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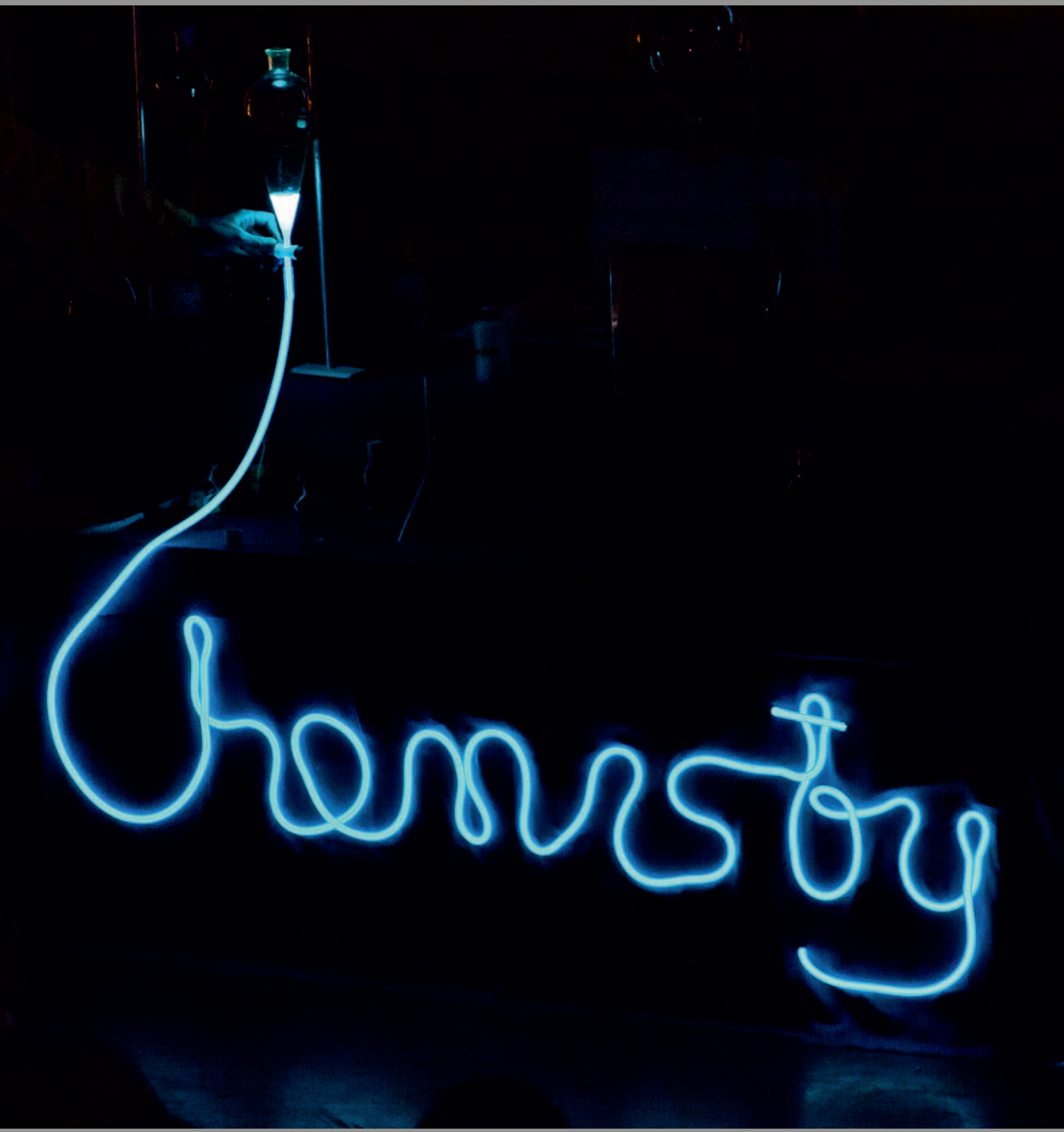
Chemistry at Cambridge Newsletter

Spring 2013



Athena SWAN: **encouraging equality**

Royal Institution Christmas Lectures

Water vapour in the stratosphere

Memories of **Dan Brown & Herchel Smith**

Chemistry alumnus James Harrison moved from science to the City, and then back into chemistry-based industry. He talks to Sarah Houlton about how his Cambridge chemistry experience has shaped his career thus far – both directly and indirectly

Can you tell us about your Cambridge experience?

I came up to Cambridge and Robinson in 1992 – and like many people at Robinson at that time, I didn't apply there, but came through the pool system. But I'm very glad I ended up there – and it made me very motivated to beat all the chemists Christ's chose ahead of me in the final exams! I quickly gravitated towards chemistry in the natural sciences tripos, with my interests more on the physical and theoretical side. I think the person who put most red ink on my work was Melinda Duer, and it was very interesting to be supervised by Lord Lewis.

I was then offered a PhD place in Dave King's surface science group, but wrote up an MPhil after a year instead. I don't think I was ready at 21 for the move from the structured undergraduate world, and seeing my contemporaries having fun in London, I sold out – there's no other way to describe it – and became a mergers and acquisitions banker in London with Morgan Stanley.

That's a far cry from surface science!

Yes, it was. But I saw the error of my ways after three years, and joined an investment management firm, Soros Private Equity Partners, involved in buying and selling companies. We'd buy them, and restructure and build them, to create growing businesses. I naturally gravitated back to chemistry and the industrial world, putting some of the things I'd learnt at Cambridge to use. Many of the skills you learn are relevant in any career – thinking from first principles, structuring your arguments, and so on – and I like to think my chemistry background helped me persuade the head of R&D at a chemical company to throw their career in with me, as the person trying to buy the company. At least I understood some of the words! I bought and sold chemicals businesses from Bayer, from Degussa (now Evonik), and from Clariant – taking a division out of a big chemical conglomerate, then putting all the other necessary pieces around it that a standalone business needs.

Did you get more closely involved with any of the businesses?

I did, yes. One chemical business I was responsible for buying from Clariant, a global manufacturer of pharmaceutical ingredients called Archimica, turned out to have all manner of issues, including fraud. We made the judgement that the existing management team would be unable to complete the business turnaround, as the issues we found meant deep restructuring was required, and I got the chance to do it myself. So I went from being a board member representing the investment company to chief executive, moving my family to Germany and then Switzerland.

Over the three years I led that business, sales, profit, employment and the depth of our product pipeline all increased. Archimica was sold a couple of years ago to the Italian company Euticals, and I moved on.

How did that experience shape your next career move?

The insight I gained into the pharmaceutical industry led me to try the entrepreneurial route, and I founded a new company, Cycle Pharmaceuticals, one year ago. We believe that many existing pharmaceuticals are not optimised for patients and we are trying to do something about this. There is very much an ethical component to our work – we want to do well by doing good.

We only work with existing approved drugs – we don't touch anything in the clinical pipeline where patient safety is not yet proven. We have two areas of focus: bringing to market our own pipeline of products, many of which are for the under-served rare disease patient population, and secondly repurposing and redeveloping discontinued drugs.

Most of the 7,000-or-so identified rare diseases are genetic abnormalities that the patient is born with, and require life-long treatment. While there are incentives for big pharma companies to research and find new drugs for rare diseases, these new drugs are understandably designed for babies so that they can take the drug as soon as they are diagnosed. That's great, but there are no incentives for the big pharma company to adapt its drug as the child grows and gets heavier and more active. There are instances of eight-year-olds popping 30 pills in the morning and another 30 at night because each individual pill is optimised for a newborn! This is something we look to address.

There are many examples of these optimisation opportunities – perhaps we can create a new formulation that does not need refrigeration. One-year-olds may rarely be away from a fridge for very long, but eight-year-olds want to go to Alton Towers – a real problem for mum and dad if they need to take their drugs every few hours. And many rare diseases fall into genetic 'families', so it may be possible to repurpose an approved treatment for one disease, to treat another.

Our other area of focus is trying to bring 'dead' drugs back to life. While many old drugs have been superseded by newer, better alternatives, there are some where we think there are good reasons why their use should increase again. For example, antibiotic resistance patterns change, and returning to older drugs where resistance has not built up, can provide therapeutic options. Then there are questions such as whether the new generations of antipsychotic drugs are really better than the older ones? So we are taking rights in discontinued drugs, and are looking to bring them back to the market for the benefit of patients.

How do you go about finding drugs to work on?

We collaborate with experts, whether within the academic community or industry. They have often already had a long career, and have developed ideas about drugs that might have potential, perhaps with a different formulation, or in a different indication. We are trying to find these people, work with them, and make their ideas reality by investing in the necessary development process. We also have a few ideas of our own!

How much development work is required?

This is the key skill set we bring. We have former US and EU drug regulatory officers on our staff, and therefore we know the right regulatory pathways to use and what drug regulators require of us. Our background is also in drug manufacturing, so we know how to put pharmaceutical supply chains in place and manage them.

What links do you maintain with the university?

I was invited back to Robinson the other week to give the annual scholars' lecture, and I'm on the college's investment committee, trying to give something back. Cambridge chemistry was such a good training programme for life – so many skills have been transferred to the workplaces I've been in. I'm not sure I use the chemistry I learnt in James Keeler's Part 1A lectures directly in my daily life but, in a way, I do, as the skills you learn from those courses – and not throwing paper aeroplanes at him – are really important.

Fighting fires

Dear Editor
The death of Dan Brown prompts me to write to you, as I probably should have done before, and provide you with some background on him, and also Herchel Smith.

Dan and I went to Cambridge together in 1948 to work with Lord Todd, and we spent most of the next three years sharing digs, registered lodgings and rooms in Christ's. Of course, we had known each other much longer before that. We graduated from Glasgow in 1944, and moved to London – he to the Chester Beatty Institute, and I to the National Institute of Medical Research in Hampstead, in 1945.

At Cambridge, we worked in the postdoc lab on the second floor of the chemistry dept, along with, among various others, Len Haynes, Gobind Khorana, Grant Buchanan, Charles Dalgleish, Ted Corbett and Ted Harvey from New Zealand, and, of course, Herchel Smith.

I always remember Dan as a good friend with a 'pawky' sense of humour, and a penetrating and persuasive intellect. His contribution to chemistry at Cambridge, to the Watson/Crick epic, and to molecular biology in general, was enormous although, I fear, largely unsung. That was the kind of guy he was.

I miss him.

Hugh Forrest
Emeritus professor of zoology,
University of Texas at Austin, US

Turn to page 13 to read Hugh's memories of Herchel Smith at Cambridge

Identity crisis

Dear Editor,
I enjoy reading Chem@Cam. However, I sometimes have difficulty with the photo captions. They could be part of the puzzles section!

On page 13 of the Autumn 2012 issue, it helps to identify people by their gender, but as I don't know the people in the groups of three men, the captions seem to be mixed up. Similarly, on page 14 of the Spring 2012 issue, it was difficult to assign names to subjects in some of the photos.
Best wishes,
Peter Scott
Editor's note: it's always a balancing act between squeezing in pictures, names, and making the page look nice. We'll try to do better in future!

eChem@Cam

Chem@Cam is now being sent out by email to those who have asked for a pdf version rather than a hard copy in the mail.

If you would like to swap your paper magazine for an e-version, then please send an email with the subject line 'eChem@Cam' to jsh49@cam.ac.uk, and we'll start to send you the mag electronically from the next issue. Don't forget to tell us your postal address so we can check that the correct person is being removed from the mailing list for the paper magazine.

If you're not sure what it will look like, you can check out e-back issues on the newly redesigned department website, www.ch.cam.ac.uk

Don't worry if you still want to receive a paper copy – we'll continue to print and mail the magazine for the foreseeable future, so you won't miss out!

chem@cam
Chemistry at Cambridge Newsletter

Contents

News	4
Research	7
Alumni	11
Chat lines	13
Puzzle corner	15

Cover

Chemiluminescent chemistry: all made from components found in coffee, as seen in one of Peter Wothers' demonstration lectures

Photograph: Nathan Pitt

This newsletter is published three times a year by the University of Cambridge Chemistry Department. Opinions are not necessarily those of the editor, the department, or the university.

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A little light relief…

Photos: Nathan Pitt

This year's Alex Hopkins lecture was given by physical chemist and former president of the Royal Society of Chemistry David Phillips. His talk, 'A little light relief', focused on the science of photomedicine from a chemist's point of view.

It looked at both the diagnostic and therapeutic aspects of light's effects on the skin – and the damage the sun can cause. He spoke in depth about the use of lasers in combination with chemical sensitisers to destroy tumours, and how better sensitisers that target tumours more accurately are being developed. And – as you can tell from the photos – there were plenty of demonstrations!

The annual lecture, which relates chemistry to everyday life and contains an element of humour, is given in memory of Alex Hopkins, a much-loved teaching fellow at Churchill and Fitzwilliam, and who also played an important role in the department's inorganic teaching.

The lecture is supported in Alex's memory by his father, John Hopkins.

RSC prize lectures

Photos: Nathan Pitt

Ken Houk and Christy Haynes in lecturing action

The department has recently hosted two US-based RSC prize lecturers. First of all, in January, Ken Houk of UCLA gave his Robert Robinson award lecture, 'Theory, dynamics and mechanisms of cycloadditions'.

Then in February, Joseph Black award winner Christy Haynes of the University of Minnesota spoke on monitoring immune cell behaviour in the context of inflammation.

Ulyana's Israeli award

Ulyana Shimanovich, a postdoc in Tuomas Knowles' group, has won an Israeli Women in Science fellowship award. Two such awards are given every year to women who are starting their first year of postdoctoral training, having completed a PhD in Israel.

'Not only did I receive the award this year, but I also had an offer of a position as a faculty member from one of the Israeli universities,' Ulyana says.

Oxford talks for Daan and Jason

Two Cambridge academics have been giving named lectures at Oxford. The 2013 Hinshelwood Lectures were given by Daan Frenkel in late April and early May. The theme of the lecture series is 'Simulating soft matter: not a numbers game', and Daan was giving six talks over the space of three weeks. The lecture series is sponsored by Shell International.

A couple of weeks earlier in April, Jason Chin gave the 2013 Andy Derome Lectures. His two talks were entitled 'Reprogramming the genetic code' and 'Imaging and controlling biological processes with molecular precision'.

Andy Derome was an undergraduate here in Cambridge, before moving to Oxford for a DPhil with Jack Baldwin. From 1982, he ran the organic chemistry NMR facility, until his untimely death in 1991. He is perhaps best known for his book, 'Modern NMR techniques in chemistry research'.

Indian of the Year

Yusuf Hamied, a chemistry alumnus and generous donor to the department and the university, has been made 2012 CNN-IBN Indian of the Year for business.

These awards recognise Indians who have made huge contributions to 'Brand India' across five categories – business, entertainment, politics, public service and sport. Ultimately voted for by the public from a list of nominees shortlisted by a jury, Yusuf won the award because of the success of his company, Cipla, in making some of the most essential drugs more affordable to people in developing countries.

'I can truthfully say that chemistry runs in my blood,' Yusuf says. 'This prestigious award is a testament to the ideals I have fought for and fiercely defended in spite of all odds, always keeping in mind as to what is best for India.'

■ Our congratulations also go to former Cambridge chemistry professor Carol Robinson, now at Oxford, who was made a Dame of the British Empire in the 2013 New Year's Honours List.

Photos: Nathan Pitt

We recently had visitors from BASF. Valerie Andre, senior manager for science relations and innovation management gave an introduction to BASF's innovation culture, while fungicides lab head Klaas Lohmann spoke about lead optimisation.

Computer heaven?

Photo: Nathan Pitt

Dave checks out the ever-growing collection of computer waste

These days, we're not allowed to throw old computers in the bin, thanks to the Waste Electrical and Electronic Equipment, or WEEE, directive. So what happens to the department's computer equipment once it reaches the end of its useful life?

The answer is – it's recycled. The computer officers have a cubbyhole, near the rear exit to technical services, where dead kit goes to await its recycling fate, looked after by Dave Pratt.

It languishes in the room until it's full, and is then taken away by a company called CDL – Computer Disposals Limited – which is monitored by the Environment Agency.

Once it reaches CDL's site in Warrington, they determine whether it can be re-used. Otherwise, the equipment is dismantled, and as many components as possible separated for re-use. That which cannot be reused is split down further, and components such as metals are recycled.

'Over the past 15 months, we've got rid of approximately 25 tonnes of WEEE computer waste in the department!' Dave says. 'Each load is about 1 tonne of computer equipment. And it takes no more than a month to fill up – though early last year, when there was a real effort to get rid of old equipment, we were emptying it once a week for two months.'

So remember – if you want to get rid of something that has a plug or any form of electrical circuitry, don't throw it away. Anything computer-related should go to Dave, while John Coston looks after all the department's other electrical waste – send an email to weee-disposal@ch.cam.ac.uk if you have something that needs to be disposed of. It's not just a case of complying with legal requirements – it's also part of the department's commitment to become more sustainable.

Shankar wins the Heatley medal

Shankar Balasubramanian has been awarded the Biochemical Society's Heatley medal for 2014. The award is being made in recognition of his role in developing novel high-throughput sequence methodologies that, the citation says, are having a profound impact on medical and environmental sciences.

The medal commemorates Norman Heatley, the scientist who overcame wartime shortages to make the mass production of penicillin possible.

It is awarded for exceptional work that makes biochemistry widely accessible and usable, or for achievements that enable widespread progress and understanding. As well as the medal, Shankar will give the prize lecture at a Biochemical Society conference.

Predicting headlines

A recent paper from Andreas Bender and PhD student Fazlin Mohd Fauzi has caused quite a bit of media interest, with news stories on BBC World, as well as newspaper stories in India and Malaysia.

Traditional Chinese and Indian ayurvedic medicine have been used for centuries, and contain complex mixtures of active ingredients. A lot of information about the chemical composition of these medicines is now available in publicly available databases.

Andreas and Fazlin used computational models to predict the biological targets of some of these molecules, and in many cases found there was a good correlation between the predicted biological target and the medicine's traditional activity.

For example, in the traditional Chinese medicine class of 'tonifying and replenishing medicine', they found compounds that are active against the well-known cyclooxygenase, or COX, receptors involved in inflammation pathways. These are the targets of western drugs such as aspirin and ibuprofen.

They also looked at anticancer targets, Fazlin explains. 'We were able to predict the activities quite well for anticancer compounds,' she says. This has real potential in drug discovery programmes. 'Even if we can only find the targets for as few as 10% of the compounds in a traditional medicine, we have highlighted potential starting points for new medicine development.'

'We know which compounds are present in plants used for specific purposes from the traditional medicine databases,' Andreas adds. 'We also have connections between chemical structure and targets from databases such as CHEMBL, and by putting all this information into our target identification models, we can anticipate what the likely protein targets of that compound are, and provide a bridge between the holistic thinking of eastern medicine, and the target-based thinking we have in the west.'

8 PENDIDIKAN

Pensyarah perlu aktif dalam R&D

UiTM pacu aktiviti menjana ilmu, teknologi baharu secara berterusan

Oleh Rafidah Mat Ruzki

Andreas was even pictured (centre) in the Malaysian newspaper!

Athena SWAN: working towards equality

The department has applied for an Athena SWAN bronze award. These awards recognise and celebrate good practice in recruiting, retaining and promoting women in science, engineering, technology and medicine within higher education institutes. The university has been very keen for departments to register for the Athena SWAN process, and there is a commitment to improve the number of women, particularly in academic positions.

Research councils are now demanding evidence that departments are working at gender equality. Having an Athena SWAN award, and working towards higher level awards, is a tangible way that we can demonstrate our commitment in this area. So there is a pragmatic reason why aiming for gender equality is important – it's not just the issues of equality and waste of talent, there is also a real argument about future funding.

'While we have reason to be satisfied with many areas of our performance, there are a significant number of issues that cause concern,' says Jane Clarke, who led the application process. 'We will not be successful moving forward without the wholehearted support of all members of the department.'

Photo: Nathan Pitt

Some of the working party take a well-earned break in the Cybercafe´. From the left: Richard Turner, Marita Walsh, Jane Clarke, Stuart Clarke, Laura Itzhaki, Amanda Maycock and Neil Harris

HOW ARE WE DOING?

As a department, we do pretty well at postgraduate and postdoc level, with a good number of women – for example, around a third of our 200-odd postdocs are female. But women are seriously underrepresented on the department's academic staff. 'Of the 20 appointments of people coming in to the department at lecturer level since 2000, not one has been female,' Jane says. 'We are also really short of women applying to come in at the research fellow level. So what is happening between our great postdocs, and the more senior positions?'

As part of the process, a mixed-gender working party was set up, with representatives of all sections of the department – from undergraduates to senior academics, plus support staff. Members of the committee were tasked to look into and address the different parts of the process, collecting data and coming up with recommendations. The results were fed in to the report that was submitted to Athena SWAN as part of our bronze award application.

Surveys formed an important part of the data-gathering process. For example, an anonymous, online survey of contract research staff was carried out, explains postdoc Amanda Maycock. 'We tried to get a handle on various issues, such as how well postdocs feel they are supported, and the working environment they experience in the department,' she says. 'Issues we picked up on included work–life balance – do people with young families or other outside responsibilities feel they are able to work for their supervisors and balance those responsibilities in a satisfactory way? There were also issues with mentoring and training in the dept – are there sufficient opportunities for people to develop the skills they require?'

Jane was then responsible for putting all the different inputs together into a cohesive whole. 'There are some things in the report that are quite shocking – but there are things in there that are very encouraging, too, as there are things that we clearly do well,' she says. 'But it does contain clear pointers to the things we need to do better.'

On the undergraduate side, working group member and third year student Antonia Mattos said that they focused on the progression of students who choose to take Part II and III chemistry. 'We identified that there is a drop-off in the number of female students who continued on to take chemistry at Part III,' she says. 'Our survey of undergraduates highlighted issues to do with aspirations, and one of our action points is to investigate those factors.'

Aspiration plays a part further up the chain, too. 'We found that, at first, PhD students and postdocs both women and men wanted to be academics,' Jane says. 'That drops off for both as they go through their PhD, but much more steeply for the women than the men. So what is it about the PhD process that discourages women from wanting to stay on? These are things that we simply don't know.'

LOOKING TO THE FUTURE

As part of the award application, an action plan was developed, describing actions that are already being taken, and will be taken in the future, to address the issues highlighted by the working party's research. 'It's important that it is not just about women who have children – it's about a healthy work–life balance for everyone,' Jane says.

'We want to have a model that says you can do world-beating science while retaining this. One of the things we have done in the department is introduce a "lab expectations" document. This specifies that all meetings should be held within child-friendly hours, so between 9am and 5.30pm, whether group meetings, seminars or departmental meetings.

'As the head of department wrote in his letter, if the great pool of women scientists are choosing not to apply to Cambridge, then we are missing out on some of the best brains in the world because they are not choosing to come here. We are committed to identifying what we could be doing better, and then doing it.'

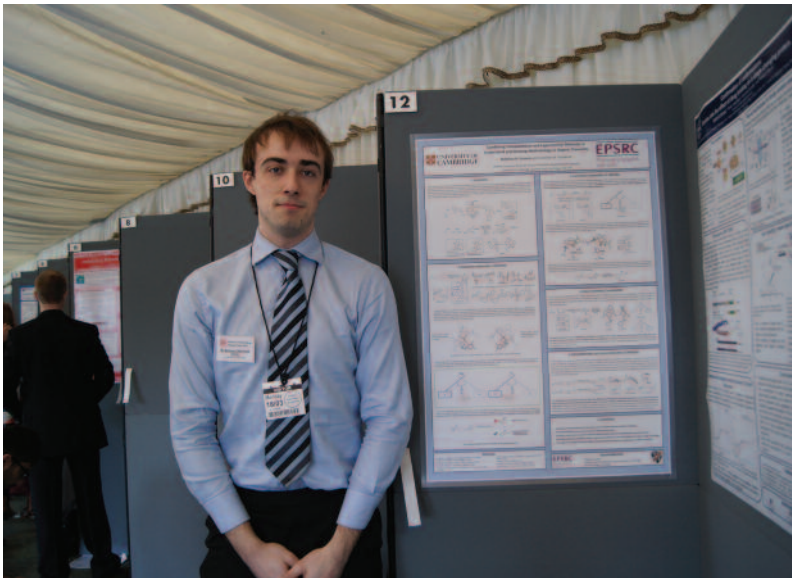
What is Athena SWAN?

The Athena SWAN charter for women in science evolved from work between the Athena Project and the Scientific Women's Academic Network (SWAN), to advance the representation of women in science, engineering and technology. The charter was officially launched in 2005, with the first awards conferred in 2006. Its principles are:

- To address gender inequalities requires commitment and action from everyone, at all levels of the organisation
- To tackle the unequal representation of women in science requires changing cultures and attitudes across the organisation
- The absence of diversity at management and policy-making levels has broad implications which the organisation will examine
- The high loss rate of women in science is an urgent concern which the organisation will address
- The system of short-term contracts has particularly negative consequences for the retention and progression of women in science, which the organisation recognises
- There are both personal and structural obstacles to women making the transition from PhD into a sustainable academic career in science, which require the active consideration of the organisation.

These six principles represent the cornerstone of Athena SWAN; to join the Charter, vice-chancellors or principals must indicate that their institution will take action to address these areas.

Chemistry in Parliament



Matthew does a good job of hiding his nerves while presenting his poster!

Matthew Grayson, a PhD student in Jonathan Goodman's group, presented his science in the the Houses of Parliament in March as part of the SET for Britain poster competition. This is designed to allow scientists to present ground-breaking research to MPs and members of the House of Lords, and encourage greater engagement between MPs and scientists in the constituencies they represent.

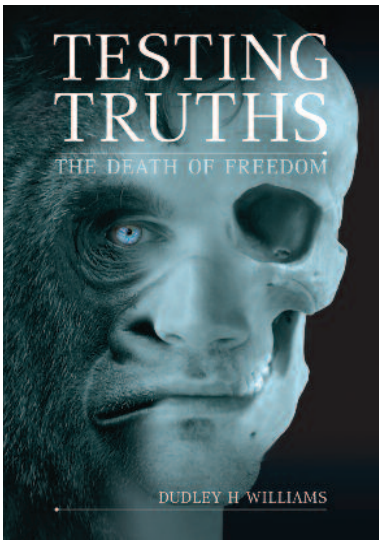
He was shortlisted from hundreds of applicants to present his research into understanding and developing methods of making key building blocks useful in biotechnology. Computational and experimental approaches are used in his project to develop a better understanding of how chiral phosphoric acid catalysts work.

There were three separate competitions – engineering, biological and biomedical science, and physical sciences (including chemistry). 'Each section had a separate two-hour poster exhibition and judging session during the day, ending with a prize-giving for the top three posters,' Matthew says. 'While I didn't win one of the prizes, my research was well received.

'It was a nerve-wracking experience, but an excellent opportunity to present my research to the wider community, and to speak with politicians regarding scientific research across the UK.'

Testing truths: Dudley's last book

Many readers will know that Dudley Williams devoted many years, and much of his retirement, to writing a book, 'Testing Truths', which covers a broad sweep of science from the Big Bang to evolution and its implications for human behaviour.



He completed the text in October 2010, just before he died, and he charged Jeremy Sanders and his wife Pat with the responsibility of getting it published. During the past year or so, the pair prepared the text and figures, and oversaw the project to fruition.

'Testing Truths' has now been published. 'For me, reading it brings back to life Dudley's voice and thinking in a way that is direct and very moving,' Jeremy says. 'You don't have to agree with all his conclusions, but they, and the many lively quotations from an extraordinary range of writers, make it a stimulating read.'

The book is available from the publisher, Silverwood Books (www.silverwoodbooks.co.uk), and from Amazon in both paperback and e-book format.

Tunnelling to a prize

Adam Reid, a PhD student in Stuart Althorpe's group, was recently awarded joint first place in the John Rose prize at King's College. This is given for the best explanation of a scientific principle of general interest.

His winning essay was on quantum tunnelling, inspired by the research he's doing for his PhD. As he says at the start of his essay, 'This ubiquitous process can often be quite poorly understood by many otherwise scientically-literate people. It is exploited to great eect in electron microscopes, and other examples of its occurrence include the nuclear fusion reaction occurring on a vast scale within the heart of the sun, and also many biochemical processes in our bodies.'

Interested? You can find a copy of his essay at www.bit.ly/YQFXVj – and Adam says that any comments, thoughts or questions from readers would be gratefully received!

Linnett lecturer Zare

Photos: Nathan Pitt

Above: Richard Zare in lecturing action; below: posing with old friends John Meurig Thomas, Ian Smith and David Buckingham

This year's Linnett visiting professor was Stanford University's Richard Zare, whose research focuses on laser chemistry and understanding chemical reactions at the molecular level. In early March, he spent a couple of weeks in the department, giving three lectures during his time here.

The Linnett lecture itself was entitled 'If you do not fail enough times, you cannot possibly succeed' – wise advice on the importance of persistance!

His other two lectures were on searching for intermediates in liquid reactions, and 'TB or not TB'.

Switch Off success

Photo: Nathan Pitt

A selection of chemists show off their woolly jumpers on Thermal Thursday

The university-wide 'Switch Off' week in February prompted a number of energy-saving initiatives, including several in the department.

The aim of the week was to run a series of activities to raise the awareness among students and staff of the impacts of energy use by the university, and to encourage them to take action in their departments and institutions to reduce energy use.

In the department, everyone was encouraged to switch off unnecessary equipment, screens, lights or anything else that uses energy on the Wednesday lunchtime, and also at the weekend. A 'Thermal Thursday', was also held, with staff and students encouraged to wrap up warm in their winter woollies so the heating could be turned down.

A brave band of woolly-wearers posed for a photo in reception – it was just that bit too cold for outdoors, even in the jumpers!

The impact on the university's energy consumption all week were striking. The various initiatives led to a overall 2.1% saving on the university's energy bill compared to the previous week, after the effects of the unusually cold snap towards the end of the week were factored in.

If this were maintained for a whole 12 months, it would translate into a cut in the university's energy bill of more than £200,000 a year.

The figure of 2.1% was reached by applying a correction for weather adjustment, due to temperatures dropping at the end of the week and the large amount of electric heating (as opposed to gas) across the university.

There was a 4.1% reduction in consumption by Wednesday without any 'degree day' correction for weather conditions, equal to 45,310 kWh. This impressive effort was followed by an end-of-the-week dwindle – that cold snap meant the temptation to turn on electric heaters was too great, and the savings reduced over the week. It also led to an increase in electricity use by several of the university's buildings that have controlled air temperatures and humidity levels. Unfortunately, this is not something that switching off, however conscientiously it is done, can prevent.

This is the first year that Switch Off week has been run on this scale. It is envisaged that in future the event will become an annual fixture in the university's calendar as part of the university's sustainability programme .

Of course, energy saving isn't just a one-week activity in February – there are plenty of things we can all be doing to reduce our energy consumption. Xin Yang of the department's Green Team has provided the energy-saving tips on this page. Some are obvious; others, like closing your fume hood when you're not working in it, might be less so.

What can you do to reduce the department's energy consumption?

Ten top tips for saving energy in the lab

Shut the sash on fume cupboards whenever you walk away

Declutter fridges and freezers, and dispose of unwanted samples

Make sure samples aren't being stored at temperatures colder than necessary

If practical, avoid having a single sample in each shaker, stirrer and centrifuge

Don't use more glassware than you need to – it takes energy to heat and treat the water used to wash it

Only run dishwashers when fully loaded

Fit timers to drying ovens

Only use purified water when mains water really won't do

Consider upgrading equipment such as fridges, freezers, dishwashers and ovens to more efficient models

Make the most of natural daylight, and switch off lights when not needed, especially at the end of the day

Ten top tips for saving energy in offices

Switch off the lights in your work area if you're last to leave

Switch off lights whenever daylight is adequate

Switch off main lights whenever task lighting is adequate

Print double-sided, turn off printers and other equipment at night, and ensure sleep modes are enabled

Dress appropriately for the season, and heat and cool your office sensibly

If it's too hot, don't open a window while leaving the radiator on high – turn it down if you can

Look at the settings on any local control units – ideally, only cool to 25°C, and heat to 19°C

Check seals on refrigerators, and make sure any freezer compartments are defrosted regularly

Use sustainable modes of transport to get to the office, such as cycling

Use reusable cups and glasses rather than paper ones

The energy savings were converted into person-cycling miles, and Jeremy Sanders used them to go on a virtual world tour on his bike. He cycled around the world more than 30 times, including a stop off to say hello to the penguins in Antarctica, and even went to the moon. You can find out where else his bike tour might (not) have taken him in a slideshow on the university website, at www.admin.cam.ac.uk/carbon/getting_involved/sow-gallery.html his almost-holiday snaps are at the bottom of the page

Water vapour and global warming

Photo: Nathan Pitt

Weather in action: Amanda with an anemometer in the Botanical Gardens

The stratosphere is normally very dry. How does the presence of water there affect our climate? That's one of the things Amanda Maycock is trying to find out

The atmosphere is an incredibly complex system, with huge numbers of processes and feedbacks interacting with each other to create the climate and weather we know and (occasionally) love. This complexity means sophisticated atmospheric models of the climate system have been developed. They vary from simple tools that incorporate only a handful of processes, to complicated models that incorporate atmospheric chemistry.

'State-of-the-art climate models now include the interactions between chemical species in the atmosphere, as we want to understand the role of chemical processes in the climate system,' explains Amanda Maycock. 'For example, what role do chemical processes play in determining air pollution and quality, and how can chemical feedbacks and processes affect the impact of greenhouse gases on the climate system?'

Amanda's background in meteorology has led her to take a particular interest in the stratosphere – the layer between 10 and 50km above the earth that contains the ozone layer. 'I'm particularly interested in how changes in composition in the stratosphere, such as the presence of water vapour and ozone, affect its radiative balance, and how this can impact on the dynamics of atmospheric circulation and influence the weather,' she says.

'Composition changes in the middle atmosphere can impact on the evolution of weather patterns in the troposphere – the layer we live in. A good example is the extreme chemical depletion of ozone in the southern hemisphere associated with halocarbons, such as CFCs, in the atmosphere. This is thought to have affected carbon uptake in the southern ocean as a result of changes in circulation and wind stress at the ocean surface.'

WATER VAPOUR

Her current projects focus on the role of stratospheric water vapour in the climate. Water vapour is a familiar concept in the troposphere where clouds are prevalent, but the stratosphere is very dry. Despite this, stratospheric water vapour is still a powerful greenhouse gas and changes in its concentration impact on the energy balance of the earth's surface.

'In model simulations of climate change, an increase in man-made emissions of carbon dioxide and methane causes changes in the concentration of water vapour in the stratosphere,' she says. 'This suggests it might be an important feedback in global warming. I'm investigating how well stratospheric water vapour is represented in the different climate models that are an integral part of large international climate policy efforts, such as the Intergovernmental Panel on Climate Change reports.'

The processes that control the concentration of water vapour rising from the troposphere into the stratosphere are complicated. 'We know they involve both microphysics and the large-scale stratospheric circulation, as well as cloud processes, but not all of these things are well-represented in the models,' she says. 'But the models are being used to predict things such as the global average surface temperature in the future, which is an important metric for policymakers. By quantifying the radiative forcing water vapour in the stratosphere has on the climate, we should be able to improve our understanding of these temperature projections.'

OZONE LAYER RECOVERY

Another problem she's interested in involves the stratospheric ozone layer. 'The World Meteorological Organisation conducts ozone assessments every four years,' she says. 'People want to know when the ozone layer will recover. With the Montreal Protocol now controlling CFC emissions we do expect it to recover, but there is uncertainty around the timescales. Will it be by the middle of this century, or will it take longer? Our modelling work contributes to this type of assessment.'

As a specialist in computer simulations, her work relies heavily on supercomputers. 'We use supercomputers at the Met Office, as well as HECToR, the UK's national supercomputer facility in Edinburgh,' she says. 'These are not the sorts of calculations you could do on your laptop! The models allow us to investigate what impact changing one factor of the system might have, such as perturbations in greenhouse gases or other chemical species, and are ➢

CV Amanda Maycock

Born: Beverley, near Hull, and grew up in Coventry

Education: Studied physics at Manchester University, followed by a masters degree in atmospheric science at Reading. She stayed on for a PhD with Keith Shine and Manoj Joshi, studying various aspects of atmospheric radiation and dynamics, and climate modelling

Career: After a short postdoc at Oxford with Lesley Gray in the department of atmospheric, oceanic and planetary physics, she moved to Cambridge and John Pyle's group last year. In July, she starts an AXA fellowship, and will become a junior research fellow at St Catharine's in October

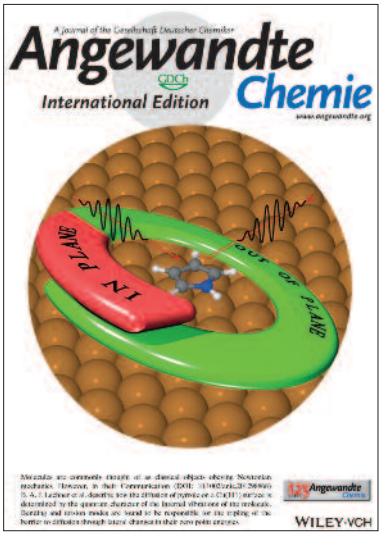
Interests: walking in the countryside, live music, reading, and she claims to be an enthusiastic, if not always successful, cook!

Did you know? Since moving to Bishops Stortford last year, Amanda has become a keen allotment gardener. 'I grow potatoes, rhubarb, raspberries, and some Jerusalem artichokes have just gone in,' she says. 'This year, we're also trying cauliflower and sweetcorn – though if the summer's as bad as the past couple have been, the corn might be a challenge!'

based on as much solid theory as possible. 'We have a good understanding of the fundamental fluid dynamics of the Earth as a rotating sphere with an atmosphere, but other factors such as clouds are less well understood and are represented relatively simply in our climate models. Every time we add another factor, it adds another layer of complexity. The core of the climate model we use at Cambridge, including circulation, clouds and other physical processes, was developed by the Met Office, and we add in the chemistry.'

Amanda is about to start an independent fellowship funded by the AXA Research Fund, looking at the interactions between the stratosphere and the troposphere. 'These are often treated as distinct parts of the atmosphere, and the dynamic coupling between them is still not very clear, but it can have a big influence on our surface weather patterns, particularly over Europe,' she says. 'I'm looking to develop an intermediate complexity model, and use it alongside a more sophisticated one to try and understand the dynamic coupling in detail.'

Small, but not insignificant…



Subtle quantum effects in the motion of molecules across a metal surface have been detected by Stephen Jenkins and postdoc Marco Sacchi, in collaboration with groups at the Cavendish and at Rutgers University in the US.

When pyrrole molecules are deposited onto a metal surface, they nestle into the hollows between the metal atoms and lie flat. The molecules hop from one site to another, with the rate determined by the amount of energy required to loosen the bond between the molecule and the surface enough to allow it to move sideways.

Experimental results from the Rutgers/Cavendish team had showed that when two coherent beams of helium atoms are fired at the surface with a delay of a few picoseconds, the frequency of the molecules hopping between sites could be determined from the interference between the beams, and therefore the height of the energy activation barrier.

However, much to their surprise, the density functional theory calculations carried out by Stephen and Marco didn't match up with the experimental observations, as they had for earlier studies on cyclopentadienyl ions. This was something of a mystery, until Marco came up with the idea that perhaps zero-point energy was involved.

This esoteric quantum phenomenon is linked to the fact that we are unable to make definitive pronouncements about the state of an object, including whether or not it is standing still. In classical mechanics, an object can slowly lose energy until it stops moving, but in quantum mechanics this is impossible as it only loses energy in discrete packets, or quanta, and when the last has gone it will still retain some residual vibrational energy.

This is known as zero-point energy, and is so small it is often assumed not to have any effect on any measurable properties. While it can be observed when bonds are broken, the molecule–surface bonds are only weakened in this case, and the vibrations of the molecule relative to the surface do not change much.

'We always knew the biggest contribution to the molecule's zero-point energy would come from the residual motion of its hydrogen atoms,' Marco says. 'They are the lightest atoms, and thus most sensitive to quantum effects. But would that contribution be constant, or would it change as the molecule moved across the surface?'

It turns out that the bending of the molecule as it moves from one site to another causes the zero-point energy to change. Including this in the calculations gives a much better correlation with the experimental results.

'This is unlikely to be limited to pyrrole,' Stephen says. 'It may happen whenever a molecule with significant zero-point energy moves across a surface with relatively low activation barriers. It may have important consequences for various applications, from catalysts to electronic and optical devices.'

B.A.J. Lechner, H. Hedgeland, J. Ellis, W. Allison, M. Sacchi, S.J. Jenkins and B.J. Hinch, Angew. Chem. 2013, article first published online: 9 Apr 2013, doi: 10.1002/anie.201302289

Visualising protein activity within living cells

Ubiquitin is involved in the control of many biological systems, but existing 3D structural information only gives details on the protein in isolation. Now, work from Sophie Jackson and David Klenerman's groups gives an insight into how it operates inside cells.

In collaboration with David Komander from the Laboratory of Molecular Biology, they applied single molecule techniques to the problem. In contrast to X-ray crystal structures on isolated protein molecules or in-depth NMR analysis, this allowed them to see how ubiquitin interacts with other proteins inside cells.

'We're interested in whether the proteins that interact with polyubiquitin chains use some form of conformational selection, and if so, do they remodel the ubiquitin structure to get it into the right conformation?' Sophie says. 'Or are these conformations already present in the cell, in such small quantities that they cannot be seen using existing techniques?'

State-of-the-art single molecule fluorescence methods enabled them to look at the conformational dynamics of the system in solution. 'We saw novel conformations that had not been seen using bulk methods such as NMR,' she says. 'It was very revealing.'

In future, the insight gained by these studies could have applications in the development of new medicines. 'The ubiquitin system is involved in so many different processes in the body that just targeting the protein itself would not be practical, as so many other, unwanted, biological effects might occur,' Sophie explains. 'By understanding the conformations the chains take up as they interact with other molecules it might be possible to disrupt a single interaction, which may have an effect in ubiquitin-linked disease states such as cancer or neurodegeneration.'

Y. Ye, G. Blaser, M.H. Horrocks, M.J. Ruedas-Rama, S. Ibrahim, A.A. Zhukov, A. Orte, D. Klenerman, S.E. Jackson and D. Komander, Nature 492, 266; doi:10.1038/nature11722

The Modern Alchemist

Last Christmas, UK TV viewers were in for a treat – Peter Wothers gave the annual Royal Institution Christmas Lectures. First held way back in 1825, the lectures have taken place every year since, a war-related gap in 1939–42 aside, when the children who make up the audience had been evacuated to the countryside. Peter joined a long list of scientific luminaries who have given the lectures, such as Michael Faraday, Frank Whittle, George Porter, David Attenborough and our own John Meurig Thomas, with topics across the breadth of science and engineering.

The theme of Peter's lectures was 'The Modern Alchemist', inspired by the alchemists' elements, and then tying in our modern understanding of the chemistry of the elements in terms of the periodic table. However, with three lectures, the first problem was just how to divide the elements up between them. 'The alchemists believed there were four "elements" – air, water, earth and fire,' Peter says. 'I decided to focus on air, water and earth in the three lectures, as fire is imponderable rather than tangible, and as anyone who's ever seen any of my demonstration lectures will know, there's always plenty of fire in them anyway.'

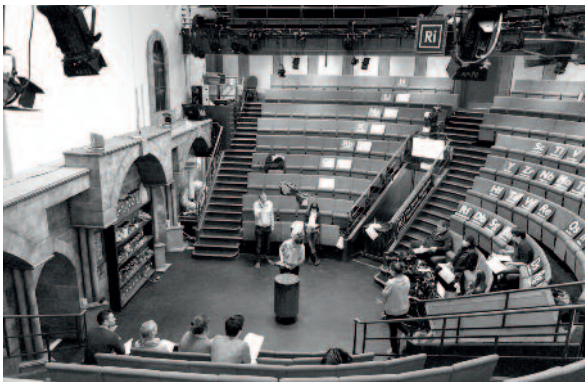
PERIODIC TABLE OF KIDS

One feature throughout the three lectures was a periodic table of kids in the audience, with cards to hold up, carefully arranged in the right place. But this posed something of a tecnical challenge – the Royal Institution's lecture theatre is fairly small and curved, with quite a big rake.

'It was pretty difficult to get all the camera angles to work out so it actually looked like a periodic table!' Peter says. 'It took the director an awfully long time to figure out how to do it, but I think the overall effect worked really well.'

With three hours to fill and much greater resources than usual, Peter had the opportunity to do numerous demonstrations he'd never been able to contemplate doing in the past – some of which he'd been itching to try for some time. For example, he'd always wanted to show just how dense gold is by balancing a person with their weight in gold. 'It would be expensive – and a bit difficult with all that gold lying around in the department for days!' he says.

Another one-off demonstration was burning a diamond. 'We designed a piece of kit that allowed us to do this, using a hydrogen flame and a spark in a chamber of oxygen gas,' he says. 'It needed to be a nice-looking diamond so it was obvious what it was, and I also wanted to show that it turned limewater milky as carbon dioxide was generated. It was really successful – even if I managed to give myself an electric shock from the sparker, as did technician Mark Hudson, when we failed to earth it properly.'



Preparing the theatre at the Royal Institution was a huge task!

Perhaps the most extreme experiment was demonstrating the reaction between caesium and fluorine. 'I don't think anyone has been crazy enough to try that in a demonstration lecture before!' Peter claims. 'Dominic Wright helped us out preparing the caesium sample in the vessel. Again, we needed specially designed apparatus, and I've a feeling Dominic thought we were nuts.'

Several special guests made appearances, too, including Harry Kroto, who was persuaded to throw the switch on the diamond-burning machine (much to Peter's relief, he remained unelectrocuted), and also provided his gold Nobel Prize medal to finish off the gold-weighing experiment. Another guest was Paralympic cyclist Mark Colbourne, who provided pedal power to electrolyse water to give hydrogen and oxygen.

LARGE-SCALE EXPERIMENTS

As well as the larger scale of some of the experiments, the only real difference from his normal lectures was that there was a little more pausing between the experiments on occasion. 'As the lecture theatre isn't as big as our BMS theatre, we couldn't set everything up on stage in advance, and some scene-shifting was required,' he says. 'We also had to wait for the supercooled water, as we were ready for it before it was ready for us!'

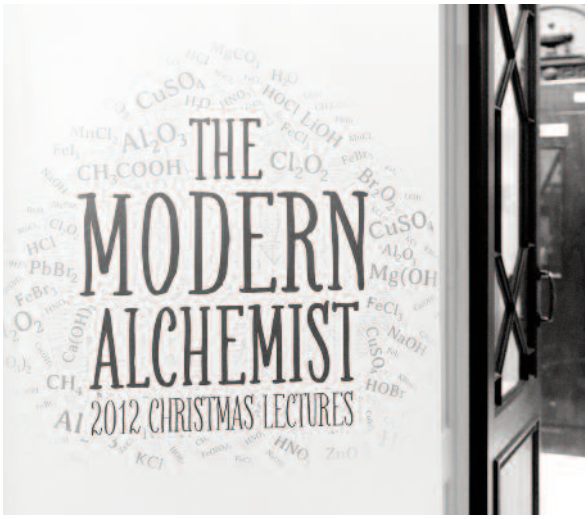
But the biggest challenge by far came from the Tesla coil that provided the climax to the first lecture, made by a schoolfriend of Peter's, Colin Tregenza Dancer, who studied physics. Tesla coils are a staple of science demonstrations – they produce very high voltage alternating current, combining nitrogen and oxygen and creating artificial lightning. However, this was no ordinary Tesla coil – it was a giant, suspended from the ceiling of the lecture theatre.

It caused havoc. While they were testing it out late at night, one of the Royal Institution's technicians started having trouble with his phone – and then the lights started to misbehave. As did the fire alarm. The next morning, the electrical technicians found their lighting control panel had developed a mind of its own. 'We started to worry that it might fry the TV cameras during filming – and, of course, the insurance company wouldn't cover a simulated act of God!' he says.

In the end, all non-essential electrical equipment was removed, with just handheld cameras brought in to film the experiment – and the fire alarm was turned off. But would it work? 'The effect was breathtaking,' he says. 'Not only was the lightning spectacular, it started flashing the house lights, chose which shots to screen in the director's gallery on the ground floor, and changed the language into German for the rather bemused editor on the fourth floor – just to remind us who was boss! But everything and everyone was fine, and we could even smell the ozone and nitrogen dioxide produced by the lightning, much to our relief!'

The lectures would not have been possible without the help of numerous other people in the department. Teaching technicians Mark Hudson and Chris Brackstone were on hand in London to help with setting up and running the experiments, and many others helped to build the apparatus. These included glassblower Keith Parmenter, John Coston in electronics, and Richard Nightingale and his team in the workshops, in particular Ollie Norris and Christopher Ironmonger.

Missed out? Thanks to the wonders of modern technology, the lectures are available on the internet for your delectation and edification. Go to www.richannel.org/christmas-lectures/2012/peter-wothers **and prepare to be amazed at the incredible power of chemistry!**



Photos: Caroline Hancox

Memories of Herchel Smith

Apologies for the poor quality of this photo, but we thought it was a great one anyway! Herchel Smith has his arm around a statue of John Dalton, with Charles Dekker, Dan Brown and Hugh Forrest lining up behind them

Herchel Smith was a graduate student, working with A.J. Birch, from 1948 to 1951. He worked at a bench immediately behind mine in the upstairs lab in the old Pembroke Street chemistry labs, and most of the other inhabitants of that lab were postdocs.

Herchel was involved in steroid chemistry, unlike the rest of the lab – most were involved in nucleotide chemistry. In particular, he was using Birch reductions to produce new synthetic steroids. At some time (when was always a matter of dispute) he produced a couple of steroids that turned out to be effective birth control agents. I think he took out patents on their synthesis, and in due course licensed these to Wyeth, for whom he went to work after he left Cambridge. He made quite a lot of money from these, and in the end endowed it to Cambridge and Harvard

.

SCIENTIFIC BETTING

I knew him quite well personally, perhaps his closest friend at the time. He told me that his father was a bookmaker – in fact, *the* bookmaker. At racetracks around England, bookmakers line up as close to the finishing line as is permitted, in an order determined by their 'clout'. Herchel's dad was at the top of the line.

On weekends, we would go to point-to-point meetings in the countryside around Cambridge. These were meetings of amateur horseriding enthusiasts who raced over a route mapped out by the locals around the countryside, over hill and dale and fence and brook. There was, or is, a form book that gave details on horses and their performances at point-to-point meetings all over England.

So, as true scientists, Herchel and I would go through the book before each race, trying to find a horse that had a good record but was being given long odds by the bookies at the track. That was hard to do but, occasionally, we would find one and then we'd pounce, by betting on that one to a high degree (by our modest standards!). On the whole, my recollection is that we maybe did a fraction better than might be expected, but certainly our results could hardly be described as spectacular. Still, it was a lot of fun – literature research, then its use on an immediate problem – and plenty of fresh air.

On at least a couple of occasions, we went to Newmarket to do, essentially, the same thing, but not steeplechasing, of course. Herchel explained to me the elaborate signalling that went on between the stands and the bookies, which I suppose is all gone now with the advent of cellphones I was duly impressed, not only by its effectiveness, but also by the fact that it was a living model of the class system in England – communication between the classes without physical contact, each sector knowing its place, and the whole working with remarkable efficiency.

On one occasion, Herchel and I attended the biochemistry seminar, being given by Gordon Whitby, who was the quintessential 'Cambridge Man'. His father, Lionel Whitby, had been Master of Downing, and Gordon had come to Kings by way of Eton. He was quite a nice guy, for all of that, but that heritage did a lot for him! After Cambridge, I don't think he did anything of any scientific note, but he ended up as a professor of pharmacy (I think) at Edinburgh, and finally as vice-chancellor there.

His seminar was on a riboflavin derivative he had isolated, a compound made by some bacterium, which turned out to be a glucosyl derivative – a glucose residue was stuck on to the 5' end of the ribityl side-chain. I had helped him quite a bit in his research, since the major piece of evidence for the structure was periodate oxidation, on which I was an expert – especially with regard to riboflavin.

So, after the seminar, Herchel and I walked back over to chemistry, and in the process decided we could synthesise the compound in a very simple and straightforward way, using Herchel's expertise with the Birch reagent (sodium in liquid ammonia). So, to a solution of riboflavin in that mixture, we added some 1-bromoglucose, and that was it. Total time taken – perhaps 30 minutes. We decided to ask Gordon for a sample of his natural product to compare with our synthetic one. And that's when the proverbial hit the fan.

Gordon went immediately to his chairman (Chibnall, maybe?), who called Lord Todd. Todd then descended on us with, perhaps, a little twinkle in his eye, and berated us for committing one of British science's cardinal sins – encroaching on someone else's territory. He didn't feel much love for the biochemists, particularly after Peter Mitchell, who had been collaborating with someone in Todd's group, stopped the collaboration, went on to win the Nobel Prize for chemiosmosis, and reflected none of the glory on Todd.

BANNED FROM BIOCHEMISTRY

At the next biochemistry seminar, Herchel and I were denounced (anonymously!) and, I think, banned from ever attending them again. We had used material revealed at a 'private discussion' before publication, and that was infra dig. It was a bit of a storm in a teacup, perpetrated by totally innocent, just-being-scientists stuents.

As far as I am aware, that was the end of the matter except that, in fact, the compound we had made was not identical to the natural material. We had probably stuck a sugar residue on to one of the ring nitrogens of the riboflavin instead. We didn't bother to investigate further but, again as far as I know, I am still persona non grata in the biochemistry department at Cambridge!

What else can I say about Herchel? He was a bright, exuberant (in the right circumstances), fascinating character. In addition to his high intelligence, he was street-smart, and could operate effectively at that level. He kept himself pretty much to himself, apart from the little I have indicated above. He did not talk much about his family, his background, or even his ambitions.

Yet, in a reserved way, I enjoyed his company. But our friendship did not persist after Cambridge, after I went to the US in 1951. I visited Herchel once when he was living in Philadelphia, probably around 1954, and we had a nice time reminiscing. I lost touch with him after that, which I much regretted.

A plea to readers...

Sadly, the Chem@Cam reminiscences cupboard is bare. Do you have any memories or photos of your time in Cambridge Chemistry? We'd really love to hear from you!

We are sad to report that cleaner Glen MacElroy died suddenly at the end of March. Glen had been working in the department since late 2008. Our condolences to his friends and family

Comings & goings

New staff
Chloe Barker
Diane Harris
Bethan Lewis
David Savage

Cricket captain Maya

Maya ready for bowling action in the preseason nets

Good news reaches us from first year PhD student Maya Hanspal – she's been asked to captain the university women's cricket team.

Left arm spin bowler Maya only started playing cricket four years ago, during the first year of her undergraduate degree at Sussex. She's now doing a PhD in Chris Dobson's group, working with Leila Luheshi.

Her research involves investigating the spreading of TDP-43 aggregation in the central nervous system, using drosophila models. This is one of the main misfolding proteins in amyotrophic lateral sclerosis, or motor neurone disease.

The university plays in the Midlands 1A division of the British Universities & Colleges Sport women's cricket league. The first two matches are against Leicester and Nottingham, with Loughborough, Oxford and Warwick making up the rest of the league.

Glassblower Phil sends his thanks

Glassblower Phil Gallego, who retired last year, has sent on his thanks for his retirement gifts – two 'red letter' days out in London.

First, he says, they visited Kew Gardens in early autumn, and then earlier this year went for afternoon tea at Flemings Hotel.

'Kew was so beautiful, and we had the most wonderful tea at Flemings,' he says. 'Thank you all once again!'

Christmas charity carpark collection

In December, we once again allowed South Cambridge Rotary Club to use our car park at weekends, raising money for charity by charging Christmas shoppers for parking.

An impressive £4,550 was raised from the chemistry car park, with the total from all their parking efforts in the city amounting to a shade over £32,000.

This time, the charities being supported were the Arthur Rank Hospice, Wallace Cancer Care, Wintercomfort, Dogs for the Disabled, and the University of Cambridge Veterinary School Trust.

The Corporate Associates Scheme

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Thanks to the generosity of the department's Corporate Associates, we have been able to benefit the education and environment for students and staff. For example, the Associates make significant contributions to the library for journal subscriptions. Moreover, they provide exam prizes, faculty teaching awards and summer studentships, and have recently funded the refurbishment of a state-of-the-art meeting room with teleconferencing and display facilities.

Corporate Associate membership not only provides essential support for the department, but also provides numerous benefits to help members work with us and achieve their business objectives. Members enjoy many benefits through their enhanced partnership with the department, such as:

- Visibility within the department;
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- Access to emerging Cambridge research via conferences, special briefings and various publications;
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- Regular communications about upcoming events and colloquia;
- Subscriptions to department publications, including *Chem@Cam*;
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- Ability to hold 'Welcome Stalls' in the department entrance hall;
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If your organisation would be interested in joining the Corporate Associates Scheme, then please email Sian Bunnage at cas-admin@ch.cam.ac.uk, or call 01223 336339.

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A spot of festive cheer

The annual assistant staff Christmas party in December brought back some familiar faces – and brought out some festive clothing! Nathan Pitt was on hand with his camera to capture the occasion

Clockwise from the right: Emma Graham shows off her fabulous Christmas jumper; Bob Baron and Richard Preston; Alan Battersby and Finian Leeper; Mike Todd-Jones and Chris Chalk; Alan Parsons, Chris Lowe and Asha Boodhun tuck into the buffet; Russell Currie, Tim Dickens, Frank Lee and Mark Miller; Karen Valelli and Gaby Bocchetti

Last issue's solutions

ChemDoku

Several readers managed to spot the connection between the elements in last issue's ChemDoku – the atomic numbers of neon, calcium, zinc, zirconium, tin, neodymium, ytterbium, mercury and thorium are 10 times the value of the more normal sudoku numbers of 1 to 9.

Correct answers arrived from John Turnbull, Keith Parsons, Jim Dunn, Ian Potts (who says that, as luck would have it, he could check the atomic numbers in the book he was reading at the time, 'The disappearing spoon' by Sam Kean which provides interesting info about half the elements up to copernicium, and which he describes as unputdownable), Tim O'Donoghue (who rather cheekily attempted to influence the cat with a cartoon of fish – nice try, Tim, but unfortunately she's not a big fish fan, though she is rather partial to dairy products, including stealing my cups of tea), Pat Lamont Smith, Alison Griffin (who says that, luckily for her, watching Peter Wothers' Royal Institution Christmas Lectures reminded her sufficiently of the periodic table that she was able to guess and then check the multiples-of-10 hypothesis), Robin Pope (who says it was a very In-TENS choice of elements – groan!), Paul Littlewood (who says he thought for a minute the link would be that they were all silvery in appearance but, of course, neon doesn't fit into that category), Robin Foster, Ian Fletcher, Annette Quartly and John Campbell.

The cat has been having a lovely morning sleeping in the wardrobe (and very cosy she looked, too, when I went to disturb her), but has been persuaded to relinquish her slumbers in favour of sitting on sheets of paper on the office floor. And this time, the lucky sheet of paper belonged to John Campbell – the £20 prize is on its way to you. And her reward for such taxing endeavours? Stealing my tea!

Yb	Sn	Th	Ca	Ne	Hg	Zn	Zr	Nd
Hg	Nd	Zr	Sn	Zn	Th	Yb	Ca	Ne
Ne	Ca	Zn	Yb	Nd	Zr	Th	Hg	Sn
Sn	Yb	Hg	Th	Ca	Nd	Zr	Ne	Zn
Nd	Zn	Ne	Zr	Yb	Sn	Hg	Th	Ca
Zr	Th	Ca	Zn	Hg	Ne	Nd	Sn	Yb
Zn	Hg	Sn	Nd	Zr	Ca	Ne	Yb	Th
Ca	Ne	Nd	Hg	Th	Yb	Sn	Zn	Zr
Th	Zr	Yb	Ne	Sn	Zn	Ca	Nd	Hg

£20 prizes are on offer for each puzzle. Send entries by email to jsh49@cam.ac.uk or by snail mail to Chem@Cam at the address on p3

This issue's puzzles

ChemDoku

	Bh			Se	Hf	Si		
Se			Sb				Tc	
		Na						Nd
	Sg						Si	
	Nd			Na			Hf	
	Se						Sg	
Sg						Tc		
	Hf				Nd			Na
		Tc	Bh	Sb			Se	

This issue's ChemDoku doesn't really have a clever link between the elements. However, they do vaguely make a sequence. Any idea why this sequence cannot be longer? As ever, you don't need to be able to answer the follow-up question to enter (though we always like to hear your suggestions) – just unravel the ChemDoku itself!

Transmutation

This puzzle come from one of our regular setters, Keith Parsons. He says that the word-ladder or word-chain puzzle will be familiar to most people. In that puzzle, one word is changed into another by successively replacing one letter in the word with another, in the same position, to give a new word until the end word is reached. For example, you can go from LEAD to LOAD to GOAD to GOLD. In this puzzle, you have to change LEAD into GOLD by following the instructions below, and in as few stages as possible.

1. Every one of the instructions in numbers 3 to 6 must be followed at least once in the chain, and only one such intervention is allowed each time to produce a new word.
2. No proper nouns or abbreviations are allowed. All words must be found in a dictionary such as Chambers.
3. A letter may be added to a word, in any position, without altering the order of any of the other letters.
4. A letter may be removed from a word, provided that the word remaining is not less than four letters long.
5. A letter may replace a letter in the word, provided it occupies the same position as the removed letter (the normal rule for these types of puzzles).
6. A completely new word may be formed as an anagram of the previous word.

Crossnumber

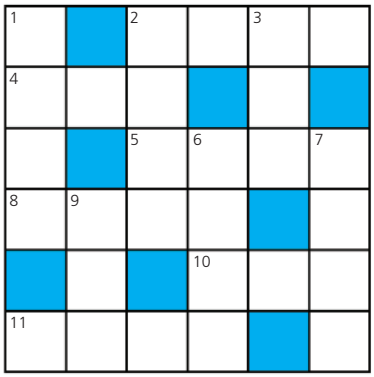
And finally, as we only had one puzzle last time, here's a bonus one to make up for it. This cheeky little crossnumber puzzle from David Wilson is carefully designed to get the arithmetic cells of readers going. All you have to do is to enter into the grid the results of multiplying the atomic number of each pair of elements the clues lead to (note that, in many cases, the clues might lead to more than one element, just to make things a little trickier). He adds that no element is used more than once, no answers begin with zero, no transuranic elements are used, and non-chemical clues may refer to the origin of names of the elements.

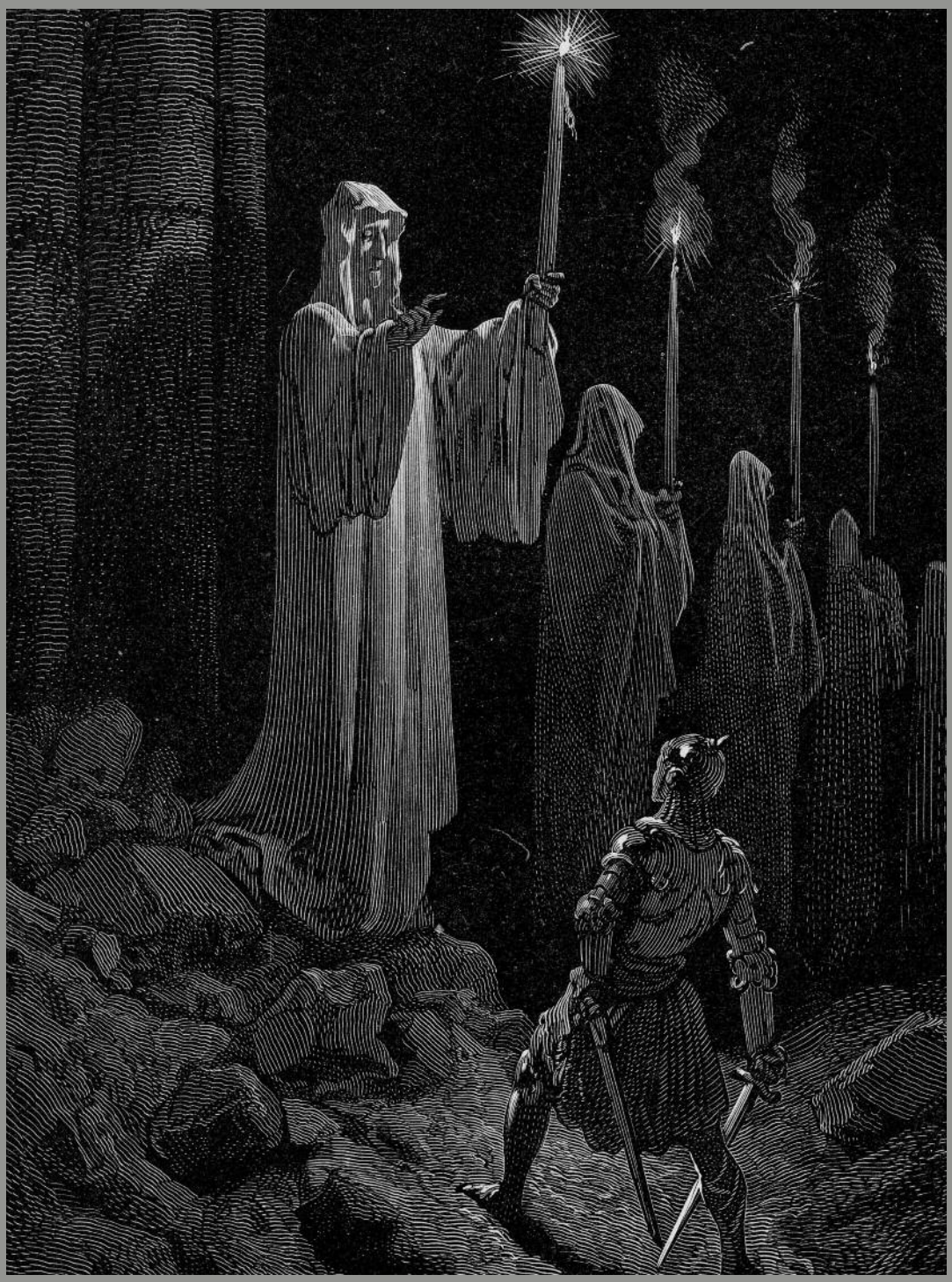
Across

2. Father x daughter
4. Element spelt differently in the US x element of beauty
5. Group 1 x Group 0
8. Element which suffers from 'plague' x element which melts in the hand
10. Element which may have killed Newton x Group 0
11. Element which may have killed Napoleon x parent element of series

Down

1. Continent x town on that continent
2. Group 1 x Group 7
3. Highest numbered non-radioactive element x Group 1
6. Ancient element x metal with single-letter symbol
7. Group 0 x element which gave Mendeleev problems with atomic weight
9. Transition metal x transition metal whose atomic number is 2 greater





What do you mean, you don't think we've quite got the hang of Switch Off week?

UNIVERSITY OF CAMBRIDGE

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