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Quarterly Update of the work and progress of the Postgraduate Institute of Science (PGIS),University of Peradeniya, SRI LANKA

We shall be pleased to receive your comments, suggestions and contributions with a view to improving the quality of this newsletter. Correspondence and requests for copies of **PGIS News** should be addressed to Dr. N C Bandara – Editor:

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Regional Training Programme in Management of Natural Resources

Prof. (Mrs.) N. S. Kumar, Principal Programme Coordinator addressing the inaugural session. (Seated L to R): Mr. S. Nakandala (Director, Technical Cooperation Programme, Ministry of Foreign Affairs), Prof. S. A. Kulasooriya (Dean, Faculty of Science, University of Peradeniya), Prof. K. Dahanayake (Director, PGIS), Mr. G. Wijayasiri (Secretary, Ministry of Foreign Affairs) and Prof. K. G. A. Goonasekera (Vice-Chancellor, University of Peradeniya)

A Regional Training Programme on the Management of Natural Resources was organized by the PGIS during October 3rd to November 2nd 2001. The programme was sponsored by the Ministry of Foreign Affairs under the aegis of its Technical Cooperation Programme. There were thirteen participants of whom eight were from the South Asian region (Bhutan, Cambodia, Myanmar, Nepal and Vietnam) and five were from Sri Lanka. The Vice Chancellor of the University of Peradeniya, Prof. K. G. A. Goonasekera, and Mr. G. Wijayasiri, Secretary to the Ministry of Foreign Affairs were present at the Inaugural Session which was held on October 3rd 2001. Prof. K. Dahanayake, the Director of the PGIS welcomed the distinguished guests and participants. The programme was organized into four modules Managing our Environment, Physical and Earth Resources, Management of Biotic Resources and Management of Natural Resources and its Impact on Society. Forty seven experts in the relevant fields were invited as Resource Persons for the Programme.

Several field trips organized to highlight some of the issues dealt with during the Training Programme, were a special feature of the Training Programme. Prof. O.A. Ileperuma conducted a field trip to an Industrial zone in Biyagama to inspect waste management facilities. Environmental impacts of gem mining were demonstrated by Prof. K. Dahanayake and scientists from the Gem & Jewellery Research and Training Institute, Ratnapura, during a field trip to Ratnapura. A field tour to identify the current status and issues related to land degradation, which included visits to Randenigala and Mahiyangana was conducted by Prof. A. Wickremasinghe and Mr. U. Amerasinghe. The floral diversity of Sri Lanka was elaborated by Dr. S. Wijesundera and Prof. M. D. Dassanayake during a visit to the Royal Botanic Gardens of Peradeniya. Professors I. A. U. N. and C. V. S. Gunatilleke organized a field trip to the Horton Plains, with the assistance of Mr. K. B. Ranawana. A field study of the Management of Natural Resources in historic Sri Lanka was made under the guidance of Prof. S. Seneviratne. Feedback from the participants indicates that the field trips were greatly appreciated and had made a profound impression on both the foreign and local participants. A farewell dinner was organized on November 1st at The Lodge, the official residence of the Vice Chancellor, University of Peradeniya.

Coordinator: Prof. N. S. Kumar

Environmental Issues of the 21st Century

Advances in modern science and technology have revolutionized the life styles of humans. Key developments in chemistry such as the Haber process, discovery of DDT & other powerful antibiotics not only resulted in increased food production and longer life spans for humans but also created a whole array of undesirable side effects. The ultimate result is the overpopulation of the planet, environmental pollution and socio-political problems such as ethnic wars that threaten the very existence of mankind.

Every year, thousands of new chemicals are introduced into our ecosystem. There will be severe shortages of safe drinking water in the next decade. How are we going to cope up with issues such as global warming, depletion of the ozone layer, power crisis, toxic chemicals in our food, carcinogens, solid wastes and potential resource shortages? At the present level of consumption, oil resources will be depleted in the next 50 years. Countries will then shift to coal which could result in increased air pollution and acid rain. Computer models predict that transboundary pollution from coal power plants in India and China will cause enough acid deposition in Sri Lanka to adversely affect sensitive ecosystems in over 50% of the country by the year 2020. Acid rain already occurs in the north-central province of Sri Lanka.

Sri Lanka has a population density exceeding even those of populous countries such as India and China. There will be immense competition for the available resources such as land which could lead to ethnic wars, social unrest and increased crime rates. The accumulation of non-biodegradable solid waste and air pollution will become major problems. Pollution of air in cities such as Kandy and Colombo is already causing serious health problems.

Are we prepared to face these environmental problems? In this context, environmental education will play a major and critical role. The earth summit conference held in June 1992 in Rio de Janeiro and attended by a large number of world leaders is the first major attempt at creating awareness on global issues related to human survival. In their proclamation, the importance of education has been aptly described as follows:

"Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues. Both formal and non-formal education are indispensable to changing peoples' attitudes, so that they have the capacity to assess and address their sustainable development concerns. It is also critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision making. To be effective, environment and development education should deal with dynamics of both the physical/biological and socio-economic environment and human (which may include spiritual) development should be integrated in all disciplines, and should employ formal and non-formal methods and effective means of communication". (Agenda 21; Chapter 36.3 ;UNCED Rio de Janeiro, 3-14 June 1992)

Global issues must be approached in a manner so as to produce educational outcomes related to changing human behaviour. In fact, the introduction of environmental science to school curriculum is essential as a first step. People should not be made to feel guilty about the harmful effects they cause to the environment. They should participate as concerned citizens and be educated on the scientific and social aspects of the problem. They should be provided with the knowledge, skills and the motivation to confront global issues including local problems which directly affect them such as deforestation, chena cultivation, garbage dumping, air pollution etc. The objective of environmental education is to develop a world population that is aware of and concerned about the environment, development and associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively towards solutions of current problems and the prevention of new ones.

We should leave a cleaner environment for the future generations. It is important to realize that the earth does not need we humans for its survival; it has done without them for billions of years in the past .Yet we need a healthy earth for our own survival, for, if we do not, the same fate suffered by dinosaurs will befall also on humans.

Prof. O. A. Ileperuma
Chairman
PGIS Board of Study in Environmental Science

Short Course in Applied Environmental Toxicology (October – December 2001)

An 80-hour postgraduate course in Applied Environmental Toxicology was conducted by the PGIS recently. Dr Ravi Gooneratne, Associate Professor in Toxicology from Lincoln University, New Zealand and several academic staff members of the University of Peradeniya served as resource persons of the first postgraduate course designed to provide an understanding of environmental toxicology problems in Sri Lanka. The course was well subscribed with a selected group of scientists numbering 24 drawn from universities, research institutes and private sector organizations. Judging by the feedback received from participants, the workshop had given them exposure to a range of toxicants found in Sri Lanka and a novel experience on problem solving skills.

The course was aimed at scientists with no formal training in toxicology, but who have an interest in toxicological problems in the country or whose jobs now require them to deal with such problems. It provided the Sri Lankan scientists with a sound knowledge of fundamental toxicology principles, toxicants of significance to humans, animals, farming practices and terrestrial, aquatic and atmospheric pollution. The emphasis was on (i) worldwide-web based teaching (ii) developing problem-solving skills and (iii) non-invasive animal models and other toxicology research techniques which could be used in future investigations. The ultimate goal was to improve the health of the environment in Sri Lanka.

The short course consisted of (i) lectures to introduce the relevant topics (ii) a series of problem-solving case studies and discussions (iii) hands-on workshops on toxicology research methodology training and (iv) worldwide-web toxicology database search to retrieve information about potential health effects, exposure guidelines and chemicals. Case studies allowed participants to apply toxicology theory to real life situations. The participants were encouraged to use the techniques learnt during the course at their workplaces.

Participants of the Short Course in Applied Environmental Toxicology. First row (left to right): Dr. M. S. S. Fawmiya (participant), Prof. K. Dahanayake (Director, PGIS) , Prof. Ravi Gooneratne (Principal Resource Person), Prof. K. G. A. Goonasekera (Vice-Chancellor, University of Peradeniya), Ms. M.G.U. Mendis and Mr. C. Edirisuriya (participants)

Toxicology is an expanding discipline worldwide. It is oriented towards prevention of adverse effects of toxicants in animals and humans and monitoring and improving environmental health. In addition, the importance of environmental factors in the induction of some non-communicable diseases, particularly cancer, is now widely recognized. Some of these problems are attributable to agents innate to the environment (e.g. food, sunlight), but an increasing number of examples establish a link between trace contaminants in the environment and human health.
Current concern for environmental quality and prevention of its deterioration from chemical pollution of technological and agricultural origin requires toxicology as a discipline. There is a need for information upon which to base decision – making relative to the prohibition, continuance or extension or release of specific chemical agents in the environment. The more recent global public awareness of undesirable and improper usage of pesticides and inadequate monitoring of chemicals in Sri Lanka strongly support the need for education and research. It is recognized that there is a need now and a demand in the future in Sri Lanka for those trained in toxicology in order to prevent deterioration and improve the health of the environment in the country.

Principal Resource Person: Prof. Ravi Gooneratne

The principal objective of the PGIS is to provide for instruction, training and research in sciences by way of its postgraduate programmes - M.Sc., M.Phil. and Ph.D. Currently there are more than 400 students following these programmes. In addition, the PGIS conducts from time to time short courses, training programmes and workshops for students, technicians and scientists to enhance their knowledge in sciences. Since the establishment of the PGIS in 1996, more than 50 such events have been organized.

Degrees Awarded and Titles of Theses (March – December, 2001)

PGIS Board of Study	Name of Awardee	Title of Thesis
Ph.D. (Zoological Sciences)		
1.	Ms. E. S. Nathanael	Some aspects of the biology and the fishery of exotic cichlids in Victoria, a deep reservoir in Sri Lanka
M.Phil. (Biochemistry & Molecular Biology)		
1.	Ms. T. D. Bambarandage	Status of insecticide resistance and resistance mechanisms in some of the insect pests of vegetables and two insect predators
M.Phil. (Chemical Sciences)		
1.	Mr. S. Malavipathirana	Metalloporphyrin coated electrodes as sensors for pesticides
2.	Ms. S. Somasundaram	Dye-sensitized photoelectrochemical cells based on TiO2 films with polymer electrolytes for solar energy conversion
3.	Mr. S. Perera	Low-cost and environmentally – friendly methodologies for treatment of water and wastewater
4.	Ms. B. M. C. A. Bandara (nee Balasuriya)	Nematicidal compounds from some Sri Lankan plants
5.	Ms. T. T. K. Weeraman	Dye sensitization of nanoporous TiO2 with solid polymer electrolytes for solar energy conversion
6.	Ms. K. W. D. S. De Silva	Chemical investigation and biological activity of Gliricidia sepium
7.	Ms. H. V. K. Diyabalange	Synthesis of potent bio-active Acridone alkaloids
M.Phil. (Earth Sciences)		

1.	Mr. P. N. Ranasinghe	Stream sediment geochemistry of three river basins of Sri Lanka with special emphasis on geochemical ratios and gem potential
2.	Mr. N. W. B. Balasooriya	Geology, microstructure and chemistry of some vein graphite deposits of Sri Lanka
3.	Mr. G. N. Wijeratne	Gold minerallization in Sri Lanka with special emphasis on Walawe basin and Ramboda areas
M.Phil. (Physics)		
1.	Mr. W. A. Samantha	Dielectric and Thermal Properties of Polymer Electrolytes Based on Poly (Acrylonitrile) and Poly (Propylene Glycol)
M.Phil. (Plant Sciences)		
1.	R. M. C. S. Ratnayake	Floristic and soil nutrient status of Hantana Forests, Sri Lanka

M.Sc. (Analytical Chemistry)		
1.	Ms. N. W. M. S. P. Navaratne	Analysis of organochlorine and organophosphorus pesticide residues in Sri Lankan agricultural export commodities with special emphasis on tea
2.	Ms. L. M. T. Peiris	Multi technique approach for the determination of the amount of active ingredient in Amoxicillin capsules
3.	Mr. W. M. S. Wijayatunga	Effect of incorporating sulphate of potash, magnesia (SPM) and kieserite to a recommended NPK mature tea fertilizer mixture (u709) on soil nitrogen availability
M.Sc. (Applied Statistics)		
1.	Mr. S. Jayakumar	Determination of factors affecting the performance of students on the subject science at GCE (O/L) examination in Batticaloa district
2.	Mr. S. M. M. Ilham	Study on growth of tomatoes grown under protected culture using non-linear curve fitting
3.	Ms. Y. Murugiah	Modelling crop growth by non-linear models
4.	Mr. P. Ainkaran	Modelling coastal fresh fish production in Sri Lanka
5.	Mr. M. M. Gamini	Application of branch and bound algorithm to minimize the production cost
M.Sc. (Environmental Science)		
1.	Ms. V. D. K. Abeyratne	Developing a passive sampler method for monitoring the air quality in Kandy
M.Sc. (Industrial Chemistry)		
1.	Mr. S. Imithiyas	Effect of using microwave energy for withering on quality of made tea
M.Sc. (Industrial Mathematics)		
1.	Mr. E. R. De Mel	Automobile spare parts distribution system design
M.Sc. (Postharvest Technology of Fruits and Vegetables)		
1.	Mr. T. M. Samansiri	Development of a processed carrot juice drink and b -carotene retention during storage
2.	Ms. K. R. Edirisinghe	Effectiveness of modified atmosphere packaging (MAP) and the 'Hydrostore' moist bag in extending the storage life of lettuce (Lactuca sativa L)
3.	Ms. R. N. K. Rathnayake	A study of potato dry rot caused by Fusarium species
4.	Ms. H. M. P. C. Herath	A study on low cost preservation of lime juice
5.	Ms. S. T.	Postharvest longevity of papaya (Carica papaya) as affected by methods of handling

	Balasooriya	
6.	Ms. H. E. M. R. L. Bandara	Development of fruit leather from locally available varieties of banana
7.	Ms. E. J. S. P. Bogamuwa	The effect of four antagonists against Fusarium oxysporum causing fusarium rot of cucumber
8.	Ms. C. S. Lekamge	Weight loss and storage life of lime in relation to fruit size, stage of maturity and storage temperature
9.	Ms. P. S. Pathirana	Utilization of carambola (Averrhoa carambola) for the formulation of low sugar ready-to-serve drink
10.	Mr. H. K. A. S. Chandana	Relationship between varietal characteristics of melon (Cucumis melo L) and the melon fly (Diptera: tephritidae) infestation
M.Sc. (Science Education)		
1.	Mr. M. M. M. Nawfal	An effective method of teaching thermochemistry
2.	Mr. S. Ragupathyraj	A study guide in magnetism for advanced level students
3.	Mr. H. Wimalawardena	Community participation in mosquito control through awareness programmes
4.	Mr. M. Cader Ali	Some common misconceptions of advanced level physics students
5.	Mr. M. S. C. Rathnasamy	A critical study on the physics question papers administered for the General Certificate of Education (A/L) examination with a view to making recommendations for quality development
6.	Mr. P. G. S. Peramuna	A teacher's guide for teaching d - block elements in Advanced Level chemistry
7.	Ms. T. H. Kalyanawathi	Impacts of gem mining on the environment in Pelmadulla area
8.	Ms. P. Rathnasinha	The use of linear air tracks for illustrating some basic mechanical principles
9.	Ms. K. P. L. N. Karunagoda	Introduction of new experiments in chemistry for G.C.E. (A/L) classes
10.	Ms. W. M. Kusumawathie	Study of the biodiversity associated with Ambuluwawa natural forest and the preparation of a nature trail guidebook for A/L biology students
11.	Mr. J. C. Kumarasinghe	Some aspects of the ecology of elephants at the Pinnawela Orphanage – Sri Lanka
12.	Mr. P. L. Samson	A study of science projects carried out by G.C.E. (A/L) students
13.	Ms.R. M. Y. M. Dayarathne	Teaching thermal physics through computer based interactive lecture demonstrations and laboratory sessions
14.	Ms. S. Kirupalamoorthi	Construction of a supplement guide on biodiversity (unit11) for G.C.E. (A/L) biology students
15.	Mr. H. M. K. B. Attanayake	A new unit plan for the unit 'matter and radiation' in A/L physics syllabus
16.	Ms. K. Rajasundaram	New approach in physical chemistry practical and developing some experiments
17.	Ms. P. C. Senavirathne	Construction of a low-cost colorimeter and its use for the study of equilibrium phenomena
18.	Ms. M. T. S. De Silva	A scheme of evaluation for the continuous assessment of A/L chemistry practicals
19.	Ms. I. Withanachchi	Diversity of ferns at upper Hantana: A sample ecological study for A/L biology students
20.	Ms. U. G. R. Priyantha	Analysis of the quality of water at school level
21.	Ms. S. S.	Preparation of a computer based self-guided study package for G.C.E. (A/L) biology

	Senadeera	students
22.	Ms. A. K. Wijesinghe	Morphological diversity of trichomes in some selected Argyreia species. (family - Convolvulaceae)
23.	Mr. I. M. S. Upali	The effect of organic fertilizers on the growth of the Azolla plant
24.	Mr. K. Baskaran	Identification of some learning difficulties of physics concepts in fields among G.C.E. A/L students and suggested recommendations to teachers
25.	Ms. W. M. P. K. M. C. Wijayarathne	A practical guide on phytohormones for G.C.E. (A/L) biology
26.	Mr. M. Chandrasekera	Computer-assisted programmes for teaching selected topics in A/L chemistry
27.	Ms. P. L. K. M. Senani	Development of simple propagation techniques for the medicinal plants Kemferi agalanga L.& Asperagus racemosus Wild
28.	Ms. J. S. Senanayake	Influence of land-based pollutions to the quality of water at the Kaluganga Bay area
29.	Mr. L. K. Waduge	Construction of a low-cost colorimeter and its application in teaching colorimetry to A/L students

Postgraduate Diploma		
1.	Mr. K. A. I. D. Silva	Wildlife Ecology & Management
2.	Mr. G. G. Dharmapriya	Physics of Materials
3.	Mr. N. K. D. Harischandra	Physics of Materials
4.	Ms. T. Sivayogam	Physics of Materials

Abstracts of Postgraduate Theses

Ph.D. (Zoological Sciences)

Some aspects of the biology and the fishery of exotic cichlids in Victoria, a deep reservoir in Sri Lanka

E. S. Nathanael, Institute of Fundamental Studies, Kandy

A fishery has been established in Victoria, a large, deep, hydropower reservoir created under the Accelerated Mahaweli programme. Since cichlids constitute the mainstay of this fishery, the primary objective of this investigation was to determine some important aspects relating to the cichlid fishery, their biology (i.e. breeding and feeding) and spatial and temporal distribution in four different sectors of the reservoir, and the natural and anthropogenic determinants affecting their populations.

To achieve this objective, apart from bi-weekly monitoring of fish catches, laboratory examination of individuals to determine their feeding and breeding habits was necessary. A comparative study was also made regarding the nutritional quality of the flesh of these three species owing to their importance as a low-cost source of protein for people in the vicinity. Since an acute decline in the annual fish production of this reservoir, with a corresponding decline in the cichlid catch was evident since the withdrawal of state patronage in July 1990, with many unwarranted anthropogenic activities, it was evident that a suitable management strategy was needed for conservation and management of this valuable resource.

The result revealed that O. mossambicus which is primarily a detritivore, with an intrinsic year round breeding potential, was the most successful colonizer of the three cichlid species inhabiting the reservoir .The other two cichlid species are more selective, with the larger individuals being confined to specific locations as in the case of O. niloticus or restricted in their establishment by the limitation of available food resources as in the case of T. rendalli. However, the progressive decline of O. mossambics and the corresponding increase of O. niloticus during the study period suggests that O. niloticus could override O. mossambicus to become the dominant cichlid species in the near future.

The socio-economics of fishermen and traders operating in the vicinity of the reservoir and details of the fish marketing system were also analyzed. Fishermen have taken to this vocation secondarily and hence have no inherent fishing skills. Progressive decline in catches

made some of the fishermen abandon fishing altogether. In the absence of alternative sources of income, traders are compelled to purchase small fish which are available in large quantities. Apart from the freshness of the fish, the socio-economic status of the consumer was identified as a key determinant of the type of fish (viz. marine/freshwater) purchased.
This study indicates the importance of developing an integrated management approach, taking into consideration the fishery resource as well as the social component affecting the resource, as well as the importance of encouraging greater user group participation for effective management of the fishery.

Supervisors: Dr. W. R. Breckenridge (Trinity College, Kandy)
Prof. E. I. L. Silva (Institute of Fundamental Studies, Kandy)

M.Phil. (Biochemistry & Molecular Biology)

Status of Insecticide Resistance and Resistant Mechanisms in some of the Insect Pests of Vegetables and two Insect Predators

T. D. Bambarandage, Department of Zoology, University of Peradeniya, Sri Lanka

Current status of insecticide resistance and underlying resistance mechanisms were studied in seven species of insect pests (five species of aphids ie. Aphis gossypii, Myzus persicae, Aphis craccivora, Toxoptera citricidus and Lipaphis erysimi; diamond - back moth Plutella xylostella; leafminer Liriomyza huidobrensis), and two species of natural predators of aphids (lady-bird beetle species Coccinella sexmaculatus and Thea cincta). All the insects except L. huidobrensis were collected from the fields at Horticultural Crop Research and Development Institute at Gannoruwa during 1997-1998. The leafminer, L. huidobrensis was collected from the Nuwara Eliya district in 1998. Insects were subjected to insecticide bioassays with malathion (an organophosphate), chlorpyrifos (an organophosphate), propoxur (a carbamate), permethrin (a pyrethroid) and DDT (an organochlorine). Bioassays were carried out by insecticide impregnated paper method and by topical application method. Log-probit mortality lines and LD50 /LD90 values for each insecticide were obtained for all the pest species. For predatory species, fixed insecticide dosages were used. Results of both bioassay methods were significantly correlated. P. xylostella and M. persicae showed highest organophosphate and pyrethroid resistance. L. erysimi had the highest resistance for carbamates. A. gossypii, A. craccivora and T. citricidus were susceptible to all the insecticides tested. L. huidobrensis had very high resistance to all the insecticides except DDT. Both predatory species showed high resistance to all insecticide groups. Activity of insect carboxylesterases were measured using the substrates a/b naphthyl acetate and p-nitropheny1 acetate. Results obtained with both substrates were significantly correlated. Highest carboxylesterase activity with the substrate pNPA was present in M. persicae (1.006 + 0.647 mmol/min/mg). Lowest activity was found in L. huidobrensis (0.143 + 0.202 umol/min/mg). Native polyacrylamide gel electrophoresis was used to resolve carboxylesterase isoenzymes. No elevated carboxylesterase bands were found in T. citricidus and in the predator T. cincta. The major mechanism of insecticide resistance of aphids and P. xylostella was elevated carboxylesterases. Malathion metabolism studies showed the presence of malathion carboxylesterases in P. xylostella, M. persicae, and L. huidobrensis. Glutathione transferase activities were high in P. xylostella and L. rysimi (1.43+ 0.244 and 1.43 + 0.933 umol/min mg respectively) and very low in L. huidobrensis (0.338+ 0.273 umol/min/mg). Presence of high amounts of oxidases was detected in A. gossypii (6.69 + 77.33 OD/mg), in M. persicae (1.37 + 1.61 OD/mg) and T. citricidus (2.63 + 33.57 OD/mg). Lowest amounts were found in L. huidobrensis (0.107 + 0.173OD/mg). Inhibition of the organophosphate and carbamate targetsite acetylcholinesterase with propoxur showed that this targetsite of L. huidobrensis and the predator T. cincta is not sensitive to insecticides. High activity of carboxylesterases and altered acetylcholinesterases were correlated with high resistance to organophosphates and carbamates. Oxidases had contributed to high resistance to all the insecticide groups. High levels of glatathione s-transferase activity had provided high resistance to organochlorines.

Supervisor: Prof. S. H. P. P. Karunaratne (University of Peradeniya)

M.Phil. (Chemical Sciences)

Metalloporphyrin Coated Electrodes as Sensors for Pesticides

S. Malavipathirana, Department of Chemistry, University of Peradeniya, Sri Lanka

Glassy carbon (GC) electrodes coated with 5, 10, 15, 20-tetraphenyl-porphyrinatoiron(III)chloride [Fe(III) TPPCI] shows the electrochemistry of the Fe(III)/Fe(II) couple in aqueous medium between the potentials of +0.25 V and –0.50 V vs. saturated calomel electrode (SCE). The reduction peak current of the Fe(III)/Fe(II) couple is significantly enhanced when small amounts of polar organo – halides, such as chloroacetic acid and endosulfan are introduced into the electrochemical cell. The peak shape and the peak location suggest that the reduction of such pesticides proceeds through a series of reactions that comprise an electrochemical reaction, then a chemical reaction followed by another electrochemical reaction (ECE mechanism), where the reduction product of Fe(III), i.e. Fe(II), forms an electroactive adduct with the pesticide, which then undergoes electrochemical reduction. The current generated during this electrochemical process is thus proportional to the bulk concentration of the respective pesticide, indicating the analytical utility of Fe(III) TPPCI modified GC electrodes as sensors for the pesticides stated earlier. In the absence of Fe(III)TPPCI coatings on the electrode,

pesticides show sluggish electrode kinetics resulting in little or no activity. Electrocatalytic ability of Fe(III)TPPCI towards organo - halide pesticides is thus demonstrated.

Although the analytical utility of Fe(III)TPPCI coated electrodes is demonstrated during cyclic voltammetric experiments, sensitivity of detection is not high enough to apply such sensors for real applications. However, steady – state amperometry overcomes this limitation by decreasing the lower detection limit by at least an order of magnitude. Optimization of analytical parameters, such as solvent composition, potential of operation, type and concentration of electrolyte, method of coating, and concentration of the coating solution, is performed whenever possible, as this process is necessary to obtain an adequate response. Under optimized conditions, the detection limit of chloroacetic acid is found to be 5 x 10-6 mol dm-3 based on the signal-to-noise ratio of three.

Electrochemical activity of copperoxychloride is monitored for comparative purposes between organochlorine pesticides and those containing inorganic chloride. Cyclic voltammetry of this analyte results in CU(II)/CU(I) and CU(I)/CU (0) processes at moderate potentials at the bare GC electrode, in both acidic and basic media, and consequently, chemical modification of the electrode is not necessary.

More importantly, the bare GC electrode produces a selective response for copperoxychloride in the presence of other common interferant species with the exception of Fe(III). Steady-state amperometry of this analyte at the bare electrode in 0.1 mol dm-3 HCl electrolyte medium, in which more pronounced response is given than in basic medium, results in a lower detection limit of 3 x 10-8 mol dm-3 under optimized conditions.

This is a significant finding in this area of research, because such low levels may not be accessible by other analytical methods available at present.

Supervisor: Dr. H. M. D. N. Priyantha (University of Peradeniya)

M.Phil. (Chemical Sciences)

Dye-Sensitized Photoelectrochemical Cells Based on TiO2 Films with Polymer Electrolytes for Solar Energy Conversion

S. Somasundaram, Department of Chemistry, University of Peradeniya, Sri Lanka

Dye-sensitized photoelectro-chemical cells based on porous nanocrystalline films of TiO2 (nanocells) are gaining much attention as promising solar energy conversion systems. The performance of these devices depends largely on the dye used as the sensitizer. The spectral response of the cell, photocurrent quantum efficiency, and stability depend on the nature of the dye. The important physical characteristics of the dye, which determine the above properties of the cell, are the absorption spectrum of the dye, the redox properties of the ground state and the excited state of the dye molecule in relation to the band position of TiO2 and the anchoring ability of the dye molecules to the surface of the TiO2 crystallites. Ruthenium complexes are good sensitizers for the nanocell. Carboxylate ligands anchor the dye molecules to the TiO2 surface and promote electron injection from the photoexcited level to the conduction band of TiO2. The search for alternative sensitizers is essential for the further development of the nanocell and other dye-sensitized molecular electronic devices. Hence as part of this study, attempts were made to search for relatively inexpensive organic dyes isolated from plants which are stable toward photodegradation. Brazilin dye from Caesalpinia sappan and Munjistin from Rubia cordifolia were extracted and purified and I-V characteristics of the cell using these dyes were studied and compared to the cells made, using the standard ruthenium bipyridyl dye. The fill factor of the cells fabricated using these dyes was comparable to that of the cell fabricated using the standard ruthenium bipyridyl dye. But the short circuit current and the overall cell efficiency values were very low compared to those of the standard ruthenium bipyridyl dye. Moreover, cell fabricated using brazilin dye give higher short circuit current and the overall cell efficiency. Values were compared to the cells fabricated using munjistin dye.

In dye-sensitized photoelectrochemical cells made from nanoporous TiO2, the liquid electrolyte leads to several technological problems such as dye desorption, solvent evaporation and degradation, seal imperfection, hence less working life. One way to overcome this problem is to replace the liquid electrolyte by a polymer electrolyte membrance.

Studies were done to replace the liquid electrolyte with polyacrylonitrile (PAN) based plastisized polymer electrolyte. For that novel all solid state dye-sensitized photoelectrochemical solar cells of the type, FTO/ TiO2/dye/PAN, EC, PC, Pr4N+I-, I2/Pt/FTO were fabricated and characterized using current-voltage characteristics and action spectra. Liquid electrolyte generally used for such solar cells has been successfully replaced by a quasi solid electrolyte comprised of polyacrylonitrile (PAN) with ethylene carbonate (EC) and propylene carbonate (PC) as plasticizers and Pr4N+I-/ I2 redox couple without a significant loss of quantum efficiency. For the polymer electrolyte, the optimum conductivity of 2.95 x 10-3 S cm-1 was obtained for the electrolyte composition PAN: EC: PC = 15:35:50 (weight %). The short circuit current and the open circuit voltage obtained for an incident light intensity of 600 W m-2 were 3.726mA/ cm2 and 693 mV respectively. This corresponds to an overall efficiency of 2.993%. From the action spectrum, IPCE value of 32% was obtained for incident light of wavelength 480 nm.

Attempts were also made with a mixture of ruthenium bipyridyl dye and ruthenium terpyridyl dye (Black dye) to optimise the PEC cell.

The short circuit current and the overall efficiency of the cell increased when the dye mixture was used. The short circuit current and the open circuit voltage obtained for an incident light intensity of 600 W m-2 for the cell with the mixture of dyes were 4.06 mA/cm2, and 697 mV, respectively, for the PAN polymer electrolyte. This corresponds to an overall efficiency of 3.5%. From the action spectrum, the maximum IPCE value of 44% was obtained for incident light of wavelength 540 nm. When black dye was used alone, the short circuit current and the open circuit voltage were 3.13 mA/cm2 and 693 mV, respectively, for an incident light intensity of 600 W m-2. This corresponds to an overall efficiency of 2.5%. From the action spectrum, the maximum IPCE value of 29% was obtained for incident light of wavelength 550 nm.

Supervisor: Prof. O. A. Ileperuma (University of Peradeniya)

M.Phil. (Chemical Sciences)

Low -Cost and Environmentally – Friendly Methodologies for Treatment of Water and Wastewater

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The increase in population and new developments in industrial technology are constantly intensifying environmental pollution problems. Environmental scientists are forever seeking more economical methods of preserving the environment. Consequently, research needs to be continuously conducted to find answers to pollution problems, in particular pollution due to metal ions, coloured substances and anions.

Dolomite, Feldspar, Laterite, aquatic plants such as Ipomea aquatica and Pisitia stratiotes and aqueous extracts of Caesalpinia bonduc seeds exhibit excellent removal ability to decrease the magnitude of many pollution parameters. The possibility of using natural substances in this regard introduces numerous advantages over conventional chemical methods. Low maintenance cost, low toxicity and small amount of sludge are some of them.

Among many natural substances investigated dolomite offers the highest efficiency for phosphate removal. Optimization of experimental parameters such as solution pH, flow rate, column length, initial concentration, particle size and adsorption capacity reveals that the present removal by dolomite is high for laboratory prepared solutions and more importantly for polluted water and industrial effluents. X-ray diffraction and adsorption isotherm studies provide mechanistic information of the removal process.

Feldspar, a readily available mineral, is a good adsorbent for sulfate, phosphate and coloured substances under optimized experimental conditions. The maximum efficiency for the removal of sulfate, phosphate and coloured substances is about 42%, 52% and 73% respectively. Studies on X-ray diffraction patterns, adsorption isotherms, desorption patterns and recovery methods suggest that the removal occurs via ion exchange in conjunction with surface adsorption.

Laterite, another readily available mineral is also a good alternative for the removal of heavy metals, coloured substances and some anions from polluted water and waste water. The efficiency of the removal process strongly depends on experimental parameters such as solution pH, amount of absorbent, particle size of laetrile, etc. More importantly, the laetrile based laboratory scale filter is useful to obtain high quality drinking water.

Another attractive treatment methodology used in the area of waste water treatment is the use of aquatic plants, Ipomea aquatica and Pisitia stretiotes. These plants are able to remove ions and nutrients from polluted water such as Mg2+, Ca2+, Mn2+, Fe2+, Co2+, Zn2+, Cu2+, Pb2+, Po43- and No3- showing the bioaccumulation of such species in the selected plants. During the treatment, decrease in electrical conductivity, pH and chemical oxygen demand is also observed.

The research on the use of aqueous extracts of shell-removed Caesalpinia bondue seeds, develops another low cost procedure for effective removal of turbidity and coloured substances from laboratory prepared solutions and industrial effluents. According to respective measurements, significant reduction in turbidity and colour of effluents collected from many industries is observed during treatment.

Supervisor: Dr. H. M. D. N. Priyantha (University of Peradeniya)

M.Phil. (Chemical Sciences)

Nematicidal Compounds from Some Sri Lankan Plants

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This thesis consists of two parts.
Part one of the thesis describes the nematicidal activity of some Sri Lankan plants against Pratylenchus loosi (Tylenchida: Pratylenchidae), Radopholus similis (Tylenchida: Pratylenchidae) and Helicotylenchus species (Tylenchida: Hoplolaimidae). Out of 454 extracts from 173 plant species screened for nematicidal activity, nine extracts were found to be active against P. loosi and Helicotylenchus species. The

LC50 values suggested that Ocimum gratissimum (leaves and twigs, dichloromethane extract), Gliricidia sepium (leaves, hexane and dichloromethane extracts), Cyperus rotundus (Rhizome, dichloromethane extract) and Hortonia floribunda (leaves, dichloromethane extract) showed good nematicidal activity against both P. loosi and Helicotylenchus sp. Comparisons were made with known nematicidal compounds and with a commercially available nematicide, ethyl 3-methylthiophenyl-N-isopropylphosphoroamidate (Nemacur®, phenamiphos), in order to calculate effective levels of nematicidal activity and to make standard concentrations for bioassay directed fractionation.

Of the known nematicidal compounds, catechol, guaiacol, pyrogallol and geraniol showed similar levels of nematicidal activity at 1,000 ppm against P. loosi and Helicotylenchus sp. while linalool and sitosterol were found to be inactive. The inactivity of the latter suggested that there were differences in susceptibility among species of nematodes.

The dichloromethane extract of Ocimium gratissimum showed LC50 (LC = Lethal concentration) of 5839, 6337 and 6697 ppm and MC50 (Moribund concentration) of 5458, 5180 and 6411 ppm, 24 hours after treatment (HAT) against and Helicotylenchus sp, P. loosi and R. similis respectively. The active constituent with LC50 of 465, 482 and 507 ppm and MC50 of 456, 457 and 478 ppm 24 HAT against and Helicotylenchus sp, P. Loosi and R. similis was identified as eugenol, (2-methoxy-4-(2-propenyl) phenol, 1-(3'-methoxy-4'-hydroxyphenyl) prop-2-ene.

The dichloromethane extract of Cyperus rotundus showed LC50 of 8625, 10,000 and 11,782 ppm after 24 h against Helicotylenchus sp, P. Loosi and R. similis. Five moderately active compounds were isolated but their structures could not be elucidated. They were C/45/1 with LC50 after 24 h of 700, 707 and 747 ppm, C/37/1 (LC50 612, 681 and 818 ppm), C/36/1 (LC50 752, 513 and 752 ppm), C/41/1 (LC50 912, 941 and 979 ppm) and C/41/2 (LC50 846, 893 and 908 ppm) against and Helicotylenchus sp, P. Loosi and R. similis.

Part two of the thesis describes the structure-nematicidal activity relationship of aryl alkenes related to eugenol. All the phenyl ethenes screened for activity were found to be inactive except ethenes with a 4'-OMe group present. As the length of the side chain increased i.e. from ethene to propene and butene, activity was found to increase. The highest activity was shown by the 3'-OH, 4'-OMe substituted butadiene, with conjugated double bonds in its side chain. The 4'-OMe substituted butadiene showed less activity, while the 2', 4'-dimethoxy substituted butadiene was weakly active.

Although the 1-(3'-hydroxy-4'-methoxyphenyl) buta-1,3-diene was the most nematicidal aryl alkene against Helicotylenchus sp., aryl alkenes with a diene side chain are photolabile and unstable. Therefore 1-(3'-hydroxy-4'-methoxy phenyl) but –1-ene (LC50=169 ppm) can be considered as the most useful nematicidal compound among the aryl alkenes screened.

The conclusions were that nematicidal activity
a. was enhanced with increasing length of the side chain and with conjugation,
b. required a 4-methoxy substituent and was enhanced by a 3-hydroxy substituent and
c. was increased by a 2-methoxy substituent and decreased by hydroxy groups ortho- and para-to the side chain and methoxy groups meta-to the side chain.

Supervisor: Prof. V. Kumar (University of Peradeniya)

M.Phil. (Chemical Sciences)

Dye Sensitization of Nanoporous TiO2 with Solid Polymer Electrolytes for Solar Energy Conversion

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Colloidal nanostructured titanium di-oxide (TiO2) with thinly covered dye molecule combinations are seriously discussed today as promising solar energy conversion system. In this work TiO2 is the most widely investigated material because of its thermal and photoelectrochemical stability. Consequently the light absorption cross section is increased while maintaining a large effective surface area. So the dye sensitized TiO2 solar cells based on nanostructured films with several dyes have been reported. Ruthenium bipyridine complexes have been widely employed as dyes owing to their stability and high life times of their excited state. However these dyes are very expensive and relatively time consuming to synthesize.

In dye sensitized photoelectrochemical cells made from nanoporous TiO2, the liquid electrolyte leads to several technological problems such as dye desorption, solvent evaporation and degradation, seal imperfection, hence less working life. Therefore the ideal dye sensitized solar cell is a fully solid state device in which the liquid is replaced by a solid conductor. In that case a solid polymer electrolyte offers a means of eliminating all these problems mentioned above.

We have chosen several dyes isolated from plants which are stable towards photo degradation for the dye sensitization of TiO2 semiconductors. They are Cu-chlorophyllin and cyanidin. In addition attempts were made to attach inorganic dyes, such as nickel-phthalocyanine (NiPc) and tungstosilicic acid (H4 [SiW12O40]). The solid state solar cells of the type of CTO/n- TiO2/Dye/Solid polymer electrolyte/counter electrode were fabricated using two solid polymer electrolytes: poly (ethylene) oxide (PEO) and

polyacrylonitrile (PAN) with plasticizers, propylene carbonate (PC) and ethylene carbonate (EC).

Each and every time the stability and efficiency of the solid cell is well comparable by matching the absorption spectra of dyes in their soluble medium and photocurrent action spectra in appropriate electrolytes.

All four dyes show their dye sensitization effects on TiO2 semiconductor surface clearly giving peaks at 450 nm (1.6x10-2 mA cm-2), 560 nm (1.7x10-2 mA cm-2), and 625 nm (1.8x10-2 mA cm-2), for Cu-chlorophillin, 410 nm (3.25x10-1 mA cm-2) and 530 nm (1.35x10-1 mA cm-2) for cyanidin, 666 nm (2.45x10-4 mA cm-2) for NiPc and 485 nm (2.75x10-1 mA cm-2) for tungsto silicic acid on their photocurrent action spectra.

The photocurrent action spectrum of the CTO/ TiO2/ Cu-chlorophyllin/PEO, PC, EC, KI, I2/CTO solid state cell shows peaks at 340 nm (for TiO2), 420 nm and 565 nm (for Cu-chlorophyllin) with corresponding photocurrent densities of 0.058mA cm-2, 0.033 mA cm-2 (Q%=0.378) and 0.0125 mA cm-2 (Q%=0.046) respectively. Under illumination of 100 W tungsten filament lamp, this cell gives a cell efficiency of 0.36%. The conductivity of the polymer electrolyte PEO, KI, I2, PC, EC is of the order of 10-5 S/cm. The conductivity of the solid cell (CTO/ TiO2/ Cu-chlorophyllin/PEO, PC, EC, KI, I2/CTO) is 3.59x10-7 S/cm.

The photocurrent action spectrum of solid state cell (CTO/ TiO2/ Cu-chlorophyllin/PAN, PC, EC, KI, I2/CTO) shows peaks at 310 nm (for TiO2) and 680 nm (for Cu-chlorophyllin) with corresponding photocurrent densities of 7.5 mA cm-2 and 0.725 mA cm-2 (Q=3%) respectively indicating that there is dye sensitization. This cell gives a cell efficiency of 0.49% under the illumination through a 100W tungsten filament lamp. The conductivity of solid polymer electrolyte PAN, PC, EC, KI, I2 is of the order of 10-7 S/cm and the conductivity of the solid cell (CTO/ TiO2/ Cu-chlorophyllin/PAN, PC, EC, KI, I2/CTO) is 4.26x10-5 S/cm.

The photocurrent action spectrum of the CTO/ TiO2/ cyanidin/PAN, PC, EC, KI, I2/CTO gives photocurrent densites of 9.75 mA cm-2 at 330 nm and 0.575 mA cm-2 at 680 nm. The cell efficiency is calculated to be 0.5%. The conductivity of the cell CTO/ TiO2/ cyanadine/PAN, PC, EC, KI, I2/CTO is of the same order as observed for the cell CTO/ TiO2/ chlorophyllin, PAN, PC, EC, KI, I2/CTO.

The cell fabricated with poly (ethylene) oxide as a solid polymer electrolyte and cyaniding as the dye, i. e. CTO/ TiO2/ cyanidin/PEO, PC, EC, KI, I2/CTO gives an open circuit voltage of 700 mV and a short circuit photocurrent density of 5.8 mA cm-2. The cell efficiency is calculated to be 1.0% under illumination through 100W tungsten filament lamp (110mW/cm2). The conductivity of the solid electrolyte in the cell (PEO, PC, EC, KI, I2) is 4.10x10-4 S/cm.

NiPc attached titanium dioxide semiconductor has peaks in photocurrent action spectrum at 372 nm and 666 nm with the corresponding photocurrent densities of 2.9x10-4mA cm-2and 2.45x10-4mA cm-2 respectively. Peak at 666 nm is due to dye. It clearly shows that nickel-phthalocynine has dye sensitization effect on the TiO2 semiconductor. The solid state cell fabricated with PAN polymer and a gold plate as a counter electrode gives the open circuit voltage of 415 mV with a short circuit photocurrent of 48 mA cm-2. The calculated fill factor is 0.33 with a cell efficiency of 5.9x10-6. The completed cell, in its photocurrent action spectrum gives peaks at 380 nm (for TiO2) and 710 nm (for NiPc sensitization) with the corresponding photocurrent densities of 1.84x10-3 mA cm-2and 2.64x10-3 mA cm-2 respectively. The carrier concentrations calculated from the slope of the Mott-Schottky plots, taking the dielectric constant of NiPc to be 11 (e=11) is 7.3x1019 cm-3.

The completed cell CTO/ TiO2, NiPc, PEO, PC, EC, KI, I2/Gold gives the Voc of 380 mV and Isc of 14.5 mA cm-2 with fill factor of 0.10 under illumination through 100W tungsten filament lamp. The calculated cell efficiency is 5.11x10-6.

I-V behavior observed by varying resistance and illumination through 100W tungsten filament lamp for the solid state cell consisting of CTO/ TiO2, NiPc, PC, EC, KI, I2/Au gives Voc =220 mV and Isc =325 mA cm-2. The high value of Isc for sold state cell prepared using two plasticizers is due to high conductivity of propylene carbonate (PC) or ethylene carbonate (EC). The cell efficiency is calculated to be 3.24x10-6.

Under illumination through sunlight with an intensity of 835 Lux, the cell, CTO/ TiO2, NiPc, CuI, Platinum gives Isc of 16.9 mA cm-2 and Voc of 3.4 mV. Hall effect studies on NiPc shows that resistivity of NiPc is 5.306x10-7 Wm at the room temperature of 30°C and in the presence of magnetic field hole resistivity, ?H is calculated as 9.32x10-4 Wm.

Supervisor: Prof. O. A. Ileperuma (University of Peradeniya)

M.Phil. (Chemical Sciences)

Chemical Investigation and Biological Activity of Gliricidia sepium

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Gliricidia sepium is native to tropical America and it was introduced to Sri Lanka as a shade plant to the tea plantation. Later it was found that G. sepium acts as a good diversionary host plant for tea termite Glyptotermes dilatatus that causes great damage to the low country tea

plantations.

Chemical investigation of CH2CI2 extract of heartwood of G. sepium gave 7,4-dihydroxy-3'-methoxyisoflavan as a new natural product. Six other compounds formononetin, afromosin, medicarpin, 4-dihydroxy-3',4'-dimethoxyisoflavan were also isolated which was previously reported from the heartwood of this plant. Further chemical investigation of hexane extract of G. sepium gave a higher yield of b-sitosterol. It was found in all parts of this plant.

Chromatographic separation of the hexane extract of stem bark yielded betulinic acid for the first time from G. sepium. The CH2CI2 extract of the stem bark gave two new natural products, 3, 4-dihydroxy-trans-cinnamic acid octacosy1 ester and more polar stigmastanol glucoside.

Shade dried flowers of G. sepium were extracted with CH2CI2 and chemical investigation of CH2CI2 extract afforded three compounds: sitosterol glucoside, kaempferol and an oleanane triterpene, soyasapogynol B.These compounds are also new to the plant.

All these compounds were isolated with the aid of various column (gravity, MPLC, flash) and preparative thin layer chromatographic techniques. Structure elucidation of the isolated compounds was carried out using spectroscopic methods, IR, UV, Mass, 1H NMR, 13C NMR, DEPT, COS, HMQC, HMBC, etc.

The toxicity experiments were carried out for tea termites, Glyptotermes dilatatus. Hexane and CH2CI2 extracts of heartwood have shown high activity. The activity-guided fractionation indicated that the first fractions of those extracts showed the highest toxicity to the termites. From that fraction of hexane extract, four toxic compounds (very less polar) were isolated and structures of them have not been investigated. Other fractions of hexane and CH2CI2 extracts showed moderate activity. MeOH extract and its fractions have not shown any activity. Toxicity of some isolated compounds, b-sitosterrol, formononetin, 3',4'-dihydroxy-trans-cinnamic acid octacosy1 ester and kaempferoal was observed. Only kaempferol has shown remarkable toxicity at low concentration and the others have shown moderate toxicity.

Olfactometer experiments were carried out for identifying the attractive components present in G. sepium.

Supervisors: Dr. A. Wickramasinghe (University of Peradeniya)
Dr. H. M. T. B. Herath (Institute of Fundamental Studies, Kandy)

M.Phil. (Chemical Sciences)

Synthesis of Potent Bio-Active Acridone Alkaloids

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This thesis discusses total synthesis of seventeen acridone alkaloids, eight of which are new.

1,3,5-Trihydroxy–9-acridone (126) was synthesised from 2-amino-3-hydroxybenzoic acid and phloroglucinol. Methylation of compound 126 under different conditions gave 3,5-dimethoxy-1-hydroxy-9-acridone (59), 3,5-dimethoxy-1-hydroxy-10-methyl-9-acridone (127), 3,5-dimethoxy-1-hydroxy-4-methyl-9-acrydone (128), 1,3,5-trimethoxy –10-methyl-9-acridone (57) and 1,3,5-trimethoxy-4,10-dmethyl-9-acridone (129). Demethylation of compound (57) afforded 1,3,5-trihydroxy-10methyl-9-acridone (58). 1,3-Dihydroxy-5-methoxy–9-acridone (130) was obtained upon condensation of 2-amino-3-methoxybenzoic acid with phloroglucinol.

Reaction of anthranilic acid with phloroglucinol yielded 1,3-dihydroxy-9- acridone (131). Methylation of compound 131 furnished 1-hydroxy–3-methoxy–10-methyl-9-acridone (132) which upon demethylation gave 1,3-dihydroxy–10-methyl-9-acridone (133).

Iodination of compound 131 afforded 1,3-dihydroxy-2,4-diiodo-9-acridone (134) whereas compound 59 gave 3,5-dimethoxy –1-hydroxy –2/4-iodo-9-acridone (135). The palladium catalysed Heck condensation reaction of 135 with 2-methyl-3-butene–2-ol yielded 1-hydroxy-3,5-dimethoxy-2-(3'-hydroxy-3'-methyl-1'-butenyl-)-9-acridone (136) and (59). Prenylation of compound 59 with 4-bromo-2-methyl-2-butene gave 3,5-dimethoxy-1-hydroxy-10-(3'-methyl-2'-butenyl-)-9-acridone (137) while prenylation of compound 131 with methylcrotanaldehyde gave des-N-Methylnoracronycine (138).

Total synthesis of coumarin derivatives 6-bromo–7-hydroxycoumarin (139), 6-bromo-7-methoxycoumarin (85) and 6-[(E)—3-Hydroxy-3-methyl-1-butenyl-]-7-methoxycoumarin [(E)-Suberenol] (82) from 4-bromoresorcinol and malic acid is reported in this thesis.

Preparation of four new acridone–coumarin dimers (acrimarines), 1,3,5-trihydroxy-2-[1''-(7'-methoxy-2'-oxo-2H-chromen-6-yl)-3''-methyl-2''-butenyl]-9-acridone (103), 1,3-dihydroxy-5-methoxy-2- [1''-(7'-methoxy-2'-oxo-2H-chromen-6-yl)-3''-methyl-2''-butenyl]-9-acridone (104), 3,5-dimethoxy-1-hydroxy-2-[1''-(7-methoxy-2'-oxo-2H-chromen-6-yl)-3''-methyl-2''-butenyl]-9-acridone (105) and 3,5-dimethoxy-10-methyl-2-[1''-(7'-methoxy-2'-oxo-2H-chromen-6-yl)-3''-methyl-2''-butenyl]-9-acridone (106) from (E)-suberenol (82) and relevant acridones is described in this thesis.

Methylation of compound 103 furnished acrimarines 105 and 106.

Supervisors: Prof. V. Karunaratne (University of Peradeniya)
Dr. H. M. T. B. Herath (Institute of Fundamental Studies, Kandy)

M.Phil. (Earth Sciences)

Stream Sediment Geochemistry of Three River Basins of Sri Lanka with Special Emphasis on Geochemical Ratios and Gem Potential

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Recent scientific investigations have revealed that about 25% of the total land area of Sri Lanka is gem bearing (Dissanayake & Rupasinghe 1995). However the gem industry in Sri Lanka is still based on traditional mining methods. Therefore only a few areas are still mined. Developing and application of scientific tools in gem exploration as well as mining and processing is therefore nationally important.

This study was mainly focused on studying some important geochemical aspects such as concentration levels, distribution, behavior of major and trace elements in stream sediments of Sri Lanka and to study the use of geochemical ratios in identifying gem bearing areas.

For this study stream sediments samples were collected mainly from Kotmale Oya and Menik Ganga basin. Samples, collected from Walawe Ganga basin, were used as a reference set and data of previous surveys were also used in statistical analysis. Gem bearing sediment samples and samples from gem source rocks such as skarn and pegmatites were collected mainly from the study areas. Samples were analyzed using the X ray fluorescence technique. International standards were analyzed and repetitions carried out to maintain the accuracy and precision of analysis. The data were treated with the use of statistical software.

The results of the study revealed that different elements are concentrated in different size fractions of sediments. K, Al, Mn, Rb, Ni and Sr concentrate in the –63µm fraction and concentration decreases towards higher grain sizes. Nb and Cr are found in the +125-177µm fraction while the highest concentration of Si was found in the +177-250 µm fraction. Zr accumulates in the +63-125µm fraction. The accumulation of clays, and heavy minerals, which contain these elements, in different fractions may be the factor behind this distribution pattern.

When comparing element concentration in the studied basins no major difference in element concentrations was observed except, low Rb and high Fe concentrations in Kotmale basin and high Cu and Zr concentrations of the Walawe basin.

It was also noted that major elements have been depleted with reference to upper crustal levels while trace elements have been enriched. High leaching rates of major elements and accumulation of major elements during sedimentation process may account for this result.

Both factor analysis and correlation coefficients show that major and trace elements behave according to their ionic potential. Elements having high ionic potentials and low ionic potentials show close relations with the other elements of the particular group.

Studying the relationship with element ratios and gem potential reveal that ratios between elements of similar ionic potentials have good relationships with gem potential. Among the studied ratios Rb/Sr+Ba/Sr ratio can be used in discriminating areas according to their gem potential more effectively. The predicted potentials by this newly identified ratio are comparable with field observations. This new ratio can therefore be applied for gem exploration after field trials.

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Prof. M. S. Rupasinghe (Department of Natural Resources, University of Sabaragamuwa)
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M.Phil. (Earth Sciences)

Geology, Microstructure and Chemistry of Some Vein Graphite Deposits of Sri Lanka

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Sri Lanka has a widespread distribution of natural graphite of high purity in some areas of the Central Highlands. characterized by Precambrian metasedimentary rocks. At present, exploration work continues mainly at Bogala and Kahatagaha/Kolongaha mines. The present study is based on graphite from these mines. Successions of charnockite, quartzite, calc-gneiss, garnet gneiss and biotite gneiss are seen associated with Bogala graphite deposits. Occurrence of charnockite and quartzite suggests the metasedimentary stratigraphy of the mined graphite containing rocks. These rocks together with biotite gneiss and rare marble characterize the geology of the Kahatagaha

Kolongagaha mine. Petrographic evidence shows that plagioclase is closely associated with graphite veins and has altered to perthite.

The graphite veins cut across gneissic rocks and show irregular branching. Width of the graphite veins of the Kahatagaha/ Kolongaha deposits may vary from 2m to 20m. Most of the graphite veins are discontinuous with thickness as varying from less than 1 mm to several tens of cms. The most common vein thickness in Bogala graphite mine is less than 2 cm.

The carbon content in graphite was determined using burning method XRF analysis and Carbon- Sulphur determinator in graphite from Bogala and Kahatagaha/Kolongaha. More than 93.00% of C was noted. This high percentage of C characterizes good quality natural graphite. Major impurity elements were Fe. Cu. St. Ca. and Mg. (9.59% - 0.12%). As. Co, Mn, Ni, Pb, Rb, S, Sr, Ti, and Zr(<1000ppm).were the minor elements in vein graphite. X-Ray diffractogrammes of different forms of graphite from the three mines studied clearly show the presence of strong peaks at d=3.365&1.680 and weak peaks at 2.137&2.036 suggesting the formation of graphite-carbon. When peak intensities of graphite-carbon have increased, the small peaks of graphite-carbon disappear.
Graphite flakes are formed from ver fine to fine fibres. Some graphite samples show graphite flakes converted into scaly structures. Well-formed crystals of graphite with distinct faces are rare but well compact equigranular aggregates with partly hexagonal crystal faces having parallel structure are common as seen by the Scanning Electron Microscopy (SEM) study.
After preliminary studies based on structural and physical characteristics, seventeen different forms of graphite were identified from Bogala. Kahatagaha-Kolongaha and Ragedara mines. Together with the common forms, three similar graphite forms were found to occur in Bogala. Kahatagaha-Kolongaha and Ragedara mines. The common forms are shiny slippery fibrous coarse radially and coarse striated flaky graphite. Other forms are platy needles, coarse-flaky graphite and their variations. Fine flaky and amorphous graphite forms occur only in the Bogala mines.
The variations in the impurity content of the different forms of graphite seem to suggest a difference in the composition of the pegmatitic fluids flowing into the fractures of the country rocks at different stages of the mineralization process. The average content of S in both locations is around 0.01%. The, main source of sulphur is sulphur bearing minerals and rocks formed in the host rock. Pyrite (FeS2) and Chalcopyrite (CuFeS2) are minerals of the sulphur bearing ores. After weathering, S had appeared as sulphur enrichment materials in the fractures and along the joints of the host rock.

Supervisors: Prof. K. Dahanayake (University of Peradeniya)
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M.Phil. (Earth Sciences)

Gold mineralization in Sri Lanka with special emphasis on Walawe basin and Ramboda areas

G.N. Wijeratne, Department of Geology, University of Peradeniya, Sri Lanka

Sri Lanka has a long history of using gold in jewellery, coins and other crafts. Mahawamsa,'the grate lineage', written about 2000 years ago and Thupawamsa (200-600AD) indicate the mining sites of gold and other metals in connection with building of shrines in ancient Sri Lanka. They also describe the nature of gold found in the mines particulary the dendritic form and sizes of pieces that varied from 10 to 15 cm characteristic of native gold.

The next available records on gold were in the 19th century during the colonial period of Sri Lanka (then Ceylon) when there was great enthusiasm for gold mining in parallel with the gold rush. This was also known as the "Ceylon gold rush" and as a result of some work carried out in the valley of Rubies in the Horton Plains, some payable amounts of gold had been recovered. The gold was found in the bottom layer of the gem deposits displaying its high specific gravity. The Ceylon administrative reports of 1893 showed that gold was also mined in the Ramboda area. Some analysis of samples has been done in foreign laboratories. This work, however, had been suspended due to lack of funds.

Gold exploration work in Sri Lanka resumed during the last two decades and has continued in a more scientific manner. Several exploration programmes have been carried out and this work was initiated with the intention of locating potential areas for gold deposits. After studying the available literature, maps and aerial photographs, the work was concentrated mainly in areas covered by the proposed mineralized belt along the microplate margin as shown in a recent plate tectonic model for the development of Sri Lankan rock associations. The study area includes a high grade metamorphic terrain of Sri Lanka which shows a marked difference to the main gold producing areas of the world, the Precambrian greenstone belts. However, there were some similarities such as the presence of wall rock alteration and the structurally controlled nature of mineralization.

Any discovery of gold deposits in Sri Lanka will certainly upgrade the economy of the country and could save a large amount of valuable foreign exchange. Even a low-grade deposit can probably be exploited profitably as labour costs are still comparatively low in the country. Further, the study is expected to contribute to the scientific knowledge on gold mineralization in high –grade metamorphic terrains.

The areas selected include the Walawe Ganga basin and the Kiri-Ibban wewa in the southern part and Ramboda in the central part of the country. Based on the information from aerial photographs, work was concentrated mainly on areas of high structural control. Panned

heavy mineral concentrates and raw sediment samples were collected from the streams, flood plains and existing gem pits. Separation of heavy minerals was carried out using the magnetic separator and identification of minerals was carried out using the petrological microscope. Gold grains visible under the microscope were separated and weighed. A statistical analysis of heavy minerals and gold was performed. Analysis of grain morphology and chemical compositions was carried out using the Electron Probe Micro Analyser and X-Ray Fluorescence Spectrometer (Energy Dispersive). The quantitative chemical data obtained were correlated with the Neutron Activation analytical data. The rock samples collected from locations around gold anomalies in the stream, which included marbles, pegmatites, skarns, pegmatitic gneiss, and veins were digested. The gold was concentrated into organic solvents and analysed by Atomic Absorption Spectrometer equipped with a Graphite Furnace. Petrological analysis was performed for rock samples from locations that showed gold enrichment.

Heavy sediment analysis revealed that ilmenite and garnet were the major heavy minerals associated with gold lying on the decomposed rock layer. The high specific gravities of such minerals as well as gold force them to be distributed at the bottom of the sequence of heavy sediments. The statistical analysis of river sediments shows anomalous increase of gold along the river and the values range from 0.20 to 9.33 g/t. These areas of anomalous gold protential were shown on a map of the Walawe basin.

The composition and the morphology of gold grains show a clear relationship. The morphologies can be divided to two main types;
(a) grains with sharp outer contours and
(b) grains with worn out outer contours
The results indicate that the sharp edged grains are in the form of Electrum (Au - 65% to 80 and Ag - 35% to 20%). A change of compositions from electrum to pure gold exists and the mechanism behind this transformation is mainly self-electro-refining. Mechanical deformation and exposure of fresh surfaces of the grains also promote this process.

The results of analysis of rock samples show comparatively high gold concentrations in twelve locations. There are five locations with very high concentrations from 0.005 ppm to 0.161 ppm. Three of them are situated at the upper part of the Walawe river. The other two are located at one of the major tributaries of Walawe river, named Mulgam ara.

The petrological analyses of rocks from comparatively high gold bearing locations show evidence of influence of fluids in a late stage of peak metamorphism. Crystallization of quartz, presence of calcite in pseudo-sphene shapes and some times also wollastonite in thin sections provides the evidence for the influence of CO2 –bearing fluids.

The results of this study clearly indicate the presence of gold – bearing veins and rocks along the Walawe river. Further analysis is necessary to identify the distribution pattern of gold below the surface of these rocks and veins. The fluid inclusion studies will be helpful to identify the nature of the fluid and to determine the age relationships. Using this knowledge it may be possible to relate the activity of gold transporting fluids to one particular stage of the peak metamorphic events.

Supervisor: Dr. S. W. Nawaratne (University of Peradeniya)

At the last convocation of the University of Peradeniya held on 20th December 2001, seventy-three students of the PGIS received their degrees as follows: Ph.D. – 3, M.Phil. – 13 and M.Sc. – 57 (Analytical Chemistry – 6, Applied Statistics – 6, Environmental Science – 1, Industrial Chemistry – 2, Industrial Mathematics – 1, Parasitology – 1, Physics of Materials – 1, Postharvest Technology of Fruits & Vegetables – 10 & Science Education – 29).

M.Phil. (Physics)

Dielectric and Thermal Properties of Polymer Electrolytes Based on Poly(propylene glycol), PPG and Poly(acrylonitrile), PAN

W. A. Samantha, Department of Physics, University of Peradeniya, Sri Lanka

Polymer electrolytes are materials that are becoming increasingly important in applications such as batteries, fuel cells and electro chromic devices. A great deal of research on polymer electrolytes is focused on identifying and optimizing solid polymer electrolytes with high ambient temperature ionic conductivity to enable the development of solid state batteries and other devices. In order to do this it is vital to understand the mechanism of ionic transport in these materials. The study of dielectric and thermal properties of a completely amorphous material like PPG may contribute to such an understanding.
In this work the dielectric and thermal properties of the systems PPG/LiCF3SO3 and PPG/LiN(CF3SO2)2 have been studied using dielectric spectroscopy and differential scanning calorimetry (DSC). The dielectric measurements reveal two peaks in the imaginary part of the dielectric spectrum. The high frequency peak has been attributed to the a relaxation process of the polymer. The low frequency peak, the intensity of which is found to be very dependent upon the salt concentration, is found very close to the a' relaxation process of the

pure polymer and may be associated with ion pairs. The DSC results show that for both these systems, the glass transition temperature, Tg increases with salt concentration. At a salt concentration corresponding to O:M = 16, the step in Tg is quite broad, which may indicate the existence of two glass transitions seen in the DSC results of other similar systems.
PAN based, elasticized, gel polymer electrolytes have high enough ambient temperature ionic conductivity values but the role played by the plasticiser and the PAN matrix is not well understood. In this work, impedance and dielectric measurements, XRD, DSC and TG measurements have been used to study the PAN based gel electrolytes. XRD results reveal that, although pure PAN powder is partially crystalline, the PAN based gel electrolytes are highly amorphous and that the lithium salt is fully dissolved. The TG results show that there are no significant interactions between the plasticizers and the PAN polymer. In the the dielectric measurements, it can be observed that there is a large contribution to the dielectric relaxation due to the presence of PAN suggesting that there is a considerable interaction between PAN and Li+ ions presumably through the CN arm making a dipole.

Supervisors: Prof. M. A. K. L. Dissanayake (University of Peradeniya)
Prof. B.-E. Mellander (Physics and Engineering Physics, Chalmers University of Technology, Gothenburg, Sweeden)

M.Phil. (Plant Sciences)

Floristic and Soil Nutrient Status of Hantana Forests, Sri Lanka

R. M. C. S. Ratnayake, Department of Botany, University of Kelaniya

The phytosociology and soil physico-chemical parameters of five woodland Alstonia woodland (ALW), a Paraserianthes woodland (PAW), a mixed species woodland (MSW), Pinus woodland (PIW) and an adjacent natural forest (NF) in the Hantana Campus land in Kandy district, Sri Lanka was investigated in this study. Stratification, life form distribution, girth class distribution and basal area of each woodland were examined to understand their vegetative structure. Their floristic features were investigated by recording the origin of plant species cumulative taxon richness, family importance values (FIV) species diversity based on diversity indices, rank abundance plots, similarity coefficient and diversity, species composition with respect to their native climatic zone and ethno botanical value of the constituent species in each of the woodlands. Further soil physico – chemical parameters such as soil pH, electrical conductivity, total Nitrogen, nitrate, exchangeable; Ca Mg and K, available P, cation exchange capacity, soil organic matter content, loss on ignition of soil, C/N ratio, water saturation capacity and soil colour of each content, loss on ignition of soil, C/N ratio, water saturation capacity and soil colour of each woodland were studied.

Stratification of most plots in the PIW was limited to the canopy layer whereas in the broad-leaved woodlands it was complex with three or four strata. Life form distribution in both the overstorey (>10 cm gbh) and understorey (< 10 cm) of the PIW was confined to few life forms. In contrast, many life forms were present in the other woodlands. Regeneration of tree juveniles in the understorey of the PIW was lower than that of the other woodlands. Relatively better plant regeneration was observed in the ALW sites, compared to the woodland with secondary vegetation. Girth class distribution of the PAW showed reverse 'J' shaped curves but not in the other woodlands. The merchantable timber class (>150 cm gbh) was highest in the PAW due to the presence of dominant species Paraserianthes falcataria. Total basal area of the five woodlands decreased in the sequence of: PAW>MSW>PIW>ALW>NF. The basal area and the FIV values of Pinaceae in PIW, and Fabaceae in PAW and Apocynaceae in ALW indicate their comparatively higher dominance due to Individuals of Pinus caribaea, P. falcataria and Alstonia macrophylla respectively.

The study area contained 53 endemic, 36 exotic and 193 indigenous species comprising a total of 281 plant species, which belonged to 213 genera and 85 families. The total species count of ALW showed the highest species richness (154) followed by NF (134), MSK (113), PAW (107) and PIW (50). The cumulative taxon area curves revealed that the distribution of species within the woodlands was patchy. Both rank abundance plots and diversity indices revealed that plant diversity of the PIW sites was lower than that of other secondary woodlands. Results of the "t" test of Shannon index indicated that PIW and NF sites were characterized by significantly lower and higher species richness ($p^3 0.001$) than in the secondary broad – leaved woodlands with few exceptions. The b diversity values also indicated that the secondary woodlands were different from the NF. The ethno botanical study of the species identified indicates that the study area contained 91 medicinal, 47 timber, 38 edible, 25 ornamental and 7 shade tree species. Due to plant introductions during the plantation era, 36 exotics were recorded in the study area. Even though the land was cleared and cultivated for a long period during the plantation era, the area now harbours a considerable number of endemic species (52). The major soil nutrient contents of the NF showed the highest values except for exchangeable Mg. The PIW sites showed the lowest values except for nitrates. Among the secondary broad-leaved woodlands, the soil parameters studied were lower in the PAW compared to ALW and MSW.

The results of the-multiple comparisons of soil parameters in the 5 woodlands studied revealed that there were no significant differences between woodlands with respect to soil pH and C/N ratio ($p^3 0.05$). However, with respect to the other parameters soil fertility status of the PIW was significantly lower than all the other woodlands except for nitrates ($p^3 0.05$). Apart from the nitrate and soil organic matter content, no significant differences were revealed between the NF and the other broad-leaved woodlands. Further among the secondary broad-leaved woodlands differences were not significant except for exchangeable Mg. Interestingly, both soil and floristic parameters of the present study showed a more or less similar pattern indicating a close soil-vegetation relationship.

Among impacts, annul fire and fuel wood collection have been identified as two major impacts and which contribute to the present degraded state of the forest. Therefore as a long-term solution to manage fire problem, the grassland area and Pinus woodland should be converted to broad-leaved woodlands or appropriate agro forestry system. According to the findings of the present study, use of mixed species seems to be more effective than mono-species plantations for land rehabilitation. The ecological implications of the results are briefly discussed with particular emphasis on the plant species and soil conservation, and the sustainable management of Hantana for the future.

Supervisors: Prof. I. A. U. N. Gunatilleke (University of Peradeniya)
Prof. C. V. S. Gunatilleke (University of Peradeniya)
Prof. L. R. Jayasekera (University of Kelaniya)

We acknowledge with thanks the ADB funding provided by the S & T Personnel Development Project of the Ministry of Economic Reform, Science & Technology for the following M.Sc. Programmes:

Analytical Chemistry
Environmental Science
Oceanography
Postharvest Technology of Fruits & Vegetables

FOREIGN APPLICANTS FOR PGIS PROGRAMMES

PGIS entertains applications from foreign students for admission to its M.Sc., M.Phil. and Ph.D. programmes. Special reduced rates of fees are available for students from SAARC countries. For details, please contact Assistant Registrar, PGIS.

Fax: +94 8 389026; Phone: +94 8 387542; e-mail: prasadi@pgis.lk

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M.Sc. Programmes (2001/2002)

The following M.Sc. programmes commenced in September 2001.

M.Sc. Programme	Board of Study	Coordinator/s	No. of Students
Analytical Chemistry	Chemical Sciences	Dr. A. Bandara	15
Industrial Chemistry	Chemical Sciences	Dr. A. Wickramasinghe Dr. P. Karunaratne	4
Science Education(with speciality in Biology/Chemistry /Mathematics/Physics)	Science Education	Dr. S. Karunaratne (Principal Coordinator) *Subject Coordinators:* Dr. G.A.D. Perera (Biology) Prof. J.S.H.Q. Perera (Chemistry) Dr. U.N.B. Dissanayake (Mathematics) Prof. M.A.K.L. Dissanayake (Physics)	29
Environmental Science	Environmental Science	Prof. M. de Silva Dr. R. Fernando	18
Fish & Wildlife Management	Zoological Sciences	Prof. M. de Silva	6
Physics of Materials	Physics	Prof. B.S.B. Karunaratne	11
Computer Science	Statistics & Computer Science	Dr. A.A.I. Perera	36

Other PGIS Activities

Workshops (WS), Short Courses (SC) and Training Programmes (TP) conducted from March to December 2001

Event	Coordinator/s	Period	No. of Participants
Canopy Hemispherical Photography for Measurements of Canopy Parameters (WS)	Prof. I A U N Gunatilleke Dr. K U Tennakoon Prof. Mark Ashton	May 9	20
Oceanography (WS)	Dr. A Pitawala	June 9 -10	42
Postgraduate Certificate Course in Advanced Biochemistry - Part II	Dr. S B P Athauda	July 01 – Oct	14
Multivariate Analysis of Ecological & Environmental Data (WS)	Prof. I A U N Gunatilleke Dr. S M Weerasinghe	July 10 - 12	22
Regional Training Programme on Management of Natural Resources	Prof. N S Kumar Prof. O A Ileperuma Prof. I A U N Gunatilleke Dr. N C Bandara	Oct. 3 – Nov. 2	11
Applied Environmental Toxicology (SC)	Prof. R. Gooneratne Dr. N C Bandara	Oct. 27 – Dec. 16	24

Foreign Visitors (March – December 2001)

- Dr. Suzanne W T Batsa, Smithsonian Institution, Washington DC, U.S.A.
- Prof. M. S. Ashton, Yale University, 360 Prospect St, New Haven, CT 06511, U.S.A.
- Dr. Matthew Fladeland, 118, Bishop St., C New Haven, CT, U.S.A.
- Dr. Mats Nordhal, Innovative Design, Chalmers University, 41296, Gotenborg, Sweden
- Dr. Ananda Gunawardena, School of Computer Science, Carnegie Mellon University, Pittsburgh, PA 15213, U.S.A.
- Dr. Rupert C Perera, 2 – 400 Lawrence Berkely Lab, University of Berkeley, CA 94720, U.S.A.
- Dr. David Burslem, Department of Plant and Soil Science, University of Aberdeen, St. Machar Drive, Aberdeen AB 24 3uu, Scotland, U.K.
- Dr. Gerhard Chroust, Department of Systems Engineering, Kepler Univeristy, Linz, 4040 Linz, Austria
- Prof. Sunil J Wimalawansa, Chief, Endocrinology Division, Robert Wood Johnson Medical School, Department of Medicine, P.O. Box 19, New Brunswick, NJ 08903, U.S.A.
- Dr. Ranjith Perera, Specialist in Statistics, 57 Booth Road, London NW9 5JS, U.K.
- Prof. Dr. Wolfgang Hofmeister, Institute of Gemstones, Research University, Mainz, Germany
- Dr. J S Sarupria, Deputy Director and Head, D & I Division, National Institute of Geography, Dona Paula, Goa, India
- Dr. R. Shankar, Department of Marine Geology, University of Mangalore, Karnataka, India.
- Dr. Ravi Gooneratne, Animal & Food Science Division, P O Box 84, Lincoln University, Canterbury, New Zealand
- Prof. Jean Louis Souquet, Inst. Nat. Polytech., Grenoble, France

Coordinators' Reports

Training Programme on Canopy Hemispherical Photography (May 9, 2001)

One-day training programme on Canopy Hemispherical Photography was successfully conducted by the Board of Study in Plant Sciences in collaboration with the Department of Botany, University of Peradeniya and School of Forestry and Environmental Studies, University of Yale, USA on 9th May 2001. The canopy hemispherical photography is a snap shot of the actual canopy geometry and it can provide direct measurements of many canopy structure parameters such as Leaf Area Index (LAI), gap fraction and distribution of openings etc. The technique is user-friendly and avoids a range of pitfalls common in determining canopy parameters. The objective of this training program was to impart knowledge of the principles of canopy parameters and its investigative tools to researchers, academics and undergraduates. During the training program, canopy hemispherical images obtained by the participants were analyzed using the HemiView program to get reliable information on canopy structure parameters. The program consisted of both theory and practicals to

provide hands-on experience to the participants. There were 20 participants including academics and postgraduate research students from universities and research officers from crop research institutes.

Canopy hemispherical photograph taken at the Sinharaja MAB Reserve

The resource persons for the workshop 'Prof. Mark Ashton and Mr. Mathew Fladeland' were from School of Forestry and Environmental Studies, University of Yale, USA. The Mc Arthur Foundation, USA sponsored part of their visit.

Coordinator: Dr. K. U. Tennakoon

Workshop on Oceanography (June 9 – 10, 2002)

A two-day workshop on Oceanography was successfully organized by the Board of Study in Earth Sciences from 9th – 10th June 2001. The main objective of the workshop was to improve the basic knowledge of oceanography of the researchers and students who are working in areas related to the subject. There were 28 participants drawn from universities, research institutes, state and private sector organizations.

Traditional lighting of the oil lamp at the inaugural session of the workshop

The resource person was Dr. R. Shankar, an eminert ocenographer from the Marine Geology Department, Mangalore University, India. The programme included lectures on environmental magnetism principles and various applications, particulate pollution monitoring, placer mineral deposits, paleoclimate/paleoceanography, C-14 method, excess Pb-210 method, estuarine front, West Indian continental margin studies and flocculation in estuaries.

Coordinator: Dr. H. M. T. G. A. Pitawala

Workshop on Multivariate Analysis of Ecological and Environmental Data (July 10 – 12, 2002)

The Workshop on Multivariate Analysis of Ecological and Environmental Data organized by the Board of Study in Plant Sciences of the Postgraduate Institute of Science, University of Peradeniya in collaboration with the Department of Botany, University of Peradeniya and the Department of Plant and Soil Sciences, University of Aberdeen, UK was held from July 10 – 12, 2001 at the Postgraduate Institute of Science. Twenty two participants attended the workshop representing five universities and four research institutions. The main objective of this workshop was to impart knowledge on PCORDWIN which is a powerful software package for multivariate analysis and classification of ecological and environmental data. The Higher Education Link Scheme of the British Council sponsored the visit of Dr. David Burslem, the resource person of the workshop, who is a competent soil scientist attached to the Department of Plant and Soil Sciences, University of Aberdeen, UK. The workshop consisted of lectures and practical sessions using the computer facilities of the Postgraduate Institute of Science. The Ministry of Forestry and Environment and the National Science Foundation provided financial assistance for the conduct of the workshop.

On the last day of the workshop, all the participants were encouraged to present their own research ideas and how the software package assisted them in overcoming some of their analytical problems. Each presentation was followed by a productive discussion.

An evaluation of the workshop was carried out by providing a questionnaire to the participants. A majority of the participants agreed that the workshop provided them with an adequate introduction to Multivariate Analysis using PCORDWIN, powerful analytical tool that could be used in their future research programmes.

Coordinator: Dr. S. Madawala Weerasinghe

Forthcoming Events

January 2002
§ Workshop on Environmental Organic Chemistry
§ Short Course on Rocks and Minerals

February 2002

§ Short Course on Microcomputer Interfacing Methods in Chemistry
§ Workshop on Business Statistics with Computer Applications
§ M.Sc. Programme in Oceanography

March 2002

§ M.Sc. Programme in Postharvest Technology of Fruits and Vegetables
§ Workshop on Repair & Maintenance of Laboratory Equipment
§ Workshop on Scientific Writing
§ Workshop on Aphid Taxonomy
§ National Workshop on Science Education for G.C.E. (Advanced Level) Teachers

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First Research Sessions of the PGIS
September 7 - 8, 2002, PGIS Auditorium

Papers for presentation are entertained only from past and present (M.Sc./M.Phil./Ph.D.) students of the PGIS. For details, please contact the Coordinators of the Research Sessions : Prof. R M G Rajapakse (rmgr@pdn.ac.lk) or Dr. K U Tennekoon (kushant@pdn.ac.lk) (Phone : 08-388693/389151/389152).
Workshops (WS), Short Courses (SC) and Training Programmes (TP) conducted from November 2000 to February 2001
