among students and the general public.

We wish to carry out these professional development programmes to a higher level during my year of Presidency. This effort also has been helped due to the fact that the year 2011 has been declared by the UN as the "International Year of Chemistry (IYC) 2011". We are planning jointly to conduct programmes to impart knowledge in chemistry at all levels of learning and to educate the general public on how chemistry contributed to the wellbeing of the society.

Under my direction, several seminars will be conducted under topical themes to impart knowledge to school children, postgraduate students, researchers, industrialists and general public. Special training programmes will be designed and conducted for the benefit of the advanced level chemistry teachers on the new syllabus.

At the secondary education level we are planning school children centred programmes based on the projects they carry out in schools in chemical sciences. In this regard we are encouraging the students to enter into a competition organized by us on their projects in chemical sciences. Before they submit their projects to the competition the student participants will be trained in writing reports and in preparing of posters. We believe this may help them to improve their soft skills such as presentation and communication abilities as well motivate them in innovation. Interschool Chemistry quiz will be expanded island wide to improve the team work of the students. We are also planning to improve the



conduct of the Interuniversity debating competition by incorporating all the universities. We solicit the cooperation of the Council and all the members of the Institute of Chemistry by giving new ideas and participating in the activities organized by the Institute to make this presidential year a great success.

Prof. M D P De Costa
President, Institute of Chemistry Ceylon

Prof M D P De Costa was ceremonially inducted by the President, Prof S P Deraniyagala, as the new President for 2010/2011 by awarding him with the President's medal.

Challenges for the 21st Century

Professor S P Deraniyagala

Head of the Faculty, College of Chemical Sciences

Professor in Chemistry, Department of Chemistry, University of Sri Jayewardenepura

As you are all aware 19th May 2009 was an important day in the history of Sri Lanka. On this day His Excellency the President Mahinda Rajapaksha declared the defeat of terrorism and successful end to 26 year old civil war which has cost many lives. His Excellency also pledged to work towards achieving rapid progress in development and usher a new era for future generation. People in this country began to breathe fresh air of tranquility after the guns went silent in the North. The people were hopeful about the possibility that the end of terrorism will mean the beginning of a new era, a chance to rethink the future of Sri Lanka in more peaceful terms with optimism blossoming.

It was during this period I was contemplating on a suitable theme for my year of Presidency 2009/2010. With the United Nation General Assembly declaring the year 2011 as International year of Chemistry to celebrate achievements of Chemistry and its contribution to the well-being of humanity with the tagline – **Chemistry, our life and our future** and along with the idea that chemistry is the heart of science, which is the foundation in which technology is built, I thought it would be appropriate to focus our attention to growing challenges to Chemists and Chemistry are facing and see how to convert these challenges to wonderful opportunities that would contribute to national development. This I firmly believe will contribute to brighter future for the society in general and chemistry professionals in particular.

My presidential address will be a brief commentary on some challenges faced by Chemist in the 21st Century. The challenges and opportunities for each country will be different depending on the local problems and resources but many of them will be common to many countries.

There are several challenges faced by Chemist and Chemistry that I consider very important. They are,

1) Challenges in communicating.

As Chemists we should all share the challenge of Communicating effectively to the general public both through media and directly, the importance, excitement and contributions that Chemistry make to Society. We must explain what chemists do and the increasingly important role chemists must play in meeting challenges of the future in pursuit of a better world. In Sri Lanka, Institute of Chemistry must give a leadership role more than what it gives now, in giving the Chemists the ammunition to do this more effectively through various activities. I suggest we have a National Chemistry Week every year during the Annual Session or otherwise and also to recognize the Chemists who have made significant contributions in the field of Chemistry both here and abroad through a Chemistry Award Night may be once in two years. When it comes to communicating the importance of Chemistry through media (i.e. Newspaper, News Magazine, Radio and T.V); Chemistry to a large extent invisible. If the message

given by Chemists are so exciting, why is that the media is not paying attention? This does not seem to be with those working in other areas such as Physics, Biology, and Astronomy where new discoveries seem much common. This challenge is quite clear. Most argue that Chemists must be more proficient in their communication skills particularly in their interaction with journalist who will write the final story. As an example, when a new medicine is announced, credit is usually given to those who carried the last steps the physician who tested the drug that was invented by Chemists. As a result chemical scientist, with responsibility for the original invention may not receive any credit what so ever and the public may not recognize that Chemists made essential contributions. Chemists and their professional bodies need to work with media experts if such patterns are to be changed.

To recruit students into Chemistry, we as Chemist must convince them through effective communication that they are needed to help meet the Challenges such as preserving the environment, developing renewable energy sources, discovering new drugs and ways to synthesize these, develop efficient new catalyst and synthesizing nanoscale materials. We will rely on Chemistry teachers at all levels to inspire students to use their own potential to unlock Chemistry's hidden secrets. So if we present these critical human needs and challenges to best and brightest students, we can attract them to Chemical Sciences. So attracting best and brightest young students young into Chemical Sciences in my opinion may stand alone as an important challenge by itself.

Furthermore, Chemistry is an international subject. As far as countries like Sri Lanka is concerned attracting best and brighter students into Chemical Science is not sufficient to produce useful Chemists. We need to catch the students young and teach in English very effectively. With ever increasing number of students clamouring for chemical education in English Medium in our country, we need to have qualified Chemistry teachers and academics who can teach in English medium. Currently we have only about 20% of the Chemistry teachers population in Sri Lanka who could teach Chemistry in the English medium.

Communication and using a language which can be understood by every one is very important when dealing with the world outside.

Our current education system is not equipped to bridge the language barrier which has been created in order to use the English language as a language to express our ideas to the world.

We as a nation must take action to promote the English language as a compulsory language within specialized fields, for example Chemistry and Physics. The international world as well as Sri Lanka would benefit greatly if our academics could communicate in a universal language.

It is a proven fact that our students as well as the lecturers are thorough with the subject matter yet we are lagging behind many nations as our ability to express our talents in English stands as a great barrier. We are always looked down and rarely recognized as we cannot use the English language in confidence.

The Sri Lankan government must get involved more actively to promote the English language in School and Universities in this country. A better structured approach and more openness towards the English language as a language for academic studies in Sri Lanka needs to be adopted and welcomed.

At the start there may be set backs as in everything in life but as a nation we must make an attempt to use English as a language for education and teaching.

Our doubts are traitors and make us lose the good we often might win, by fearing to attempt - **William Shakespeare**.

2) Find alternatives to fossil fuels-i.e. we are looking at the energy for the future and at the same time has to find possible approaches to solve problems that have serious Environmental problems (In our quest for suitable sources of energy, appropriate way to transfer it and efficient ways to use it we need to develop an approach that is sustainable and will not pollute our environment. The practical challenges in dealing with energy needs are enormously important and new significant development in basic sciences are needed in order to meet these challenges). This is truly an interdisciplinary issue as we need to address the potential dramatic shortfall in the global energy supply in the not too distant future. Engineers, Physicists, biologists as well as chemists (of course) will be involved. All these scientists will have to intensify their cooperation, in academic as well as in industry.

As Chemists, we are challenged to develop inexpensive and unlimited energy sources to have sustainable future. Currently about 80% of the world energy is obtained from burning of fossil fuels- Petroleum, natural gas and coal but this has to change soon. This is because there is only a finite supply of fossil fuel which becomes scarer and burning fossil fuels produces CO₂ that contribute to the green house effect or global warming by which solar energy is trapped within the atmosphere and warm the planet. Burning fossil fuels also produces oxides of nitrogen and sulfur and other pollutants that affect plant and animals.

There has been considerable interest on finding feasible and harmless ways to capture and permanently sequester CO₂ underground or in ocean thereby preventing the accumulation in the atmosphere. CO₂ concentration has increased considerably since the beginning of the industrial revolution. Unless contribution of fossil fuels are halted or unless CO₂ from fuel burning is completely and permanently sequestered CO₂ concentration in the atmosphere will inevitably continue to rise with potentially significant consequences from global warming.

One of the major challenges Sri Lanka is faced with is the fuel or energy crisis. In the year 2006 we spent Rs. 215 billion to import crude oil. In the year 2007 and

2008 it has increased to Rs. 276 and Rs. 360 billions respectively. As a result of high import fuel prices, the local price of diesel and petrol have been increased considerably causing an increase in cost of almost everything (includes food, transport fares & power). What are the alternatives that need to be developed ; although energy systems are dominated by fossil fuels. Answer: There is no single solution but a variety of approaches could make useful combinations.

Solar Power

Scientist, including chemists, have also been pursuing the direct capture of sunlight either for heating or directly generating electricity. Here we are talking of photovoltaic cells that can directly convert solar energy to electricity. Presently photovoltaic cells can convert 30-40 % of incident light to electricity. So the technical challenge is to device materials and manufacturing processes for photocells that are cheap, long lasting and efficient in the conversion of light to electricity; ways also needed to collect, store and distribute energy when and where it is needed. These problems have not yet been solved completely. A related advance is the convention of electrically conductive polymers, which are not metals. Alen J Heeger, MacDiarmid, Shirakawa received the Nobel prize for Chemistry in 2000 for opening up this new area of science.

Another alternative way to take the advantage of sun's energy is the development of photo cells where chemical reactions are made to take place to generate electricity. For example, photochemical splitting of H₂O could be combined with H₂ fuel cell. Thus this area of producing electricity depends on basic research in photochemistry.

Nuclear Energy

7% of worlds total energy is nuclear energy. Nuclear energy has several advantages if the nuclear waste problem can be solved. A typical nuclear energy plant produces 20 metric tons of radioactive waste each year.

Advantages of Nuclear Fuels: Inexpensive, no greenhouse or acid rain effects, energy can be generated near where it is to be used.

Disadvantages : hazard if the Plant is run carelessly, making nuclear weapons, Radio active by products in terrorist activities. If these problems can be solved, the current negative perception of nuclear energy will undergo a change, and will permit the full use of nuclear energy to the world, particularly after we stop burning fossil fuels.

Wind power

Sri Lanka has great potential for new sources of renewable energy. Apart from solar energy, wind power –coastal wind is also readily available to be put into production of energy. Wind power is the most environmentally friendly source of energy for large scale electricity production. It is a renewable form of energy that produce no pollution. Wind turbines produces electricity by converting the kinetic energy of the wind into electrical power. Since the energy content

is directly proportional to the wind speed raised to the third power, measuring wind conditions will therefore be of considerable importance of optimal efficiency. Wind power is now considered as world fastest growing source of energy and is widely used in Denmark, Germany, Spain, India and USA. In these countries wind turbines are often grouped together in what are called wind farms.

Other alternatives include, electrochemical cells, development of fuel cell technology, high capacity storage batteries which are light, inexpensive, long lasting and rechargeable, production and storage of hydrogen as a contribution to the hydrogen economy, biodiesel and bioalcohols. Thus there are many alternatives to petroleum. All these alternatives need to be included in medium to long term plans in the energy sector.

Some Challenges for Chemists

- Develop more stable and less expensive materials and methods for the capture of solar energy and its conversion to energy or to useful products.
- Design inexpensive, high-energy-density, and quickly rechargeable storage batteries that make electric vehicles truly practical.
- Develop practical, less expensive, more stable fuel cells with improved membranes, catalysts, electrodes, and electrolytes.
- Develop materials, processes and infrastructure for hydrogen generation, distribution, storage, and delivery of energy for vehicles.
- Develop photocatalytic systems with efficiencies great enough to use for chemical processing on a significant scale.
- Learn how to concentrate and securely deal with the radioactive waste products from nuclear energy plants.
- Develop practical superconducting materials for energy distribution over long distances.
- Develop technologies and catalysts for the cleaner use of coal as a fuel and for the conversion of coal to other fuels.
- Develop methods to use biomass as a renewable fuel source.
- Develop technologies for the improved extraction of conventional fossil fuels, including unconventional sources such as oil shale, tar sands and deep-sea methane hydrates.
- Develop practical and environmentally responsible methods of carbon dioxide capture and sequestration.
- Develop lower cost, lighter weight, more durable, more resilient and recyclable materials for the construction of safer lighter-weight vehicles.
- Develop improved materials, processes, and practices that will allow reduce energy use per unit of gross domestic product.

3) Challenges to preserve the environment – As Chemists in co-operation with other scientists need to develop a better understanding of the atmosphere and the biosphere so that we can maintain a livable environment.

With respect to this title, we have come a long way. If we look in to the progress to date briefly, Geochemists have made major progress in learning about the chemistry of earth and its components, including rivers, lakes and oceans. The chemistry of the atmosphere has been elucidated in much more detail. A field called earth system engineering is emerging which address global warming, carbon sequestration environmental benign manufacturing and it will require further development with chemical sciences and engineering as important components. This will also address new analytical, computational and assessment techniques through which global-scale interactions in complex system can be better understood and optimized. Chemists have identified how oxygen (O_2) is converted to ozone (O_3) in the stratosphere under the influence of UV light from the sun. We also know how human generated (anthropogenic) gases such as Chlorofluoro carbon (CFC) refrigerants caused degradation and depletion of the ozone layer. It is also well known that increasing CO_2 concentration in the atmosphere causing global warming or Green house effect. Other gases such as water vapour also contribute to green house effect, but CO_2 is of particular importance because CO_2 levels correlate with human activity. For this reason there has been extensive debate about the extent to which global climate change is anthropogenic. Other major green house gases are methane, nitric oxide and tropospheric ozone. Methane is the principal component of natural gas but is also produced from other sources such as rice paddies and farm animals. Tropospheric O_3 is generated naturally and by sunlight induced reactions of by products and nitric oxide is formed in microbial reactions, in part from nitrogen containing fertilizers and as a by product from chemical reactions. CO_2 and CH_4 generated by human activity – appear to be making the greatest contribution to global climate. Both gases CO_2 and CH_4 are more abundant in the atmosphere than at any time during the preceding 400,000 years. We also know that burning petroleum products in gasoline and diesel engine of vehicles can lead to air pollution by emissions of unburned hydrocarbons, sulfur and nitrogen oxides produced during the combustion process. When this was realized fuels were refined to reduce sulfur content and vehicles were filled with catalytic converters to remove hydrocarbons, oxides of nitrogen from vehicles exhaust. The oxides of sulfur and nitrogen are principle species that contribute to acid rains. Catalytic converters are used now world wide which is an excellent example of beneficial global effect of chemical science and technology. Today almost all chemical manufacturers in US and increasingly, worldwide subscribe to a program called **responsible care**. In brief it involves a pledge by the manufacturers to make only products that are harmless to the environment and to its living occupant and by processes that are also environmentally and biologically benign.

Another important initiative, is called Green Chemistry developed as part of efforts to reduce pollution at the source. It is defined as “the design of the chemical products and processes that reduce or eliminate the use and generate of hazardous substances. This was originated in US and it is increasingly, becoming a worldwide program.

Take DDT as an example, DDT is a very efficient pesticide used in the control, of malaria. However, its wide spread use cause problems, since it is very stable. As a result of its stability it persists in the environment, enters the food chain and now its use is completely eliminated. At one point, it was thought persistence is a good thing, it will keep on working but it is now known that its accumulation and persistence lead to unexpected problems. We need to find insecticides and herbicides used in the control of weeds that have limited persistence and last enough to do the damage and then disappear harmlessly. Similar persistent problem is there with CFC's. CFC's are so stable and unreactive under normal conditions. They are quite harmless to human and other living things. However they can diffuse through the atmosphere, reach the Stratosphere where the ozone layer is formed and damage the ozone layer. The elucidation of this chemical process by which CFC's destroy the ozone layer in the stratosphere was done by Crutzen, Molina and Rowland who won the Nobel prize in 1995 for this work.

Although we have come a long way and considerable progress has been made as reviewed briefly we still have to go a long way as many challenges remain. If we are to promote a favourable legacy for the future generation, chemists will need to develop effective ways to meet the following challenges.

1. Chemists need to understand in full the complex chemistry by which atmosphere and earth interact and provide scientific basis for policies that preserve our environment. This I consider as a fundamental challenge where we learn about the world we live in. We have to understand fully the dependence of global climate on carbon dioxide concentration in the atmosphere. Is there a way to deal with carbon dioxide produced by burning coal and hydrocarbon fuel, so that it causes no problem. We have to come up with ways to trap carbon dioxide that would otherwise build up the atmosphere. Alternatively, we have to come up with ways to reduce generation of carbon dioxide. As human activities continue to destroy forest, will this affect the carbon dioxide cycle and what needs to be done about this.
2. Ensure that chemical manufacturing and chemical products are environmentally and biologically benign, never harmful.
3. Learn how to make products that are stable over their necessary life but then undergo degradation so they do not persist in the environment or in living creatures.
4. Invent agricultural chemicals that do not harm unintended targets in any way and are not overly persistent.
5. Develop selective catalysts that enable the manufacture of useful products without producing unwanted waste products and without using excessive energy.
6. Invent processes for the generation and distribution of energy that do not release greenhouse gases or toxic contaminants into the atmosphere.
7. Help humans control their population growth by inventing birth control methods that are safe and effective, inexpensive, and widely available and accepted.

Challenges in synthesis and manufacturing – Chemists are challenged to develop highly selective, energy efficient and environmentally benign new synthetic methods. For example, synthetic chemists will need to devise ways to predictably carry out synthesis on the surfaces of a semiconductor chip to enable the attachment of genes for use in diagnosis.

Some challenges for chemists

- Develop methods that will enable synthesis of all important molecules in reasonable yields using compact synthetic schemes, so that no useful compound is inaccessible to practical synthesis.
- Use computer methods to design important target molecules and design efficient ways to make them.
- Exploit combinatorial methods to discover important properties in synthetic materials.
- Understand fully the basic chemical and physical properties of surfaces, especially those of solid catalysts.
- Synthesize new substances that can spontaneously self-assemble into complex organized systems with important properties.
- Devise good manufacturing processes-efficient and environmentally benign, producing no unwanted by-products, and using little energy-for all important products.
- Intensify manufacturing processes, so that compact chemical plants can make required amounts of products efficiently, safely, and with minimal environmental impact.

4)Challenges in the development of interesting new materials - Self Assembly and Nanoscience holds great promise.

This is an area that deal with the design and manufacture of materials, an area in which chemistry and chemical engineering play the central role; there is considerable overlap with the field of materials science, which is built on chemistry, chemical engineering, electrical engineering, and physics. We are familiar with such advances as modern plastics, paints, fabrics and electronic materials, but great opportunities and challenges for the future still remain. As one example, materials with useful superconducting properties will have a huge impact on our lives if they can be developed in a way that permits practical transmission of large electrical currents over long distances without resistive loss. We conclude that the opportunities for the invention and production of novel materials with exciting new properties make this one of the areas of greatest opportunity for future research and development.

Some challenges for chemists

- Invent improved structural materials that are stable at high temperatures and easily machined.
- Invent materials with useful electrical and optical properties, including high-temperature superconductivity.
- Invent materials that are lighter, stronger and more easily recycled.
- Invent materials for surface protection (plant and coatings) that are truly long-lasting and rugged.

- Understand and utilize the properties of nanoscale materials and materials that are not homogeneous.
- Create nanomaterials technology from nanoscale chemical science.

Challenges in drug discovery from plants

Plants have been the basis of many traditional medicines systems throughout the world for thousands of years and continue to provide mankind with new remedies. Plant based medicines initially dispersed in the form of crude drugs such as tinctures, teas, powders and other herbal formulations, now serve as the basis of new drug discovery. The process of drug discovery from plants involves a multi disciplinary approach combining botanical, new disciplines known as ethanobotanical, phytochemical and biological techniques. Botanists and ethanobotanists collect and identify the plants of interest. Phytochemists prepare extracts from the plant materials and subject these extracts to biological screening and continue the process of isolation and characterization of the active compound(s) through bioassays – directed fractionation.

Plants continue to provide us new chemical entities (lead molecules) for the development of drugs against various pharmacological targets, including cancer (paclitaxel extracted from yew tree, Marketed as Taxol), HIV/AIDS ((+) Calanolide A isolated from Malaysian rain forest trees, anti HIV drug), malaria (Anti malarial drug Arteether isolated from a plant used in Chinese medicine), Alzheimer's disease (Galanthamine isolated in Russia) and pain (Morphine-6-gluconomide), alternative pain medication with fewer side effects than morphine. Several natural products of plant origin are in clinical use, including TAXOL, Galanthamine, arteether to name a few, and some are undergoing Phase II and Phase III clinical trials. Although plant – based discovery programs continue to provide an important source of new drug leads, numerous challenges are encountered.

1. Natural product scientists and pharmaceutical industries will need to continuously improve the quality and quantity of compounds that enter drug development phase to keep pace with other drug discovery efforts.
2. The approach of herbal drug development is associated with several problems. Crude herbs/plants (various plant parts and exudates) are mostly formulated as tablet and capsule, and to some extent as oral liquid preparations. These dosage forms are not successful due to problems encountered in absorption, therapeutic efficacy and poor compliance. Tablet or capsule dosage form requires powdering of crude herbs and particle size affects the process of blending, compression and filling. In addition, homogeneity is difficult to achieve due to the handling of large bulk quantities, high moisture content and inherent nature of raw materials (crude drug). Crude extracts are difficult to formulate in solid dosage forms due to their hygroscopic nature, poor solubility and stickiness.

3. As drug discovery from plants has traditionally been time-consuming, faster and better methodologies for plant collection, bioassay screening, compound isolation and compound development must be employed. Innovative strategies to improve the process of plant collection are needed, especially with the legal and political issues surrounding benefit-sharing agreements. The design, determination and implementation of appropriate, clinically relevant, high-throughput screening assays can be challenging, once a screening assay is in place, compound and extract libraries can be tested for biological activity. The common problem faced during screening of extracts is solubility and the screening of extract libraries is many times problematic, but new techniques including pre-fractionation of extracts can alleviate some of these issues.

4. Challenges in bioassay screening remain an important issue in the future of drug discovery from medicinal plants. The speed of active compound isolation can be increased using hyphenated techniques like LC-NMR and LC-MS. Development of drugs from lead compounds isolated from plants, faces unique challenges. Natural products, in general, are typically isolated in small quantities that are insufficient for lead optimization, lead development and clinical trials. Thus, there is a need to develop collaborations with synthetic and medicinal chemists to explore the possibilities of its semi-synthesis or total synthesis. One can also improve the natural products compound development by creating natural products libraries that combine the features of natural products with combinatorial chemistry.

Finally let us see what steps that can be taken to enhance the effectiveness of chemistry in contributing to human welfare and understanding (How we are going to achieve the goals that were highlighted little while ago as challenges to the 21st century).

It can be concluded by saying chemists needed to be prepared to work increasingly in multidisciplinary teams, and this will change the way we educate future chemical scientists. In other words we need to rethink graduate education in chemistry. Universities need to come together to share their ideas on retooling the Ph.D in Chemistry. We need to reexamine Ph.D programs because of the growing interdisciplinary nature of research and the increased emphasis on team work. Will the traditional research division make sense? What are the characteristics graduates should possess? It can be also concluded that chemists must put much more effort in to effective communication with the media and with students from grade 1 up.

I urge that educators revise undergraduate and secondary school courses in chemistry to make them broadly appealing to students with a variety of interests, and that teachers in grade 1-13 invite chemical scientists to speak with their students about the challenges and opportunities waiting for those who choose to become scientists. We also urge that students get into research as

soon as possible, so they can learn what it is that scientists find so exciting.

I urge that we cooperate with the media in explaining the achievements and goals of the chemical sciences, and that the general public encourage their sons and daughters to consider careers in science to help solve the challenges we have identified. I urge government agencies and private foundations to support the fundamental research that underlies applied science in addition to supporting the applied

science itself. I urge that chemically based industry also support university research and education, and continue progress in Green Chemistry, with its important environmental benefits.

I conclude that the chemical sciences has not only a great past but an even more exciting future, but that we will need to communicate more effectively with our fellow citizens, and will need their support so that we can indeed make the contributions that we see as possible.

Membership News

The following persons have been either transferred or admitted to the categories of membership and designation between January 2010 to May 2010.

Admission to Member

Dr. S Chakrawarthy, Mr. W A R Fernando

Transfer to Member

Mr. K T Arulananthasivam, Mrs. K A P S Kuruppu

Admission to Affiliate

Dr. (Ms.) R Madanayake

Admission to Associate

Ms. D Attanayake, Ms. D G M R Dabera, Ms. G L M L A De Silva, Ms. E W M P W N U Ellepola, Ms. S D Hettiarachchi, Ms. S M J Hettiarachchi, Ms. W A C L Jayasekara, Ms. N M R Shashikala, Mr. P P G P Panduka, Ms. M C R Peris, Mr. T A N Peiris, Ms. D S R Perera, Mr. N M S D Perera, Ms. K S U Rathnayake, Ms. M D W Samaranayake, Ms. H D M Sriyathne, Ms. S P I U Hewage, Ms. V Vigneshwaran, Ms. G D Wijesuriya, Ms. D M I Y Dissanayake, Ms. I Fhazi, Ms. N S Jayawardana, Ms. J Mariyathas, Mr. S Vaseetharan, Mr. P T Wansapura, Ms. S D A Wickramasinghe, Mr. K W S C P S Wijesinghe, Ms. S Yasodharshini, Ms. L G H I Guruge, Ms. V G Thangavadivale, Ms. L H S M De Silva, Ms. G I D S D Malawana, Ms. A W Kalubowila, Ms. H M K C Herath, Mr. K R S Thenna Hewa, Ms. G G E H De Silva, Ms. T S N Peiris, Ms. C D Devasinghe, Ms. M D L M Mahawatta, Ms. S Princy, Ms. S Karunamoorthi, Mr. J N Dias, Ms. I C Dissanayake, Ms. K S P Lokuge, Mr. D S Ranasinghe, Ms. R A D T Dharshani, Ms. P G P S D Panangala, Ms. B A H E Balachandra, Ms. D P W Jayatunga, Ms. N A S Karunarathne, Ms. D H K Amarasekara, Ms. H M Ramanayake, Ms. P N N Paranawithana, Ms. I Lewkebandara, Mr. H G A Jinadasa, Mr. K N Amarasinghe, Mr. G K R P Gajanayake, Ms. W A N Wickrama Arachchi, Ms. C N De Silva, Ms. E M A R Edirisisinghe, Ms. P P K Karunaratne, Ms. M R C K Mallawa, Mr. A R Adhikari, Ms. R N De A Dissanayake, Ms. R P D Y D Chandrasena, Ms. H D H K De Alwis, Ms. J H P D S Tissera, Ms. W D C S Abeywickrama, Mrs. S K M Kuruppu, Ms. S S S Dayarathna, Ms. H L T H De Silva, Mr. W R S De Silva, Mr. N D Hapukotuwa, Mr. J A M A Karunathilaka, Ms. P C Kathiriarachchi, Ms. J A Labrooy, Ms. A Mahalingam, Ms. T N Meegahawatta, Ms. W W V T Mendis, Ms. M A D D Nimmi, Ms. J P S L Perera, Mr. H P N D P Pushper Sri, Ms. A R Rajamanthre, Ms. K W V P Ranasinghe, Mr. R H P K Senadeera, Mr. A T U Somapala, Ms. S Thenuka, Ms. K Varartharajaperumal, Mr. D S P Warnakula, Mr. W A I Wickramasinghe, Mr. W V P A Chinthaka, Mr. A S B Rajapakse, Mr. V N P Liyanage, Mr. S Srivijendran, Mr. S H L Madunil,

Admission to Licentiate

Ms. T E Kularathna, Ms. K A L C Gunerathne, Ms. W A M T Nissanka, Ms. W T N Perera, Ms. M G A S Jayawickrama, Mr. A J S Chinthana

Admission to Technician

Mr. K S J Kolambage

Kandiah Memorial Graduateship Award - 2010



Mr N D A Wageesha of Department of Biochemistry, University of Sri Jayewardenepura, Nugegoda has been awarded the Kandiah Memorial Graduateship Award in recognition of his research on '*Hypercarotenaemia in Sri Lankan children below 5 years of age and experimental studies on Hypercarotenaemia in rats and mice*'. The research was carried out under the supervision of Prof. E.R. Jansz, Dr. S. Ekanayake of the Department of Biochemistry, University of Sri Jayewardenepura, Nugegoda and Prof. S.P. Lamabadusuriya of Department of Paediatrics, University of Colombo, Colombo. Mr. Wageesha obtained his Graduate Chemist qualification in 2007 from the College of Chemical Sciences, Institute of Chemistry Ceylon with a Second Class upper division honors. Presently he is working as a Research Assistant, Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura.

Kandiah Memorial Graduateship Award - 2010

Hypercarotenaemia in Sri Lankan children below 5 years of age and experimental studies on Hypercarotenaemia in rats and mice

N.D.A. Wageesha

Department of Biochemistry, University of Sri Jayewardenepura, Nugegoda

Introduction

Hypercarotenaemia, also known as Carotenaemia was first described by Hess and Myers in 1919. Hypercarotenaemia is a benign condition, which arises in Sri Lanka due to excessive intake of carrots, pumpkin and papaw. Hypercarotenaemia can occur at any age but is more common in infants and young children (Wageesha *et al.*, 2008). Generally hypercarotenaemics have yellow skin, specially palms and soles mainly due to the deposition of carotenoids in adipose tissue. It can be distinguished from jaundice as the sclera of the eye is not affected because it is largely protein. On testing blood, serum β -carotene levels are elevated by 3-4 times the normal while vitamin A levels remain normal.

There is some evidence that not all infants fed in this way develop clinical features of hypercarotenaemia. There appears to be a genetic factor at play. It was proven that the enzyme carotenoid 15, 15'-monooxygenase (CMO1) catalyzes the first step in the conversion of dietary pro-vitamin A carotenoids to vitamin A in the small intestine (Lindqvist *et al.*, 2007). There was no detailed study carried out on hypercarotenaemia in Sri Lanka prior to Priyadarshani *et al.*, (2009). In the study by Priyadarshani *et al.*, (2009) eight hypercarotenaemics were clinically identified and their carotenoid and vitamin A profiles were estimated.

The objectives of the study;

1. To identify infants/children with hypercarotenaemia and determine the clinical cause for the development of hypercarotenaemia in these study subjects.
2. Using rats and mice as experimental models, attempt to determine whether inherited defect in intestinal absorption/malabsorption of carotenoids could be a contributory factor for the development of hypercarotenaemia in the study subjects.
3. Study the approximate prevalence of hypercarotenaemia in Sri Lanka

Methodology

Ethical clearance

Ethical clearance was obtained from Ethics committee of the University of Sri Jayewardenepura, Gangodawila, Sri Lanka. The age of the hypercarotenaemic patients varied from 9 months to 5 years. The dietary histories were obtained through a questionnaire based study. The blood of children/infants (n=36) was obtained through a Consultant Paediatrician. None were hypothyroidic, jaundiced, or on vitamin A supplementation.

Serum carotenoids and vitamin A in hypercarotenaemics;

Venous blood (4 mL) was drawn from each patient into a tube free of any additives. The blood samples were centrifuged and serum separated and stored at -20°C for analysis. In the longitudinal study the same patient's blood was drawn at periods of one month and two months time after cessation of carotenoid containing food.

Hypercarotenaemic sibling susceptibility to hypercarotenaemia

A questionnaire designed to obtain information (age, sex, initiation of solid foods, food combinations, vitamin A mega dosing, number of siblings and their dietary pattern and monthly income etc.) was administered to parents of above hypercarotenaemics (n=35). However, as data is recalled, it is subjected to a certain degree of variability.

Prevalence Study

A questionnaire was self administered to parents (n=780) of nursery/ kindergarten children (convenient sample) in three international schools and 7 other private nurseries to obtain information on extent of feeding of carotenoid rich foods and development of hypercarotenaemia among those children and their siblings. The age range of children was 2 years to 5 years and was residents of Western province. The questionnaire was formulated to obtain the information on Gender and Age, solid food was first given, food combinations frequently fed to the

child, whether vitamin A mega dosed or not, development of hypercarotenaemia, number of siblings and their dietary patterns and if they have experienced hypercarotenaemia etc.

Animal study

For the animal study twenty male Wistar rats and 28 male ICR mice aged 3 weeks were obtained from the MRI, Colombo. After a week of acclimatizing the rats and mice were divided into two equal groups with mean weights and fed with freeze-dried carrot incorporated (30 g/ Kg) standard rat/mice feed. At the same time, boiled carrot with butter was given to the test group daily (1 g/day for rats and 0.5 g/day for mice). This diet was continued up to 2 ½ months in an attempt to induce hypercarotenaemia.

The controls were fed with standard rat/mice pellets with same amount of butter incorporated in the diet.

Validation of the RP-HPLC technique

Prior to commencement of the experiments using the RP-HPLC, validation, of the instrument for the parameters being measured was carried out to minimize the possible errors. The conditions for analysis of both vitamin A and carotenoids were optimized for the above instrument. The following validation parameters were tested and optimized for the analytical technique that was used in all the HPLC assays.

- Precision
- Repeatability
- Linearity using the standard solutions
- Limit of detection

The main analytical technique that was used was Reversed Phase High performance Liquid Chromatography (RP-HPLC). Serum carotenoids, their metabolites, internal standards (β -apo-8'-carotenal and retinyl acetate) which was added prior to the extraction were extracted into hexane, repeatedly under dim light after addition of ethanol (1:1 based on serum) (Bieri *et al.*, 1979; Barua *et al.*, 1998) until there was no colour in the hexane layer. For analysis of carotenoids and metabolites, one hexane portion was evaporated under a stream of nitrogen and re-dissolved in 200 μ L of RP-HPLC mobile phase (58% Acetonitrile: 35 % Methanol: 7% Tetrahydrofuran) and other portion was re-dissolved in 200 μ L of 100% methanol for vitamin A analysis.

Quantification

- a. Major carotenoids and their metabolites
RP- HPLC equipped with C_{18} column was used to estimate the concentration of carotenoids and their metabolites in the samples. Peaks were detected at 450 nm and the major carotenoids and their metabolite peaks were identified by
 1. Comparison with that of the standard retention times
 2. Peak enrichments using carotenoids standards
 Quantification was performed with reference to peak area of the internal standard and the percentage recovery factor.
- b. Vitamin A
Vitamin A analysis was carried out at 325 nm.

Identification of peak corresponding to vitamin A was done by using enrichment with all-*trans*-retinol. Quantification was performed using the standard curve ($r^2 = 0.9926$) of all-*trans*-retinol.

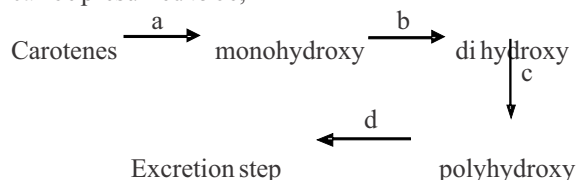
A spectrum of the serum extracts and fractions eluted from the RP-HPLC were scanned between 190-800 nm by UV/Visible double beam spectrophotometer in a quartz cuvette against the relevant solvent blank.

Results and Discussion

Serum carotenoids and vitamin A in hypercarotenaemics;

The serum carotenoids, their metabolites and vitamin A levels of 36 hypercarotenaemic patients on reporting are summarized in Table 1 (a) and Table 1 (b) in Annex I.

The general progression of metabolism of carotenoids can be presumed to be;



Where, step (a), (b), (c), (d) can be fast or slow. This will dictate the final serum carotenoid profile.

As an example if step (a) is slow compared to step (b), (c) and (d) the accumulation of carotenoids will be high and the serum profile will indicate this. If this step is fast compared to the other steps there will be increased monohydroxy derivatives in the serum profile. If the rate of the step (a), (b) and step (c) were high compared to the rate of the step (d) the concentration of polyhydroxy metabolites will be high compared to the mono and di hydroxy metabolites. If the rate of the step (d) is high the clearing out will be more rapid and the carotenoids and mono, di and polyhydroxy metabolites will be less in the serum profile. Therefore the serum carotenoid profiles of the hypercarotenaemics will be dictated by the steps mentioned above, which will give rise to a wide range of profiles in hypercarotenaemics. Hence a defect in any step will give rise to a significant accumulation of prior product and thus can be identified by the serum carotenoid profile. The vitamin A levels were normal except in one case (Range 6.3 μ g/ dL to 93.5 μ g/ dL). No hypervitaminosis by vitamin A. Therefore the 15-15' dioxygenase is under control in hypercarotenaemics. In non hypercarotenaemics carotenoids were not seen in the serum profiles with vitamin A levels ranging between 21.8 - 47.8 μ g/dL.

Longitudinal study:

The levels of the serum carotenoids, their metabolites and vitamin A levels after cessation of carotenoid bearing foods for one month and two months were shown in table 2 (a) and table 2 (b) respectively (Annex II). In this longitudinal study there was a decline of all serum carotenoid levels and their metabolites. However the rate of decline was variable in each case which is

carotenoids. Each individual may have different levels of activity or quantity in the key regulatory steps as discussed earlier. If enzymes (a), (b), (c) and (d) are found always in the same quantity and activity in all individuals the serum profiles must be similar to each other. The vitamin A levels remained at a consistent level even after cessation of yellow and orange coloured pro-vitamin A carotenoid bearing food and fruits. This is probably due to the action of liver 15-15' – dioxygenase activity where the enzyme acts on stored pro-vitamin A carotenoids and produced the required amounts of vitamin A (During *et al.*, 2001).

Sibling study:

Among the 36 hypercarotenaemic patients who present for medical advice only 21 had siblings and 17 out of them had similar diet as their hypercarotenaemic sibling had ingested. However none of them had experienced hypercarotenaemia at any stage. Therefore the ratio of hypercarotenaemia to non hypercarotenaemia was 21:17. If simple Mendelian genetics were applied, a homozygous dominant parent is ruled out. However a heterozygous dominant parent should give a ratio of 1:1 hypercarotenaemia to non hypercarotenaemia, while two heterozygous recessive parents will give rise ratio of 1:3 in hypercarotenaemic to non hypercarotenaemic. The sample is too small for Mendelian genetics to apply. However, among the 36 investigated cases, there was a pair of identical twins fed on similar diets where both developed hypercarotenaemia. The carotenoid profiles of the identical twins were very similar to each other. This clearly gave a strong indication of involvement of genetics with the hypercarotenaemia either in absorption or in the metabolism of carotenoids in hypercarotenaemics. Here all the key regulatory enzymes, enzyme (a), (b), (c) and (d) acts in a similar manner with similar rate and activity due to the similar genetics which governs their activity.

Prevalence study:

The test group of the survey was children aged six months to five years. Majority of them were attending International schools at Wattala, Panadura and Kalutara in the Western province of Sri Lanka. These schools were chosen as the parents were well exposed to public awareness programs on nutrition intake and are able to give their children copious quantities of carotenoid rich foods.

From the questionnaire results, among all subjects investigated; approximately 1.5% had developed hypercarotenaemia. Out of those ingesting large amounts of carotenoids rich food and fruits, approximately 2% developed hypercarotenaemia. Therefore even if the same amount of carotenoid bearing foods as given to hypercarotenaemics, are given to most children they do not develop hypercarotenaemia, indicating no major correlation between carotenoid intake and hypercarotenaemia. Likewise the questionnaire results also showed that the mega-dosing with vitamin A also has had no major effect on development of the condition, which ultimately proves that the defective gene(s) are not common in all.

Stools of infants.

The RP-HPLC chromatograms of four controls/non hypercarotenaemics shows that there are α and β carotenoids in the faeces. In the three samples from hypercarotenaemics faeces there were no such peaks corresponded to α and β carotenoids. The present amounts per unit weight of freeze dried faeces were shown in table 3 (Annex III) and the RP-HPLC chromatograms of the two groups shown in the Figure 1 and 2 (Annex IV).

Animal study

Studies with Wistar rats and ICR mice resulted in no outward features of hypercarotenaemia. Serum samples from the both test models showed no evidence of major carotenoids or their metabolites. This could be due to very fast metabolism of any absorbed carotenes. The main adipose tissue around the kidney and the liver tissue yielded no carotenoids. The digesta of Wistar rats and bile from mice do not show any amounts of carotenoids or their metabolites.

One positive result emerged in the Wistar rats and ICR mice study was that the presence of α -carotene and β -carotene and isomers in the faeces, at a level of 24.7 and 30.8 $\mu\text{g/g}$ of α -carotene and β -carotene respectively. This implies that there may be control on carotenoid absorption in the gut where the nutrients are available in sufficient quantities. From this it can be inferred that the CMO 1 gene directed oxygenase in the intestinal mucosa could have at least two functions; that is splitting the pro-vitamin A carotenoids to vitamin A and control over the absorption of carotenoids or both.

Conclusions

Thirty six infants and children who developed hypercarotenaemia on a carotenoid rich diet were studied. This included a pair of twins with very similar serum carotenoid metabolic profile, while variations were observed in other cases. This is indicative of the condition being genetic.

A longitudinal study showed that serum carotenoid levels declined at slightly varying rates on cessation of feeding carotenoid containing yellow/orange food/fruits, although vitamin A remained normal.

All 17 siblings of the hypercarotenaemics, who were also fed on carotenoid rich diets as their siblings, did not show the symptoms. It was difficult to discern if the inheritance pattern of the mutant parental gene was heterozygote dominant or recessive.

A study conducted on children (n=780) up to 5 years on carotenoid rich diets intakes showed the prevalence was $\leq 2\%$, again indicating a genetic basis of hypercarotenaemia. Wistar rats and ICR mice could not be induced with hypercarotenaemia. There were no detectable levels of carotenoids in their liver or adipose tissue. Hence there is no storage and similarly there was no evidence of carotenoids or their metabolites in serum, bile (in mice) and digesta (in rats). However faeces of both rodents showed the presence of α -carotene and β -carotene.

Faeces of non hypercarotenaemic children (n=4) like rats and mice showed the presence of these carotenoids while hypercarotenaemic children (n=3) had no α and β -carotenes, indicating that one method of control in all three species were probably at the level of absorption.

Additional Data
Annex I

Table 1 (a): Levels on reporting to consultant.

Patient #	Vit A Level (i g/dL)	â carotene (i g/dL)	á carotene (i g/dL)	â cryp'xanthin (i g/dL)	Polyhydroxy (i g/dL)	Monohydroxy (i g/dL)
1	Sample was Discarded Due to Improper Storage					
2	91.0	95.0	101.0	ND	163.0	57.8
3	90.7	74.0	95.0	17.0	487.0	35.5
4	55.9	18.0	25.0	16.0	75.0	41.3
5	43.2	9.1	17.6	6.2	40.0	5.5
6	27.3	49.3	71.9	ND	77.2	10.9
7	33.2	38.5	43.4	ND	67.0	11.0
8	39.2	15.3	30.2	ND	93.2	12.8
9	24.0	22.1	15.4	151.6	44.6	214.0
10	93.5	18.4	15.5	23.2	87.2	35.4
11	61.7	29.6	28.3	ND	99.2	19.8
12	18.7	2.0	2.0	7.0	7.0	4.5
13	74.6	40.2	13.2	14.6	293.6	75.3
14	46.0	50.7	62.7	3.7	822.7	35.4
15	33.7	6.3	11.3	13.9	24.6	10.6
16	45.9	53.0	96.4	ND	63.8	21.3
17	23.7	125.7	11.0	ND	21.9	19.0
18	53.1	148.7	119.2	60.6	326.8	43.6

Key: β cryp'xanthin – β-cryptoxanthin; Polyhydroxy- Polyhydroxy metabolites; Monohydroxy- Monohydroxy metabolites;

ND- Not detected

LOD for vitamin A = 0.25 µg/dL; for all carotenoids = 0.5 µg/dL

Additional Data
Annex I

Table 1(b): Continuation of levels on reporting to consultant.

Patient #	Vit A Level (i g/dL)	â carotene (i g/dL)	á carotene (i g/dL)	â cryp'xanthin (i g/dL)	Polyhydroxy (i g/dL)	Monohydroxy (i g/dL)
19	37.0	4.3	3.8	2.2	34.3	54.3
20	31.6	57.6	106.7	ND	507.9	23.9
21	21.9	84.5	103.7	88.3	43.9	20.5
22	28.8	11.7	8.6	ND	22.5	6.5
23	6.3	ND	10.7	ND	27.8	3.5
24	16.2	9.6	ND	ND	9.8	40.3
25	13.5	26	26.1	36.4	54.5	8.7
26	47.0	3.4	TA	22.2	23.9	18.3
27	52.7	28.3	37.4	10.8	101	11
28	17.9	TA	1.8	ND	18.8	2.00
29	20.0	13.8	21.7	ND	53.3	5.6
30	44.0	29.9	29.00	5.00	193.7	8.00
31	24.7	TA	TA	ND	13.9	ND
32	33.0	13.8	21.70	18.50	53.3	5.60
33	21.0	11.7	8.60	ND	22.5	6.50
34	26.3	28.6	18.90	4.80	47.9	8.60
35	31.3	32.5	17.80	5.30	47.6	13.40
36	27.1	2.2	2.90	ND	48.8	2.90

Key: β cryp'xanthin – β-cryptoxanthin; Polyhydroxy- Polyhydroxy metabolites; Monohydroxy- Monohydroxy metabolites;

ND- Not detected; TA- Trace amounts

LOD for vitamin A = 0.25 µg/dL; For all carotenoids = 0.5 µg/dL

Additional Data

Annex II

Table 2 (a): Serum carotenoids, their metabolites and vitamin A levels after a one month period from cessation of carotenoid rich foods.

Patient #	Vit A Level (i g/dL)	â- carotene (i g/dL)	á- carotene (i g/dL)	â-cryp'xanthin (i g/dL)	Polyhydroxy (i g/dL)	Monohydroxy (i g/dL)
1	20.5	4.0	12	ND	64	7.4
2	25.1	13.1	9.9	ND	24.5	9.5
3	43.1	12.5	14.4	ND	32.9	7.0
4	61.7	19.5	21.6	13.5	114.9	37.3
5	44.2	ND	0.0	ND	30.6	TA
6	59.3	6.5	12.5	ND	38.5	6.8
7	46.7	45.9	44.4	ND	88.9	8.0
10	32.7	6.0	5.4	ND	21.5	7.1
11	36.9	5.9	9.0	ND	29.5	4.3
13	76.5	25.5	8.8	92.2	151.6	68.6
14	53.3	4.4	9.0	ND	177.2	12.3
15	43.7	5.8	6.1	18.5	53.7	13.4
16	41.2	20.1	46.5	ND	59.6	11.8
17	65.9	13.5	30.9	ND	16.0	4.9
18	44.1	49.4	47	30.9	58.4	13.8
20	23	4.3	9.6	ND	59.8	4.8
21	50.5	7.2	7.2	5.9	36	25.1
22	25.7	TA	TA	ND	24.1	1.8

Key: β cryp'xanthin – β-cryptoxanthin; Polyhydroxy- Polyhydroxy metabolites; Monohydroxy- Monohydroxy metabolites; ND- Not detected; TA- Trace amounts

LOD for vitamin A=0.25 µg/dL; For all carotenoids =0.5 µg/dL

Additional Data

Annex II

Table 2 (b): Serum carotenoids, their metabolites and vitamin A levels after a two months period from cessation of carotenoid rich foods

Patient #	Vit A Level (i g/dL)	â carotene (i g/dL)	á carotene (i g/dL)	â cryp'xanthin (i g/dL)	Polyhydroxy (i g/dL)	Monohydroxy (i g/dL)
1	23.1	ND	ND	ND	ND	ND
7	36.6	21.7	25.7	0.0	51.8	6.5
13	31.7	10.5	3.0	12.8	23.0	16.0
15	44.6	9.1	7.8	30.9	58.4	13.8
17	49.5	14.5	24.4	ND	17.0	5.1
18	14.6	3.4	5.9	ND	14.1	ND

Key: β cryp'xanthin – β-cryptoxanthin; Polyhydroxy- Polyhydroxy metabolites; Monohydroxy- Monohydroxy metabolites; ND- Not detected;

LOD for vitamin A = 0.25 µg/dL; For all carotenoids = 0.5 µg/dL

Additional Data

Annex III

Table 3: Major carotenoids levels present in faeces of hypercarotenaemics and non hypercarotenaemics

	NHC 1	NHC 2	NHC 3	NHC 4	HC-1	HC-2	HC-3
â carotene (µg/g)	1.53	1.74	1	1.8	ND	ND	ND
á carotene (µg/g)	0.7	1	TA	1.4	ND	ND	ND

Key: NHC- Non hypercarotenaemic; HC- Hypercarotenaemic; TA- Trace amounts; ND- Not detected

LOD for all carotenoids =0.5 µg/dL

Additional Data

Annex IV



Figure 1: Non-hypercarotenaemic patient faeces RP- HPLC profile



Figure 2: Hypercarotenaemic patient faeces RP- HPLC profile

Professor Pearlyn Pereira Gold Medal Memorial Oration - 2010

Mechanistic Studies of Photo-induced Electron Transfer and Development of Fluorescence Probes Based on Hydroxamic Acids for Analysis of Metal Ions

Professor M D P De Costa

Department of Chemistry, University of Colombo, Colombo

Tribute to Madam Pereira

Professor W. P. D. Pereira was born on 24th June 1928 and received her secondary education at Methodist College, Colombo. Though born into a wealthy family, she had the foresight in 1948 to realize the value of education. She was the first female to specialize in Chemistry at the then University of Ceylon. Usually, Mathematics is not popular among the girls but she offered Pure Mathematics as the subsidiary subject. She was awarded a B.Sc. Special degree in Chemistry from the University of Ceylon in 1952. In 1952, Dr. Devanathan returned to the Department with a PhD in Electrochemistry and commenced research in the field of Electrochemistry with minimal facilities. Ms. Pearlyn Peiris carried out pioneering research under the guidance of Dr. Devanathan, which led to the development of the "Devanathan Theory" in electrochemistry. The First Master of Science Degree in Chemistry was conferred to her by the University of Ceylon in 1954. The title of her thesis was "Adsorption of potassium halides at the mercury/water interface". In 1957, she was recruited to the permanent staff as an Assistant Lecturer. She proceeded to Cambridge in 1959 to work on Flash Photolysis for her PhD under the supervision of Dr. A.B. Callear. She was awarded a Ph.D. from the University of Cambridge in 1962. The title of the thesis was "The reaction of atomic hydrogen with ethylene". In 1962 she returned to Sri Lanka and was appointed as a Lecturer in Chemistry.

She was promoted to the post of Senior Lecturer at the Department of Chemistry, University of Colombo in 1969. She was awarded the Commonwealth Scholarship and spent her first sabbatical at the University of Oxford in 1970. Since her return in 1971 she was actively involved in research. Some of the undergraduate students who have carried out their research projects with her are R. Balasundaram(1964), J.N.O. Fernando (1965), C.D.R.A. Jayawardhana (1967), A.P. de Silva (1975), P. Kathiragamanathan (1976, a Full paper 1977), D.C. Wijesuriya (my batch mate, 1984), S.M.C.E. Silva (last student of her, 1986). In 1972, she along with Dr. J.N.O. Fernando, obtained a research grant from NSF to work in the field of Industrial Electrochemistry. They produced one M.Sc. student in 1976 (D.T. Jayamanne). She was the Acting Head for a short period when Prof. Siriwardhana was out of the University in 1976. During her two year sabbatical leave from 1978-1980, she served as a Lecturer in Chemistry at the Nairobi University, Kenya. In 1980, she was promoted as an Associate Professor.

In 1982, she was appointed as the First Professor in Physical Chemistry at the University of Colombo. In 1984, she became the first female Head of the Department of Chemistry, University of Colombo. She was the President of the Institute of Chemistry in

1986/87. She set up two scholarships one at the Institute and the other at University of Colombo in memory of her father and mother in 1986. She took her sabbatical leave and proceeded to Australia and was to return to Sri Lanka in April 1989. Unfortunately Sri Lanka lost a PEARL in Tasmania on 14th February 1989.

1. Introduction:

Mechanistic studies of chemical reactions attract the interest of many scientists with the development of sophisticated and sensitive tools such as spectroscopic and electrochemical techniques. The recent developments in the study of excited state behavior of molecules have become very convenient due to the development of such techniques. Many scientists have already uncovered fascinating photo-physical and photochemical processes leading to photochemistry as a synthetic tool for organic chemists, as a physical method for physical organic chemists, as an analytical tool for analytical chemists and so forth. Many reactions, which could not be performed under normal thermal conditions in the early days, became easily achievable under photochemical conditions. The absorption of ultraviolet or visible light by an organic molecule takes it from its lowest energy state (ground state) into a higher electronic state. Even though electronically excited molecules are normally very short lived, their high energy is sufficient for unique chemistry to occur. Some of these unique processes are,

1. Photochemical reactions.
2. Photo-induced electron transfer
3. Emission (Fluorescence and Phosphorescence)

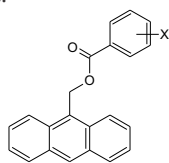
The work presented herein was carried out in the following areas.

1. Photo-induced electron transfer studies
2. Fluorescence and electrochemical sensors for analysis of trace metal ions

2. Photo-induced Electron Transfer (PIET) Studies

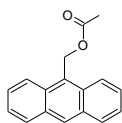
Photo-induced electron transfer (PIET) has attracted much attention during the past two decades. Several reviews¹ and books² have been published in this area. The intramolecular PIET however became more attractive to scientists, since it is the basic mechanism of the biological and chemical - energy conversion processes. Studies of the photochemistry of naphthalene methyl benzoate³, revealed that these esters are photostable and that the fluorescence quantum yields are very low. Photo-induced electron transfer from the naphthalene chromophore to the benzoate chromophore has accounted for both these observations. In order to confirm that the photo-induced electron transfer process occurs in these bichromophoretic compounds, we have synthesized a series of esters **1a-1m**. For the estimation of PIET rates⁴⁻¹³ in these compounds from fluorescence

quantum yields, compound **2** was prepared as the standard.



1a - 1m

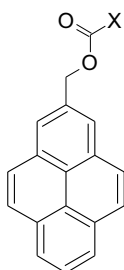
- | | | |
|--------------------------|---------------------------|--------------------------|
| a: X = 4-H | b: X = 4-OCH ₃ | c: X = 4-NO ₂ |
| d: X = 4-Br | e: X = 4-CH ₃ | f: X = 4-CF ₃ |
| g: X = 3-CF ₃ | h: X = 4-CN | i: X = 3-CN |
| j: X = 4-F | k: X = 3-F | l: X = 4-CH ₃ |
| | m: X = 3-NO ₂ | |



2

By comparing the fluorescence quantum yields of **1a - 1m** with **2** in methanol, the rates of photo-induced electron transfer from the anthracene chromophore to the substituted benzoate chromophore were estimated. The results indicate that the fluorescence quantum yield decreases with electron withdrawing substituents, making the PIET process more efficient.⁶ The estimated electron transfer rates were correlated with Hammett -values with the reaction constant, $\rho = +3.28$ ($r = 0.98$).⁴ This provides strong evidence for the presence of intramolecular electron transfer in the excited state. In order to study the effect of the rigidity of the medium, the measurements were carried out in media such as aqueous sodium dodecyl sulphate (SDS) and Triton X-100 (TX - 100). The reaction constants were found as 3.42 ($r = 0.96$) and 2.41 ($r = 0.99$) in SDS and TX-100 respectively.⁵ This variation is explained by considering the microviscosity and micropolarity of the interior of the micelle systems. The polarity of the solvents also play an important role in intramolecular photo-induced electron transfer.⁶⁻⁹

In order to study the variation of the light absorbing chromophore in the photo-induced electron transfer, the esters of pyrenyl methanol, **3a - 3c** were prepared and fluorescence quantum yields of **3b** and **3c** were measured with respect to **3a** in solvents such as cyclohexane, benzene, diethyl ether, THF, chloroform, IPA, acetonitrile and methanol.⁷ The PIET rates of **3b** and **3c** were estimated and were found to be well correlated with the solvent parameter $E_T(30)$. The electron transfer rates were higher in **3c** than in **3b**. This observation can be attributed to the lower reduction potential of the naphthoate chromophore compared to that of the benzoate chromophore.⁸⁻⁹



3a - 3c

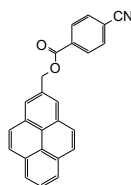
a: X = CH₃—

b: X =

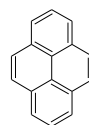
c: X =

The photo-induced electron transfer in bichromophoric compounds frequently gives a broader emission band (known as exciplex emission) at longer wavelength in moderately polar solvents such as CH₂Cl

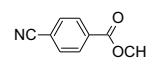
and CH₂Cl₂. We have recorded the emission spectra of **4** in these solvents. However, such bands were not observed. The absence of an exciplex band at longer wavelength could be due to the non-emissive nature of the charge transfer complexes in these esters. In order to study this non-emissive behavior in these esters, we recorded the fluorescence spectra of pyrene, **5**, in the presence of 4-cyano methyl benzoate, **6**. The band at longer wavelength appears and the intensity of this band increases at the expense of the monomer band as the concentration of **6** increases. This confirms the occurrence of intramolecular electron transfer in the bichromophoric esters, **1-3**. However, the so formed charge transfer complexes are not emissive.⁸⁻⁹



4

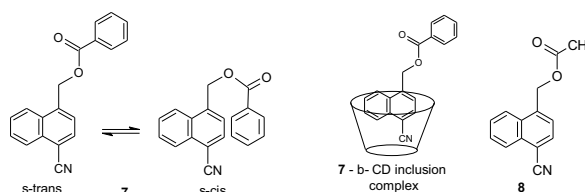


5



6

The intramolecular electron transfer of **7** was studied in β -cyclodextrin (β -CD) in order to gain an insight into the mechanism of photo-induced electron transfer (PIET). The fluorescence quantum yield of **7** increased with increasing β -cyclodextrin concentration and finally became equal to that of **8**. The increase in fluorescence quantum yield of **7** with increasing β -cyclodextrin concentration can be attributed to the lowering of electron transfer rates. The formation of a complex between **7** and β -cyclodextrin lowers the electron transfer rate. The linear variation in the logarithm of electron transfer rates with β -cyclodextrin concentration confirms the association of **7** and β -cyclodextrin in a 1:1 complex.^{7,11-12}



For efficient electron transfer in the excited state the s-cis configuration of the ester is necessary. The formation of the inclusion complex with β -CD increases the energy barrier for rotation and before the ester exists mainly in the s-trans form and PIET is greatly reduced.

3. Hydroxamic acid derivatives as fluorescence probes in the analysis of metal ions at trace levels: Chelation Enhanced Fluorescence Quenching (CHEQ) Sensor:

Recently, photosensitive receptors combining an aromatic fluorophore moiety and a recognition site has become a highly studied area of research. One of the major reasons for such studies is due to the fact that these molecules give a fluorescence response which is tunable and highly sensitive to chemical inputs, such as a proton or a metal ion.^{14,15} Of the many promising applications of these systems, chemosensing, optical

switching, and molecular computation are among the most exciting, which motivates the tremendously increasing scientific activity in the field. The sensors are important because the molecules used in such sensors are small enough to enter the various spaces of interest, cause minimum disruption to the sensitively poised steady states existing and most importantly they are able to communicate their findings to human observers due to the fluorescence on-off behavior.¹⁴

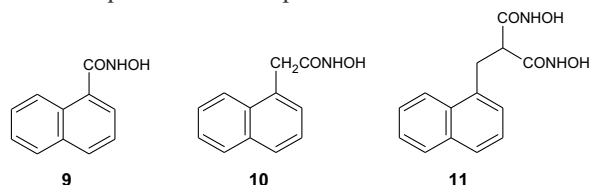
In this regard two different types of fluorescence sensors have been developed, namely:

- a) Chelation enhanced fluorescence (CHEF) sensors,¹⁶
- b) Chelation enhanced fluorescence quenching (CHEQ) sensors.¹⁵

In the first kind, interaction between fluorophore and receptor is most often through PIET, which leads to quenching of the fluorescence in the free form. In the presence of the guest metal ion to be sensed, the fluorophore-receptor interaction is turned off since the binding of the metal ion to the receptor lowers the PIET from the receptor to the fluorophore, and therefore fluorescence intensity is enhanced. In some instances, it is also possible that conformational changes due to the complexation yield exciplexes giving new fluorescence bands at longer wavelengths compared to the monomer emission.¹⁷ These fluorophores are superior in the analysis of metal ions since the intensity of fluorescence is enhanced due to the presence of trace metal ions. The selectivity in the analysis is based on the selectivity of the receptor group that interacts with the metal ion, which is most often by ion-dipole interactions. For example, de Silva *et al* successfully developed a fluorescence sensor with anthracene as the fluorophore and crown ether as the receptor.¹⁶ Here the PIET from the crown ether part to the excited anthracene fluorophore quenches the fluorescence. In the presence of sodium ions, which can be fitted in to the cavity of the crown ether, PIET is turned off and the fluorescence is enhanced.

In the second type of sensor, the fluorophore itself is fluorescent when the receptor site is free. In the presence of the metal ions the fluorescent intensity is lowered. In most cases the metal ion is chelated to the receptor unit of the sensor and the complex sensor is non-fluorescent and, therefore, the net fluorescence is quenched. Basically, these quenching processes can be divided into two kinds of mechanisms, static and dynamic quenching.¹⁸ The static quenching mechanism involves the interaction between the fluorophore molecule and the metal ion in the ground state of the fluorophore molecule, to form a non-fluorescent complex. The quenching efficiency is governed by the formation constant of the complex as well as the concentration of the metal ion. In dynamic quenching, the fluorophore molecule interacts with the metal ion during the lifetime of the excited state of the fluorophore molecule. The quenching efficiencies depend on the viscosity of the solution, lifetime of the excited state of the fluorophore and the concentration of the metal ion quencher. Determination of many kinds of metal ions such as Co(II), Cr(II), Cu(II), Mo(IV), and

V(V), inorganic anions, organic and biological materials based on fluorescence quenching techniques have been reported.¹⁹

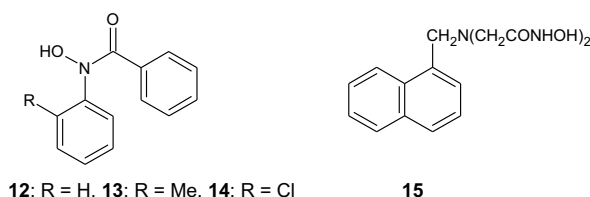


Recently De Costa *et al.* have reported²⁰⁻²² in detail the complexation and quenching of the fluorescence of 1-naphthylhydroxamic acid **9** and 1-naphthylacetohydroxamic acid **10** by metal ions such as Fe(III), Cu(II) and Zn(II). The stoichiometry of the complex formed and mechanism of fluorescence quenching of compounds **9** and **10** with Fe(III), Cu(II) and Zn(II) were studied in great detail by spectrometric and fluorometric methods.

Complexes of 1:1, 1:2 and 1:3 of metal:ligand were formed and all of them gave charge transfer absorption bands at different wavelengths. Factors affecting the complexation were found to be the pH of the medium, ligand and metal ion concentrations. The [metal ion]: [ligand] at a given concentration of the ligand was also very important in determining the stoichiometry of the complex. The quenching of the fluorescence was found to be static and due to the formation of a non-fluorescent complex in the ground state. All the metal ions studied formed a 1:1 complex at 1×10^{-5} M concentration of ligand **10** at pH 3, 5.6 and 6.4 for Fe(III), Cu(II) and Zn(II) respectively. Linear Stern-Volmer plots were obtained for both compounds and formation constants (log K) for the 1:1 complexes of **10** with Fe(III), Cu(II) and Zn(II) were estimated as 3.63, 3.72 and 2.45 M^{-1} respectively.

In another study,²³ the fluorescence quenching behaviour of hydroxamic acid **9**, **10** and **11** with Mn(II) was investigated. It was found that compound **9** forms a very weak complex with Mn(II), while compound **11** forms a very stable complex with Mn(II). Most interestingly, Mn(II) forms stable complexes at pH 9.5 compared to pH 3 with Fe(III). The calculated formation constants (log K) for **10** and **11** with Mn (II) are 2.92 M^{-1} and 4.22 M^{-1} respectively.²³

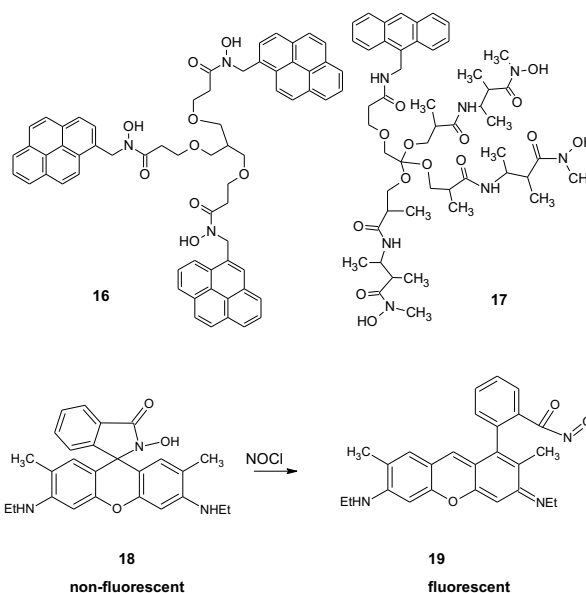
The fluorescence quenching properties of compounds **12**, **13**, **14** and **15** with the metal ion-receptor site as N-substituted arylhydroxamic acid and benzoic group as the fluorescent chromophore and a compound **15** with metal ion-receptor site as aminodihydroxamic acid and naphthalene group as the fluorescent chromophore were also investigated.²⁴



Fe(III) quenches the fluorescence of compound **15** in two-steps with two sets of linear relationships in the Stern-Volmer equation.^{25,26} This might be the consequence of two different modes of coordination. The charge transfer spectra of compound **15** with Fe(III) confirmed the formation of 1:1 and 1:2 complexes. Due to the enhanced inter system crossing of the chromophore, the quantum yield is very low for compounds **12 - 14** and the weak emission from these compounds do not obey the Stern-Volmer equation. The greater Fe-Ligand covalent bond character of compound **15** than that of compounds **12-14** also accounts for the effective quenching of compound **15**. The quenching of compound **15** by Mn(II) was studied at pH 4, 7 and 9.5. Analyses of the data obtained (relative quantum yields and Stern-Volmer plots) indicate that there was hardly any quenching at pH 4 and 7. However at pH 9.5 the fluorescence of compound **15** was effectively quenched. Furthermore, the Stern-Volmer plots confirm that only one type of complex is formed. However, unlike with Fe(III), Mn(II) does not show any charge transfer absorption in the visible region. Therefore the investigation of the stoichiometry by absorption studies is not possible. However based on the knowledge from our studies of these complexes, it is reasonable to assume that Mn(II) forms a 1:1 complex with dihydroxamic acid even at low ligand concentration. Therefore, the quenching mechanism of compound **15** by Mn(II) at pH 9.5 could be explained on the basis of 1:1 complex formation.

From the above observation it is clear that Fe(III) and Mn(II) quench the fluorescence of the aminodihydroxamic acid **15**. Fe(III) and Mn(II) both have unpaired d-electrons which effectively quench both singlets and triplets of compound **15**. The quenching of fluorescence by paramagnetic metal ions is a well-known phenomenon. The paramagnetic properties of Fe(III) and Mn(II) mostly promote dissipation of the excited state energy in a non radiative process. From the above results we can conclude that coordination occurs through the (O, O) hydroxamate linkage at low ligand concentration and *via* the amino-N and hydroxamate-N donors of compound **15** at high ligand concentration.²⁶ In (O, O) coordination, one proton per ligand is replaced by the metal but in (N, N) coordination two protons must be replaced resulting in a much more significant pH dependence of the conditional stability constant of the complex formed. Therefore, a reasonably high metal ion concentration or low pH value favours the [O, O] coordination in aminohydroxamic acids. Similarly, low metal ion concentration or a reasonably high pH value favours the (N, N) coordination.

Many scientists have developed various types of fluorescence sensors based on hydroxamic acid for analysis of different species.²⁷⁻²⁹ For example, Fages *et al.*²⁷ have developed a pyrene-tethered hydroxamic acid ligand, **16** and studies confirm that the binding of ligand with Ga(II) produced excimer emission. This can be used as a sensor for Ga(II). Marmolle *et.al.* have developed a new hydroxamic acid derivative,²⁸ **17** as a sensor for analysis of Fe(III).



A new rhodamine-hydroxamic acid-based fluorescent chemosensor, **18** for the rapid detection of HOCl in aqueous media has also been developed. The system, which utilizes an irreversible HOCl-promoted oxidation reaction, responds instantaneously at room temperature with linear proportionality to the amount of HOCl. This system is highly selective for HOCl over other reactive oxygen species (ROS) and highly sensitive in aqueous solutions. Biological imaging studies using living cells and organisms to detect HOCl are successfully demonstrated.

A new fluorogenic calix[4]arene³⁰ has been synthesized by reacting the acid chloride of fluorescein and partially reduced nitrocalix[4]arene. The synthesized compound is characterised by UV, NMR and mass spectra. Fluorescence characteristics of N,N-(fluorescein)-7,19-dinitro-25,26,27,28-tetrahydroxy-1,13 calix[4]aryl hydroxamic acid have been investigated in methanol, chloroform, toluene and dioxane and tested for lasing performance. Relative output, lasing wavelength and laser yield of the compound are reported. The dependence of solvent polarity on its lasing properties is discussed. The formation constants of metal-hydroxamic acid were also subjected to the computational studies as well.³¹

4. Hydroxamic acid derivatives as electrochemical sensors in analysis of metal ions at trace levels

Use of carbon-paste electrodes becomes very attractive in the analysis of metal ions³² in solution chemistry due to the low cost, simplicity, higher sensitivity and greater selectivity of the technique. A chelating compound, paraffin oil and carbon powder mixer are used in the preparation of the paste which is placed in the tip of a capillary tube in the fabrication of carbon paste electrodes. A stripping voltametry technique is used in the analysis where the fabricated carbon paste in the electrode is selectively chelated with the metal ion and the resulting current in the reduction process is measured while scanning the applied

potential. The carbon-paste electrode is fabricated with the hydroxamic acid derivatives of **12** and the analysis of a mixture of Cu(II) and Co(III) is carried out to determine the optimum conditions for selective analysis.^{33,34}

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Education for Sustainable Consumption of Mineral Resources of Sri Lanka

H.Dasaratha Gunawardhana

Senior Professor of Chemistry, University of Colombo

The late Mr. J.P.R. Fonseka was employed at the Chemistry Section of the Geological Survey Department, 48, Sri Jinaratana Road, Colombo-02. He was a competent analytical chemist especially in the area of classical analytical methods. His work involved the use of Jones Reductor, Silver Reductor, Titrimetry, Gravimetry etc. in the analysis of minerals.

The concept of 'sustainability', implies meeting human needs while preserving the environment and natural resources needed by **future generations**. The highest priority during 19th and 20th centuries was to meet the human needs at any cost. This was not the sustainable development. It was only during last three decades, more emphasis was paid on the economic development by providing human needs without affecting the environment – sustainable development. . In his book on “*Environmental Aspects of Sri Lanka's Ancient Irrigation System*”, Prof. C.G. Weeramanthri has stated that traditional **wisdom** has much to teach us. He further says that the concept of **sustainable development** was a part of our ancient culture associated with the irrigated agriculture. The modern international environmental law has only recently appreciated the necessity of this concept of sustainable development, and often discusses the concept as a modern invention. What is the traditional \wisdom? It is undoubtedly obvious that Science and Technology was directly responsible for the economic development of Sri Lanka during ancient times. Those who are not familiar with science wrongly argue that ancient Sri Lanka had only the technology without science. It is true that ancient Sri Lankans did not have the so-called **modern science** which is not more than 500 years old. The ancient technology was based on **unwritten science (traditional wisdom)**, and is not the modern science. The survival of the ancient technology was possible for several years due to its association with this unwritten form of science which would have been in some cases a kind of family secrets. **The survival of technology is dependent on science**. The economic development through agriculture in ancient Sri Lanka was due to the application of 'Sciences' (traditional wisdom) to the technological needs during that period. **The sustainable development achieved during the ancient time** was completely ignored or disregarded. Often, the concept of sustainable development is taken as a modern invention. In fact, it is a concept regarded as a part of **our ancient culture**. It would be fruitful for us to have some understanding on the application of unwritten science to ancient technology in order to achieve economic development by the application of modern science which is familiar to us now for the existing technology. Since “**Education determines the economy of a Country**” there is a need to educate our children or even all stakeholders including teachers on the sustainable consumption of the mineral resources.

Sri Lanka is endowed with industrial mineral resources such as, Apatite, Clay (kaolin), Ilmenite, Monazite, Mica, Quartz, Granite, Silica sand, Gemstones Feldspar, Graphite, Rutile etc.

The mineral resources are mostly **non renewable**. Graphite and mineral sands (mostly rutile, monazite) are mainly exported. The country also exports geuda (pale white or colorless sapphire), loose gemstones, and jewellery. The Government owns apatite, graphite, and mineral sand mines; the remainder of the country's mines are owned and operated by the private sector. The essential step is the search for an appropriate and common paradigm for resource availability based upon a sustainable development where future generations are likely to be better off than the current generation. The education for sustainable consumption of especially non renewable natural resources plays a vital role in the sustainable development of the country. This social need should be met without affecting the environment. Following diagram illustrates this aspect.



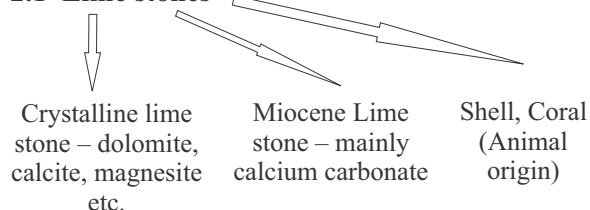
Fig. 1 Earth system: History and Natural Variability

A brief account on the sustainable consumption of mineral resources of Sri Lanka is given below.



Fig. 2: Mineral Resources of Sri Lanka

2.1 Lime stones



Some uses of lime stones are: Cement (Miocene Lime stone), Construction industry (Calcite, Dolomite), Paint (Shell), Food industry (Coral) etc. Coral is a very pure form of calcium carbonate. Coral was for construction industry where such purity is not required. “Not sustainable consumption”

The Administrators of Sri Lanka should also know something about Mineral Resources. Why? With foreign assistance it was planned to establish a Cement Factory in the Central Province. **The foreign** consultant has been informed that “Limestone” is available in the Central Province to Manufacture Cement. At a meeting I attended I told the foreign consultant that the area contains dolomitic limestone (dolomite) which is not suitable for the manufacture of cement due to its high magnesium content. This was the end of the planned projects!

2.2 Apatite –Eppawala apatite

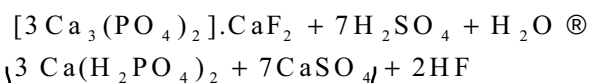
It is estimated that this deposit (discovered in 1971) contains 60 million tons which is adequate for sustainable consumption as a phosphate fertilizer required for several generations. Despite this discovery, it is unfortunate that Sri Lanka still imports triple super phosphate (TSP) spending several million rupees annually. The technology for the conversion of apatite to super phosphate and TSP is well known.

(ii) Apatite (Eppawala)

Mineral Apatite:- $3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2$ or $\text{Ca}_5(\text{PO}_4)_3\text{F}$

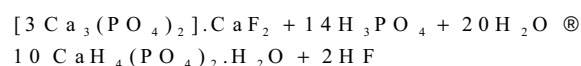
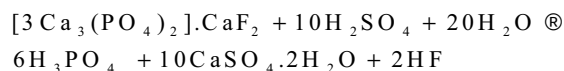
Discovered in 1971

Estimated Amount : 60 Million Tons

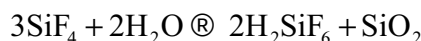


Superphosphate

With excess sulphuric acid Triple Superphosphate (TSP) is formed.



(TSP) 46% soluble in P_2O_5



H_2SiF_6 is used to manufacture industrially important cryolite.

2.3 Mineral sands- rutile, ilmenite, zircon, monazite etc. Beach sand contains Ilmenite, Rutile, Magnetite, Zircon, Monazite and Silica. The resources based at Pulmoddai is replenished annually (15%) with the advent of the north-east monsoon season. Utilising around 150,000 tons per annum for an upgrading plant, the reserve can last for over 25 years. Four million tons of heavy mineral sands (grades of over 60% heavy mineral) are available in Pulmoddai. **This deposit rates among the best known in the world**, especially due to its heavy mineral contents of between 60% to 70%. India is looking to buy more rutile and ilmenite mineral sands from Sri Lanka, a media report said quoting Kerala state industries minister Elamaram Kareem. Sri Lanka's *The Sunday Times* newspaper in a Kerala dateline report said two state-run firms Kerala Minerals and Metals Ltd and Travancore Titanium Products Ltd were looking to import more mineral sands from Sri Lanka. The newspaper report said there was not enough ilmenite to feed the full capacity of the Titanium plant. Ilmenite and rutile is used to produce Titanium metal used in the aerospace industry, and Titanium dioxide pigment, used in paints. In 2008, China was the biggest buyer of Sri Lankan mineral sands, followed by India, according to data released by the island's geological survey office. Large mineral resources are found in the eastern coast of Sri Lanka, where a 30-year war ended this year. The sands are extracted by state-run Lanka Mineral Sands.

TiO_2 pigment is used in paint industry Titanium metal is used in Aircraft industry

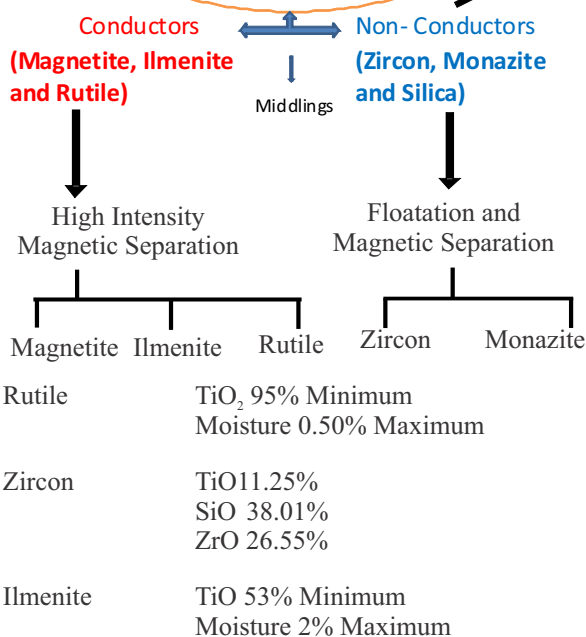
Beach sand containing Ilmenite, Rutile, Magnetite, Zircon, Monazite and Silica

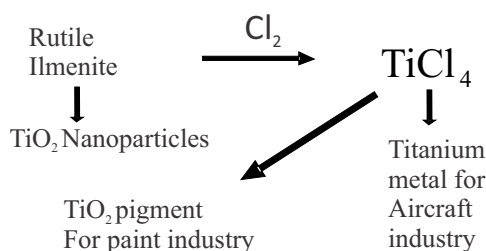
Spiral Concentration

Dryer

High Tension (H.T.) Separator

Silica





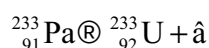
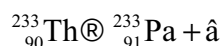
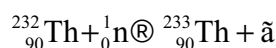
Zircon (ZrSiO_4)

Zirconium Metal :- Some uses

- (a) Nuclear power plants,
- (b) Items, e.g. Zirconium crucibles

Monazite: A reddish-brown phosphate mineral containing rare-earth metals, $(\text{Ce}, \text{La}, \text{Y}, \text{Th})\text{PO}_4$, important as a source of cerium and thorium is found in Benthara Ganga Area

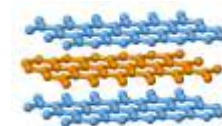
Thorium can be converted into a nuclear fuel, Uranium - ^{233}U .



Nuclear fuel is a material that can be consumed to derive nuclear energy

2.4 Clay, Feldspars - Large quantities of two dimensional aluminosilicate (Clay) and three dimensional aluminosilicate (Feldspars) are available in Sri Lanka. The country has substantial deposits of, alluvial clay, ball clay, bloating clay, china clay, clay ochre, kaolin, non bauxite clay and shale. Ceramics industry is the largest mineral-based sector in Sri Lanka. The Government sought to exploit the export market for ceramics used in electronic goods and roof tiles and to achieve an annual growth rate of 5% for the industry. To boost clay production and identify additional clay reserves, the industry hoped to locate new good-quality feldspar and kaolin deposits. No new ball clay deposits had been identified in the recent past. The Clay Reserves that were being mined at Boralesgamuwa and Meetiya goda were expected to run out during the next 2 to 3 years.

2.5 Graphite -The mineral graphite is one of the allotropes of carbon. It was named by Abraham Gottlob in 1789 from the Greek $\gamma\rho\alpha\phi\epsilon\iota\nu$ (graphein): "to draw/write", for its use in pencils, where it is commonly called lead, as distinguished from the actual metallic element lead. Some uses of graphite are,



Electrodes: An estimate based on USGS data indicates that graphite electrode consumption was 197,000 tonnes in 2005. Foundry facing and lubricant: an estimate based on USGS graphite consumption statistics indicates that 2,200 tonnes were used in this fashion in 2005. Neutron moderator: Special grades of synthetic graphite also find use as a matrix and neutron moderator within nuclear reactors. Brake linings: US natural graphite consumption in brake linings was 6,510 tonnes in 2005.

Mica is a generic term applied to a group of rock-forming complex aluminosilicate minerals having a sheet or plate like structure with varying chemical composition and physical properties. Crystals of Mica are characterised by highly perfect basal cleavage in the direction of large surfaces permitting it to split or delaminate into extremely thin and flat films.

2.6 Quartz, Silica sands & Granite

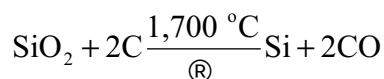
Major Forms of Silica are quartzite, vein quartz, silica sand and granite.

Quartzite - This occurs in many parts of the country. The usefulness of this is low due to the presence of impurities such as iron.

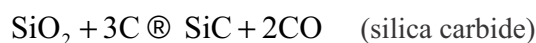
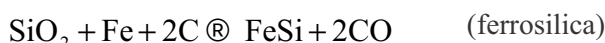
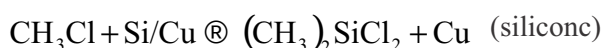
Vein quartz (Silica quartz) - The vein quartz is known for its high grade (purity i.e. 99.9% SiO_2)

Silica sands- These are found in Madampe, Nattandiya and Mrawila areas.

Granite - the durable and elegant material, is not easy to come by as it comes deep within the earth. Its character reflects the creative forces of nature - the patterns of each block of granite tell a story of gigantic pressures, the searing heat of the earth's core, and its violent birth in the volcanic eruptions of bygone millennia. Granite brings grace to the gardens, homes, palaces and temples of Sri Lanka's ancient royalty and add to them a timeless and lasting beauty that has survived for centuries. Sri Lanka has four major types of granite deposits (granite proper, gneissose granite, regmatite and graphic granite) in substantial amounts, suitable for processing into cut and polished stones. The colour, grain structure, hardness and strength of Sri Lankan granite is suitable for the



Silicon is used in electronic industry



Siliconc, ferrosilicon and silicon carbide are important in industry.

3. Education on Minerals

Curricula – GCE (A/L)

Biology – Present Curriculum – not specific on minerals.

Revised curricula – GCE (A/L) – not specific on minerals.

Chemistry – Present curriculum – Unit 15.2 Depletion of non-renewable resources such as Mineral sands, Gems, Calcium carbonate, Apatite, Graphite, Dolomite and Clay.

Revised curricula – GCE (A/L) – Unit 15.6 – Investigates some chemical industries based on mineral resources. Production of glass, cement, detergents, rutile, ilmenite and crude oil.

This indicates that the Secondary Education does not provide adequate knowledge in Mineral resources of Sri Lanka.

Since universities are located in different areas of Sri Lanka, each university should give more emphasis on aspects of mineral resources in the area. Eg. Eastern University – mineral sand deposit at Pulmudai.

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International Year of Chemistry (IYC) 2011 Chemistry – Our Life, Our Future

World wide events are being planned under the above theme to celebrate the International Year of Chemistry 2011. Institute of Chemistry Ceylon being the Professional body of Chemists in Sri Lanka has taken the leading role to celebrate IYC highlighting the achievements in Chemistry benefiting the mankind.

The 63rd General Assembly of the United Nations has proclaimed the year 2011 as the International year of Chemistry (IYC) in recognition of the achievements and its contributions to the well-being of humanity. Chemists world over are organizing events to celebrate the international year of chemistry 2011 to highlight the importance of chemistry and its contributions to sustain life on earth. International Union for Pure and Applied Chemistry (IUPAC) and United Nations Educational Scientific and Cultural Organization (UNESCO) have been designated to organize global events to commemorate the IYC. Incidentally the year 2011 also coincides with the 100th anniversary of the award of the Nobel Prize to Mm Marie Curie highlighting the women's participation in Chemistry.

The National IYC Secretariat (Sri Lanka) has been established at the Institute of Chemistry Ceylon headquarters, Adamantane House. The Presidential Secretariat endorsed the establishment of the Secretariat and supports the events organized by us. Through out the year many activities will be conducted to celebrate the event. Among them,

conduct of seminars to educate general public of the importance of chemistry in day to day life, school programmes to increase interest of young in Chemistry and radio television presentations as well as articles in the daily papers highlighting the current developments in Chemistry useful to the mankind will be addressed.

One of the major events organized by the National IYC Secretariat is the “Chemistry exhibition – Wonders in Chemistry” at the BMICH from 27th to 30th January 2011 with the participation of the Universities, Research Institutes and Industry. In each day a different theme is highlighted to show the contributions made by Chemistry for the benefit of the humanity.

We are extending an invitation to all the members to participate actively in our celebrations either organizing a particular event or giving ideas to conduct programmes connected to Chemistry. We also request you to publicize the exhibition to draw more industrialists and other interested parties to participate in the exhibition. Reservation for the stalls has been commenced and if you or an industry known to you is interested in participating you are requested to contact the office of the Institute of Chemistry to reserve a stall.

Details of the planned events can be obtained from the Institute office or from the website of the Institute. We look forward to your participation in our activities to celebrate the IYC 2011.

40th Annual Sessions of the Institute of Chemistry Ceylon 2011

Theme:

Chemistry Education for the Well Being of Society

Date: June, 2011

Venue: Adamantane House, I.Chem.C.

CALL FOR ABSTRACTS AND EXTENDED ABSTRACTS

Last Date for receiving abstracts and extended abstracts is 31st January 2011

CALL FOR REVIEW PAPERS

The Institute of Chemistry permits presentation of review papers at the Annual Sessions to be held in June 2011

Closing date for submission of abstracts of review papers is 31st January 2011.

AWARDS 2011

The following awards will be presented at the Annual Sessions 2011 of the Institute of Chemistry Ceylon.

- **Institute of Chemistry Gold Medal**

Awarded for an outstanding research contribution in the use of any branch of Chemical Sciences for National Development in Sri Lanka. Credit will be given for the utilization of local raw material and where the contribution has already resulted in a positive impact in the development and innovation in industry.

- **Dr. C L De Silva Gold Medal Award**

Awarded for an outstanding research contribution done in any branch of Chemical Sciences during the last five (5) years in Sri Lanka. Credit will be given for the utilization of local raw materials and where the contribution has already resulted in a publication in a Citation Indexed Journal or Registering a Patent.

- **Devanathan Memorial Award**

Awarded for an exceptional research contribution of an original nature in the field of Physical Chemistry and/or related areas such as Physical - Inorganic, Physical - Organic and Biophysical Chemistry.

- **Chandrasena Memorial Award**

Awarded for an exceptional research contribution of an original nature in the field of Organic Chemistry and/or related areas such as Biochemistry, Pharmacognasy, Bioactivity studies etc.

- **Kandiah Memorial Awards**

Awarded for the best research contribution in chemistry carried out by a postgraduate student registered at a Higher Educational Institute and for work carried out in Sri Lanka, with the exception of special analysis that cannot be done in the country. These results must be less than 20% of findings. Sandwich programs carried out partially abroad do not qualify for the award.

Kandiah Award for Basic Chemistry:- For research predominantly in Basic Chemistry (Organic, Inorganic, Physical, Analytical).

Kandiah Award for Applied Chemistry :- For research in chemistry related areas such as polymer, food, biochemistry, biotechnology etc. where interdisciplinary research is involved and provided that chemistry has a central role and comprises at least 50% of the content.

Kandiah Memorial Graduateship Award:- For 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 Education Institute for a Post Graduate Degree either by course work or research and for the work carried out in Sri Lanka.

- **Prof. M U S Sultanbawa Award for Research in Chemistry:-** Awarded for the best research paper presented at the Annual Sessions of the Institute of Chemistry Ceylon, for work carried out in Sri Lanka.

Closing date for receiving applications/nominations for the above awards: 31st December 2010

Further information could be obtained from the Registrar, Institute of Chemistry Ceylon

Report on the 39th Annual Sessions & 69th Anniversary Celebrations

The 39th Annual Sessions of the Institute of Chemistry Ceylon was held from 16th - 18th June 2010 on the theme “Beginning of a New Era: Challenges and Opportunities for Chemists in National development”.

1. Ceremonial Inauguration

The Ceremonial Inauguration was held at the Central Bank Auditorium, Rajagiriya on 16th June 2010 from 8.00 a.m to 11.10 a.m. The Chief Guest at the event was Professor T. David Westmoreland of the Department of Chemistry, Wesleyan University, Connecticut, USA and the Guest of Honour was Professor Paul R. Sharp of the Department of Chemistry, University of Missouri, Columbia, USA.

The proceedings began, as is traditional, with the lighting of the oil lamp followed by the National Anthem. The “Welcome Address” was delivered by Prof. S.P. Deraniyagala, President, Institute of Chemistry Ceylon. Prof. Deraniyagala, then, delivered his Presidential Address on the topic “Beginning of a New Era: Challenges and Opportunities for Chemists in National Development”. This was followed by the addresses of the Chief Guest and Guest of Honour.

The Chief Guest and Guest of Honour distributed the following Awards, Prizes and Certificates:

- Long Service Award: Mrs Chandrani de Silva
- Distinguished Services Award – Dr. Lakshmi Arambewela and Prof. Siromi Samarasinghe
- Kandiah Memorial Graduateship Award – Mr. N D A Wageesha
- Graduateship Examinations in Chemistry, Scholarships, Prizes and Awards
- Winners at the All Island Interschool Chemistry Quiz Contest

The Kandiah Memorial Graduateship Award Lecture was delivered by Mr. N.D.A. Wageesha on “*Hypercarotenaemia in Sri Lankan children below 5 yrs. of age and experimental studies on hypercarotenaemia in rats & mice.*”

Prof. M.D.P. De Costa, President Elect proposed the Vote of Thanks.

The ceremony closed with the gathering being invited to refreshments.

2. Annual General Meeting

The 39th Annual General Meeting of the Institute of Chemistry Ceylon was held at 12 noon on 16th June 2010 at Adamantane House, Rajagiriya. The President, Prof. S.P. Deraniyagala chaired the meeting. The Minutes of the 38th Annual General Meeting were adopted after minor corrections. The audited Financial Statements (years 2008 and 2009) were circulated and approved. The election of Office bearers and members of the Council (by secret ballot) of the Institute of Chemistry for the year 2010/2011 followed.

Prof. Deraniyagala thanked the Council and the Sponsors for the support extended to him throughout his term as the President. Prof. J. N. O. Fernando speaking to the gathering commended the work carried out by the President and the Council. Mr. Hettigedara briefed the members about the planned activities for the IYC. The AGM concluded with the members present being invited to lunch.

3. Symposium

A symposium was held on 17th June 2010 at Horizon, Mt. Lavinia Hotel. The symposium was dedicated to Graduate Chemists on the theme “Moulding Chemical Education for National Development in Sri Lanka”

The Chief Guest was Prof. Paul R. Sharp and the Guest of Honour was Prof. T. David Westmoreland. They made presentations entitled “Chemical Education and the Role of Research” and “Chemical Education for the 21st Century: Local and Global Perspectives” respectively. Prof. J. N. O. Fernando, Hony. Dean of the College of Chemical Sciences, former President, Mr. Mevan Pieris and eight former Graduate Chemists made presentation on a variety of chemistry related topics. The discussion was coordinated by, and the final conclusions were drawn by Prof. S. Sotheeswaran, Visiting Professor of Organic Chemistry, College of Chemical Sciences, Institute of Chemistry Ceylon.

4. Orations

The J.P.R. Fonseka Memorial Oration was held on 18th June 2010 at Adamantane House. The orator, Prof. H. D. Gunawardhana, Senior Professor of Chemistry, University of Colombo, made a presentation entitled “Value addition of non-renewable natural resources of Sri Lanka”.

5. Technical Sessions

The Technical Sessions were held at Adamantane House on 18th June 2010. Fifteen papers were presented, mainly in the areas of Food Chemistry, Natural Products and Analytical Chemistry.

6. Annual Dinner & Induction of the New President

The Annual Dinner & Induction of Prof. M. D. P. De Costa as the New President was held on 18th June 2010 at Palm Lounge, Galle Face Hotel. The Chief Guest for the event was Prof. and Mrs. H. D. Gunawardhana.

7. Media Coverage

Max Television covered the inaugural ceremony.

8. Sponsorships and Donations

Haycarb PLC, Microchem Laboratories (Pvt) Ltd, Sri Lanka National Commission for UNESCO, Nexus Business Solutions (Pvt) Ltd, Bank Of Ceylon, Graduate Chemists and many more donations.

M. R. M. Haniffa & R. D. Wijesekera
Hony. Joint Secretaries

Stereochemistry

By S. Sotheeswaran

Stereochemistry, a sub-discipline of chemistry, involves the study of the relative spatial arrangement of atoms within molecules. An important branch of stereochemistry is the study of chiral molecules. A molecule is chiral if it is **not** superposable on its mirror image.

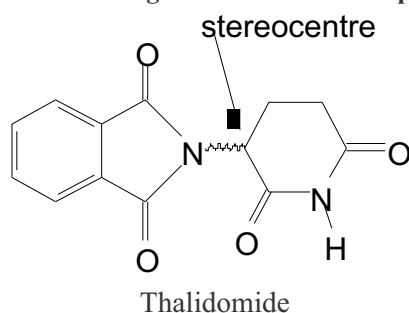
Stereochemistry is also known as 3D chemistry because the prefix "stereo-" means "three-dimensionality".

Stereochemistry is a hugely important facet of chemistry and the study of stereochemical problems spans the entire range of organic, inorganic, biological, physical and supramolecular chemistries.

Stereochemistry includes methods for determining and describing these relationships; the effect on the physical or biological properties these relationships impart upon the molecules in question, and the manner in which these relationships influence the reactivity of the molecules in question (dynamic stereochemistry).

Louis Pasteur could rightly be described as the first stereochemist, having observed in 1849 that salts of tartaric acid collected from wine production vessels could rotate plane polarized light, but that salts from other sources did not. This property, the only physical property in which the two types of tartrate salts differed, is due to optical isomerism. In 1874, Jacobus Henricus van 't Hoff and Joseph Le Bel explained optical activity in terms of the tetrahedral arrangement of the atoms bound to carbon.

One of the most infamous demonstrations of the significance of stereochemistry was the thalidomide disaster. Thalidomide is a drug, first prepared in 1957 in Germany, prescribed for treating morning sickness in pregnant women. The drug however was discovered to cause deformation in babies. It was discovered that one optical isomer of the drug was safe while the other had teratogenic effects, causing serious genetic damage to early embryonic growth and development. In the human body, thalidomide undergoes racemisation: even if only one of the two stereoisomers is ingested, the other one is produced. Thalidomide is currently used with contraceptives in women to prevent pregnancy-related deformations. This disaster was a driving force behind requiring strict testing of drugs before making them available to the public.

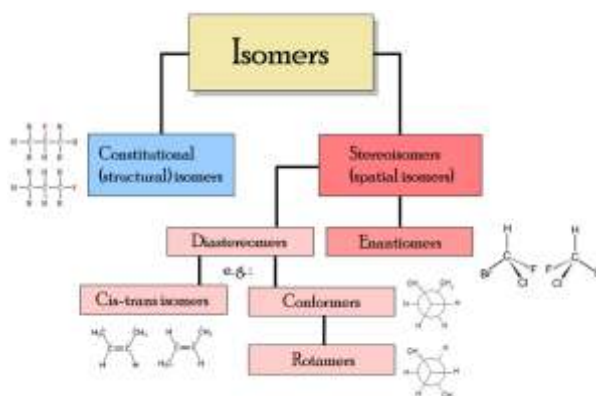


At the stereocentre, two spatial orientations are possible to give the two stereoisomers of thalidomide.

Cahn-Ingold-Prelog priority rules are part of a system for describing a molecule's stereochemistry. They rank the atoms around a stereocenter in a standard way, allowing the relative position of these atoms in the molecule to be described unambiguously. A Fischer projection is a simplified way to depict the stereochemistry around a stereocenter.

Types of stereoisomerism are:

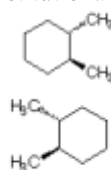
- Atropisomerism
- Cis-trans isomerism
- Conformational isomerism
- Diastereomers
- Enantiomers
- Rotamers



I have given below three problems and answers. Try these problems before looking at the answers.

Problem 1

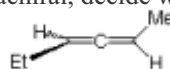
Compare the following two molecules and determine if they are identical, enantiomers, diastereomers, constitutional isomers, or non-isomers.



Answer: They are enantiomers

Problem 2

Determine if the molecule below is chiral or achiral. If achiral, decide whether it is also meso.



Answer: Chiral (the compound is not superposable on its mirror image)

Problem 3

Compare the following two molecules and determine if they are identical, enantiomers, diastereomers, constitutional isomers, or non-isomers.



Answer: They are diastereoisomers.

Message from the President, IUPAC



IUPAC

International Union of Pure and Applied Chemistry

24 August 2010

Dear Colleague in Chemistry,

In December 2008, the 63rd General Assembly of the United Nations adopted a resolution proclaiming 2011 as the International Year of Chemistry (IYC 2011). Ethiopia, supported by many countries, submitted the UN resolution after a bid endorsed in August 2007 by the IUPAC Council, drawing attention to the UN Decade of Education for Sustainable Development, 2005-2014. The resolution underscores that national and international activities carried out during 2011 should emphasize the importance of Chemistry for sustainable development in all aspects of human life.

The International Union of Pure and Applied Chemistry (IUPAC) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) have been placed at the helm of this global event. They strongly believe that it is time to celebrate the achievements of Chemistry and its contributions to the well-being of humankind. For this purpose a wide range of IYC 2011 events is planned, all focused on achieving four key goals:

- Increase public appreciation of Chemistry in meeting world needs.
- Encourage an interest in Chemistry among young people.
- Generate enthusiasm for the creative future of Chemistry.
- Celebrate the achievements of Marie Curie and the contributions of women to Chemistry.

The Official International Launch Ceremony for IYC 2011 will take place at UNESCO World Headquarters in Paris on 27-28 January 2011.

The agenda for this exciting cornerstone activity includes an international seminar, an exhibition, and other related social and cultural events; attendance is by invitation only. On behalf of the organizing committee for the Launch Ceremony, I cordially invite you to participate in this once-in-a-lifetime opportunity to celebrate Chemistry and welcome your attendance at the opening festivities. Although there will be no admission fees to attend the Launch Ceremony, it will be necessary for you to pay your own costs of transportation, meals, and hotel accommodation, and to register in advance.

You may indicate your intention to attend the Official Launch Ceremony for IYC 2011 by responding **before the 30th of October 2010** to the IUPAC Secretariat using the following contact information:

IUPAC Secretariat
Attn: Dr. Terry Renner
P.O. Box 13757
Research Triangle Park, NC 27709 USA

e-mail: secretariat@iupac.org
telephone: 1-919-485-8700
fax: 1-919-485-8706

IYC 2011 presents a unique opportunity to promote, celebrate, and advance Chemistry in all of its beneficial aspects. The influence of IYC 2011 will extend long after the program of events for the year has ended. The year 2011 itself will be the point from which the Chemists of the world can refocus priorities for Chemistry to lead the way in achieving a better and more readily sustainable world environment in which we all must live together. IUPAC and UNESCO eagerly anticipate working with you to reach this important goal.

Please see www.chemistry2011.org for additional information.

Yours sincerely,

Nicole J. Moreau
President of IUPAC

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/-
07	Nucleic Acid and Protein Synthesis	Prof J Welihinda	Rs.75/-
08	Extraction of Energy from Food	Prof J Welihinda	Rs.50/-
09	Corrosion of Materials	Dr A M M Amirudeen	Rs.75/-
10	Vitamin C-Have all its mysteries been Unravalled ?	Prof E R Jansz & Ms S T C Mahavithanage	Rs.75/-
11	*Environmental Organic Chemistry (second edition)	Prof S Sotheeswaran	Rs.150/- (US \$3)
12	Enzyme Kinetics and Catalysis	Prof (Mrs) S A Deraniyagala	Rs.100/-
13	Insecticides	Prof (Mrs) Sukumal Wimalasena	Rs.95/-
14	Organotransition Metal Catalysts	Dr S P Deraniyagala & Dr M D P De Costa	Rs.75/-
15	Some Important Aspects of Polymer Characterization	Dr L Karunanayake	Rs.75/-
16	Hard & Soft Acids & Bases	Prof (Mrs) Janitha A Liyanage	Rs.65/-
17	Chemistry of Metallocenes	Dr Sarath D Perera	Rs.65/-
18	Lasers	Dr P P M Jayaweera	Rs.65/-
19	*Life and Metals	Prof (Mrs) Janitha A Liyanage	Rs.75/-
21	*Silicones	Prof Sudantha Liyanage	Rs.65/-
22	Pericyclic Reactions: Theory and Applications	Dr M D P De Costa	Rs.65/-
23	NMR Spectroscopy	Dr (Mrs) D T U Abeytunga	Rs.65/-
24	Industrial Polymers	Dr L Karunanayake	Rs.75/-
25	Inorganic NMR Spectroscopy	Prof K S D Perera	Rs.65/-
26	Mosquito Coils and Consumer	Ms D K Galpoththage	Rs.100/-
27	Atomic Absorption Spectrometry	Dr K A S Pathiratne	Rs.100/-
28	Iron Management on Biological Systems	Dr (Ms) R D Wijesekera	Rs.100/-
29	Nutritional Antioxidants	Prof. (Mrs) Sukumal Wimalasena	Rs.100/-
30	*f-Block Elements	Prof Sudantha Liyanage	Rs.65/-

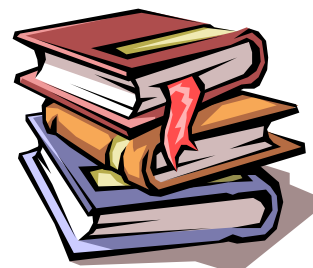
* - Second Edition /new print published on popular demand

CCS Publications

01	Functional Group Analysis in Organic Chemistry	Prof AAL Gunatilake Prof S Sotheeswaran	Rs. 175/-
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General Publications

- ★ **Chemist & The Environment** (Rs.300/-)
- ★ **Infrastructure Support Services for Industrial Development** (Rs.200/-)
- ★ **Chemical Industries in Sri Lanka – Part II** (Members: Rs. 200/-, Non-members: Rs.275/-)
- ★ **Proceedings of the Workshop on the Technological aspects of the Production & Processing of Essential oils in Sri Lanka** (Rs.100/-)
- ★ **Proceedings of the Training Seminar on Towards a Cleaner Industrial Environment in the New Millennium** (Rs150/-)
- ★ **A-Level Chemistry Facts, Patterns & Principles by Dr. Seetha I Rodrigo** (Rs.1500/-)
- ★ **Proceedings of the Prof R S Ramakrishna Memorial Training Seminar on Modern Analytical Methods**(Rs.200/-)
- ★ **Historical Accounts of the Educational Activities (1972 - 2004)** (Rs.350/-)
- ★ **Proceedings of the Training Seminar cum Workshop on Sampling, Statistics and Standardization in Chemical Analysis and Environmental Management** (Rs.150/-)
- ★ **Polymer Industries of Sri Lanka** (Rs. 200/-)
- ★ **Industry & Environment** (Rs. 200/-)
- ★ **Herbal Medicine Phytopharmaceuticals and Other Natural Products: Trends and Advances** (Rs. 500/-)
- ★ **Chemistry in Sri Lanka** (Rs. 150/-)





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		02
Total Membership as at March 2010		55

2. Committee of Management

The following were elected to the Committee at the 49th Annual General Meeting held on 23rd July 2010.

Chairman	- Mr. R M G B Rajanayake
Vice Chairman	- Dr. M P Deeyamulla
Chairman Elect	- Prof. Sudantha Liyanage
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. W J P D Jayalath
Hony. Auditor	- Prof. L G Chandrasena

3. Committee Meetings

There were 11 Committee Meetings held during the period, June 2009 to July 2010. 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 2008/2009 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) Annual Sessions

4.2 Inter - University Chemistry Competition, 2010/2011

4.3 All - Island Inter School Chemistry Essay Competition 2010/2011

4.4 Book donation at North Central Province.

4.5 Teacher training workshop.

4.6 Popular lectures.

4.7 Donation of teaching and learning resources for chemical society of selected University.

4.8 Newton A. Dias Weerasinha Memorial Scholarship

4.9 Book donation programme

4.10 Writing monographs by few committee members

4.11 Industrial visit

4.12 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.

I M S Herath
Hony Secretary