



MOLECULAR ORIGAMI WITH FLUORINE CHEMISTRY

BY DR LUKE HUNTER

Fluorine chemistry is all around us. The water we drink contains fluoride, and so does our toothpaste; fluorinated polymers are found in the nonstick coatings of our frying pans, and in the waterproof layers of our clothing. Even the medicines that we take contain fluorine: by some estimates 20% of all currently marketed drugs are organofluorine compounds.

What makes fluorine such a useful element?

It all comes down to two simple properties. Show the Periodic Table to an undergraduate chemistry student, and ask them to consider fluorine's location in the top right corner. Based on this location, the student should be able to tell you that fluorine is *very small* and *very electronegative*.

These two properties – small size and high electronegativity – are very simple to understand, but when combined in the same atom they lead to a fascinating (even explosive) wealth of chemistry.

Nowhere is this illustrated more clearly than in the pharmaceuticals arena. Often, a drug candidate is highly active but has poor absorption properties or a short half-life in the body. These problems can be overcome by judiciously inserting a fluorine atom into the molecule as a replacement for a hydrogen or hydroxyl group. Since fluorine is *small*, such a change shouldn't dramatically alter the size of the drug molecule; however, since fluorine is so *electronegative*, the C–F bond is highly polarized and this can have a number of knock-on effects such as tuning the acidity/basicity of adjacent functional groups, blocking

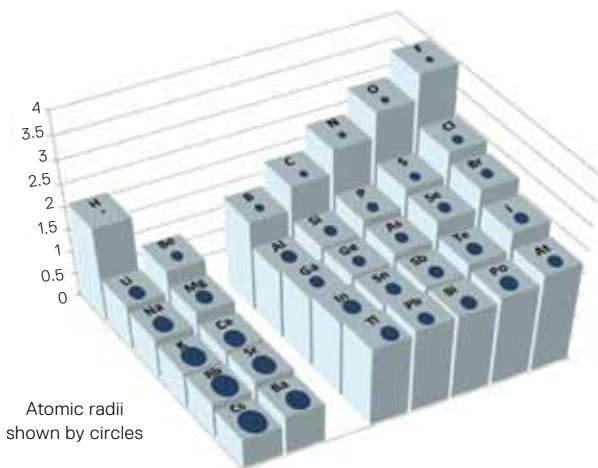


Figure 1. Fluorine has a special place in the Periodic Table.

metabolically sensitive positions, or making the molecule more hydrophobic (better able to traverse cell membranes).

The importance of fluorine in medicinal chemistry is now well established. So, is there anything left to be discovered?

Absolutely! There is another aspect of fluorine chemistry that is only beginning to be appreciated: *fluorine atoms affect molecular conformation*. The highly polarised C–F bond participates in a variety of stereoelectronic interactions with neighbouring functional groups, and these interactions can affect molecules' 3D shapes in unique ways.^[1] For example, C–F bonds tend to align antiparallel (180°) to adjacent C=O bonds due to dipole repulsion, but at 60° to adjacent C–N bonds due to orbital interactions akin to the anomeric effect.

Armed with knowledge of effects such as these, it is now possible to “program” molecules to adopt desired conformations by decorating them with precise patterns of fluorine atoms. For example, molecules containing several adjacent fluorine atoms are found to adopt unique conformations including zigzag, bent or even helical shapes (Figure 2).^[2] And it's all controlled by the stereochemistry of the fluorination pattern.

This concept has fundamental importance, because if we can control a molecule's shape, we can control its function. Consider the world of peptides and proteins. In order to function correctly, proteins need to be folded into the proper 3D conformation. If we wish to replicate this in small peptides, it is essential to control the peptide's shape in

some way.

Here in the School of Chemistry, the Hunter group is using selective fluorination chemistry to achieve this goal. We have developed methods to synthesise unusual fluorinated amino acids (Figure 3, top), and we have shown that these building blocks have unique shapes controlled by the fluorine stereochemistry.^[3] The project has now reached an exciting stage: we are incorporating these shape-controlled amino acids into a variety of peptides that critically rely on 3D conformation for optimal biological activity.

One example of our current research concerns the ubiquitous cell-surface receptors known as integrins (Figure 3, left). Our bodies contain many different types of integrins, and these receptors have different roles and distributions throughout the body. Integrins have been implicated in a number of diseases including thrombosis and cancer, so there is worldwide interest in finding ways to selectively target them. Here at The University of Sydney, we have designed a series of peptides that should bind to integrins; the key to selectivity is to incorporate our novel fluorinated amino acids, which give the peptide ligands the optimal 3D shape for selective receptor binding. We are currently investigating the therapeutic potential of these

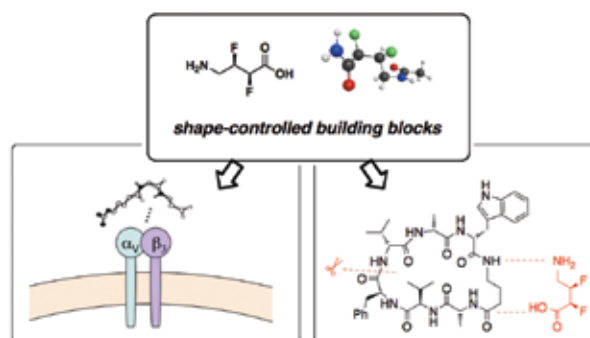
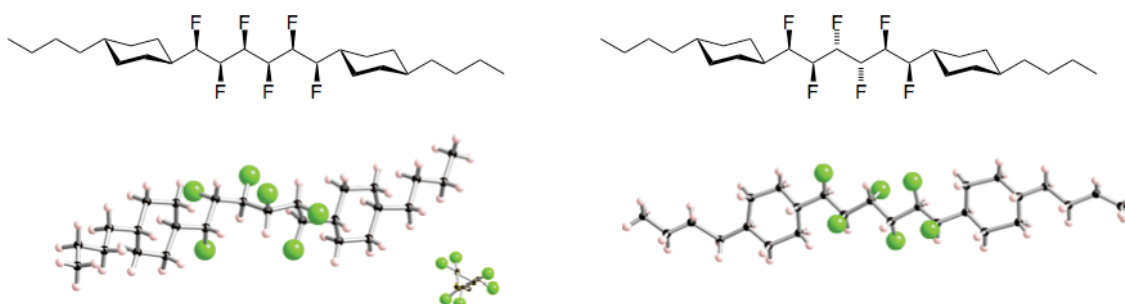


Figure 3. Conformation is critical for peptides' biological activity

fluorinated peptides in collaboration with GlaxoSmithKline (England & Wales).

Another avenue of our current research involves cyclic peptides. Many natural products with valuable therapeutic potential consist of a cyclic peptide structure; e.g. unguisin A (Figure 3, right), a marine-derived antibiotic with promising activity against *Staphylococcus aureus* (“golden

Figure 2. Molecular origami: selective fluorination leads to helical (left) and zigzag (right) shapes.



continued from page 2

staph"). Cyclic peptides such as unguisin A can be synthesised in the laboratory by first creating a linear precursor, then connecting the head and tail in a cyclisation reaction. Unfortunately however, cyclisation is often a difficult and low-yielding reaction because the head and tail are too far apart to react together efficiently. In the Hunter group, we are incorporating shape-controlled fluorinated amino acids into the linear precursor. The idea is to pre-organise the linear precursor into a "bent" conformation, bringing the head and tail closer together and improving the cyclisation yield.

These are just two of the several therapeutically-relevant peptide systems that we are currently investigating, in collaboration with biologists around Australia and overseas. It's an exciting time to be

involved in fluorine chemistry and molecular origami at The University of Sydney.

References

1. Hunter, L. The C–F bond as a conformational tool in organic and biological chemistry. *Beilstein J. Org. Chem.*, **6** (38), 2010. DOI:10.3762/bjoc.6.38
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DR LUKE HUNTER

Luke Hunter graduated from the University of Sydney in 2001 with Honours in Chemistry and a University Medal. He remained at the University of Sydney for postgraduate study, and completed his PhD in 2005. Luke subsequently took up postdoctoral positions at the University of Melbourne, the University of St Andrews (UK) and the University of New South Wales, before commencing his independent career in 2009 with the award of a University of Sydney Postdoctoral Research Fellowship. Luke's research interests include organofluorine chemistry, peptide chemistry and natural product synthesis.



THE REAL THING

BY PROFESSOR GREG WARR
HEAD OF SCHOOL

2011 is the International Year of Chemistry, and the 200th anniversary of Robert Bunsen's birth on 30 March, 1811. Be honest, isn't a Bunsen burner still what the word "chemistry" makes you think of?

One of Bunsen's major subjects of investigation was the emission spectra of elements, including the new ones he discovered with Kirchhoff in the 1860's. In modern terms, Bunsen was a spectroscopist. Spectroscopists today use light to identifying atoms and molecules in exploding supernovas, in the atmospheres of exoplanets orbiting distant stars, and in interstellar clouds. And chemists use the same knowledge and understanding to create new materials to capture light's energy and convert it into electricity or heat, or to change the structure of the material itself.

Bunsen's contemporary, the painter Joseph Turner, also knew that light changes matter. Turner's fame endures today because of the creativity of his landscape painting style that was a prelude to impressionism. He was called "the painter of light" for his exquisite oils and watercolours, many of which featured glorious red sunsets over water. But Turner's reds were also famously ephemeral. It was said by curators and collectors that a Turner sunset was different only a month after it was painted.

In the International Year of Chemistry we should try to appreciate that distinctive feature of chemistry. Chemistry is the creative science that both endures and evolves. On one hand it is a hard, physical, analytical science, forever measuring

and seeking new understanding the properties of atoms, molecules and their assemblies. At the same time it's the science that uses newly emerging understanding to create new kinds of matter.

"You are lost the instant you know what the results will be," said Juan Gris, a pioneer of cubism (and presumably a fan of pyrite). In research the most unexpected results are also the most exciting and inspiring because they challenge our understanding. This year we should remember that chemistry is the science that took charcoal and created buckyballs, carbon nanotubes and graphene; that took crude oil and created plastics, pigments, paints and dyes; and it's the science that uses fluorine to twist molecules into new shapes, makes conducting molecular chains, and salts that stay liquid below 0°C. Unlike art, creativity in chemistry does not arise until you understand what you are doing.*

*Apologies to Juan Gris, and to Henri Matisse who once said "truth and reality in art do not arise until you no longer understand what you are doing."



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THE HUSH FUND

BY PROFESSOR JEFFREY REIMERS

How chemistry works: from the quantum mechanics of the single electron to the colour and chaos of everyday motion.

In 1929 Dirac famously said “The underlying physical laws necessary for the mathematical theory of a large part of physics and the whole of chemistry are thus completely known, and the difficulty is only that the exact application of these laws leads to equations much too complicated to be soluble.” Chemistry works by Dirac’s laws, but just how was inconceivable. Now some 80 years later, mathematics and computers have advanced to the point where the deep inner secrets of chemistry are constantly being exposed. Materials and drugs can be designed from first principles, shortening the time and effort required to make significant new discoveries. Unified chemical theories now depict processes from biological self assembly to enzyme function to industrial catalysis to molecular colour and reactivity to molecular conductivity to organic photovoltaics to the nature of metals to superconductivity.

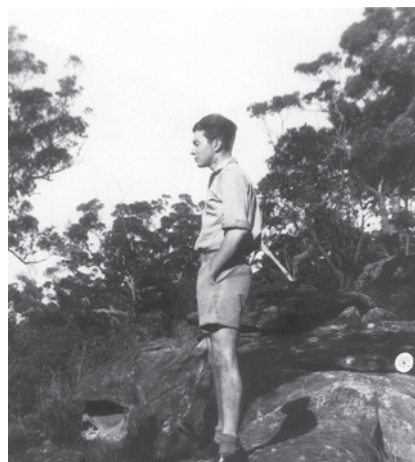
As a young student at The University of Sydney a decade after Dirac, Professor Hush was inspired by this vision. In a long career of academic research, he has worked to provide understanding at the basic quantum-theoretical level for chemical properties and reactivities. This has been extremely wide-ranging in scope: however, a continuing theme has been the dynamics of electron transfer reactions, from through-molecule electron transport to electrode processes, photosynthesis and most recently Molecular Electronics, the ultimate form of nanotechnology.

Professor Hush is one of Australia’s most distinguished and internationally-renowned chemists. He has been

elected as a Fellow of the Australian Academy of Science, of the Royal Society of London, to Foreign Membership of the U.S. Academy of Arts and Sciences, and as Officer of the Order of Australia. His most recent honour is the 2007 Robert A. Welch Prize, the major United States award for chemical research, given for the first time for Theoretical Chemistry.

In 1972 Professor Hush returned after 23 years at major universities in the United Kingdom to establish this country’s first academic department devoted to such studies, The Department of Theoretical Chemistry at The University of Sydney. A wide-ranging teaching program was introduced, and a flourishing research program evolved. He was a major organizer of the Australian Summer Schools in Theoretical Chemistry during 1977-1984, events that brought computational methods into mainstream scientific use in this country. His work has established both Australia and The University of Sydney as major world players in the field. This legacy continues now long after his formal retirement, with Theoretical Chemistry being listed in 2011 as one of 15 research areas at which the University is internationally truly outstanding. Professor Hush himself remains actively engaged in research at this University.

The Hush Fellowship Fund provides prizes and encouragements for students in Theoretical Chemistry, as well as bringing to Australia distinguished overseas leaders to address public meetings to enhance teaching and research.



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



Donations can be made to the Hush Fellowship Fund by using the donation form provided or by using our online donation form at <http://bit.ly/9hNHF3>



Heidelberg



A small selection of the columns available in the Hashmi lab

GOLD IN GERMANY

BY MS ALTHEA TSANG, POSTGRADUATE STUDENT

Last year, I was fortunate enough to carry out some research at Heidelberg University, funded by the award of a DAAD scholarship. Heidelberg, in the south-west of Germany, is home to the country's oldest university and is famous for the half-destroyed castle at one end of the town. Chemistry-wise, researchers such as Wittig, Curtius, Knoevenagel and Mendeleev have passed through the university and Heidelberg is famous for being the birthplace of the Bunsen burner, invented by Robert Bunsen. During my six months at the university, I worked in the laboratories of Professor Stephen Hashmi in the synthesis, isolation and reactivity of organogold intermediates. This work was recently published in the Australian Journal of Chemistry (*Aust. J. Chem.*, **63**, 1619-1626, 2010. DOI: 10.1071/CH10342)

While in Europe, I took the opportunity to participate in Thieme's 18th International Conference on Organic Synthesis, in Bergen, Norway. Being invited to give an oral presentation at the conference remains a highlight

of my time overseas. This was an excellent opportunity to meet well-known academics and to learn about their research interests, and to meet other chemists from around the world and talk about their experiences as research students.

Being situated in central Europe meant that traveling to other countries was easy, especially with the German train system. During my time overseas, I managed to see other parts of Germany, Switzerland, Austria, Poland, Hungary and the Czech Republic. Some of my highlights include seeing (and tasting) the chocolate from Switzerland, attending a concert at Vienna's Musikverein and walking around the Christmas markets in Prague.

I'd like to take this opportunity to thank Professor Stephen Hashmi and the DAAD for the opportunity to experience chemistry and Germany as a research scientist and tourist.



RISING STARS IN BUSAN

BY MR WILLIAM BRANT, P/G TEACHING FELLOW

It was the 10th conference of the Asian Crystallographic Association (AsCA), my first international conference, which I had initially submitted an abstract to in the hopes of presenting a poster of my work on the development of defect perovskites as cathode materials in lithium ion batteries. I had never anticipated that I would be one of the six students chosen to present my work as a part of the "AsCA Rising Stars" symposium session. It was not easy however; after applying for the session I was one of 20 other applicants who then had to present a poster to a series of judges. The winning posters were selected based on the quality of delivery and content. The oral presentation itself was possibly one of the most nerve-racking experiences I have had, however it was definitely very rewarding, creating a completely new perspective on my PhD project I had not previously considered.

Left: Busan by night

JOAN R. CLARK SCHOLARSHIP

BY MR PATRYCK ALLEN, P/G TEACHING FELLOW

Late last year, I embarked on a two month research trip funded by the Joan R Clark Scholarship. Firstly, I'd like to send a big thank you to the selection committee for giving me this fantastic opportunity to work overseas – the trip would not have been possible without this valuable support.

My adventure started by joining over 500 crystallographers from around the world at the 10th Conference of the Asian Crystallographic Association in Busan, South Korea. It was fantastic to see so much interesting work going on around the world from so many researchers with similar interests to myself.

I then flew to the United Kingdom to learn all about a new technique called Resonance Ultrasound Spectroscopy under the research supervision of Professor Michael Carpenter in the Department of Earth Sciences at The University of Cambridge. Highlights of my time in Cambridge included spending time in such a different academic environment, weekly adventures at old English

bars with Paul Saines and Jack Clegg (past students from the School of Chemistry), visiting friends in Oxford, and meeting a whole bunch of new and interesting people with similar interests and different backgrounds.

I also spent a week in Prague working with our collaborators at the Department of Structure Analysis within the Czech Academy of Sciences who wrote the “Jana” Rietveld refinement software packages. I was lucky enough to celebrate my 25th birthday in Prague by taking a city night tour, followed by a ‘chilly’ river cruise at -18 °C. I was also lucky enough to have time to walk around many of the Prague’s great tourist attractions on the weekend, and I even got to try some traditional Czech liquor which was given to me as a generous birthday present from our collaborators. All in all, the trip was an extremely valuable learning experience, providing me with many amazing experiences that I will remember for many years to come.



Visiting Trinity College



Resonant Ultrasound Spectroscopy Apparatus

[Continued from page 4]

Following the conference I took a few days to fully enjoy Busan and its surroundings. Busan is a place of great natural beauty juxtaposed with dense city scapes. Every night I explored as much of Busan I could, from the night markets to the unique choices on offer at a Korean BBQ restaurant. Post-conference, I ventured beyond the city to climb to the top of a mountain overlooking the Beomeosa temple before returning to explore more street stalls and the famous Busan fish market.

Overall the conference and exploration of Busan has been one of the most worthwhile experiences of the year, creating a fantastic end to my first year as a PhD student.



Top left: AsCA Rising Stars Session
Top right: Busan fish market
Bottom left: Atop Godangbong
Bottom right: Just a short walk from the city

SPOTLIGHT



The Schmidt/Crossley and Perrier groups have been awarded \$637k from the Australian Solar Institute for research into photochemical upconversion.



Dr Peter Rutledge has been awarded a Vice-Chancellor's Award for Outstanding Teaching. Peter was particularly commended for his work

in curriculum design, the innovative use of personal feedback, his lively connection with students and his leadership through publications.



Dr Ron Clarke has been awarded the inaugural McAulay-Hope Prize for Original Biophysics at the Annual Conference of the Australian Society

for Biophysics (ASB), held last week in Adelaide.



Associate Professor Sébastien Perrier has been appointed to the Physics, Chemistry and Earth Sciences (PCE) panel of the

Australian Research Council College of Experts. To view list of experts please visit http://www.arc.gov.au/about_arc/CoE_PCE.htm.



Professors Trevor Hambley and Thomas Maschmeyer have both been elected as Fellows of the Australian Academy of Science. The full list of new FAAs is at <http://www.science.org.au/news/media/24march11.html>

A DRUG TO HELP PEOPLE WITH SOCIAL ANXIETY

BY A/PROF MICHAEL KASSIOU



At any one time, about 3% of the population suffer from crippling social anxiety, characterised by excessive fear of exposure to situations that involve potential scrutiny by others. Social anxiety is also seen in many other psychiatric conditions including depression, schizophrenia, autism and addictions. Modern neuroscience is learning much about the way in which the brain regulates social behaviour, opening up opportunities to pharmacologically stimulate social processes in individuals who are socially withdrawn. Promising targets include the hormone oxytocin which is known to strongly regulate social processes in mammals. However there are problems with administering oxytocin as it is very rapidly broken down in the body and does not easily penetrate the brain. To overcome these problems our group is developing non-peptidic compounds that stimulate oxytocin receptors in the brain but that are more potent, brain penetrating and longer lasting than oxytocin itself. One such compound has shown that when given to rats it strongly stimulates social interest. This compound forms the basis of an expanding drug discovery program to find compounds that can reverse the social deficits seen in many psychiatric disorders. To view the ABC news story visit <http://bit.ly/fffYpA>

A TREASURE HUNT FOR CHEMISTRY

BY A/PROF ADAM BRIDGEMAN, DR PETER RUTLEDGE & DR MAT TODD

We've recently introduced an innovative new student activity for first year students: the Chemistry Treasure Hunt. Each week, students are given three chemistry-themed questions. The answers to the first two questions are a letter (eg D-glucose, an E-alkene, penicillin F) and a number (the number of carbons in a sesquiterpene, rings in brevetoxin, an NMR coupling constant), specifying a square on the standard University map. The answer to the third question identifies a physical object in that area, and the challenge for students is to find and photograph the object. At the end of the quiz, the locations on the map reveal the final treasure: the shape of a molecule.

Hundreds of students have taken part, both for fun and for assessment. Any team successfully completing the quiz can use that mark in place of their worst tutorial quiz performance, and there is the added lure of a prize for the first team to submit the correct answer to the Hunt. The final clue is posted online at midnight on a Monday towards the end of semester, prompting a flurry of activity – in 2010, the first correct answer was posted at 00:25, with four more submitted by 01:00 – the competition was intense. Two members of the winning team, Louise Fisher and Renee Noble, are shown receiving their prizes from Dr Todd.

The Chemistry Treasure Hunt was supported by a University of Sydney Strategic eLearning Development Grant. To read more, see A Treasure Hunt for Chemistry, Bridgeman, AJ; Connor, R; Rutledge, PJ and Todd, MH. *Journal of Chemical Education*, **88**, 437-439, 2011. (DOI: 10.1021/ed100867m)



THE QUEST FOR RED

BY DR JUDE PHILP, SENIOR CURATOR
THE MACLEAY MUSEUM

The Quest for Red: trade & experiment is the new Macleay Museum exhibition, celebrating International Year of Chemistry. This excerpt describes August Hofmann's legacy in the search for perfect reds.

Aniline dyes, the first synthesized dyes, were developed from research at the Royal College of Chemistry in 1840s Britain; a country in the midst of an industrial revolution and one of the greatest producers of dyed cloth.

From 1845 German-trained August Hofmann was College Director, research focused on the structure of aniline with a view to finding malarial drugs through synthesizing quinine from coal-tar. His student, William Henry Perkin attempted to further this study. Working on his home stove Perkin distilled coal tar to get benzene and toluene. Through the oxidization of this base mixture he created the first synthetic dye – mauve - in 1857.

Once the basic principles of creating synthetic dyes were realized European chemists quickly patented a profusion of colours through changing the oxidant— tin chloride, mercury nitrate, and arsenic acid—depending on the colour and hue required. These oxidants had long been used in textile processes; indeed tin was one secret of the most brilliant of cochineal dyes.

The creation of synthetic dyes was only half the problem of this volatile industry. Poisoning and explosions were not uncommon in the small experiments carried out by Hofmann in his students; for mass production and distillations safer ways methods had to be devised. While England and France were the centres of colour innovation, Germany led the way in industrialization. Such was the speed of German innovation in the technologies of heating, distilling

and refining that by the turn of the century aniline was seldom produced elsewhere.

The international impact of this research reached well beyond the decorative arts. Through the methods of analytical chemistry other products, such as naphthalene and quinine, emerged. The German medical company Bayer and the imaging company AGFA started as producers of aniline dyes. Destructive agents such as mustard gas, along with Eosin, used to stain biological tissue in microscopic investigation were also fabricated. From enamel paint to plastics, little in our world is not marked by the discovery of the structures of traditional dyestuffs.

The Great Hall tapestry by Goeblin Tapestry works 'Joseph and his bretheren' 1773 University Art Collection



INORGANIC FOUNDATION NEWS

On Monday, 7 March the Foundation for Inorganic Chemistry held its AGM and dinner. Guest of honour and speaker for the night, Professor Margaret Sheil, CEO of the ARC, gave an interesting talk on Commonwealth Grant Schemes. The dinner, which was held at St Andrew's College, was enjoyed by all. The Foundation also took the opportunity to remember the late Manuel Aroney who was heavily involved with the Foundation for many years. You can read more about Manuel on page 8.

If you would like to find out more about the Foundation for Inorganic Chemistry and the upcoming Freeman lecture, please visit <http://inorganic.chem.usyd.edu.au/>. Please note that this website is currently undergoing changes that we hope will make it more informative and interactive to its members and friends.



Professor Peter Lay, Academic Director of the Foundation with Guest of Honour Professor Margaret Sheil

The Quest for Red Details:

When: 27 March - 1 December
Where: The Macleay Museum, Gosper Lane, off Science Road, University of Sydney
Cost: **Free**
Phone: 02 9036 5253
Website: www.sydney.edu.au/museums

UPCOMING INORGANIC AND BIOINORGANIC SYMPOSIA

The Foundation for Inorganic Chemistry will hold a One-Day Symposium in Inorganic and Bioinorganic Chemistry on Wednesday 29 June at the School of Chemistry followed by a dinner at St Paul's College (commencing 7 pm) to honour Professor Hans Freeman. The Guest of Honour is Professor Harry Gray from Caltech, a close colleague of Professor Freeman. Members of the public are invited to attend the Inaugural Hans C. Freeman Lecture at 5:30 pm that afternoon in the Eastern Avenue Auditorium titled "Electron Flow through Metalloproteins" to be delivered by Professor Gray.

An Inaugural One-Day Student Symposium in Inorganic Chemistry will follow on Thursday 30 June which is proudly supported by the RACI and will feature Professor Gray as the Keynote Speaker. Further information, registration and abstracts for both symposia are available at <http://inorganic.chem.usyd.edu.au/>. Important Dates: Abstracts close on 4 May and Early Bird Registrations close on June 1st.

OBITUARY MANUEL ARONEY AM, OBE

It is with great sadness we pass on the news that our friend, colleague and Chemistry alumnus Manuel Aroney passed away on Tuesday, 15 February. Manuel was a long time staff member of the School of Chemistry, who retained his involvement in the School and particularly the Foundation for Inorganic Chemistry well after his retirement as Associate Professor. Many of you will also know of Manuel's extensive work within the Greek community and promoting Greek-Australian cooperation and exchange, for all of which he was recognised by prestigious awards from both the Greek and Australian governments. A celebration of Manuel's life will be held at a reception in the Nicholson Museum on the 28 June at 6:30-8:30pm. Enquiries can be made to Philip Penwright at p.penwright@chem.usyd.edu.au or phone: 02 9351 4504.



1932-2011



The School would like to invite alumni and current chemistry students to visit LinkedIn. LinkedIn is a business-orientated social networking site but is mainly used for professional networking. We hope you will join, and share information about yourselves and provide anecdotes about your time with us, or even arrange alumni events. We'll try to post things of interest to you, but this group is mainly for you to reconnect with each other. We'd love to hear what you're doing now! Visit <http://linkd.in/hw5soa>

SCHOOL OF CHEMISTRY



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ELECTRONIC NEWSLETTER

As part of the School's efforts towards a greener future, we'd like to reduce the number of paper copies of this Newsletter we mail out. If you would like to help us in this effort by electing to receive ChemNEWS electronically, please email Anne (anne.woods@sydney.edu.au).

DONATIONS

Donations can be made to the following funds by using the donation form provided in this newsletter or by using our online donation form at <http://bit.ly/9hNHF3>

*Inorganic Fund; Cornforth Fund;
Hush Fund; Michael Bishop Fund
Hans C. Freeman Fund*

The School of Chemistry would like to take this opportunity to thank Alumni and Friends for their very generous donations. Your support continues to make a profound impact on our various programs.

SEMINARS

Chemistry seminars are held throughout Semesters 1 and 2 on Wednesdays (9am, LT2) and Fridays (11am, LT4) unless otherwise stated. If you would like to be notified of these weekly seminars and other weekly chemistry news and events please email Anne (anne.woods@sydney.edu.au) and she will add you to the electronic mailout. Alternatively you can visit <http://bit.ly/aHrxZ7>. Seminars are also advertised on our Facebook page.

To keep up with what's happening in the School, subscribe to our current news via sites such as Facebook, LinkedIn and Twitter. See our homepage for the relevant links.

