

September 2009

Coordinator: Steph Neulinger

Roving Reporter: Gavin Perri

Editor: Peter Gill



MONTHLY HIGHLIGHTS

CONGRATULATIONS

Congratulations to **Mark Ellison, Vance Lawrence, Geoff Salem, Karen Dean, Annie Colebatch, Ben Noble and Jeremy Neeman** for the terrific job they did organising and hosting some 89 young chemists in Years 10 to 12 (and their teachers) from a whole range of ACT High Schools in the RACI Titration Stakes. Furrowed brows and deep concentration were the order of the day as the various teams fought for glory.

Congratulations to the following students who have submitted their theses:

Mr Thanh Vinh Nguyen, Sherburn group, submitted his PhD thesis on the 10th of August: *Design, synthesis and guest binding of new synthetic hosts*.

Ms Emma Wiadrowski, Sherburn group, submitted her MPhil thesis on the 17th of August: *Investigating radical reactions of thionocarbonates*.

RECENT ARRIVALS

A sincere welcome is extended to the following people who have joined us recently:

Mr Bernard Baituti has recently commenced a Master of Chemistry (coursework) degree in Ron Pace's group.

Mr Daniel Bransner has commenced as our new glassblower in the workshop area.

Dr Stephen Taylor is a Visiting Fellow from the University of Auckland, collaborating with the Gill group.



Ms Anna Vavrina-Kun has commenced her Grad Dip Chem program under the supervision of Geoff Salem.

RECENT DEPARTURES

Visiting scholar **Sylvain Le Roux** who has been working with the Sherburn group departed 31/7/09 and has returned to the Pierre and Marie Curie University, Paris.

Visiting scholar **Hai Anh (Ryo) Le** who has been working with the Collins group departed 14/7/09 and has returned to the National University of Singapore.

Visiting scholar **Juliali Negi** who has been working with Elmars Krausz departed 31/8/09 and has returned to Amity University, New Delhi.

STUDENT MATTERS

New Graduate Lounge

Another way to pass the time will be in the new Graduate Lounge at University House, opening 4 September 2009. This is a new drop-in space for postgrads who want somewhere to chill, want to host a meeting, or need some info on student services or advice. The area has been made specifically for graduate students to use, so please take advantage of it. You'll be receiving emails with more details of the grand opening soon.

Counselling Centre Workshops:

Managing Grief and Loss Across the Lifespan, conducted by Shannon O'Brien, Tuesday 22 September

http://counselling.anu.edu.au/seminars_and_workshops/index.php

Academic and Professional Skills Program

Journal article publication (Sciences), 2 September

Practical strategies for editing and proofreading [repeat], 10 September

Academic honesty: The appropriate acknowledgement of sources [repeat], 17 September

Negotiating effectively with supervisors, 22

September

For more information and to register for a course, see:

<http://researchstudents.anu.edu.au/skills/apspcourses.php#283>

Student Profile



Name: Laura de la Cruz

Qualifications/Degree: Diploma in Chemistry

Favourite TV Show: Bill Cosby Show

Favourite Movie: The Big Lebowski

Favourite Music/Band: Beatles

Sporting Code and Favourite Team/Player:

Swimming, un-doped Ian Thorpe

What is your thesis topic/Field of Interest? Making any kind of contribution to finding a vaccine against dengue fever

If you could be a chemical element for a day which one would you choose and why?

Oxygen ... I'd like to be part of water

What have you learnt about yourself during your time here?

To put more effort into being patient

If you could dine with any three people who would you choose (alive or dead)?

Uff, there'd be different settings for this one, I guess....at the moment: JS Bach, Masaaki Suzuki and Andreas Scholl

What do you see yourself doing upon completion of the program?

Something between travelling and a postdoc

If you were stuck on a deserted island for one week what three essential items would you hope to have with you?

A pen, a piece of paper, a bottle

What has been the most enjoyable experience during your studies at RSC?

Group excursions and group lunches

Favourite Saying

"Should work"

If you are a student interested in adding your voice to the RSC News editorial team, email

steph@rsc.anu.edu.au

MONDAY SEMINAR SERIES - AUGUST **RSC Lecture Theatre, 1pm.**

7th: Michelle Weir **End of Term** (Wild group)

8th **TUESDAY: FREE SPOT**

14th: David Pinkerton **End of Term** (Banwell group)

21st: Anna Lehmann **End of Term** (Banwell group)

28th: Dave Brittain **End of Term** (Coote group) –
moved from 8/9/09

THURSDAY SEMINAR SERIES – AUGUST **RSC Lecture Theatre, 4pm.**

3rd: Prof Marek Samoc, Wroclaw University, Poland (Humphrey group)

10th: Prof Sandro Gambarotta, University of Ottawa, Canada (Humphrey group)

17th: Assoc. Prof Michelle Coote, RSC

FOR YOUR INFORMATION


The next **DAG meeting** will be held at 1.30pm on the 3rd of September in the Boardroom.

The next **School Forum** will be held at 10.30am on the 4th of September in the tearoom.

Masquerade Chemistry Ball 2009

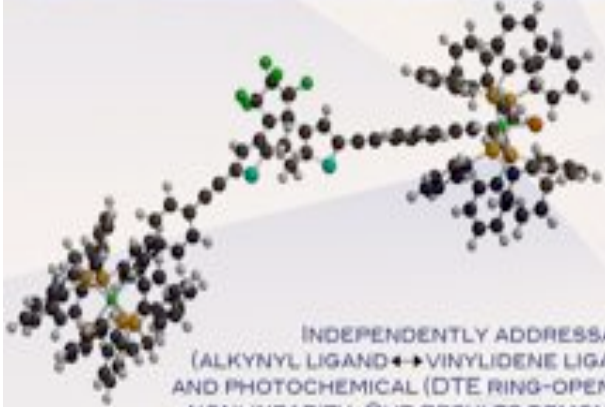
When: Saturday, 19 September
6.30pm nibbles and drinks for a 7pm start
Where: Ainslie Football Club
Dress: Formal
Theme: Masquerade
Mask: Required!

\$30 Student RACI members
\$35 RACI members and non-RACI Students
\$40 All others
 Tickets from Steph - Rm 56



MOLECULE OF THE MONTH – SEPTEMBER

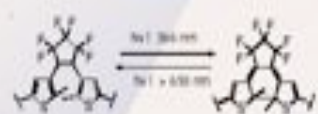
A HEXA-STABLE MOLECULAR CUBIC OPTICAL NONLINEARITY SWITCH ACCESSED WITH THREE ORTHOGONAL STIMULI



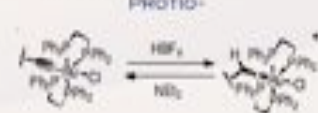
ELECTRO-

$$\text{Ru}^{2+} \xrightleftharpoons[+e^-]{-e^-} \text{Ru}^{3+}$$

PHOTO-

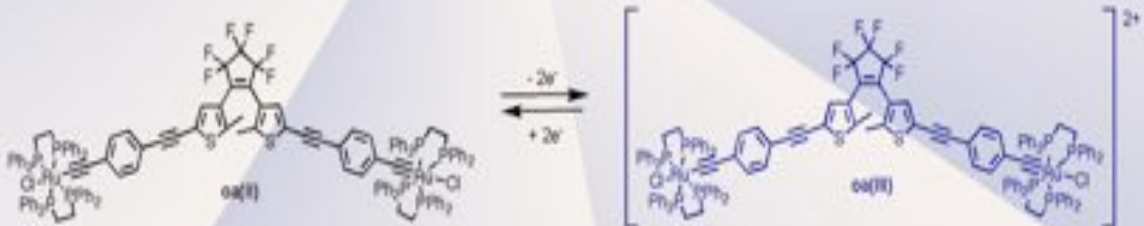


PROTIC-



INDEPENDENTLY ADDRESSABLE MODULES IN THIS COMPLEX RESPOND TO PROTIC (ALKYNYL LIGAND ↔ VINYLIDENE LIGAND), ELECTROCHEMICAL (METAL-CENTERED REDOX: $\text{Ru}^{\text{II}} \leftrightarrow \text{Ru}^{\text{III}}$) AND PHOTOCHEMICAL (DTE RING-OPENING ↔ RING-CLOSING) STIMULI, RESULTING IN CHANGES TO CUBIC NONLINEARITY. OUR RESULTS DEMONSTRATE SUCH COMPLEXES CAN BE USED IN THE CONSTRUCTION OF MULTI-INPUT LOGIC GATES OPERATING ACROSS A BROAD SPECTRAL RANGE.

KATY A. GREEN, MARIE P. CIFUENTES, T. CHRISTOPHER CORKERY, MAREK SAMOC, AND MARK G. HUMPHREY, *ANGEW. CHEM. INT. ED.*, *In press*



FUNNIES

The following phrases, frequently found in technical writings, are defined below for your enlightenment. They are adapted from 'A glossary for research reports, by C. D. Graham, Jr., which appeared in Metal Progress, Vol. 71, No. 5, May. 1957. Graham had evidently read too many scientific papers by the time he composed this clever compilation.

PHRASE: "it has long been known..."

DEFINITION: I haven't bothered to look up the original reference.

PHRASE: "Of great theoretical and practical importance..."

DEFINITION: Interesting to me.

PHRASE: "While it has not been possible to provide definite answers to these questions..."

DEFINITION: The experiment didn't work out, but I wanted to publish anyway.

PHRASE: "Three of the samples were chosen for detailed study."

DEFINITION: The results on the others didn't make sense and were ignored.

PHRASE: "Accidentally stained during mounting"

DEFINITION: Accidentally dropped on the floor.

PHRASE: "Handled with extreme care during the experiments"

DEFINITION: Not dropped on the floor.

PHRASE: "A fiducial reference line on the specimen"

DEFINITION: A scratch.

PHRASE: "Although some detail has been lost in reproduction, it is clear from the original results..."

DEFINITION: It is impossible to reproduce the original results but they were the only ones that really made any sense.

PHRASE: "Typical results are shown"

DEFINITION: The best results are shown.

PHRASE: "The most reliable data are those Jones..."

DEFINITION: Jones was a student of mine.

PHRASE: "Agreement with the predicted curve is excellent."

DEFINITION: Fair.

PHRASE: "Agreement with the predicted curve is good."

DEFINITION: Poor.

PHRASE: "Agreement with the predicted curve is satisfactory."

DEFINITION: Doubtful.

PHRASE: "Agreement with the predicted curve is fair."

DEFINITION: Imaginary.

PHRASE: "Correct within an order of magnitude..."

DEFINITION: Wrong.

PHRASE: "It is believed that..."

DEFINITION: I think...

PHRASE: "It is generally believed that..."

DEFINITION: A couple of other guys think so too.

PHRASE: "It is clear that much additional work will be required for a complete understanding of..."

DEFINITION: I didn't understand it.

PHRASE: "A careful analysis of obtainable data..."

DEFINITION: Three pages of notes were obliterated when I knocked over a glass of beer.

PHRASE: "A statistically oriented projection of the findings..."

DEFINITION: Wild guess.

PHRASE: "A highly significant area for exploratory study..."

DEFINITION: A totally useless topic suggested by my committee.

- Submitted by Michelle Weir

Newly Classified Element: Governmentium (Gv)

Recent research has led to the discovery of the heaviest element yet known to science. The new element, Governmentium (Gv), has one neutron, 25 assistant neutrons, 88 deputy neutrons, and 198 assistant deputy neutrons, giving it an atomic Mass of 312.

These 312 particles are held together by forces called morons, which are surrounded by vast quantities of lepton-like particles called peons. Since Governmentium has no electrons, it is inert; however, it can be detected, because it impedes every reaction with which it comes into contact.

A minute amount of Governmentium can cause a reaction that would normally take less than a second to take from four days to four years to complete. Governmentium has a normal half-life of 5 years; it does not decay, but instead, undergoes a reorganisation in which a portion of the assistant neutrons and deputy neutrons exchange places. In fact, Governmentium's mass will actually increase over time, since each reorganisation will cause more morons to become neutrons, forming isodopes.

This characteristic of moron promotion leads some scientists to believe that Governmentium is formed whenever morons reach a critical concentration. This hypothetical quantity is referred to as critical morass.

When catalysed with money, Governmentium becomes Administratium, an element that radiates just as much energy as Governmentium since it has half as many peons but twice as many morons.

- Submitted by Ray Withers

COMMUNICATION & MEDIA REPORTS

Dogs, drugs and detection

Taken from ANU Reporter, Spring 2009

A new method for catching sports drug cheating is shaking up the greyhound industry and could have major applications for the human world too. Michael Cavanagh reports on an organic chemist who's not averse to spending a day at the dog track. By Michael Cavanagh.

The yapping of greyhounds and the noise of the people betting on the outcome of the races seems like a strange setting for a chemist – so what is **Dr Mal McLeod** doing here? McLeod, from the Research School of Chemistry at ANU, is leading a team that's developing a reliable method to identify drugs that have been illegally administered to racing greyhounds by their trainers or owners. The research program is helping the body that governs greyhound racing in Australia to crack down on the use of steroids within the sport.



McLeod's work so far has helped the guardians of greyhound racing to successfully prosecute a number of people for the illegal use of steroids in their dogs. This is in a sport which last year had prize money totalling over \$68 million spread across more than 43,000 races.

"There was a big unmet need. Up until now there has been a little bit of testing in the United Kingdom. We are now leading the charge," McLeod says. "The goal posts have shifted for the trainers; many of them can't operate the way they used to."

While testing on athletes and in horse racing has been going on for many years, it was only in July 2008 that Greyhounds Australasia started testing the dogs for possible illegal use of substances such as steroids. This led to the Sydney-based Australian Racing Forensic Laboratory (ARFL) joining forces with ANU to find a foolproof manner in which greyhounds can be tested for steroid abuse. The ARFL drew up a list of 12 steroid agents which it decided were most likely to be used by trainers and owners and were readily available in Australia. Many of these drugs are similar to those used by humans and racehorse owners to try and beat the system. The drugs are presently registered in Australia for human or veterinary use.

Probably the most famous is stanozolol, which became well known after Canadian Ben Johnson tested positive for the drug, following his record-breaking 100 metres run in the 1988 Seoul Olympics. He was subsequently stripped of his gold medal and the record. Other high profile Olympians caught using performance-enhancing drugs include Linford Christie and Carl Lewis.

Yet despite the increasing success of catching sports drug cheats of the human and equine varieties, the same testing methods do not apply to greyhounds. All this rests on the analysis of metabolites – the products of chemical reactions within an organism when it attempts to break down complex molecules and eliminate them from the body. The human metabolites of stanozolol do not match the major metabolite obtained when the same drug is administered to greyhounds. Drugs metabolise differently in humans to greyhounds. Until now nobody performed the research on dogs to work out why. As part of their experiments, McLeod's team made a number of new compounds. One of these was called 6 alpha-hydroxystanozolol, which was found to match the greyhound metabolite. This discovery has led to numerous positive swabs for stanozolol doping in greyhounds around the country.

"You have to know what you are looking for, and you need to be able to back that up in the hearing ... The sport is definitely cleaner now, that is a fact."

The team's work has been part of the task to develop a foolproof method to test for the listed drugs in the urine samples that are mandatorily taken from dogs that finish first, second and third in a race. To make sure it is foolproof, the nominated list of drugs of abuse was sent by the ARFL to Queensland Racing Science Centre where there are greyhounds used in scientific research. These dogs were given one of the nominated drugs under veterinary supervision and according to ethical guidelines. It was then that McLeod's team stepped in. The researchers have developed compounds – like 6 alpha-hydroxystanozolol – which are tested against the metabolites extracted from the urine from the Queensland greyhounds. Matching 6 alpha-hydroxystanozolol to a greyhound metabolite sets off a 'red flag' and indicates the presence of an illegal drug when testing is carried out.

“It can be a bit of a needle in a haystack finding the correct structure as there is very little of the metabolite that comes from the dog and therefore we have to make an educated guess,” McLeod says.

“With the data that we obtain, there are a number of possible structures that we narrow down to find a match.”

McLeod’s findings mean that the compounds are matched to the different drugs which have been listed by the ARFL. This enables the greyhound racing authorities to confirm that an illegal drug has been found in the specimen taken from a dog that has finished in a place while competing somewhere in Australia.

“You have to know what you are looking for, and you need to be able to back that up in the hearing when the case against the dog’s connections is being held,” McLeod says. “The sport is definitely cleaner now, that is a fact.”

One only has to go to the website [Australian Racing Greyhound.com](http://AustralianRacingGreyhound.com) to see how many cases are being prosecuted for illegal use of steroids on dogs by their owners and trainers. Yet McLeod points out that the increase in successful prosecutions has led people wishing to gain an unfair advantage over their competitors on the greyhound racing circuit to try other substances.



“We are seeing a shift to other drugs because of the successful prosecutions. People are looking to other drugs,” he says.

“Once we have finished working through and developing tests for the 12 drugs on the original list, we will look at more exotic agents which could be used for abuse in greyhound racing.”

While this is a relatively new area when it comes to greyhounds and doping, much of the research into human drugs abuse in sport has been done.

“There may be some overlap in our work between dogs and humans. There may be some metabolites which have not been identified. But we are really filling in the gaps there as we are not testing for new agents in humans,” McLeod says.

“The general methods we are using are of relevance to all drug testing. It could also be that some of the metabolites we identify are common to humans or horses and have not been previously identified - this would be a small benefit. We have some ideas for improvements in the identification of metabolites but no concrete results at this stage.”

The future is also not all in trying to identify better ways in which to detect illegal drug use in greyhound racing. As part of the research, the ANU team is learning more about metabolite structure while working on developing genetically engineered enzymes for the improved synthesis of drug metabolites. The synthesis of drug metabolites is needed by all drug testing – animal and human – and even in areas like pharmaceutical development.

“These techniques will not only be useful in the fight against doping,” McLeod says. “They will have much broader application to areas like drug development in the pharmaceutical industry. We will be able to make the drug metabolites and test them to ensure they do not give rise to toxicity or other side effects.”

Metabolites from pharmaceutical compounds are formed as part of the natural process of eliminating the compounds. Profiling these metabolites plays an important part in helping to show if there are any side effects that could occur from the using of the drug. His work is expected to result in lowering the costs of producing metabolites that help identify any possible side effects of drugs. This would enable pharmaceutical companies to carry out more thorough testing on new drugs which are yet to be approved for use in the community.

“Drug companies are already required to understand the metabolism of new drugs before approval. Better and cheaper ways to make the metabolites will enable drug companies to do more thorough testing. This should reduce the risk of adverse outcomes with new drugs,” McLeod says.

Meanwhile, punters can be more confident that the greyhound they are betting their money on is competing in a much fairer environment.

COMMUNICATION & MEDIA REPORTS

The Secret to Longevity: It's Inside Us Already

Scientists at the Australian National University may have discovered the fountain of youth, but it won't allow us to turn back the clock any time soon.

A team led by **Professor Chris Easton** from the university's Centre for Free Radical Chemistry and Biotechnology found that the body's amino acids resist cell damage.

Professor Easton said even breathing transformed oxygen into free radicals, which degenerated the body.

"But, of course, we need to breathe to stay alive, so it is one of the great paradoxes of life."

Most biological free radicals are highly reactive and will react with almost anything they contact.

"While they're important to our existence, they tend to be indiscriminate," Professor Easton said. "So while they are necessary for life, at the same time they are destroying us."

But the ANU scientists discovered that amino acids helped prevent that damage from occurring.

"Thankfully, living things seem to have evolved to use robust amino acids to make up proteins essential to life, and have their own set of free radical neutralising molecules called antioxidants. If we were made of anything else, the degenerative process would be greatly accelerated." The team exposed amino acids to hydrogen peroxide and oxygen and found free radicals caused less damage than expected.

They also found certain types of amino acids resisted damage more than others. Of the 20 amino acids in the body, four completely resisted free radicals, while the others were "extremely robust", Professor Easton said.

But the findings won't result in a miracle cure for ageing. That would require altering human DNA to change the composition of the amino acids in the body. Professor Easton said the research contributed to "academic curiosity rather than any real industrial application".

"Next time you look in the mirror, know that your body is looking after you, and that your wrinkles could have been much worse."

- Taken from *The Canberra Times*, 13/08/09

DEPARTING POSTDOCS: Deb Crittenden

Deb Crittenden came to the RSC in April 2005, immediately after completing a PhD at the University of Sydney. Since then, she has been a postdoc in the Gill group, where most of her research has centred on intracules. These relatively little-known functions provide insight into the positions and locations of pairs of electrons, rather than single electrons. Her work has already yielded eight published papers and a number of others are in the pipeline. It was hardly surprising, therefore, to learn that some sharp-eyed Kiwis recently spotted her and offered her a lectureship at one of NZ's top universities. Although it is always good to see RSC postdocs taking plum jobs at other institutions, we will miss her when she leaves at the end of the year.

Name: Dr Deborah Crittenden

What is your field of interest? Theoretical and computational chemistry.

What experience have you gained while studying at the ANU? Plenty of experience in the weird, wacky and wonderful world of electronic structure theory.

What have you learnt about yourself during your time here? That I really am a geek – the withdrawal symptoms I had when *Mathematica* was off-line taught me that.

What are your plans after finishing at the RSC? I'll be taking up a lectureship in Theoretical and Computational Chemistry at the University of Canterbury, Christchurch, NZ.

What has been the most enjoyable experience during your time at RSC? I've enjoyed playing badminton with the Badminton Social Club on Thursday afternoon and a few seasons of soccer in the Purple Shins comp.

If you could bottle anything from RSC and take it away with you, what would it be? The vibe of the place.

5 quick questions:

- 1 Funniest person at RSC? Ray Withers
- 2 Biggest troublemaker at RSC? Ray Withers
- 3 Biggest workaholic at RSC? Not Ray Withers
- 4 Loudest person at RSC? Ray Withers
- 5 If you could be any element for a day which would you choose and why? Tantalising Tantalum – “a rare, blue-grey, lustrous transition metal that is highly corrosion resistant” (Source: Wikipedia) – what's not to love?

Group Leaders: If there is a postdoc in your area who will be departing shortly, please let us know as we should like to do a piece on them for the RSC News.

TITRATION STAKES

The Secondary Schools Titration Stakes Competition was held at the ANU on the night of the 12th of August. The competition is sponsored by the Royal Australian Chemical Institute. A team from Daramalan College took our first place, pictured below with Geoff Salem, Mark Ellison and Ray Withers.



Staff Publications as at 26 August 2009:

For a full list of RSC publications from 2002, see <http://rsc.anu.edu.au/research/Publications/index.php>

Brookes NJ, Graham DC, Christian G, Stranger R, Yates BF **The influence of peripheral ligand bulk on nitrogen activation by three-coordinate molybdenum complexes – a theoretical study using the ONIOM method.** *J. Comput. Chem.* (2009), 30(13), 2146–2156. <http://dx.doi.org/10.1002/jcc.21199>

Cheng C-J, Kan D, Lim S-H, McKenzie WR, Munroe PR, Salamanca-Riba LG, Withers RL, Takeuchi I, Nagarajan V **Structural transitions and complex domain structures across a ferroelectric-to-antiferroelectric phase boundary in epitaxial Sm-doped BiFeO₃ thin films.** *Phys. Rev. B* (2009), 80(1), 014109/1–11. <http://dx.doi.org/10.1103/PhysRevB.80.014109>

Colebatch AL, Cordiner RL, Hill AF, Nguyen KTHD, Shang R, Willis AC **A bis-carbyne (ethanediylidyne) complex via the catalytic demercuration of a mercury bis(carbido) complex.** *Organometallics* (2009), 28(15), 4394–4399. <http://dx.doi.org/10.1021/om900462p>

Conlan B, Cox N, Su J-H, Hillier W, Messenger J, Lubitz W, Dutton PL, Wydrzynski T **Photo-catalytic oxidation of a di-nuclear manganese centre in an engineered bacterioferritin ‘reaction centre’.** *Biochim. Biophys. Acta – Bioenergetics* (2009), 1787(9), 1112–1121. <http://dx.doi.org/10.1016/j.bbabi.2009.04.011>

Cordiner RL, Hill AF, Wagler J **Reactions of [Ru(CO)₂(PPh₃)₃] with alkynylphosphonium salts: phosphaaenyliene vs phosphonioacetylide coordination.** *Organometallics* (2009), 28(16), 4880–4885. <http://dx.doi.org/10.1021/om9003384>

Crittenden DL, Bernard YA **Compact expressions for spherically averaged position and momentum densities.** *J. Chem. Phys.* (2009), 131(5), 054110/1–7. <http://dx.doi.org/10.1063/1.3204011>

Dewhurst RD, Hill AF, Willis AC **The interplay of bis(tricarbido) and dimetallaoctatetrayne complexes of platinum.** *Organometallics* (2009), 28(16), 4735–4740. <http://dx.doi.org/10.1021/om900485b>

Ekonomiuk D, Su X-C, Ozawa K, Bodenreider C, Lim SP, Otting G, Huang D, Caflisch A **Flaviviral protease inhibitors identified by fragment-based library docking into a structure generated by molecular dynamics.** *J. Med. Chem.* (2009), 52(15), 4860–4868. <http://dx.doi.org/10.1021/jm900448m>

Elix JA **ARTHONIALES – Arthoniaceae.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 1–12.

Elix JA **ARTHONIALES – Chrysotrichaceae.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 13–18.

Elix JA **LECANORALES – Ramboldia.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 19–31.

Elix JA **LECANORALES – Ophioparmaceae.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 32–36.

Elix JA **LECANORALES – Protoparmelia.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 37–40.

Elix JA **LECANORALES – Phyllopsoraceae.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 41–59.

Elix JA **LECANORALES – Stereocaulaceae.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 60–74.

Elix JA **LECANORALES – Tephromela.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 74–83.

Elix JA **TELOSCHISTALES – Letrouitiaceae.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 483–494.

Elix JA **TELOSCHISTALES – Physciaceae.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 494–533.

Elix JA **LECANOROMYCETIDAE INCERTAE SEDIS – Brigantiaeaceae.** In *Flora of Australia. Volume 57 – Lichens 5.* McCarthy PM, ed. CSIRO Publishing: Collingwood, VIC (2009), pp. 602–605.

- Evans DJ, Searles DJ, Williams SR **Dissipation and the relaxation to equilibrium.** *J. Stat. Mech.* (2009), (07), P07029/1–11. <http://dx.doi.org/10.1088/1742-5468/2009/07/P07029>
- Ge Q, Corkery TC, Humphrey MG, Samoc M, Hor TSA **Organobimetallic Ru^{II}–Re^I 4-ethynylpyridyl complexes: structures and non-linear optical properties.** *Dalton Trans.* (2009), (31), 6192–6200. <http://dx.doi.org/10.1039/b902800e>
- Hadler KS, Mitic N, Ely F, Hanson GR, Gahan LR, Larrabee JA, Ollis DL, Schenk G **Structural flexibility enhances the reactivity of the bioremediator glycerophosphodiesterase by fine-tuning its mechanism of hydrolysis.** *J. Am. Chem. Soc.* (2009), 131(33), 11900–11908. <http://dx.doi.org/10.1021/ja903534f>
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- Jones MT, Schwartz BD, Willis AC, Banwell MG **Rapid and enantioselective assembly of the lycorine framework using chemoenzymatic techniques.** *Org. Lett.* (2009), 11(15), 3506–3509. <http://dx.doi.org/10.1021/ol901364n>
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