From the Head

This is my last column as Head of School and looking back over the newsletters of the past four years, the common themes are unquestionably change and success. We are going through an extraordinary period of staff turnover and this shows no signs of abating. The recently announced changes to the Research Quality Framework (RQF) model that will allow universities to count the research performance of staff where the work was done elsewhere will strongly encourage head hunting and further staff movements. Indeed, this has already begun with two of our staff having recently announced their intentions to move to Queensland: Professor Bob Gilbert is off to the University of Queensland and Dr Mark Coster is off to Griffith University. Both have contributed a remarkable amount to the School and the University – Bob over more than three decades and Mark in only three years. As colleagues we recognise the opportunities these moves provide and wish them both well. However, there is some cause for concern because it is not coincidental that both are heading off to the state where the government is most proactive in supporting science and the universities. Science departments in NSW universities are now unique in Australia in receiving next to no support from their state government and this will place them at a severe disadvantage over the next few years as the impacts of the RQF take effect. The potential losers in this are NSW students if their universities are not in a position to compete for the best staff and therefore it is important that we lobby the NSW State Government to at least match the other states in the level of support provided to science.

We also need to be creative and aggressive in tackling the threats imposed by the new research environment. Part of this is to continue to move our focus from competing at the national level to competing internationally. The academic employment scene is becoming a lot more flexible and this will make it easier to attract top staff from overseas. Fortunately, the School of Chemistry is already attracting top class academics from overseas as reflected in our three most recent appointments and in the applicants for the positions we currently have open. Given the right support, I am confident that we will continue to attract outstanding staff and retain our standing as a leading department. The University of Sydney is undergoing a major restructure of its senior management and its Faculty structure. The Colleges have gone, being replaced by 6-9 faculty clusters, one of which is Science, Agriculture and Veterinary Science. As part of this change, there is to be substantial move of funding to the faculties and schools which has already begun. With this move comes increasing responsibilities, but the consequence is that we will be better placed to control our own destiny and to achieve our goal of being one of the top chemistry departments in the world.

Professor Trevor Hambley
Head of School
A Passion for Porphyrins

A passion for porphyrins has inspired the research of Professor Max Crossley in his 26 years in the School of Chemistry. Porphyrins are natural highly coloured molecules that play critical roles in living organisms. The many shades of green in plants and the vivid red of blood are all due to these important molecules. As well as being colourful, porphyrins are essential for the light harvesting and electron transfer reactions of photosynthesis and for the oxygen-carrying properties of haemoglobin in red blood cells. In addition to these key redox roles, they are key components of a number of important enzymes and co-factors in animals, plants and microorganisms.

The diverse and fascinating roles of porphyrins in nature have inspired much research to try to understand how they work and to try to simulate their useful characteristics by making synthetic analogues. Max and his research group are recognised internationally as leaders in both the development of new porphyrin chemistry and in its innovative application to commercially important problems. Max’s research has been funded continuously with large grants by the Australian Research Council since 1981. In the last decade, in addition to substantial infrastructure development grants, research funding to Max and his collaborators in Australia has exceeded A$7.25 million.

Max’s early research at Sydney was directed towards specific functionalisation of the periphery of porphyrin molecules and to gaining understanding of the structure, tautomomerism and bond orders in porphyrin systems. Understanding fundamental porphyrin chemistry has underpinned the many subsequent research achievements. An interest in photochemistry was inspired by the stunning X-ray crystal structures of photosynthetic reaction centres determined by the 1988 Nobel laureates for chemistry (Deisenhofer, Huber and Michel) and led the group to focus on the synthesis of chemical models for this natural process or “artificial photosynthesis.”

Recently Max and his post-doctoral colleagues Dr Paul Sintic and Dr Ian Blake have succeeded in synthesising the closer working chemical mimic yet of these photosynthetic reaction centres. In addition, multi-porphyrin arrays based on dendrimers or branching structures that mimic key features of natural light harvesting systems have been constructed. This research exploring artificial photosynthetic reaction centres has, in turn, generated exciting achievements and understandings in the cutting edge research fields of ‘molecular electronics’ and ‘photovoltaics’. In particular, new compounds have been developed for use in novel organic photovoltaic cells, an area in which Max collaborates with leading researchers in Japan and Sweden. Put simply, the aim is to make even smaller and more efficient devices that rely on charge separation and electron transfer.

Much of the research conducted by the Crossley laboratory has focused on the design and synthesis of new advanced materials based on metallocorphyrins. Studies in the areas of molecular wires, molecular switching devices, molecular shift-registers and non-linear optics have been groundbreaking. Much of this work has been conducted in concert with theoretical chemistry studies led by colleague Dr Jeff Reimers. Most recently large scale funding from the large computer chip manufacturer, Intel, has enabled a successful, concerted effort involving six postdoctoral and three postgraduate researchers to produce molecular memory cells for long-term, non-volatile flash memory storage.

Similarly, early research on chemical models to mimic selective reactions of the oxygenase enzymes of our bodies has provided significant new insights to reveal how these enzymes work. Working with collaborators at the University of Nijmegen in The Netherlands, Max and his team have succeeded recently in observing the full catalytic cytochrome P450 cycle on a single molecule using real time single molecule molecular imaging techniques.

The remarkable properties of porphyrin derivatives offer opportunities to use them creatively in biological as well as physical applications. The focus in this biologically directed research has been on molecular recognition, which is essential in important biological processes such as smell and enzyme-catalysed reactions, and on devising novel receptor molecules and drug candidates. One recent example of such a drug development that has been awarded a full international patent in 2006 arose from a research collaboration between Max and Professor Norman Hunter of the Dental Research Institute at Westmead Hospital. The new drug has the potential to control gum disease and gingivitis. Max’s other interest involves amino acid chemistry and has resulted in the development of novel gamma-lactam antibiotics, and the synthesis of the antibiotic and anti-tumour agents, anticapsin and bacilysin, the important metabolic intermediate, omega-aminobutyric acid, and dipeptide inhibitors of the enzymes gamma-glutamyl cyclotransferase, prolidase and of the HIV protease.

A further innovative application of molecular recognition involved a study of the binding of amino acids to the chiral cavities of novel bis-porphyrin derivatives, which developed the concept of using individual molecules as ‘molecular rulers’ to measure distances at the molecular level. Other projects in which molecular recognition has played a key role have led to new insights into complementary and self recognition, templated-synthesis and molecule self-replication, and to the proposal of an ‘artificial genetic code’.

The Crossley laboratory attracts many international researchers – currently the group has eight postdoctoral fellows and ten research students. Present members of the group hail from Denmark, Switzerland, China, England, Scotland, Singapore, and Malaysia. Previous members of the group have come from Iceland, Sweden, Japan, USA, Germany, France, The Netherlands, Vietnam, Spain, Lithuania, and even Albania. Twenty-four doctoral students have been trained in the laboratory and most of them have continued with careers in chemistry. Four have recently become Professors of Chemistry: Professor Margaret Harding (who is also Dean of Graduate Studies) at UNSW, Professor Steven Langford at Monash University, Professor Paul Burn at University of Queensland, and Professor Joost Reek at the University of Amsterdam. Quite a few of the others have entered the industrial side of research and development including Dr Andrew Stanford who is now Associate Director of Medicinal Chemistry research at Schering-Plough Corporation in New Jersey, and Dr Megan Fisher who is Business Development Manager of CSIRO Molecular and Health Technologies. Of the present group, Peter Brotherhood won the Feutrill Prize and IUPAC prize for best poster presentation of research at the RACI National Convention in 2005, and Tony Khoury, Dr Deanna D’Alessandro and honours student Adam Hambly won the NJC prize for best poster presented at the 4th International Symposium on Porphyrins and Phthalocyanines held in Rome in July 2006. Max has received a number of prizes for his research, which he attributes in part to having had many excellent and dedicated research students in his laboratories.

Max has been awarded the Birch Medal (1998) and the H.G. Smith Memorial Medal (2001) of the Royal Australian Chemical Institute and a Centenary Medal in 2003, and he was elected a Fellow of the Australian Academy of Science in 2001. Max is also the Academic Director of the Cornforth Foundation for Chemistry.
Martin Trikojus. Trikojus was a lecturer in organic chemistry who gave me some vacation work in his lab, my first taste of the biological side of chemistry that was later to be my main area of operation”.

In the photo below, taken in 1929 of the Organic staff and research students, Trikojus (who would go on to take the Chair of Biochemistry at Melbourne University) sits on the left, with Organic professor John Earl in the centre and Francis Lions on the right; and at the top of the page, John Cornforth holds the prizes he has just received as dux of Sydney High in 1933.

Cornforth went up to the University the following year, at age 16. He described his situation in a later biographical note: “Though by that time unable to hear any lecture I was attracted by laboratory work in organic chemistry (which I had done in an improvised laboratory at home since the age of 1½) and by the availability of the original chemical literature.” When he graduated in 1938, it was with first-class honours and a University medal.

After a year of post-graduate research, he won an 1851 Exhibition scholarship to work at Oxford with Robert Robinson. So too did a talented Sydney colleague Rita Harradence who, like John, had been drawn to chemistry by an inspirational teacher at school, in Rita’s case, Miss Lilian Whitmore of St George Girls’ High. As War broke out, John and Rita travelled to Oxford. The two had first met earlier, in the lab, when Rita called on John’s glass-blowing skill to repair a broken Claisen flask. It was the start of what turned out to be a hugely productive life-long partnership.

In Oxford, they worked for their doctorates on steroid synthesis, writing their theses in 1941 and marrying the same year. The major project in Robinson’s laboratory during the War was unravelling the chemistry of penicillin and, in 1943, the Cornforths joined the team.

After the war, they moved to the Medical Research Council’s National Institute for Medical Research in London, continuing an odyssey that is well-documented elsewhere. Among the references given below is the text of Cornforth’s Nobel Lecture Asymmetry and Enzyme Action. There, you can read his own account of the work carried out at the National Institute and later at Shell Research’s Millhead Laboratory of Chemical Enzymology that led to the Nobel Prize for Chemistry in 1975 (which he shared with Vladimir Prelog).

Accepting the Nobel Prize, Cornforth paid this tribute to Rita: “Throughout my scientific career my wife has been my most constant collaborator. Her experimental skill made major contributions to the work; she has eased for me beyond measure the difficulties of communication that accompany deafness; her encouragement and fortitude have been my strongest supports.”

The references below also include a paper Scientists as Citizens, the text of a public lecture Cornforth delivered in 1992 on the occasion of the RACI-75th birthday (and incidentally, his own). I think you will enjoy his turn-of-phrase. For example: “A few hundred years ago – a mere breath of time – a concentrated source of energy was discovered in the fossil fuels essentially, the energy of old sunlight trapped by life and buried by the earth. Humanity has exploited this resource with all the restraint of a fox in the chicken house.”

Doubt, he noted, is the foundation of science: “It may seem odd that a system of knowledge based on doubt could have been the driving force in constructing modern civilization. At its foundation in 1660 the Royal Society of London, for improving natural knowledge, was given by a quasist and still surviving custom a coat of arms and a motto. One motto considered was Quantum acceperis, which translates as “What a lot we don’t know.” It is a good motto and I don’t know why it was not adopted. Perhaps some much mistaken person thought that it wouldn’t be true for long enough. In the end, the one chosen was Nullius in verba. This means, from its original context, “We take nobody’s word for it.”

He concluded: “Scientists have some influence on how science is taught; and they have in the schools the opportunity to start the sceptical revolution.” Len Basser couldn’t have put it better.


Basser’s Classroom to the Nobel Prize: Sir John Cornforth, The High Bulletin, 50(2) (2001), 5

Len Basser Legacy, The University of Sydney Gazette (November 2005), 7.
During his career Len has spent periods at the ANU, ETH Zurich, Florida State University and NUS Singapore, as well as almost annual periods at Cambridge University. He is a Senior Member of Robinson College, Cambridge - an appointment for life that conveys some of the privileges of a Fellow when in residence. He currently also holds the position of Adjunct Professor of Chemistry at James Cook University.

Len is a past President of the Australian Institute of Nuclear Science and Engineering (AINSE) and past Chair of the ARC Chemical Sciences Sub-Panel as well as Chair of the Physical Sciences (Mathematics/Physics/Chemistry) Panel. He remains a member of several international conference organising committees and is also currently a member of the IUPAC Committee on Chemical Nomenclature and Structure. He has been a consultant to both national and international companies.

He continues to be an active researcher in the area of macrocyclic and supramolecular chemistry. He has published over 250 research papers and patents and two monographs. His research standing continues to receive recognition through invitations for plenary and other invited conference lectures, guest editorships and membership of journal editorial boards.

Len Lindoy is a Fellow of the Australian Academy of Science and has served on the Academy’s Council. Over his career he has received a number of prestigious awards such as the RACI’s Olle Prize (twice), the Burrows Medal and the H. G. Smith Medal as well as the Gold Medal for Excellence in Research from AINSE. He was the 1998 Liversidge Lecturer of the Royal Society of NSW and the Royal Society of Chemistry (UK) Australasian Lecturer in 2000. In late 2005 he was appointed the inaugural Eastchem (Scotland) International Visiting Fellowship lecturer at the Universities of Edinburgh and St Andrews. In 2003 the University of Wollongong awarded him a DSc (honoris causa) in recognition of his contributions to the University and to Inorganic Chemistry.

Attention: Science Teachers

Did you know that the School of Chemistry runs a High School Workshop, also known as the Kickstart Program, for year 12 students? On average 100 schools (1,500 students) attend each year to participate in a series of hands-on experiments and instrumental demonstrations from the Chemical Monitoring and Management topic. If you would like more information about this program please visit http://www.chem.usyd.edu.au/school/kickstart.html or contact the School’s High School Liaison Officer, Dr Jeanette Hurst on 02 9351 3105, email: j.hurst@chem.usyd.edu.au. The School also runs Science Teachers’ Workshops every second year. Next STW is due in 2007.

To keep up-to-date with School events please visit http://www.chem.usyd.edu.au. ♦

A Symposium for Bob Gilbert

In Honour of Professor Bob Gilbert’s 60th Birthday, the School will hold a Symposium on Theory of Macromolecular Kinetics from 21-22 October, 2006.

Bob’s impact on Australian science is incalculable. He has been, and is, a teacher, mentor, colleague and friend to generations of Australian scientists. His contributions span the fields of unimolecular reactions, collision theory and free radical and emulsion polymerisation mechanisms. His latest research is aimed at understanding the mechanisms and kinetics governing the formation of starches, ubiquitous biological polymers. The theme linking all Bob’s research is the development of theories of reaction kinetics and a drive to unravel the fundamental mechanisms at work in chemical reactions.

A hallmark of Bob’s science is his close interaction with experiment and this symposium will bring together some of the world’s leading theoretical and experimental researchers in the fields of molecular and macromolecular reaction theory. It is a celebration both of Bob’s career to date and the wealth of research in these scientific areas. For further information please visit http://www.chem.usyd.edu.au/gilbert/ ♦
Ms Jill Halliday

Chemistry Alumni Scholarship

Jill Halliday is a recent chemistry graduate, having completed a BSc(Hons) degree in 2004. Jill then worked for a short period in the Faculty of Pharmacy as a research assistant, before returning to the School of Chemistry thanks to the aid of an Alumni scholarship. Jill is currently pursuing a PhD in organic chemistry under the supervision of Dr Mal McLeod.

Jill’s research is directed towards the highly toxic natural product methyllycaconitine which has been isolated from many Delphinium plant species and is the most potent, non-peptide based blocker of a class of ion-channels found in the brain known as nicotinic receptors. These receptors are involved in cognitive processes such as learning and memory. While methyllycaconitine is not suitable for use as a therapeutic in its own right, it represents a prime lead for the investigation of these attractive drug targets.

Jill’s thesis is aimed at synthesizing small molecule analogues of methyllycaconitine in the search for new drugs to treat debilitating disorders such as epilepsy, Alzheimer’s disease and schizophrenia. Jill has developed new methodology for the formation of the biologically important core of methyllycaconitine (Org Lett, 2006, 8, 3399), which is easily elaborated into compounds for biological testing. Initial results from a cellular assay of our receptor targets (frogs’ eggs), show that these simplified analogues do retain the desired functional activity.

News in Brief

I am pleased to be able to report that Dr Adam Bridgeman has accepted our offer of the position of Director of First Year Studies and has joined our First Year Team. Previously, Adam was Senior Lecturer at the University of Hull where he led a complete revamp and revitalisation of their teaching program. He has research interests in the development of computer and web based teaching tools and computational approaches to the study of biological compounds and molecular materials. He was awarded a University of Hull Teaching Fellowship Award and the 2004 Royal Society of Chemistry Higher Education Teaching Award.

Congratulations to Professor Cameron Kepert on his winning the inaugural Alan Sargeson Award. This award will allow for Cameron to visit and talk at chemistry departments around the country.

I am happy to announce that one of our postgraduate students, Ms Gemma Solomon, has been successfully nominated by the Australian Academy of Science to attend the Lindau Meeting of Nobel Laureates as one of the Australian Representatives. Professor Max Crossley has also been invited to attend this meeting as the leader and mentor of the Australian contingent. Read more about Max on pages 2 & 3.

The School of Chemistry would like to take this opportunity in thanking Honorary Associate Professor Manuel Aroney for his outstanding contributions to the Foundation for Inorganic Chemistry over the years. Manuel’s tireless efforts, especially in the organization of the Foundation’s AGM and functions, have been very much appreciated by us all.

DONATIONS

The School would like to thank the following people for their generous donations from May to September 2006:-

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