chem@cam

Chemistry at Cambridge Newsletter

Summer **2006**

Statistical mechanics and colloids

The synthesis of unusual inorganics

Surface chemistry of catalysts

Memories of Lord Todd at Cambridge

Philip Brown was at Cambridge in the early 1960s, before moving into journalism. He sold the company he set up, PJB Publications, in 2003, and along with his wife Patricia has recently provided the department with a donation for a Next Generation Fellowship. He spoke to Sarah Houlton about his views on academia and funding

Photo: Nathan Pitt

A PhD in organic chemistry leading into a job in journalism is a great career path! How did it happen for you?

I was at Cambridge from 1960–63, with a degree in pharmacy from London, and B.C. Saunders was my supervisor. When I wasn't working in the lab, I was busy as the photo editor on Varsity. That was rather fun! I ended up taking a job as medical and science reporter at the Daily Express, working with Chapman Pincher.

I stayed at the Express for nearly three years, then went to do communication work for the pharmaceutical company Sterling Winthrop, before moving to the advertising agency J. Walter Thompson. I set up a business publication for the international pharmaceutical industry in 1972; in 1976 JWT sold it to me as it was becoming something of an embarrassment to them. We were becoming more journalistic and writing about clients who were (understandably!) a bit narked their advertising agency was writing nasty things about them.

I ran what became PJB Publications for 27 years, with publications in human and veterinary medicines, devices, diagnostics and agrochemicals. We built the company up to 250 people, and sold it to Informa at the end of 2003.

You're now chairman of the Council of the School of Pharmacy in London. How has academia changed since you were a student?

The one thing that seems to override everything these days is talk about money. This all has to be seen against a backdrop of student numbers. When I was a student about 6% of young people went to university. It's now close to 46%, and this government's objective is to get that up to 50%.

I think this in itself has been a hugely complex exercise, far more complicated than the policy designers thought it would be. You are presented with extremely complex formulae for how much money you will get. And there's no planning – you can't carry money over from one year to the next and you just have to assume that your budget will increase. You'll get 3 or 4% more if you're lucky, but if you actually try and work out how it's going to come then you don't have the faintest idea.

The comparison with industry is striking. You've got civil servants ladling in money at one end, and you may get to the end of the financial year, say, £46,000 out on your budget of £15 million, and it's a tragedy. Yet in industry if you were just £46,000 short on that sort of budget you'd be a complete and utter hero! They just don't have the risk–benefit equation in balance. I get requests that say 'Should we be doing this? It will cost money!' I have to ask what the benefit will be. If they can show me we're going to get, say, more postgraduate students if we do it, then I say let's do it!

The idea of getting half of young people into university is a brave step towards the social engineering of the country. And we've got to do it. But I think the way we fund it and go about it is all over the place. A big difference in the system in the US is that the universities there are ruthless in terms of getting money out of their alumni. You are expected to pay!

I think it goes back to the responsibilities inculcated into young people when they're at university that they come away already knowing the debt they owe their university rather than discovering it when they've got a couple of million quid in the bank. This might sound cynical, but benefactors here are benefactors because they can afford it. It's very different from the US approach where you're expected to cough up a percentage of your earnings to your old college because of what they gave you.

What about the Research Assessment Exercise? Is it a fair way of deciding how funding should be distributed?

That's a very good question. There is certainly a fair amount of politics involved, and they keep changing the ground rules. The yardstick at the moment is sustainability; as we understand it, what they will be assessing, as well as the calibre of the research, is the number of very good researchers in a department who will be very good for a long time to come. Though nothing is as clear as it should be! The grant I've agreed with Cambridge will give some money to the bright people the department is trying to attract, and give them the wherewithal to buy equipment and set themselves up.

What is also strange is the fact that grants from industrial sources don't come anywhere near as high in the pecking order as those from 'respectable' organisations like the research councils. Yet university funding has to be diverse: while you can get very nice grants from the research councils, if you're not doing the research they want you can't get a grant.

What's the effect of a bad report?

We've worked out at the School of Pharmacy that if we dropped a star rating in the RAE, we'd instantly lose about £400,000 of grants out of our annual budget of £15 million. It would also have a knock-on effect on our ability to attract good people. We estimate in the first year it would cost us around £1 million, and it's a downward spiral from there.

If you see a chemistry department dropping from four-star to three, the knock-on effect is so much greater than the loss of government grants. It loses some of its standing in the scientific community, the good people start leaving, and it turns into a death spiral. Suddenly we'll find that there are no chemistry departments left, other than the really big ones with international reputations.

Another thing that the RAE is now looking for is a research policy – that a department's research is all going somewhere – and I really don't know how that fits with academia. Diversity is the great joy of academia, where people can suddenly have a bright idea and pursue it. There is a danger that the result could be a quasi-industrial approach with an r&d director, and you be come like one of the big pharma companies with 40 committees to get through before any decisions can be made. It's unwieldy, and definitely against the best interests of the science.

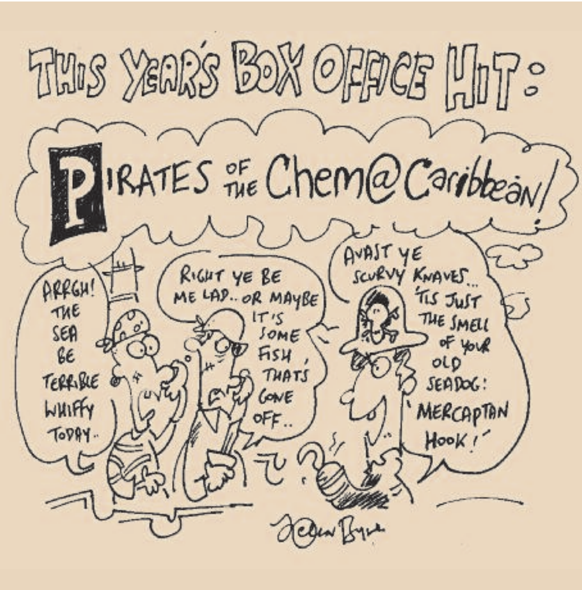
The great thing about research is diversity and, putting my pharmaceutical hat on again, one of the great losses has been the large number of mergers of pharma companies in recent years. The diversity has been lost. If you have four or five good departments or different companies working on a problem, it was that diversity which was far more likely to prove inventive. You only have to look at these monolithic entities that have emerged to realise how unproductive they are.

Of metals and mercaptans

Dear Editor
Many thanks for the copy of the Spring issue of *Chem@Cam*. This is the first contact I have had with the department since June 1954, when I went down from Trinity with a rather poor Third.

However, I had an interesting career, starting with four years in the heavy chemical/metallurgical industry with National Smelting at Avonmouth.

I then went to AWRE Aldermaston, where I remained until retiring 10 years ago. I was in chemical technology, working from one end of the periodic table to the other, from hydrogen and its isotopes to uranium and plutonium, with an interval in materials science (including carbon-reinforced carbon composites and three-directionally silica-reinforced phenolics).



I ended up as Head of the Nuclear Materials Division (which sounds rather grander than it was) with responsibility for nuclear materials management generally, development of (pyrochemical) plutonium recycling, minimisation of radioactive waste arisings, and the development of radioactive waste conditioning for storage and disposal.

I was interested to read about the antics of Drs Mann and Saunders on skatole and mercaptans. I remember Saunders having the lab technician break an ampoule of some mercaptan on the stairwell of the chemistry lecture theatre in the early 1950s to give departing students the benefit of his researches.

And I think it was Mann (my supervisor) who told me a story about him and another mercaptan researcher during the war. They got on a bus one afternoon with a woman who had a rather large and suspect looking cabbage she had bought cheaply in the market.

The smell from their hands was such that the poor woman took the cabbage back to the platform and threw it off the bus, saying she would never go to that stall again...

Yours sincerely
Paul Stickland,
14 Gorselands, Newbury,
Berks, RG14 6PX

A drop of champagne

Dear Editor
I very much enjoyed the article on Steve Ley's 60th birthday. Would have loved to heard the talk on 'Champagne: an important catalyst…'

We never had a talk about champagne when I was studying chemistry in the U.S. But I do recall that one of my friends, in graduate school by that time, needed a high-pressure container for a reaction. His adviser told him to take a bottle of champagne home to his wife, have a lovely evening, and the next day he could use the bottle for his reaction.

He was very happy to follow instructions to the very last drop.

Patricia Short
London

Arsenic in the beer

Dear Editor,
The correspondence on beer analysis reminded me of a story told by my school science master, John Hunter, who had studied chemistry at Manchester University shortly after the First World War.

There had been a bad outbreak of arsenic poisoning in Manchester in 1900, with an estimated 6000 people affected and 70 deaths. All had been beer drinkers and the problem was eventually traced to invert sugar being used in local breweries. This had been manufactured using sulphuric acid derived from iron pyrites contaminated with arsenopyrites.

For many years following this, final year chemistry students were given the task of analysing products from the local breweries using the Marsh test for arsenic. This was a task greatly enjoyed, since only a few ml (cc in those days) of each sample were required for the test, the remainder being consumed by the students as the analyses progressed.

Yours sincerely
Rodney Pollitt
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chem@cam
Chemistry at Cambridge Newsletter

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Teaching fellow Peter Wothers in action, burning magnesium during his talk 'A little light relief' at this year's open day. More photos from the day can be found on p12

Photograph: Nathan Pitt

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Photo: John Holman

A transformation... from the dark and dingy G19 to the light and airy Todd-Hamied room

G19 becomes the Todd-Hamied room

Yusuf Hamied performs the official opening, in front of Jeremy Sanders, and Lord Todd's children, Helen Brown, Sandy Todd and Hilary Todd

The department's ground floor meeting and seminar room, G19, will be remembered by former students as hot in summer, cold in winter, and a less than inviting place. No longer. As the latest part of the transformation of the Lensfield Road labs, it has become a state-of-the-art meeting room, complementing the refurbished lecture theatres to give a world-class suite of meeting conference facilities.

The transformation was possible thanks to the generosity of former student Yusuf Hamied. Yusuf did a PhD with Lord Todd in the late 1950s, and is now chairman and managing director of the Mumbai, India-based pharmaceutical company Cipla, which his father set up in 1935. He decided that the room should be named in honour of his former mentor, Alexander Todd.

The official opening took place on Friday 9 June, alongside the newly-refurbished Centre for Biological Chemistry, which is in the old Lab 287.

After an opening speech by head of department Jeremy Sanders, Yusuf spoke about his memories of Todd, and Sandy Todd about his father and the influence he had in the scientific world.

Two scientific presentations from chemical biologists followed, on current developments in the fields Todd had worked on. Chris Abell, who is also the Todd-Hamied fellow at Christ's, talked about vitamins, and Shankar Balasubramanian about dinucleotides, nucleic acids and beyond.

The official unveiling took full advantage of the technology in the new room, and was beamed back to the big screen in the Wolfson lecture theatre.

Clockwise from above: Yusuf Hamied, Sandy Todd, Dennis Marrian, Chris Abell and Shankar Balasubramanian

Photos: Nathan Pitt

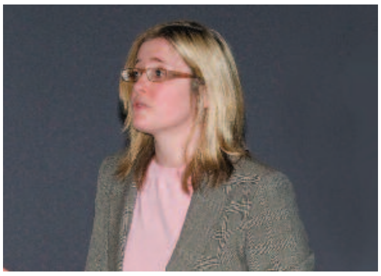
Melville Lectureship

Photos: Nathan Pitt & Caroline Hancox

Anticlockwise, from the left: Bert Meijer, Andrew Brown, Saghar Khodabakhsh and Rachel O'Reilly

This year's Melville Lecturer was Bert Meijer from Eindhoven University of Technology, who spoke about supramolecular polymerisation processes as the keynote speaker in the afternoon symposium in May.

Supporting lectures were given by Dorothy Hodgkin fellow Rachel O'Reilly, PhD student Andrew Brown, and Saghar Khodabakhsh, who is to become a research fellow at Emmanuel in October.



Lab 287 transformed

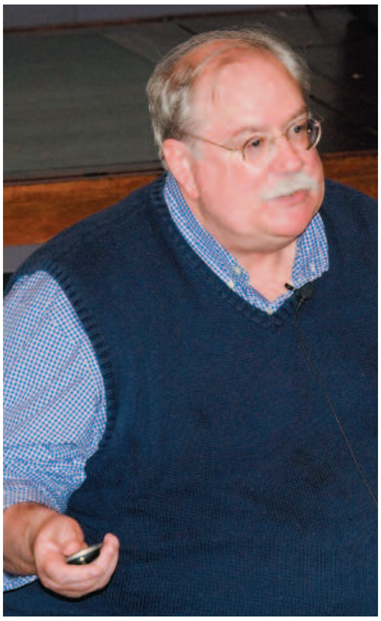
The new Centre for Biological Chemistry, which takes the place of the 1950s synthetic lab 287, will provide communal facilities for all the groups interested in chemical biology and biological chemistry.

The design and execution of the new lab has been masterminded by Chris Abell, and it's a far cry from the old lab. Jeremy Sanders reports that in his PhD days he left his fiery mark in one of the now-demolished fume cupboards…

The old Lab 287 (above), and in its new Biological Chemistry guise

Photos: Nathan Pitt

Photos: Nathan Pitt



Two more eminent visitors to the department: pictured left is David Evans from Harvard, who gave this year's Todd lectures, and on the right is Henk Lekkerkerker from the University of Utrecht in the Netherlands, who is the current Schlumberger lecturer in the theoretical sector

Alex Hopkins

We are sad to report that Alex Hopkins, college teaching officer in inorganic chemistry at Churchill and Fitzwilliam colleges, died in June after a long battle with cancer.

His partner, Sally Boss, is taking part in the Grunty Fen Half Marathon in Ely on 10 September, along with many of Alex's family and friends. The aim is to raise money for Cancer Research, with the sponsorship going towards research into finding a cure for melanoma.

If anyone else wants to join in the run – either the half marathon itself or the one-mile fun run – then please contact Sally on srb39@cam.ac.uk.

Any offers of sponsorship would also be gratefully received. This can be done online at the Cancer Research UK website; the correct page can be accessed directly at http://tinyurl.com/jtfqw

Eric Walters (left) and Philip Brown (right) sign on the dotted line at the recent Chemistry Advisory Board meeting at the Royal Society, watched by CAB chairman Alan Watson and head of department Jeremy Sanders

Photos: William Archer

Generous donations

Carol Robinson has been appointed Royal Society Research Professor in Chemical Biology.

Her chair was previously supported by a donation from the Walters-Kundert Charitable Trust, and the trustees have agreed that the substantial sum that remains from the donation can be used to support Carol's lab, and also to provide start-up funds for one of the university lecturers who will be appointed later on this year.

In recognition of this generous donation, Carol is to be director of the Walters-Kundert Laboratory for Chemical Biology, and the future lecturer the Walters-Kundert Next Generation Fellow. A further Walters-Kundert NGF will be appointed in 2007.

Another start-up fund for a future lecturer has been generously donated by Philip and Patricia Brown, and the new appointee will be the Philip and Patricia Brown Next Generation Fellow.

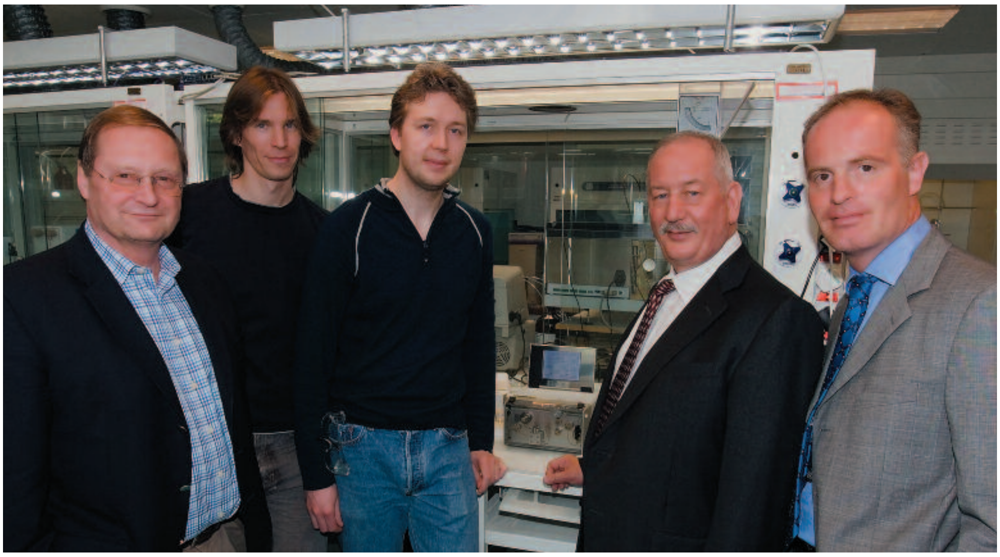


Photo: Nathan Pitt

Microadditions to the ITC

Pictured, left to right: Steve Ley, Ian Baxendale and Kristian Knudsen from chemistry, the H-Cube, and Ferenc Darvas and Alex Drijver from Thales Nanotechnology

The latest additions to the Innovative Technologies Centre in the basement are two microreactors from Hungarian company Thales Nanotechnology.

The ITC's H-Cube is the 100th of the machines to be produced, and was given as a gift to Steve Ley's group in recognition of his help in promoting the use of this sort of flow technology. It is a bench-top flow hydrogenator which allows hydrogen to be generated *in situ* by the electrolysis of water.

The hydrogen can then be used for organic synthesis in a flow reactior. Various packed catalyst cartridges can be used for the reactions. A continuous flow of product emerges into a collection vial. The reaction mixture can be heated to 100°C and pressurised to 100 bar.

The second system is a yet-to-be-released X-Cube, which is designed to carry out high temperature and high pressure flow reactions.

The ITC was set up last year to bring together a range of automated synthesis equipment. A particular focus is on flow reactors, where chemicals are pumped through a tube and, as the product emerges from the end, more reactants are fed in, giving a continuous reaction process.

Japanese medal

Steve Ley has been awarded the Nagoya Gold Medal for organic chemistry. The prestigious award from Nagoya University in Japan is made every year to an organic chemist who has made significant contributions to the field.

Previous winners include such luminaries as K.C. Nicolaou, Bob Grubbs, Sam Danishefsky and David Evans.

Steve will be presented with the medal in Japan in November, when he will be giving two lectures, one entitled 'Natural product synthesis: a stimulus for discovery', and the other 'New tools for molecule makers'.

'I'm really pleased,' he says. 'I'm particularly proud to be the first UK-based chemist to be honoured with this award.'

Catherine arrives

The department's new Technical Secretary, in succession to David Watson who retired earlier in the year, is Catherine Gibbs.

She took up the position in July. Catherine is a New Zealander by birth, but has been in the UK since 1989 when she arrived for three years – and never went back.

With a degree in horticultural science from Massey University, she has spent the past eight years as laboratory facilities manager at the Wellcome Trust Sanger Institute at Hinxton, where she helped manage the Institute's growth from 400 staff to more than 900.

An introduction to the chemistry lab

Once again this year, the department took part in the Salters' Festival of Chemistry. The aim is to give schoolchildren a taste of what it's like to do experiments in a real chemistry lab, not just the school classroom.

The Salters' Company is very involved in chemistry education, also running the Salters A-level syllabus and a chemistry education centre at the University of York.

Teams of four 11 to 13-year-olds from schools in Cambridgeshire and around took part in the day, and the experiments were run as a competition. Perhaps the most important difference between carrying out experiments and those at school is the fact that they could spend proper time on them, without having to rush through as they do in school lessons.

Students from Impington Village College (above) and Appleton School (below) dressed and ready for chemical action

Photos: Nathan Pitt

Academic appointments

A number of appointments to the academic staff have been made in the past few months.

Oren Scherman is the new lecturer in the Melville lab. An American, Oren did his PhD with Bob Grubbs at Caltech, and has been working in Eindhoven with Bert. Meijer.

Spectroscopist Stuart Mackenzie has joined us from Warwick as a lecturer in physical chemistry, and took up his post at the beginning of July.

In October, Michele Vendruscolo, currently a Royal Society research fellow, will become a university lecturer in theoretical chemical biology.

Two further current research fellows, David Spring and Matthew Gaunt, are also becoming university lecturers, both in organic chemistry.

It's two in, two out for the research fellows in theoretical. Jonathan Doye and Ard Louis are both taking up posts as lecturers at Oxford. Mark Miller, currently a junior research fellow at Churchill, is to be an EPSRC advanced research fellow. And Jochen Blumberger, who did a PhD with Michiel Sprik, is returning from a postdoc at the University of Pennsylvania in Philadelphia to become a Royal Society research fellow here in Cambridge.

Bussing it to Bristol

Every year, the University of Bristol organises a one-day organic synthesis conference. This time, a group of Cambridge chemists went en masse.

Thanks to the generosity of Sigma-Aldrich who paid for it, a coach arrived at the department at 5.30am to pick up a group of bleary-eyed members of the Ley, Paterson, Gaunt and Spring groups.

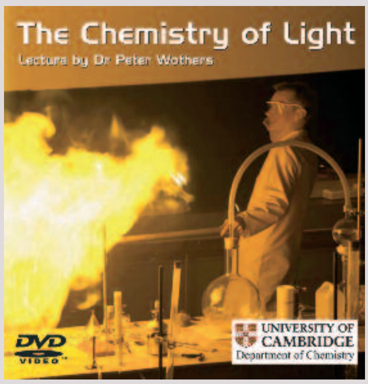
'It was a very early start, but it was worth it,' says Damien Webb, a PhD student in Steve Ley's group who organised the bus. 'Everyone really enjoyed the meeting, and we'll definitely try and organise something similar again for next year's event.'

A rather sleepy group sets off in the dark (below). They were rather more awake for the photo on the right once they arrived!

At this year's Open Day, Peter Wothers' lecture 'The chemistry of light' was filmed, and a DVD has been produced. It provides a fantastic opportunity to relive the lectures with close-ups and replays, as well as links to additional material.

Copies of the DVD cost £5. Send a cheque, payable to the University of Cambridge, to DVD sales, Department of Chemistry, Lensfield Road, Cambridge CB2 1EW.

All proceeds will go towards future Science Week activities.



Molecular interactions

Jean-Pierre Hansen combines calculations, simulations and experiments to look at the properties of matter

Jean-Pierre Hansen: playing dice

Photos: John Holman

Investigating the properties of molecules in isolation is a fairly straightforward proposition: it's reasonable to ignore the interactions between the molecules of a gas as they are so far apart. But once you squeeze them closer together in a condensed phase such as a liquid or a solid, the molecules exert an effect on each other which cannot be ignored. Statistical mechanics is the art of dealing with macroscopic samples of large numbers of interacting molecules, and this is the focus of Jean-Pierre Hansen's work.

'In a liquid or a solid, the interactions between molecules are essential, and you have to calculate the properties of such very large assemblies of molecules from first principles,' he explains. 'We want to understand how these interactions lead to macroscopic properties. For example, if you have a glass of water, we would like to be able to predict from the quantum mechanics of the microscopic scale what the macroscopic properties we can measure – such as specific heat or conductivity – will be.'

The calculations involved, however, are fearsomely large and complicated, so intelligent approximations have to be made, and then refined in the light of the results, for them to be practical. Computer simulations are also an essential part of the process, with the three different techniques – calculations, simulations and experimental – being used together to get the best results. 'By inputting positions and velocities for hundreds of thousands, or even nowadays millions, of molecules you can look at how the whole system of molecules evolves over time,' he says.

One of the most important simulation techniques he uses is the Monte Carlo method. 'It's essentially a random process: you just play dice,' he says. 'You pick two different possible configurations, measure their relative energies, and give a random preference those with the lowest energies. It's a very simple way of imagining the system, but effective since any system evolves spontaneously to the state with the lowest possible free energy.

CLASSICAL OBJECTS

'It also means that we do not need to use complicated quantum mechanics calculations. Quantum mechanics is indispensible when determining the structure of molecules and their mutual interactions, but the molecules can then be treated as classical objects governed by Newton's equations of motion, which are much easier to work with.'

These simulation techniques are being used to investigate the behaviour of numerous different types of molecules and systems, and one example where Jean-Pierre has been very active over the years is the colloidal dispersion. Colloids are natural or synthetic mineral or polymeric particles, or biomolecular aggregates such as viruses. They are tens of hundreds of nanometres in size, and are suspended in water or some form of organic solvent.

'Colloidal dispersions play a very important role in life as very much of our food is made up of them, for example butter and yogurt,' he explains. 'Mud is another example: it is made up of dispersions of clay platelets, which are flat colloids. You slip over in the mud because the platelets slide along each other.'

The colloids can consist of neutral particles or highly charged ones. 'When they are charged, carrying thousands of elementary charges, there are very strong repulsions between them,' he says. 'This will have a big impact on the mesoscopic structure – not microscopic or macroscopic but in between, of the order of microns. You can watch them move under a normal optical microscope, as their size is of the same order as the wavelength of light. This is a very active area because of its technological implication in industries such as food, cosmetics and pharmaceuticals.'

Jean-Pierre and his group have carried out a great deal of work in this field. 'We have modelled them, making judicious approximations to try and calculate the partition function,' he says. 'If you know this, you know an enormous amount about the system: it's a multidimensional integral, and if you integrate it over all the coordinates of all the many particles you can calculate the free energy, all the thermodynamic properties, but also the local structure, as probed by radiation scattering experiments.'

Experimentally, colloids are fairly straightforward to investigate, because the size means X-rays are unnecessary

CV Jean-Pierre Hansen

Born: Luxembourg

Status: His wife Martine is from Paris, and their daughter Anne-Elise lives in Oxford with his 10-year-old grandson. 'He's very British!' he says.

Education: From school in Luxembourg he went to university in Liege, Belgium, initially to follow in his father's footsteps and study engineering. He soon realised that his preference was for fundamental rather than applied science, and changed to physics halfway through. A PhD at Orsay, Paris in theoretical physics (he almost came to Cambridge instead!) was followed by a research position at CNRS, also in Paris, and then a postdoc at Cornell University in the US.

Career: Jean-Pierre returned to Paris and a chair at the Université Pierre et Marie Curie in 1973, before moving to Lyon in 1987 as deputy director in charge of the research labs at the newly-established Ecole Normale Superieure there. He moved to Cambridge to head the theoretical chemistry section in 1997.

Interests: His big interest outside chemistry is history of art. His wife was educated at the Louvre School of Art, and they love to visit exhibitions, as well as collecting art. 'Not expensive things – just pieces we like and can afford!' he claims. He's also interested in archaeology, reading, hill walking and visiting beautiful cities, particularly in Italy.

Did you know? One of Jean-Pierre's earliest memories is seeing Winston Churchill during his post-war visit to Luxembourg in 1946. 'I vividly remember looking down from my grandfather's town house and seeing him drive past in his open-topped car. He spotted me and waved at me with his big cigar. This was the greatest hero of the 20th century, waving at me, and I had no idea who he was!'

for scattering measurements: light scattering is a very good diagnostic for the motion and structure of these particles when they are packed together in concentrated suspensions.

Jean-Pierre believes the interplay between colloids and polymers is a particularly interesting subject. 'Colloids are hard particles; they are like very small billiard balls, whereas polymers are very soft particles as they consist of long chains which twist around themselves,' he explains. 'We've done a lot of work over the past five years where we've treated polymers not like threads, as many people do, but as soft globules. One of these polymer coils is a little like a ball of wool – it's ultra-soft because the polymer chain doesn't occupy all of the available volume, leaving plenty of space inside.'

DIBLOCK COPOLYMERS

Another area of polymer chemistry he's been looking at recently is the assembly of diblock copolymers. A diblock copolymer consists of a chain of one monomer, A, attached to a chain of a second monomer, B, so the properties of the long polymer molecule change part way along it. If monomer A likes water but monomer B does not, when the chains are suspended in water A will be happy but B will curl up more tightly than A to avoid contact with the solvent.

'This drives the self-assembly of the copolymers,' he says. 'Instead of being disordered in solution, they will tend to form micelles, where all the B parts clump together, leaving the As on the outside of the structure, or lamellar phases where they arrange themselves in layers.'

The micelles can even arrange themselves in a cubic lattice, or cylindrical micelles can form, where long tubes are created with the Bs on the inside and the As on the outside. 'This is a lovely example of spontaneous self-assembly to form complex structures,' he says. 'I'd even go so far as to say that it is a very primitive prototype for self-assembly in cells. We know that biomolecules such as proteins are not randomly distributed, but they self-assemble in order to realise their biological function.'

Jean-Pierre and his group have been using a model system that is far simpler than the biological molecule itself to investigate how the self-assembly process works on a molecular scale. 'We have to take a model because if you put in all the chemical detail you would run out of computer time very quickly!' he claims. 'Our simplified models retain the essentials of these AB copolymers: their flexibility, the fact that they like to curl around and cannot intersect, and that one part likes the solvent and the other doesn't.'

Using this simpler model, he has carried out large-scale computer simulations of the self-assembly. 'We find that they first form clusters, and if you increase the concentration of copolymers in solution they will form micelles,' he says. 'If you then increase the concentration further the micelles – which are objects typically tens of nanometres across – will form lattice structures rather than remaining disordered. So the self-assembly actually takes place in two stages.'

By taking a very simple monomer, it was possible to work out the structure factor, which gives the stability distribution of such copolymers when they start to cluster. 'This is analytical work rather than requiring computer simulations,' he says. 'We could work it out because we made simplifying assumptions which allowed us to calculate the density beyond which the copolymer molecules will form clusters, and later on micelles. This is very important, because while large scale simulations, in principle, give "exact" results for small samples, if you have an approximate theory which can reproduce your simulations this will save an enormous amount of computing time and also make predictions, as long as the theory can be shown to bear comparison with simulation or experimental results.'

Other problems on which Jean-Pierre's group has worked recently include highly polar liquids near interfaces, ion and water translocation through ion channels across membranes, and effective, solvent-induced interactions between charged proteins.

Throughout his career in statistical mechanics, Jean-Pierre's philosophy has been to combine calculations, simulations and experimental, as what is learned from each improves the accuracy of the others. 'If you make approximations in your theory, you may get good or bad agreement with either your experiment or your simulation, and you learn from that,' he says.

EXPERIMENTAL FEEDBACK

'This helps you discover what is wrong with your approximations, and then improve them. Feedback from experimental results is very important. If our calculations disagree strongly with the experiments, it will be for one of two reasons: either the model is too simple and has thrown away an important part of the chemistry or physics, or it may be that the theory we used to make the approximations was bad.

'This is why the simulations are also so important, as they involve no approximations, provided you trust your models. If the computer simulations disagree with the experiment, then the model was not accurate enough. You can then carry out theoretical calculations on the same model, and try to extract structure factors or diffusion coefficients, for example.

'If there is still disagreement with the experiment, it could be because the model is wrong, as it was in the simulation, or because the approximations are too rough. Using the combination of techniques tells you what you need to do to make the simulations and approximations better. If you just try to do number crunching, which many people do, you may get some nice curves, but you don't get any insight into what's actually going on.'

The future is French

Although he's approaching retirement age, Jean-Pierre has no intention of retiring from science. Thanks to the vagaries of the French pension system, he'll be returning to France in October of next year, to the Ecole Normale Superieure in Paris. We won't have seen the last of him, though – he's planning to remain at Cambridge part-time, and will be back here to work with his collaborators for a few days every month.

'The 10 year Cambridge experience has certainly been a tremendous personal enrichment and a real pleasure,' Jean-Pierre says. I am also very pleased to feel that the theory sector, founded in the 1930s by Sir John Lennard-Jones, is thriving with young talent and world-class research, covering an exceptionally broad range of complex topics.'

The Hansen group: Chris Pearson, Ronald Blaak, Jean-Pierre, Ivan Coluzza and Anna Oleksy

A flash of inspiration

What's going on at the surface of catalysts as reactions take place? Heike Arnolds is using very fast laser pulses to try and find out

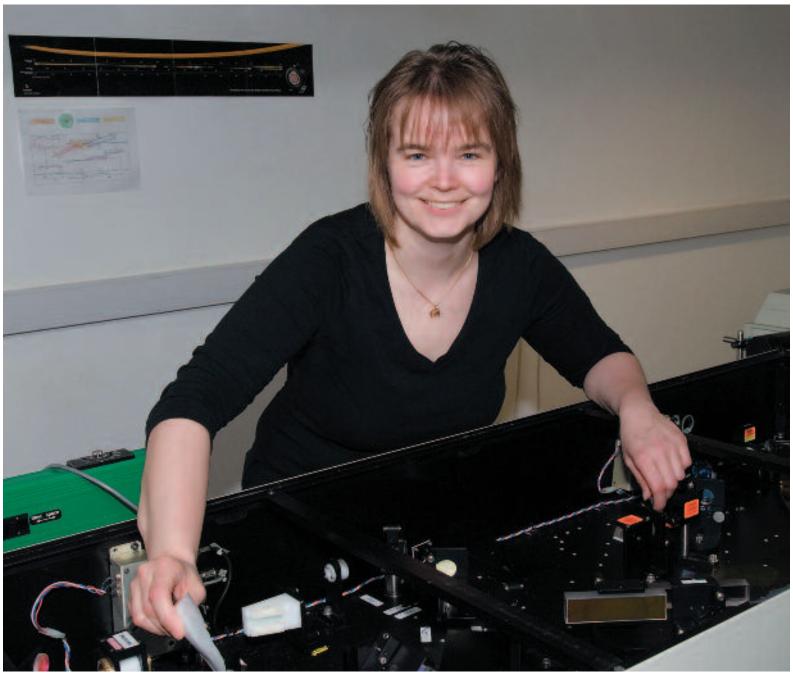


Photo: Nathan Pitt

Heike Arnolds: using very fast lasers to look at bonds breaking

All modern cars contain a catalytic converter that cleans up the exhaust, by promoting chemical reactions that remove nitrogen oxides, carbon monoxide and unburnt hydrocarbons. Catalysts are an essential part of many industrial chemical processes, too, from making polymers to medicines.

If the effectiveness of such catalysts is to be improved, then it is important to understand what is happening on the surface of the catalyst as the reactions take place. However, the basic bond breaking and making steps in a reaction take less than one picosecond – only a trillionth of a second. How can you measure something that fast?

Heike Arnolds is using spectroscopic techniques to do just that. 'By firing two very short laser pulses at the surface, very quickly one after the other, we can get a snapshot of what is going on,' she explains. 'The first laser pulse kick-starts the reaction and the second one does the spectroscopy. But it's much harder doing this on a metal surface than in the gas phase, because the surface is like a sponge that soaks up the laser excitation, making signals much fainter.'

She has been looking at how carbon monoxide and nitrogen monoxide molecules interact with each other when they are adsorbed next to each other on an iridium metal surface. 'If you heat the surface up slowly, then the two gas molecules will react with each other to form carbon dioxide and nitrogen,' she says. 'If you fire a laser at the surface to heat it up, and then fire a second laser of infrared light, you can look at the infrared spectra of the bonds as they form and break.'

An added complication is that by breaking the nitrogen–oxygen bond in the reaction, atomic nitrogen is left behind on the surface, which changes the conditions, leading to an effect on any further reactions.

LASER PULSES

As a result, instead of allowing the reaction to go to completion, she has been giving the molecules just enough of a push with the first laser to move them closer together so she can see how they interact with each other, but not enough to break the bonds completely. 'We've seen in separate experiments using just nitrogen monoxide that when it's heated up with the laser, the NO molecules tilt over towards the surface,' Heike explains.

'When we have both gases adsorbed on the surface, the NO still tilts, and its oxygen moves closer to the carbon in the CO, which is attached to the surface. By monitoring the IR spectrum of the CO molecules we can see the effect that the oxygen from the NO has as it gets closer to the carbon atoms. But the surface heats up and cools back down again too quickly for the reaction to come to completion, so by the time the next couple of laser pulses come around, the NO molecules stand up perpendicular to the surface again.

'No-one has ever been able to observe anything resembling a reaction actually taking place on a surface before; normally they're looking at what happens during heating or desorption. We're trying to understand what's going on at the catalyst surface during fundamental reactions, and being able to observe what's going on from first principles may lead to improved catalysts.'

The next step is to investigate photocatalysts. 'In an ideal world, it would be possible to use sunlight to split water into hydrogen and oxygen, which would give an environmentally friendly fuel source,' she says. 'Normal photocatalysts need ultraviolet light to work, but in sunlight most of the light is in the visible spectrum. Catalysts that work better with visible light would be extremely useful.'

She believes that the answer may lie in rough surfaces. If light is shone onto a normal metal surface, most of it is reflected off and the light intensity directly at the surface (where the molecules sit) is quite low. But if lots of little pits are made on the surface, then the light can form a plasmon – lots of electrons oscillating together – on the surface, which greatly increases the intensity.

'It's a little like having a lot of tiny lightning rods on the surface,' Heike explains. 'We hope to find that because these plasmons create localised hot spots on the surface where the electric field is enhanced, then the reaction rate for chemical reactions taking place at the surface will be increased. This may lead to better reaction yields, and we may also be able to tune the catalyst for specific substrates by designing the surface structure carefully.'

CV Heike Arnolds

Born: Recklinghausen, Germany

Status: Lives with boyfriend Keith Atkins, a computer consultant who studied chemistry at Cambridge – but they met in Oxford!

Education: Studied physics at the University of Marburg in Germany, and after a year doing a master's degree on high temperature superconductors in Oxford returned to Marburg for a PhD in surface science.

Career: Came to Cambridge in 1996 as a postdoc in Dave King's group. She's been an EPSRC Advanced Research Fellow since 2005 .

Interests: Digging the garden, painting in both oils and watercolours, carving wood and going to the gym 'to get rid of pent up aggression'

Did you know? Heike has been bellydancing for 12 years. 'It's good fun, excellent for your posture, and being able to balance a sword on your head is a great talent to have!'

Achieving the impossible

Paul Wood is using high temperatures and pressures to create molecules and lattices that look unlikely on paper

At high temperatures, it's possible to force reactions to take place that need huge amounts of energy, and so could not even be contemplated at room temperature. This is a major focus of Paul Wood's chemistry – carrying out reactions at high temperature to overcome the energy barriers that otherwise make them impossible.

Using Teflon-lined autoclaves that can be heated up to 250°C and pressurised to 100 atmospheres, Paul is making new inorganic compounds where the density of the metal atoms is higher than one might think possible. A good example is his work on porous compounds. These have great potential in the area of hydrogen storage, which is of growing importance because of the desire to power cars by hydrogen fuel cells. 'There needs to be a safe way of storing the hydrogen, so that people don't think they're driving the Hindenburg around the M25!' Paul says.

Paul poses with his Squid – a superconducting quantum interference device magnetometer

Photo: John Holman

POROUS COMPOUNDS

The first of his porous compounds was made, essentially, by accident, and consisted of cobalt ions, hydroxide groups and squarate ligands – so named because they're square in shape. 'We thought it looked rather interesting, and wondered how we could go about making more of them,' he says. 'It's not like organic synthesis, where you can say that a particular reaction is likely to work and give a particular result. It's more a case of taking a ligand that is a certain shape with a certain set of properties, adding metal ions and hydroxides into the brew, and believing that there's a good chance that the result might be a porous compound.'

The water in the reaction mixture is used to stabilise the channels that run through the structure. 'The hydroxide in the complex wants to hydrogen bond to water,' Paul explains. 'If there is nothing there to stabilise it while it's being made, the channel will collapse. The obvious thing to use is a solvent – water – and the hydrogen bonds from the hydroxide groups attached to the metal seem to stabilise the channel pretty well.' The water is not included in the lattice structure; it is merely the template used to make it. Once the framework has been 'bolted' together it can be boiled off, leaving a porous compound.

The third component in the structure – the organic ligand – to some extent controls how big the channel can be. 'Whether it is open or closed depends on how well the water in the channels hydrogen bonds to the framework,' he says. 'We've made a few structures that we were sure ought to contain channels, but they collapsed because the interactions between the ligands seem to stabilise a more close-packed arrangement.'

A second area of Paul's work involves magnetochemistry, a field where the main thrust comes from the data storage industry. 'While most people in this area are focusing on single molecule or single chain magnets which have the potential to store data a thousand times more efficiently than current technology allows, we are focusing on a more theoretical area,' Paul claims. 'We're trying to make compounds which have as many metals squeezed together as possible.'

The compounds he's making are being made as model compounds for theoretical physicists to investigate further. 'One of the very active areas in the theory of magnetism is extended lattices with geometrical frustration,' he says. Magnetism results from the spin of unpaired electrons, in which the electrons on an individual metal ion act like a bar magnet. Just like bar magnets, these spins usually prefer to line up with the south pole of one opposite the north poles of their neighbours. 'Imagine what happens if you put bar magnets at the corners of a triangle,' he says. 'There will have to be some thermodynamically unfavourable south–south and north–north interactions. This is called magnetic frustration.

'If we can create an entire lattice that's made up of triangles and hexagons, or triangles and squares, this frustration will extend across the whole lattice. Physicists are interested in the quantum mechanical consequences of this. While I'm no physicist, I've gone much further into the theory of magnetism recently than I ever thought I should. Feeding this bit of physics into my knowledge of synthetic inorganic chemistry has been a great way of finding new materials with really odd magnetic behaviour.'

CV Paul Wood

Born: Blackpool

Status: Single

Education: A first degree at Imperial College in London was followed by a PhD there with Derek Woollins in main group chemistry.

Career: A postdoc in Vancouver working on the asymmetric reduction of imines provided an introduction to working with high pressure equipment, and was followed by a second at Clemson in South Carolina. He returned to the UK for a lectureship at UEA in Norwich in 1994, then moved to Cambridge in 2000 as a lecturer.

Interests: Rowing, skiing, sailing and trying to work his way through the St John's college wine cellar.

Did you know? He took up rowing at the grand old age of 37, having been asked by the college chaplain at dinner one night if he'd row in the fellows' boat. He'd had enough wine by that stage to say yes, got hooked, and now rows regularly. 'It counters the ravages of age and a lifetime of beer consumption!'

Let there be light!

This year's open day was another roaring success, attracting 2000 visitors to the department. It kept photographers John Holman and Nathan Pitt busy!

This year, the theme of the Chemistry Department's contribution to Science Festival was the chemistry of light, and the department was transformed into pink, green, orange and blue zones.

About 2000 members of the public came through our doors. At least 200 students, researchers, staff and academics helped towards the day's success, with about 140 contributing on the day.

Peter Wothers gave his lecture, 'A little light relief', three times on Saturday, and a further three on Monday. Each one was rapturously received. Thanks to Peter, Mark and all those behind the lecture, including the teams in the workshops who got the wires in the right places.

This year, we commissioned George Williams of dvDesign to produce a DVD of Peter's lecture. The result is fanstastic, and our aim is to get a copy of this lecture into every school in the land. Help us do this by buying your own copy and spreading the word.

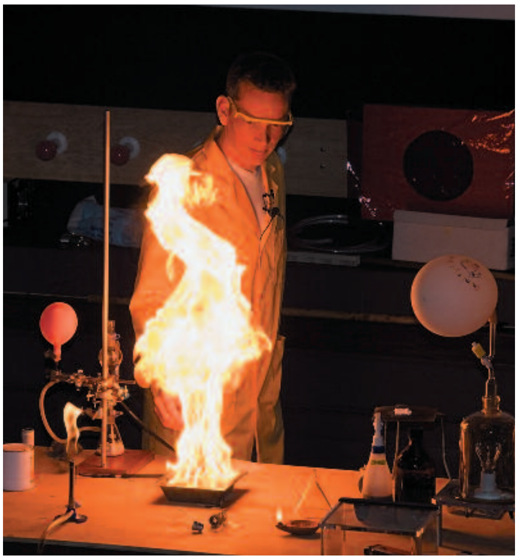
All the favourite hands-on experiments were enthusiastically demonstrated to kids and their parents, but this year we had some new attractions. The cryobananas show (organised brilliantly and safely by Joel and the Lambert group) took on theatrical status. Paul and Jen printed about 100 photos of visitors in Prussian blue at the Cambridge Blueprints stand. And a new element trail (thanks, Chris!) led families all around the periodic table as well as the multicoloured building.

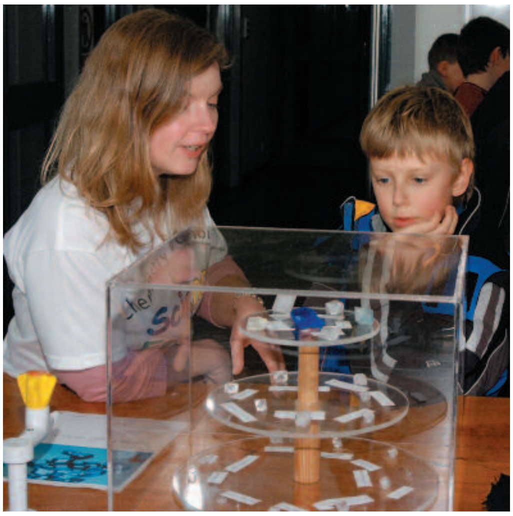
Each experiment was organised by senior researchers or PhD students, with help from undergraduates on the day. Thanks to all of you who worked so hard and brilliantly. Your efforts are greatly appreciated by the visitors. Special thanks must go to Emma Powney for her unstinting work in the lead-up to the event and on the day.

The day would not happen without the support of our sponsors. We are again very grateful to Eric Walters and the Walters Kundert Trust for the generous support that underpinned all the activities. We also thank Cochranes, Kimberley-Clark, Fisher Scientific, Laserpen.co.uk, Unilever and the RSC. And thanks to the St. John's Ambulance team who were in attendance.

Next year's Open Day will take place on Saturday 17 March. Watch out for publicity regarding new activities and competitions for researchers.

Further details will be announced at www-openday.ch.cam.ac.uk *Paul Barker*





Remembering Lord Todd

Dennis Marrian worked with Alex Todd in the 1940s, and has many fond memories of that time in Manchester and then Cambridge

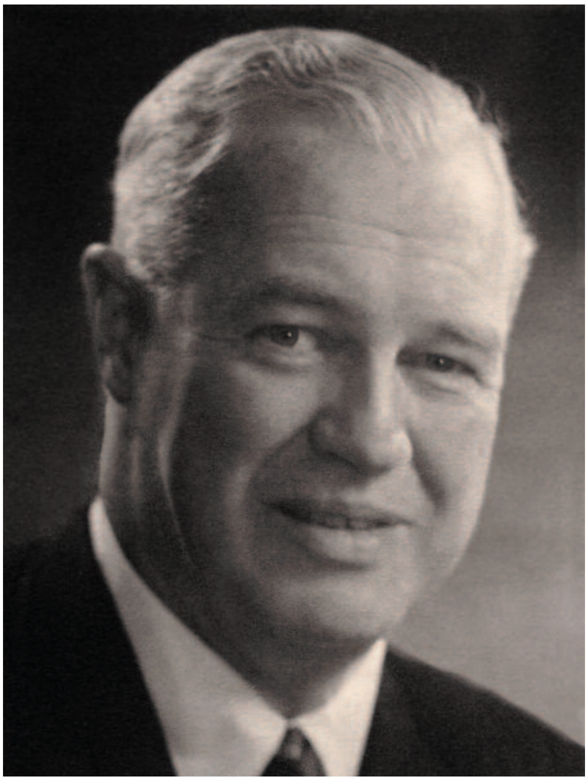
In 1945, I shared a lab with Alex and three others. In those days, the traditional way of cleaning dirty laboratory glassware was to rinse it with alcohol, pour away most of this, then add a goodly slug of conc. nitric acid and stand clear. The resulting cleansing reaction was violent, often preceded by a period of apparent inactivity – and the longer this period lasted the more violent the reaction.

We had just given our teapot this treatment and were awaiting the outcome when in walked Alex on one of his visits to discuss progress – and, of course, he was leaning back against the fume cupboard when off went the reaction violently enough to send the teapot lid off with a clatter. Alex looked behind and remarked,' Hmm! Your pot's gone up!' I suspect this method of cleaning flasks would give our masters in Brussels apoplexy today.

Those of us who had been working with him in Manchester and came to work with him in Cambridge formed a close group of friends, many of whom gathered in 1971 to mark Alex's retirement from the Cambridge chair.

Sometime in the course of these liquid celebrations, Norman Whittaker suggested that it would be nice if we could meet for dinner on a regular basis and this we did on the first Friday of every May until shortly before Alex died. We acclaimed Alex's suggestion that we should be called the Toddlers. At Alex's instigation we held a sweepstake on the winner of the Guineas, always raced at Newmarket on the day following the Toddlers' dinner. It seemed to me that it was won by Alex far more often than was statistically probable.

Lord Todd at the time of his 1957 Nobel prize win



CHEMICAL SUCCESSES

Many people – especially those whom I might refer to as the insoluble residue of the Toddlers – have been in the happy position of benefiting personally and career-wise from having Alex as a guide, mentor and friend for more than 50 years, and the successes he brought to a wide range of chemical problems are matters of chemical history.

But every great man needs to be able to unwind and let his hair down. In this, of course, his family played the greater part, but on most Sunday mornings I played my part – not in church, but on the golf course.

I had become acquainted with Alex in my first year at Manchester as he turned out to play tennis for the senior common room against the undergraduates of St Anselm hall of residence where I had rooms. The matches were followed by dinner, frugal enough in wartime Britain but an opportunity to meet my Professor in mufti, so to speak. I still recall my attempts to lob my return of service over the towering figure of Alex at the net.

He was always partnered by the University bursar who stood very little over five feet high, and who used to destroy my morale by insisting on receiving my first serve on his backhand. They made a formidable pair.

Another personal contact with him had me with my bandaged arm in a sling coming across Alex in a corridor. 'What's happened to you?' he asked. In those days, distillation apparatus used by undergraduates had to be joined together using bored stoppers and glass tubing. The fitting had to be snug enough to take a vacuum so the holes could not afford to be bored too wide and the tubing had to be pushed through. If the push went off line, the tube broke and the jagged end did a lot of damage to the base of one's left forefinger. 'Sorry about that,' said Alex, and showed me his left hand with exactly the same injury.

Like others in the lab at Manchester, we were involved in regular duties of fire-watching overnight. Alex did his stint, of course, but he had problems we did not have. The camp beds were nowhere near long enough for him, so we had to extend his with a chair to let him get a modicum of sleep. And so in many ways Alex got to know us, as well as *vice versa*.

In the Honours School of chemistry at Manchester, the first two years dealt with the classical reactions and were well presented by Norman Burkhardt, Basil Lythgoe and Hal Openshaw. But when Alex gave the advanced third year course, we suddenly found we were being taught by the chap involved personally in many of the topics – steroids, vitamins and so on – as Peter Russell found out in the year two ahead of me.

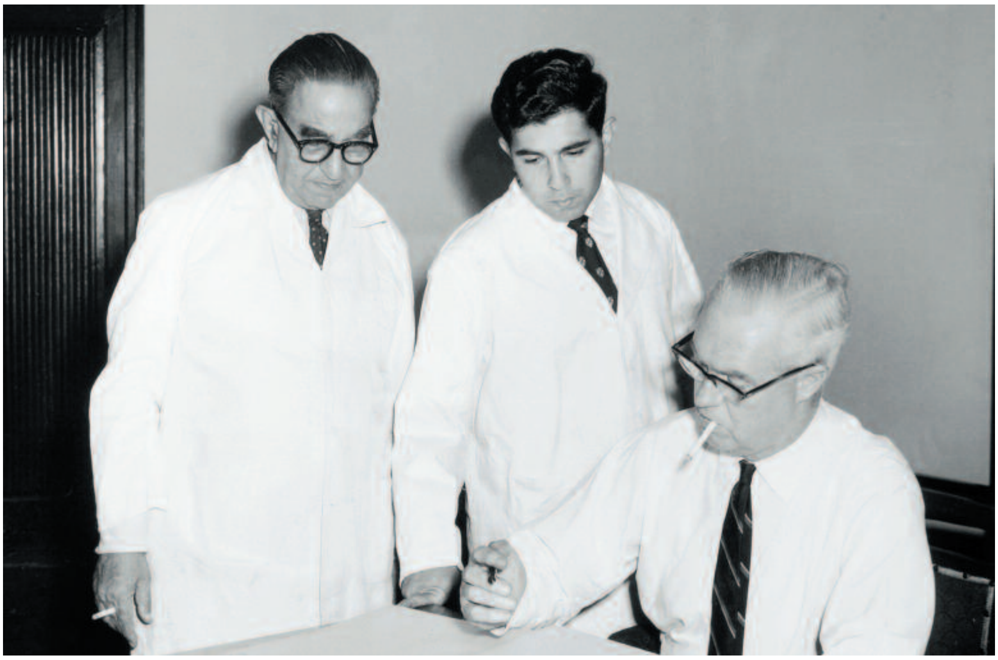
Discussing how the structure of the steroid nucleus was arrived at, Alex showed an earlier view which had a rather odd feature or two, later corrected. Peter airily remarked that surely anyone might have guessed that this was an improbable structure to say the least. We can all think of many who would have been pretty crushing in reply – but Alex paused very briefly before replying, 'Yes, I agree. But when we put forward that possible structure…' Peter never forgot that kind reference to the great Dr Hindsight.

CHEMISTRY BY GASLIGHT

We certainly were in for a load of surprises when we arrived in Camrbdige, leaving behind a well-equipped lab and finding a department almost Gothic in in content and appearance. In the severe winter of 1945 we became used to a lab essentially unheated to the extent that it was common to find that merely moving a Winchester of the very well-named glacial acetic acid was enough to turn the contents solid.

The main research lab was still lit by gas lamps probably because, as Alex discovered, the professor of organic chemistry had a seat on the board of the local gas works. Alex soon stopped that. Then he found that each book ordered for the library was automatically duplicated and left on his desk without charge. He stopped that too. And he found that the lab was ordering quite large amounts of starch, then unavailable to the general public and this was being sold off to people to starch their shirts and collars (before the days of drip-dry). So he stopped that.

On a different topic, he described the girl that Ralph Gilson had appointed as



Yusuf Hamied (centre) with his father, K.A. Hamied, and Lord Todd – in the days before smoking bans!

his secretary as 'overperfumed and under brassierred'. She didn't last long (to our regret).

While we might not have made ourselves very popular with the rest of the department, several of us were able to bring some extra expertise to the chemical laboratories' cricket team which played in one of the local leagues. Alex frequently turned up to support us on Parker's Piece where our matches took place. At the end of the season we put on a Serfs v Scientists match (lab assistants v the rest) in which Alex was happy to be included – fielding at first slip, as I recall.

Ever since the days of Rutherford, Aston and other worthies, there had been a tradition that some Fellows of Trinity would gather on the first tee at Gog Magog golf club on a Sunday morning and, depending on the numbers who turned up, anything from a two-ball single to a three-ball sixsome would ensue. The golf might have been eccentric, but the conversations were more important (to the understandable irritation of other players following on behind).

After his arrival in Cambridge, Alex was soon invited to join in with, in those days, F.G. Mann, Jackie Roughton (colloid science) and Gordon Sutherland (infra-red spectroscopy) – and when any of this foursome was not available I was asked to fill in. And when I returned from two years in New York in 1951 Gordon had gone off to America, and I took his place on a regular basis.

The best arrangement of partners seemed to be that Alex and I took on the other two – as I said, real organic chemists against the rest. This was where I heard lots of Alex's stories. His son Sandy sometimes joined us and I used to feel that Alex was a bit edgy until Sandy had successfully teed off on the opening hole since a sliced drive would clear the hedge bordering the main Haverhill to Cambridge road.

Alex's concern stemmed from the day when he was still a youngster and his uncle had taken him to play at Western Gales. Alex's first drive sliced onto the Kilmarnock road and hit a passing bus – fortunately without causing casualties. But he did cause the same uncle considerable economic distress by achieving a hole-in-one since said uncle had to stand drinks to all in the club house.

The fourth hole at the Gods is a short one, but the ground falls away steeply on the players' left and, as night follows day, Alex would pull his tee shot off into this wild country. 'Och,' he would always say, 'I'm away down the hill.' I told him that that phrase might look well on his tombstone.

SNIFF AND SNORT

New Year's day games were rather special – if even less serious than usual. We had with us a bottle of something adequate for a cold day, and played 'Sniff and snort', whereby the winner of the hole had a snort of whisky, while the losers only got a sniff. The contests soon evened out as you can imagine.

On normal days, I had devised a complicated way of scoring designed to ensure that the contest was not decided before reaching the last green but sometimes, in spite of this, one or other of us would begin to gain too great a lead which had to be dealt with before he got out of sight.

On one such occasion I felt that Aex had to be distracted and since it was during Tripos time, I suggested that the Theological tripos would be better if it had a practical exam, and suggested that 'Turn the given sample of water into wine and *vice versa* might do.' Alex paused in mid-swing and suggested, 'You are presented with a lady of easy virtue and a well-known church worker. Identify and prepare a derivative of each. (Extra time allowed).' The game evened out quickly as we all fell about.

Once or twice a year, Alex and I would join two of his old Glasgow friends, Tom McCrae and Sandy Morrison (research directors of Glaxo and Roche respectively) for a day's golf at John O'Gaunt or elsewhere. On one of those days, he recalled a wartime visit to an army establishment for a meeting to do with chemical warfare. After lunch in the mess he asked the barman if he could have some cigarettes (often in short supply in those days). The man replied that commissioned officers can have 10, non-commissioned officers five. 'Which are you?' Alex replied with pride, 'I'm neither. I'm a professor of chemistry.' The man looked at him and said, 'You can have two!'

Of course, if you are a great man and your name rhymes with God, you must expect to be the subject of various little poems, some motivated by pure envy (these doubtless emanated from the Cavendish lab) but some did show a proper degree of reverence. Here is another suggested chemist's prayer. 'Lord give me leave to build a lab, so large that when I've trod, its vasty naves and aisles I'll think, I'm in thy house, Oh Todd.'

DIY DISASTERS

A few final little memories – though a dab hand at practical chemistry, Alex was no DIY expert. His wife, Alison, fondly recalled the time that she had asked Alex to put up a towel rail in the bathroom in their first flat in London. And very splendid it looked – until the weight of the towel caused the whole affair to fall off the wall.

Like Sir Humphrey Davy he abominated gravy, and firmly believed that in the closing seconds of the seventh day when the world was being constructed God thought up parsnips. He had a proper disdain for any benighted person who put sugar on porridge. And he claimed that after he no longer had to be a role model to his children, he never ate any form of milk pudding.

His brush with the civil servant who was the secretary to meetings of the Todd Royal Commission on the future of medical education was also memorable. At the end of the first meeting, the secretary, who felt things might not be going in the direction favoured by his masters, said he would write up the minutes and circulate them. 'No you won't,' said Alex. 'I will dictate the minutes and you will circulate them.' And I would bet his first draft would need no emendations, as was the case when he dictated his scientific papers.'

All in all, he was a very human and warm-hearted chap – and great fun to know – although not the best person to sit behind in a group photo!

Forgotten, but not gone

Photo: John Holman

Joe Farman: still monitoring the ozone levels around the world

Global warming may hog the headlines these days, but that doesn't mean the ozone hole has gone away, as the man who discovered it, Joe Farman, explains

It's now common knowledge that there is an ozone hole above the Antarctic. Yet until the mid-1980s, no-one had any idea that it was there and, according to Joe Farman, who led the team that discovered it, it was found by accident.

'We basically found the hole because we were there when it happened,' he explains. Although he's now retired from the British Antarctic Survey, Joe is to be found most mornings in an office over in atmospheric chemistry, where he continues to keep tabs on the ozone levels around the world.

With the help of 25 years of measurements of ozone levels in Antarctica, it became clear to Joe and his team that humans had managed to do something that was having a hugely detrimental effect on the atmosphere – and it turned out to be the emission of chlorofluorocarbons. These are a source for chlorine and bromine atoms, which catalyse the destruction of atmospheric ozone.

'The industry manufacturing these chemicals didn't seriously take off until the mid-1960s,' he says. 'And in the 15 years that followed they managed to create an ozone hole that is, essentially, the first manmade thing to be visible from space. That's a rather horrifying thought.'

The hole appears as soon as the sun comes back after the Antarctic winter. 'All the preparative chemistry goes on in the dark – getting the chlorine and bromine into compounds which the sun readily breaks down,' Joe says. The maximum ozone abstraction grows by about 3% a day, so within about 30 days – by the first week of October – a typical ozone hole has developed.

How long the hole lasts is a matter of meteorology rather than chemistry. 'Some years it might last way into December, while in others it may be gone by the end of October,' he says. 'As far as we can tell, it's purely dependent on the weather.'

Joe says people have criticised the scientists for not speaking out about the hole sooner, but counters this by saying that they had to be absolutely sure that it really was happening. 'The only way you can be sure that something has changed is by having a good record of what the past was like. The natural variability in ozone levels from year to year is rather large, and the models weren't very good in the early 1980s,' he says.

'None of the chemists had bothered to think about what happens at low temperatures. With two-dimensional models, they didn't achieve low temperatures at the south pole – or its isolation. So it was hardly surprising that when we first said that there was an ozone hole there, many people claimed that it couldn't possibly happen that way. But it did.'

OZONE MEASUREMENTS

The measurements are, essentially, of the quantity of ozone between the instrument and the sun. 'If the sun is visible it's easy: you just point the detector at the sun and take the reading,' he says. 'If it's not, you have to take readings pointing at the sky or the clouds, and then use tables of data to work out how much ozone there is. The only readings we really trust are those made directly using the sun; we use these measurements to create the data that enable us to make measurements when the sun isn't there.'

In the winter, when there is no sunlight, there is no option but to use the moon to take readings from instead, but the distribution of errors is even greater then. 'At the time when you want to make your best measurements, it's actually the time when it's very difficult to take measurements at all,' he says. 'The sun is low, and while you can take moon observations, these are subject to a really strange "law" which says that it is almost impossible to avoid underestimating the true amount of ozone.'

Measurements began in the mid-1950s and, looking back, Joe reckons that there's little evidence that there was an ozone hole in 1980. 'The first really nasty looking one occurred in 1983,' he says. There is little sign that things are getting better. 'Since 1990, in every normal meteorological year the ozone hole has been large and deep,' Joe claims. 'People have almost forgotten that this is not natural, but solely the result of rapid industrial growth over just 20 years. Such mistakes must be avoided in the future!'

CHLORINE ACCUMULATION

Even though very little chlorine is being released now, there is still more than enough in the atmosphere to keep the ozone hole reappearing for many years year. 'F12 [dichlorodifluoromethane] has only just saturated in the atmosphere, despite all the efforts that have been made recently to control its release,' Joe says. 'One-third of it will still be there in 2100: that's an awful lot of chlorine.

'I would like to think that in a few more years there will be just a sign that things are getting better,' he says. 'But it's not clear that it will. If you believe in global warming, which means there's an increase in temperature at the surface of the earth, then the corollary is that the stratosphere has to cool, and we know this means you need less chlorine to produce the same result in the lower temperatures. As a result, it's still very unclear what the timescale for recovery is.'

While Joe says that people are now making the right noises, the Montreal Protocol on reducing the output of ozone-depleting gases took far too long to come into effect. 'It was all built on consensus, which really isn't the right way to approach an environmental problem as it means, in essence, you go at the speed of the slowest,' he says.

'What we need is the big boys to stand up and say they're not waiting for the slow ones, and are going to press on with what needs to be done regardless. If only we could get that sort of attitude towards global warming.'

Pimp my van

Spot the difference: Beastie before and after, and Zoë poses with the proof of its history

When Zoë Waller inherited the family camper van, little did she think that she'd end up on the telly with it – and that TV appearance would transform her rusty old van, Beastie, into a gleaming gold passion wagon.

Last September, just before she was due to start a PhD in Shankar Balasubramanian's group, Zoë had spent a long day working on the van, getting increasingly fed up of being covered in paint. She settled down to recover in front of the television and happened upon the show 'Pimp my Ride', where beaten up old cars get given rather dramatic makeovers. And she realised that it could be the answer to her prayers.

'I emailed the show, and sent them some pictures of just what a bad state my van was in,' she says. 'I also told them that it had been in the family since the 1960s – and I'd even been conceived in it! This must have appealed to them, and I got an email back almost immediately, saying that they loved the van.'

Underneath the badly wrecked bodywork the van was in pretty good nick, and after passing a screen test with flying colours, Zoë's van was ready to be Pimped. 'I asked them not to lower the suspension because the ride was rough enough already and I wanted to be able to drive over speed humps,' she says. 'Everything else, I had no say in.'

It was with some trepidation that Zoë went to the unveiling, but her fears were unrealised and she loved the result. 'It's really special! The paint sparkles. On top of the primer there's a layer of sparkly silver paint, then yellow gloss and three layers of lacquer. It looks almost like glass!'

Inside it's been treated to a new sound system with TV screens in the doors, and the bed completes the passion wagon effect. And her favourite part? It's a toss up between the heart-shaped exhaust pipe and the 'Beastie' motif on the rear windscreen.

'People beep their horns at me when they see the van – even before the show was televised!' she says. 'It quite literally turns heads.'

On yer bike!

Current Schlumberger professor Henk Lekkerkerker was determined to get in on the act when John Holman was snapping Jean-Pierre Hansen and his group for the feature on page 8.

He wanted a photo of himself, complete with bike, helmet and cycle clips, to send to his wife to give her a taste of the full Cambridge experience.

We think he fits in rather well!

Comings & goings

Leavers:
Michael Sleep
Charles Westley

Joiners:
Ashleigh Matthews
Flora Fleurival
Milton Lo
Robert Beale
Irene Derungs Ollero
Nathan Haridien
Anthony McPherson

Our eagle-eyed photographers spotted the tree surgeons at work out in the car park in the spring. Nathan Pitt was desperate to get his paws on the chainsaw and have a go, but somehow he managed to content himself with recording the occasion for posterity with his camera

Back to the future

Chem@Cam is always on the lookout for people around the department with unusual interests, and secretary Joanne Castle and her husband Ian, who works in stores, fit the bill perfectly. They are both members of a mediaeval display group, the Lion Rampant, who perform at castles and shows during the summer months.

'I first saw the group performing at Castle Rising about 15 years ago,' Joanne explains. 'I really enjoyed their display, and would go back and see them again once or twice a year at different venues. Then I met Ian, started to take him along, and one time we got chatting with some of the members of the group at the end of the show. And the next thing we knew, we were members too!'

That was three years ago, and the couple have been performing with the group ever since. 'During the winter, from about early October to late March, we practise once a fortnight,' she says. 'Then in the summer we are busy performing. We both dance and do archery, and help out backstage with the fighting. Ian is looking to get into the musical side of it, too, playing the recorder, while I sing.'

You can catch Ian and Joanne performing with the group this summer at the Chiltern Open Air museum at Chalfont St Giles in Buckinghamshire on 12 and 13 August, and again at

The mediaeval costumes are a far cry from Joanne and Ian's normal work attire!

Castle Rising near Hunstanton over the August bank holiday weekend.

In the meantime, Joanne and Ian will continue to practise in their spare time. 'There are no formal practice sessions in the summer,' she says. 'That doesn't stop us, though. Archery is a little difficult as our garden isn't big enough, but I think the mediaeval dancing we do in the living room raises a few eyebrows.'

Getting hitched

Wedding bells have been ringing in the Sanders group – two of his postdocs got married to each other in April.

Chantelle Bondy and Greg Davidson are both Canadian, and met at the University of Windsor in Ontario when they were doing their PhDs with Stephen Loeb.

The wedding was in Chantelle's home town, Windsor, and they headed to Bruges in Belgium for their honeymoon. 'It was a beautiful spring day, everything went perfectly, and we couldn't have been happier!' says Chantelle.

21 (again)

Liz Alan was astonished to arrive at the office on the morning of her 60th birthday to find out that some anonymous balloon pixie (whom she suspects might have been Jane Snaith) had decorated the door with birthday balloons.

The party continued over cake and coffee when she was presented with a beautiful bouquet and John Lewis vouchers from her fellow secretaries, plus an orchid from Jeremy Sanders' research group. Her card featured a pair of bright red shoes. 'That was great – I've always loved wearing colourful shoes that are more appropriate for a 21-year-old!'

Liz adds that Jeremy was very tolerant of the noise level in the office. 'I'm sure she did *some* work that day!' Jeremy says.

Photo: Nathan Pitt

Photo: Nathan Pitt

Mike Sleep, who worked in the large-scale lab, retired earlier in the year, after 19 years carrying out synthetic work in the department. He was presented with a cheque by Sue Johnson, which he was going to use to buy a digital camera

Last issue's winners

Chemdoku

Chemdoku continues to draw the crowds. Another bumper crop of entries flooded in to the gas-based puzzle we ran in the last issue.

This time, the metaphorical hat was a mug celebrating Sheffield Wednesday's success in the 2005 League One play-off final. Yes, it may have been a prize for finishing fifth, but it was an excuse for a grand day out – and the club shop to shift a few more mugs. And this mug's a sucker for all that sort of thing.

The lucky punter whose name was pulled out of said coffee mug by *Chem@Cam*'s glamorous assistant was Steve Painter, who works for Bayer in Newbury.

Correct answers also came from... Derek Thornton, Roger Duffett, Peter Grice, Steve Blasdale, Paul Cheshire. Roger Duffett, Dave Stewart, Michael Gerry, Annette Quartly, Pete Kennewell, Robert Ward, Penny Chaloner, David Thompson (who reports that the idea of Chemdoku appeals to his science teacher son, and suspects that the kids will have had additional homework over the holidays), Richard Brown, Peter Ham, Pat Lamont Smith, Robin Pope, D. Nixon, Keith Parsons, Helen Stokes, Alison Griffin, Donald Bush, Nick Webster (who really should have won as he offered to donate the winnings to the department beer fund), Paul Littlewood, Alice & Stephen Bull, Gary McDowell, Malcolm Stebles, Nick Broughton, Helen Fox (with a bonus 'entry' from her 7-year-old daughter Catherine who managed to fill in five symbols), Grant Buchanan, A.J. Wilkinson, Jim Dunn, John Salthouse, Bill Collier and Ian Fletcher.

Just an average

At last, we have a winner for 'Just an average'. It still proved far from simple, with the only correct solution coming from Ian Fletcher in Cirencester. The correct equations are: 14 x 7 = 98, 3 x 32 = 96, 27 x 3 = 81, 8 x 9 = 72 and 16 x 4 = 64.

Chem@Cam will forgive him for pointing out that the only gremlins in in last issue's puzzle page were in the spelling of 'gremlins' as he managed to date his letter 2005! £20 is on its way.

Elementary fun

Annette Quartly's 'Elementary fun' puzzle in the last issue drew much praise from *Chem@Cam* readers. The answer is that the atomic number of Chemistryfunium is 119. Her solution is too long to reproduce here, but if you're interested, drop us an email at jsh49@cam.ac.uk and we'll forward it on to you.

Correct answers were received from Richard Brown, Pat Lamont Smith, C.W. Haigh (who thought it a 'particularly good problem'), Roger Duffett, Ian Fletcher and Keith Parsons. This time, Roger Duffett's name was the first out of the mug.

£20 prizes are on offer for all of our puzzles. Send entries by email to news@ch.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

One for all

Our regular puzzle contributor, Keith Parsons, returns to the playing cards for his puzzle this time.

Four players in a bridge tournament were dealt the hands described below. For the purposes of this puzzle, the face values of the cards range from Ace = 1 through to King = 13.

North's hand contained three pairs (a pair being defined as two cards having the same face value). The total face value of the 13 cards was 121.

East's hand contained two pairs, and the total face value of the 13 cards in the hand was 93.

West's hand contained three pairs, and the total value of these 13 cards came to 95.

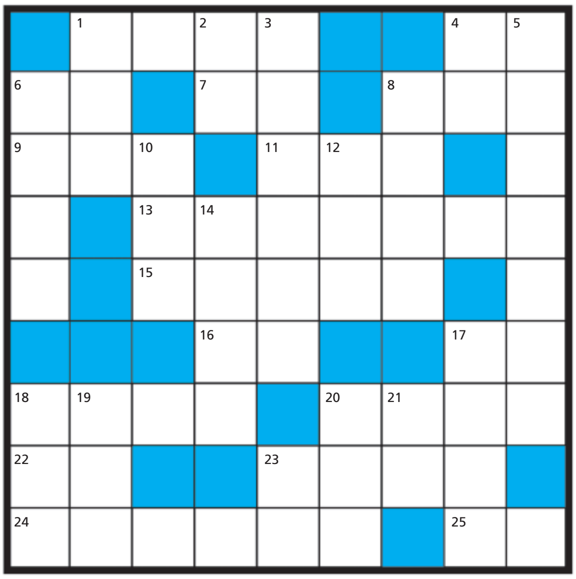
The totals of the lowest seven cards in East and West's hands differed by 2.

A total of 12 pairs were dealt, and the other two cards corresponding to each pair were dealt singly to two other players. No player's hand contained more than two pairs of even value cards, and no player had three or more cards with the same face value.

What were the face values of the cards dealt to every player?

As ever, a £20 prize will go to the first correct answer drawn from whichever random receptacle comes to hand. Send those answers to the address in the panel above.

Elementary crossword



As a change from Chemdoku, this issue we have a chemical crossword. It was sent in by Graham Quartly, husband of Annette who set the 'Elementary fun' puzzle. He wrote, 'Thank you for keeping my wife entertained with your puzzles. I have also to do my bit to test her mental agility, and I thought you might be interested in this puzzle I designed for her. Of course Annette will be barred from entering, as she has already solved it!'

It's not quite a normal crossword, though. Each square on the grid must be filled with the symbol for a chemical element such that the resulting words, across and down, fit the clues. For example, 'European language' requiring six elements could not be F Re N C H or S Pa Ni S H as they are too short, but could be S Pa N I S H or I Ce La Nd I C.

The usual £20 prize will go to the sender of the first correct solution out of whichever coffee container happens to be lurking in the *Chem@Cam* office.

Across

1. Nasal inflammation
4. You could be as right as this
6. Greek goddess
7. Family
8. Field size
9. Extend library loan
11. Start of a story
13. Air transport
15. Backs off
16. Love god
17. Tin
18. False accusation
20. Fish
22. Often full of rubbish
23. Repetitive arrangement
24. Sea mammals
25. US uncle

Down

1. Bird
2. Boat of animals
3. Horned animal
4. Not common
5. Determination
6. Unbeliever
8. Receives
10. Question as to location
12. Organ
14. Fine uniform
17. Stony piles
18. Room on a ship
19. Not of this world
20. Dung lost in the past
21. Overdue
23. Friend

I know you had a great time on Science Day, but don't you think you're a bit small to be sneaking in to study chemistry?

UNIVERSITY OF CAMBRIDGE

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