chem@cam

Chemistry at Cambridge Newsletter

Summer 2007

How do proteins fold in cells?

Synthetic success – at last!

The potential of chiral surfaces

Keeping a competitive edge in science

The UK pharmaceutical industry is, historically, a big success story for chemistry. Sarah Houlton talks to Richard Barker, director general of the Association of the British Pharmaceutical Industry, about competitiveness, government support and what the future holds for the sector

How did you end up working in the pharmaceutical industry?

I'm a chemist by background, and my DPhil in biological NMR taught me that the most interesting chemical problems are actually in biology, and the greatest potential for technology is in addressing the problems of biology in medicine. I continue to believe that is the case – some of the most fascinating science is to be done in biology and medicine. Whether this produces chemical drugs or biological drugs is less important when you've the skill to be able to identify the structures of biological macromolecules, and how they fit with the other macromolecules or small molecules. We need the ability to unravel the very complex systems biology that is the cell and that is you and me.

What needs to be done if the UK is to keep its competitive edge in science?

I believe it's very important to continue the flow of people studying hard sciences – chemistry, physics and mathematics – and at the ABPI we are extremely determined to keep the pressure on government to ensure we have a good flow of high quality, practically skilled physical scientists coming through.

We have, therefore, been very concerned about closures of chemistry departments. We also want to make sure that when the government publishes positive-looking figures of the number of newly qualified biologists, they're not confusing people who are sports scientists or psychologists with people who could do molecular biology. Our impression is that the number of molecular biologists hasn't risen at all in recent years. So if we're really going to see bioscience as a major driver of economic growth and prosperity in this country in the next decades we need to address these issues.

We will be approaching both of the two departments who deal with education in the newly reformed government to ensure that they understand not only what industry needs but what we understand the broader society needs.

What is the industry doing to ensure its future success?

Whatever you may read in the press, the industry continues to invest in very exciting research, and is increasing the number of molecules in the pipeline – it's up around 4,000 in the past five years. For example, there are very many different innovative potential cancer medicines in the pipeline. If people read that the pharma industry is only doing minor modifications of the successful drugs that we already have, then that's not borne out by the facts.

It's also probably worth remembering that the process of bringing the new medicines to the patient is an extremely long and uncertain one that requires huge investments – recent numbers suggest it's about £500m per medicine. It's so high as those that succeed also have to pay for those that drop out: we might start with 5,000 to 10,000 molecules to get one out of the pipeline in 10 to 12 years. This is not getting any easier.

What that means is that we're very interested in any technology that will help predict which medicines will succeed and which will fail – predictive medicine techniques like biomarkers and bioimaging are going to be increasingly used to winnow down the potentially viable clinical candidates in the early stages.

It will also be used to understand how the medicines actually work, which I'm pleased to see with my NMR background! We're going full circle: now NMR is being used in the form of MRI to study how the blood flow in the brain is modified by psychoactive drugs and how conjugated antibodies reach active sites in the body, for example. We are now able to do this by using chemical techniques and marrying them with biology.

Does the industry get enough support from government?

I believe that the UK government, unlike many others, actually has a quite a positive view of what the industry brings to the country. It contributes billions of pounds to the economy: last year we exported £4.2bn of medicines, more than we imported, but even more importantly we employ about 75,000 highly skilled people, and about 250,000 others alongside them providing support. So I think the government is smart enough to know that, in economic terms, the industry has a huge contribution to make. Thus far we have seen that, too, in a quite light touch regulation of prices. The Pharmaceutical Price Regulation Scheme, which sets prices, will evolve over the coming years, but we believe it's a very sound basis for the pricing of most medicines.

But the area that as a society need to think hard about is the value of medicines and how we address the value of medicines. The National Institute for Clinical Excellence in England, and the Scottish Medicines Consortium in Wales, provide assessments that are often regarded by the health economics community and the public as a precise and objective science. But it cannot be: you cannot measure the suffering someone has from a disease and therefore the value of relieving that suffering narrowly in the way that they do, using the cost per quality adjusted life year to quantify it.

I think we need a very broad debate in society on how we should put a value on medicine. We recognise that the government and the NHS have to use rationing to some extent as there is more medicine and more health intervention than we've got money to pay for. But we think we've got plenty of room to be able to be more sophisticated and more thoughtful about the way health technologies are evaluated, and ensure that the right patient gets the right medicine at the right time.

CV Richard Barker

Education: Education: Studied chemistry at Oxford before moving into biochemistry for a DPhil in biological NMR. This was followed by a year's postdoc in Munich, and a second in Leeds.

Career: After a spell working in the oil industry for Esso Petroleum, he spent 12 years with McKinsey as a management consultant, ultimately heading up its healthcare business in Europe. He moved to IBM to run its healthcare business, and relocated to the US. After a decade with IBM, he moved into pharma with Chiron, then a couple of early stage companies. He returned to the UK three years ago to the role of director general at ABPI.

Interests: Richard loves the outdoors, particularly walking in some of the more mountainous regions of the world, including the Alps, Rockies, Andes and Himalayas. 'I love to get a nice lungful of thin fresh air!'

Poetic licence

Dear Editor
The limerick which was quoted in the article 'Preserving the chemical past' relating to Lord Todd in the Spring 2007 edition of *Chem@Cam* reminded me of another amusing verse associated with chemistry at Cambridge.

Dr Sugden was lecturing on the infrared spectroscopy of gases to a physical chemistry group in the early 1960s. On one of the blackboards, which was initially hidden from view, someone had written in large bold chalk (with apologies to Lewis Carroll):

The time has come, the walrus said,
To talk of many things
of delta J's and delta n's
and spectral lines with wings.

Those who remember both Dr Sugden and their spectroscopy will readily appreciate the gales of laughter which greeted the sudden appearance of this verse when it was revealed in the middle of the lecture. I recall that Dr Sugden was also very amused.

I took Part II chemistry in 1963-4 and attended lectures from many of the familiar names who have received recent mention in *Chem@Cam*.

After Cambridge, I studied for a DPhil at Sussex. The chemistry department was a very new then and had attracted several academic staff from Cambridge as well as Oxford and other UK universities. My research supervisor was Colin Banwell, who had been a student of Norman Sheppard.

Soon after I started there, John Murrell brought his theoretical chemistry group down from Sheffield. Ruth Lynden-Bell was also there. I always look forward with particular interest to reading about chemistry at Lensfield Road in the late 50s early 60s in your Alumni section.

Kind regards,
John Fleming
Chertsey, Surrey

Tomorrow's chemists

Dear Editor
I was fortunate enough to attend this year's Chemistry open day in March, and I was really impressed with what I saw. It was wonderful to see hundreds of children carrying out chemistry experiments, and the enthusiasm of the students supervising them. The department is also extremely fortunate in having such a brilliant science communicator as Peter Wothers, whose talk really brought the chemistry of gases to life.

It is also very important that they also got to see chemistry as a practical subject, at a time when lessons including wet chemistry experiments are declining in schools, and even in the early stages of some university courses.

The concerns about the numbers of young people studying science are growing in industry. If there are insufficient good young chemists being trained, then in future we will struggle to fill our labs, and drug discovery will go the same way as much of the rest of industry and increasingly be done in places like India and China where the universities are producing large numbers of well-trained chemists.

For the pharmaceutical industry to survive in the UK, we need to ensure that our children are enthused about chemistry. Events like the open day at Cambridge which show that chemistry is fun are extremely important if children are to be encouraged to study the subject instead of the 'easier' options that are growing in popularity at the expense of vital subjects like chemistry.

Yours sincerely
Tony Wood, vice-president and head of discovery chemistry,
Pfizer Group R&D, Sandwich, Kent

chem@cam
Chemistry at Cambridge Newsletter

Contents

Cover

Julia Parker, from Stuart Clarke's group, at work in the BP Institute

Photograph:
Nathan Pitt and Caroline Hancox

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.

Address:
Chem@Cam, Department of Chemistry, University of Cambridge, Lensfield Road
Cambridge CB2 1EW
Phone: 01223 763865
e-mail: news@ch.cam.ac.uk
website: www.ch.cam.ac.uk

This publication is supported by **Cambridge University Press**

The chemists' league

Alan Fersht – highest Cambridge chemist…

Several Cambridge chemists feature in a new 'league table'. Compiled by Henry Schaefer and Amy Peterson at the University of Georgia, it ranks chemists by h-index score.

The highest ranked is Alan Fersht, in 14th place, who also has the distinction of being the British chemist who is furthest up the list.

The h-index was devised by physicist Jorge Hirsch in 2005 as a measure of research impact. The h-index is the number of papers a scientist has published that have been cited at least that number of times. So Alan's h-index score of 97 means that he's published 97 papers that have each been cited at least 97 times.

Several other Cambridge chemists also feature on the list of those with an h-index of at least 50. Chris Dobson weighs in with 86, Dave King's score is 58, Steve Ley's 53, and both Jack Klinowski and Jeremy Sanders have an h-index of 51.

Two chemists who left us recently are also there: Andy Holmes, with and Paul Raithby.

Of the younger generation of Cambridge chemists, David Wales is the closest to making the list, with an h-index of 47. As might be expected for a ranking method that relies on volume of publications, quite a few of our retired chemists feature in the list, too. Dudley Williams, with a h-index of 76, is the highest ranked of these, closely followed by Jack Lewis on 74 and Nick Handy with 71. Ray Freeman, Brian Johnson, David Buckingham, Olga Kennard and Alan Battersby all scored at least 50 too.

You can peruse the full list at www.rsc.org/chemistryworld/News/2007/April/23040701.asp

…with Chris Dobson not far behind

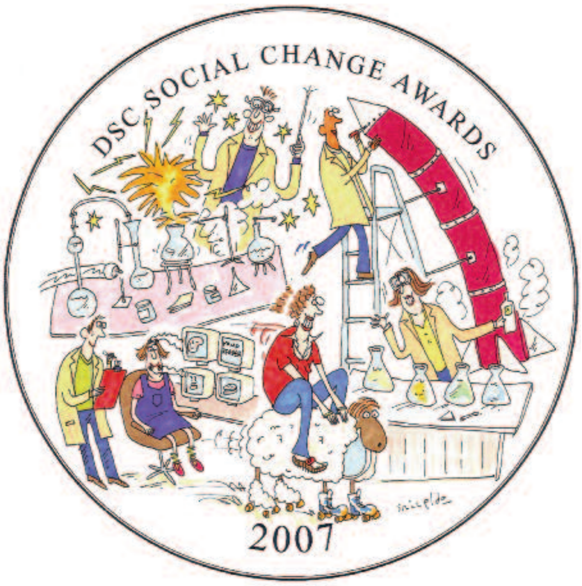
Photos: Nathan Pitt

Three of the distinguished lecturers who have visited the department recently… Melville lecturer David Tirrell from Caltech, who spoke about non-canonical amino acids in macromolecular design, evolution and analysis…

… Merck lecturer Shu Kobayashi from Tokyo visited in May, and spoke about catalytic reactions in aqueous media…

…and Fraser Stoddart, director of the California NanoSystems Institute and Fred Kavli Chair of Nanosystems Science at UCLA, who spoke on molecular memories

Chemistry's part in Science Festival award



Not just a flash in the pan – Peter Wothers blows things up in cartoon style

The Cambridge Science Festival – of which our Open Day festivities are a part – won the prestigious Public Body Award from the Directory of Social Change. This is the first time the DSC awards have been made.

The award was given to the festival for its work with the community to achieve shared social change objectives. The three shortlisted nominees were voted on by charity professionals and the general public, and Cambridge romped home with more than half the votes.

'We're absolutely delighted to receive the award, and very pleased to be inspiring the next generation of scientists,' says Nicola Buckley, the university's festivals and outreach coordinator.

The prize included a cartoon drawn specially for the winner from photos submitted by the university. Eagle-eyed readers will be able to spot the rather fine likeness of Peter Wothers in action!

Salters students' success

Photo: Nathan Pitt

The Impington Village College team dressed and ready for action

Just after the department open day in March, we hosted a group of school students as part of the Salters' Festival of Chemistry. This is the third year in a row we;ve taken part, and 20 teams of four kids from year 8 or 9 came to do some chemistry in our teaching labs.

'It's a competition, and they did two experiments,' explains organiser James Keeler. 'One of the experiments we devised ourselves, and it involved column chromatograpy. It was really quite complex, as they had to pack, load, run and collect fractions from the column. Those who did it well were amazing.'

The day finished with Peter Wother's 'It's a Gas!' lecture which, once again, was rapturously received.

Computational developments

The computer officers have plenty of news to report, with both new people and new services appearing in recent months. First of all, there are two new computer officers: Philip Marsden and Greg Willatt.

Philip has actually been around in the department for a while, having finished his PhD with Bobby Glen in 2006, and spending the past year on a temporary contract as a computer officer in the Unilever Centre. He's now on a full-time contract, mainly focusing on Windows admin, and is currently implementing an active directory domain in the Unilever.

Greg, meanwhile, joins us from BT, and is working in the Unilever and the theoretical sector, supporting users with hardware and software problems.

The Windows active directory system that's being developed and expanded in the department has big advantages for those involved in collaborative work. In the Unilever, however, it's being taken a step further. There will be centralised file storage and common file shares across research groups, increased security, and standard software packages like Office will be deployed over the network so if it becomes corrupted it will be repaired or reinstalled automatically. And if the worst happens, it will be faster to recover broken machines.

'This will all result in less time being spent by us fixing machines,' claims computer officer Mike Rose. 'This will lead to happy computer officers with more time to work on projects beneficial to the rest of the department. And many of the active domain developments will be adoped department-wide in the future.'

New software is available, too. Chemistry is paying for a university-wide licence for Hyperchem, and we have led the negotiations for a three-year site licence across 13 departments for Mathematica.

'It's expensive commercial software that is very broad, and provides a systematic interface to all sorts of computations, from traditional numeric and symbolic computation to data format conversion, and the creation of user interfaces,' Mike explains.

Meanwhile, there has been an open-access wireless network up and running around the department for a few months now.

'It's aimed at visitors and conferences, and is available in the Cybercafe, library, Unilever Centre offices and the theoretical sector,' Mike says. 'Access to the open-access wireless network is, as it says on the tin, absolutely open and unrestricted.'

Winning experiments

First prize winners Jen Ryder (above) and Joel Gustafsson (below) collecting their champagne from Head of Department Bill Jones

Photos: Nathan Pitt

At this year's Open Day, we sent two panels of highly qualified judges around all the activities, and asked them to judge each activity for their presentation, content and fun.

The scoring was remarkably close in the end but the winners were clear cut. First prizes of champagne and a £100 voucher went to Jen Ryder and the Blue Goo group from the Unilever Centre, and Joel Gustafsson and the Lambert group for Going Cryobananas.

Champagne and £50 vouchers went to those in second place: Nick Johnson and the Klenerman group for the marvellously messy cornflour slime, and Jessops' Paul Franklyn for Cambridge Blue Prints.

Those in third place also got champagne: Alistair Boyer and the Ley group for chemiluminescence, and Lech-Gustav Milrov and the Market Gardeners for the fruit & veg batteries.

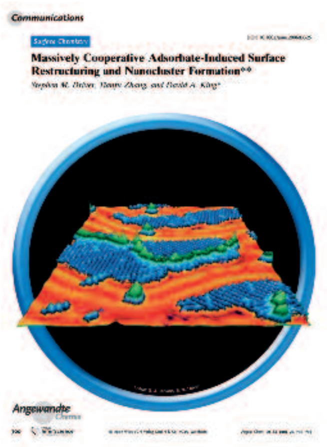
Thanks must go to our fantastic junior judges, Rosie (13), Georgie (13), Hugh (9) and Toby (9), and their somewhat more aged helpers, Stuart Clarke and Brian Johnson.

In addition, the organisers gave RSC books to several people, in recognition of their efforts: Silvia Gonzalez and Tom Anderson for supervising the molecular models, Louise O'Brien, who designed the element trail, and Chris Mitchell for his services to Open Day over the past three years.

Olga's award

Congratulations to Olga Kennard, founding director of the Cambridge Crystallographic Data Centre, who has been awarded the Gmelin-Beilstein Medal by the German Chemical Society for her contributions to chemical informatics. She will be presented with the award at the Third German Conference on Chemical Informatics in November

A little golden artwork



Artwork from the King group featured prominently in Angewandte Chemie earlier this year. The image, illustrating a paper by Stephen Driver, Tianfu Zhang and Dave King entitled 'Massively cooperative adsorbate-induced surface restructuring and nanocluster formation', was used as a Frontispiece image. 'It's nearly a front cover!' says Stephen.

The scanning tunnelling microscope image, showing gold nano-clusters embedded in islands of nitrogen dioxide on a Au{111} surface at 77K.

'When NO_2 adsorbs on this surface, it forms islands,' Stephen explains. Neighbouring islands are arranged in a mesoscopically ordered fashion as a result of the interaction of their stress fields and the pre-existing "herringbone" reconstruction pattern of the Au{111} surface.

'When the islands grow to a certain size, they start to lift the reconstruction, "squeezing out" excess gold atoms in what we term a massively cooperative restructuring process, involving concerted motion of around 100 Au atoms. The ejected atoms aggregate into a string of nano-clusters, each containing four to five gold atoms, marking the positions at which they were ejected.'

Stephen, Dave and first-year PhD student Mary Ross, in partnership with BP Alternative Energy, are now starting to explore the potential catalytic reactivity of these Au nano-clusters in a series of follow-up experiments.

Recognition for Richard

Richard Layfield: 'shocked and stunned'

Richard Layfield has been awarded the Meldola Medal by the Royal Society of Chemistry. The medal is given every year to British chemists under the age of 32 for 'promising original investigations in chemistry'.

Richard is being honoured for his 'innovative and imaginative contributions to the organometallic chemistry of magnesium and manganese'. It will be presented at a ceremony in November, and as part of the prize, Richard is attending this year's IUPAC general assembly in Turin.

'I was shocked and stunned when I heard I was getting the medal!' Richard says. 'I'd completely forgotten about the application for it. But it's really nice to get external recognition of my work like this.'

Sadly, however, Richard is leaving us for pastures new – after eight happy years in the department he's off to take up a lectureship in inorganic chemistry at Manchester this autumn. Having grown up as a die-hard Leeds United fan, he claims he's extremely glad his office looks east over the Pennines…

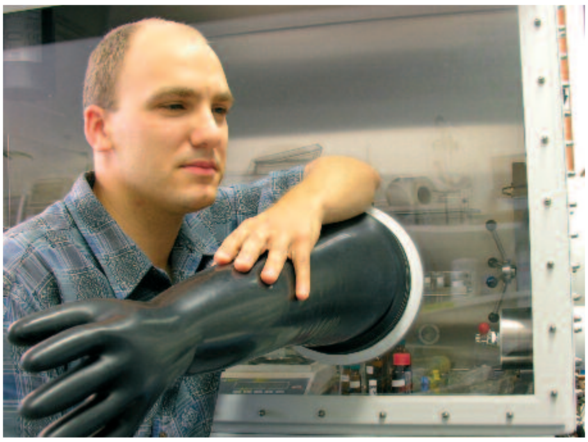
Two more prizes for Steve

Steve was presented with the ACS award by John Chan of sponsors Sigma Aldrich (left) and ACS president Catherine Hunt

Steve Ley has another couple of additions to his collection of awards. He picked up the American Chemical Society's award for creative work in synthetic organic chemistry in Chicago back in March, the first Brit to be given the annual prize since his former postdoc supervisor Derek Barton won it in 1989.

Then, in June, he was given the Paul Karrer Gold Medal by the University of Zürich. This is given every year in honour of the former Zürich professor, and Steve won for his contributions to chemical synthesis as related to natural and biologically active molecules.

Jonathan joins inorganic sector



Jonathan's getting a helping hand in his impending move to Cambridge

The department has appointed Jonathan Nitschke to a university lectureship in inorganic chemistry, and to a Next Generation Fellowship funded by the Walters-Kundert Charitable Trust.

Jonathan, who is American, obtained his PhD in organometallic chemistry with Don Tilley at Berkeley, and was a postdoctoral fellow with Jean-Marie Lehn in Strasbourg for two years before moving to a junior faculty position in Geneva in 2003. He will be taking up his post from 1 October, gradually moving his group of students and postdocs from Geneva to Cambridge over the following few months.

His group studies self-assembly in water, creating remarkably complex and beautiful structures from simple inorganic and organic components. Jeremy Sanders – recently promoted to head of inorganic – says, 'We are all delighted by Jonathan's appointment and look forward to working with him. We also greatly appreciate Eric Walters' generous donation of a Next Generation Fellowship which has enabled us to recruit Jonathan and his group.'

Jonathan explains that the NGF will make getting his group up and running in Cambridge much easier and quicker. 'It means I'll avoid losing momentum in my current research programme,' he says. 'It will allow me to pay for a postgrad student and a postdoc to come with me from Geneva; had this not been possible, it would have taken a long time to recover from losing them! It also means I'll be able to replace kit that I have to leave behind. I'm sincerely grateful to Eric and I'm really looking forward to continuing my academic adventure in Cambridge.'

Academic promotions…

Chemistry was very successful in this year's round of university senior academic promotions.

As of 1 October, four of our scientists will take up personal chairs: Shankar Balasubramanian, Wilhelm Huck, Bill Jones and David Klenerman.

Jane Clarke will also become a reader on the same date, funded by the Wellcome Trust. Congratulations to all.

…and departures

Two of our research fellows are moving on to pastures new to further their independent research careers.

Julian Huppert, a former student of Shankar Balasubramanian and currently a research fellow at Trinity, has been appointed to a Research Councils UK Fellowship, leading to a lectureship, in computational biology in the physics department here in Cambridge.

And Michal Sharon, Dorothy Hodgkin research fellow with Carol Robinson, has been appointed to a lectureship at the Weizmann Institute in Israel. We wish them both all the best.

A long time coming

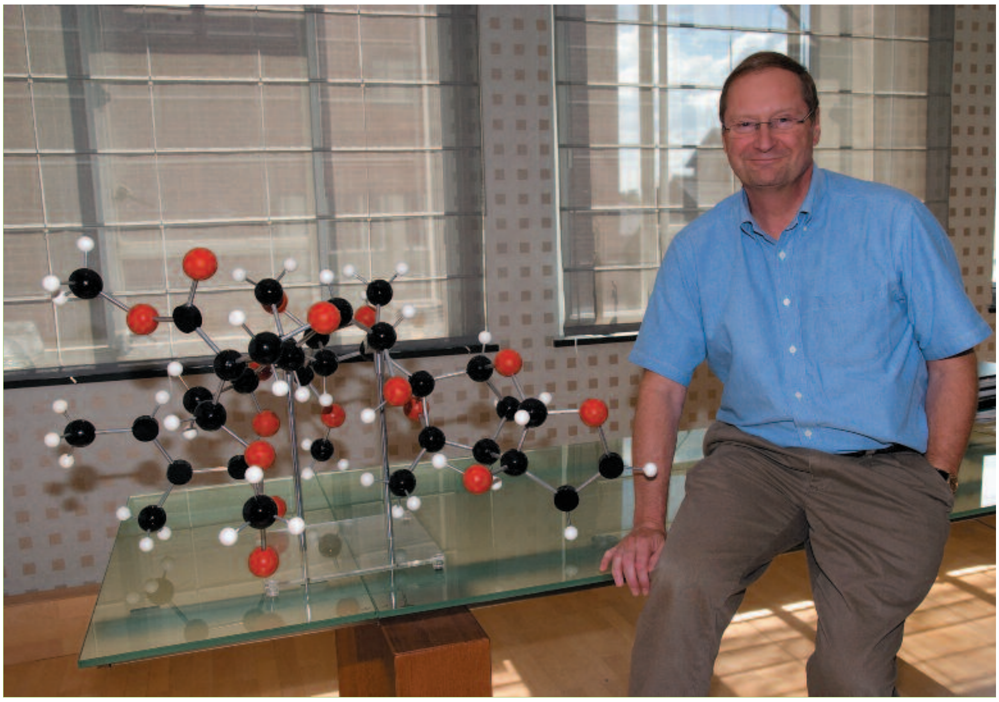


Photo: Nathan Pitt

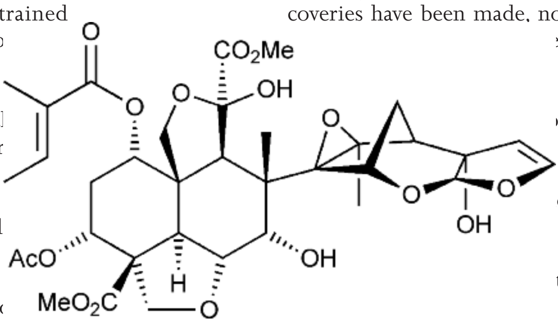
Azadirachtin has taxed many organic chemists around the world for 22 years, but Steve Ley's group has finally completed the first total synthesis

It's taken more than two decades, but Steve Ley's group has finally completed the total synthesis of the insect antifeedant azadirachtin, a world first. The project, started during Steve's time at Imperial College and continued in Cambridge when he moved here back in 1992, has taxed more than 40 PhD students and postdocs over the years.

Azadirachtin has been a target for total synthesis in many research groups around the world for years. The molecule is an attractive target partly because of its biological activity, and partly because it's so fiendishly complicated. It was first isolated from the neem tree in 1968, and it took another 17 years for the correct structure to be elucidated and synthetic efforts to begin in earnest.

The neem tree is native to India, and has many uses – its twigs are used as toothpicks, powdered extracts are used for stomach complaints and an oil as a topical antimalarial, for example. It also has very low mammalian toxicity. 'Its mystical properties have fascinated people for centuries, being mentioned way back in ancient Sanskrit writings,' Steve says. 'But the most important is its insect antifeedant activity – azadirachtin deters insects from feeding. It's a bit like a slimming pill for insects! We became interested in it because we thought we might be able to learn a lesson from nature – if it has learnt how to protect itself against predatory insect attack, then maybe by studying it we might be able to find alternatives to conventional, more toxic insecticides.'

To describe the molecule as complicated is something of an understatement. It has 16 contiguous chiral centres, seven of which are tetrasubstituted. And there is a diverse array of oxygen functionality – there's a reactive enol ether, a strained acetal, an epo secondary hydroxyl group, a cycl ether, an ester an acetate, a Michael acceptor and a hemiacetal. 'It's a "who's wh of oxygen functionality, all in one molecule!' Steve says.



They decided to try and make the molecule in two halves, and then join the two parts together. 'It seemed a strategically sensible approach, but maybe it was chemically naïve!' Steve says. 'As it turned out, joining the two fragments proved far from trivial and resisted all our best efforts, and we had to devise a different strategy.'

In the end, with the left hand skeleton in place, they used a Claisen enol ether rearrangement reaction, with a gold catalyst or microwave heating, to create an allene. This was beautifully set up for a radical cyclisation reaction that created the right hand side skeleton of the molecule, with all the carbon atoms and stereochemistry falling into place.

Along the way, many important discoveries have been made, not least that cule have disrupting hope to be le to use this information to gen- new struc- that mimic tural prod-

The work over the 22 years has also generated a large number of innovative synthetic solutions to the challenges presented by the molecule. Its complexity means extremely selective chemistry is required. 'It's very difficult to make changes in the presence of such a diverse array of oxygen atoms,' Steve says. 'You correct one thing, and then something else comes and bites you.

'And the synthesis wouldn't have been possible without the advances in mass spectrometry and NMR that have been made in recent years, and the department is fortunate in having some of the best equipment and people to help solve these problems. It's a major achievement for UK chemistry, particularly when you consider how many groups around the world have been looking at the problem.'

Steve is a great believer that champagne is the best reward for a successful synthesis, and azadirachtin proved such a beast to make that a beast of a bottle was required. So in July the group celebrated the success with a Balthazar of champagne – that's 16 bottles in one, or 12 litres.

'This molecule has been one of the biggest synthetic challenges of my career,' Steve concludes. 'Many very talented people have worked on the problem over the years, and it's a fantastic result for all of them that we've finally tamed it.'

CV Steve Ley

Born: Stamford, Lincolnshire.

Status: Married to Rose, who works for him in the department. Their daughter Becky is a molecular biologist, and produced Steve's first grandchild, Eloise, last year

Education: A chemistry degree from Loughborough, followed by a PhD there with Harry Heaney

Career: After a postdoc with Leo Paquette at Ohio State, he moved to Imperial College to work for Derek Barton. He was appointed a lecturer there in 1975, made a professor in 1985 and head of department in 1989, and moved to the BP 1702 chair of chemistry in Cambridge in 1992

Interests: Nice wine, nice food, nice cars and opera. He also collects Chinese snuff bottles

Did you know? Steve has been known to sleep in skips full of autumn leaves, but these days he much prefers five-star hotels!

A fold in time

Most protein folding studies have been carried out in isolation, but what happens in real cells, where there are many other interactions? That's one of the questions Sophie Jackson is looking to answer

Photos: Caroline Hancox

Looking back, Sophie Jackson is a little surprised that she ended up a biological chemist. Studying chemistry at Oxford, she even chose quantum chemistry as a supplementary subject. 'I look back on that now and can't help thinking, with hindsight, that choosing biochemistry instead would have made more sense!' she says. 'But I'd not enjoyed biology at school, and it was only in my last year at Oxford that I had any exposure to biological systems. I spent a month isolating the protein plastocyanin from spinach to look at electron transfer processes. And I found that I really love research, and that there are so many really amazing biological systems out there.'

Having started a PhD at Imperial with Alan Fersht, after a year she moved with Alan to Cambridge in 1988. 'The first year was pretty difficult as I had huge amounts of biochemistry and molecular biology to learn,' she recalls. But she learnt a huge amount across the two projects she worked on, one of which was looking at how a very small protein folds, and the other was on the enzyme subtilisin, which is used in washing powder. 'The process of making subtilisin using Bacillus bacteria is very smelly, and it was hard work trying to measure small changes in biological activity in an enzyme that eats itself!' she says.

Undeterred, she stayed in Alan's group for 18 months after her PhD, and after two years with Stuart Schreiber at Harvard, she returned to Cambridge in 1995 as a Royal Society University Research Fellow to embark on her independent research career. 'I started off with a protein folding project, and over the past decade it's branched out in lots of different directions,' she says. 'In recent years, there has been a lot of work on smaller and smaller proteins that fold faster and faster.

FAST FOLDING

While there was something of a transatlantic battle to find the fastest folding protein, it was actually driven by a desire to have experimental results on systems that were small enough for computational folders to tackle. But many of these proteins are just fragments, and most of the proteins in our bodies are significantly larger. So I wondered whether the rules that have been found for these small, simple proteins can really be applied to these larger, more complex systems. There's a big gap in our knowledge of how these large proteins with complex structures fold, and as these systems are experimentally and computationally much more challenging to study – I now know why!'

Sophie is looking at how some larger proteins fold, and whether what has been found for the smaller fragments can be applied to them. One protein she's studying, green fluorescent protein or GFP, is found in a jellyfish and fluoresces green under blue light. 'We knew before we started that, in comparison to the smaller proteins, there are really large kinetic barriers to folding,' she says. 'We've been carrying out single molecule studies in collaboration with Dave Klenerman in the department. His nanopipette technology is perfect for looking at what's going on in proteins like this, and GFP is an ideal candidate to study.'

What they've managed to do is find direct evidence of intermediate states in the folding process. These states had been inferred from studies on bulk proteins, but being able to look at single molecules means they now have proof of precisely what intermediates are formed during the folding process. 'We've also got direct evidence of parallel pathways,' she adds. We collaborate with Peter Hore's group in Oxford using fluorine NMR, and along with the NMR studies we've done in the department we've managed to identify parts of the protein that we believe are key to the folding process.'

GFP has a very complex set of parallel folding pathways, with large numbers of intermediate states. 'We've started off by looking at unfolding pathways using the single molecule studies, and have managed to find evidence that the protein can unfold through some intermediate state,' Sophie says. 'This is interesting, as most intermediate states are so transient and unstable that they are impossible to observe. But there is a fast-track to unfolding, too, so we can look at both routes. It's been fascinating finding evidence of parallel pathways and seeing intermediate states we otherwise wouldn't be able to see, but we've also established that it's a fabulous methodology to apply to the problem.'

Sophie has also been looking at is knotted proteins – proteins where the long chain of amino acids has a knot tied in it. 'For decades people assumed that these structures would never exist because it was one thing to fold a protein, but quite another to tie it in a knot,' she explains. 'But in the past five years or so, it has become clear that there are quite a few proteins that do, in fact, have knots in them. We have no idea at the moment why they are knotted and what kind of functional purpose the knot serves, but we are now starting to get some clues about how they fold.'

About 300 knotted proteins are known so far, and these cover a whole

CV Sophie Jackson

Born: Preston, Lancashire. She was a premature twin, and her only two months in Preston were spent in hospital with her brother. They grew up in Cheshire.

Education: Studied chemistry at Oxford, followed by a PhD with Alan Fersht, first at Imperial, then Cambridge.

Career: After 18 months postdoc with Alan, she moved to Harvard for two years postdoc with Stuart Schreiber. She came back to Cambridge as a Royal Society University Research Fellow in 1995, and is now a Senior Lecturer.

Interests: She spends much of her spare time engaged in craft-y pursuits. She makes stained glass windows, many of which are presents for friends who are getting married, and the first two she made were of protein structures! She also makes glass fusion jewellery. Away from the crafts, she loves walking, including going on hiking holidays in mountainous regions of the world.

Did you know? Sophie spent last New Year dancing around a campfire in the Sahara desert with Bedouins.

gamut of different protein types, functions and structures, and there are also several different types of knots. Sophie started off with a simple protein YibK, which is a methyltransferase enzyme with a trefoil knot, and is trying to work out precisely when in the protein folding sequence the knot is tied. 'It's not that big a protein, and as well as a lot of kinetic analysis we've been looking at other members of the same family of proteins that aren't knotted,' she says. 'We're establishing the fact that it's possible to unfold and refold a knotted protein in vitro, and the knot can be retied efficiently, both rapidly and spontaneously.'

It's becoming clear that proteins have no problems in knotting themselves. 'A mutation in one protein that has been found to have a double knot is known to be associated with Parkinson's disease, so that could be very interesting to investigate further,' she concludes. 'These are completely novel systems, and traditional folding mechanisms can't be used to suggest how they fold. I can't yet tell you how proteins fold into knots, but we're carrying out numerous different experiments and a lot of protein engineering to find out. Maybe this time next year we'll have more of an idea!'

Protein folders have been making measurements on stability and folding in vitro for a couple of decades, but does all the knowledge they've accumulated actually translate to what's happening in vivo within cells? 'It's a really important question, but it's very technically challenging,' Sophie says. 'We've developed an assay of ubiquitin, a small protein that's extremely widespread, and have introduced mutants with different stabilities to see how stability correlates with function. One of the questions we want to ask is whether there's a threshold stability at which the protein starts to function, and past which further stability doesn't add a great deal to the activity. Or is it a more linear relationship where as you increase the stability, you increase the function? Where diseases are caused by misfolded proteins, more than 80% result from stability issues – the protein no longer works because it's no longer stable enough to fold.'

These kinds of studies are important if we are to be sure that it is fair to translate all the knowledge that has been gained from *in vitro* studies to the real world *in vivo*. 'Our preliminary studies suggest that there we do indeed see loss of function for proteins that are very destabilised, and pretty much normal function for proteins that are only slightly destabilised,' she says.

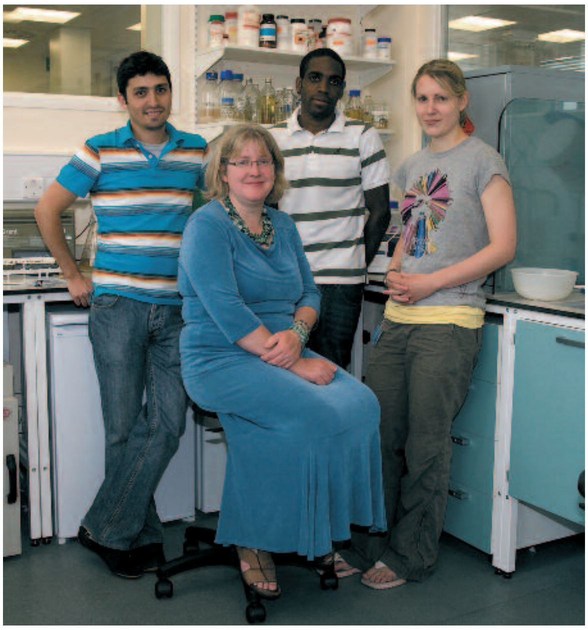
'But it's much more difficult to work in cells than *in vitro*, because it's hard to isolate what we're looking at from everything else that's going on around it. You can do the same experiment many times in the lab and get the same result every time, but once you move into cells, they're very different from each other, even if they've been cultured *in vitro*. We have to do repeat experiments to get averages of behaviour – it's much more a statistical problem of collecting enough data.'

Processes in cells are extremely complex: the activity that's being studied may be influenced by many different factors, such as ions or other proteins. 'You also have to make sure that each of the mutant proteins is expressed to exactly the same amount, but there that's an assumption and there may be some variability,' Sophie explains. 'But in vitro, it's simple to measure exactly how much there is, and you know for sure when you do experiments that the concentration is the same.'

In general, she says, there seems to be a reasonable correlation between stability and activity, and there is a linear relationship rather than a threshold for activity. 'We are getting similar results in cells and in vitro, which is encouraging, because otherwise it would negate all the huge number of experiments that have been carried out in water rather than in cells!' she says. 'I never really believed it would, but it's important to be able to prove it.'

Another important area of work in Sophie's group is on molecular chaperones – proteins that help other proteins fold correctly. 'There are many different chaperones in our cells,' she explains. 'We've been focusing on HSP90, which is interesting for many different reasons,' she says. 'Most chaperones are fairly non-specific, but this one works on a specific subset of client proteins. While these proteins are very diverse in their structures and functions, many play critical roles in cellular processes. The question is, what is the common feature of all of the proteins HSP90 recognises?'

Sophie and the current members of her group – David Pina, Shimobi Onuoha and Anna Mallam



ANTITUMOUR ACTIVITY

There are about 100 of them now, and about 90% are associated with cancer, so it's perhaps unsurprising that the natural product geldanamycin, which binds to HSP90, has very potent antitumour activity. 'If you knock out the activity of HSP90, all of the client proteins that need it to function stop working,' Sophie explains. 'So instead of inhibiting one specific cancer-causing pathway, as many anticancer drugs do, it knocks out a whole collection of pathways at the same time.

'It's interesting how the pharma industry's ideas change,' she adds. 'Specificity used to be essential, but the problem with that is that cancer cells have so many different interconnecting pathways they can develop resistance to the drugs. Now several companies have drugs that target HSP90 in development because taking it out blocks so many different pathways.'

Sophie's trying to understand some of the basic aspects of HSP90's structure and function. 'It's actually a very complex system,' she says. 'It doesn't work alone, but alongside a whole host of co-chaperones, and while it's beginning to become clear what some of these do, for others we still have no idea.

'We've been combining a number of biophysical techniques, such as mass spectrometry in conjunction with Carol Robinson's group, to try and find out what's going on. We've been using mass spec, for example, to look at what happens to the whole protein in drug binding. Remarkably, we find there are very long-range effects – there are changes in the shape of the client protein not just at the end of the protein where binding occurs, but much further away, too. Technically, it's extremely challenging.'

Asymmetric surfaces

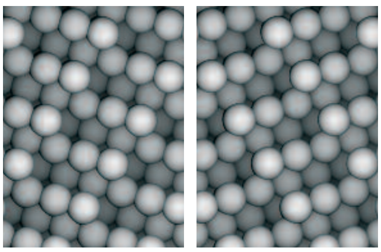
Many industrially important molecules are chiral – they can exist in two different forms, or enantiomers, which are mirror images of each other, a bit like a pair of hands. A common way of making just one of the two enantiomers involves chiral catalysts, where a metal core is attached to a chiral ligand to induce asymmetry in the product. But what if the surface of the metal itself were chiral – could the resulting product be made selectively without any chiral ligands?

That's one of the questions Steve Jenkins is trying to answer with his computer models. 'It would be really useful if we could get a surface to act catalytically in a chirally selective way, either so it would only react with one enantiomer in a starting material that is a mixture of both, or perhaps so it would direct a reaction towards giving more of one product than the other,' he says.

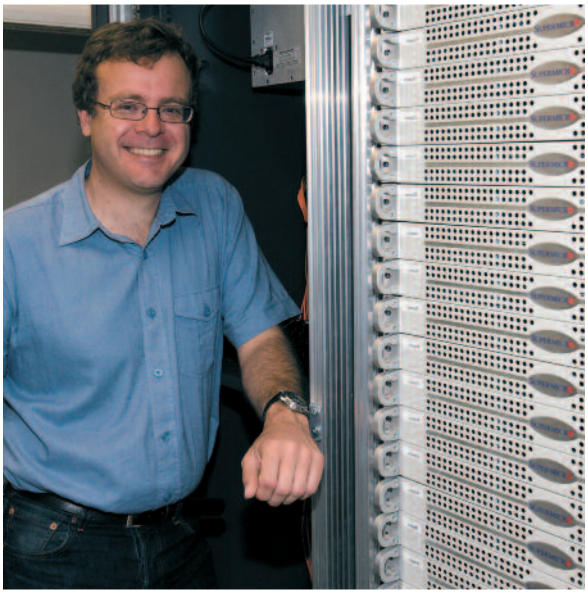
The first problem is getting that chiral surface in the first place. There are, essentially, three ways of doing this. One way would be to use a bulk material that is chiral to start with, but the range of these materials is very limited, and typically comprises minerals like quartz, which aren't known for their catalytic properties. The second alternative is to take an achiral surface and attach chiral molecules to modify its properties, but for this you need to have a supply of homochiral modifier molecules to begin with.

It's the third possibility that Steve finds fascinating. 'What about a material that's achiral in bulk, but has a surface that is intrinsically chiral?' he wonders. 'That would give you access to a much wider variety of materials, such as the transition metals that are familiar as catalysts. It all hinges on the angle at which you slice the crystal, as the arrangement of atoms on the surface varies depending on that angle.'

Surface science studies have historically tended to focus upon just a few different angles of cut, corresponding to simple crystal planes with high symmetry and low energy. In the Miller Index notation, which provides a convenient three-digit code uniquely identifying the plane orientation, these are 'low index' surfaces, {100}, {110} and {111}. More recently, however, interest in high index surfaces, such as {421} or {643}, has been growing, driven by the knowledge that they have a more complex surface structure, and potentially surface chirality as well.



Chiral surfaces with a kink: D and L {421} are mirror images of each other



Caroline Hancox

Could chiral surfaces be used as selective chiral catalysts? Steve Jenkins is trying to find out

'When you cut the crystal at certain angles, rows of atoms make up an array of parallel steps, forming regular ridges like a sheet of corrugated iron, while cutting at other angles can create kinks in those steps,' Steve says. 'For a while now it has been recognised that these structural kinks can be associated with surface chirality, and many people have assumed that kinks and chirality are inextricably linked. Our recent work has shown that this is not the case, however, as we have identified surfaces that are chiral without kinks, and others that are kinked without chirality!'

Together with colleague Steph Pratt, he has just completed a comprehensive analysis of surface structure and symmetry for a number of important crystal types, set to be published in *Surface Science Reports* later this year.

Steve believes that any chiral catalytic selectivity that one of these surfaces will have will be more subtle than simply one enantiomer sticking to the surface, and the other not. 'What would probably happen is that the two would both stick, but in different orientations,' he says. 'That difference might be detectable, and it might also have an effect on the sort of reactions that could happen, as the orientation could have an influence on whether it can pick up another atom from the surface. So even though deposition of the molecules on the surface might not be hugely chirally selective, the orientation could be really important.'

He's focusing on a small group of molecules to probe these effects, starting with two pairs of related molecules – glycine and alanine, and pyruvic and lactic acids – the first of each pair being achiral, the second chiral, and the basic chemistry of converting the first to the second is well understood. 'We've been putting these molecules on copper surfaces, and we find there is a very definite triangular binding arrangement, with each molecule attached to three copper atoms,' he says. 'On achiral surfaces, both enantiomers of a chiral molecule can bind equally well, but on chiral surfaces the necessary three-atom sites are aligned differently with respect to the two enantiomers. It should have quite a marked effect.'

He's also started looking at the reaction pathway for the conversion of pyruvic acid to lactic acid, calculating the energies of the intermediates that are formed on the surface along the way. 'At the moment this is being done on an achiral surface, but eventually we want to do this on a chiral surface as well, in the hope that one enantiomer of lactic acid would be formed preferentially,' he says. 'But the calculations are much larger! Other people in the surface chemistry group are doing practical experiments to see whether the calculations are right, and we're trying to point them in the direction of interesting experiments on the basis of our calculations. And the next important question we're keen to answer is whether it really is possible to use chiral surfaces to induce chirality in a reaction.'

CV Steve Jenkins

Born: Manchester, but moved to Weston-super-Mare aged 5, so considers himself a West Country boy

Education: Studied theoretical physics at Exeter, followed by a PhD there, also in theoretical physics, and a three-year postdoc. He moved to Cambridge – and into chemistry! – in 1997 as a postdoc with Dave King, and has been a Royal Society University Research Fellow since 2001.

Status: Lives in Soham with fiancée Vicky, who's just finished an MA in Communication, Media and Culture at Anglia Ruskin University.

Interests: Reading non-fiction – especially history and archaeology. He spends much of the rest of his spare time creating raytraced digital art, often inspired by his scientific work. He's also an occasional runner, and did a half marathon last year.

Did you know? Steve once ate 60 packs of Wotsits trying to complete a set of collectable freebies, and still goes green at the thought of them more than 20 years later!

What to do next after a PhD?

The chemistry department organised its first residential Local GradSchool at Wyboston Lakes conference centre back in April. Over a long weekend, more than 50 second and third year postgrads from across the school of physical ciences attended the event.

The development of transferable skills is increasingly being seen as an important element of a PhD, but the challenges of completing the research project make it difficult for a postgrad to find the time to stand back and assess where they are now, and what they want to do next.

A GradSchool offers a number of benefits for participants. It is designed to assess and develop personal effectiveness, networking and teamwork, communication, and career management skills away from the workplace. It allows the students to identify ways in which they can develop themselves, to see the relevance of their skills in different environments, and feel more able to promote themselves and their abilities.

Third year student Muhammad Khurram Naseem Qureshi was enthusiastic about the weekend. 'It was somewhere outside of this world where I identified new dimensions both within myself and other fellow participants,' he explains. 'I discovered how we can all help each other be more self-aware and optimise our personalities, through undertaking the carefully designed tasks and activities. It was also an opportunity to try some absolutely new things in a safe environment. I found the personalised feedback from tutors and group participants to be especially useful.

He added that attending the weekend helped him redefine his understanding of a career. 'It is something that everybody searches for, adapts to, and pursues in a quite customised way,' he says. 'It made me recognise the importance of identifying values deep rooted inside us, and how these can determine our selection and choice of careers, and, ultimately our professional satisfaction.'

He believes the GradSchool was a great opportunity. 'I was able to identify, measure and organise my energies, gifts and skills with vision, in order that I may pursue the right field of interest as my future career.'

Feedback from participants identified that the event had been educational and a valuable use of time, although it was found very intensive, undertaken at a fast pace, and run for very long hours over all four days.

One quote from the feedback forms summarised the majority of views expressed: 'It was a thoroughly exhausting experience – but I feel a great sense of achievement.'

Christine Wilson, transferable skills training programme coordinator

Khurrum bending over backwards during one of the activities

The Corporate Associates Scheme

Accelrys
Akubio
Amura
Astex Therapeutics
Astra Zeneca
Biotica
Boehringer Ingelheim
BP
BP Institute
Bristol-Myers Squibb
Cambridge BioTechnology
Cambridge Display Technology
CambridgeSoft
Dow
ETRI
GlaxoSmithKline

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 pay for university-wide access to SciFinder Scholar and ChemOffice. They also make significant contributions to the library for journal subscriptions. Moreover, plans are afoot to provide new undergraduate chemistry exam prizes and new faculty teaching awards, and the CAS has funded four summer studentships.

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;
- Invitations to recognition days and networking events at the department;
- Access to the department library and photocopying/printing facilities;
- Regular communications about upcoming events, colloquia, and updates about the department;
- Complimentary subscriptions to Department publications, including *Chem@Cam*;
- Access to emerging Cambridge research via conferences, special briefings and various publications;
- Priority notification of and free access to departmental research lectures;
- Ability to hold 'Welcome Stalls' in the department entrance hall;
- Preferential conference rates for Corporate Associate members;
- Free access to the teaching lectures held within the department;
- The full services of the Corporate Relations team to facilitate interaction with students, staff, and other parts of the University of Cambridge to help achieve your corporate objectives.

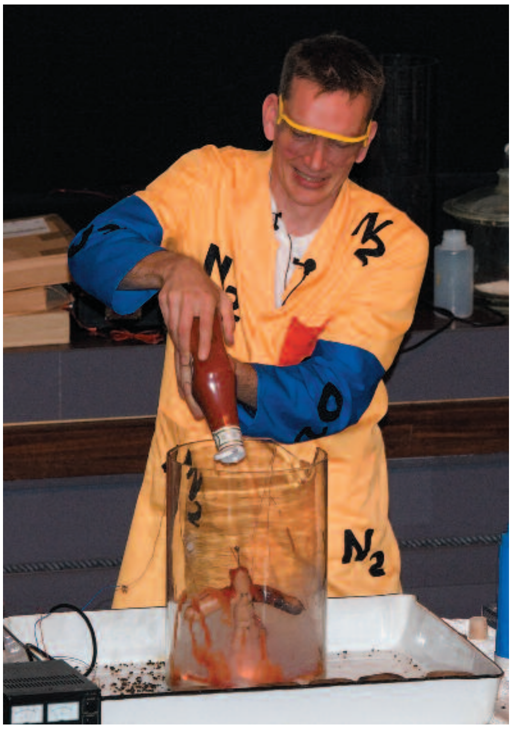
If your organisation would be interested in joining the Corporate Associates Scheme, then please email Jane Snaith at cas-admin@ch.cam.ac.uk, or call 01223 336537.

We look forward to hearing from you!

Insense
Jeol
Johnson Matthey
Kodak
Merck Sharp & Dohme Research Laboratories
Novartis
Pfizer
Proctor & Gamble
Roche
Shell Global Solutions
The Society of Chemical Industry
Shell Global Solutions
Solexa
Syngenta
Unilever

The chemists of the future?

The department was packed with kids for this year's open day. John Holman, Nathan Pitt and Caroline Hancox were on hand to photograph the fun



A strange white film covered most floors in the department on the morning of Monday 19 March. What had happened? Had the Jones group experiments with pharmaceutical powders gone wrong? Was there a dandruff epidemic?

No, it was the spectacular cornflour activity at Open Day. Nick Johnson and his team had a swimming pool of cornflour slime to show off the delights of polymer science. The swimming pool was constructed by our own workshops and filled with about 100kg of cornflour. Nick's explanation of non-Newtonian fluids while walking on water was nothing short of a miracle.

IT'S A GAS

Peter Wothers' lecture this year, It's a Gas!, went off like the many flaming hydrogen balloons used in the demonstration – spectacular! A DVD of the talk will be available in the autumn.

New this year was a huge display by the Centre for Atmospheric Science and the British Antarctic Survey, who showed everything from weather ballons to inflatable penguins. Thanks to Rebecca and all in CAS for this. Also new this year was the Virtual Zone. Tucked away in the Unilever Centre, visitors used computers to visualise molecules, the ones that were on display in the smelly Model Zone. Thanks to Jonathan Goodman and Ramla Shahid for setting this up and proving that virtual chemistry can be part of these public displays. And thanks to Silvia Gonzalez-Calera and Tom Anderson for the fragrant Model Zone where ball-and-stick models of chemicals in everyday smells (pleasant ones!) could be constructed.

Many of the usual favourite hands-on experiments were available. I cannot mention everyone by name, but the cryobananas show from Joel and the Lambert Group also had an ice-cream stall where fresh ingredients were converted into a decadent ice-cream with just the right amount of liquid nitrogen. And Jen Ryder switched Prussian Blue for Blue Goo and with the Unilever Group sent hordes of children home with multicoloured putty.

Open Day would not happen without the support of the sponsors. We are again very grateful to Eric Walters and the Walters Kundert Trust for the generous support that underpinned all the activities. We also thank Kimberley-Clark, Fisher Scientific, Cochranes and the RSC. And thanks to the St.John's Ambulance team who were in attendance, although they had a remarkably boring afternoon. For the first time in the organisers' collective memory, there were no incidents requiring St John's attendance. Are we 100% safe? Only through proper risk assessment and...

...and so on to next year's Open Day, which will take place on Saturday 16 March. Watch out for publicity regarding new activities and competitions for researchers. Details will be announced at www-openday.ch.cam.ac.uk

Around 2000 members of the public came through our doors, and about 200 students, researchers, staff and academics helped out. Thanks to all of you who worked so hard and brilliantly. Special thanks must go to Emma Powney for her brilliant and hard work in the lead-up to event and on the actual day.

Paul Barker

Theoretical identification

The photo of 1960s theoretical chemists in the last *Chem@Cam* generated lots of name suggestions. Here's the correspondence, and the full collection of names has been collated under the photo. We're now missing just one, if all our suggestions are accurate – second right on the middle row. There's also some confusion about whether Bryan Nicholson is in the photo and, if so, which face he is. Any further suggestions would be gratefully received!

Front row: Andrew Hudson, Mark Child, Ruth Lynden-Bell, John Murrell, Christopher Longuet-Higgins, Lionel Salem, Ian Mills, Bill Dixon, Colin Thomson; Middle row: Robert Lloyd Evans, Terry Miller, Anthony Stone, Alan Carrington, Andrew McLachlan, Peter Todd, ???, Bill Jones; Back row: Gavin Currie, Paul Dyer, Douglas Abraham(s?), Steve Graham (or Ted Edgar?)

Dear Editor,
The photo was taken when Christopher Longuet-Higgins had just announced that he was leaving the subject of theoretical chemistry and moving into artificial intelligence. A small conference was organised at Cambridge, of his students and former students, to celebrate his achievements. The date was early 1960s. It might have been summer 1963, or possibly 1965 (I was away in the US on sabbatical for the academic year 1963-64). Many of us presented short papers on our current activities. I have this photo enlarged and framed on my office wall. I myself worked with Christopher as a postdoc for one year, 1956-57, when I had just returned from two years at the University of Minnesota.)

I should be able to provide all the missing names, but of course I am failing at that game, despite being familiar with all the faces. However, I can do some. To the left of Anthony Stone is a youthful-looking Terry Miller, now full professor at Ohio State (he was post-docing with Alan Carrington, who was a director of research in Cambridge with Longuet-Higgins at the time). Terry Miller now runs the Columbus Conference, the big annual spectroscopy conference in the US.

To the left of Mark Child is a man who went to the department of chemistry at Canterbury, where he was a lecturer for many years. He did ESR research. He must be retired now.

Ian Mills, Emeritus Professor of Chemistry University of Reading

Dear Editor
I was a student of Colin Reese between 1964–67 and remember some of the people in the photo of the department of theoretical chemistry published in the latest *Chem@Cam* (which I find a very interesting read, even though chemistry no longer plays any part in my life).

In the middle row on the left is Robert Lloyd Evans who published some work on string theory after he left Cambridge. In the middle wearing glasses is Bryan Nicholson who gained a Fellowship at Trinity College and studied at Harvard (I think). He is no longer in chemistry.

Now for a few guesses. On the right of the back row is probably Ted Edgar, and to his right is possibly Douglas Abrams.

The picture will have been taken between 1964–67 because Robert shared a flat with me during our time at Cambridge.

Keep up the good work on the magazine!

Yours sincerely
David Martin, Marple Bridge, Stockport

Dear Editor,
I can identify one of the back row of the theoretical group on page 13 of the spring 2007 issue. The young man with glasses, dark hair and a rather fetching shirt is Douglas Abraham – grand master of the Ising model and the like and a professor in the department of theoretical physics in Oxford.

He taught me during the year I spent in Oxford, before I returned to Cambridge to finish my PhD with Antony Stone after my Oxford supervisor, Charles Coulson, died.

Yours sincerely,
Robert Tough

Dear Editor
The very tall guy, second from the left, is certainly Paul N. Dyer, who graduated with a First in 1965. Best wishes for an excellent magazine.

Jim Miller, Department of Chemistry, Loughborough University

Dear Editor,
I think that the person at the right on the back row is Steve Graham.

He was an undergraduate at Queens and became a PhD student in about 1963.

Stu Whittington, Department of Chemistry, University of Toronto

Dear Editor,
As the ? in the front row next to Mark Child, I can identify a few more of the people in the photograph. At the other end of the front row beyond Ian Mills are Bill Dixon and Colin Thomson. Peter Todd is next to Andrew McLachlan. The photograph was taken at a symposium held to mark the move of Christopher Longuet-Higgins from Cambridge to Edinburgh. It was probably taken in 1967 – it was after I took up an appointment at the University of Sussex in 1966. Some of us in the photo met up again many years later at the memorial Service held for Christopher Longuet-Higgins in Brighton.

Yours
Andrew Hudson
Piltdown, East Sussex

Dear Editor,
I can throw some light on the Carrington photo identities. I was not there so it wasn't 1963-1966, but I remember all but one of them, although I can't put a name to all of them. It does not look like an annual department photo; there's no secretary. Many on the front row had left before I arrived, but those at the back overlapped with me and were there after 1966.

On the far left of the front row is Andy Hudson, a student of Alan Carrington 1962-65, who postdoced in New Zealand, was a lecturer at Sussex, and is now retired

At the far right of the front row is Colin Dixon?, a postdoc with Alan C 63-64?, then a lecturer at St Andrews. He drove an Armstrong-Sidley car in which he survived a serious accident. I think he has since died.

Second left on the middle row is Terry Miller, a student with Alan Carrington on a Marshal Scholarship from 1965-68, so he went with Alan to Southampton. He's now a professor at Ohio State, where he runs the annual Columbus Spectroscopy conference.

Third from the right of the middle row is Peter Todd, a student of Alan Carrington 1961-64, who I think went to work at Esso in Cheshire

On the left of the back row is Gavin Currie, a student of Alan C, 1965-68?, in Cambridge and Southampton? He drove a Morris Minor, postdoced at NRC Ottawa, and then worked for Statistics Canada, possibly on the build up to the Montreal Olympics

Next to him is Paul Dyer, a student of Alan C 1965-68, at Cambridge and Southampton. And next to him is Douglas Abrahams, a statistical mechanician, subsequently a lecturer at Oxford.

The name of the last person on the right escapes me, but he worked with Christopher in the molecular symmetry group, and may have gone to Africa after his PhD.

Best wishes
Richard Moss
Penrith, Cumbria

Portraits of the 1950s

Regular readers of *Chem@Cam* will remember that back in Autumn 2005 we published an article by Antony Barrington Brown about the iconic photograph that he took of Crick, Watson and the DNA model. Antony's been back in contact, with more photos. He writes...

Dear Editor

You will recall that you kindly published a couple of reminiscences of my time in Cambridge in 1948–51.

After only a brief time with Esso Research as an analytical chemist, I returned to Cambridge to set up as a photographer in Park Street opposite the ADC. My studio and all the adjoining properties were demolished when the multi-storey carpark was built.

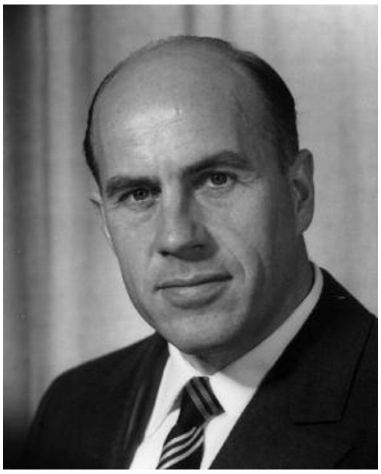
Much of my photographic work was portraying dons at the behest of their colleges, and also some scientists individually, in their place of work. In case you might be interested, I'm sending you prints of some chemists taken in the 1950s.

All my portrait negatives are soon going to the National Portrait Gallery.

Yours sincerely,

Antony Barrington Brown
Warminster, Wilts

Some of the photos are reproduced here; the rest will be published in the next issue. While we know a lot about some of the subjects, we're a little hazy about a number of the others, and would love to hear from anyone who can tell us more.



Left: Ralph Gilson, taken in 1957. Gilson was Todd's administrator in Manchester, and moved with him to Cambridge
Right: George Kenner, 1953. A porphyrin chemist who went to Liverpool, and enthused Alan Battersby in the subject
Far right: B.R. Brown, 1953. A marvellously filthy labcoat, but who is he?

Far left: J.H. Schulman, 1953. Does anyone know any more about who he is?
Left: Morris Sugden, 1953. Physical chemist whose prime interest was in combustion, with a sideline in microwave spectroscopy
Right: John Lennard-Jones, theoretical chemist famous for the Lennard-Jones potential

Photo: Nathan Pitt

It's a very small world...

Yusuf Hamied, chairman of Indian drug company Cipla and a former student with Lord Todd, is a regular visitor to the department, and generously paid for the conversion of cold, uncomfortable Room G19 into the wonderful space that is the Todd-Hamied room, complete with exhibits about the life and work of his former supervisor.

Earlier in the year, Yusuf was back in Cambridge to be inducted into the University Guild of Benefactors in recognition of his donations to both chemistry and Christ's. At the ceremony, his wife Farida told Jeremy Sanders an interesting tale – on a recent flight to Delhi at Christmas she'd got chatting to the young woman sitting next to her on the plane, and it turned out she was a Cambridge chemist. Not only that, she was extremely complimentary about how great the Todd-Hamied room is for having meetings in.

On his next Cambridge visit, Yusuf popped in to see how the room was looking, and it turned out that Jeremy had been doing a little detective work. Armed only with the knowledge that she was a PhD student from India, he'd managed to determine that the young woman in question was Sunita Kumari, who's in Shankar Balasubramanian's group.

Jeremy arranged for the pair to meet up in the Todd-Hamied room, and photographer Nathan Pitt was on hand to record Yusuf's delight at meeting her.

Nic's front page fame


ATHENS NEWS

Firefighting fatigue claims lives

When Nic Davies, the technician who runs the Part Ib lab, was visiting his parents in Greece this summer, he managed to get one of his photos on the front page of the national English language newspaper.

'Greece was on fire for two or three weeks because of the heatwave,' Nic says. 'Fires were raging about 5km from my parents' house in the Peloponnese, and we saw the smoke billowing over the hills. So my dad and I headed uphill to look at the planes dropping water on the fire to try and control it, and as I'd taken my camera with me I took loads of photos.'

He sent a picture to the Athens News, which his parents get every week, and thought it would be amusing if they spotted his picture in the paper after he'd gone home. They used the dramatic shot of the plane emptying its water on the front page. And yes, it was spotted!

He says it was really sad watching the olive groves burn. 'An olive tree takes 20 years to become productive, and we could see people's livelihoods literally going up in smoke,' he says.

Greece was incredibly hot while Nic was out there – when he arrived at the end of June the temperature was an astonishing 47°C! It stayed over 40° for the next week, before cooling down to a positively chilly 38°. 'I was really glad to cool down when I got home as it was far too hot for me,' he says. 'And I'd forgotten what clouds look like – I'd not seen one while I was out there!'

The fires caused devastation, but made for some dramatic photos

Mykola Karabyn says a sad farewell to Irene Derungs Ollero, who worked with him in the lecture theatres

Photo: Nathan Pitt

Comings & goings

New staff

Sian Bunnage
Carlos Davies
Danute Griksiene
Oliver Norris
Ernesto (William) Prist

Leavers

Anthea Bramford
Angela Locks
David Hadaway
Sarah Maslen
Catherine Gibbs
Irma Kvarinskaite

Retired

Chris Rayner

Another little Spring

This issue's 'aaaaaah' moment comes in the shape of Oliver Spring, son of Dave. Born on 27 May at the Rosie maternity hospital, he weighed in at 7lb 5oz and Dave reports that all went well.

Daughter Elizabeth was born in August 2005, so Dave and his wife Lauren are being kept rather busy. 'He's putting on a lot of weight,' he claims. 'He's a hungry boy and complains if he's not being fed every two hours…'

Oliver takes a quick snooze before his next feed

Marko practises his best cheesy grin

Smile, please!

Thanks to a mix-up by one of *Chem@Cam*'s spies, last issue's report of two boys born on the same day was slightly inaccurate – Tanya Radic's son Marko was actually born the day before Stuart Mackenzie's son Fraser.

However, it does give us a good excuse for a bonus baby photo. This one of the marvellously smily Marko was taken by photographer John Holman for his passport.

'As Marko's a New Zealand citizen by descent, he needed a photo with his birth certificate to get into the NZ books,' Tanya explains. 'So it seemed sensible to get him a passport at the same time.'

Fun and games

This year's sports day was held at the Leys School playing fields, with the usual mix of sports like football, cricket, rounders, boules and croquet. Caroline Hancox had her camera at the ready

Photos: Caroline Hancox

Last issue's winners

Chemical crossword

Graham Quartley's latest Chemical Crossword produced another fine crop of entries. Correct answers came from:

Michael Aicken (who continued his pub theme with one of a hostelry he found on holiday in Cornwall), M.W. Pascoe, David Norman, W.G. Roberts, Peter Keefe (who spotted *Chem@Cam's* deliberate error – 'I must be getting old at 78, as I cannot tell the difference between SPaNiSH and SPaNiSH!), Jim Dunn, Clifford Price (who claims it helped to while away a long trans-Atlantic flight, a joint effort from the Walker family of Bovey Tracey, Ed Moll, Reginald Lewis (who says that his win in last issue's Chemdoku prompted a contemporary of his to write to him – so there are at least two 80+ year olds reading the magazine, which at least goes some way to helping those who only had to learn about 90 elements keep up to date), John Salthouse (who reports that he's now retired but was up at Cambridge from 1959–65, doing his PhD from 1925–65 under the supervision of Tom Waddington, before moving with him to Warwick, and then put in 30 years as a lecturer/senior lecturer at Manchester), J. Billingsley, Bill Collier (who sais, 'What a delightful crossword, and what a pleasant change from the Times Jumbo! My daughter – also a chemist – and I had a good chuckle over some of the answers), Paul Littlewood, Richard Brown (who answered *Chem@Cam's* plea for nice postcards and sent in one of a stained glass window), Richard Moss, Keith Parsons, Tom Banfield, Ian Potts (who claims it was elementary only in the chemical sense), Paul Stickland (who claims Trinity 1951 and hence must be another of our septuagenarian readers), John Malone, John Carpenter, David Thompson (who says he's been in the fertiliser industry ever since he left St John's in 1964, Roger Duffett, Annette Quartly (who says she's married to the setter but did it herself!) and Keith Preston.

And the winner is… David Thompson. He adds… '5 across caused me some amusement. Potash in the fertiliser business refers to potassium chloride, although the analysts still prefer to refer to the oxide form in representing the potassium content, even though the oxide is not there – t'would be an interesting problem to keep potassium oxide in the huge quantities that mineral fertilisers are needed in. I've had no end of problems over the years in the business trying to explain to non-chemists what is going on! It is almost as bad as trying to explain to a marketing type why urea only has 46% N – they ask why we can't sell the more concentrated form before you dilute it!'

In case any readers remain bamboozled, the correct answers are:

Across: 1. SUPErB; 5. POTaSH; 9. PaNdAs; 10. LaScAr; 11. CHeAtS; 13. TiErS; 14. OAr; 15. ReAl; 16. AlKAlINe; 19. URn; 21. CoSmOPOLiTaN; 24. SUNSHINe; 26. NOWHeRe; 28. BOOTh; 30. AlGa; 31. GaSbAg; 32. CURbS; 33. ThIn; 34. SAcCHArIn; 35. SLaY; DOWN: 1. SPaTiAl; 2. UNdEr; 3. PAsS; 4. BLaCKSmITh; 5. PArSnIP; 6. TaCO; 7. SHeAr; 8. HAt; 12. STeRn; 15. ReInSTiGaTe; 16. AlCoHOLiC; 17. AlONe; 18. NeON; 19. UNHeAlThY; 20. BiNBAgS; 22. LiONeSS; 23. TaW; 25. SO; 27. ReGaIn; 29. BrUIn; 32. CAr.

Hidden identity

The 'Hidden Identity' problem had the entire readership bamboozled. However, we did have this marvellously creative contribution from Roger Duffett. He says:

After lateral broodings that have caused me to dip into areas of my subconscious that I have not visited for some time, I wish to submit for your delectation the following solution.

It is evident that the noun that emerges from the progression from HI to LO is associated with an allusion to he Fall of Man, as described in Genesis Chapter 3 verse 24.

'So He drove out the man; and He placed at the east of the garden of Eden Cherubims, and a flaming sword whirling around to guard the way of the tree of life.'

As a stranger to the nuances of Cambridge politics, I can neither identify the man who has fallen from grace nor the constituents of the angelic host. However, the 9-letter noun is undoubtedly Cherubims, even though the Hebrew plural formation does not actually permit this word. Nevertheless, English speakers frequently use it in preference to Cherubs, which has a slightly erotic connotation, or Cherubim, which seems insufficiently plural to define such a multiplicity of elevated entities.

The word is derived as follows.

SIX AND II are the atomic numbers of C and He.

YOUR LUMINOUS GUIDING CLUE is Ru (Ruthenium), an invaluable element in solar technology.

BE ELEMENTARY is a double bluff, not referring to Beryllium but heard as B (Boron).

HMM! An inquisitor with a less labyrinthine mind, or less addicted to erotic fantasies, would have stopped at Cherubs. However, his desire for a 9-letter noun has caused him to resort to a paired alignment in a Hidden Markov Model (HMM), thereby introducing the final letters IMS (familiar as the acronym for Intra Model Sets.

I must now sit quietly in the shade with a cold compress on my over-heated brow to recover.

Unfortunately for Roger, Chem@Cam's normally impeccable archaeological filing system appears to have separated the solution from the question… so he'll have to wait until next time for the correct answer. Anyone else have any further suggestions, or are you all stumped?

£20 prizes are on offer for both puzzles. Send entries by email to jsh49@cam.ac.uk or by snail mail to *Chem@Cam*, Department of Chemistry, University of Cambridge, Lensfield Road, Cambridge

This issue's puzzles

	Pb		Pd				Pr	
				Po		P		
Po	Pu							
		Pa	P	Pu	Po	Pb		
					Pt			Pr
		Pt						
					Pb		Pa	
Pa			Pu					
	Po			Pa		Pt		Pd

It's back to the old Chemdoku this month, only this time it's been set by Keith Parsons, which rather saves *Chem@Cam* the bother of devising one herself. Keith calls his puzzle Pseudoku, and the nine chemical elements whose symbols start with P (hence the P) are to be arranged in the grid such that, with an extra (hence the E) rule, none of the elements is repeated along each main diagonal, as well as in each row, column and 3x3 square.

Transmutation

Graham Quartly's back with a transmutation problem. He says:

We all know the parlour game of changing one word into another by changing a letter at a time. This can be taken on at a chemical level to turn lead into gold, viz.

LEAD – LOAD – GOAD – GOLD.

The challenge is to turn a chemical element of more than four letters into another, by once change of letter at a time, at each stage leaving a valid English word, with no proper nouns allowed. The fastest transmutation wins!

Maintaining order

Our roving reporter Don Flory talks to senior building service technician John Palmer about his Irish roots and naval past

Photo: Caroline Hancox

It only takes a brief word from John Palmer to tell you that he hails from the Emerald Isle, but whether his lively, seamanlike gait indicates years of service in the Navy is debatable! John, the department's senior building service technician and maintenance supervisor, has worked in Lensfield Road for nearly a decade, and his maintenance group now consists of three electricians, two plumbers and a carpenter.

'The original parts of the building are a bit of a pain in the backside!' he says. 'There are lots of leaks and problems like that. But I love working here.'

John was born in Belfast and spent his schooldays there, and it was soon after he left school in the late 1960s that the sectarian violence took hold. 'Luckily for me, I lived in a quieter Unionist part of the city, well away from the large "no-go" divided estates. during the early days of the conflict,' he explains. Nevertheless, it was always devastating to discover that someone he knew had been shot, and especially so when four of his old schoolfriends were killed in the violence.

From school, he became an apprentice fitter at a textile manufacturer in Belfast, but towards the end of this apprenticeship he broke his ankle, being off work for three months before being made redundant. 'I hung around Belfast for six months, then one day I was walking past a Navy recruiting office, and I thought, "What the hell!" and joined up. At that time, there was very little going on in Belfast, and it seemed there was little hope for the future, and with the conflict in full swing I thought signing on for four years in the Navy would be a way of getting out and starting a new life.'

John had never been away from home before, so it was with some apprehension that he made the long trek from Belfast to Plymouth to join a land-based training centre at HMS Raleigh. After a few weeks being instilled with Navy discipline, he transferred to HMS Sultan, a land-based engineering school in Gosport, where he spent six weeks doing basic training and learning something of the workings of naval machinery.

TOUR OF DUTY

His first proper placement, as an engineering mechanic, was on an odd-looking ship called HMS Blake, a second world war destroyer that had been converted to take helicopters. After a spell on board travelling around the UK and the Mediterranean, and a further tour of duty on HMS Matapan, a sonar trials ship travelling around the UK, John joined HMS Reclaim. At that time, it was the oldest ship in the Navy – a King solver class tug – used as a deep-sea diving ship for testing sea-diving equipment, and which had a diving bell and decompression chambers.

'I had the task of struggling to look after the very old engines as we travelled around the Mediterranean and other European seas,' he says. 'After five years, and with not much leave to speak of, I decided I wanted to spend more time on land with my wife, Grace.' He'd been married for three years, having met his wife at a disco when he was with HMS Sultan in Gosport, where her father was serving in the Fleet-Air-Arm. By this time, they had a year-old daughter Angela (a son, Michael, was to arrive four years later), and John felt he couldn't say no when Grace asked him to leave the ship.

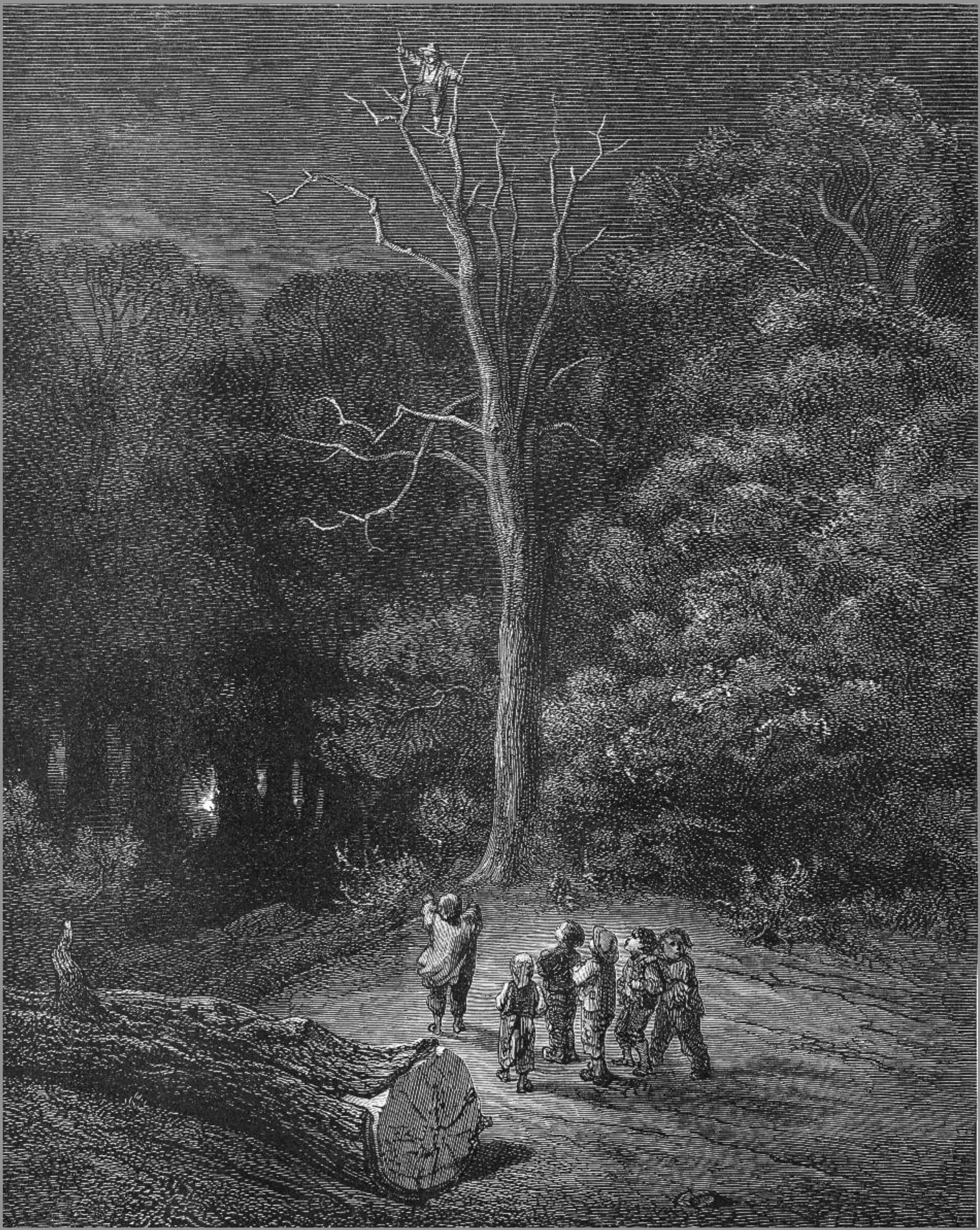
'I left the old tug, and we moved to Newcastle for a year, the Navy having decided I could spend some time with HMS Exeter, a destroyer that was being built in the Swan Hunter shipyard on Tyneside. My job was as officer's writer, a sort of secretary aiding the commander of the ship,' he explains. But they were soon heading back south to Gosport, with John back studying at HMS Sultan's engineering school where, at last, he became fully qualified as an engineering technician.

By this time, John had been in the Navy for 11 years – rather more than the four he originally signed up for – but his final three years of service were to prove the most exciting and interesting. Up to then, he had hardly travelled far on the high seas, but his transfer to the engine rooms of the aircraft carrier HMS Invincible at Portsmouth was to change all that. The ship was home to more than a thousand seamen, and carried dozens of aircraft, and John finished his Navy days travelling to the Far East, Caribbean and Mediterranean, which he describes as a fantastic experience, all paid for by Her Majesty's Government.

But in 1986, 14 years after signing up, it was time to move on. 'My daughter was 10 and my son five, and it was time for them to have a more stable existence,' he says. 'I found a job at a computer company in Harston near Cambridge, and managed to get a house in the village under a government housing scheme, where we still live.'

But after seven years as its building services technician, the company folded and he was made redundant. After five years at a local water treatment company, John came to work at Lensfield Road in 1998. 'I really enjoy working in the chemistry department,' he says. 'Every day is different, and I get to meet so many interesting people.'

His activities outside work – three nights at the gym every week aside – are somewhat limited as his wife is now disabled with rheumatoid arthritis, but they now have four grandchildren, three boys and a girl. Could it be that John's tales of life in the Navy will prompt them one day to follow in their grandfather's footsteps?



Look! I can see the chemistry department from here!

UNIVERSITY OF CAMBRIDGE

Chem@Cam is written, edited and produced by Sarah Houlton

Printed by Cambridge Printing, the printing business of Cambridge University Press