chem@cam

Chemistry at Cambridge Newsletter

Autumn 2007

Simulating chemical processes

Hydrogen bonds and catalysts

The magic of helical nanotubes

Innovation – the lifeblood of science

The main aim of the Chemistry Innovation Knowledge Transfer Network is to improve innovation performance in the chemistry-using industries. Sarah Houlton spoke to its chief executive, Carol Boyer-Spooner, about its role

What is the Chemistry Innovation KTN?

Back in 2002, the DTI put together the Chemistry Innovation Growth Team, which identified a number of areas where action was required to improve performance across the UK chemistry-using industries. This led to the formation of a chemistry innovation centre, pulling together people from academia and industry. In 2005, the government brought in the Knowledge Transfer Network concept, and we adjusted our business plan to fit into this new model. The CIKTN was launched in February 2006, backed by £4.6 million in funding over three years from DTI, and we started the journey of rolling together the three former Faraday Partnerships – Crystal, Impact and Insight – into Chemistry Innovation.

We began to transform what was, essentially, a technology push activity into a connector activity, and set up three stakeholder forums to get input from chemistry users. The Innovation Strategy Board (ISB) includes more than 20 leading industrialists, and their task is to provide strategic direction and advice on the innovation priorities for the chemistry-using sector. The Academic Stakeholder Forum (ASF) looks at the strategic issues involved in how academics engage with industry, how barriers between them can be removed, and whether the skill sets needed by industry to deliver their priorities are available. And the aim of the Regional Stakeholder Forum (RSF) is to align strategies and promote partnership so that the funds government puts into the regions are effectively linked with central government funding, which primarily comes from the new Technology Strategy Board.

So what are your aims?

There are several! To deliver improved industrial performance; drive knowledge transfer right along the supply chain and provide unique 'independent' networking opportunities to connect stakeholders. But the overriding aim is to provide a coherent voice for the chemistry-using industries to government. The sector is very fragmented, with 23 separate trade associations. We are therefore trying to corral the troops so that government is more likely to support chemistry!

We do this primarily by connecting people. One of the most important things when we started out was to set out a clear strategy outlining the drivers for industry, and we have identified seven priorities for the chemistry-using industries. Some are technology-focused, and others are 'softer' things – which this industry is not so good at doing – such as creating a culture of innovation, and ensuring the necessary skills are available to take an idea and transform it into a profitable business.

Another important role is securing funding to carry out innovation projects – and making sure the sector gets its fair share of government support! As well as the core funding – formerly from DTI and now under the auspices of the Technology Strategy Board – there is additional funding from the EU, research councils and the regional development agencies. For example, we're currently putting together a materials chemistry project in the north-west that will bring together the four big institutions for materials in the region. There will be £7 million of RDA funding, and we also hope to draw money in from EPSRC and the government, adding up to a total project of about £30m over five years.

What have you achieved already?

I think developing a coherent strategy for the sector is a significant achievement in its own right, as we've been able to provide clarity to government about what is important for this industry. I also think we've done well to get the subsectors of the chemistry-using industries to speak with one voice. That might not sound like much, but to get so many diverse sectors saying the same thing was a challenge! When members of the ISB listed their priorities, it was noticeable that there were a number of issues that they all felt were important, whether they were from big or small companies, working in drug discovery or paint manufacture. Some had a different emphasis to others, of course, but we still ended up with seven priorities that everyone bought into.

We also now have a chemical industry representative on the Technology Strategy Board, which should make a difference. We've also changed the structure of how things operate – by asking industry what the barriers to innovation are, and then helping them to connect with people who can remove them. From the innovation strategy board's point of view, innovation leadership is a key topic that needs addressing – how we get organisations to change their cultures to encourage innovation, rather than just r&d is a key focus for us.

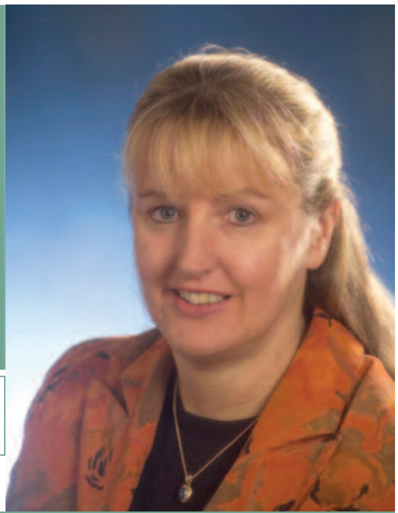
What importance does all this have for people studying chemistry?

Firstly, we hope it will turn a career in chemistry back into something that they are likely to consider! I hope it will be more obvious that the sector does 'good' things and is a real career choice. We're slowly and surely getting there – the government is now starting to talk about modern manufacturing rather than the demise of the sector. The traditional image of the chemical industry is large factories making bulk products like chlorine and polypropylene, but the future will not be like this – it's about emerging technologies and how we can exploit them for the benefit of society as a whole, while also making money for UK plc. Industry needs to be clear about what sustainability in the UK actually means – fortress UK doesn't exist, and we have to look beyond the boundaries of the UK, and exploit best practice, wherever it is.

So what's next for CIKTN?

When it comes to our three-year review in about a year's time, we want to be able to demonstrate five or six big things that are going to make a difference. I think these will include areas like biorefineries, materials chemistry and probably something in the area of formulation. Rather than tinkering at the fringes with small projects that individual companies are best doing themselves, our role is to promote big investments, such as the materials chemistry project, that can really make a difference.

CV Carol Boyer-Spooner



Born: Kyneton, near Melbourne in Australia

Status: Married with three stepchildren

Education: Graduate from the University of Melbourne as a bachelor of business

Career: She began her career in the commercial side of ICI Australia, and stayed with the company for 23 years, heading to Singapore as chief operating officer of the decorative business, before moving to the UK to do a similar role in Europe in 1999. In 2004, Carol moved to Chemicals North West as chief executive, and went on to become chief executive of the Chemistry Innovation KTN when it was formed in 2006.

Interests: Carol loves sport, including skiing and Aussie rules football – though as it's something of a challenge getting to watch it live over here she's adapted to watching football, and is now a Bolton Wanderers fan. She also played basketball for Victoria back in Australia. Other loves include food, wine and connecting with friends.

Did you know? She used to be a passionate republican but completely changed her mind after meeting the Queen! Her family are shocked at her new royalist sentiments…

More poetic licence

Dear Editor
This is a further contribution to your theme of verse composed around Sir Alexander Todd (*Chem@Cam*, Summer 2007). I wrote down the bit I can remember of a cabaret songs I composed for the Chem Lab Christmas party between 1954 and 1960. The 'knight' in the song was, of course, Professor Todd, who had been awarded a knighthood that year.

Why can't we knights wear armour every day ?
I'm a charmer in my armour
(So the boilermakers say)
So I would LOVE to wear it
It would make me feel tres gai
Why can't we knights wear armour every day?

Why can't they see that armoury
Is as safe as houses?
I'd be just as placid if caustic or acid
Were spilt by mistake on my ferric blouses.
And the Teddy boys of Cambridge...
...think the world of my drainpipe trousis!
Why can't we knights wear armour every day?

The performers were all research students of B.C. Saunders. Poznan Mirosevic-Sorgo was the presenter and organiser of the cabaret. Romantic songs were supplied by Harry Goldwhite, an excellent, trained tenor. I did the music, including songs at the piano. In defence of the awful doggerel, I may say that gently satirical shows were popular then (*At the Drop of a Hat, Beyond the Fringe*) and the verses were not meant for posterity. One aimed to be irreverent but not obscene and have at least one chemical quip per verse. Alex, in the front row, responded by grinning quite a lot and he still talked to me afterwards. In following years, I did the cabaret with Roy King, a student of John Harley-Mason, who also worked behind stage at Arts Theatre shows.

Regards to the Chem Lab
Andrew Holmes-Siedle
Eynsham, Oxfordshire

A brilliant man

Dear Editor
I am writing in response to your request for information concerning B.R. Brown, the chemist in the 'marvellously filty labcoat'. Incidentally, in earlier editions of *Chem@Cam* he is in a photograph of cricketers taking part in a game between the Oxford and Cambridge laboratories. I think, however, he was then back at Oxford.

I was very fortunate that, over the years, I came to know Ben well. I followed him as a postdoctoral student on the same research problem – pigments of the aphididae – which Ben studied in Cambridge under Professor Todd. In the subsequent years, a part of both our research interests followed very similar lines, and as a result our paths crossed regularly. He was a person of very great integrity and modesty, and talked only rarely of his background preferring, particularly on a cold, grey damp November day, to draw your attention to the magnificent fire of anthracite burning in the fireplace of his rooms. It was the envy of all of his colleagues – the coal brought directly from South Yorkshire in the cavernous boot of his car on a recent visit to see his mother, a miner's widow. He was, nevertheless, immensely proud of his upbringing, and of a wonderful chemistry master at Mexborough Grammar School who had inspired him – and many others – to undertake a career in science.

There was, however, much more to Ben than chemistry, for he was also a distinguished international amateur sportsman. Very sadly, he died some 15 years ago from motor neurone disease. His Times obituary has a trio of eminent signatories, Ewart Jones, J.H. Melanby and J.A.N. Railton, and I quote part of their warm and eloquent tribute: 'And all this was present in a man whose origins would please the college selectors of today, seeking as they do for the brilliant young men and women whose backgrounds have not given them the easy opportunities of the middle classes in the competition for university places.'

Ben's path through education 50 or so years ago was a familiar one. Since those days, the thriving mining communities in South Yorkshire – Wath-on-Dearne, Swinton, Mexborough, Grimethorpe and others – have been devastated both socially and economically. It is a similar story elsewhere in the country. Sadly, despite the optimism which accompanied the fundamental changes in the organisation of secondary education enacted in that same period, there seems (paradoxically, perhaps, to those whose expectations of these changes were highest) to be an increasing disparity emerging in educational achievement for schoolchildren from different social and economic backgrounds.

One may debate the reasons why, but it now makes the chances of those 'brilliant young men and women whose backgrounds have not given them the easy opportunities of the middle classes in the competition for university places' so much more difficult. Yet, as Ben's career so vividly demonstrates, these scholars are just those the country most needs in all areas of its economic and national life. It is a problem that, I suspect, should be addressed sooner rather than later; if not in Oxford, then why not Cambridge?
Yours sincerely
Edwin Haslam
Harle Syke, 7 Curie Mews, Exeter

You can read more about Ben Brown on p12

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Himesh Fernando, a PhD student in Shankar Balasubramanian's group in the Centre for Biological Chemistry

Photograph:
John Holman and Nathan Pitt

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New role for Dave

The environment will remain a huge focus in Dave's new position

Dave King finishes his seven-year term of office as the government's chief scientific advisor at the end of the year, but he's found something else to fill the four days a week he's not in Cambridge – he's going to be in Oxford, establishing and directing the new Smith School of Enterprise and Environment. He starts on 1 January, and will still be running the surface science group here in Cambridge.

The new institute at Oxford will be part of the division of social studies, and will draw together academics from different departments. 'The main objective is to establish teaching and research covering environmental studies related to enterprise and government,' he says. It will encourage private sector solutions to environmental problems, and address environmental issues in conjunction with both policy makers and business leaders.

The new role is a logical next step from his government work, where climate change was a big topic, and he believes his greatest achievement as chief scientific advisor was to raise the profile of climate change.

'I think there's no question the biggest challenge facing us in the 21st century is climate change, and I've managed to raise its profile, first in the UK and in the past four or five years I've given about 400 talks on the subject, including to the parliaments in Australia, Rwanda and Finland,' he says. 'Another important development was raising the profile of evidence-based policy advice across the whole of government, perhaps the most important of which is the in-depth Foresight processes that have been initiated.

'We've produced only a dozen reports since 2002, but it's painstakingly slow and very thorough, and ministers are well aware of the robustness of the reports that come in. The first was on flood defences, and the most recent on obesity, which is going to be very difficult to tackle because, like climate change, it's a transdepartmental issue, but the potential savings in costs to the country are massive.'

1920 chair filled by John

John Pyle is to be the new 1920 professor of physical chemistry, taking over from Dave King. John, who also runs the atmospheric chemistry group, believes it's important to continue to strengthen the already excellent contribution made by the physical chemistry sector.

'One of the nice challenges is that chemistry is becoming increasingly cross-disciplinary, and it's important to make sure we have a strong physical chemistry presence,' he says. 'I'm delighted and honoured to be following in some very illustrious footsteps as 1920 professor.'

To make sure he is involved in the whole department, John will have an office in the main building as well as retaining his presence in the atmospheric chemistry group on Union Road.

■ John and postdoc Andrew Robinson have just got back from a trip to Borneo on a fact-finding trip ahead of a major project the group will be carrying out there next year.

They will be looking at biogenic emissions from the rainforest, and will be making measurements of halocarbons along the coast of Borneo and Malaysia. Watch out for a report on the project in a future edition of *Chem@Cam*!

John: delighted and honoured to be made 1920 professor

RSC prizes for Joe and Richard

Two members of the department received awards from the Royal Society of Chemistry at its recent general assembly in Birmingham. Joe Spencer was given the Bader Prize, and Richard Lambert the Surface and Colloid Chemistry prize.

Joe was given the Bader award for his 'breakthroughs in the biosynthesis of clinically important natural products'.

Richard's citatation described the award as being made for his 'outstanding achievements in advancing the understanding of catalysis using surface science methodology'.

Pictured right are Joe (above) and Richard with RSC president Jim Feast at the Brimingham ceremony.

■ Another award has gone to Ian Smith, an emeritus professor from Birmingham who was originally a lecturer here, and can often be seen around the department. He's been awarded an honorary degree from the University of Duisberg-Essen in Germany, where he gave a talk entitled 'A chemical odyssey: from earth's atmosphere to the interstellar medium'.

Jean-Pierre says goodbye in style

Jean-Pierre Hansen celebrated his retirement as 1968 chair of theoretical chemistry with a two-day conference at Trinity College this summer.

Organised by Ali Alavi, Jean Louis Barrat and Michiel Sprik, many luminaries from the theoretical chemistry world were present to wish Jean-Pierre well and thank him for his great contributions to science.

Jean-Pierre hasn't left us completely, though – thanks to the vagaries of the French pension system he's moved back to France to continue his science at the Ecole Normale Superieure in Paris, and will be back here to work with his collaborators for a few days every month. ■ The new 1968 professor is Daan Frankel, who joins us from the FOM Institute for Atomic and Molecular Physics in Amsterdam. You can read more about him on page 8.

Right: Jean-Pierre enjoying the conference
Below: Plenty of well-wishers were in attendance

Photo: Nathan Pitt

Successful predictions

Every three years, the Cambridge Crystallographic Data Centre runs a 'test' for groups working on the prediction of crystal structures. This is a notoriously difficult and computer-hungry field, and for the first time one of the entrants got all four predictions right.

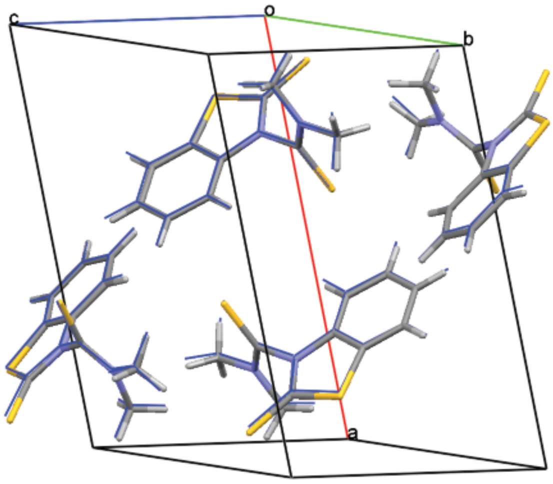
It was organised this year by Graeme Day, and 15 research groups who have been developing methods for predicting crystal structures entered. Graeme reports that the success rate was dramatically higher than it had been in previous years. 'Last time, only one structure was predicted correctly,' he says. 'This time, three groups got one right, another three succeeded with two, and one group got them all correct.'

All of the molecules in the test were small organics, with between eight and 33 atoms. Being able to predict crystal structure in advance is particularly important for the pharmaceutical industry, where polymorphs – the presence of two or more different crystal structures – causes huge problems in formulation. And being able to predict physical properties in a reliable way would save them enormous amounts of time and money.

The four-out-of-four success was achieved by a French commercial organisation, Avant-garde Materials Simulation, in conjunction with the Institute of Pharmaceutical Innovation at the University of Bradford.

However, because their technique involves expensive quantum mechanics calculations for each of hundreds of possible crystal structures, in practice it is extremely demanding on computing resources and takes a very long time.

Despite this, it represents a huge breakthrough in the field. 'The results of this year's test reflect a significant development over the past few years,' Graeme says. 'Crystal structure prediction can now be seen as a real tool to be used alongside experimental studies when designing new materials or developing a pharmaceutical molecule.'



The blue lines are one of the correct predictions, overlaid with the X-ray determined structure, shown with normal atom colours

Recognition for Michele

Michele Vendruscolo has been named an EMBO Young Investigator. The programme was set up by the European Molecular Biology Organization, an association of scientists working in the field within Europe, in 2000 and is designed to help young researchers establish their careers. This is partly done through financial support, but it also enhances their standing within the scientific community.

This three-year award brings all sorts of advantages, says Michele. 'For example, we can use instruments at the EMBO main laboratory in Heidelberg, and it helps set up meetings and collaborations,' he says. 'And EMBO will be paying for my group to go to a joint meeting in Florence with the group of Fabrizio Chiti, who was a PhD student with Chris Dobson in Oxford, and is also an EMBO Young Investigator.

While 15 to 20 of these awards are made every year, only a handful have gone to theoreticians like Michele. 'I'm a physicist working in a chemistry department so being recognised as a molecular biologist is not easy!' he says. 'Crossing the boundaries is difficult, so I'm especially pleased that they have recognised the interdisciplinary nature of my work.'

Polymer conference

Photo: Nathan Pitt

The conference attendees: Oren's on the far left, and Rachel on the front row in bright green

The annual recent appointees in polymer science, or RAPS, conference, held in Cambridge this September and organised by Rachel O'Reilly with help from Oren Scherman and Pietro Cicuta, was a roaring success. Aimed at young researchers working in polymer science, whether chemists, physicists, pharmacists, engineers or material scientists, who have been working in the field for less than five years, it gives them the opportunity to network, find out about grants that might be available and, of course, talk science.

'The two-day conference is deliberately designed to be focused on networking, with stimulating scientific discussions during long coffee breaks and poster sessions,' Rachel says. 'Everyone is encouraged to participate during the conference, and there are plenary lectures from established academists and industrialises, as well as the recent appointees themselves. There were 60 attendees, 20 of whom were new, and all of them had either been appointed to their academic or industrial positions in the past five years, or have recently moved into a polymer science-related field.'

They also invited a small number of postdocs who are looking to forge an academic career in polymer science in an effort to help them decide whether it really is for them. Several industrialists from DuPont, AWE, Infineum and Kodak were also in attendance, as well as exhibitors including Polymer Labs, Wyatt Technology, Perkin Elmer, Presearch, Shimadzu and Viscotek who could give advice about equipment.

The conference has had a long association with industry, and the organising committee has made a huge effort to bring in more sponsors. Sponsorship is vital because it allows the organisers to give grants for people to attend the meeting, so cost is not a barrier. 'As well as the six exhibitors, it was really good to have people from EPSRC around to talk to,' Oren says. 'Representatives from two journals – Soft Matter and Nature Materials – were also there to talk about publishing.'

'The conference has been invaluable to me on a scientific level,' Rachel concludes. 'I'm working with people I met through RAPS – and it really helped set up a couple of collaborations I would never have got into otherwise.'

If anyone is interested in becoming involved with RAPS, contact Rachel at rko20@cam.ac.uk or check out the website, www.raps.org.uk

Carol's protein prize

Carol Robinson has been awarded the Christian B. Anfinson Award from the Protein Society. It's given every year to recognise significant technical achievements in the field of protein science, and Carol won it this year for her 'outstanding pioneering scientific contributions in the fields of mass spectrometry and structural biology'. Previous winners include Alan Fersht.

The award will be presented at the Society's annual meeting in San Diego next summer, and she's trying to persuade as many of her group as possible to go with her. 'I'm very pleased to win the award, and see it as recognition of the fantastic work done by the people in my group over the years,' she says.

Carol also has something slightly unusual to report – a mother–daughter authored paper. Last summer, her Durham maths graduate daughter Paula worked with her as a summer student. She was modelling the structure of unfolding intermediates in the gas phase, and the work has now been published in *Angewandte Chemie*.

Although she enjoyed her time in the department, Paula decided that maths was really her first love, and is now training as an actuary. 'So it will probably turn out be her first and last paper!' Carol says.

Carol: 'outstanding pioneering science' in the fields of mass spec and structural biology

Danny wins for his protein formation work

Shang-Te Danny Hsu won the Young Investigator Award at the recent triennial meeting of the International Society of Magnetic Resonance which, coincidentally, was held in his home country of Taiwan. Four candidates were shortlisted from the abstracts they submitted to give presentations, and Danny's was judged to be the best.

Danny is a postdoc in Chris Dobson's group, and is looking at the structure of a protein as it is actually being created. Proteins are made by ribosomes, and it was believed that newly formed proteins folded while they were still attached to the ribosome, but there was no proof.

'We are trying to show what is happening by NMR,' Danny says. 'It's a real challenge!' By looking at the dynamics of the protein as it is formed, they managed to show that the ribosome does indeed help the protein to fold correctly.

The work was only possible because of the very high field NMR machines that are now available – as well as the 700MHz machine in the department, Danny says they have access to a 900MHz NMR in Utrecht as part of a large-scale EU facility, which has enabled them to study these complex processes at very low concentrations.

'This is the first time we have been able to look at protein folding events attached to a ribosome,' he says. 'The next challenge will be to look at how they fold in the context of living cells.'

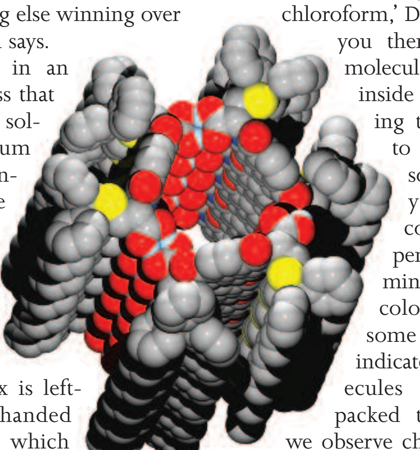
The magic of nanotubes

Dan Pantos discovered by accident that some naphthalene derivatives spontaneously form helical nanotubes. He's now finding they have fascinating properties

Photo: Nathan Pitt

Some of the most interesting discoveries in science have been the result of serendipity, and Dan Pantos has it to thank for the nanotubes he's investigating. Working on amino acid derivatives of naphthalenediimides, or NDIs, as building blocks for dynamic combinatorial chemistry, he was surprised to find that they spontaneously assemble into helical nanotubes in the solid state and solvents like chloroform – normally this sort of molecule simply stacks up with the aromatic naphthalene rings on top of each other. 'This is the first time that we've seen something else winning over this pi-stacking,' Dan says.

All this happens in an instantaneous process that takes place in aprotic solvents with medium polarity. The NDI synthesis takes just five minutes in the microwave, gives yields of 85–90% and needs no chromatography to purify the product.



Whether the helix is left-handed or right-handed depends entirely on which form of the amino acid is used – the naturally occurring L or the unnatural D. Yet there are no covalent or ionic bonds holding the helices together – it's all done by hydrogen bonding and the entire structure is dynamic. The assembly is a little like a swarm of bees – the tubular shape of the swarm stays the same even though the individual bees keep entering and leaving. It's the same with the nanotubes: as the molecules are only hydrogen bonded they can go in and out of the tubular arrangement, but the overall shape is not altered.

Dan has also discovered that if you add C_{60} fullerene carbon 'footballs' to the mix, they are taken up by the nanotubes. 'C_{60} has really low solubility in chloroform,' Dan explains. 'But if you then add these NDI molecules, the C_{60} goes inside the tubes, increasing their solubility up to 16 times, and the solution goes a dark yellow-brown colour.' This happens in a matter of minutes. The dramatic colour change and some spectral features indicate that the C_{60} molecules are very tightly packed together. 'Because we observe chirality on the C_{60} absorptions we concluded that C_{60} "feels" the helix of the nanotube.'

He also found using the C_{60} uptake that in a 1:1 mixture of the two different forms of the NDI, they self-sort and the left-handed molecules only hydrogen bond with other left-handed ones, and the right-handed ones with right-handed ones. 'We couldn't have predicted that,' he says. 'The nice thing is that you can also make derivatives with different amino acids on each side of the NDI, say cysteine on one side and lysine on the other, and in NMR experiments you can see interactions between the different amino acid side-chains, which shows that they must be close to each other in the stacks that make up the nanotubes.'

Adding C_{70} instead of C_{60} had a very different effect. Unlike the football shape of C_{60}, C_{70} is more like a rugby ball, and so doesn't automatically slip inside the nanotubes. But rather than doing nothing, when Dan added C_{70} molecules to a solution of the nanotubes, the system reacted and something new happened. 'It's really beautiful – and our task now is to try and understand it!'

Although the project is still in its early stages, Dan already has ideas about what these nanotubes might be used for. 'This fullerene complexation could be used as a way of generating supramolecular wires,' he says.

'Because there is a string of C_{60} molecules going right through the middle of the nanotube and they are closely packed together, it would be interesting to do electrochemical studies to see if electrons go shooting down the "wire", or simply bounce about between the fullerene and the NDI molecules.

'Another interesting idea would be to adsorb an NDI molecule onto a surface, and then study the self-assembly of the nanotube on the surface. And, because they are easy to destroy by simply adding methanol to break the hydrogen bonds, another possibility would be to use them as a nanopipette for transferring fullerenes – once the nanotube was broken with methanol, the NDI would simply wash away.'

Left: The NDI molecules stack up in a helical arrangement
Left below: Solutions of C_{60} alone, NDI alone, and the two together

CV Dan Pantos

Born: Arad, a city in Romania about 20km from the Hungarian border and 80km from the Serbian one.

Status: Girlfriend Patricia is American, and is currently a postdoc in Pavia, Italy

Education: Dan studied chemistry at the university of Timisoara, also in western Romania. His two-year masters degree was done half in Timisoara and half at the university of Bremen on an Erasmus fellowship. He then moved to the US for a PhD with Jonathan Sessler at the University of Texas at Austin.

Career: He moved to Cambridge in January 2006 as a postdoc with Jeremy Sanders, and has been Stokes Research Fellow at Pembroke since October.

Interests: Dan claims to be addicted to computers and spends far too much time fixing them for fun. He's also addicted to music, from heavy metal to Beethoven, and claims music is on constantly at home.

Did you know? He once performed for former Romanian president Nicolae Ceausescu. 'We were forced to go to a stadium every day for two months to practise waving balls around,' he says. 'Apparently, that showed our love for our dear leader and communism. But we didn't have much choice in the matter!'

Simulation: more than

The simulations carried out by Daan Frenkel look at the formation of diamonds, protein folding, and he's even thinking about the possibility of growing three-dimensional integrated circuits

Photo: Nathan Pitt

The new head of theoretical chemistry, Daan Frenkel, started life as a spectroscopist before developing a love of simulations. 'I was working on the spectroscopy of liquids, but there were no good theories around to account for the experimental observations,' he says. 'In the early 1970s, computer simulations of the liquids were the only way of understanding what the experiments were telling us. As time went on, I became increasingly interested in applying simulations to try and predict novel phenomena that might then be observed in experiments.'

Although he trained as a chemist, much of his work has been at the interface between chemistry and physics, and, more recently, the interface between chemistry, physics and biology. 'Theoretical chemistry is really just a set of tools that we use to address many different problems,' he explains. 'It's not just computing the properties of single molecules. These molecules interact with each other and other molecules, so we have to understand much more than just the individual molecules. We're looking at the behaviour of many particles, the sort of materials and strange structures they can form; for example, we've done a lot of work on the rate at which crystals form.'

He adds that much of what he does really looks at quite straightforward questions, such as the boiling process. 'You might think that all there is to know about boiling has been known for a century or more, but it turns out not to be the case at all,' he says. 'In the past decade or so we've learnt a lot about whether liquids always boil, and in fact there are some that never boil!'

One of the things his group does with their simulations is to try and find out what phase – liquid, gas, solid, whatever – at a given temperature and a given density is thermodynamically stable.

FREE ENERGY

'Using computer simulations, it's possible to compute the themodynamic stability and free energy – all the things that people learn in first year chemistry and then happily forget! We compute the quantities you need in a thermodynamic formula to determine which phases are stable under what conditions. At a very simple level, we take a model system of a few thousand atoms or molecules, and it turns out that it's often much easier for systems like colloids than for "simple" atoms. Colloidal particles tend to have interactions that we understand fairly well, but if you take something like water, which would seem to be one of the simplest molecules, it's actually one of the most complex. There may be 20 different models, and not one describes everything we know about water!'

As a result, in order to compare simulations with experimental results, it's much easier to look at colloids first but, he says, sometimes you have to face the chemical realities. 'One thing we did recently was to compute the phase diagram of carbon at high temperature and pressure. The conditions at which diamonds form are not easy to reproduce in the lab – in planetary interiors, the pressure may easily reach a million atmospheres and the temperatures may exceed 3,000°C. But if you do a simulation of the material at these high temperatures and pressures, it's easier – the computer doesn't start to smoke!'

This technique was used to look at the crystallisation of diamonds from liquid carbon. About 25 years ago, a group at the Livermore National Laboratory in California had been carrying out experiments on shock waves in methane, and found that small diamonds formed. Their suggestion was that if diamonds formed under these conditions, then perhaps some of the outer planets like Uranus and Neptune, which have a relatively high carbon content, might be full of diamonds.

MAKING DIAMONDS

Over the years, several papers appeared containing simulations of how the diamonds might form, but Daan says that they all worked on the assumption that the diamonds would definitely be made. 'We came from the opposite direction, and tried to compute what the rate of formation would be,' he says. 'Somewhat disappointingly, we discovered that diamonds would not form at all, at least not in that environment. Maybe even further out in the universe there might be some white dwarf stars that formed diamonds as they cooled down – perhaps even an entire star made of diamond!'

What Daan found particularly interesting was that when they looked at the crystallisation of diamond from molten graphite, in conditions where diamond really is the stable phase, at high pressures the diamond will crystallise quite easily. But at lower pressures – and not even as low as the region where graphite is more stable – diamonds never form.

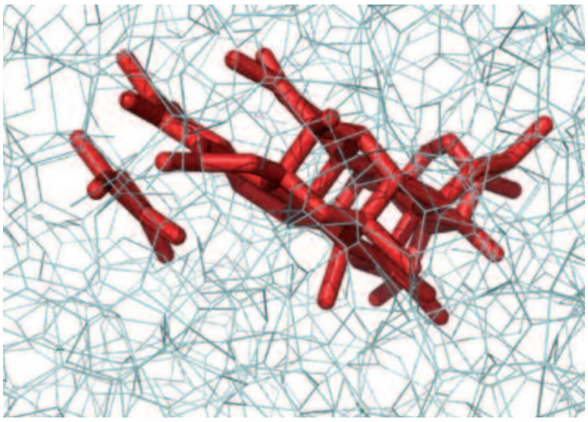
'This is because the liquid carbon is completely different,' he says. 'At higher pressure, it is a bit like molten diamond, where each carbon atom is coordinated to four others, but more disordered than in a diamond crystal, then the crystals

just a molecule

will grow quite easily. At lower pressure, the carbon atoms are coordinated to three others, so it's more like molten graphite and the energy cost of creating a surface between a diamond crystal and the liquid is so great that they form rarely, if at all. We estimate that if you had a planet the size of Uranus that was 15% carbon, it would take longer than the lifetime of the universe to form just one crystal. So it's just not going to happen. And in reality it's even less likely than that as the actual carbon composition of Uranus is more like 1–2%.' So, unfortunately, there's no point in sending a diamond-mining expedition to the outer reaches of the solar system.

Daan has also been looking at simple models that would explain how proteins can change their conformation under the influence of other molecules. 'If you have an enzyme and something binds to it, then the enzyme will probably change its conformation,' he says. 'But in order to work out what is actually happening, you have to use simplified models – you can't do a fully atomistic calculation and hope to study the system for more than a few dozen nanoseconds because the number of calculations involved is just too huge. And typically these processes are three or four orders of magnitude slower than that.'

He also got interested in the role of chaperones, the large molecules present in cells that help proteins fold, and also protect them during the folding process to prevent them causing damage or being destroyed. 'We were interested in one chaperone, GroEL-GroES, which is a double-barrelled complex a little like two cups joined together at the bottom,' he says. 'An unfolded protein will stick to the rim of this cup (the GroEL part), and then be pushed inside by the GroES cap, where it folds.'



A crystal nucleus in molten carbon. Thick red lines indicate 'crystal' bonds and thin grey lines indicate 'liquid' bonds. Even thought he nucleus looks 'graphitic', the final result is a diamond crystal

Initially, they were just interested in what happens inside the cup. 'What people thought before was that the cup closes, something happens, it reopens and when the protein comes out it is, hopefully, correctly folded,' he says. 'But experiments have shown that for most proteins that's not true – it takes, on average, five to seven attempts for the protein to fold correctly. And we were a little puzzled why these misfolded proteins would be released. 'What we found from our simulations was that seriously misfolded proteins actually translocate from one side of the two-cup structure to the other through a hole in the middle. This is controversial because many biologists believe it's not possible, but we think it is. There's not a single experiment yet that supports what we are seeing, but there is a similar process that takes place in a mitochondrial membrane, so there is some precedent.'

Another current interest of Daan's is in designing new materials inspired by biology. 'Molecules have the ability to do the most fabulous things in living cells,' he says. 'Think of DNA, for example. It is, of course, the carrier of genetic information, but what it does is incredible. The two strands bind very selectively, so if you have, say, a string of 12 nucleotides, it will bind very strongly to the complementary 12 nucleotides, but more weakly to any other 12.' This can be used for gene detection, either by coating a surface with single stranded DNA to which the complementary single strand will attach, or by coating colloidal particles with the two strands, which will then aggregate in solution to give an extremely sensitive way of detecting the genes – anthrax can be detected in this way.

THREE DIMENSIONS

However, Daan is trying to turn this around to make new materials. 'If we coat different colloidal particles with different pieces of DNA, can we use them to make complex materials from the colloids?' he wonders. A long-term dream of his is that this might be a way to make three-dimensional integrated circuits. Silicon chips are currently made by taking a wafer of silicon, depositing doping agent on to it, oxidising and etching it, giving maybe 20 layers of complex oxides. 'But at some point, the layering has to stop,' he says. 'It's impossible to make a chip that truly goes into the third dimension. To make a 3D circuit, you would need to use some form of self-assembly process – the components would have to assemble themselves.'

That may sound relatively straightforward, but that's far from the case – it's not just one or two components but a whole host of them, all of which need to assemble in the right place. 'At the moment, we have no clue how to do it!' Daan says. 'But by looking at very simple models I hope to come up with some potential strategies. And even if we manage to do that, there may be other problems; perhaps they would burn out becaue they dissipate too much heat, but that's a practical problem that we could consider later. Just making them is a real challenge, but I believe that one of the longer term objectives of "nanotechnology" should be to make truly three-dimensional nanostructured materials by self-assembly. And we hope to learn how to do it from biology.'

CV Daan Frenkel

Born: Amsterdam, Netherlands

Status: His wife Erika is a physicist, and is moving to the Cavendish in February. They have two daughters, Floor, who's studying medicine in Amsterdam, and Evelien, who is just finishing up at high school.

Education: Studied chemistry at the University of Amsterdam, followed by a PhD in spectroscopy under Jan van der Elsken. He then moved to UCLA to postdoc for a couple of years with John McTague, a spectroscopist who was becoming interested in computer simulations.

Career: In 1980, Daan returned to the Netherlands to work for a year in Shell's research labs in Amsterdam, before moving to an academic job in the physics department at the University of Utrecht. He returned to Amsterdam and the FOM Institute for Atomic and Molecular Physics in 1987. He took over from Jean-Pierre Hansen as head of theoretical chemistry here in Cambridge in October, and will be splitting his time between here and Amsterdam, where he still has teaching duties, until next summer.

Interests: He loves cooking, especially with his wife, and reading. He particularly enjoys historical novels, and will read three or four on one period before moving on to another. And as a good Dutchman, he cycles.

Did you know? In the Netherlands, 'Christmas' presents are given on the feast day of the patron saint of children, St Nicholas, or Sinterklaas, on 5 December. His institute there always has a Sinterklaas party, and Daan has been known to play the part of Sinterklaas, in a red bishop's outfit and a white beard. He reads out poems taking the mickey out of people who have done daft things during the year, and gives out presents. Time will tell whether he will carry on this ancient Dutch tradition in Cambridge!

What makes a good catalyst?

Martin Smith is taking a lead from nature in his search for new catalysts – he's looking at which parts of enzymes are important

Proteins such as enzymes fold up into complicated shapes, containing features such as helices, turns and sheets, and function as catalysts with unparalleled reactivity and specificity. But can we design small molecules that mimic structural and functional elements of proteins? This is the sort of question that Martin Smith's group is trying to answer with their work on conformation and catalyst design.

'We're looking at a bottom-up approach to catalyst design,' he says. 'Rather than screening large numbers of compounds, we're trying to control catalyst conformation and relate this to catalytic activity.' He points out that whilst a number of synthetic catalysts are very effective, there are none that approach the efficiency of an enzyme. 'I want to establish a structure–conformation–catalysis relationship for a class of small molecules, and see whether we can make better catalysts as a result'.

What his group is trying to do is build small molecules that fold and then probe their conformation in solution using NMR. 'We're interested in non-conventional hydrogen bonds where a carbon–hydrogen bond is acting as the hydrogen donor, and we can exploit these to control the conformation of small molecules,' he says.

These molecules mimic the secondary structural features of proteins but, Martin says, they are tiny. 'We can build molecules that populate a well-defined conformation in solution, and are about the same size as four amino acids – a small fraction of the size of a whole protein. We've built a range of secondary structural components similar to those you can see in a protein, but rather than using α-amino acids as building blocks, we use functional groups such as cyclopropanes.'

Much of this is far easier said than done. 'The conformation is controlled through a range of factors including hydrogen bonding,' he explains. 'It's difficult to force a floppy linear molecule to fold, as this involves getting a hydrogen bond donor at one end of the molecule in close proximity to an acceptor at the other end, maybe 25 atoms away. Making sheets this way is even more difficult as there is no repeating pattern along the molecule, unlike in a helix where there's, say, a 10-membered ring that recurs up and down the chain.'

He adds that, in one sense, making a catalyst in this way is a simple idea – it involves designing 'linking' segments that join the features with catalytic activity and hold them in the right place. But, of course, the reality is more complex. 'In our molecules, most of the amino acids have been replaced – they may contain amide linkages but they don't look much like the ones that nature makes. When they're assembled however, the conformation should be similar to those observed in natural systems. The ultimate challenge is to emulate nature in both structure and function – we know how to build folded molecules but the next step is to turn them into something useful'

Martin admits that it's a difficult project because not only is it hard to design and synthesise molecules that fold in the right way, but it's also a challenge to work out whether they populate the intended conformation. 'We're now starting to screen for catalytic activity and get some interesting results,' he says. 'The ultimate aim is to produce catalysts for transformations that may not work well at the moment – such as electrocyclic reactions. We're particularly interested in reactions that generate multiple asymmetric centres in one step, building complexity from simplicity, with a view to generating natural product-like scaffolds.'

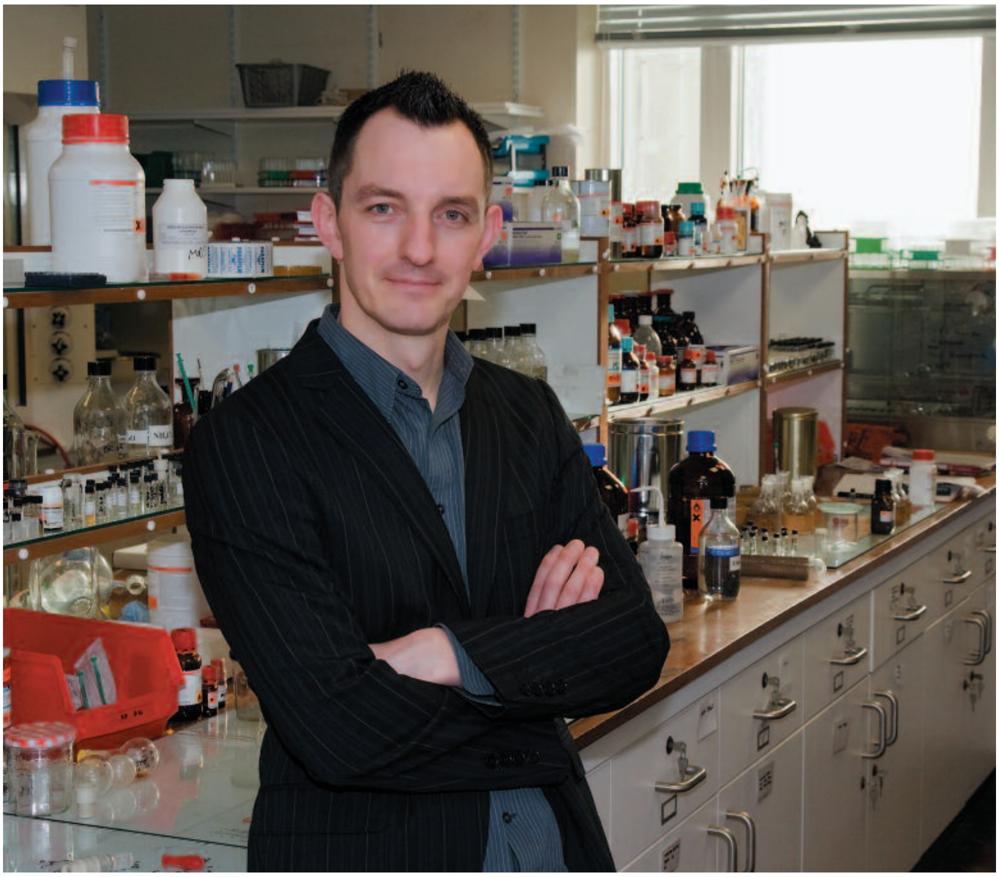


Photo: Nathan Pitt

CV Martin Smith

Born: Bangor, North Wales, but grew up in Middlesbrough

Status: Girlfriend Rachel is another organic chemist, and works for the drug company Merck in the US

Education: Studied chemistry at Oxford, and stayed for a DPhil with George Fleeton carbohydrate mimics

Career: Martin moved to Cambridge in 1999 with a Drapers' Company Research Fellowship at Pembroke to work in Steve Ley's group. He was made a Royal Society University Research Fellow in 2002

Interests: He supports the 'mighty' Boro, even though he says they're shocking at the moment. He's also a fan of fine wine (and the drinking thereof) and panoramic photography.

Did you know? He was born in Bangor because his father – an ex-footballer – was manager of Bangor City, and has the distinction of having taken them into the European Cup.

The chemistry of the night

At night, different chemical processes take place in the atmosphere, and measurements made up in the sky above London are helping work out what goes on

An unusual lab in the sky!

Until recently, atmospheric field studies have concentrated on the chemistry that goes on in the daytime. But it's important that the night is also included in the models of what's going on in the atmosphere to gain a more complete understanding of how it removes pollutants.

Ailsa Benton, a second year PhD student in Rod Jones' group, has been carrying out measurements of night-time nitrogen chemistry 180m above London at the top of the BT tower as part of a month-long collaborative field campaign.

The nitrate radical, NO_3, is the primary oxidant chemical in the atmosphere, and is particularly active against some of the hydrocarbons at night, whereas during the day it is comparable to the hydroxyl radical. Formed by the reaction of NO_2 with ozone, it is part of a complex chain of reactions that need to be understood when modelling the chemistry of the boundary layer of the atmosphere, as is done when looking at pollutants in cities.

'During the day, NO_3 is broken down by the sun very rapidly so concentrations are generally very low, except in very polluted cities where ozone levels get very high, at around 100 parts per billion,' Ailsa says. 'At night-time, this removal route ceases, so nitrate concentrations increase and under moderate NO_2 concentrations, an equilibrium is reached with NO_3, NO_2 forming N_2O5.'

The main sink for NO_3 is the reaction of N_2O_5 with water, which forms nitric acid. Nitric acid rapidly deposits on surfaces and can contribute to acid rain, rendering nitrate and dinitrogen pentoxide unavailable for ozone formation the following day. So the chemical processes that go on at night in the boundary layer of the atmosphere, where there is a lot of vertical mixing of chemical components, can have a considerable influence on the daytime composition of the atmosphere.

Although nitrogen oxides are only present in tiny amounts, they are very important in the chemistry of the troposphere. 'Measuring species at such low concentrations requires a very sensitive detection technique,' Ailsa says. 'Absorption spectroscopy, where the light being absorbed by a particular chemical species is measured, allows the unambiguous determination of absolute chemical species concentrations making it particularly useful for atmospheric competition measurements.'

To make the measurements, they use a broadband cavity-enhanced absorption spectrometer, or BBCEAS. This has a red LED that emits a fairly broad range of wavelengths of light at around 620-680nm. The light enters a cavity which is created by a pair of mirrors that reflect red light, and by measuring the small percentage of light that leaks out of the end of a cavity filled with nitrogen and comparing amount this with that leaking out of a cavity with atmospheric air flowing through it, the concentration of any species that absorbs in this red region of the spectrum can be measured. One of these is nitrate.

The instrument at the top of the tower has an inlet poking outside. Air is drawn into it by a pump, and other measurements are made both on the tower and at ground level at Regent's Park, around 1km away.

At night, the equilibrium between nitrate and dinitrogen pentoxide generally favours dinitrogen pentoxide. 'We heat the gas coming into the cavity to around 90°C, which converts it all to nitrate so it can be measured, as dinitrogen pentoxide doesn't absorb as nitrate does,' she says. 'Therefore we're actually measuring the sum of NO_3 and N_2O_5.'

The field campaign is a collaboration between Cambridge, the Universities of Birmingham and Manchester and the Centre for Ecology and Hydrology (CEH) in Edinburgh. They are also measuring size distributions of aerosols, meteorological data and the concentrations of pollutants such as SO_2, NO, NO_2, CO_2 and ozone.

'Combining these data with measurements of species that are present in larger quantities, such as NO_2 and ozone, which are measured by more conventional means, we can gain a more thorough picture of the night-time chemistry of the boundary layer of our cities,' Ailsa says.

Measuring the sum of NO_3 and N_2O_5 above London at night with the BBCEAS instrument

Portraits of the 1950s

Antony Barrington Brown's portraits of Cambridge chemists in the 1950s we published last time drew a huge response from readers. Here are some of their reminiscences. More contributions welcome!

Brief memories

Dear Editor
If my memory serves me right, I may be able to augment background details on Antony Barrington Brown's photographs.

George Kenner went to Liverpool as a chemistry professor. He died under tragic circumstances on Snowdon.

J.H. Schulman was a colloid scientist. My (then) boss used to consult with him on matters of surface chemistry in mineral preparation. The colloid science department flourished for some years, but was broken up when Professor Rideal left to head the Royal Institution, before moving on to a professorship at Imperial College.

Morris Sugden became the director of the Shell Research Centre at Thornton, Cheshire.

Sir John Lennard-Jones was our professor of theoretical chemistry. He gave a most lucid series of 12 lectures on quantum theory and wave mechanics to Part II students. He moved to the University College of North Staffs, and was its vice-chancellor when it became Keele University.

I can't help on B.R. Brown, but I hope others can.

Your sincerely
John Mainhood
8 Vauxhall Gardens, Tonbridge, Kent

A brilliant keeper

Dear Editor
Ben Brown was a fellow of Trinity Hall and my supervisor in organic chemistry. He had gained his first degree at Oxford and came to Cambridge to work for Todd. In 1954 he returned to Oxford, where he spent the rest of his career.

Though a very good chemist, his main claim to fame for me was his brilliance as a goalkeeper. He played for Pegasus, a combined Oxford and Cambridge graduate team, and one of the top amateur soccer teams in the country. He also played for England, and played in the 1952 Olympic games.

He died of motor neurone disease in 1992, and was a delightful man to know.

Yours sincerely
Keith Humphreys
College Farm House, Meldreth, Cambridgeshire

A miner's son

Dear Editor
Ben Brown was my tutor at Oriel College, Oxford in the early 1970s. He was the son of a Yorkshire miner, who died when he was 5, but got a West Riding scholarship to Oxford in 1943. He did well there, getting a First and going on to a DPhil. He was awarded an 1851 senior studentship and a fellowship at Trinity Hall, and this photo was obviously taken during this time.

He combined an active research and teaching career with playing goalkeeper for Pegasus, which won the FA Amateur Cup in 1951 and 1953. He represented England in the 1952 Olympic games in Helsinki, and gained seven caps for his country. In 1954 he was persuaded to return to Oxford as a fellow of Oriel and a University lecturer, where he remained until his untimely death from motor neurone disease in 1992.

He was a reserved, quiet man of old-fashioned views but very sympathetic to his students, and never quite lived up to his early promise, preferring to devote himself to college life and his wide range of other interests.

Yours sincerely
John Campbell (part of the Battersby group 1975–78)
6 Brookvale Drive, Thornhill, Cardiff

Tennis whizz

Dear Editor
I knew Ben Brown quite well in the early 1950s at Cambridge. He was particularly active in sport. On one occasion, I played him at tennis. He won so comprehensively we did not play again!

Your sincerely
Harold Booth (1944-46, 1948–52)
8 Reigate Drive, Attenborough, Nottingham

Ex administrator

Dear Editor
I can shed some light on some of the photos you published in the last issue. Ralph Gilson, who moved with Lord Todd as department administrator in 1946, was the person who employed me when I left school in 1947. I had been trained as a draughtsman in various technical colleges, but was unable to find a job in that line of work in the city. A job was available at the chemistry department in Pembroke Street with the lecture room staff, so I took it as a temporary job (not knowing any chemistry!) and stayed for the next 49 years!

Gilson had a great deal to do with the building of the chemistry department in Lensfield Road which was started in 1951, and for this work was awarded the MBE. He did not stay long when the department began to move there from Pembroke Street in 1956, and became the first UK managing director of the instrumentation company Perkin Elmer when it set up its first branch in this country at Beaconsfield, Bucks. Sadly, I believe he died a few years ago.

Ben Brown was known far more for his other interest than his chemistry – football. He played in goal for Pegasus, played in the amateur FA Cup final at Wembley and was selected for England, also playing at Wembley.

One thing I'm sure the England selectors didn't know – he was colour blind. I remember he occasionally asked me the colour of a solution.

Best wishes
Don Flory
162 King's Hedges Road, Cambridge

Surface chemistry

Dear Editor
I was at Cambridge 1938–40 and there was a Schulman there who, I think, worked on surface films, or some aspect of surface chemistry, possibly with A.E. Alexander who lectured to my year.

Yours
Emeritus Professor R.R. Baldwin
(Hull University)
86 Victoria Avenue, Hull HU5 3DS

Bomb deflection

Dear Editor
I did a PhD with Schulman as my supervisor over the years 1950-52. He was reader in surface chemistry in the department of colloid science in Free School Lane – Professor F.J.W. Roughton was head of the department.

Schulman was a kindly but rather private person. A group specialising in the properties of monolayers spread in aqueous surfaces and on the micellar structure of detergents was established in the department, I think in the 1930s, by Sir Eric Rideal, and Schulman was a leading member of the group. He was married in September 1950, just before I arrived in Cambridge from Australia, and was a Fellow of Trinity Hall.

A major achievement occurred during the war when he put his knowledge of the spreading of monolayers on water to good use. During the bombing of London, the specular reflection of the






From the top:
Ben Brown,
Ralph Gilson,
Jack Schulman,
George Kenner,
Morris Sugden and
John Lennard-Jones

moon on the Thames provided a great guide for German bombers. Schulman developed a method of mixing activated carbon with a spreading liquid and was able to black out several miles of river in a matter of minutes. For this work he received an OBE.

I would be sad if Schulman's life and career should be totally lost to memory and I hope this might go some way to redressing the balance.

Yours sincerely

Brian Harrap (Fitzwilliam 1950)

Passing muster

Dear Editor

You ask about Dr Schulman, and while I do not know very much about him, he was some sort of senior researcher (deputy director) when I joined the colloid lab at the end of 1936. I believe he worked on surface films.

I did not get as much as I should have done during my time at Cambridge, for which various reasons can be advanced. At the end of my second year, there was perhaps some doubt about me. I was invited to present my work to Lennard-Jones, so I talked to him for an hour-and-a-half and must have passed muster, but scientifically I was very lonely.

Later I used his equation, and also found L-J's grandson living in the house in which I was born in Ipswich; he was researching for BT at Martlesham.

Morris Sugden, when he was at Shell, communicated to the *Proc. Roy. Soc.* some work I had carried out as a visiting reader at UMIST in 1968. It turned out to be the most influential paper I have written, with some 250 citations, mainly after 1990! Since that time, I have published several papers in refereed journals without any funding, the last this year at 93 years old. A bit unusual, perhaps?

Yours sincerely

Prof R.N. Haward
East Barn, Old Ditch, Westbury-sub-Mendip, Wells, Somerset

Stable emulsions

Dear Editor

Jack Schulman succeeded Sir Eric Rideal as head of the department of colloid science in Free School Lane in 1946. This small department was founded by Rideal in 1932 and physically it was part of the old Cavendish Laboratory, its neighbour being the department of surface physics.

Schulman was perhaps best known for his pioneering theoretical and experimental work on microemulsions, thermodynamically stable emulsion systems that are very widely exploited today. He left for the US in 1958 and was later succeeded by one of the ADRs, Denis Haydon, who about five years later was my own research supervisor.

In my time, the department maintained a loose association with physical chemistry at Lensfield Road, Haydon was the presenter of a short course of lectures on surface chemistry for the Part II tripos. The colloid lab was dissolved in the late 1960s.

Yours sincerely

Brendan Carroll (Trinity Hall 1963)
56 North Road, Birkenhead

Cambridge to Columbia

Dear Editor

J.H. Schulman started in the early 1930s in E.K. Rideal's department of colloid schience. He was eventually awarded his ScD and enjoyed a high international reputation, and became a reader. He was an OBE for his wartime work, and was also president of the Varsity ski club.

In 1960 he transferred to Columbia University School of Mines, as professor and chairman.

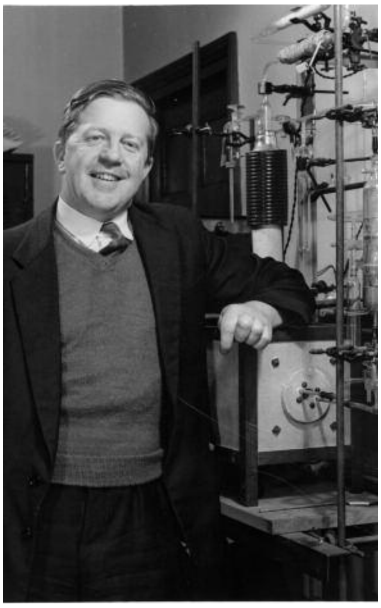
Your sincerely

E. Desmond Goddard (degree 1951, under Schulman's supervision)
9 Hatsawap Road, Cambridge, Maryland, US

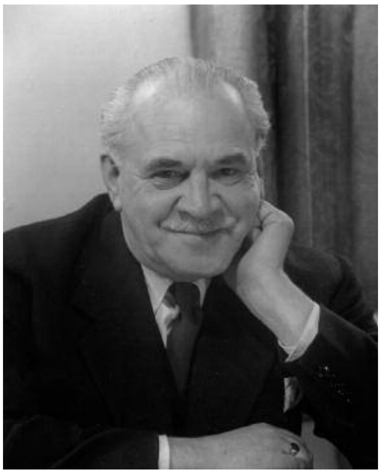
More 50s faces

As promised last time, here are the rest of Antony Barrington-Brown's photos of chemists taken half a century ago.

We've had plenty of reminiscences about Lord Todd in recent issues, but what about the rest? There are some famous names in there and some rather less familiar ones, but we'd be fascinated to hear any memories readers have of them.



Right: A photo of R.G.W. Norrish, taken in 1958
Far right: F.J.W. Roughton, taken in 1952. Was the hat his normal attire in the lab?!



Far left: P.G. Ashmore, taken in 1958
Left: A portrait of Alexander Todd from 1953
Right: H.J. Emeléus, pictured in 1952 when smoking was rather less frowned upon than it is today!

The man behind the Russian doll

Long-time readers of Chem@Cam may remember the tale of the Russian doll found hiding in the cupboard. We've now got the full story from Masha Kochetkova, daughter of Nikolay Kochetkov who brought the doll with him from Russia when he came to work with Lord Todd half a century ago. She tells us more about her father

The small Russian doll that inhabits a display cabinet in the Todd-Hamied Room was brought to Cambridge by Nikolay Kochetkov, a Soviet scientist who worked in the Lord Todd's laboratory 50 years ago and was one of the first Russians who came to Cambridge after the war.

Stalin's death in 1953 made contact between the Soviet Union and the West much easier. Professor Todd, then head of the department of organic chemistry, received a Soviet government delegation in mid-1950s, and suggested he would accept two chemists from the Soviet Union to work in his laboratory for six months. But he imposed three conditions – they had to be good chemists (he said he would send them back to Moscow if they were not!), they would not be involved in politics, and they would not have any supervision from the Soviet embassy.

Todd's proposal was passed on to Alexander Nesmeyanov, president of the USSR's Academy of Sciences, and he offered Nikolay Kochetkov, one of his close collaborators, the chance to go to England. Nikolay agreed, though with some hesitation because at that time for people living in the Soviet Union travelling to England was like travelling to the moon – they could not be sure they would return home safely. Many people who travelled abroad or had contact with foreigners during the Stalin's time had been arrested. Electron Mistryukov, a recent graduate from the Moscow University's department of chemistry, travelled to Cambridge too.

Nesmeyanov told Nikolay he was going to work in the great laboratory and asked him to find out how 'they' (in the West) manage to work so well. And Nikolay's wife Vera gave him that little Russian doll, called Mr Tchoob, as a good luck charm.

Nikolay wrote later that Professor Todd was very supportive and encouraging, and had asked him not to worry about anything. He interviewed Nikolay about his research at home and sent him to the library to read up on nucleoside and nucleotide chemistry. Within a week, Nikolay had a space in Professor Todd's laboratory and was asked to work out a method for the synthesis of nucleoside diphosphate glucuronic acid.

After years of isolation from the West, Nikolay suddenly found himself in an international scientific centre which many prominent scientists visited. He attended meetings and colloquia, finding the informal discussions on complicated scientific problems a far cry from what he was used to at home. Those he met included Sir Robert Robinson, Sir Ian Heilbron and Professor Christopher Longuet-Higgins. He learned a lot from these meetings, came to love their style and adopted it in his future career.

He appreciated Todd's guidance not only in science, but also in his new Western life that was very different from all his previous experiences. For instance, Todd made sure that no journalists were able to come near him, and advised him not to speak to any of them either. This proved to be a good decision, as the stay in Cambridge coincided with the Suez crisis and the uprising against the Soviet Union in Hungary, both of which might have made journalists interested in his thoughts.

Nikolay worked very hard. During his later trips to Cambridge, he met technicians who recognised him as that crazy Russian who worked in the laboratory at the weekends. And it was to one of these technicians Nikolay gave Mr Tchoob before he went back to Moscow after a six month stay in Cambridge. His visit paved the way for many Soviet researchers to visit the UK. Nikolay and Lord Todd stayed in touch until the late 1980s, meeting in both the UK and the USSR, and at international conferences.

His work in England gave Nikolay's career at home a huge boost. Great discoveries in molecular biology, such as Watson-Crick's double helix, also pushed forward the development of this science in the Soviet Union. In 1958, the USSR Academy of Sciences founded two new institutes – one focusing on the chemistry of natural products and the other on radiological and physicochemical biology. Nikolay was appointed deputy director and head of the laboratory of carbohydrates and nucleotides in the former.

The first tasks for the leaders of the new institute were to define directions for research, work out the appropriate organisational structure and then find and recruit staff to the new institute. With the experience in the chemistry of monosaccharides and nucleosides he had gained in Cambridge, Nikolay was well equipped for the job, but there were not

A life less ordinary

Nikolay Kochetkov was born in Moscow in 1915, at the time of World War I, when Russia was a monarchy and Tsar Nicholas II ruled the country. Nikolay lived through two revolutions, Democratic and Bolshevik, the civil war, establishment of the USSR, Stalin's dictatorship and the World War II. He spent six years in the army, two of which were on the front. He then re-launched his scientific career, worked through the period of the 'developed socialism', Gorbachev's perestroika, the collapse of the Soviet Union and the establishment of new Russia.

His family ran a small textile business. He had wanted to become a chemist from an early age, but his route to becoming a scientist was long and difficult. His first job was the leader of a team of girls at a brick factory.

The chemical faculty of Moscow University was Nikolay's first choice for higher education. He passed exams but did not receive a place because of his 'unacceptable' social origin and joined the Moscow institute of fine chemical technology. After graduation, he started a postgraduate course, but it lasted for only two weeks, after which, in his own words, the government made the choice for him and conscripted him to the army.

His first destination was 5,000 kilometres to the east of Moscow, and Nikolay could never forget the dreadful conditions there. With the winter temperature falling down to –50°C, up to 300 conscripts lived in a huge dugout with a small stove. When his two-year service was coming to the end in 1941, Germans invaded the USSR. He stayed in the army for another four years before he finally made it to Moscow University to work with Nesmayanov.

many specialists to select from to fill other vacancies. There was no chemistry of nucleic acids in the USSR at that time, and the chemistry of carbohydrates was limited to processing cellulose.

Nonetheless, heads of laboratories were appointed, and a special group of graduates from the Moscow University's department of organic chemistry was formed. Under the Nikolay's supervision, they were taught and trained to work in these new fields.

The next challenge was to increase their knowledge, as their experience in carbohydrate and nucleotide chemistry was far from comprehensive. They had to understand the current science, learn the methods and find their own niches before they could move forward scientifically. But they were all very enthusiastic and ready to do whatever was needed to get on.

Nikolay launched 'anti-illiteracy' seminars in his laboratory to discuss scientific news informally, inspired by his experiences in Cambridge. And he didn't have to wait long for success – their first scientific articles went to press in the early 1960s. The Kochetkov school was born.

In the beginning, the focus in chemistry of nucleotides was on the chemical modification of heterocyclic bases. The reaction of adenosine and cytidine with chloroacetaldehyde, which was later used for the synthesis of fluorescent polynucleotides, sequencing polynucleotides and analysis of their secondary structure, was discovered in his laboratory.

In carbohydrate chemistry, research started from the development of new methods of synthesis of unusual monosaccharides and it resulted in the orthoester method of glycosylation that was later widely recognised. A number of glycosides and oligosaccharides were synthesised and the structures of complex polycarbohydrates derived from plants, seaweed and sea molluscs defined. Nikolay was one of the first researchers who realised the potential of using mass spectrometry in carbohydrate chemistry, and using this method enabled the laboratory to study more complex carbohydrate-containing products.

In 1968, Kochetkov was appointed director of the Zelinsky institute of organic chemistry, which employed around 1,200 people, and part of his lab moved with him. There were modern research and analytical lab, units for the design and building of new equipment for the research and facilities for the pilot production of chemical substances. His duties included the scientific supervision and administration of the institute. He stayed in this post for 22 years, and said this time was the happiest and most creative period of his life.

Kochetkov's laboratory flourished and made significant contributions to the chemistry and biochemistry of carbohydrates. New scientific directions were developed and a number of polysaccharides, including bacterial antigens, were synthesised. Many methods for carbohydrate synthesis and analysis were developed or improved, including the use of ^{13}C NMR for the structural analysis of regular polysaccharides. Many graduates, postgraduates and trainees from other parts of the Soviet Union and from abroad worked and studied in the laboratory.

Todd and Kocehtkov relax over a drink

Kochetkov was elected correspondent member of the USSR Academy of Sciences in 1960 and a full member, or academician, in 1979. He received almost all the highest state awards for scientists in the Soviet Union, as well as many from foreign societies, and was a member of the editorial boards of a variety of journals. He also wrote several books, some of which were translated into English

He had never been a member of the communist party, but he was upset and angry about the changes which the collapse of the Soviet Union brought to the country and its science. The state funding of science disappeared overnight, and people began leaving to work elsewhere. Those who stayed had to learn how to find funding for research and commercialise scientific achievements as they had never had relevant experience. Nikolay remained involved in his laboratory's affairs and did his best to help it to survive until his death at the age of 90 in 2005.

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Thanks to the generosity of the department's Corporate Associates, we have been able to benefit the education and environment for students and staff. For example, the Associates pay for university-wide access to SciFinder Scholar and ChemOffice. They also make significant contributions to the library for journal subscriptions. And there are plans to provide undergraduate chemistry exam prizes and faculty teaching awards, and the CAS has funded four summer studentships.

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Bringing water to the rainforest

This summer Joe Piper, a PhD student working on single molecule spectroscopy in Dave Klenerman's group, spent most of July in a remote corner of north-west Thailand helping to install a water system with the Karen Hilltribes Trust in the village of Ban Khun Mae la Tai. There are 200,000 Karen in Thailand, who live as farmers in the remote forest, growing rice and vegetables, and keeping animals.

'I was team leader of a group of student volunteers who all became great friends, and we had a fantastic time together,' he says. 'I was the group's point of contact with the charity and Karen engineers, and also organised rations, group travel and first aid.'

The engineers, volunteers and villagers first dammed a mountain spring, and installed a filtration tank based on sand, gravel and charcoal. They then dug two kilometres of pipes down into the village, built two 10,000 litre storage tanks, and installed eight taps throughout the village.

While the village was in a beautiful spot with panoramic views of mountains with lush forest from all directions, its 160 people had to rely on a dubious water system that ran out during the dry season, and wasn't drinking quality. But Joe reports that their hosts were incredibly warm and welcoming, despite the fact that their Karen 'mother' Villae had never seen a white person before – or a television!

'We arrived in heavy rain and thick mud that quickly coated our wellies and gave our clothes a nice dark-red tinge,' he says. 'We tried to believe it wasn't that organic, despite the pigs, dogs and chickens roaming about the place!'

Organising the food, the rota and hygiene were a bit of a challenge at first, but with the help of iodine drops, foil and lots of detergent they even managed to serve up noodle soup an hour after they arrived, and the first of many curries that night. 'After that, the food was really good!' he says.

Digging in the pipes was hard work with a hoe!

Despite its remoteness, Joe says that the local village school for 5 and 6 year olds was very good, and everyone else was bussed out, hanging on for dear life to a Thai multi-taxi. He became good friends with the village schoolteacher, who now has an inflatable globe as well as the paper and pencils they left.

He says the work on the water system was gruelling, but ultimately really rewarding. 'Our 2km trek to the top carrying 20kg of sand in our big backpacks needed some skills and determination,' he says. 'The filtration tank and dam were right up in the rainforest in the hills, and it was surprisingly similar to the rainforest section in the natural history museum – as close as I'd been to the jungle before! The hoeing to dig in the pipes down to the village was pretty brutal in the humidity and heat.'

Carrying the cement, sand and gravel up 200m for the 10,000 litre storage tanks was also pretty tough and involved ascending a slippery path, but even so they managed 14 trips a day. 'We'd be at work for 9ish, and 6.30 if it was a concrete mixing day, then break for lunch and finish at 4.30 before showering off the mud. And every fourth day we took a break from the hard graft to cook for the rest of the team.'

Joe adds that they had many exciting and unusual experiences. 'One day we followed Villae to her remote sweetcorn growing field and met her mum, after shaking the leeches off our wellies. Another day, we were hoeing and our chief Karen engineer Aka found a large hairy tarantula – which he took the teeth off and stroked, saying, "Ah, my friend." There was plenty of other bug life – we had a scorpion in our room and saw a big snake while walking down the road, but were remarkably unscathed. Ironically, one of the team brought a "bug pot with lens" as a present for the kids – but we couldn't find any insects small enough to fit inside!'

They found their first aid essentials invaluable – particularly the betadine iodine spray, plasters, Micropore tape to stop the plasters being sweated off, and rehydration sachets. And they were always smothered in a heady mixture of Deet and suncream. 'When we had finished the hard work of building the water system, we went on a fantastic two-day trek through the mountain forest,' he says.

'The time in the village will definitely remain one of the most exciting and treasured experiences of my life. It was an amazing opportunity to provide direct development aid to a village without a safe water system. We raised the money for the pipes and cement and got to help install it ourselves. It was a real privilege to share the homes with the Karen and work together in such a beautiful landscape and lifestyle.'

Joe's thanks go to Dave Klenerman and the rest of the people around the department who supported his fundraising efforts. He adds that more funds are always needed to pay for essentials like mosquito nets, blankets and schools. You can find out more at www.karenhilltribes.org.uk

Left: Helping out with reading lessons at the village school

Right: A bucket chain for building the storage tanks

It's a bird's life

Photo: John Holman

Owling mad: would you be scared of this fake feathered friend?

Eagle-eyed chemists in the department may have noticed that there are a couple of new additions to the roof facing into the centre of the chemistry department – a falcon and an owl.

They're not just there for show, though – they started roosting on the roof a couple of months back in an attempt to reduce the number of pigeons that infest the area.

There is a real pigeon problem on the roof above the lecture theatres, and the mess they make is a maintenance nightmare. In a desperate attempt to get rid of them, Andy Middleton suggested that the answer might lie in hunting birds. Sadly the real thing was deemed too dangerous, and a fake falcon and owl were installed on the roof instead.

For the first few days they had a dramatic effect as the pigeons turned chicken and flapped off. But the ruse failed and they soon realised they'd been tricked – and came back to leave their messy mark once more.

'It does seem to have cut down the numbers slightly,' says acting technical secretary David Watson. 'But they're not as stupid as we hoped and they realised they weren't in danger of being eaten far too quickly.'

Any pigeon-eradication suggestions from readers would be gratefully accepted!

Comings & goings

New Staff

Katie Dryden-Holt

Gabriela Ridlova

Mihails Hanins

Antonia Maria Moya Velasco

Rolandas Kvarinskas

Karen Sime

Leavers

Robert Beale

New baby

To cleaner Flora Fleurival, a little girl called Yvette

A chemical feast

Andrew Wildsmith and Nick Bampos enjoy the sunshine before dinner at Hipping Hall

In late September, Nick Bampos and Jon Burton (who moved to Oxford in January, and took the photo) passed through Yorkshire on the way to a friend's wedding in Edinburgh, and on the way stopped off at Hipping Hall (www.hippinghall.com).

Not only does Nick report that it has a first rate restaurant, but it was established and is run by a familiar face – Andrew Wildsmith, who did a PhD in the department with Andy Holmes.

'We had a fantastic time,' Nick says. 'The food and wine were as good as I've had in a restaurant – a credit to the head chef Jason Birbeck – and to make the experience complete, Andrew has nine rooms attached to the establishment that allow guests to retire in comfort after the excellent meal and wake up to enjoy a top notch breakfast.'

Nick adds that it's situated at the south-east tip of the Lake District and at the western fringe of the Yorkshire Dales, and there are some lovely walks close by. 'At a time when a group of chefs around the country are developing their own spin on "molecular gastronomy" (presumably the mythical understanding food at the molecular level), it is nice to know that Andrew is a true PhD chemist involved in the synthesis of food,' he says.

'Apart from being an excellent host, we had a cup of tea with Andrew and it was so nice to see that he was still aware of the chemical literature and who is doing what – perhaps because so many academic and industry-based chemists pass through the north and drop in on Andrew to eat, drink and have a relaxing time. We'll certainly visit Andrew again!'

This year's Pfizer welcome party for the organic sector had the theme 'Chemists of the Caribbean'. It was the turn of the Paterson group to organise it, and they really got into the swing of things with pirate costumes and more Caribbean-themed get-ups. This included Ian himself, who's sporting a rather fetching panama hat and an extremely scary shirt in the middle of the picture

Photo: John Holman

The department's academic secretary, Howard Jones, turned 50 in November, and his colleagues made sure it didn't go un-noticed… As a surprise, they snuck some 50 themed decorations around his office, so he couldn't pretend it wasn't happening!

Last issue's winners

Pseudoku

The Pseudoku set by Keith Parsons drew the usual clutch of entries, most of whom correctly identified promethium as the missing P-element.

Correct solutions came from Ed Moll, Peter Keefe, Jim Dunn, A.J. Wilkinson, C.M. Bowditch (who reports he enjoys the magazine, even though it is 60 years since he first entered the old chemistry lab right across from Pembroke), Bill Collier (who claims that he's feeling rather young – not reaching 'three score years and 10 until next year), A.M. Griffin, Richard Brown (on a marvellous postcard of postage stamp celebrating the 100th anniversary of the Nobel prizes, albeit depicting physics rather than chemistry), Mike Summers-Smith, Tom Banfield, Mark Alderton, David Wilson, Adrian Conrad (who claimed that promethium, being radioactive, had decayed into invisibility), Norman Sansom (who says he was at Cambridge in 1964–67, and enjoys reading about Lensfield Road in *Chem@Cam* even though he gave up the chemistry in 1970 to move into computer programming, remaining in the field until he retired from the University of Brighton's computer service last year), Roger Duffett, Pat Lamont Smith, Richard Chambers, Hannah Steinitz, Karl Railton-Woodcock and Annette Quartly.

And the winner, picked by this issue's glamorous assistant and random number generator Jeremy Sanders, is Richard Chambers. Congratulations.

Tom Banfield actually replaced the 'missing' Promethium with the recently discovered element Pseudonium, and claims this remarkable substance appears to have variable atomic number and masquerades as a Group 1 metal on Mondays, Group II on Tuesdays, and so on. This means that every Sunday it joins fluorine, chlorine and the rest as a halogen, when it goes by the special name of Ovaltine because of the unusual shape of its electron structure (the p-orbitals, naturally). It is rumoured that it becomes a noble gas on only one day a year, every 2 February – Mendeleev's birthday. But, alas, the necessary funding has not yet been secured to prove this conjecture.

Transmutation

A good clutch of entries was also forthcoming for Graham Quartly's 'Transmutation' problem. Several readers pointed out the minor flaw in the way the puzzle was set (which Graham himself also picked up on, albeit too late for publication), in that CERIUM to CURIUM is a simple one-step transmutation that is within the letter of the rules, if not the spirit of the puzzle! A couple of others tried to claim that CESIUM to CERIUM to CURIUM should also be allowed, but of course we're not letting them get away with that – as any fule kno caesium has an A (if we're supposed now to spell sulphur as 'sulfur' the USian types really ought to play the game with 'caesium' and 'aluminium'!).

However, there was a swathe of acceptable entries. Popular changes involved NICKEL, SILVER and COPPER. Annette Quartly took 12 steps from Cu to Ag, and 13 from Ni to Ag, but as she suspected, that wasn't very efficient. Similarly inefficient, at 12 steps, was Chris Willis' attempt from Ag to Ni, and Ian Potts' Ni to Ag in 11 was barely better. Pat Lamont Smith managed it in 8, Robin Cork went the other way in seven, Mark Alderton did Cu to Ni in seven, and David Wilson managed both Ni to Cu and Ni to Ag in 6, albeit both with dodgy words. Richard Brown's C to Ni took him 10 steps, and while Tom Banfield's Ra to Ni took him 15 steps, at least he used an element no-one else did. And Jim Dunn went from Ag to Cu in nine.

Roger Duffett almost managed Ni to Ag in four, but had to make up a word to do it. 'Silker' sounds like it ought to be one, but neither the only dictionary in the office *Chem@Cam* shares with a selection of eminent emeritus profs (a New Oxford belonging to Alan Battersby) nor a collection of internet-based alternatives thought it should be allowed. He did, however, manage Cu to Ag legally in six. And he also managed Radon to Boron in five, even if one of them was 'racon' – a contraction of 'radar beacon'!

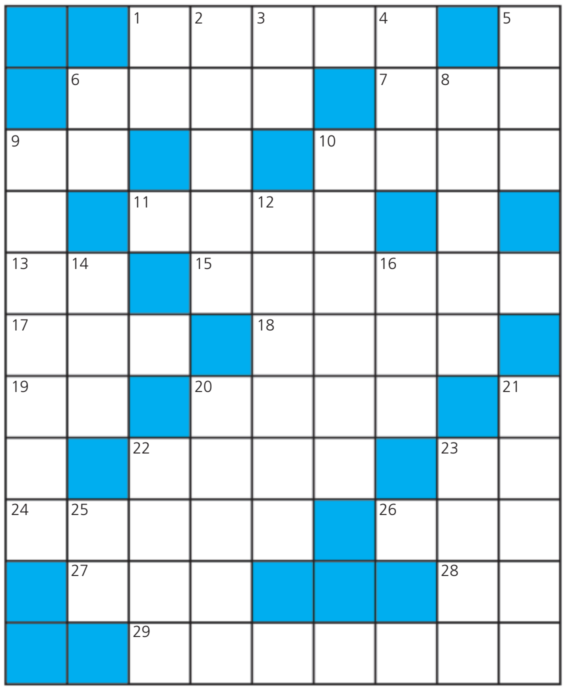
Also managing six-step changes were Norman Sansom (C to Ag), Adrian Conrad (Ag to Cu, and if I'd allowed his 'cheat' of changing a double letter for another double letter, would have managed Ag to Cu in five), and Dennis Pelmore (Ag to Cu again).

And the prize goes to Dennis Pelmore, who was at Emmanuel between 1933 and 1936, for SILVER-SALVER-CALVER-CARVER-CARPER-CAPPER-COPPER, the same as Adrian Conrad's. Dennis claims he's glad he doesn't have to umpire this puzzle. On reflection, he has a point… our glamorous assistant picked him at random from those who had managed legal six-step changes.

An honorary virtual prize for cheek has to go to Ian Potts who claimed he could go from TERBIUM to ERBIUM by replacing the T with nothing

£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 CB2 1EW

This issue's puzzles



This issue, Graham Quartly returns with another elementary crossword. As before, the aim is to fill each box with the symbopl for a chemical element, so that the words formed across and down match the clues. For example, if the clue was 'Australian city' with five spaces available, it could not be PErTh or CaNbErRa, but could be BrISBaNe.

Across
1. Tea urn
6. Bohemian of the 50s
7. With bow
9. Flooded defence
10. Feeling
11. Charm or strange desire?
13. Raw chemical
15. Science of men and robots
17. Part of a complex
18. Excite
19. Beanpole
20. Apostle
22. Element
23. Swindle is not for the pros
24. Orthodox?
26. One of many surfaces
27. Pen
28. Friend is a gem with nout taken away
29. Harmless

Down
1. Took a school exam
2. Bodily fluid
3. Fine
4. Turkish mountain
5. Courts
6. Rhythm
8. Scold
9. Characterless
10. Chemical that excites them
12. Pleasure-loving
14. Obtain once more
16. German number
20. Rank or halt
21. Army men
22. Medical chemical
23. Rodent
25. Russian river

Molecular rearrangement

And finally... another puzzle from Keith Parsons.

Rearrange all of the letters used to spell the seven molecules listed below to give the names of seven other organic molecules. All are single word names, and there are no prefixes such as D- or iso-.

CAMPHENE ■ CHOLINE ■ INDANE ■ ISATIN
MENTHOL ■ RIBOSE ■ TOLUENE

The new group of chemical names have the following chemical types:

2 hydrocarbons ■ 1 polysaccharide
1 purine ■ 1 sugar ester ■ 1 ether
1 first member of a homologous series

Technical excellence

Sue Johnson is retiring soon, having been in the department for nearly 20 years, latterly as principal assistant. She talks to roving reporter Don Flory about her life in education and future plans

Photo: Caroline Hancox

Sue Johnson, the department's principal assistant who has spent her entire career working in education at all levels, is to retire in March. She was born in Histon near Cambridge in 1948 and, after attending the local primary school, went on to study at the Parkside Grammar School in the city.

In 1969, after a further three years gaining a certificate of education at Goldsmith's College in London, she decided to take time off and have a breather from the world of education. 'I didn't want to go straight into teaching without a break,' she says. 'So I came back to Cambridge for two years, and worked in the department of investigative medicine, which I quite enjoyed.'

But in 1971, education called her back, and she began teaching science at a girls' comprehensive school in Norwood, south London, and remained there for the next 19 years, totally immersing herself in the life of the children. Many of the youngsters were of Afro-Caribbean and Asian origin, and Sue found herself comforting them when their parents would not, giving them extra tuition, helping with drama production and giving up her weekends and part of her annual holiday to supervise school trips.

Being a notoriously difficult school, coping with the pupils wasn't easy, but with the help of her teaching colleagues the problems were gradually worked through, even though it also meant Sue devoted a lot of her free time to pastoral work, dealing with children who were bullied, caught stealing from local shops, or abused. 'I remember one girl who had not been to school for five days because she had been beaten so badly at home,' she says. 'Another girl could not come to school because she had no shoes to wear.'

But Norwood's loss was the chemistry department's gain when in 1991 she decided she needed a complete change from teaching, as the time at Norwood had left her emotionally and physically drained. She joined the Part I teaching in the department as a technician in John Bullman's section.

In 1994, she was appointed to a newly created post as principal assistant and chemical safety technician and later on, in 1999, she succeeded Chris Abell and Stephen Elliott as safety officer.

The ever expanding department and the resulting increasing amount of work her role entailed meant that the job was split in two, leaving Sue as principal assistant and a full-time safety officer was recruited – a position currently held by Margaret Glendinning.

Sue's job involves a variety of functions. These include supporting the assistant staff on a personal level, training coordination with the support staff, and involvement with environmental matters. 'I've enjoyed the job over the years,' she says. 'However there have been some difficulties, too – for example, when the chief custodian was off work sick for some time, which meant spending extra hours at night and at weekends covering for him.'

Now that retirement is just around the corner, Sue is looking forward to spending more time with her family. 'I have a brother and two nieces and a nephew whom I will be able to see more often, and I hope to have more frequent contact with a number of my former school friends, some of whom now live abroad,' she says.

Sue has always been interested in travel, and would love to visit India, a country which has always fascinated her – many of the children she taught at Norwood originally came from there. She also enjoys reading, gardening and crosswords and hopes to become more involved in community life in Histon, where she lives. 'It's a big village, and there's a massive amount of varied things going on there, something I hope to be part of after March when I leave the department.'

And when she finally leaves, Sue will be missed. 'The department is very grateful for the commitment that Sue has shown over the years,' says head of department Bill Jones. 'We will also miss her ever-present good sense of humour!'

Stores' new look

The latest part of the department to be refurbished is stores. It took a good three months to do as they couldn't move out completely,, and during that time they had to relocate twice.

But it's all been worth it, says Kevin Veal, as they have much more space, and the new office area is far airier. 'We've also got "prison bars" on some of the windows,' he says. 'I'm not sure if they're to keep us in – or to keep everyone else out!'

The stores team, then and now. Left, from the early 1970s, chief storekeeper Jack Fenning, Roger Sansom, Percy Jackson and Cecil Utteridge. Right: the current team: Ian Castle, David Woollard and Kevin Veal

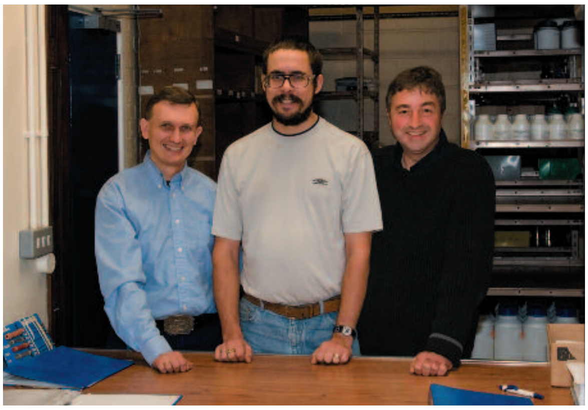


Photo: Nathan Pitt

If that doesn't scare off the pigeons, I don't know what will!

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