chem cam

Chemistry at Cambridge Newsletter

Summer 2013

Science day: **illuminating chemistry**

Athena Swan accreditation achieved

Data, calculation and experiment

Keeping the **IT systems** operational

Tim Dickens leads the IT team within the chemistry department, having joined from GlaxoSmithKline five years ago. He tells Sarah Houlton about the problems the computer officers face, some of the current projects they're working on – and what they do all day!

A large and complex department like chemistry must have huge IT demands. Can you give us some numbers?

For starters, we have about 800 users on site, plus at least 700 other collaborators with IT access. All take up disk space and support resources, generating work for the Computer Officer (CO) team. We have 100TB of secure storage, replicated in two different locations, to ensure that we don't lose important data if a disk fails, and then back-up to a safe third location. That's on top of more than 200 servers in house.

We're supporting several different operating systems – four versions of Windows, various Mac OSs plus Linux, and then there's the phone system, which is internet-based. People are also, increasingly, using mobile devices such as iPads and Android phones, and we need to boost our wireless capabilities. Last year we received 3700 support requests, or tickets, and we're always particularly busy at the start of the academic year. We've also disposed of 15 tonnes of obsolete IT equipment in the past year, and upgraded much of the department's networking infrastructure, mostly at weekends and early in the morning to avoid inconveniencing people.

What's involved in keeping the infrastructure running?

One aspect is ensuring all the backups happen overnight and, if they don't, follow up to find out what happened. We manage more than 1000 desktop computers on top of those 200 servers, so that's a lot of software updates to apply! We've built several automated installation systems so we can install software much more quickly with less intervention by the computer officers, and also set machines in a consistent fashion. We also respond to hardware failures.

A problem we've faced quite a bit in the past couple of years is responding to power glitches. We get a lot of these, one way or another, and it can lead to computers overheating and failing, and we may have to replace disk drives or even motherboards as a result. Every time there is a power failure we can lose a week or more of project work recovering from the mess it generates! Hence in the last 12 months we have invested in the intallation of uninterruptable power supply infrastructure for our most critical systems.

We also have to maintain some very old and obsolete computers, required to run instruments that would cost tens of

Photo: Nathan Pitt

thousands of pounds– or more – to replace. That can be challenging.

How do you know if there's a problem?

We've implemented a system we call Hobbit that electronically monitors IT components – there's even a website where people can check it out themselves the status of the key services that we offer. The aim is to gain a good insight into how everything is working. For example, if the network routing wasn't working or the department firewall was out, they would go red on the Hobbit system. We can then look into the situation, and find out what is making the item fail. We want to detect any service-threatening events before they become service-affecting.

We have done our best to configure the whole IT infrastructure in a resilient manner, so if a service fails on one machine it can be moved over to another machine, either automatically or manually, to keep the service running. It's a bit like a duck on a pond – it may look serene but underneath the surface there is a lot going on, and when there's a system failure the computer officers paddle hard to keep everything working and avoid users being impacted.

What about the support system?

Well, when people send a ticket to support@ch.cam.ac.uk, it is queued up and triaged by Dave Pratt, who moves it into the right queue so the best person to solve that problem will receive it. The centralised system is much more effective than everyone sending emails to individuals. Avoiding the ticket system won't move your problem to the front of the queue! Importantly, without rewriting *War and Peace*, the support request should include all the relevant information. You'd be amazed how often we get requests that simply say, 'My computer doesn't work!'. A description of a few symptoms go a long way to helping us diagnose the problem. Also, please don't put multiple requests on the same ticket as they may need to go to different people and thus might get lost in the system, and for any particular problem please keep replying to the same ticket with follow-up information to keep it all together.

We encourage people not store critical data on their local machine. The file server is the place to store this information. While we can be very sympathetic if your laptop is lost, or stolen from the Panton Arms, there's not much we can do if you haven't kept an up-to-date copy of your data on a server.

What about the department-specific applications – what do these include?

There is a departmental system built on a relational database, so every piece of data is 'atomic' for storing most of our administration data. If you change a telephone number in one place, it will change everywhere, and if someone changes their name after they get married, say, that will change everywhere, too. We use a very similar technology for exam marks processing, and the departmental website also picks up information directly from the admin database.

We have recently developed a bench list manager for managing desk space and fume hoods, which is currently being populated with data, and an in-house 'dropbox' service so important data isn't backed up and shared on potentially risky external cloud services. This is a service we hope to launch to users later this year.

I've seen your project planning system with all its post-it notes – it's not very hi-tech! What's it for?

As well as the day-to-day support and upkeep of the systems, we work on many other projects, and the way we keep track of them is by moving coloured post-it notes from the list of everything we want to do into the priority list, and then into the 'done' section when they're finished. Once a year we have a ritual clearing of the board and start again. It's amazing how much we take off the done side! ➢

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Glowing chemistry

Dear Editor,
The cover picture on the Spring 2013 issue of *Chem@Cam* reminded me of my school days at the Royal Grammar School in Newcastle, where we used similar chemicals to produce a blue colour – but the solutions ran through three (parallel) paths through the letters 'RGS' to produce a beautiful effect most of the time. It was, however, a pain to set up, as all of the individual flows had to be adjusted so you got three blue letters, not just a bright blue sink!
David Thompson

Of Brown and Todd

Dear Editor,
When I read in your last issue about the death of Dan Brown (which sadly I had not heard of earlier), a flood of reminiscences of my six years at Cambridge (1953–59) was evoked. Although Alex Todd was my research supervisor, I saw as much of Dan as of Alex and, in the period after Alex's Nobel Prize was announced, rather more.

It was Dan who proposed that I should synthesise some diazoketones in an attempt to make 2-ketoesters of DNA in order to split the polymer with mild alkali in the same way as with RNA and avoid the tedious enzymatic route which, in those days, was the only way to get significant quantities of deoxy-nucleosides.

Although I was fully informed about the dangers of diazomethane and had heard the (possibly apocryphal) account of the fatal experience of the Oxford chemists who had left some ham sandwiches in the fume cupboard they were producing the gas in, I nevertheless, managed to inhale a minute quantity which led within a half hour to my collapsing in my room. After a further hour or so, I staggered to Addenbrooke's where I was given oxygen and discharged. To this day, I remain acutely sensitive to diazomethane and can always tell if there is the minutest trace in the air.

In my penultimate year, Werner Bergmann, a Yale professor who had been looking for evidence of some kind of evolution of DNA/RNA in primitive life forms investigated a rare sponge, *Cryptotethia crypta*, and discovered unusual materials he could not identify but named 'spongouridine' and 'spongothymidine' on the basis of their UV spectra. By good fortune, the spongouridine sample he sent to Alex Todd proved to be identical to a product which Dan had recently made in a failed attempt to convert uridine to deoxyuridine. He had inverted the 2'-hydroxyl group and made uracil arabinoside.

Werner was delighted to get an immediate positive identification and begged Alex to send him 'one of his bright young postdocs' to work with him. Rather to my surprise, I was chosen with the 'warning' that I would have to be prepared to spend a month or two each year collecting sponges in the Caribbean!

Tragically, Werner, who had been unwell and was on sick leave when I arrived, had a heart attack and died about a month after my starting work and finding two 'new' nucleosides. Then another scarcely credible event led to the work being abandoned; the Yale lab cleaners clearing out Werner's lab/office incinerated a pile of what appeared to be student exam booklets but which, in fact, Werner had used as his research notebooks. None of his postdocs from previous years knew how the material had been extracted, despite my spending a great deal of time and money phoning them in the US and round the world.

Unexpectedly, I was then invited to join the Yale Faculty as an Instructor, primarily to teach pre-med students. Later, Harry Wasserman, who was on sabbatical leave at the time, asked me if I would like to collaborate with him on an idea which he had of using ethoxyacetylene to synthesise polynucleotides ,rather like the DCC which Gob Khorana was then successfully using. Naturally, I accepted and found myself following up work begun at Cambridge!

After two fascinating years at Yale, I was offered a post as assistant lecturer at Keele (then the University College of North Staffordshire). There I taught chemistry for nine years and was then invited to become the senior tutor (with a limited teaching load) and, after a further 12 years, university registrar.

During my teaching period, Dan Brown acted as external examiner for one of my students, and a few years later he asked me to be external examiner for one of his students.

Sincerely yours,
David Cohen

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 at www.ch.cam.ac.uk

Digital trickery

Dear Editor,
Charming though the ultrarealistic-looking picture of Jeremy Sanders on his bike in the Antarctic looks, it sets a bad precedent. Digital manipulation of images (and other data) is all too easy in science nowadays, as the egregious Schön, Batlogg *et al*. case showed all too well.

It would be as well if we maintained a strict distance from it, certainly in anything touching (as does, of course, *Chem@Cam*), even slightly, our scientific work.
Jeremy Ramsden
Fitzwilliam 1974
We'll have to disagree on this one. Had there been any pretence of realism, however remote, I'd have agreed. However, it is so clearly a 'joke' photo there is surely no risk of confusion. What do readers think? — Ed.

chem@cam
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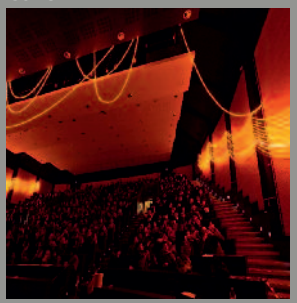

Let there be light: Peter Wothers' science day lecture illuminates the BMS lecture theatre with a hydrogen–oxygen flame front rapidly moving through several hundred metres of tubing

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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Rewarding green-ness

The department has won a bronze award in the university's Green Impact environmental awareness scheme, designed to support and encourage departments in the university to reduce their environmental impacts. Our team was set up in December, with 15 members including academics, postdocs and PhD students.

It took five months to work through all 20 criteria in the online workbook that are required to achieve a bronze award, and we are now half-way to gaining silver. 'Thanks to the hard work undertaken by team members and non-team members, we gained a bronze award at our first attempt,' says team leader Xin Yang. 'We are optimistic that we will also achieve a silver award later this year.

Pictured receiving the award from Jeremy Sanders are Xin Yang with fellow committee members Michelle Cain, Antara Banerjee and Sarah Connors.

Castrol surface science lab opens

The new Castrol Surface Science lab was officially opened at the end of May. Under the auspices of Paul Davies and Mike Casford, research in the laboratory will investigate the surface behaviour of lubricating oil additives *in situ* using a range of techniques, notably infra-red and sum frequency generation spectroscopy, plus atomic force microscopy and calorimetry.

'Castrol are interested in getting a better understanding of how lubricating oil works at the molecular level,' Paul explains. 'Our main contacts at Castrol are mechanical engineers, and their input adds a different perspective to the research.'

The sponsorship from BP subsidiary Castrol over the next eight years will support a senior postdoc, plus state-of-the-art laser equipment. 'We have intense but informal meetings about four times a year at which we review progress and flesh out new goals and topics,' Paul adds. 'Sometimes this requires additional funding which is usually forthcoming. Bureaucracy is kept to an absolute minimum, which is a great strength of the collaboration. This is how research should be!'

Pictured are the department's Stuart Clarke (second left), Mike Casford and Paul Davies (third and second right) with BP representatives (from the left) Rachel Fort, Gareth Brachi, Dave Hall, Daniel Carlisle and Tony Smith

Photo: Caroline Hancox

Athena SWAN bronze awarded

The department's recent application for an Athena SWAN bronze award was successful, following a large amount of work put in by Jane Clarke and the rest of the Athena SWAN committee. The awards are designed to encourage and recognise the commitment of higher education institutions to addressing gender inequalities and improving career progression for female academics.

The award has to be renewed in three years' time, when we must show progress in our action plan. However, simply retaining bronze will not suit our ambitions, Jane says – silver should be possible if we fulfill our action plan.

'We are delighted that all our hard work resulted in a bronze award,' she says. 'But it's not the end of the process – we must continue to work hard to ensure the department has a supportive and welcoming environment for everyone, and help people reach their potential. Next stop, silver!'

Pictured with the award are a delighted Amanda Maycock, Jane Clarke and Richard Turner

Academic promotions

This year's academic promotions have been announced.

Stuart Althorpe and David Spring are to become professors, and Stuart Clarke and Tuomas Knowles are promoted to reader.

In addition, Oren Scherman has been made director of the Melville laboratory.

Congratulations to all!

Joe Farman

Photo: John Holman

We are sad to report the death of Joe Farman, the man who discovered the ozone hole. Since his retirement from the British Antarctic Survey more than 20 years ago, he has had an office in the European Ozone Research Coordinating Unit within the department. His work on the ozone hole has had an impact on the work of generations of atmospheric scientists – he understood how the stratosphere works. For a man who avoided the limelight, his policy work was both brave and hugely influential.

Fellowships & honours

Two of our academic staff have been awarded prestigious fellowships. Jane Clarke has been made a fellow of the Academy of Medical Science, while Chris Dobson is now a foreign associate of the US National Academy of Science.

And Jacek Klinowski has been made an honorary professor at his *alma mater*, Jagiellonian University in Krakow, Poland. Founded in 1364, it is one of the oldest universities in Europe.

Supporting the next generation of chemists

It is now 10 years since the department launched its highly successful Next Generation Fellowship (NGF) scheme, which provides our brilliant young scientists with unrestricted research funding over a period of five years. This enables newly appointed university lecturers to expand and develop their teams in a flexible way, empowering them to pursue exciting discoveries as they emerge.

Sophie Jackson was the first NGF in 2003, and Matt Gaunt, Oren Scherman, David Spring, Carol Robinson, Jonathan Nitschke, David Klenerman and Tuomas Knowles have all been similarly supported by generous donations as they started their independent scientific careers.

Matt Gaunt, who was awarded his NGF in 2006, believes the funding has had a huge impact on his research. 'Support that allows you to explore scientific questions that you don't know the answer to, but you have a hunch could be really exciting, makes such a difference,' he says. 'The award of a Philip and Patricia Brown Next Generation Fellowship transformed the potential for my team to develop and grow. It allowed us to explore new areas of research that were not funded through other mechanisms, which led to discoveries with major implications for synthetic chemistry. These only came about because we had the flexibility to take a bit of a long shot on an idea I wasn't sure would work.'

Building on this enormously successful initiative, the department has developed a strategy to support and develop all of its young scientists, from PhD students through to newly appointed university lecturers.

'Our successful research is strongly supported by industry, government and other funding agencies,' says head of department Daan Frenkel. 'However, in the current financial climate, it is much harder to support blue-sky research that will lead to the next revolution. My great concern is for my younger colleagues, the stars of the next generation, who should be given the opportunity to realise their brilliant, audacious ideas. Our aim is to ensure that the department continues to be a breeding ground for innovation and discovery.'

As well as NGFs, this strategy consists of three new initiatives: Next Generation Studentships, Research Springboards and Next Generation Lectureships. Each programme is being championed by an academic from the department. For example, Melinda Duer is championing the Research Springboards, which seek to provide early-career research fellows with unrestricted funding during the crucial first years of their post.

'I wanted to lead this initiative because my own experience shows the enormous impact that investment in this stage of a scientist's career can make,' she says. 'All too often, the pressure young scientists are under to secure funding leads them to pursue incremental changes within established fields. Research Springboards will enable our research fellows to pursue their best ideas, rather than their safest.'

Rather than directly funding research activity, Next Generation Studentships and Next Generation Lectureships aim to provide new posts in exciting fields. 'Research Council funding is extremely important but it is increasingly targeted towards specific areas, explains Isabelle de Wouters, the department's research facilitator. 'For example, there has been a real drop in the number of flexibly funded studentships awarded in the past five years. If a world-leading researcher wants to explore a new area, we want to be able to support them. Our new strategy will help to ensure that we can.'

To find out more about the department's strategy to support the next generation of world-leading chemists, email Isabelle at id205@cam.ac.uk

Photo: Caroline Hancox

In June, Nobel chemistry laureate Ada Yonath (above) of the Weizmann Institute of Science in Israel received an honorary doctor of science degree from the university. While in Cambridge, she visited the department to give a talk, entitled 'What was first: the genetic code or its products?' Another visitor is pictured below – Melville lecturer Jeffrey Moore of the University of Illinois at Urbana-Champaign, speaking about mechanoresponsive materials and self-healing systems

Photo: Nathan Pitt

Entrepreneurial wins

Spin-out company Aqdot and its founders have received several prizes in recent months. The company, set up to commercialise a novel one-step 'shrink wrap' approach to microencapsulation developed by Cambridge chemists, won the first Royal Society of Chemistry Emerging Technologies competition.

This was organised by the RSC to identify research-intensive small enterprises with significant potential impact on the UK economy, and support them on the path to commercialise their technology. Aqdot was chosen after a presentation to a panel, including representatives of private-sector companies, by founders Jing Zhang from Chris Abell's group, and Roger Coulston from Oren Scherman's group. It will help Aqdot work with industry partners, and access further investment from members of the selection panel.

Both Jing and Aqdot were also successful in the Rice Business Plan competition, with Jing winning the Woman Entrepreneur Award and Aqdot reaching the final and being placed fifth.

The competition is the world's richest and largest graduate-level business plan competition, with 42 teams from around the world competing for $1.3 million in cash and prizes. In 2013, more than 600 applications were submitted to the competition, which is supported by more than 130 corporate and private sponsors, and the majority of the 250-plus judges come from the investment sector. The team presented to more than 500 investors and entrepreneurs at the event in Houston, Texas.

Photo: Royal Society of Chemistry

RSC prize presentation, from the left: RSC chief executive Robert Parker, Roger Coulston and Jing Zhang from Aqdot, and David Willetts, the UK minister for universities and science

■ A second chemistry department spin-out, Sphere Fluidics, has won an academic enterprise award for the best European life sciences company. Now in its fifth year, this is the only pan-European award for academic spin-outs. The finalists make 'Dragon's Den' style presentations to a judging panel plus an audience of 200 delegates at a conference in Brussels in June debating the importance of linking research, innovation and entrepreneurship.

Photo: Caroline Hancox

We finally have a new chemical waste store to replace the old one, which was simply not up to the task any more. The old store is now gone, and the new one is nearby, in the Union Road car park. It includes a fume cupboard, as well as bunded shelves for users to place their waste on for disposal. Pictured is one of its first users, Simon Chapman who works in the Part 1B teaching lab

ERC grant success

The European Research Council hands out substantial grants every year to both established and new academics around the EU, and three Cambridge chemists have received them this year.

Shankar Balasubramanian has been awarded an ERC advanced grant to study the existence and biological function of RNA G-quadruplexes, via an integrated, interdisciplinary approach that combines chemical biology, synthetic chemistry, and molecular and cell biology, together with genomics.

ERC starter grants have gone to Andreas Bender and Tuomas Knowles, both amounting to about €1.5 million. Andreas' grant will help him in his research into the effects that combinations of chemicals may have in the human body, while Tuomas is studying the physical properties of heterogeneous protein complexes by developing new microfluidic chip architectures to measure the key physical properties.

Forum engages academia and industry

The latest in a series of Chemistry Industry Engagement Forums took place in July, under the auspices of Cambridge Enterprise. This time, Cambridge academics, postdocs and students met with a group of Pfizer scientists, with discussions covering ion channels, solid forms for drug development, understanding chemical space and deconvoluting data from phenotypic screens.

The aims of these IEFs are to encourage PhD students and postdocs to think more broadly about the potential wider benefits of their research interests, and how they might increase industrial collaboration. They also enable commercial companies to meet Cambridge research leaders, and PIs in various departments to get a better idea of research topics that interest the company.

'Overall, the forums might provide a platform to identify areas of common interest that may lead to research collaborations, studentships or placements being arranged,' explains Deborah Longbottom, the IEF contact in the department. 'Even in the absence of these outcomes, they are an excellent opportunity to foster communication between academia and industry.'

Having already held a forum with BP earlier this year, funding remains for two more, which Deborah hopes will be held within the next 12 months. If any company is interested in participating in a future forum, then contact Deborah at dal28@cam.ac.uk.

There have been bonus effects from the forums, too. BP has offered to provide lab coats for all our first year intake – at about 500, this is not an insignificant offer! – and to provide funds for more prizes for undergraduate students.

In addition, Pfizer Neusentis has for the past two summers (and the plan is to continue in the future) delivered a lecture course and workshop on medicinal chemistry in the department, which has gone down very well indeed. It is also sponsoring a graduate symposium, which will be held in the department on Friday 1 November, with a mix of graduate students young academics and a Pfizer representative speaking.

■ The department is currently developing its graduate lecture series year on year, and one area we are very keen to develop is first-hand knowledge of a variety of potential career pathways for both postdocs and PhD students that are already tried and tested by our alumni. If you are willing to come back during April or May 2014 to talk to our current cohort about your own career choices and answer their questions, please email Deborah at dal28@cam.ac.uk

Photo: Cambridge Enterprise

The forum gave university scientists from various disciplines the opportunity to interact with a group of scientists from Pfizer

Winning ways

It's prize season again, and once more we have a bumper crop to report. First up, a swathe of awards from the Royal Society of Chemistry. In alphabetical order… Jane Clarke received the Interdisciplinary Prize; Matt Gaunt won the Corday Morgan prize; Jonathan Goodman received the Bader award; and Steve Ley was given the Longstaff prize. Oren Scherman received two awards: the Hickinbottom award, and also the RSC/SCI joint colloids group's McBain medal, while Michele Vendruscolo won the Soft Matter & Biophysical Chemistry award. Last but not least, Peter Wothers has been given the Nyholm prize for education.

Many other bodies have also recognised the excellence of Cambridge chemistry recently. Clare Grey has won two prizes: the International Battery Association's research award, and the Günther Laukien prize. Shankar Balasubramanian, meanwhile, has won the Tetrahedron Prize for creativity in organic and biomedicinal chemistry, and Steve Ley the 2013 French–British Prize by the Société Chimique de France. And Gonçalo Bernades has been given the European Federation of Medicinal Chemistry's prize for a young medicinal chemist in academia.

A couple of recent PhD students have also won RSC prizes. Eric Appel received the Macro Group's John Weaver PhD prize for best thesis in macromolecular chemistry. And Rebecca Melen, now a postdoc in Canada, won the Dalton Young Researcher award.

New appointments

The department has appointed three new lecturers: Andreas Bender, George Booth and Lucy Colwell. Andreas was previously a fixed-term lecturer in molecular informatics, and is now a permanent member of staff. His research focuses on combining algorithm development, implementation and validation in the area of computational methods.

George Booth is a three-year fixed-term lecturer in theoretical chemistry. He was a research fellow at Trinity, working in Ali Alavi's group developing stochastic methods, and specialises in computational electronic structure theory.

The third new appointment is university lecturer Lucy Colwell. Her science focuses on data analytics, particularly as applied to biological or medical systems. A Cambridge maths graduate, she obtained her PhD at Harvard.

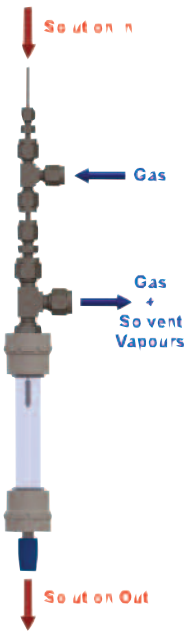
■ Peter Braesicke is leaving us. After 14 years in the department, he is to become professor of theoretical atmospheric physics at KIT in Karlsruhe, Germany, heading up the atmospheric modelling group at the IMK-ASF.

In-line evaporation

The latest development from Steve Ley's Innovative Technology Centre in the basement is a prototype device that facilitates the reduction of solvent consumption during reactions, and which can also be used to recycle solvents. It is designed to be used as part of a continuous flow reaction train, where reagents are pumped in at one end, and reactions are carried out sequentially as the chemicals pass through the different modules, before emerging at the other end, transformed.

'We're interested in the development and integration of new technologies for the implementation of sustainable processes,' explains postdoc Claudio Battilocchio. Flow chemistry devices like this evaporator, described in a recent paper in *Green Chemistry*, offer real possibilities for more efficient and more sustainable syntheses, via lower usage of various resources, from solvents to energy.

The device is an in-line evaporator, consisting of a series of concentric stainless steel tubes which sends a fine spray of the solution to be evaporated into a glass column. This acts as an evaporation chamber, and can be heated. The solvent vapours are collected and condensed, while the concentrated solution passes through the column. It is designed to be integrated into a continuous flow synthesis line via standard connectors on either end.



This evaporator was used in the synthesis of the neurotensin receptor-1 antagonist meclinertant. 'It enabled several steps of the synthesis to be telescoped, shortening the overall process,' Claudio says. 'No detailed synthetic route to this molecule has ever been described in the literature.'

In a second paper published recently by the ITC group, this machine-assisted continuous flow synthesis is compared to a more conventional batch mode synthesis. 'Batch chemistry has been around for centuries and we all know the power of the flask!,' Claudio says. 'Our work clearly shows that the use of enabling methodologies can accelerate the elaboration of a complex molecule.'

Meclinertant was obtained using an eight-stage machine-assisted protocol with no need for chromatography, and the process reduced the consumption of reagents and solvents compared to the batchwise synthesis. The integration of solid supported reagents and scavengers minimised the handling of materials and downstream processing. 'Machine-assisted processes, if properly designed, can represent a big advantage over batch mode synthesis, especially on scale,' Claudio says.

B.J. Deadman *et al. Green Chem.* 2013, **15**, 2050; C. Battilocchio *et al. Chem. Eur. J.* 2013, **19**, 7917

Molecular trigger for Alzheimer's identified

Cambridge chemists have made a breakthrough in understanding the onset of Alzheimer's disease. Tuomas Knowles, Chris Dobson and colleagues have identified the pathway by which the aberrant proteins that cause Alzheimer's are formed.

Misfolded proteins can catch normal proteins, clumping together into amyloid fibrils, which may contain millions of non-functioning protein molecules. These fibrils can continue to grow, forming the plaques that are found in the brains of Alzheimer's patients.

Until now, the mechanism by which the plaques formed was unknown. Work in Cambridge chemistry, much of it carried out by PhD student Samuel Cohen, shows that once a small but critical level of malfunctioning protein clumps has formed, a runaway chain reaction is triggered. This multiplies exponentially the number of protein composites.

A secondary nucleation process leads to the formation of more small clusters of a few protein molecules. These toxic oligomers travel dangerously around the brain cells, killing neurons and, ultimately, causing loss of memory and the other symptoms of dementia.

'We are essentially using both physical and chemical methods to address a biomolecular problem, mapping out the networks of processes and dominant mechanisms to recreate the crime scene at the molecular root of Alzheimer's disease,' Tuomas says.

'Increasingly, using quantitative experimental tools and rigorous theoretical analysis to understand complex biological processes are leading to exciting and game-changing results. With a disease like Alzheimer's you have to intervene in a highly specific manner to prevent the formation of the toxic agents. Now that we've found how the oligomers are created, we know what process we need to turn off.'

S.J.A. Cohen *et al. Proc. Natl Acad. Sci.* 2013, **110**, 9758

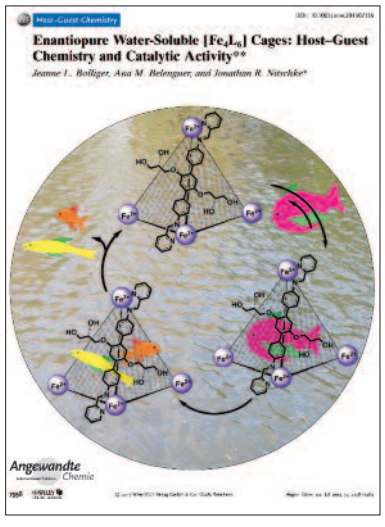
Reaction catalysis by containment?

Reaction catalysts typically bring reactants together in the right way through coordination. But what if the catalyst were able to hold the reagents in place by containing them instead? This is the idea behind a project in Jonathan Nitschke's group, as postdoc Jeanne Bolliger explains.

'We have made a range of cage-like molecules via self-assembly, and in the middle is a cavity that can be used for various purposes, such as encapsulation or chiral recognition,' she says. 'We also thought it might be possible to catalyse reactions within the cavity.'

It's very simple – the self-assembling molecules are dropped into water, where they cluster together, forming a hydrophobic cavity in the centre. If hydrophobic molecules are added in too, they can become trapped inside, where they are able to react. Numerous examples have been carried out successfully, particularly hydrolysis reactions.

Even if the cage is very big, the reactions still run in water, Jeanne says. 'We have done a lot of work in the group on self-assembling cages, and I wanted to extend the idea by making larger cages, and also adding hydrophilic groups such as glyceryl to make the assembly water soluble,' she says.



The illustration, used on the section cover in the journal, uses fish to illustrate how large molecules get trapped inside the cages. If they cleave into smaller fragments, these escape, giving back the empty cage ready for the next catalytic cycle. This escape is important, as otherwise the system would suffer from product inhibition

A good example of the technique's potential is the insecticide dichlorvos, which is extremely toxic, and will hydrolyse within the cavity to less toxic compounds. 'This has possibilities in the area of chemical warfare, as it could be possible to "deactivate" phosphate-based nerve gases, which are chemically similar to dichlorvos,' Jeanne explains. 'We're hoping to collaborate with the UK government's Defence Science and Technology Lab on this as the gases are too dangerous to work with in the department.'

Something that can be done in the Lensfield Road labs is to extend the cage further to give larger cavities, while remaining water soluble. 'I hope to be able to get several molecules inside to carry out chemical reactions, using the cage like a mini reaction vessel,' she says. 'Of course, the larger they are, the more challenging the synthesis of the compounds that make up the cage will be.'

J.L. Bolliger *et al. Angew. Chem. Intl Ed.* 2013, **52**, 7958

Models + experiments = data

Photo: Nathan Pitt

Information in action: Jonathan in the library

Computers have made huge inroads into chemistry, to predict what will happen in experiments, and to mine and manage data. Jonathan Goodman does both

Wouldn't it be good if one could predict exactly what was going to happen in a chemical reaction before getting the round-bottomed flasks out? Avoiding trial and error could save a huge amount of time, effort and resources. While for many reactions, the chemist's knowledge will tell them what will probably happen, in the real world they know it might do something else entirely. The answer may lie in computer models, and that's one focus of Jonathan Goodman's research – developing models and then testing how good the predictions are by running the experiments.

'Molecular informatics helps us think about computational data, experimental data, and how they fit together,' he says. 'But the qualities of the information in the two types of dataset are very different, which makes the process of fitting them together very interesting.'

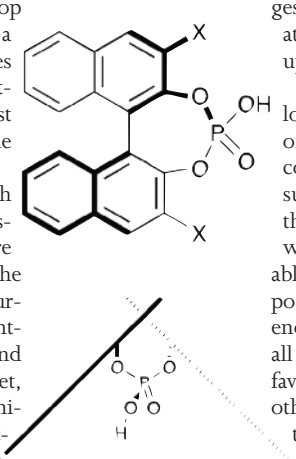
A great example involves chiral binop ligands. These comprise a binaphthyl diol (or binol) attached to a phosphate group; they are chiral, and binop-based catalysts are designed to give chiral induction in the reactions they facilitate. However, it has been impossible to predict from the structure or the chirality of the binop which chiral form will preferentially be made in the reaction – just looking at the structure left you no closer to the answer than a straight 50:50 guess.

'We really wanted to understand what was going on,' Jonathan says. 'We carried out a series of calculations on reactions using these catalysts to try and find out why sometimes it gives an R product, and sometimes an S. And it worked – it told us we had to look at the catalyst differently.'

Drawn on a sheet of paper, the binop looks completely flat. But looking at a 3D structure sideways-on, it becomes clear that it's actually bent – shaped a little like a roof. 'If you look at it from just the right direction, some aspects of the shape suddenly become clear,' he says.

'Calculations also told us that much of the structural information can be disregarded, which simplifies the picture further. There is a chiral pocket below the "roof" where the reagents interact during the reaction. It's then fairly straightforward to work out which way round the reagents will fit in to the pocket, which will give you an idea of the chirality of the final product. This is a picture you can – and should! – draw on your fume cupboard. It gives the same answer as the calculations, but of course was only possible because those calculations told us what information we could safely ignore. Otherwise, there are too much data to comprehend; this reduces it to the key interactions. Of course, looking at it now, it seems obvious!'

Clearly, they needed to test it against a number of different experiments to check it wasn't just a one-off. PhD student Matt Grayson found a paper on just this experimental system, with about 40 examples, and the 'sketch' technique worked for all bar three. 'We thought that was a pretty good hit rate, but it wasn't enough!' Jonathan says. 'We looked more closely at those three, and one was simply an error in the paper, with the starting materials having been inverted; a second was based on a literature example that was incorrect; and we repeated the third experiment and found that, using modern chirality determination techniques, historical data they'd used was wrong and it also fitted our model.'



Binop may look flat, but from sideways-on it's anything but

SYNTHETIC PREDICTIONS

Individual reactions are one thing, but what about complex synthetic routes? If a computer model could predict the best way to carry out the total synthesis of a natural product, it would save a huge amount of time and effort. It's early days for this, but they do now have an example of such a 'calculomimetic' synthesis, carried out by PhD student Russell Currie.

The molecule, dolabriferol, which is extracted from the sea hare *Dolabrifera dolabrifera*, has two carbon chains joined by an ester and eight of its 21 carbon atoms are chiral. Various groups had tried the obvious synthetic strategy – making two fragments and forming an ester between them. It had proved extremely challenging – the ester is both crowded and fragile. However, calculations suggested a single long chain of carbon atoms, with an acid catalyst, might roll-up, break in half and form dolabriferol.

'The reactions needed for our calculomimetic synthesis are all in the second year undergraduate chemistry course, so there's nothing particularly subtle going on,' he says. 'However, there are hundreds of competing pathways, all of which look pretty reasonable mechanistically, so the number of possible products of that reaction is enormous! We did the calculations for all of them and found that one is more favourable energetically than all of the others – and that's the one that leads to the natural product.'

He adds that it was pretty nerve-wracking to carry out that final step. 'The precursor wasn't trivial to make, and then to take the molecule you've spent months making and, potentially, destroy it, was a little alarming. 'I sometimes wondered if Russell's ambition was to prove me wrong! But I had absolute confidence that it would work – and it did.'

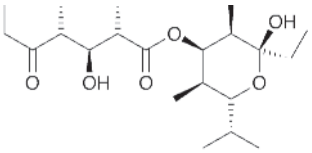
Another aspect of Jonathan's modelling work involves wider database interrogation. 'A real problem in chemistry

is working out whether you have the molecule you think you have,' he says.

'Part of this is checking whether the literature is correct, and we have worked with the Royal Society of Chemistry over the years helping to make sure data published in RSC journals are correct. Anyone who publishes in one of these journals will have their analytical data tested by a programme we wrote, and chemistry worldwide is improving as a result.' He likens the programme to a spellchecker, highlighting things that look suspicious. 'If the data were all checked manually it would be more accurate, but this would take an unfeasibly long time,' he says. 'It can be done much, much more quickly via computer.'

However, he had his sights set higher than just data checking – perhaps it might be possible to extract additional information from the data? A good example is the structure determination of natural products. Often, these are isolated in minuscule amounts from scarce sources, and there are many examples of total syntheses being published of structures that proved to be incorrect.

In collaboration with Jonathan Burton at Oxford, they looked at the natural product elatenyne. The structure that was originally proposed involved two fused pyran rings; however, dozens of alternative structures are possible, both in terms of the carbon skeleton and the configuration of the numerous chiral centres.



Left: dolabriferol, as made by calculomimetic synthesis

'We calculated the NMR spectra for all the possible isomers and diastereomers, but the problem is that many of the spectra are so similar, the error in the calculations makes it difficult to separate them and identify the best match for the experimental NMR,' he says.

'We calculated the spectra for 34 different structures, and four were good matches for the experimental spectrum. One of these was the most likely, we thought, but we couldn't be completely sure on the basis of the data. This was published in 2008, and last year Jonathan Burton's group made this isomer – which has two linked furan rings instead of the originally proposed fused pyrans – and our "best guess" was correct. Importantly, our calculations greatly reduced the number of possibilities, and the amount of synthetic effort required, as the odds were biased in their favour.'

The comparison process has now been improved further, thanks to an algorithm, called CP3, which was developed by PhD student Steven Smith. 'The calculated and experimental data are so similar it is often difficult to tell,' Jonathan says. 'CP3 gives a probability for all the different possibilities, and the probability of pinning down the correct alternative is much higher than you'd expect for any of the more traditional ways of comparing them. Using CP3, you can often be more than 95% certain that you have chosen the right one, which is enormously useful, particularly when you are trying to identify which diastereomer a reaction has made.' There's now a CP3 applet on Jonathan's departmental website where calculated and experimental spectral data can be entered to give a probability of accuracy.

If both experimental and calculated spectra are not available, another algorithm, DP4, can still calculate probabilities. 'As only one set of spectral data is being inputted, it will provide less information, but what it does produce is still very useful,' he says. 'For example, in one molecule with 64 possible diastereomers, while other techniques do predict the correct structure is the most likely, the highest probability for any of these is about 45%. DP4 was 100% certain that it would be one diastereomer – and it was correct. Again, this dramatically reduces the number of lab experiments that need to be done.'

Similar techniques are also being applied to other knotty problems, such as predicting toxicology, polymerisation and solubility properties. 'If you can draw the structure, theoretically you ought to be able to get all the information about the molecule and its properties, because you've defined exactly what it is,' he says. 'Calculating NMR spectra is a step towards that, but there is still a very long way to go.'

COMPUTER-FRIENDLY DATA

With so much chemical information out there in the literature, finding useful data can be extremely challenging and time-consuming, if not impossible. A great step forward was made with the development of the IUPAC International Chemical Identifier, or InChI, a decade ago. Computers aren't particularly good at reading pictures, and this is a way of translating the features in a chemical structure into a string of characters that are machine-readable (and, with practice, can be decoded by humans).

Photo: Lafayette Photography

Don't they scrub up well?! Back row, left to right: Jack Gibb, Mike Porter, Paul Wolstenholme-Hogg, Tim Allen, Russell Currie, Matthew Grayson, Andrew Dominey, Bruno Falcone, Matthew Morton, Edward Makiyi; front row, left to right: Chad Allen, Guy Naylor, Lois Overvoorde, Jonathan, Alethea Peters, David Ponting, Yi Luo

Jonathan is now working with IUPAC on an extension to this – the reaction InChI, or RInChI, which enables reaction schemes to be encoded in a way that makes them searchable by computer.

'Reactions are much more complicated than single structures, and if you included every single piece of information, they would be impossibly large,' he says. 'We want to throw away all the information that's not really required, pulling out the key concepts of a reaction. That way two people working in different continents who do the same reaction should come up with the same RInChI.'

The main issue is trying to work out which information is important, and what constitutes a substantive difference between two sets of reaction conditions. If they use a similar but slightly different solvent, is that the same reaction? What about a 10° temperature difference? Or 1.1eq of a reagent compared to 1.2eq? Where does a reaction start to be different? 'We really don't know the answer to this, but the RInChI throws away almost everything except the key reagents,' he says. 'So, for example, NaOH and KOH are different, unless they are simply recorded as OH^-.'

The concept is now being tested with the RSC's chemical database, ChemSpider. 'This reaction capability will be released later this year, but there's currently a trial website we're working with to test reaction searching,' he says. 'There are now a quarter of a million reactions in the database, and it can be searched for, say, reactions using the same starting materials that gave different products.

'Long-term, we should be able to use chemical informatics tools to look for patterns in reactions, and get a better idea of what has and hasn't worked in the past for key transformations. In a way, it's an answer looking for a question, but I believe it is an extremely exciting step forward in checking and improving chemical databases, and identifying what is already known. We look forward to finding out what it can do.'

Jonathan Goodman

CV

Born: Thornbury, near Bristol, and grew up in Middlesbrough, near Yorkshire

Education: Natural Sciences here at Cambridge was followed by a PhD with Ian Paterson and a postdoc with Clark Still at Columbia University in New York.

Career: He returned to Cambridge as a college research fellow at Clare. He's now reader in chemistry, and admissions tutor and director of studies for chemistry at Clare

Status: Married to Victoria. They have two children: Mahoney and Edmund.

Interests: Listening to his children singing

Did you know? Three generations of chemistry: our department library contains articles by Jonathan, his father, and also his grandfather!

The excitement of chemistry

One of the highlights of the year is the department open day, when hundreds of kids flock to the department to find out how much fun chemistry is. Nathan Pitt and Caroline Hancox photographed it all

About two thousand happy punters flocked to the department for this year's open day, part of the university's Science Festival in March. The enthusiastic crowd of budding scientists were eager to try their hands at extracting DNA, investigating the properties of ferrofluids, or experiencing the unusual properties of cornflour and water in large quantities. A special mention must go to the team who managed to contain the cornflour – it has a rather bad habit of going everywhere!

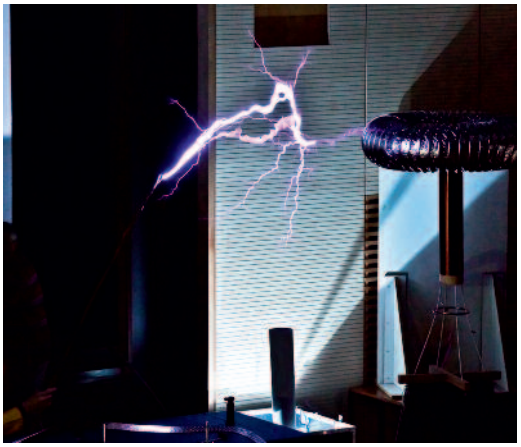
Peter Wothers' demonstration lecture recreated some of the highlights of the Royal Institution Christmas Lectures he gave last year. As the Modern Alchemist, he unpicked the chemistry of the world around us, looking at air, water and earth, the original ancient Greek 'elements that tantalised alchemists for centuries – complete with plenty of explosions and loud bangs.

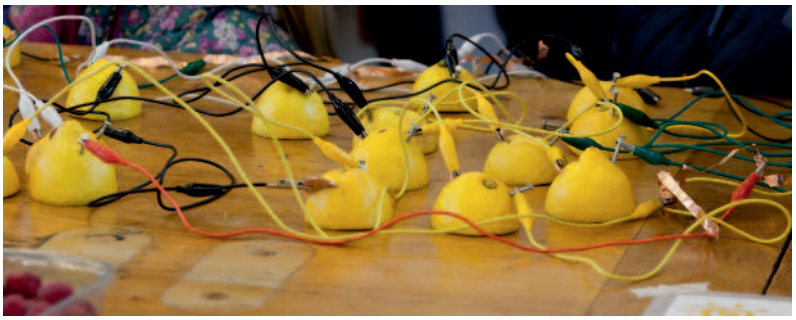
The Centre for Atmospheric Science, the British Antarctic Survey and the Facility for Airborne Atmospheric Measurements also had a display, explaining what it's like to work in Antarctica, and how we can learn about our climate and how it has changed.

'It is difficult to overstate the importance of this activity, not just for the department, but for society,' says head of department Daan Frenkel. 'Demonstrating the excitement and relevance of science in general, and chemistry in particular, to young people is of absolutely crucial importance for the future.'

As always, such a big endeavour would not have been possible without the help of the very many staff and student volunteers to run the experiments and make the day run smoothly.

Particular thanks go to Emma Powney and Emma Graham for their sterling organisational efforts, Pat Chapman, the 'powerhouse' in the Part 1A lab, and Peter Wothers' team in the lecture theatre, Chrs Brackstone, Mark Hudson and Mykola Karabyn.





Photos: Caroline Hancox & Nathan Pitt

A return to the Pembroke Street lab

Hugh Forrest continues to reminiscence about his time in Cambridge chemistry, and some of his colleagues

As I mentioned in my reminiscences about Herchel Smith in the last issue, the lab I worked in in the early 1950s was mostly inhabited by postdocs, including Len Haynes, Grant Buchanan, Charles Dalgliesh, Herchel Smith, Dan Brown, myself, two Kiwis, Ted Harvey and Ted Corbett, and Gobind Khorana (We called him Gob, but later he went by the more dignified Gobind).

Physically, Gob was a small man, but one day, in a discussion on body strength, he marginalised his size, and to prove his point, he picked me up – and I'm 6'4" – and carried me around the lab! I have always thought that should be worth a line in my CV ('Hand-delivered by a Nobel Prize winner', or something like that) but it never got in there!

I once visited Gob in Wiscosin and experienced some of the travails of a Nobelist. Dinner at his house was constantly interrupted by the ringing of the phone with a person at the other end demanding to know the secret of life...

Later, I worked in his lab at MIT for six months, having been awarded a US public health fellowship to try to determine the structure of the coenzyme of methanol dehydrogenase from methanol-oxidising bacteria; I had a vague idea that it was a nucleotide. It took another year or two to establish that structure, and to name the coenzyme, methoxatin (sometimes called PQQ). It was not a nucleotide!

Gobind Khorana: later to win a Nobel Prize

Gob was not really interested in the problem. His whole focus was in synthesising RNA, with huge intensity. I once asked him why he had moved from Wisconsin, where he had, essentially, had his own institute, to MIT and Boston. His answer? Anonimity! In the big city he was unknown; in Madison, a small town, he was confronted on a continuing basis, not only as described above but also even by the Wisconsin legislature with the constant query, 'hy are we paying this guy so much?!'

Gob's concentration on the task was awesome. I have known (more or less) a fair number of Nobel prize winners: Sir John Cornforth, Lord Todd, of course, G.W. Beadle, C.S.Lewis and Jim Watson to name a few – and, particularly, Howard Temin, who won the prize for reverse transcriptase. He had been a grad student at CalTech, and had worked briefly in my lab. Later, after the Nobel prize, he told me I had taught him biochemistry, and how to do research. I was flattered and, of course, humbled.

All of them had that capacity for intenseness of purpose. On the other hand, the brightest and most intelligent man I ever met was a lecturer in genetics here at the University of Texas at Austin, Alexander Fabergé-grandson of the 'egg' Fabergeé. His travels from Russia through France and England to the US are an epic in their own right!

He never got a Nobel prize – I guess his 'problem' was that every last detail had to be proved completely before he would move beyond the current theory. There's a lesson there, of course, but I won't belabour it.

Obviously I moved well beyond chemistry in my career, into biology and genetics – a little too early, as it turned out, as is obvious from the contents of *Chem@Cam* which now are as likely to be of biological interest as anything else. Chemistry is still the backbone!

Some of this is the routine replacement of equipment – when it gets past its useful life it has to be upgraded. But there are other, one-off projects. For example, we aim to make the entire department WiFi enabled. This will involve the installation of at least 120 wireless points throughout the building. Each has to be connected back to a network point, so that's a lot of work! We've also implemented Eduroam, which means that anyone visiting from another participating university can plug their computer into our network and gain access to the outside world.

We will soon be back into G30 after the asbestos removal process is completed, and will refresh all the PCs in there at the same time; we've already updated the PWF machines in the library, 154 and the CyberCafé. We've also installed several new high performance clusters, the latest of which is for Stuart Althorpe and Clare Grey, which is currently undergoing acceptance testing.

This, and two other clusters, have been installed over in the engineering department as we've run out of space in chemistry, but by using console management systems we can support them remotely. The only time we need to visit engineering is if we need to physically go and change a broken disk, for example.

Another project involves implementing energy saving processes, such as sending machines to sleep or even switching them off automatically if they're not being used. This may sound trivial, but how do we handle all the PCs that run lab equipment, for example? We've already implemented a shutdown policy on all the shared PWF computers. We're also looking at selectively switching off parts of the high performance computing clusters if they are not fully loaded.

And the million-dollar question – why can't I find a computer officer when I want one?

Because we're busy! There are nine people in the team, and we are hoping to take on a sandwich student from Anglia Ruskin university to help provide extra frontline support. This could be an excellent model for the department – and also Anglia Ruskin, as their computer science students can't get jobs because they don't have experience, and they can't get experience because they don't have a job!

We have to do a lot of work out of the way in machine rooms, and if we're working on a complicated project we might go and find somewhere quiet to work where we're not going to be interrupted. We spend as little time as possible in meetings, and those of us who do supervisions more than make up for the limited amount of time that takes with the work we do out of hours. If only we were just sitting around waiting for the next issue to arise…

Our computer officers are hardworking, very committed, work cohesively, are always prepared to support each other and generally open to new ideas and considering fresh approaches to the way they work. The overwhelming number of our users are a pleasure to work with as they work in a collaborative fashion!

Over the five years I've been here, I've seen a massive growth in the reliance on IT and people's expectations of its reliability. IT has become more and more important to chemistry, as people increasingly simulate experiments and construct computational models.

Half a century ago, there would have been several glassblowers in the department; now there is just one. The way the team of computer officers is growing is an interesting reflection on the way chemistry is changing.

Science made fun for Ghanaian schoolkids

In July, postdoc Yalda Javadi and PhD student Elin Sivertsson from Laura Itzhaki's group spent a couple of weeks on a science roadshow in Ghana, volunteering for the Lightyear Foundation. The foundation's aim is to promote practical science classes using low-cost materials in Ghanaian schools.

The roadshow visits both state and private schools in both big cities and rural areas, teaching kids at all levels from primary to senior high school. 'While the Ghanaian national curriculum does include science, lessons are almost exclusively taught by writing on the board for pupils to copy,' Elin says. 'It's a very poor country, and schools rarely have enough money for a lab, and the few schools lucky enough to have one feel the equipment is too expensive to use in everyday lessons!'

The aim of Lightyear is to make science come alive through engaging, hands-on experiments using materials easily available in the developing world. 'The children learnt about forces while building bridges from kebab sticks and pieces of string; water purification from using old plastic bottles, sand, stones and fabric; and respiration using a model lung made from a plastic bottle, balloon and some tape,' Yalda says. 'It was great to see the kids – and teachers – get involved, and learn about science while having fun.'

The first stop was a school in the capital city, Accra. 'It was amazing – when we reached the school, the children welcomed us with cheers!' Yalda says. 'We gave three lessons, including a "sport science" lesson teaching about respiration, heart rates and fitness, plus reaction speed and hand–eye coordination. We finished off by showing the kids how to create "seams" on plastic footballs using elastic bands to make them go further!'

Bridge building at the Immaculate Heart Roman Catholic School in North Accra

The next two days were spent in another Accra school, the Street Academy, where many of the children are from incredibly poor backgrounds, and often end up working with their parents at the expense of schooling. The team first worked with a group of more able kids, who fetched swamp water, and – with the help of one of the teachers as an interpreter – showed them the principles of water purification using sand, stones and pebbles, and they explored what combination of cloth, sand and stones made the best filter. 'The teachers loved this, and asked us to teach it to the whole school!' Yalda says.

At a third school, again in Accra, the lessons introduced the ideas of forces, bridges and engineering, with the kids split into groups and asked to build a bridge across a 50cm gap. They had to use sticks, rope, metal, paper and tape – all of which had a price – to build the strongest, cheapest bridge they could.

After a weekend spent at a Cape Coast beach resort, they headed up country to Bedomase, a rural village near Kumasi. The next few days were spent running classes at two local schools, all leading up to the last day of the trip, the local community show, where the children had the opportunity to show what they'd learnt in the Lightyear classes.

One school group explained about the importance of clean water, and performed a dance to show how alum is used for coagulation and sedimentation in water purification. A second group showed what they'd learnt in the sport science classes. 'It was so rewarding to see the students, and the whole community, get excited about science,' the girls explain.

'We had a truly fulfilling time in Ghana,' Yalda says. 'Some of the kids even told us they wanted careers in science and technology when they were older. It is amazing to think that we helped to inspire children in this way.'

You can find out more about the Lightyear Foundation at www.lightyear-foundation.org

Yalda (in blue) and Elin (in orange) with students from Bedomase District Assembly School, just before the community show

Relics are the name of the game for Matt!

Matt Dunstan, a PhD student in Clare Grey's group, has a rather unusual hobby. When he's not carrying out x-ray diffraction or solid-state NMR experiments on materials for carbon capture and storage, he designs board games. And he's about to have his first game published.

'There's a new style of board game, the strategy board game, where players don't directly fight each other,' he explains. 'Instead, they're all trying to achieve the same sorts of goals.' In Australia-born Matt's game, Relic Runners, players are archaeologists running around the jungle trying to find a collection of relics before the other players do.

Although he's been designing games for fun for some time, this is the first to be published, and that's happening because he was a finalist in a competition in Spain. 'The game was put forward to a few publishers, and a French company decided they like it,' he says. 'It's being released in September, by a French publisher, and will be sold in 35 countries around the world, both in game shops and online.'

He hopes it won't be the last – he's now working on a new game based on influencing people in the Roman Senate, plus another very small game with just 16 cards that's all about outplotting your opponents.

'I'm really excited that my name's going to be on the box,' he says. 'It's certainly not about the money – you don't get rich designing games!'

Last issue's solutions

ChemDoku

There were rather fewer ChemDoku entries than usual this time – was the puzzle more difficult? Or have the email snails stolen the rest? Anyway, the vague sequence was that the second letters of the symbol were a–i, and there couldn't be a 10th as there's no element whose symbol has a j as the second letter.

Entries came in from Keith Parsons, Alison Griffin, Neil Mckelvie, Bill Collier, David Thompson (who wondered if Mj or Megajoule might be allowed as the 10th member of the series, if an element could be associated with a particular energy situation), Stephen Roughley, Peter Rose, Ian Potts, Ian Threlfall, Karl Railton Woodcock (who suggested that Injudicium, symbol Ij, maybe should be an element), Ron Thompson, John Campbell and Robin Pope. This time, the cat picked the catbiscuit sitting on the entry from John Campbell.

Crossnumber

There were only three entries for David Wilson's Crossnumber, but all proclaimed to have loved the puzzle. Said entrants were John Wilkins, Ian Potts and Karl Railton Woodcock. The feline assistant decided Ian Potts' entry was most worthy of catbiscuit consumption.

Transmutation

Again, three entries were received; Ian Potts managed six steps twice (lead, lade, blade, baled, bald, bold, gold) and lead, lade, galde, glide, gelid, geld, gold). Karl Railton Woodcock also managed six (lead, leas, sale, sole, soled, sold, gold). John Campbell submitted an entry, but couldn't do it in fewer than seven. As Ian won Crossnumber, the cat made the executive decision that the prize should go to Karl. So it will.

This issue's puzzles

All but one

Here's another little teaser from David Wilson. The answer to each clue is to be obtained by adding up the atomic numbers of the members of the group, but in each case leaving out element to be determined by this rule: the last digit of each answer is the first digit of the next answer. The rule is cyclic, so that the last digit of answer number 6 is the first digit of answer number 1.

Transuranic elements are excluded, and names of elements are the ordinary English names. Answers should be sent in by listing the six elements left out.

1. Noble gases
2. Elements whose names have 5 or fewer letters
3. Elements whose symbol is a single letter
4. Elements whose names begin with 'T'
5. Elements whose symbol doesn't begin with the same letter as their name
6. Transition elements Sc-Zn inclusive

Email entries to jsh49@cam.ac.uk or send them by snail mail to Chem@Cam at the address on p3

Killer ChemDoku

S		C		Mg			Mn	
N	Mg		Be		Cl	Al		
	F		Li	Mg		Al	Cl	
Al		Cl						
N			Fe		Al	Si		Li
	C	Ne		N			Cl	
Cl					S			F
	O		Ar	Cl		Si		
N								

And finally, David Thompson sent along this ChemDoku alternative – a Killer ChemDoku. The basic rules are the same as for the normal puzzle, with the symbols for elements 1 to 9 entered into the grid ChemDoku-style. In addition, the atomic numbers of the elements confined within the dotted shape need to add up to the atomic numbers in the top corners of each of the shapes. That sounds dreadfully confusing, but it's not… honest! Thanks to David for the puzzle – and for mangling my braincells drawing the grid…

Photo: Nathan Pitt

Two long-serving members of staff retired recently. John Coston worked in the electronic and electrical section for 45 years, and retired in June; Judith Battison, librarian since 2005, retired in July. We wish them a long and happy retirement!

Photo: Nathan Pitt

Comings & goings

New staff

Tony Gill

Caroline Mendonca

Promotion

Tom Sweet

Sun shines on postdoc party

Photo: Nathan Pitt

Unusually for the English summer, the rain forgot to show up!

The department's postdoctoral affairs committee (PDAC) held a summer garden party for contract research and academic staff at Peterhouse in July. About 70 guests enjoyed Pimms, scones and strawberries during an afternoon of glorious sunshine.

Daan Frenkel addressed the attendees, emphsising the key role of postdocs in maintaining the department's top ranking amongst UK universities. He also highlighted the importance of the department's recent Athena SWAN bronze award, awarded for good practice in recruiting, retaining, and promoting women in science and technology, but stressed that this is an ongoing process.

Other topics included the appointment of Chris Abell, who is the academic representative in PDAC, as the university's new director of postdoctoral affairs.

PDAC exists to represent the interests of contract research staff within the department. Current projects include the development of a new mentoring scheme for postdocs, and a review of the staff review and development programme. The next PDAC event will be in the autumn. It also holds a monthly lunch for postdocs in the Todd Hamied room. All contract research staff are welcome! Please email any comments or suggestions to the committee at chem-post-doc-affairs@lists.cam.ac.uk.

Amanda Maycock

Jane Clarke, professor of molecular biophysics, senior Wellcome Trust Research Fellow and deputy head of department, describes some of the people who have influenced her life, career, and her desire to encourage women to embrace academic research

Of course the first and most lasting influence on any person's life must be their family. Others who have written in these columns highlight the influence that their families have had. I am no exception. The support my family, of all generations, grandparents, parents, husband Chris, and my children, have offered to me cannot be underestimated.

My mother, Shirley, was the first of our family to go to university. Daughter of a collier in the Rhondda Valley, she commuted daily during the war to Cardiff University, and later, following in the footsteps of her mother and grandmother, became a teacher. She imbued in me a curiosity for the natural world – I remember holidays poking about in rock pools, and learning about the wonder of the symbiosis between flowers and insects. During cooking I discovered ball and socket joints, and, when we had stuffed hearts for dinner, bicuspid and semi-lunar valves. There was no doubt in my mind that I would be a scientist – and no doubt that it was possible to combine successful career and successful motherhood.

Her influence went further than that and I started as a schoolteacher in 1973 – following the family mould – a career I really enjoyed. However, my greatest sadness is that my mother did not live to see me get my PhD. She knew I had been accepted to Cambridge and was delighted. My thesis was dedicated to her.

The next most influential person, the one who caused me to change careers, was Bud Suddath. In 1986 my husband was sent by his employer to Atlanta, where I could not teach (no 'College English' or Georgia history!), so I went back to school at Georgia Tech to do a Masters degree and update my science. One of the courses there was taught by Bud: chemistry professor, an outstanding protein crystallographer, an inspiring teacher and generous friend.

The course was about protein structure, and we had to do a project, looking at structures and investigating the relationship between structure and function – I was inspired! I knew that I just *had* to work with proteins.

Bud encouraged this ambition and wrote me the letter that helped me secure a place in Cambridge to do my PhD when we returned to the UK. But, another tragedy, although he was still young Bud was struck down by a heart attack not long after I started my PhD – another of my mentors who did not see what they had started come to fruition!

Searching for a PhD place in Cambridge is always daunting, I suppose, but for a 40-year-old mother with childcare responsibilities, it was more so.

While all the biochemists turned me down flat, Alan Fersht took a chance and offered me the golden opportunity to work in his lab, arguably the best protein chemistry group in the world, and at a time when he was just embarking on an exciting new research area – protein folding.

Alan is truly a most inspiring scientist. He has a frighteningly incisive mind. His careful, analytical approach, his intolerance of mediocrity ('don't waste clean thoughts on dirty data') and his love of mulling over primary data have all been an inspiration.

He offered me the opportunity to follow where my curiosity led – to try new avenues of research – and taught me the importance of recognising when to stop if things were not working!

Alan was also an extraordinarily generous supervisor. While working as a postdoc in his lab after my PhD, I had an idea – to do comparative studies of families of proteins. He gave me a student to work with, and when the first paper was written, edited it with his customary critical eye (oh that red pen!) but then crossed his name off. 'It was your idea, publish on your own – it will start your career' – and it did!

Alan has been supportive ever since – although rather like head of a pride of lions, he absolutely expects the 'young ones' to stand on their own two feet once out in the jungle that is academia. He equipped me with all the skills I needed, and that includes resilience.

One of the great things about academic science is the set of friendships you forge worldwide. Friends who you meet at conferences who become very close, who support you and inspire you and collaborate with you, and compete with you.

It is impossible to mention them all, but Carol Robinson (Oxford), Susan Marqusee (Berkeley) and Sheena Radford (Leeds) have all travelled the same paths as me from the beginning.

They are a group of inventive, ambitious, inspiring protein scientists, who motivate me to be as good as they are.

Now I am approaching retirement, and when I reflect on my career one thing shocks me – just how few women there are in academic science. I see young women chemists walk through the door of this department as fantastic graduate students and postdocs – and then they disappear! The situation I find myself in is no better than that I found when I went to university in the late 60s. The proportion of women academics in this department, and in this university, is no better now that it was then. This makes me angry and frustrated.

My final inspiration is my one-year-old granddaughter, Martha. I cannot tolerate a situation where she might go to university in 17 years time and again find nothing has changed. (And of course I hope she wants to be a scientist!) In the 1960s, my mother taught me to believe that I could do anything. Feminism was rife; we were optimistic and knew that the world was changing.

But any progress in the world of academic science is very hard to see! We cannot just let things lie. We have to actively work to change the way we behave, we have to see value in diversity, we have to alter our perception that success and excellence looks exactly like 'us' – I am a good example of someone who has been successful following a non-standard career track. In my final years, I hope to help the chemistry department be a place where more young women will aspire to work and believe they can find success.

I know we're trying to encourage young chemists, but don't you think you're a bit *too* young to become lecturers?

UNIVERSITY OF CAMBRIDGE

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