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Electrifying Battery Chemistry

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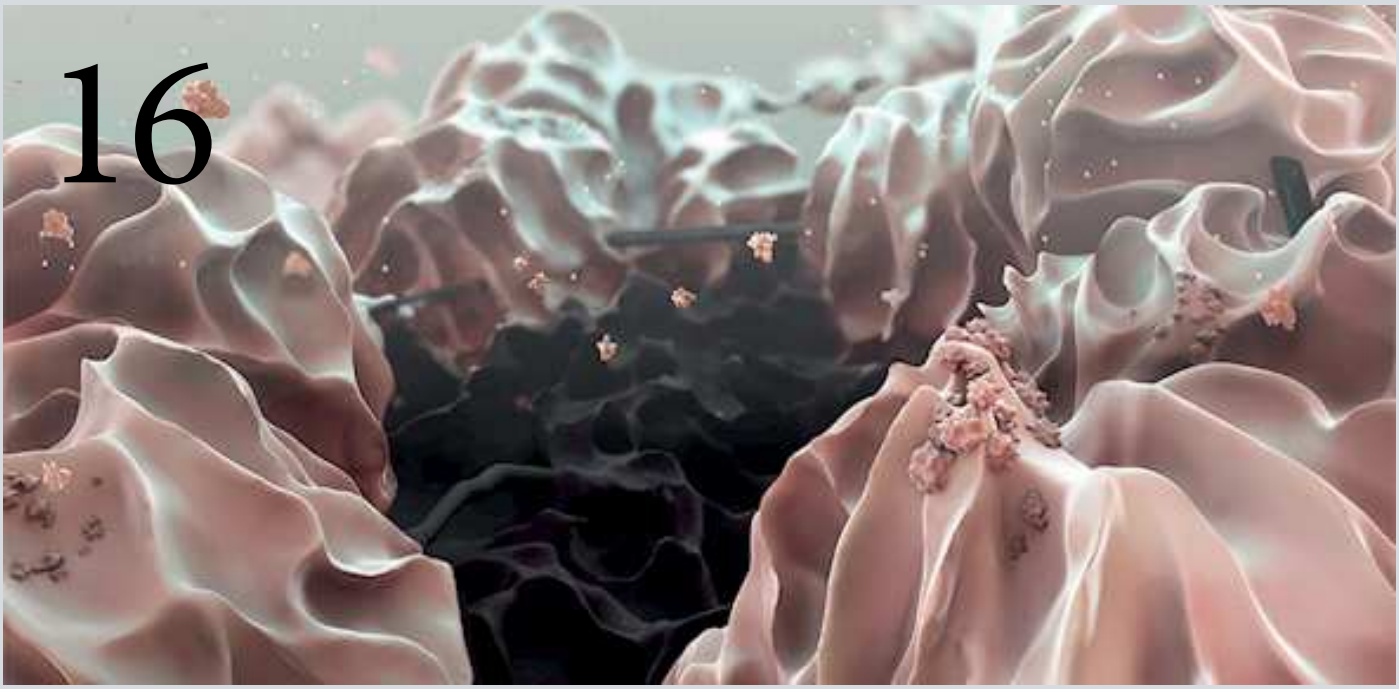

Battery Chemistry Research

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ALUMNI

Tim Guilliams

Welcome

to the new look Chem @Cam

On the cover....

Lithium-air battery demonstrator made by the Grey Group

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First of all, I want to thank my predecessor, Dr Sarah Houlton, who steered this magazine for over ten years, through the noughties and beyond. She introduced its much-loved features, most of which have been included in my first edition. Others, like *ChemDoku* (my personal favourite), *Compare & Contrast* and *As I see it*, we intend to bring back as we develop. But I want to hear from you, the readership. What do you think about the features? How should they develop?

Publishing your comments, positive or negative, is the job of a good modern magazine. And I look forward to receiving your letters, texts and emails.

Carmen Pryce
Editor

Q&A

John Pyle

On October 1, 2015, John Pyle, the 1920 Professor of Physical Chemistry, was appointed Head of Department. John is clear about the challenges for the Department of Chemistry.

"We are a great department and we have wonderful people across the board. Give them the tools and they'll deliver! The funding environment is changing rapidly so we need to be agile and inventive. It's crucial that we maintain our base of superb fundamental science while at the same time we respond to these new challenges".

John's Letter from the Head of Department (see opposite) is a new feature, published here for the first time. But he is also the first to take part in our second new feature, a light-hearted Q&A:

What is your earliest memory?
Sitting in a dark and gloomy room in Manchester with my brother while some family drama was happening and wondering what was going on?

What do you owe your parents?
Everything, they were both inspirational. My father worked on the railways as a signalman and my mother was a confectioner. He taught himself five languages and was interested in music, reading, everything. And my mother used to help me with my homework and was just a brilliant mum.

What did you want to be when you were growing up?
I wanted to be like my brother. He was ten years older than me, and became a chemical engineer. I admired him so I followed him into science. But I didn't want to do exactly the same as him so I did my first degree in physics.

What makes you happy?
When Bolton Wanderers win.

Which living scientist do you most admire?
Well, I've got two actually. Sir John Houghton and Paul Crutzen. Sir John was head of department when I did my DPhil at Oxford. He was Professor of Atmospheric Physics, then head of the Met Office and founder of the Hadley Centre. He sees obstacles as opportunities.

Paul Crutzen popularised the geological term for the period we are in now – the Anthropocene - and won a Nobel Prize in Chemistry.

Which deceased scientist do you most admire?
Joe Farman was a geophysicist who discovered the ozone hole over Antarctica. He worked for the British Antarctic Survey and when he retired he came and worked here. He was quiet but lots of fun. That discovery really defined him and he used it to influence industry and policy.

What is the trait you deplore most in scientists?
I hate it when people make a real mess of their office. (John's rather small galley-style office is crammed with files, papers and books. The desk is festooned with stuff but the computer, phone and 19th century silver and glass pen and inkstand sit proudly in their places, clearly well used ...and loved. I believe he's joking? Ed.) It's not a general trait but I once heard a relatively well-known atmospheric chemist describe science as a contact sport. I found that repugnant. Although science is competitive, it's also about meeting, collaborating and working together to make useful contributions to society.

What is the trait you deplore most in yourself?
Prevarication (I haven't found him so, yet! Ed.)

What is your most treasured piece of equipment?
Well, I do like fountain pens and I have a Mont Blanc Meisterstück (Meisterstueck, an old fashioned German expression, denoting a piece of work an apprentice produces to become a master in his trade).

What is the closest you've come to death?
Well, my brother died in an accident in the mountains and my daughter's car was written off recently and you know, one minute you're here and the next...

What or who is the greatest love of your life?
Who is family and what is hills and mountains, any mountains. We used to go for family weekend walks in the Pennines. Glorious.

What do you most dislike about your appearance?
Increasingly, whenever I catch myself in multiple mirrors I see the growing bald patch! But there's nothing to be done.

Who would play you in the film of your life?
Dustin Hoffman or Robert De Niro, just because, over the years people have said I look like them. Can't see it myself. I was once mistaken for Angus Deayton but I wouldn't want him to play me, and definitely can't or won't see that!

What is your most unappealing habit?
Sulking when Bolton Wanderers lose.

What is the worst job you've done?
Chairing a committee with two sides that didn't get on. They were trying to develop a piece of scientific equipment and the house was divided. It was horrible, just awful.

What has been your biggest disappointment?
Minor ones for sure - for example, I wish (my family wishes!) I could sing – but nothing major. I'm a pretty positive person: when one door closes, another opens and I have been lucky with open doors.

What was your biggest discovery?
I remember I had a penny drop moment, when I could picture how and why the polar atmosphere behaves as it does. It's complex but I had got the physical picture in my head.

What next?
Well, it's a bit like going into the unknown. There is a range of things that can be done to help the department and strengthen what we do. I hope whatever it is will be fun, challenging and rewarding.

Letter from the Head of Department

I am writing this after just six weeks as Head of Department. I am honoured to take on the role of leading one of the world's very best chemistry departments. I am very conscious of the contributions made by a series of great predecessors. I want in particular to thank Daan Frenkel, my immediate predecessor, for all his efforts, both for the department and for me as incoming Head.

The department is in excellent health. We have superb academic leaders, brilliant support staff and fantastic students. We finished top in the 2014 UK Research Excellence Framework exercise. In international ranking tables, we remain in the handful of top chemistry departments worldwide.

To maintain our position is a challenge at a time when, in real terms, science funding is declining. We have ambitious plans for new buildings and infrastructure and for enhanced research support at all levels – students, research fellows and both starting and established academics. So I'm immensely grateful for some very generous financial support, including recently from Yusuf Hamied and the Walters Kundert Charitable Trust, as discussed elsewhere in these pages.

I will be writing in more detail in future editions of Chem@Cam. I am always happy to hear from you.

Yours,

John Pyle

Sanders' Secret Symposium

A symposium celebrating the research career of Professor Jeremy Sanders was held in the Department of Chemistry on 4 September 2015, but the speakers remained a mystery until the day before the Symposium.

Former Sanders Group members Nick Bampos (now Deputy Head of Department) and Chris Hunter (now Herchel Smith Professor of Organic Chemistry), along with secretary, Sian Bunnage, started planning for Jeremy's retirement a year in advance secretly searching for over 100 former group members. "They all did an extraordinary job with the organisation under the circumstances," says Professor Sanders.

Jeremy was genuinely surprised by the amount of effort and energy that went into keeping the details of the symposium a secret. "I only saw the list of attendees on the day before the event," he says. All the symposium speakers were former members of Sanders' group, and spoke in chronological order." It was a genuine symposium but they all said nice things about me, which was unusual!" the self-effacing professor relayed.

Jeremy was at the forefront of developing dynamic covalent chemistry and the closely related subject of dynamic combinatorial chemistry. He is also highly regarded for his innovative applications of NMR spectroscopy in organic and biological chemistry.

Professor Jeremy K. M. Sanders timeline

- **1969:** BSc Imperial College London
- **1972:** PhD Cambridge
- **1972:** Postdoctoral researcher Stanford University
- **1973–1996:** Demonstrator, Lecturer, then Reader the Department of Chemistry
- **1995:** Elected Fellow of the Royal Society
- **1996:** Professor
- **2000–2006:** Head of the Department of Chemistry
- **2006–2010:** Deputy Vice-Chancellor, responsible for overseeing the University's 800th Anniversary celebrations
- **2009–2011:** Head of the School of Physical Sciences
- **2009:** Davy Medal, Royal Society
- **2011–2015:** Pro Vice-Chancellor for Institutional Affairs
- **2014:** Appointed CBE for services to scientific research.

The event was very like a family reunion, starting with dinner on Thursday evening, running through the symposium on Friday, to an extended buffet lunch ending on Saturday evening. "My son, a professor in Mexico, flew in on Wednesday night, with his violin. My daughter, who is a trumpet player, was also there and they played for us during a break in the Friday dinner," says Jeremy.

"It leaves me almost lost for words, but amazing, astonishing, humbling, overwhelming, and magical are a few that I might use," he says. "It was lovely to catch up with so many former group members. It was a particular pleasure to see so many partners and children. I've created four couples from my group over the years. And in fact, my last two PhD students became a couple. So, I'm a matchmaker as well as a chemist."

Jeremy's post retirement plans include becoming the first editor-in-chief of the new Royal Society journal, *Royal Society Open Science*, taking a leading role in the department's fundraising campaign and working as an unpaid senior postdoc in Chris Hunter's group. There he will continue to do research and use his vast experience to help young researchers, nudge projects along and generally 'be useful'.

Laboratory Opens Doors

Over 90 guests attended the opening ceremony of the Yusuf Hamied Laboratory for Chemical Synthesis & Catalysis on 12 September 2015.

The new state-of-the-art research laboratory, which was made possible by the generous support of Dr Yusuf K Hamied, will enable Professor Matt Gaunt and his research group to continue their ground breaking research into the invention of catalytic strategies for chemical synthesis.

The event was attended by University Vice-Chancellor Sir Leszek Borysiewicz; Pro-Vice-Chancellor for Institutional Affairs, Professor Jeremy Sanders; Professors Daan Frenkel and John Pyle; plus members and friends of the Gaunt research group.

Matt recounted the history of the space, which has witnessed the research of many eminent Cambridge professors including Professor Lord Alexander Todd, the Nobel Prize-winning chemist and former Master of Christ's. Matt reflected that Todd would have been happy that the lab has 'opened the doors' to cutting edge synthetic research.

Dr Hamied, Chair of the socially conscious pharmaceutical firm Cipla, received his PhD in Chemistry in 1960 under the tutelage of Lord Todd. He has funded many projects in the Department of Chemistry over the years and he spoke about his strong connections with the university, saying he was proud to support chemistry at Cambridge.

Professor Daan Frenkel, former Head of Department, thanked Yusuf for his support for the new laboratory, which bears his name.

The Walters Kundert Charitable Trust offers long term support to Chemistry

The Department of Chemistry would like to thank the Walters-Kundert family for their support of the department, both in the past and for their recent generous gift.

For over a dozen years, the Walters Kundert Charitable Trust has supported both the department's Next Generation Fellowship programme and the Chemistry Open Day.

Carol Robinson, Jonathan Nitschke and Oren Scherman were all beneficiaries of Next Generation Fellowships sponsored by the Trust, each receiving funds of £50,000 per year for five years, to help them launch their research groups. Dame Carol Robinson is now a Royal Society Research Professor at the Physical and Theoretical Chemistry Laboratory at the University of Oxford, as well as the Dr Lee's Professor of Chemistry. Jonathan Nitschke is now a professor in the department and Professor Oren Scherman is Director of the Melville Laboratory.

The Trust has also provided support for the department's hugely popular Chemistry Open Day, held as part of the annual Cambridge Science Festival, in which the department opens its laboratories to the public and offers numerous activities for children of all ages, including the traditionally explosive lectures given by Dr Peter Wothers.

The Walters Kundert Trust has recently pledged £1.25M to fund a Walters-Kundert Next Generation Fellowship in the department in perpetuity, and has endowed £400,000 to support outreach programmes including the Chemistry Open Day. Additionally, the Trust has provided £1.25M to fund a graduate student position in Chemistry in perpetuity, to be based at Selwyn College.

> The support of the Walters Kundert Charitable Trust and our other philanthropic donors is helping the Department of Chemistry to retain its position as the number one chemistry department in the UK, and one of the top five chemistry departments in the world.

Department opens its doors to potential graduates

On Friday 23 October 2015, the department held its second Graduate Admissions Open Day, with over 100 potential graduate students attending from across the UK and Europe. An army of volunteers from our community of PhD students and postdocs offered help throughout the day: manning the registration desk, keeping research sessions in order, acting as tour guides, presenting posters, and being great ambassadors for the many research groups in the department.

The focus of the day was to give potential students the opportunity to experience life as an academic. Head of Department, Professor John Pyle welcomed the guests and Dr Deborah Longbottom introduced them to the department's comprehensive Graduate Education programme.

Academic staff from all five Research Interest Groups (RIGs) gave research talks. Visitors were able to view some core facilities and laboratories on department tours. And the day closed with a social reception.

The day was organised by Dr Rebecca Myers (Head of Graduate Recruitment) and Graduate Representative, Suil Collins, a PhD student in Professor David Spring's group.

Happy 50th Anniversary CSD

In July 2015, the founder of the Cambridge Crystallographic Data Centre (CCDC), 91-year-old Lady Olga Kennard gave the keynote lecture at a conference marking the 50th anniversary of the Cambridge Structural Database (CSD). The conference was a celebration of the world's only current and comprehensive database of small molecule crystal structures. Originating in the Department of Chemistry in 1965, the CSD now supports research worldwide. Olga said, "I had a passionate belief that the collective use of data would lead to the discovery of new knowledge which transcends the results of individual experiments." The success and longevity of the CSD has proved her right.

Athena SWAN: Going for Silver

The Department of Chemistry submitted its application for the Silver Athena SWAN award in December 2015 – but what does this mean?

Participating in the Athena SWAN programme is helping the Department of Chemistry achieve one of its main goals: to provide a supportive environment where all students and staff feel able to succeed.

"This is much more than a paperwork exercise – the steps we are taking are positively addressing longstanding gender inequalities in the sciences," says Dr Nick Bampos, Chair of the department's Athena SWAN working party.

Nick, who is Deputy Head of Department, has seen the department come a long way in encouraging more women to participate in chemistry at all levels, but he is also aware of the further steps that need to be taken.

"We still have many clear objectives in the action plan we've developed as part of our Silver application," says Nick. These goals include improving the proportion of women undergraduate and graduate students, ensuring women are represented in departmental decision-making, and increasing the number of women applying for academic positions. But he points out that these aren't just empty wishes. "For each goal we have listed concrete actions that we must take to ensure the goal is reached," he says.

One example of an action already taken by the department is that all principal investigators (PIs) must now take online equality and diversity training before participating in staff recruitment.

The Department of Chemistry has taken other actions as part of the Athena SWAN programme, including supporting flexible working and requesting that all meetings should be scheduled in core working hours (after 9am and before 5pm).

In fact, adopting these working practices and attempting to improve working conditions for women has improved conditions for all staff and students, regardless of gender.

"The Bronze award submission identified the challenges that needed to be addressed in order to generate an inclusive, supportive and productive environment not only for our female colleagues, but also for all members of the department. Our submission for a Silver award celebrates the impact of the work achieved thus far and outlines areas we need to work on over the next four years", says Nick. The working party will continue to meet on a monthly basis ensuring the department works towards achieving the action plan objectives and, with the support of the Head of Department, will generate policies and structures that will help the department recruit, retain and promote world-class female scientists.

As former Head of Department Daan Frenkel puts it: "To me the Athena SWAN award scheme... is a process that we should and would continue even if the scheme did not exist – the proposed practices reflect plain common sense and the very process of applying has already been immensely beneficial."

To find out more about Athena SWAN, visit the department's Athena SWAN web pages at www.ch.cam.ac.uk/content/athena-swan-bronze-award.

If you have any comments about the department's Athena SWAN programme, please contact Nick Bampos at athena.swan@ch.chem.ac.uk.

Graduate students, Gabi Schneider-Rauber and Ines Heimann

What is Athena SWAN?

- Athena SWAN is a national scheme which recognises a commitment to supporting and advancing women's careers in science, technology, engineering, maths and medicine (known as the STEMM subjects) in higher education and research.
- Athena SWAN grants bronze, silver and gold awards to organisations who can demonstrate increasing levels of good practice in recruiting, retaining and promoting women in STEMM.
- The Department of Chemistry received the Athena SWAN Bronze award in 2012 and submitted the Silver application in December 2015.

The Grad Students' experience

Gabi Schneider-Rauber and Ines Heimann are graduate students who became Athena SWAN Committee members in 2014.

"As graduate representatives, our main role was to create and analyse a survey about the graduate experience related to gender issues and work culture," explains Gabi, whose research involves solid state chemistry and pharmaceutical materials in Professor Bill Jones' group.

The survey took place in February 2015 and was designed to identify any differences in male and female academic careers, as well as highlighting areas where the department could do things to improve the quality of the work environment for everybody. The survey results showed the progress and impact of changes implemented since 2012, and those findings have been fed in to the current Silver application.

"One of the most positive things about being on the committee was having the opportunity to work with a variety of peers, staff and academics, regardless of their position in the department hierarchy," says Ines.

"I've seen that the actions taken by the Athena SWAN initiative were, and still are, necessary and needed to create a good working environment for everyone," says Ines, who is working on atmospheric models in Professor John Pyle's group. "In fact, my involvement with the Athena SWAN Committee has made me more assertive and able to notice gender inequality and challenge people. It is a small thing but I was on a plane, sitting between two guys who were both encroaching on my seat - I was squashed in the middle. So I pushed my elbows out and claimed back my space."

Gabi adds: "I come from Brazil, and it was surprising to see people in the department discussing gender and bullying, to see people being concerned and tackling these issues. It was really important to me, and it is something I would like to take back and see happening in my country."

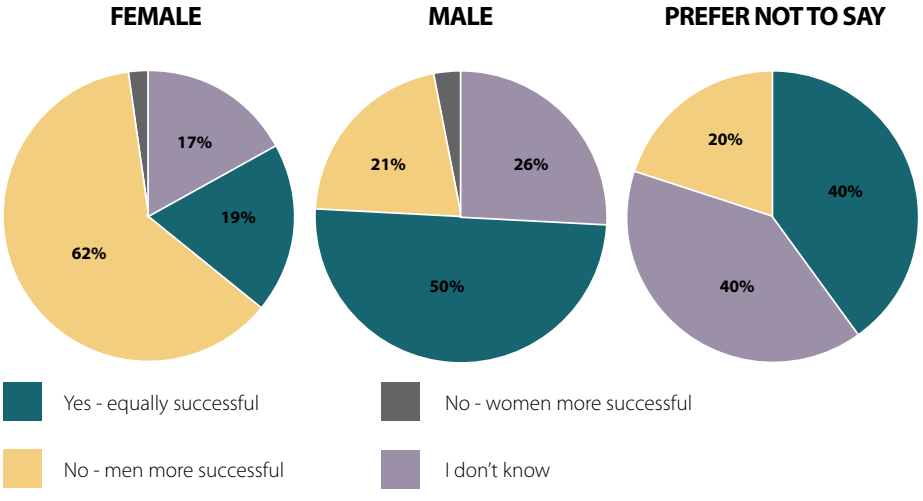
"Overall, we really enjoyed the experience," says Gabi. "The enthusiasm and the amount of effort everyone on the committee put into the initiative was just great." The two students agree it has been a fantastic experience that has motivated them to continue their research and to keep on supporting equality in their future careers.

SURVEY RESULTS

The results of the graduate student survey show that the perception of gender equality changes between PhD and Postdoc level. While 74% of the students agreed that women and men with equivalent undergraduate qualifications have equal potential to be successful as graduate students, only 32% agreed that they have equal potential to have a successful research career. The majority of female students feel men have more successful research careers, while the majority of male students feel women and men have equally successful careers (see figure).

Athena SWAN goals:

- Improve the proportion of women Undergraduate and Post Graduate Students.
- Introduce a mentoring system for research staff.
- Support flexible working hours and arrangements; ask groups to schedule meetings in core hours; tackle any culture of excessive hours.
- Ensure women's representation in departmental decision-making.
- Increase the number of women applying for academic positions: have credible female candidates on all shortlists, and identify and encourage suitable candidates from within the department and externally to apply for vacancies.
- Monitor PhD to Postdoc and Postdoc to research transitions and use the exit data to identify how to recruit more female Junior Research Fellows.
- Ensure staff promotion and recruitment processes are fair and transparent.
- Improve support provided to staff starting or with an existing family, and those with additional caring responsibilities.
- Gather intelligence on why more women than men leave the department to take up non-academic roles.



Where are they now?

Dr Tim Guilliams

Then: **PhD in Dobson Group 2009–2013**
Now: **Chief Executive, Healx, Cambridge**

"The pharma model is broken, there is an urgent need to develop new ways of performing drug discovery", says Dr Tim Guilliams, founder of Healx, an award-winning Cambridge start-up that applies advanced computer technology to biological data to help develop faster and cheaper treatments for rare diseases.

As well as being at the cutting edge of science and technology, Healx has an innovative business model, operating as a social enterprise. It works hand-in-hand with patient groups and charities, helping them identify existing drugs that can work for their disease, while promoting a partnership model where they either work on a non-profit basis or agree to share future profits.

So what was the journey that enabled Tim to fuse top-flight science and technology with innovative business ideas? It all began with a PhD in the Department of Chemistry combined with a frenetic social life creating numerous societies focused on promoting exchanges between industry and academia.

Tim pursued his doctoral degree in Chris Dobson's group, renowned for its innovative research into protein misfolding diseases, including Alzheimer's and Parkinson's. His PhD work focused on antibody fragments as novel biophysical and therapeutic tools for Parkinson's disease.

Even as a PhD student, Tim was focused on the social impact of scientific discoveries. "I've always been driven by impact. Back in 2010 I began to see that policymakers lacked opportunities to debate important issues with industry representatives and academics, and that this interaction was necessary to help them to get these issues right."

With this in mind, in 2010 Tim co-founded the CONNECTIONS Lecture Series to provide events and opportunities for these groups to meet. Feeling that more was needed, in 2012 he co-founded the Cambridge University Science and Policy Exchange (CUSPE), which provided a forum for debates and more direct exchanges between academia, government and industry.

During the final year of his PhD, a placement at the Department of Business Innovation and Skills (BIS) crystallised Tim's evolving belief that large government bodies cannot react quickly to social issues, and that the quickest way to effect change is through technology transfer and knowledge exchange to smaller and more agile organisations.

Tim was awarded his doctorate in 2013, after which he began to formulate the idea of Healx, a social enterprise that would apply novel computer technology to help find cures for unmet therapeutic needs. He wanted to use machine learning and artificial intelligence to help develop faster and cheaper treatments for rare diseases.

The technological breakthrough came when Tim met Dr Andreas Bender, Lecturer in Molecular Informatics at the Department of Chemistry. Andreas' academic work focuses on predicting the properties of molecules, particularly small molecules, which could be of therapeutic interest.

Building on this approach, and with Andreas as Chief Technology Officer, Healx uses a computer-based model to make better predictions on which drugs will work best for which diseases and which subpopulations. "Healx applies big data to biotechnology and combines advanced machine learning with bio-information," says Tim. The technology used is on the cusp of computer learning and biology.

A small grant of £15,000 from Accelerate Cambridge at the Judge Business School, combined with advice, mentoring and free office space, made it possible to get the start-up off the ground – Tim says that it would have been "nearly impossible without them". Entrepreneurs from the Cambridge Cluster provided

investment, including Dr Hermann Hauser, KBE, Dr Jonathan Milner and Dr Ronjon Nag.

Healx then rapidly completed a seed-funding round of £300,000 in April 2015. One month later it won the Grand Finale of the Cambridge University Entrepreneurs / CR Lowe Carpe Diem Enterprise competition and was awarded "Life Science Business of the Year 2015".

In addition to Andreas Bender, Tim has been pleased to recruit other outstanding people. The Healx Chair is no less than Dr David Brown, former Global Head of Drug Discovery at Roche, and a co-inventor of Viagra (at Pfizer). The Chief Scientific Officer is Dr David Cavalla, one of the leading experts in the field with over 15 years drug re-positioning experience.

And what of the future? Tim believes that in ten years Healx will not only be finding cures for rare diseases, but also finding the right mix of drugs for each individual patient, based on their genetic make-up and a comprehensive understanding of human biology.

And continuing his commitment to knowledge-sharing, in April 2015 Tim co-founded the Cambridge Rare Diseases Network (CRDN), a charity that aims to build a network of academics, policymakers and industry professionals and raise awareness about rare diseases. CRDN held its first Summit at the Judge Business School in September, the event receiving BBC coverage and featuring keynote speakers including Professor Stephen Hawking and Professor Sir Greg Winter.

"I've always been driven by impact. Back in 2010 I began to see that policymakers lacked opportunities to debate important issues with industry representatives and academics, and that this interaction was necessary to help them to get these issues right."

Tim agrees with the prediction of Healx Chair David Brown that "the application of computerisation to biotech and human health will lead the third industrial revolution." With this in mind, there can be no doubt we will be hearing a lot more of Tim and Healx in the future.

Healx uses a unique technology platform to identify new applications for already approved drugs that can be "repositioned" to cure rare diseases. It recently gained acclaim for its work in the case of young American Bertrand Might, the first patient ever to be diagnosed with an NGLY1 mutation, leading to an ultra-rare condition now called "Congenital Disorder of Deglycosylation". Healx is now working with a group of researchers, clinicians and patients to find a cure for this condition.

Picture courtesy of Healx

A BBC camera crew capture the Cambridge Rare Disease Network launch event. Left to right: : Anna Todd, BBC reporter; Dr Jelena Aleksic, CRDN Co-Founder; Dr Tim Guilliams, Chief Executive Healx and CRDN Co-Founder.

Call My Bluff

Decanting the Chemistry of Wine

M. E. Kavanagh

The room was full, taste buds expectant and sparkling glasses waited to be filled with liquid from mysteriously masked bottles. Three 'experts', Silvia Vignolini, Daan Frenkel and John Pyle, readied themselves at the front of the room. The guests coalesced into teams. The stage was set for the first Department of Chemistry "Call My Bluff" wine tasting – an evening event for the Cambridge Alumni Festival 2015.

Four interactive rounds of wine-tasting are prepared. The experts - a materials chemist, an outgoing Head of Department and a Professor of Atmospheric Chemistry (the incoming Head of Department) - must expound on the qualities, origins and history of the samples, while the alumni must decide who is telling the truth, and who is bluffing.

Dr Vignolini, materials chemist, used pH indicator strips to assess the acidity of one sample. Outgoing Head of Department Prof. Frenkel, observed that his first sample had no reflection and after scanning the wine with an app on his smartphone told drinkers the wine could only be a Pinot Grigio from Count Dracula's birthplace in the Carpathian Mountains. The incoming Head of Department, Prof. Pyle, took a rather more sophisticated, and safe, approach - wearing safety specs and brandishing red, blue and green lasers to conclude that, from the differential absorption of light, the wine must contain a high proportion of sulphites and was therefore likely to be of low quality.

Guests were educated throughout the evening on the finer points by which chemistry impacts wine production, from the overall flavour and palate of a wine which is predominately influenced by the balance of sugars (glucose and fructose), acid (malic, tartaric and lactic) and organic compounds called phenols that are present; to the various esters, terpenes and other volatile aromatics which contribute to the aroma of a wine. The banter included the impact that atmospheric chemistry and climate change can have on grape maturation, and the fine balance that exists between "good" microbes, like those in yeast required for fermentation or in Botrytis fungi responsible for giving a Sauternes its sweetness.

While many of the guests were alumni with strong ties to the Department of Chemistry, others – mainly partners of alumni – came from diverse backgrounds. But most were attracted to the event by the free, ethanolic (sorry, alcoholic) content of the evening. Revellers commented that they were surprised to find that chemists have a sense of humour. Others lamented that the party had to end. The success and enjoyment of this inaugural event in the Department of Chemistry and Alumni Festival calendar must surely lead to a repeat. Roll on 2016.

Then...

Professor Anthony Kirby FRS

Tony Kirby was a Cambridge undergraduate in the late 1950s. He went on to complete a PhD in 1962, and after a postdoctoral year in the US returned to the department as a demonstrator (assistant lecturer). After a research career covering "all aspects of organic reaction mechanism, particularly in aqueous solution", he is now Professor Emeritus of Bioorganic Chemistry. Tony celebrated his 80th birthday this year, and is still asking questions about the catalytic efficiency of enzymes.

"From the perspective of a not particularly political student I don't think the 'social scene' in the department was very different in the early 1960s. PhD students remain very much focused on themselves and their work. What has changed is the physical environment and the range of research tools at hand. Also, groups were smaller and scattered about the lab. And group meetings were practically unheard of.

"The Lensfield Road labs were brand new. My bench was in Lab 122 but at that time it was full of open benches, with just a few fume cupboards along the sides. Safety generally was far less strict – both for practical chemistry and for access to the lab: you just walked in. We had no desks, computers or mobile phones; you made room on your lab bench to write reports and notes - by hand of course. Literature searching meant reading the printed journals as they came in. Without NMR, we relied mostly on UV, IR and elemental analysis.

"In the 50s, the structure and reactivity of DNA and RNA became a high-profile target and the then new labs were some recognition of the major contribution made by Todd's Cambridge School to nucleic acid chemistry. Ironically, organic chemistry was seen, by some, as being on its 'deathbed'. I vividly remember my supervisor Malcolm Clark starting his invited research lectures with a suitably inscribed model coffin on the desk in front of him, before launching into a rousing presentation of the 'new' Organic Chemistry".

...and now

Patrick Flagmeier

Patrick is currently a PhD student in the Dobson Group. He grew up in in Bielefeld, Germany.

"My focus is on my work. I work in the Dobson Group but I have the opportunity to collaborate with the Knowles, Klenerman and Vendruscolo groups which means I get the chance to work on highly challenging questions related to protein aggregation from various angles. And the best part is all the groups are located in one building. I don't know where else such collaborations would be possible? The Graduate Committee organise University-wide events, ranging from quiz nights to sport days, which brings you into contact with groups outside the department and the chance to exchange expertise.

"Cambridge has a lot to offer now; exciting talks by leading scientists from different backgrounds. There's sport; in my first year I played football for my college and in my second year I rowed, winning blades with my crew in Lent Bumps, and that was a great experience.

"You meet a lot of highly motivated individuals with diverse interests and backgrounds. That's how I found myself joining a team of students, here in Cambridge, organising GapSummit 2016, a global conference, focusing on challenges in biotechnology.

"You're exposed to topics that are not directly related to your field of study. For example, I'm following the recent discovery of CRISPR Cas9 and CPF1, which has the potential to be even more efficient at gene editing than Cas9.

"And then there is the Careers Service, supporting students with presentations and helping us to make decisions about what happens after Cambridge.

"All these opportunities make the Department of Chemistry an exciting place to perform research."

Knowledge Transfer Facilitator

Yolande Cordeaux

Knowledge Transfer Facilitator - it sounds like a job title you might find in a Philip K Dick novel. Total Recall – We Can Remember It For You Wholesale; just let our knowledge transfer facilitator inject this tiny transistor into your brain. However, Dr. Yolande Cordeaux informs me, it is nothing of the sort. Shame.

Yolande was appointed as Knowledge Transfer Facilitator in the Department of Chemistry in January 2015. "It's about going beyond academia and collaborating with the outside world to meet some global challenges or progress some research," she says. In other words, Knowledge Transfer involves a broad range of activities, which support beneficial collaborations between universities, businesses and the public sector.

"It's about working with industry partners, talking to government bodies and policymakers to deliver solutions that have real impact – it's about matchmaking academic interests with genuine problems.

"For example, with the healthcare sector we might work together to design and synthesise new therapeutics or develop new drug delivery systems. In agritech it might be working towards better solutions for crop protection. In the energy

"It's a fascinating job, and I'm always learning something new. It amazes me to see how far the applications of our research can go. It's a real privilege to be there as a new idea emerges, and to be part of its journey into the wider world."

sector, it might be developing renewables or improving existing methods of energy storage. With policy, it could be applying our expertise in atmospheric chemistry to help advise on issues such as pollution and climate change. Basically, for the majority of global challenges we face today, there is a role that chemistry can play in finding a solution."

Yolande is one of several appointments around the University currently funded by the EPSRC (Engineering and Physical Sciences Research Council) Impact Acceleration Account (IAA). The aim: to promote wider and more effective engagement with the impact agenda. A key objective is shortening the time to impact.

It becomes clear 'impact' in this context is not simply the action of one object crashing into another. No, here we are talking about the academic, economic and societal impact of research.

"As well as brokering relationships with collaborative partners, Knowledge Transfer is also about commercialising some of the fantastic research that goes on in the department," explains Yolande. "Academics will come to me because they have discovered something new, and they might suggest people or companies that they feel can help them progress. They're looking for a route to getting ideas into the wider world; it could be a consultancy, a spin-out company or patenting an idea."

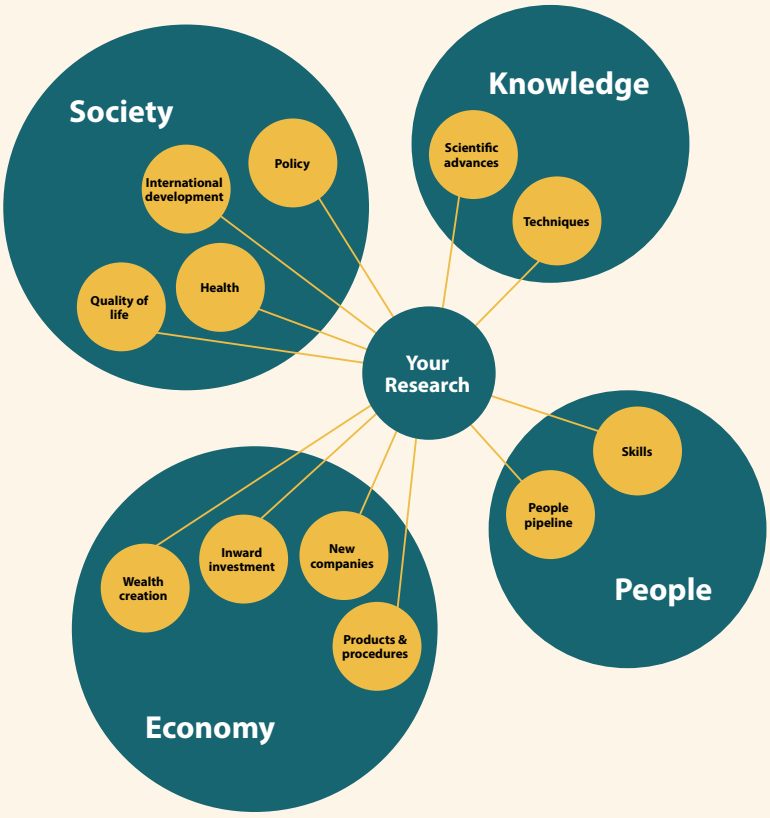
This two-way exchange element of Knowledge Transfer is at the heart of successful and sustainable collaboration.

Busy academics may not have the time to build knowledge transfer relationships and this is where the Knowledge Transfer Facilitator proves their worth. Yolande helps by identifying pathways to impact and managing relationships with internal and external stakeholders on knowledge transfer projects.

"It's a fascinating job, and I'm always learning something new. It amazes me to see how far the applications of our research can go. It's a real privilege to be there as a new idea emerges, and to be part of its journey into the wider world."

To find out more about Knowledge Transfer in the Department of Chemistry, email Yolande Cordeaux: **yc265@cam.ac.uk**.

"As well as brokering relationships with collaborative partners, Knowledge Transfer is also about commercialising some of the fantastic research that goes on in the department."



WHAT IS IMPACT?
This diagram exemplifies the potential variety of impacts that could be achieved through research.

Lithium Air Battery Breakthrough

Grey Group Postdoctoral Researchers Breathe New Life into Battery Technology

Advances in battery technology are big news, as Tao Liu, Gunwoo Kim and Paul Bayley found when their lithium-air battery research was published in *Science*, November 2015.

The postdocs, who share a credit on "Cycling Li-O_2 batteries via LiOH formation and decomposition" with their supervisor Professor Clare Grey, experienced a maelstrom of media attention, trending on Twitter, featuring on BBC News television and radio, and being interviewed by news organisations all over the world.

The chemists developed a lithium-air battery that has a high energy density, is extremely efficient and can be recharged more than 2000 times without showing much degradation.

But why are lithium-air batteries such a hot topic? Battery life, battery size, battery power and battery weight are all major considerations when buying a new piece of kit: from smartphones to power plants and today's electric vehicles.

All these devices require rechargeable batteries. The current commercial front-runner is the lithium-ion (Li-ion) battery. But lithium-air batteries would, theoretically, be far better. They can store much more energy than lithium-ion, and lithium-air batteries have a capacity that is possibly ten times that of lithium-ion and an energy density very close to that of petrol. The Cambridge team has demonstrated a battery that makes the theory seem possible.

"In their simplest form, batteries are made of three components: a positive electrode, a negative electrode and an electrolyte," says 1st author, Tao.

"But we're always looking for the Olympic ideal in battery technology: Faster, Higher, Stronger. Building batteries with higher capacities, that can be charged faster, and that are more robust. Lithium-air battery chemistry is like breathing," Tao explains. When batteries are discharging or 'in use' they're breathing in O_2 the reaction producing a solid oxide. When batteries are charging or 'plugged in', that's breathing out O_2 by breaking down the oxide.

Tao shares an office with Paul and Gunwoo called 'The Fishbowl'. It was originally given this name because it has no external facing windows, instead it has three floor-to-ceiling picture windows and sits in what is basically a corridor, close to the Grey Group lab. It used to be a meeting room and people walking by could observe the goings on. Opaque film, added when the room became an office, allows only the tallest, and the most determined, to peep above the 2m screen.

"What we've achieved is a significant advance for this technology which suggests whole new areas for research. There are many hurdles to be addressed, for example, we've got to improve how fast you can charge and discharge the battery and deal with the lithium-metal anode – so plenty to keep us busy!"

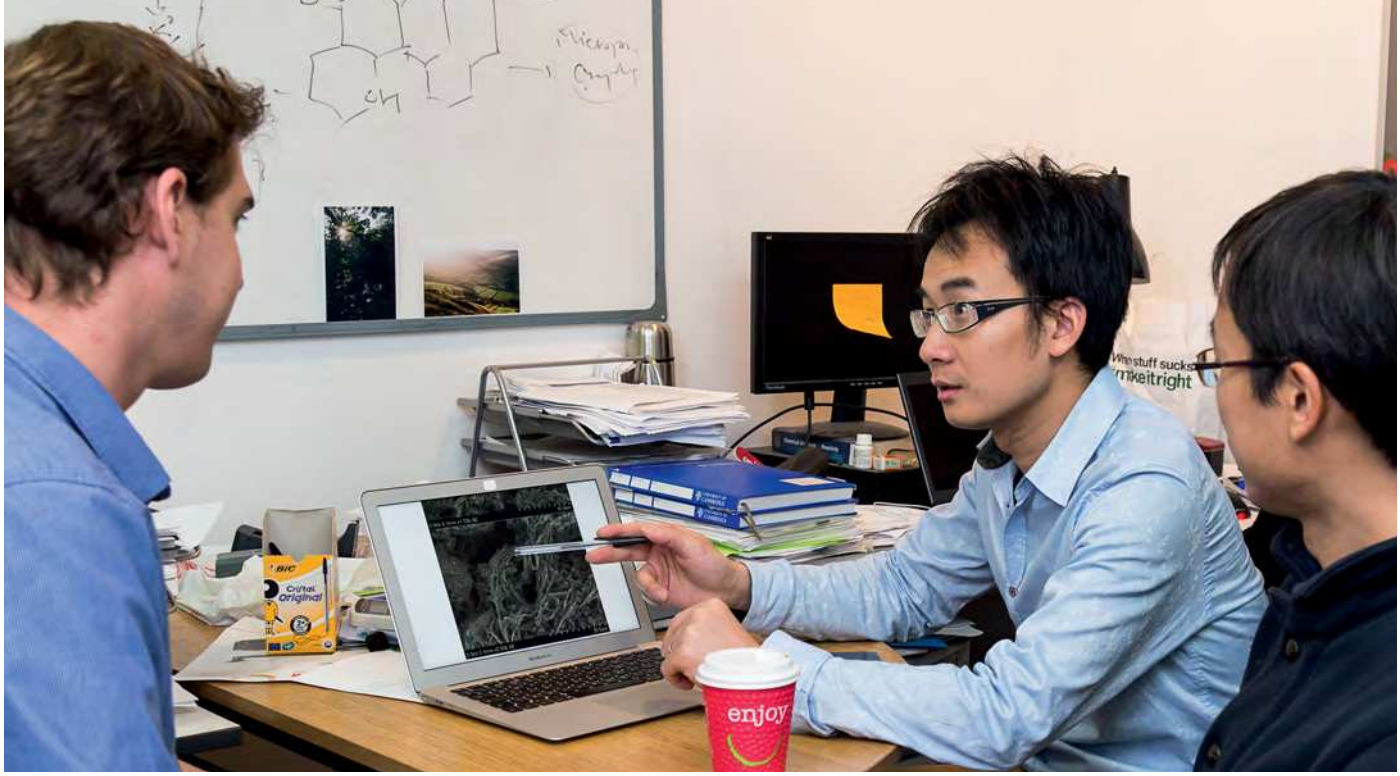
Professor Clare Grey

"We all have our own primary projects", says Gunwoo, who did his PhD with Clare Grey. "I am a spectroscopist looking at the passivating layer, the solid electrolyte interphase (SEI) and the resulting decomposition of electrolyte, using NMR (nuclear magnetic resonance imaging). The nature of this layer defines the battery's performance and lifespan."

"I was a catalyst and surface chemist. I did a PhD with David King and Stephen Jenkins", says Tao. (Professor Sir David King is a former Head of Department and was chief government scientific officer). "I worked on fuel cells in the Materials Science Department. Now, I'm an electrochemist working on lithium-air batteries," Tao adds with a chuckle. "I'm trying to understand how Li- O_2 batteries work during cycling: what is the chemical process? And how to improve it."

Paul has a background in ionic liquid electrolytes and focuses on lithium-metal dendrite formation on the lithium anode.

"We just got talking one day and realised we had similarities in our projects and complementary skills, which allowed us to progress the research," Gunwoo explains.

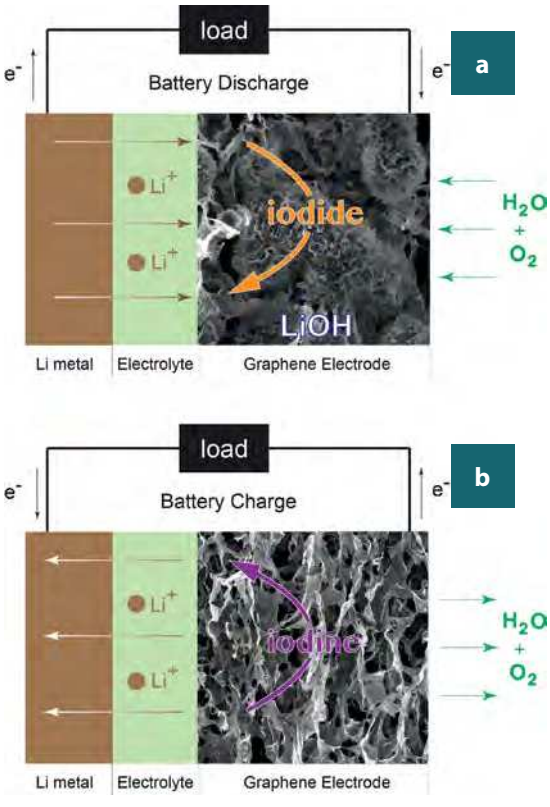


The spotlight is on the chemistry at the positive electrode, the cathode. A macroporous reduced graphene oxide is used as a framework to catch the discharge product. "We see a unique formation of lithium hydroxide, which is different to the more usual lithium peroxide," says Paul, "and it's a highly reversible hydroxide formation."

Using NMR the team showed the hydroxide building up and filling the 'spongy' graphene cathode during discharge and then dissolving as the battery is recharged.

There are three exciting things about this process: lithium hydroxide is not as harmful as lithium peroxide to the battery's integrity – it does not result in as many unwanted side reactions, the process is reversible and the battery is tolerant to water impurities. This water tolerance brings the battery one step closer to a lithium-air, as opposed to a lithium-oxygen battery.

Despite the clamour for high-octane soundbites, Paul ended on a positive quote with a note of caution, "We need to be careful not to over-promise the possibilities but it does breathe new hope into the practicalities of rechargeable lithium-air battery technology."



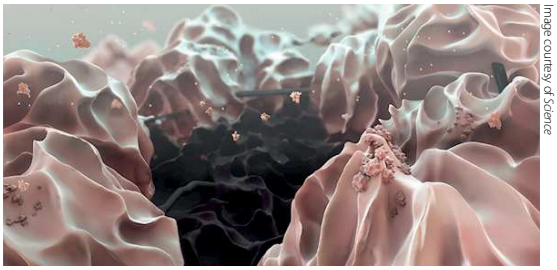


Image courtesy of Science

MAIN IMAGE, TOP: Grey Group Postdoctoral team at work in the Fishbowl. Left to right: Paul Bayley, Tao Liu, Gunwoo Kim.

ABOVE: Computer enhanced electron micrograph showing the large LiOH particles formed on the underlying graphene framework with the small LiI redox mediator floating around.

LEFT: Schematic representation of a Li-air battery based on a Li metal anode and graphene cathode; (a) during discharge and (b) during charge.

Noticeboard

Recognition and Awards

Professor Chris Abell was appointed Pro-Vice-Chancellor for Research, to start 1 January 2016 for a term of three years.

Professor Ali Alavi was elected Fellow of the Royal Society.

Professor Sir Alan Battersby celebrated his 90th birthday with a symposium in his honour.

Professor Jane Clarke was elected Fellow of the Royal Society.

Professor Daan Frenkel was awarded the Bakhuis Roozeboom Medal.

Professor Matthew Gaunt won the Royal Society Wolfson Research Merit Award and the American Chemical Society Arthur C. Cope Scholar Award.

Professor Clare Grey won the Arfvedson-Schlenk Award.

Professor Chris Hunter was elected Honorary Member of the Royal Irish Academy.

Professor David Klenerman was elected Fellow of the Academy of Medical Sciences.

Professor David Wales was awarded the Royal Society of Chemistry Tilden Prize.

Appointments and promotions

Dr Robert Phipps was awarded a Royal Society University Research Fellowship.

Dr Aleks Reinhardt was appointed University Lecturer in Theoretical Chemistry.

Upcoming events

January

Friday 22 January 2016
The 4th UK Solar Fuels Symposium St John's College, Cambridge

Chaired by Dr Erwin Reisner of the Department of Chemistry and Dr Junwang Tang of University College London.

See **http://solarfuelsnetwork.com** for more details.

February

15 – 20 February 2016
Linnett Lecture

Xiaoliang Sunney Xie will be the Linnett Lecture visiting professor to the Department of Chemistry. Xie is the Mallinckrodt Professor of Chemistry and Chemical Biology at Harvard University, and is considered a founding father of single-molecule enzymology.

March

Saturday 12 March 2016
Chemistry Open Day

As part of the University of Cambridge Science Festival, the Department of Chemistry opens its doors, offering hands-on experiments, demonstrations and 'explosive' lectures to budding scientists of all ages.

For further information contact Emma Powney at **elp23@cam.ac.uk**

Thursday 17 March 2016
Alumni Medal Ceremony

Dr Yusuf K Hamied will be awarded the first Department of Chemistry Alumni Medal for services to the community. As part of the ceremony Dr Hamied will give a brief talk about his life and experience. For further information contact Diane Harris at **dh473@cam.ac.uk**

How you can contribute

Online Giving
The University's Development and Alumni Relations Office has made it easier to make donations online to Chemistry.

If you wish to make a donation to the department, please go to: **philanthropy.cam.ac.uk/give-to-cambridge/chemistry**

Your donation will play a vital role in securing the future of the Department of Chemistry as a centre of excellence for study and research.

One off donations by cheque
Your gift made by cheque or money order to the Department of Chemistry will allow the department to use the donation where it is most needed.

Make a regular gift by Standing Order
Regular gifts by standing order allow the department to budget more accurately and to plan its spending more reliable. To give by standing order, please complete the form below.

A Gift in Your Will
One very effective way of contributing to the long-term development of the Department of Chemistry is through the provision of a legacy in your will. One advantage of giving a legacy is that they are tax-exempt, and therefore reduce inheritance tax liability.

The University provides advice about how to give legacies at campaign.cam.ac.uk/how-to-give, which also has a very helpful downloadable document at the bottom of the page called "A Gift in Your Will".

For any further information on how you can help the Department of Chemistry, please feel free to contact our Head of Department, Professor John Pyle (chemhod@hermes.cam.ac.uk), who would be pleased to talk with you confidentially.

Gift Aid
If you are a UK taxpayer you can Gift Aid your donation, adding an extra 25p for every pound you give.

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4. If you pay tax at the higher rate (additional rate) you can claim further tax relief in your Self-Assessment tax return.
5. If you are unsure whether your donations qualify for Gift Aid tax relief, please contact the University of Cambridge or visit the HM Revenue & Customs website www.hmrc.gov.uk/charities-donors.
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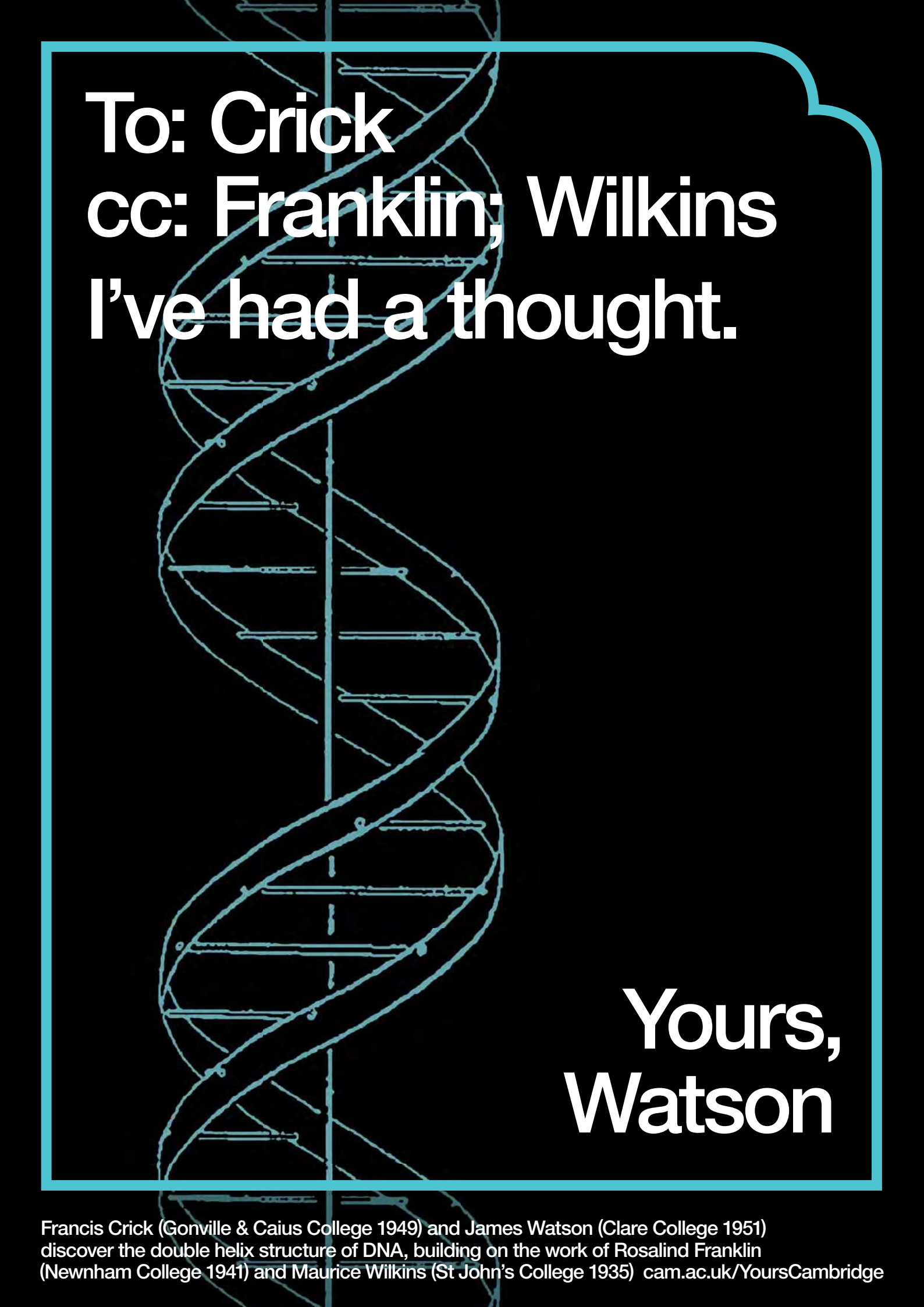

Francis Crick (Gonville & Caius College 1949) and James Watson (Clare College 1951) discover the double helix structure of DNA, building on the work of Rosalind Franklin (Newnham College 1941) and Maurice Wilkins (St John's College 1935) cam.ac.uk/YoursCambridge