ChemNEWS

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Newsletter of the University of Sydney Chemistry Alumni

Professor Trevor Hambley
Head of School

General queries to:

Chemistry Alumni
School of Chemistry, Bldg F11
The University of Sydney
NSW 2006 Australia

Email
alumni@chem.usyd.edu.au
Phone
+61 2 9351 4504
Facsimile
+61 2 9351 3329
Web sites
http://www.chem.usyd.edu.au
http://alumni.chem.usyd.edu.au/

The University of Sydney
AUSTRALIA

From the Head of School

In July the RACI held its National Convention (this year named Connect) in Sydney. The meeting was a great success and proved that chemistry in this country is in much better shape than even the more optimistic of us dared hope. The meeting was an even greater success for the School with an extraordinary number of our staff and students winning major awards. This has been a great year for the School with staff and students winning the RACI's premier awards for research (H G Smith Medal), for younger chemists (Rennie Memorial Medal) and for the best PhD thesis (Cornforth Medal). Staff and students have won numerous other awards and these are all listed on page 8. In addition, one of our own staff members, Cameron Kepert, has been awarded a Federation Fellowship! These awards are in my (unbiased) view, an appropriate reflection of the quality of our staff and students and, perhaps even more importantly, of the support they give each other.

I finished my previous column in this journal with a promise (threat?) to talk more about the research assessment exercise on which Australia is about to embark. This now has a name: the Research Quality Framework (RQF), and it appears that the outcomes of this assessment will be used as a basis for allocating part of the funding that goes to universities. Consequently, the universities will take this very seriously and it is likely that we will see very significant changes in the university sector. Sadly, if the UK experience is any indication, many of these changes will be for the worse.

The UK-RAE does not appear to have included a strategic element and as a consequence it has generated behaviour that is in the interests of individual universities, but is not in the interests of the country. As an example, high quality chemistry departments (as assessed by the RAE) have been closed because the universities evidently believed that they could end up with a higher average research ranking by moving resources into less expensive areas. At the same time, Britain is struggling to maintain some parts of its chemical industry because it no longer trains sufficient chemists to meet its needs. There is a real danger that the RQF will generate similar aberrant behaviours in Australia and great care must be taken before the assessment targets are converted to policy changes. This is a particular risk for the more expensive sciences such as chemistry and comes at a time when a number of independent assessments have established that even at current levels the universities will not be able to train sufficient chemists to meet the needs of industry.

The other side of the UK experience is that some departments have been able to grow and become more internationally competitive. This is the opportunity that the RQF presents for strong schools and universities, such as ours, and it is one that we will be pursuing vigorously.

Finally, a thank you to all that have donated money to our various funds. Support from alumni is one of the things that distinguishes US universities from those in the rest of the world and it is very encouraging to see that you, our alumni, are willing to support our students and our Foundations.

Professor Trevor Hambley
Head of School

Noel Hush (left) with Alexander Kuznetsov

David Beretan; Fritz Schaefer and Brian Salter-Duke

A Tribute to Noel Hush

Noel's 80th birthday was celebrated with three events in early July.

The first was a two day symposium with presenters that included many of Noel's colleagues and former students from around the world: Steve Boxer (Stanford, USA), David Buckingham (Cambridge, UK), John Dyke (Southampton, UK), Shunichi Fukuzumi (Osaka, Japan), Alexander Kuznetsov (Moscow, Russia), Sven Larsson and Sture Nordholm (Göteborg, Sweden), George McLendon and David Beretan (Duke University, USA), Tom Meyer (University of North Carolina USA), Nobuhiro Ohta (Hokkaido University, Japan), Mark Ratner (Northwestern University, USA), Jean-Michel Saveant (Paris, France), Fritz Schaefer, (University of Georgia, USA), Peter Taylor (Warwick University, UK) and Jens Ulstrup (Technical University of Denmark, Denmark). Nobel Laureate Henry Taube gave a video presentation.

The second was a magnificent candle-lit banquet in St Paul's College, attended by symposium members as well as Noel's family and friends.

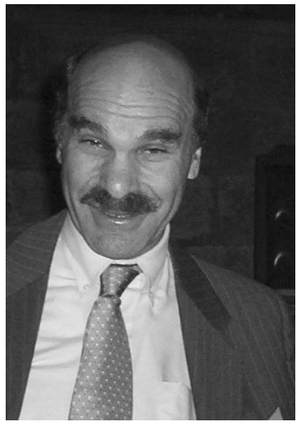
At this banquet, the third event was announced: the launching of the Hush Fund, to create a lecture series in the area of Noel's many scientific interests.

The School would like to take this opportunity to thank Dr Jeff Reimers for all his hard work in making this event such a success.♦

Hans Freeman (left) with Thomas Barlow

Mark Ratner; Noel Hush and David Beretan

Mark Ratner



Nobuhiro Ohta and Shunichi Fukuzumi

PROFILE:

Noel Sydney Hush

Professor Hush is one of the world's eminent chemists and one of the finest in Australia. He has been awarded the Order of Australia and the prestigious Flinders and Craig Medals of the Australian Academy of Science. His international recognition includes the Fellowship of the Royal Society of London and the Royal Society of Chemistry Centenary Medal. He is one of the very few Foreign Members of the American Academy of Arts and Sciences.

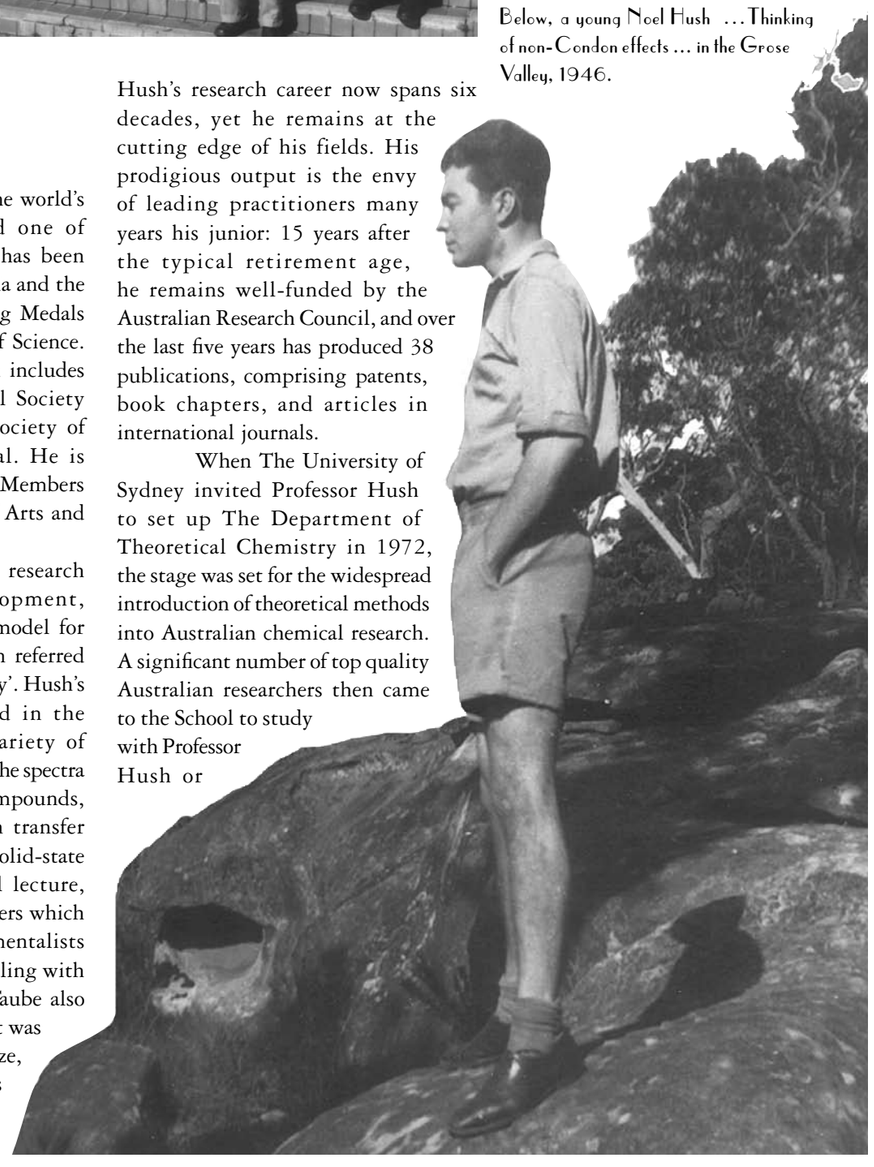
His most renowned research achievement is the development, starting in the 1950s, of a model for electron transfer; this is often referred to as 'the Marcus–Hush Theory'. Hush's fundamental model is used in the interpretation of a wide variety of processes in chemistry, such as the spectra of intervalence inorganic compounds, photosynthesis, and electron transfer in biological, inorganic, and solid-state systems. In his 1983 Nobel lecture, Henry Taube, stated 'The papers which most influenced the experimentalists … were those … by Hush dealing with adiabatic electron transfer.' Taube also said, concerning the work that was responsible for his Nobel Prize, 'In pursuing these interests … we have relied on theory introduced by Hush'.

Hush's research career now spans six decades, yet he remains at the cutting edge of his fields. His prodigious output is the envy of leading practitioners many years his junior: 15 years after the typical retirement age, he remains well-funded by the Australian Research Council, and over the last five years has produced 38 publications, comprising patents, book chapters, and articles in international journals.

When The University of Sydney invited Professor Hush to set up The Department of Theoretical Chemistry in 1972, the stage was set for the widespread introduction of theoretical methods into Australian chemical research. A significant number of top quality Australian researchers then came to the School to study with Professor Hush or were significantly influenced by him. These people now take leading roles in basic science, computational methods development, nanotechnology, biotechnology, and drug design both nationally and internationally. Indeed, the theoretical methods either developed by or facilitated by Professor Hush are now widely used throughout drug design and materials design.

Noel Hush's work provides one of the mainstays for advances in materials science in the 21st Century. The Hush Fellowship Fund provides an opportunity to recognise and perpetuate his work. ♦

Below, a young Noel Hush … Thinking of non-Condon effects … in the Grose Valley, 1946.



Jim Eckert writes about

Sydney University 100 Years Ago

In 1900, the University of Sydney, approaching its 50th birthday, was still a very modest enterprise. There were 4 Faculties (Arts, Science, Medicine and Law) and the student population stood at 583. In the photo on the right, taken at that time from Broadway, then called George Street South, the University's Main Building sits on top of the hill. Steam motors head towards Railway Square, one pushing a ballast trailer and behind, another hauling a water sprinkler. Otherwise horses rule. Look at the roadway. Collecting samples for the manure analysis in the Senior Chemistry Prac can't have been too much trouble.

Up at the University, a long-standing problem was coming to a head. The Library needed a new home. From the start, the book collection had been housed on the first floor of the Main Building, in what later became the Senate Room. By 1900, books were spilling into other rooms and had been for 20 years. The Government now agreed to pay for a new library building, enabling the University to use as an endowed book fund a large sum of money left to it in the 1880s by Thomas Fisher, a local businessman with a soft spot for the place. So, in 1901, work began on the construction of a Gothic annex on the south side of the Quadrangle. This would become the original Fisher Library.

When the Library opened in 1909, its various features were noted with pride – the huge reading room with an open-timbered roof (surviving today as the MacLaurin Hall), the adjoining multi-tiered book stack, with electric book lifts and glass floors, and externally, an architectural style consistent with the rest of the Main Building "but more ornate in character and richer in detail. … No other building in Sydney has such a wealth of carving and grotesquerie, for, continuing the Gothic tradition, the gargoyles grin in stony ecstasy from every cornice".

Meanwhile Science Road as it came to be named was taking shape. The Macleay Museum and a building specially designed for Physics had opened in the late 1880s. Buildings for Chemistry, Engineering, Geology and Biology soon followed, six buildings for the Faculty of Science (Engineering would not become a Faculty in its own right until 1920) and all of them up and running in little more than a decade.

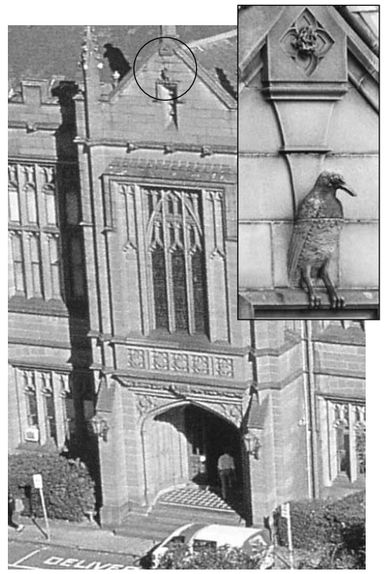
In the photo below, taken in the early 1890s, the tall tower on the left belongs to the Engineering Building, demolished in 1910 to make way for the Union (today called the Holme) Building. The horse in the foreground grazes in front of the Physics (now the Badham) Building. The square tower is still there. It was built to provide a line-of-sight to the Sydney Observatory and a platform for astronomical observations.

The building owed much of its design to Physics professor Richard Threlfall. Threlfall had an abiding professional interest in explosives, in spite of (maybe that should be because of) a school-boy experiment that had cost him two fingers of one hand and the top of the thumb and a finger of the other. Yet he became by all accounts a superb experimentalist. His book *On Laboratory Arts* was full of "clever dodges" and remained on recommended reading lists for over 30 years. He resigned in 1898 after 12 years in Sydney and returned to England where he pursued another interest, electrochemistry, through a long and successful career in industry.

Further up Science Road, facing Chemistry, was the Geology Building, the domain of T.W. Edgeworth David, another formidable figure at this time and for decades to come. A colleague later wrote of "his clear ringing voice" and "compelling eloquence" and of how completely the public's imagination was captured by his exploits. These included leading the first ascent of Mt Erebus and the first trek to the South Magnetic Pole as a member of Shackleton's 1908 Antarctic Expedition; and winning a DSO during World War I while serving as Chief Geologist to the British forces on the Western Front. His life reads like something out of a Boys' Own Annual. The cartoon of David below appeared in *Hermes* shortly after his return from Antarctica.

South of the Main Building at the turn of the Century stood the Medical School (now the Anderson Stuart Building). Thomas Anderson Stuart was the first Dean of the Faculty of Medicine, appointed to the Chair of Anatomy and Physiology in 1882 at age 26. "This rangy and aggressive Scot" set to work gathering support and funding for the construction of a new building. Progress was a bit slow for his liking but, by 1889, he and his staff had moved into "a magnificent and handsome structure", seen by some at the time as altogether too magnificent and handsome.

Anderson Stuart later recalled the opposition of those who believed that the proper role of the University was to provide a liberal education based on classical, literary and mathematical studies, not training in the so-called "bread studies", medicine, science and engineering. Anderson Stuart would have none of that. He wrote: "Happily it is possible to train the mind by technical learning, as well as by learning for which there is no immediate use. … It is not what is known that makes a man cultured; it is how he knows it, the method by which he approaches knowledge."



Anderson Stuart's nickname among the students was *coracoid* (from the Greek *corax* for raven), given to him according to legend because of his prominent nose. He apparently didn't mind and responded by having a stone raven included among the decorations on his building. Circled in the present-day photo above and shown close-up in the inset, it stands on the gable high over the eastern entrance. Above it, his initials are carved in ornate intertwined letters. More accessible is a second raven, this one cast in bronze, that now perches on a small fountain in a corner of the recently refurbished courtyard.

The University celebrated its 50th birthday in 1902. To mark the occasion, a garden party was held in the Quadrangle and, as you see in the photo below, it was a time for parasols, top hats and frock coats. Chemistry professor Archibald Liversidge is one of the two men walking towards the camera, the one on the right.

Original prints in the University Archives were reproduced with the help of Reference Archivist Julia Mant. Mr Clive Jeffery, Technical Officer in the Department of Anatomy and Histology, provided the inset photo of the stone raven.

Sources for this piece were:

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Australia's First – The University of Sydney: Celebrating 150 Years, Focus Publishing (2000). ♦

Lay Prof Peter Biological and Medicinal Inorganic Chemistry

My research is in the area of bioinorganic and medicinal chemistry and spans from fundamental spectroscopic, structural, electrochemical and mechanistic research to synthetic inorganic chemistry, biochemistry, molecular and cell biology, and pharmacology. In particular, the chemistry, biochemistry and cell biology of metals with respect to toxicology and roles in occupational cancers, cardiovascular disease, and diabetes, and the design of anti-inflammatory and anti-cancer drugs, have been studied.

A collaboration involving The University of Sydney, Nature Vet Pty Ltd, and Medical Therapies Ltd on copper anti-inflammatories (with Prof. Trevor Hambley and A/Prof. Brendan Kennedy), has led to the commercialisation of veterinary drugs for the treatment of horses and dogs, and human clinical trials are planned for late 2005. The high efficacy and low toxicity of the drugs leads to the potential to replace some of the applications of the COX-2 inhibitors, such as Vioxx and Celebrex, which have been removed from the market, or have had their use restricted, because of cardiovascular side-effects.

We have made many fundamental discoveries with respect to the molecular basis of Cr(VI)-induced cancers (Cr(VI) is the most commonly encountered occupational carcinogen) and the mechanism of action of Cr dietary supplements and anti-diabetic agents. Recent research on the potential carcinogenic hazards of widely used Cr dietary supplements was classified as one of the hot articles of the year by the editors of the prestigious journal, *Angew. Chem.*, and received local and international press coverage. This research showed that Cr(III) supplements themselves are inactive in *in-vitro* assays on enzymes involved in insulin potentiation and the supplements (and their products with biomolecules that carry Cr(III) to cells, such as transferrin) can be oxidized by biological oxidants to form Cr(VI) and Cr(V). These oxidized forms inhibit the phosphatase enzymes in the same way as the well-known vanadium anti-diabetics, which then bring about insulin potentiation. This research also offered the first explanation as to why Cr supplements only appear to affect glucose metabolism in diabetic animals and humans, because their tissues are under oxidative stress, which facilitates the oxidation of the supplements to Cr(VI). These results have raised considerable concern about the safety of Cr dietary supplements if they are activated by oxidation to carcinogenic Cr(VI), especially for elite athletes who take large amounts of the supplements supposedly to convert fat into muscle. Our hypotheses of activation was further supported by recent X-ray microscope experiments in which we showed that adipose (fat) cells treated with the Cr(III) supplements resulted in localised high concentrations of Cr(VI) in organelles surrounding the fat globules within the cell.

"This research may assist in the design of new supplements and drugs to reduce the incidence of cardiovascular disease."

Studies on the direct measurement of intracellular chemistry have been made possible by the use of microprobe X-ray techniques for interrogating the intracellular chemistry of drugs (drug design), carcinogens, toxins, and metals in disease processes at a micron and even sub-micron spatial resolution. This has led to invitations to join consortia for future X-ray microprobes at the Advanced Photon Source at Argonne National Laboratories (USA), the Stanford Synchrotron Research Laboratory, California, the Canadian Light Source, the Singapore Synchrotron and the Australian Synchrotron. Our research into medical applications of X-ray microprobes also includes changes to aorta endothelial cells and smooth muscles cells in response to oxidative stress. A general efflux of metal ions was observed, including Cu and Fe, which are implicated in the formation of the arterial plaques that lead to cardiovascular disease. This research may assist in the design of new supplements and drugs to reduce the incidence of cardiovascular disease (with Prof. Roland Stocker, UNSW and Dr. Paul Witting, Anzac Institute, Concord Hospital) by examining agents that prevent such an efflux under oxidative stress. Collaborative studies were performed on cardiac myocytes (heart muscle cells) under conditions that mimic life-threatening ischemic reperfusion injury after a heart attack. The first determination of the global changes in these cardiac cells may be used in the design of new drugs and supplements to reduce such damage to the heart tissues. Finally, we were the first to demonstrate the transport of mercury from amalgam dental fillings through the dentine into the pulp and (by inference) the blood stream using an X-ray microprobe. This research has profound implications for improving the safety of the procedures for preparing such dental fillings. The research has also provided fundamental insights into the transformations in teeth that lead to tooth decay and studies of the incorporation of environmental pollutants, such as lead, into teeth.

Infrared and Raman microprobe spectroscopy (with A/Prof. Robert Armstrong and Dr. Elizabeth Carter) is being employed to develop faster and more reliable methods for breast cancer diagnosis in collaboration with the Institute of Magnetic Resonance Research at Royal North Shore Hospital. Similarly, ongoing projects with Westmead Hospital involve vibrational spectroscopic methods for the early identification of pathogens.

With A/Prof. Armstrong, Raman spectroscopy and X-ray absorption spectroscopy have been used to provide fundamental insights into the binding of small molecules (particularly O_2 and NO) to heme proteins. More accurate and precise information on metal-ligand bond lengths and angles than was currently available from most protein crystal structures was obtained and has challenged some of textbook notions on the binding of such molecules. In addition, the first structural information for species that are too unstable to crystallise, such as NO adducts of Fe(III)-heme proteins and HNO heme adducts, was obtained. Finally, in collaboration with Dr. Joel Mackay and Dr. David Gell in the School of Molecular and Microbial Biosciences, we have used these techniques to characterise the heme environment of the intermediates and final products in the interaction of α-hemoglobin specific binding protein (AHSP) with α-hemoglobin (α-Hb). This is important in stabilising α-Hb, which would otherwise undergo oxidation to the met form with the release of the toxic heme group. The binding of AHSP to α-Hb (in the oxy or met forms), results in the formation of a low-spin Fe(III) bis(histidine) heme group. ♦

Brief History

Peter Lay joined the School of Chemistry in April 1985, as a Lecturer in Inorganic Chemistry. Peter grew up in country Victoria (Korumburra) and completed his Honours degree (1st Class) at the University of Melbourne under the supervision of Dr. Geoffery Lawrance in 1977. He then went to the Australian National University where he completed a PhD under the supervision of Professor Alan Sargeson. His PhD Program included studies on cage complexes, osmium amine chemistry and inorganic reaction mechanism.

Late in 1981, Peter moved to Stanford University on a CSIRO Postdoctoral Fellowship where he joined the group of Nobel Laureate, Professor Henry Taube and spent sixteen months developing osmium/ammine mixed-valence chemistry to parallel the much-studied ruthenium chemistry. The second year of the CSIRO Postdoctoral Fellowship was spent in the CSIRO Division of Applied Organic Chemistry where he performed research on the photochemistry and photophysics of Ru complexes and Zn porphyrins as photosensitizers for the photoreduction of water to hydrogen, in collaboration with Dr. Wolfgang Sasse and Dr. Albert Mau. In 1985, Peter moved to Deakin University on a QEII Fellowship where he performed some of the early research in the area of microelectrode electrochemistry with Professor Alan Bond. During the period 1983-1985, Peter was also a visiting fellow at the Australian National University where he performed a variety of spectroscopic experiments with Dr. Jim Ferguson and Dr. Elmars Krausz (including MCD and single-crystal spectroscopy).

Since coming to The University of Sydney, Peter moved up the ranks to a Personal Chair in Inorganic Chemistry in 1997 and became an ARC Professorial Fellow in 2002. He has held visiting professorships at the University of Berne, Switzerland in 1991 and the National University of Argentina, Rosario in 1999 and has been awarded the Edgeworth David Medal of the Royal Society of NSW and the Rennie, Burrows and H. G. Smith Medals of the Royal Australian Chemical Institute.

2005 Chemistry Alumni Scholarship

Mr Christopher Mitchell (pictured left) has again won the Chemistry Alumni Scholarship for his continued outstanding research in the field of Organic Chemistry duing 2005.

Chris's research is directed towards the total synthesis of the marine-derived natural product lasonolide A. This potently cytotoxic macrolide exhibits especially promising properties for the treatment of pancreatic cancer.

The Hush Fellowship Fund

The Hush Fellowship Fund has been established by the School of Chemistry for the purpose of holding annual lectures by noted international scientists in the area of Professor Hush's research interests, to commemorate his great scientific achievements.

This is an opportunity for friends and colleagues of Professor Noel Hush (pictured left) to recognise and to perpetuate his research interests through this ongoing lectureship fund. Read more about Professor Hush on pages 2 & 3.

Donations

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

The Alumni Fund
Dr Janet Newman
Dr Thomas Peat

The Inorganic Fund
Ms Carol Bae
Professor Len Lindoy
The Nell & Hermon Slade Trust
Mr Thomas Savage

The Cornforth Fund
Dr Jack Cannon

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

A donation form is included with this Newslettter.

News in Brief

Awards

Congratulations to Professor Bob Gilbert, Director of the Key Centre for Polymer Colloids, who has won the 2005 RACI Applied Chemistry Award.

This year Associate Professor Cameron Kepert has been awarded a Federation Fellowship in recognition of the international standing he has achieved in a remarkably short time. This is an extraordinary achievement by Cameron.

Professor Peter Lay has been awarded the RACI's HG Smith Medal. This medal is the RACI's premier research award and is given to the Australian chemist judged to have contributed most to chemical research over the past ten years. Read more about Peter's research on pages 6 & 7.

Dr Greg Halder, Postdoctoral Fellow, is the winner of the Cornforth Medal for "the most outstanding PhD thesis submitted in a branch of Chemistry, Chemical Science or Chemical Technology in the previous thirteen months".

Professor Hans Freeman has been made a Member of the Order of Australia. This thoroughly deserved award is in recognition of Hans' many contributions to bioinorganic chemistry and to the development of crystallography in Australia. In addition to his many research contributions, Hans played a major role in gaining access for Australians to major facilities such as synchrotrons, and this has led to Australia building its own synchrotron due to be commissioned in 2007.

Congratulations to Dr Mal McLeod who is the recipient of the RACI Rennie award for 2005. The Rennie Memorial Medal is awarded to the candidate with 8 or less years of professional experience who has contributed most towards the development of chemical sciences. It is the RACI's premier award for younger scientists. Well done!

Arrivals and Departures

We welcome Dr Mat Todd, Lecturer , and Dr Nigel Lucas, Australian Postdoctoral Fellow, to the School of Chemistry and farewell Professor Margaret Harding and Professor Les Field who both leave us to take up positions at the University of NSW. However, we are pleased to announce that Margaret and Les have been made Honorary Professors within the School of Chemistry.