

news letter

CENTRE FOR GREEN CHEMISTRY
Chemistry for a sustainable future

GREEN CHEMISTRY DOWNUNDER

Centre for Green Chemistry

Issue 6- April, 2002

From the Director

Professor W. Roy Jackson, Director



Prof. Milton Hearn has been appointed as my successor. He will take over the Directorship on the 1st January 2003 but is going to relinquish his Chair in Biochemistry and work closely with the Centre from July 1st this year. Milton will bring added strength to the Centre in promoting interactions with both nanotechnology and biotechnology.

These areas are of key interest to

both the Australian and Victorian governments and the possibility of attracting further research funding is high.

On the research front, the collaboration between Dr Chris Strauss, CSIRO, Molecular Science and Personal Chemistry, Sweden, has led to funding for a postdoctoral research fellow and the acquisition of a highly automated microwave reactor system which is located at the Centre for Green Chemistry's laboratory. The interest in chemical manipulation of brown coal and waste materials is rising with three new students commencing projects in collaboration with the Department of Natural Resources and Environment's laboratories at Rutherglen and Tatura. Euneace Teoh gave a lecture on "Tandem Synthesis of Cyclic Amino Acids" and other students presented posters at the 26th Annual Synthesis Symposium at Melbourne University in December last.

The Centre is currently hosting Dr Sirirat Chancharunee, Head of the School of Chemistry at Naresuan University Thailand who is on a Thai-Australia Fellowship. Dr Chancharunee is collaborating with Dr Patrick Perlmutter on the development of NARC and NARC related processes which can be conducted in the laboratories of developing countries, and on the development of green undergraduate laboratory experiments. Prof. Jochanan Blum from Hebrew University, Jerusalem, spent three weeks in the Centre and gave two seminars. His discussions with Centre participants will almost certainly lead to the establishment of two joint projects and possibly to the creation of a Green Chemistry centre in Israel. Prof. J. Pelechowski and Dr D. Bogdal, Krakow Technical University paid a short visit to the Centre to discuss collaboration on microwave chemistry with Dr Strauss.

The Advisory Committee had served for two years and in accordance with our plan, the membership has been changed. New members are Dr Robyn Elliot, General Manager Institute for Drug Technology; Prof. Paul Haddad, Head, School of Chemistry, University of Tasmania; Mr Roy Rose, General Manager Corporate Risk, Orica Australia Ltd; Dr Helen Tope, Senior Policy Officer, EPA Victoria and Prof. Pietro Tundo, Director, INCA. The Centre thanks the retiring members Dr Harry Blutstein, Mr Ian Swan and Prof. John Warner for their contributions as founding members of the Advisory Committee.

Finally, full details of our progress throughout 2001 have been published in our Annual Report to the ARC. This is available on our web site or a hard copy can be obtained from our office (details overleaf).

Italian Australian Technological Innovations Conference and Exhibition (IATICE)

The Centre was involved in IATICE which was held at Le Meridien in Melbourne from 25-28 March 2002. A Workshop on *Green and Sustainable Chemistry* was held on Wednesday 27th March which was Chaired by Prof. Pietro Tundo, from, Interuniversity Consortium "Chimica per l'Ambiente" (INCA), Italy and Prof. Jackson from the Centre for Green Chemistry. There were nine speakers, six of whom were from Italy and three from Australia. Dr Ray Shaw, General Manager Technology Support, Rio Tinto Ltd spoke about Sustainable Chemistry and Australian Industry, Prof. Jackson and Tundo about the state of Green Chemistry in Australia and Europe and more specific scientific presentations were made by Dr Attilio Citterio, Politecnico de Milano, Prof. Serafino Gladiali, University of Sassari, Prof. Giorgio Cerichelli, University of l'Aquila, Dr Ruggero Curic, University of Bari and Dr Malgorzata Biniecka, University of La Sapienza, Roma. The workshop was one of the best attended out of the IATICE program and several of the presentations stimulated enthusiastic discussion.

A Memorandum of Understanding between the Consorzio Interuniversitario Nazionale "La Chimica per l'Ambiente" INCA and the Centre for Green Chemistry, Monash University, was officially signed, by Prof. Pietro Tundo (President of INCA) and Prof. Robert Norris (Dean of Science, Monash University) at the IATICE Conference. This agreement will regulate the research and educational activities on Green Chemistry between the two Institutions for the next 5 years. The MoU aims to identify at least four areas where meaningful and profitable interactions will be established, potential sources of funding will be defined and a timetable for action laid down.

The workshop was accompanied by a splendid reception held on the observation deck of the Rialto Tower, a musical evening - *A panorama of 19th and 20th century works for piano four hands* and dinner for a lucky few hosted by the Regione Campania.



From left: Prof. R. Norris, Prof. P. Tundo, Prof. R. Jackson, Dr N. Sasanalli and Prof. M. Hearn

RESEARCH ACTIVITIES

Improving Soil with Coal-Derived Materials



Acidification of soil is a naturally occurring process. However, factors such as excessive use of nitrogen fertilisers and overharvesting can accelerate its progress. Acidification leads to increased solubility and

availability of phytotoxic metals such as aluminium and manganese, and the loss of nutrients such as phosphorus and calcium. This can have devastating economic and environmental implications. An estimated 90 million hectares of Australian agricultural land are currently classified as being acidic ($\text{pH}_{\text{Ca}} < 6.5$). Major trouble spots include the Western Australian wheat belt and significant sections of northern and eastern Australia.

Previous research has shown that organic materials high in oxygen functional groups (e.g. carboxylates and phenols) can improve acidic soils. These functional groups, which may be characterised by titrimetric or spectroscopic methods, can act as ion exchange sites useful for pH buffering in soil, nutrient transport to plants and the binding of phytotoxic metals such as aluminium, rendering them harmless to plants. 'K humate' (potassium humate) from brown coal is one such organic material abundant in oxygen functional groups. This project trialled a commercial humic product sold as a soil conditioner in order to characterise, quantify and maximize its effect on acidic soils. Experiments were conducted in which a calcium additive was incorporated into the K Humate. The calcium source was 'Calsumag', a commercially treated coal fly ash which contains inorganic additives such as calcium and magnesium which are beneficial to soil.

These two products were trialled on two acidic soils – a sandy soil used for pasture, and a clay loam vineyard soil. The pasture soil was investigated in controlled soil column leaching experiments where columns packed with soil were treated on the surface with various amounts of amendments, and then leached with water to simulate rainfall. After a period of leaching, the soil was analysed down to 15 cm in the profile for chemical parameters pertinent to soil fertility such as pH and aluminium levels. The vineyard soil was investigated in a field experiment where plots were treated with various coal-derived amendments, and the chemistry of the profile (down to 25 cm) of each plot was monitored at regular intervals over about a year.

The findings of both studies were that in many cases K Humate in conjunction with a calcium source such as fly ash, increased pH, decreased aluminium levels, and increased calcium and plant-available phosphorus levels down to substantial depths into the soil profile (at least 6 cm). For one of the soils, which is prone to waterlogging, the addition of K Humate improved water retention and the permeability of soil to liquid.

Results have been successfully presented at national and international conferences and have led to new projects including: a follow-up study of the vineyard field trial focussing on effects of humates and fulvates (ex brown coal) on microbial activity, aggregate stability and water-retention capacity of soil; investigations of the use of organic amendments from various sources (e.g. compost, municipal waste, etc) on the levels of phosphorus in soil; alleviation of salinity in soils again using various organic amendments; and the characterisation of an acidic high organic carbon soil. These projects involving green products have the support and expertise of local and overseas collaborators from both private and government sectors.

Jason Issa (PhD Student) - April 2002

Student Profile – Jennifer Kate Edwards PhD Student, University of Newcastle

Kate graduated from Gosford High School, NSW in 1996. Her interests then took her to the University of Newcastle where she



completed an undergraduate degree, BSc Science (Professional). The course involved a core of science discipline whilst including a range of business, law, economics and philosophy subjects.

After completing her honours degree in physical chemistry, Kate began a PhD in medicinal chemistry under the supervision of Dr Adam McCluskey and Dr Janet Scott. Her project, which is a joint project between the Centre for Green Chemistry and the University of Newcastle, involves the synthesis of dynamin inhibitors. These drugs leave cells unable to carry out endocytosis, which leads to a new technique in causing cell death. Control of dynamin in the brain could be useful in the treatment of brain disorders and cancer. As part of her research, Kate has produced several libraries of compounds using three different approaches. This work has been published in *Tetrahedron Letters*, "Green Approaches to Knoevenagel Condensation: Comparison of Ethanol, Water, and Solvent-Free (Dry Grind) Approaches". A poster of this work will be presented at The 14th International Conference on Organic Synthesis in Christchurch, NZ this July.

Kate is currently spending three months in the Centre for Green Chemistry under the supervision of Dr. Scott. She has been using micro calorimetry to characterise endothermic and exothermic events in reactions leading to the compounds she has previously synthesized and is using green synthetic methods to generate new compounds to be tested for activity.

Correction

In our last issue we referred to a talk given by Dr Janet Scott in Brisbane. This was to the Queensland Chapter of the Environmental Engineering Society not to the Queensland Institute of Environmental Engineers. Our apologies for the incorrect naming.