From the Head of School

As you will see from the content of this newsletter, the only thing constant about the School of Chemistry at present is change – and lots of it! Most of the change is for the good, although a number of retirements from the academic and general staff mean that we are losing a lot of experience. Fortunately, most of these staff will continue to have a strong involvement with the School. We are also losing Professor Les Field who is moving to the “other place” (UNSW) to become Deputy Vice-Chancellor (Research). The offer of this senior position is a great tribute to Les’s standing and reflects the outstanding contributions he has made to the University of Sydney in many senior roles. He will leave a big hole in the School, but we wish him well.

In November, we had a joint celebration to open the new “Advanced Catalysis for Sustainability Laboratory” and to name the First Year Laboratories as the Boden Laboratories. As many of you will know, Dr Alex Boden was an extraordinary benefactor to the School and University for many years. His contributions had been recognised by the naming of the Boden Library, but developments in electronic journal access over the past few years led to the closing of the library. Dr Boden was an author and publisher of very successful chemistry texts and therefore we felt it most appropriate to name the laboratories after him - and the University Senate agreed.

The new “Advanced Catalysis for Sustainability Laboratory” will house the research groups of our Federation Fellow, Professor Thomas Maschmeyer and Associate Professor Tony Masters. Both the opening and the naming were performed by the Vice Chancellor, Professor Gavin Brown, and an excellent evening in the courtyard followed with great wine and a string quartet!

The big news over the past six months has been the outstanding success of the School in winning ARC grants. Of 28 Discovery applications submitted from the School, 16 were successful, a 57% success rate, very close to double the national average! Total new funding from this Discovery grant round was $8.470 million. We also received $2.308 million in Linkage grant funding and $0.902 million in LIEF funding. Adding these to the $1.5 million for a Network grant makes a total of $13.180 million allocated to the School by the ARC in 2004.

It is a good thing that our research is going well because the current hot topic in the universities is research assessment exercises (RAEs). There is evidence that the RAE in the UK has contributed to some problems there, so it is an exercise that we approach with some trepidation. However, it could also represent a mechanism for strong research departments such as ours to receive more appropriate levels of infrastructure support. I’ll report more on where this is heading in the next newsletter.
My Research

My research background has been in two major areas - the synthesis of organic molecules, both natural and novel; and the area of supramolecular chemistry, which can be broadly defined as the chemistry of multicomponent molecular assemblies held together by weak interactions. The aspect of both these areas that intrigues me most is our ability to design and make molecules with particular functions. These molecular functions range from areas as diverse as mimicking the behaviour of biological systems (e.g. enzymes or the photosynthetic reaction centre) to use as drugs against a variety of diseases, to the encapsulation and transport of small molecules inside larger ones. In short, I’m interested in making molecules that do something and then looking at how they do whatever it is they do.

The key to these areas of research is to design a molecule for a particular purpose and then to bring the molecule to ‘life’ by making it. It is relatively simple to draw a molecular structure on paper or a computer screen - we’re limited only by our imaginations. However, sometimes the reactions don’t yet exist to make the molecules that we can imagine. One aspect of organic synthesis involves developing molecular tools and reactions to enable us to make the molecules of our imaginations, and whilst a lot of progress has been made in this area in the past decades, it is very much a work in progress. We can use the tools we develop either to make molecules that have been obtained (normally in very small quantities) from natural sources, or alternatively to prepare molecules whose structures are completely new. Finding ways to make even the smallest molecules can be extremely complicated and take months, if not years, to achieve. The challenge often lies in finding simpler, shorter and more efficient ways to make such molecules.

In general, the functional structures in Nature are not single molecules, but rather aggregates of molecular components. In an attempt to mimic Nature and build large molecular structures more rapidly, many chemists are investigating the formation of molecular aggregates by the ‘self-assembly’ of smaller molecular building blocks. This requires ‘programming’ the building blocks with information that will enable them to find their place and hold them in the correct position in a larger assembly. In turn, this requires us to be able to make building blocks of a particular design – and brings us back to synthesis.

My current research spans a number of areas, all of which rely on being able to make molecules of a particular design for a certain function; some of these are potential drugs, whilst others should be capable of mimicking Nature’s molecular receptors and catalysts.

I am particularly interested in the synthesis of cyclic peptides, as they have a number of applications...
in fields spanning both chemistry and biology. For example, many naturally occurring cyclic peptides exhibit biological activities including anticancer, antifungal and antibacterial activities. As such, they are potential drug targets and the synthesis of these molecules and their analogues is of great interest. Peptide synthesis is generally straightforward and often carried out by robots. However, the synthesis of cyclic peptides is often hampered by the low yields obtained upon cyclisation of a linear peptide precursor. We have recently developed a new method for cyclising peptides in high yield and are currently applying this new tool to the synthesis of naturally occurring cyclic peptides that exhibit either antimalarial or antifungal activity.

In collaboration with co-workers from Westmead hospital, we are also investigating the design and synthesis of non-peptide antifungal drugs. These compounds appear to act via a new molecular target, which is particularly important since resistance is developing to currently available antifungal drugs. In addition, most of the currently available drugs have nasty side effects or can only be administered by injection and are expensive. We aim to develop compounds that are safer and easier to use, and that can be readily synthesized at low cost, to treat the increasing number of patients with invasive fungal infections.

As well as making molecules that might find application as drugs, we are interested in preparing molecules that have other functions. Modified cyclic peptides are being examined as platforms to arrange molecular ‘arms’ capable of recognizing a specific molecule or catalyzing a reaction. These molecules have been designed to mimic natural receptors and enzymes, and should help us to better understand how Nature’s molecules function. This will, in turn, allow us to design molecules that function more efficiently and specifically. We are also using cyclic peptides to prepare molecules that will self assemble to form a molecular capsule, capable of including a smaller molecule in its interior chamber. These compounds have many potential applications, including catalysis, molecular transport and drug delivery.

In collaboration with Prof. Brad Smith (University of Notre Dame, USA) we have designed and synthesized peptide sensors that are currently being tested for their ability to detect cells undergoing apoptosis, or programmed cell death. These molecules have potential application in a number of biomedical areas. For example, they may be used to detect whether an anticancer compound is having its desired effect and killing tumour cells.

Most of these projects are still in their early stages; we have designed molecules which we expect to function in a certain way and are working out how to make them in an efficient manner. I look forward to being able to report on whether they function as planned in the future.

Mr Nima Sayyadi (PhD Student); Dr Kate Jolliffe & Dr Aaron Reynolds (Postdoctoral Fellow)
Two very special events occurred on the 24 November 2004. The first was the official opening of the Laboratory of Advanced Catalysis for Sustainability (LACS), and the second was the naming ceremony of the First Year “Alexander Boden Laboratories”.

The Vice-Chancellor, Professor Gavin Brown, opened both events which were attended by over 200 people. This included the Boden family; Dr Robyn Williams (Science Communicator and ABC Science Show Host); Dr Ian E. Maxwell (CEO of e-Learning); and staff and students from the School of Chemistry and elsewhere in the University and their guests.

Professor Thomas Maschmeyer kicked-off the evening with a 15-minute talk about the work that will be carried out at LACS which is aimed at discovering and developing sustainable chemical processes, using catalysis and new, fundamental insights at the molecular and nanoscopic level.

The Vice-Chancellor then introduced Dr Ian Maxwell who gave a fascinating talk on innovation breakthroughs in catalysis using high speed experimentation. This was followed by an amusing, and informative talk by

Prof. Trevor Hambley, Mrs Elizabeth Boden, Vice-Chancellor Prof. Gavin Brown and Mrs Diana Thomas
Robyn Williams on the role of chemistry in society.

From there we moved on to celebrate the naming ceremony of the First Year “Alexander Boden Laboratories” where the Vice-Chancellor regaled us with stories of Dr Boden. This was followed by the unveiling of the Alexander Boden commemorative plaque. With this the First Year Teaching Laboratories were officially named the Alexander Boden Laboratories.

The School is proud to have the name of Dr Alexander Boden associated with its First Year Teaching Laboratories and we hope that the memory of Alexander Boden will inspire staff and students alike. The School would also like to recognise the strong and ongoing support given to us by Dr Boden and his estate. He was indeed a remarkable man!

The evening concluded with refreshments and a Jazz Quartett in the Chemistry Courtyard.
The Organic Synthesis

by

Pat Stamford

Background

Synthetic Organic Chemistry has been a focal point and a real strength in the School of Chemistry for more than 50 years and the School has hosted some of Australia’s foremost synthetic chemists. Over this period, many members of the School have willingly provided chemical expertise and specialised organic synthesis, not only to the research community within the University, but also to external agencies requiring these services. This demand provided the platform for the formation of the Sydney Organic Synthesis Unit by Dr Simone Vonwiller in 1999 which specialised in custom synthesis, contract research and consultancy.

By 2003, growing demand for contract synthesis provided the impetus to formally adopt the Unit as a Centre within the University and the Organic Synthesis Centre (OSC) was born.

Providing External Services

The OSC now acts as one of the commercial enterprises of the School of Chemistry and provides professional services to industry and the chemical research sector. Over the last 12 months, the OSC has been able to provide a wide and unique range of services to many agencies both public and private. These have included: (i) the synthesis of high quality specialist organic chemicals for the pharmaceutical, biotechnology and materials industries in quantities from milligrams to kilograms; (ii) the development and formulation of synthetic strategies for new compounds as well as assessment and optimisation of synthetic schemes; (iii) the active involvement in research programs through the design and provision of novel compounds for various applications; (iv) consultancy and the provision of expert witnesses; (v) the provision of expertise to support applications for research funding where there is a need for professional organic synthesis; and (vi) the provision of research assistance (on a contract or long-term basis) in research programs that require the on-going synthesis of organic compounds.

The OSC also provides a service to the wider Australasian Organic Chemistry community through the development
Pat Stamford joined the School in September 2003, as Executive Officer of the Organic Synthesis Centre. Originally from Manchester, UK, Pat immigrated to Australia in 1968 and was raised in Sydney. He was an undergraduate student at the Australian National University where he completed his Honours in 1987. He then completed his PhD at the Research School of Chemistry under the supervision of Dr Nick Dixon in 1991.

In October 1991 he took up a junior faculty position at the University Chemical Laboratories, University of Cambridge, and embarked on a close collaboration with Professor Sir Alan Battersby FRS on many facets of the biosynthesis of Vitamin B\(_{12}\) and related porphyrins. During his time in Cambridge Pat was also elected Research Fellow in the Sciences at Clare Hall. In 1996 Pat moved to the University of East Anglia, UK, where he was lecturer in Bioorganic and Natural Product Chemistry.

In 2002 Pat returned to Australia to commence an MBA at the Macquarie Graduate School of Management. During this time, he also accepted the opportunity to join the University of Sydney as the Executive Officer of the Organic Synthesis Centre and the Centre for Structural Biology & Structural Chemistry. Dr Stamford is a member of the Royal Australian Chemical Society and of the Royal Society of Chemistry.

Pat is married to Linda, and has two daughters, Rowena (5) and Eleanor (3).

Additional information about the Organic Synthesis Centre can be found at http://osc.chem.usyd.edu.au.

Centre Research

In addition to the “professional service” niche occupied by the OSC, members of the OSC staff are also involved in primary research activities. This research is either cooperative (i.e. where OSC participates in a program collaboratively with other research groups within the University) or more fundamental (e.g. developing new practical methods for molecular synthesis). Current programs of research include investigations into expanding the synthetic toolbox available to practicing chemists through the re-evaluation of many long-established synthetic methodologies together with related aspects of biomimetic and chemoenzymic synthesis.

The Organic Synthesis Centre continues to grow and is finding a longer and longer list of clients who find that OSC really fulfils a need which has been difficult to satisfy in other ways. It is a venture which has built on a real strength in the School of Chemistry and provides another avenue by which the School is reaching into the wider Chemistry community.

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Servicing the USyd “Chemistry” Community

The University of Sydney supports one of the largest concentrations of molecular scientists in Australia; whether they are associated with Chemistry or closeted in other disciplines such as the biological sciences, materials sciences, physics or medicine. In many instances, the research programmes in which these scientists operate require molecules which may be difficult to access for a variety of reasons. Often these research groups don’t fully comprehend which molecule will best suit their research outcomes or, more simply, they may not possess or appreciate the relevant facilities, expertise or skills that are needed for synthesis. In each of these instances the OSC provides an invaluable service either through direct provision of material or through the development of cooperative research programs. The OSC now even provides services to research groups involved in synthetic Organic Chemistry within the School of Chemistry itself.

and hosting of OrgNet Australasia. OrgNet is a free email network regulated by the OSC for Australasian Organic Chemists to enable the rapid dissemination of important messages and information.

Brief History

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Donations

The School of Chemistry would like to thank the following people for their generous donations from October 2004 to April 2005:

- The Alumni Fund
  - Dr Paul R. Collins
  - Dr Joyce E. Fildes
  - Mr Ronald Hinde
  - A/Prof. Robert Hunter
  - Dr Phillip L. King
  - Dr Janet Newman

- The Inorganic Fund
  - Alpha Chemicals Australia Pty Ltd
  - Mr Robert Geyer
  - Mrs Sarach J. Irvine
  - Dr William R. Tulip

If you would like to make a donation please visit http://alumni.chem.usyd.edu.au/pages/donations.html, or contact Anne on (02) 9351 2755.

Chris Ling

Chris Ling joined the School of Chemistry in June 2004, in a joint appointment with the Bragg Institute at ANSTO (Lucas Heights). Chris received his BSc from the University of Melbourne in 1994, earning the Dean's Prize. He moved to the ANU for his Honours year in 1995, working in the solid-state chemistry group of the RSC under the supervision of Ray Withers, John Thompson and Siegbert Schmid. He stayed for a PhD with the same supervisors, studying structural modulations in oxide-ion conductors using electron, synchrotron x-ray and neutron diffraction methods.

In 1999 Chris moved to Chicago as a postdoc in the Neutron and X-ray Scattering Group of the Materials Science Division at Argonne National Laboratory. This US Department of Energy lab operates both a spallation neutron source and a 3rd-generation synchrotron x-ray source, of which he took good advantage. While there, he worked mostly on magnetic materials, including colossal magnetoresistive (CMR) oxides and molecular magnets.

In 2001 Chris moved to the Institut Laue-Langevin (ILL) in Grenoble, France, the world’s leading research reactor. At the ILL he was directly involved in the development of neutron scattering instrumentation, while his insider status at a major research facility gave him the opportunity to collaborate with many leading European research groups on experiments into the structure, dynamics and magnetism of materials.

Chris returned to Australia to take advantage of the vastly improved research reactor being constructed at Lucas Heights and the Australian Synchrotron being constructed at Monash. When completed in 2006 and 2007, respectively, these will be world-class facilities for materials science research. Chris’ principal research interests concern the relationship between structure and magnetism in solid-state materials, and particularly those cases where the two are in delicate equilibrium; this can lead to pronounced changes in physical properties when the equilibrium is disturbed, such as CMR. He is working to establish a solid-state chemistry research program directed towards the synthesis of such materials.

Congratulations to Dr Lou Rendina who was awarded the 2004 RACI Organometallic Award (jointly with George Koutsantonis). Lou also won this prestigious award in 2003.

I am pleased to announce that our very own Associate Professor Scott Kable has been awarded a Centenary of Federation Teaching Award for his contribution to Chemical Education, and in particular, the Australian Physical Chemistry Enhanced Laboratory Learning Project. This is a great achievement!

Our heartiest congratulations to Ms Deborah Crittenden, Ms Jenny Waern and Mr Adam Wootton who won the 2004 C.G. and R.J.W. Le Fèvre Postgraduate Student Lectures Award. The lectures were established in 1985 following a gift of $2,000 from Emeritus Professor R.J.W. Le Fèvre and are awarded on the recommendation of the Sydney University Chemical Society. All three students gave exceptional lectures and have very impressive track records for young scientists at the earliest stages of their careers.

Double congratulations to Margaret Harding and Cameron Kepert. Both have been promoted this year to Professor and Associate Professor respectively. Both promotions are thoroughly deserved.

Congratulations to Dr Tony Lacey, on winning the Peter Dunlop Memorial OH&S Award for 2004. This award recognises Tony’s leadership on safety matters in the School and the University. Tony retired at the end of 2004 after 45 years of invaluable service to the School. However we are fortunate to have Tony back in 2005 as an Honorary Senior Lecturer.