

CEB *Focus*

Department of Chemical Engineering and Biotechnology



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Message from HoD Professor Nigel Slater



On my office wall is a cherished photograph of my research supervisor and the research group in which I worked for my PhD exactly 40 years ago. It has a simple legend: “*Una laudandi, singula obliviscendi*”. The translation is clear but the significance evaded me, until now. Before

Christmas we received the outcome of the HEFCE Research Excellence Framework – the government’s exercise

to rank research quality and impact across all departments. CEB was ranked top of our “Unit of Assessment” (departments in Aeronautical, Manufacturing and Chemical Engineering). Would either Chemical Engineering or Biotechnology have achieved so much on their own? We do not know but I believe not; together we triumphed whereas individually we may not have done. In 2015 CEB will all come together in West Cambridge and we can then begin to reap the benefits of improved synergy that lie at the core of this enormous project. For that reason I am firmly of the belief that the best is yet to come.
Happy 2015!



From left to right: Undergrads Kaichen Gu and Chang Yi, Elena Gonzalez, and PhD students Jantine Broek and Fanny Yuen

Editorial Note

The *CEB Focus* Editorial Team wishes readers a fantastic 2015! *CEB Focus* Newsletter is the product of a joint team effort led by Elena Gonzalez (PA to HoD Professor Nigel Slater) assisted by fellow editors PhD students Jantine Broek and Fanny Yuen and undergraduates Chang Yi and Kaichen Gu. The Editorial Team’s commitment to this project with their personal contributions and enthusiastic ideas help further develop the publication look and editorial content. We are always keen to see new faces so please email us on ceb-focus@ceb.cam.ac.uk if you are interested in joining us.

The Front *Cover Article* focuses on recent department initiatives in support the next CEB’s Athena SWAN application as well as the launch of a new regular feature ‘CEB Women in Chemical Engineering and Biotech’ with the first profile in the series contributed by inspirational academic Dr Krishnaa Mahbubani.

From now on the *Industry Business* section will be presented by Dr Graham Dransfield, CEB Knowledge Transfer Co-ordinator, offering a summary of the most relevant corporate news and an overview of the latest exciting collaborations with industry. Undergraduate Focus tells about the latest CEB Careers Fair and CUCES (ChEng Society) plans for 2015 undergrad events including the upcoming Frank Morton Games in Birmingham.

Research Highlights tells about the recent high profile annual CEB Research Open Day offering seminars and research poster presentations attended by talented young researchers, their PIs and captains of industry. Young researchers showcased the latest research projects highlighting remarkable impact and potential for academic-industry joint ventures. The Research Feature is a contribution by former ChemEng HoD and Emeritus Professor John Davidson highlighting the development of the Bacon fuel cell in the Department that facilitated the Apollo Mission to the moon.

Biotech Graduate Dr Jan Onno Reiners, Executive Coach, is profiled in the *Alumni Corner*, which also highlights the recent visit by former Faculty member Professor Jim Wilkes, who ‘dontaed’ the slide ruler belonging to Terence Fox’s (1st Chemical Engineering HoD and Shell Professor’s) to be displayed in CEB’s new home in West Cambridge.

People Focus presents three CEB beneficiaries from the Gates Trust Foundation, Scholars Hilary Fabich, Ashley Fidler and Rebekah Scheuerle. Finally, Staff Room tells of the latest progress made in the new building site, new departmental appointments and staff leavers including the retirement of IT Manager Dr Jim Thompson and Professor Alan Tunnacliffe and the departure of Dr Dan Holland gone to New Zealand in search of pastures new. Good luck to all!

CEB Focus would like to thank webmaster Vanessa Blake for regularly providing photos and department members, alumni and corporate partners for article contributions. Please keep sending them to ceb-focus@ceb.cam.ac.uk. To receive a regular e-copy of *CEB Focus* **subscribe** by sending a message to ceb-news-request@lists.cam.ac.uk with “Subscribe” as the subject of the message.

CEB Pro Equality in the Workplace

Elena Gonzalez



Professor Sabine Bahn with female researchers at the Cambridge Centre for Neuropsychiatric Research lab

STEMM subjects (science, technology, engineering, mathematics and medicine) have traditionally suffered from an under-representation of women, hence education and research in key scientific fields are not reaching their full potential. Moreover, an article by Jamie Campbell “*Women trapped in universities’ ivory basements*” (The Independent, 7 December 2014) cites a study suggesting that ‘*British academia is rife with gender inequality and sexism*’. He goes on to say that ‘*Women are far less likely to become professors than men, only accounting for one in five of such posts. And those who do make it to the level of professorship face further discrimination – being paid on average 13.5 per*

cent less than their male counterparts’. The study in question is based on first-hand accounts from women representing the sciences, arts and humanities, collected over a five-year period. Around half of those approached declined to have their stories included “for fear of reprisals and/or repercussions”, according to the author of the study, Dr Heather Savigny, senior politics lecturer at Bournemouth University.

In recent years there has been a significant increase in engagement with the national Athena SWAN Charter (114 member institutions holding over 300 Departmental awards). Athena SWAN awards specifically recognise good employment practice for women working in STEMM subjects and from 2015 will be extended to cover the arts, humanities and social sciences. The Athena SWAN awards process enables departments and faculties develop an action plan aimed to help improve the recruitment, retention and promotion of female academic and research staff. Research Councils UK expect all RCUK funding recipients to be able to provide evidence of commitment to equality and diversity and Athena SWAN participation can play a key role in meeting these expectations.

A growing number of Cambridge University departments, leaders of research and teaching in STEMM subjects, have already been recognised by Athena SWAN with more than 80 per cent of all STEMM staff in the University now working in departments with an award (1 Gold, 1 Silver and 11 Bronze awards in total). In 2014, the University joined an elite group of only 5 universities to hold a Silver Institutional Award.

In light of the latest results highlighting the areas CEB needs to improve on, CEB Athena Team has already started working on the next Athena SWAN application putting an action plan together in line with the University’s commitment to gender equality to ensure gender inequalities are addressed in Chemical Engineering and Biotechnology. It is hoped that these efforts will help the Department gain an Athena SWAN Bronze Award this year.

Among some of the CEB gender-friendly initiatives recently launched, the CEB Postdoc Committee has started putting together a list of links to University webpages useful for people with caring responsibilities, including pages on maternity and paternity leave. One aspect of the feedback previously received by the department on its Athena SWAN Bronze application was that the Department should not rely on information being available on the University webpages but rather should ensure that members of the department are aware of policies. The Committee has since agreed to implement a page on the departmental website listing useful links for all staff.



Recognising commitment to advancing women's careers in science, technology, engineering, maths and medicine (STEMM) employment in higher education and research.

The Committee also discussed the issue of maternity leave, maternity cover and grant extension for contract research staff. Funding bodies have different policies and cases are treated on an individual basis, therefore it can seem difficult to obtain information without disclosing a wish to have a family. It was thought this should be brought up centrally in the University, maybe through the Office of Postdoctoral Affairs, but also through the Department Athena SWAN self-assessment panel currently being re-formed.

On an academic level, Professors Sabine Bahn (CEB) and Tim Minshall (Engineering) have been elected as gender equality champions for the School of Technology.

The Department of Chemical Engineering and Biotechnology has a good record of attracting female students at undergraduate and postgraduate level. For many years, the student intake has been roughly one third female, higher than average for science and engineering, but there is still work to be done. The work of the School Champions in the Senior Gender Equality Network (SGEN) will support the Gender Equality Group (GEG) and provide visible leadership on gender equality. They will also promote good practice by providing a local focus and influencing cultural change.

Professor Bahn commented; *'We are currently meeting with representatives from to try to identify problems/issues, which could be linked to the low number of women particularly in our School, which has the lowest percentage number of women in academic positions (11.4% compared to 14.2% in Physical Sciences and >26% in the other 2 STEMM Schools).'* Professor Slater, HoD, welcomed the appointment and said; *"We are delighted that one of our senior academics can be a role model for our female students."*

In addition, the University is a supporter of The 30% Club (www.30percentclub.org/) - a group of Chairs and CEOs committed to better gender balance at all levels of their organisations through business leadership. This initiative aims to not only train academics but also the future elite of the country and to make sure that women are represented in top positions in universities and industry.

As part of the CEB Alumni Relations strategy conscious efforts are being made to ensure graduate alumnae, females leaders of industry and academia, are being encouraged to contribute to department talks and seminar series, career panel events, etc... CEB would like to help empower our female graduates, leaders of chemical engineering and biotech industries and science, by giving them the chance to tell others about their own experiences in their chosen career path. It is crucial to give women a platform to share their valuable knowledge and career insights To facilitate this aim, CEB Focus, Department Newsletter is now launching a regular feature: *'CEB Women in Chemical Engineering and Biotechnology'*. This new initiative calls for Department women from all levels and functions to get involved: From female undergraduates, to research students, postdocs and senior academics, they are all being encouraged to contribute their personal profile to the termly publication. CEB hopes that presenting department female role models can help inspire an increasing number of other women to follow suit and lead by example, more specifically encouraging other females and prospect applicants to aim high, chase their career dreams or consider a course of study or a career in research or academia with us.



NEW: CEB Women in Chemical Engineering and Biotechnology

Dr Krishnaa Mahbubani, Lecturer and Researcher at BioScience Engineering Group

Welcome to the brand new regular feature about women in the Department. As it is supposed to be a profile of me... let's start with my name – I'm Krish to the faint of heart and I have been with CEB for a good few years now starting with my PhD – where I worked with colleagues and industrial collaborators to develop a method by which we can stabilise live bacterial vaccines at room temperature. That bit of research is currently progressing through pre-clinical trials via a biopharmaceutical company (and the Daily Telegraph thought it interesting enough to make mention of it).

I am now applying my knowledge and expertise in biochemical preservation to my current research work in cryopreservation, freeze drying to aid supply chain logistics for biological products such as red blood cells and stem cells. (The ultimate goal: room temperature stable biological materials). The project involves collaborating with a research centre in Riyadh, Saudi Arabia. They are attempting to set up a cryopreservation laboratory there and I partly have the responsibility to manage a collaboration with large cultural and strategic differences. It's certainly put up its fair share of challenges.

I've had some exciting, multifarious opportunities – supervising and working with some of the brightest minds, presenting my research at global conferences and to 16-year olds, publishing articles for both academic and diverse audiences, creating a video of my research outcomes, getting to talk on the radio about my happy friendly bacteria. These are just tips of the iceberg really. I even had the chance to spend a year lecturing (but that's a story for another day, I suppose).

There is more to me than just my research. Outside of the lab, I've played rugby at University and county levels, but now I compete in powerlifting competitions, setting multiple Hong Kong and British records along the way. This is my way of staying sane in a very demanding and arduous profession.

There's really two questions here: Where do I find the time? And why? Well for one, it's all about blocking off time for what YOU want and things that make you happy and centred. Whether it is time for your kids (replace with siblings or partner or friends) or time for that run, that hour in the yoga studio or just sit in the sunshine. Okay, the latter might only be applicable 2 days in a year, but you get what I mean. It doesn't matter what that thing is. Block some of it off for YOU. Yes, I can sometimes be a hypocrite – cos well, things happen and I forget. But it is about learning, and re-learning to be selfish now and again.

And why should you take the time out to do these non-work activities? It's called a work-life balance and for me, taking the time out to do other things has taught me a lot about myself and how I can push myself in my work environment. Especially if I clear my head on a regular basis or have something to look forward to at the end of the day -and there's nothing like repeatedly attempting to lift a weight to teach you discipline and perseverance.

I can honestly say, I've done my parents proud – an engineer and a doctor – exactly what every conservative Indian family wants for their children. Though the question of the hour is specifically about what it is like to be a woman in CEB... Well, statistics and facts (you can find plenty in the previous article) will tell you that getting recognized as a female engineer or scientist in the UK is nigh on impossible and equally, if you're waiting for recognition by your peers (and it really doesn't matter where you work), I wouldn't hold your breath. The world still has a lot of growing up to do.

Recognise your own achievements and be your own person. Stand in front of the mirror and be happy with the person YOU see. If I was waiting for some recognition about my abilities, I'd never have made it to University let alone pick up that barbell or that rugby ball. It's not about breaking the barrier. It's about not acknowledging it and putting yourself on the level playing field whether or not you are invited.

This Year, CUCES Will Bring You...

Samuel Wibberly, CUCES President 2014-2015



CUCES Committee at Christmas Dinner

Michaelmas Term is finally over and now that lectures have been attended, exercises have been tackled and supervision work has been completed (well most of it anyway), it is now time for the vacation.

We will come back to Lent term 2015 where CUCES will be adhering to our new year's resolution. We are promising even more careers events and hopefully new additions to the consortium to broaden range of industries on offer. You will be kept well informed of these in our weekly bulletins that will be going out on time and with no date errors as well as our new CUCES webpage under the CEB website, in a huge effort to cut down the number of emails from us in your Hermes accounts.

More 'Meet Your Mentors' events will be scheduled so we can keep the inter-year communication at a high whilst offering everyone a much needed break from work. Ensuring that postgraduates are included in our events is also part of the resolution – an exclusive event with our new postgrad rep for the next term has already been planned. In terms of social events we are promising to get bigger and better too. We are aiming to get one to two formal planned for the entire department, hopefully done in synch with exercise deadlines so you can truly celebrate handing them in. We are also working on arranging a few out of department trips too; chocolate factories and industrial site visits may be in the pipeline. Of course, our biggest trip of the term will be Frank Morton Birmingham. We are promising a truly amazing day for all who attend full of friendly competition and the opportunity to socialise with fellow chemical engineers from across the country.

Before we sadly step down at the end of the term we have one final promise - a truly awesome Annual Dinner. We are planning on going out with a bang with our yearly event and we are aiming to make it a memorable one.

Frank Morton Sports Day Back in 2015

Betsy-Ann Ward, CUCES Social Representative 2014-2015



The Frank Morton Sports Day is returning to Birmingham in 2015, and this time we are going to be there! With over 2700 Chemical

Engineering students from across 28 universities in the UK and Ireland taking part in 19 different sports, this year's event is set to be bigger and better than ever before!

The sports day is held annually on the campus of one of the competing universities. It is named after Frank Morton, a prominent professor of Chemical Engineering, who taught at Birmingham University until 1956. When he switched to teach at UMIST (now University of Manchester), his love for sport and connections at both universities led him to organise the first of these sports days. The competition began in 1961 as a football match between the two departments, but by the 1980s, the event had grown to include many more universities and sports.

This year's event will be held on Tuesday 17th February 2015, and will be mainly based in Birmingham's Barclaycard Arena. A team of around 80 undergraduates will represent the CEB. The sports include 5-a-side football, netball, hockey, tag rugby, basketball, tennis, squash, ultimate frisbee, rounders, quidditch, relay race, dodgeball, badminton (doubles), laser quest, crazy golf, bowling, bench ball, volleyball and sports day. We will have an early start on the day to get on a coach to Birmingham in time for a careers fair and opening ceremony in the morning, followed by sports competitions during the day. We will then return to the Barclaycard Arena for the closing ceremony, food and the start of the bar crawl along Broad Street, ending in the club Gatecrasher! There will also be alternative events will be available for those who do not wish to take part on the bar crawl.

We are all really looking forward to Frank Morton 2015, particularly since we were unable to represent Cambridge in last year's event in Glasgow – so let's bring it on!

CEB Careers Panel

Beth Jones, CUCES Careers Representative 2014-2015 and Careers Panel Moderator



Total of nine industry representatives at the event

On the afternoon of Tuesday 2nd December, CEB welcomed nine industry representatives to the department to share their career experiences with current students. Lining up in LT1, all were invited to introduce themselves to students in attendance, before the floor was opened up to questions from the audience. With panellists there representing consortium companies, as well as an entrepreneur, banker and offshore installation manager of an asset in the Caspian Sea, students were presented with a fantastic opportunity to find out as much as they could about the options open to them when in possession of a Chemical Engineering degree.

A wide range of topics was discussed, from specific job information to more general life advice. It was very interesting to hear how all panellists agreed that the most important thing to look for in a career is personal passion and enjoyment for what you do. With only a limited amount of time for students to decide upon what it is we should be doing when we graduate, we do all feel the pressure to make the 'right decision', often without the facts we need to do so, such is the nature of job hunting in today's society. It was thus comforting to hear that, should you not enjoy the job you start off doing, there is no shame in trying something else and pursuing what you do want to do, no matter how long it takes you to find out what that is.

Once questioning had ceased, panellists and students moved towards the tea room and mingled over Chinese

food and drinks. With only 30 students or so in attendance, half of what had been expected based on previous events of this nature, there was no shortage of food, so lots of people took Chinese home to have for dinner too! CEB would like to thank all industry representatives for giving up their time to come and talk to students, as a lot of useful information was shared and feedback from students in attendance was very positive. Also, thanks to CUCES for organising food and drink and to Elena Gonzalez for securing all panellists in attendance. This event is something we want to run next year, earlier on in Michaelmas term, so that more students are likely to be free to come along and benefit from insider careers information!



Career Panels coordinator Beth with two industry representatives

CEB Basketball Team Report

Csaba Katai, CEB Basketball Team Captain 2014-2015

Basketball isn't as popular as other traditional British sports (e.g. rugby, football ...). However, due to the significant population of international students in Chemical Engineering a team could form to battle against other Colleges and Societies. The way this was done, was by joining King's College and entering the University College League that way.

Initially we were expecting a good run in the league. However, due to adversities (injuries and other commitments) we didn't achieve the results we wanted. Said that, the team however, showed great development in terms of playing as a team and showing good team chemistry along with the attention for one another even in critical and pressured situations (such as a match at stake).

The team will continue next term as well with trainings every Wednesday (8pm in Kelsey Kerridge Sports Centre) and a League game every two weeks (normally at weekends). All Chemical Engineers with all levels of skills are warmly welcome for a good practice!

Energy at Cambridge University

Dr Shafiq Ahmed, Energy@Cambridge Strategic Research Initiative Coordinator

Following on from a visit last year, when the University of Cambridge and Shell signed a research framework agreement to facilitate a range of new research projects, a senior delegation from Shell, led by Andy Brown, Director of Upstream International, visited for a number of high level meetings, organised by the Energy@cambridge Strategic Research Initiative, with senior academics from across the University. The visit included the Shell 2014 Lecture and Future Energy Challenge Poster Competition.

On 22 October Professor Lynn Gladden, Pro-Vice-Chancellor for Research and Chair of the energy@cambridge Strategic Research Initiative hosted Andy Brown, who gave the 2014 Shell Lecture 'Deploying Gas Technology for a Sustainable Energy Future' held at St Catharine's College and attended by both students and academics.

Before the start of the lecture Professor Lynn Gladden and Andy Brown announced the winner of the Energy@cambridge organised Shell Future Energy Challenge Poster Competition. The first prize of £250 was won by Michael Price, a graduate student and Winton Scholar in the Department of Physics, who presented on the power efficiency gain of Perovskite solar cells and lasers which will lead to cheap large-area solar energy generation. The runner-up prize went to Aliasger Haiderali, a graduate student in the Department of Engineering, whose work focuses on numerical modelling of monopiles for offshore wind turbine applications.

Andy Brown then spoke about the long-term global energy challenges and how gas, engineering, innovation and technology will play a crucial role to tackle these. He looked at how various gas technologies have evolved, culminating in some of the largest and most exciting engineering projects of the day, and gave examples of the Prelude Floating Liquefied Natural Gas (FLNG) facility being built in Korea, the largest floating facility man has ever built; the Pearl Gas-to-Liquids (GTL) Plant in Qatar, the largest investment any FTSE company has made in a single project, featuring technology capturing no less than 3500 patents; and carbon capture and storage (CCS) technology to capture CO₂ in flue gases planned for use in the Peterhead Combined Cycle Gas Turbine in Scotland.



Andy Brown presenting the 2014 Shell lecture

More recently Shell has given a £3.8 million donation to the Magnetic Resonance Research Centre at Cambridge and is a Partner in the EPSRC Computational Methods for Materials Science Centre for Doctoral Training.



Shell Future Energy Challenge poster competition prize winner Michael Price together with Andy Brown, Shell

Andy Brown emphasised how innovation in unlocking unconventional gas resources has changed the view on global gas resource availability which has already transformed the US economy, which contrasts with a lack of progress in Europe, where energy policy yields neither substantial CO₂ reductions nor affordable electricity.

There is a long-standing relationship between Shell and the University of Cambridge stretching back to 1945 when the University received an endowment from Shell to establish the new Department of Chemical Engineering and Shell Chair in Chemical Engineering.

CEB Graduate Researchers' Society Business

The CEB Graduate Researchers' Society (GRSoc) has now been in action for 1 term - the inaugural committee has been working closely with the Postdoc Society to start and run the 'Meet the People' events. Running every fortnight, with 2 or 3 internal speakers from the PhD and postdoc community, these events have become a great way of learning a little more about what's going on around the department, as well allowing researchers to work on their presentation skills and gain feedback. These events will be continuing in the New Year (now running on a Thursday), and all department members are welcome to attend (and enjoy the refreshments!).

Next to these wonderful events organised by GRSoc, they are providing grads with information necessary to get familiar with CEB and Cambridge on www.ceb.cam.ac.uk/about/graduates/faqs

Still some questions left? No worries, you can always e-mail them grsoc@ceb.cam.ac.uk. If you want to be up to date about CEB Graduate Researchers' Society events and other talks interesting for CEB grads, go to their Facebook page www.facebook.com/groups/GRSoc/



Members of the CEB Graduate Researchers' Society (GRSoc)

CEB Focus now recruiting

Join the CEB Focus Editorial Team!



- Do you enjoy researching and reporting information?
- A social person with an inquisitive mind/eye for detail?
- Perhaps enjoy reading and/or writing about chemical engineering and science matters?

If yes to any of the above, we can give you the opportunity to become a member of this dynamic project team, meet like-minded people and have a say in department matters, publication content to be featured, content design and display. No previous experience is necessary.

For more information about this engaging and fun newsletter project and view and download previous issues from www.ceb.cam.ac.uk/news/ceb-focus and/or contact Elena Gonzalez, Chief Editor and PA to HoD Professor Nigel Slater on eg314@cam.ac.uk Alternatively contact The Editorial Team on ceb-focus@ceb.cam.ac.uk

CEB Focus Team Aims

Team members work closely together and liaise with an external designer to produce each publication issue as per the editorial schedule. The Newsletter aims to disseminate timely department information of interest to our audience (external and internal) in a professional manner as per the *CEB Focus* editorial guidelines. This will in turn help raise CEB's visibility and profile nationally and internationally and engage with our global audience.

CEB's Research Output Quality and Impact confirmed



The Department of Chemical Engineering and Biotechnology has yet another reason to celebrate the arrival of 2015 with the successful outcome of the 2014 Research Excellence Framework (REF).

REF, which judges the quality and impact of research in UK universities published the latest round of results on 17 December 2014. These confirmed our improved performance as we were ranked top of the 25 entrants in our Unit of Assessment (UoA Aeronautical, Manufacturing and Chemical Engineering) with 92% of our submission rated as 'world leading' or 'internationally excellent', demonstrating CEB's strength in research.

The REF assesses the quality and impact of research submitted by UK universities across all disciplines. The results will be used by the four UK higher education funding bodies to allocate block-grant research funding to universities from 2015-16. It was previously known as the Research Assessment Exercise (RAE), and was last conducted in 2008.

Professor Slater, CEB's Head of Department, said; *'I am delighted that CEB was ranked top (by GPA) of the 25 entrants in our UoA (Aeronautical, Manufacturing and Chemical Engineering) in REF 2014 – indeed, one of only four top ranks in the University. Furthermore, we increased the percentage of 4* staff (quality that is world-leading in terms of originality, significance and rigour) from 30% in 2008 to 47% in 2014. This is an astounding achievement and it was made possible by the enormous and sustained efforts of every single academic through the vast range of outstanding contributions that they all made to the way in which Chemical Engineering and Biotechnology functions. They all have every right to be immensely proud and I am deeply grateful to them all.'*

A very special thanks to Lisa Hall (CEB's Head of Research) and her team on the REF Committee, who all worked tirelessly to compile our REF submission. The number of different re-writes were countless, right up to the final submission. The immense attention to detail with the choice of every single publication that we submitted was inestimable and the battle to craft four good impact case studies was awesome. Their efforts were monumental and we are all very deeply indebted to them.'

He then added; *'Despite the success, 2015 will be time to continue the hard work for the next REF but we will all soon be coming together in our new building West Cambridge and we can then begin to reap the benefits of enhanced synergy that lies at the core of this enormous project. For that reason I am firmly of the belief that the best is yet to come.'*

On a University-wide level, the latest Research Excellence Framework figures released confirm Cambridge's global strength and depth in research. Almost nine out of ten (87%) University of Cambridge submissions for the UK's Research Excellence Framework (REF) have been rated as 'world leading' or 'internationally excellent', demonstrating the UoC's strength in research.

Professor Sir Leszek Borysiewicz, UoC's Vice-Chancellor commented; *"These results demonstrate Cambridge's strength in depth across research, in particular confirming our global leadership in the pure and applied sciences, clinical medicine, and in subjects as diverse as the Classics and business and management studies."*

See more at

www.cam.ac.uk/research/news/research-excellence-framework-confirms-cambridges-global-strength-and-depth-in-research and the full REF results on www.ref.ac.uk

Salters Prize goes to ChemEng Grads



Paul (far right) with Andre (middle) with other Salters Prize Winners

Chemical Engineering graduate Paul Hodgson has been awarded one of this year's Graduate prizes from The Salters' Institute of Industrial Chemistry. Congratulations to Paul, who was crowned a winner of Salter Chemistry Prize at the awards ceremony in London back on 20 November 2014.

Each year, the Salters' Institute invites every UK department of Chemistry or Chemical Engineering to nominate one final year undergraduate. The selectors do look for candidates who will ultimately be able to occupy

leading positions in the UK Chemical Industry. Today the Institute aims to promote the appreciation of Chemistry and related sciences among the young and to encourage careers in the teaching of Chemistry and in the UK chemical and allied industries.

Paul successfully completed Part IIB of his Chemical Engineering course in CEB last year graduating with an MEng. Mr Hodgson is currently a PhD student in the Department working on second generation biofuels with the Combustion research group led by Prof John Dennis.

Incidentally, one of our new PhD starters, Andrew McGuire, was also awarded a Salters' Graduate Prize at the very same ceremony. He did his Undergraduate at the University of Strathclyde and now works with Professor Markus Kraft in the Computational Modelling (COMO) group.

Paul commented; *'it was a tremendous honour to receive a Salters' Graduate Prize for Chemical Engineering, along with, Andrew McGuire, who has moved from Strathclyde University to study for his PhD in this Department. With much of the focus of the awards being on the candidates' future career, I feel it is a credit to the Department that the judges clearly valued the contribution that Post-Graduate study and academic research makes to the chemical industry.'*

For more information visit www.saltersinstitute.co.uk/prizes/graduate-prizes/

Undergraduate Course Scores 100%



Chemical Engineering graduation day

The National Student Survey (NSS) is conducted each year on all final-year undergraduates in the country. The most important question, widely used in the compilation of national league tables, is how satisfied students are with each course. In the 2014 results, 100% of the Cambridge Chemical Engineering undergraduates who responded agreed with the statement "overall, I am satisfied with the course".

This is the first time we have achieved 100%. Dr Barrie comments; *'The undergraduate course is large with over 600 lectures accompanied by extensive project work, laboratory work and College supervisions. This is a nice recognition of the efforts made by a large number of people (academic staff, support staff, demonstrators and supervisors) who have contributed to our undergraduate teaching.'*

The survey contains 44 questions in total – 23 which are identical for all Universities in the country and 21 which are specific to the University of Cambridge. The results show that the Chemical Engineering course does better than the Cambridge average in many areas, notably on questions relating to academic support, on organisation and management, and on responding to feedback from students. A relative weakness identified is the promptness and helpfulness of feedback on work. The result will help maintain Cambridge's position at the top of the national league tables for Chemical Engineering courses.

Annual CEB Research Showcase



Dr Geoff Moggridge presenting "An Improved Prosthetic Heart Valve"

The Department's Research Open Day was held on Wednesday 14 January 2015 at Fitzwilliam College. The event brought together the Department's research groups through a series of talks and research project poster presentations covering a wide spectrum of on-going research activities. Young scientists from Reaction Engineering, Microstructure Engineering and Biotechnology discussed their most stimulating research and showcased the broad range of research activities carried out across the three departmental sites. It was also an opportunity for group leaders, postdoctoral researchers and PhD students to share ideas, forge new and innovative links with industry, and to explore opportunities for cross-disciplinary collaboration.

'The event has proved successful and I hope we continue to do this in the future' – Dr Claire Michel, Post-doc Committee Chair

Speaker Highlights:

Dr Axel Zeitler

Terahertz spectroscopy and imaging for chemical engineering applications

Terahertz radiation has unique properties in that it easily penetrates through most polymeric materials and is therefore an exciting new tool to study such materials, which are often opaque at visible frequencies. As well as being a non-destructive probe of materials, in organic molecular crystals terahertz radiation interacts with

vibrational modes that extend across large domains of a crystal lattice. Even though it is possible to excite molecules using a variety of energies, it is only through the careful selection of the low energy in the terahertz range that it is possible to selectively excite crystal lattice vibrations and study the presence and nature of interactions between molecules.

Dr Gabriele S Kaminski Schierle

In vivo studies of protein aggregation kinetics with multiparametric imaging

Misfolding and aggregation of peptides and proteins is a characteristic of many neurodegenerative disorders, including Parkinson's and Alzheimer's disease. Their common feature is that normally unstructured and soluble proteins misfold and aggregate into insoluble amyloid fibrils, which make up the deposits in the brains of patients suffering from these devastating illnesses. We have recently reported that amyloid proteins that are associated with protein misfolding diseases develop an intrinsic fluorescence in the visible range. This discovery has enabled the process of amyloid formation from disease-relevant polypeptides to be monitored in a label-free manner and with high specificity.

Dr Ian Wilson

Soft solids are hard work

Many conventional as well as newer advanced materials are soft solids. Their behaviour depends chiefly on the timescale of the deformation. The soft solids we are interested in are multiphase materials structured at the microscale, which is required for their product properties. In highly dense suspensions and bubbly liquids this gives rise to a rich variety of rheological behaviours and time dependencies. The complexity of these systems means that modelling must be accompanied by experimentation to determine the dominant physical phenomena.

Dr Polina Yaseneva

Sustainability of flow processes in pharmaceutical industry

The pharmaceutical industry has the highest rate of generated waste per unit of produced drug and consequently produces considerable environmental impacts. Recent external pressures from society, political agenda and tightening regulatory requirements have

forced the pharmaceutical industry to move towards developing more sustainable processes. The EU SYNFLOW project has the aim to develop more sustainable chemical processes based on novel catalytic and process technologies. Within the project we developed a three-step evaluation methodology, starting with material proxy indicator, then gate-to-gate process evaluation and finally a comprehensive LCA.

Dr Geoff D. Moggridge

An Improved Prosthetic Heart Valve

Diseased and dysfunctional native heart valves are routinely replaced by a prosthetic valve. Currently, no clinically acceptable such polymeric valve have been manufactured. The material properties of natural valve leaflets are anisotropic in nature and a stress-strain relationship substantially different to that of isotropic polymeric materials. We are investigating self-assembling polymeric nano-composites, which mimic the anisotropic fibrous structure of natural tissues, as potential prosthetic heart valve materials; combining the durability of mechanical valves and the hemocompatibility and flexibility of natural tissue valves.

Dr Silvia González Calera

Sooting tendency and Soot particles characterisation of liquid hydrocarbons in wick-fed diffusion flames

The complexity of petroleum-based fuels has prompted researchers to search for mixtures of limited number of components that represent the behaviour of real fuels. These surrogate fuels are used to facilitate the development of new combustion technologies and to generate insight and understanding of underlying fundamental processes. Differential mobility spectrometry (a fast particle analyser that measures the particle size distribution real-time) and high resolution electron microscopy were used to characterise soot particles generated at different heights in a laminar wick-fed diffusion flame for a variety of components found in surrogate fuels.

Professor Sabine Bahn

Disease Biomarkers for Schizophrenia- from laboratory to patient bedside

The onset of schizophrenia is the result of complex interactions between genetic, developmental and

environmental factors. We have identified a number of highly significant peptides and proteins in serum that distinguish first-onset paranoid schizophrenia patients from healthy controls. Our findings suggest alterations in glucoregulatory, inflammatory and hormonal processes in drug-naïve patients with first-onset schizophrenia. We also identified disease-relevant metabolic and inflammatory changes in affected and unaffected siblings of schizophrenia patients and have preliminary evidence for the existence of schizophrenia subgroups, based on the expression of serum proteins.

Dr David Fairen-Jimenez

Adsorption Processes in Metal-Organic Frameworks

Self-assembled functional materials have emerged as an extensive class of materials with an extraordinary degree of variability. Metal-organic frameworks are known for their extraordinary porosities, being able to reach apparent surface areas up to 8,000 m²/g. In our research, we combine molecular computational techniques with a range of experimental techniques that include gas adsorption, neutron and X-Ray diffraction and *in vitro* studies for drug delivery applications. A combination of experimental characterisation and simulations allows studying in detail how the structure influences the adsorption performance and therefore forms an essential part in the identification and design of promising materials.

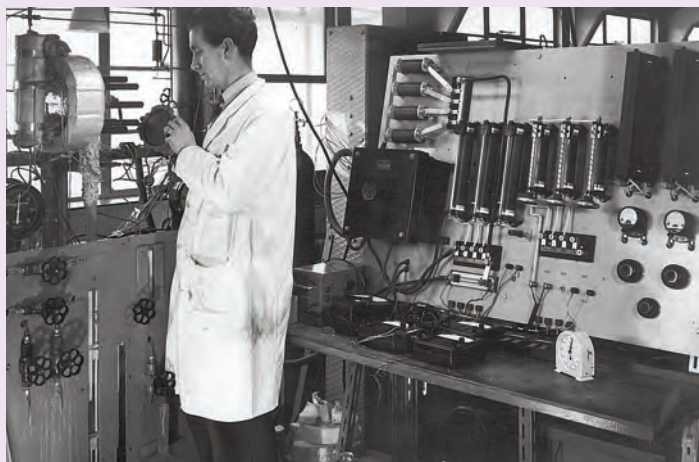
'I know the organisers have put in a lot of effort in organising the research day and I think this is a fantastic opportunity' - Dr Gabriele S Kaminski Schierle



Dr Josh Etkind from Shell, Claudia Orellana, and Dr David Fairen at the poster session over lunch

A Trip to the Moon: From the Bacon Fuel Cell to the Apollo Mission

Professor John Davidson, Former Chemical Engineering Head of Department Emeritus



Bacon with the technology in the lab that took man to the Moon

In the early years of Chemical Engineering in Cambridge, 1948–1959, the Department was host to a remarkable inventor, Mr Tom Bacon. Tom developed the hydrogen-oxygen fuel cell, which was crucial to the Apollo Project to send people to the Moon.

Bacon's fuel cell used pure hydrogen and oxygen to generate electricity by reverse electrolysis. The electricity was used for electronics and control motors on the spacecraft; the water, formed by the reverse electrolysis, was drunk by the astronauts. The spacecraft carried large supplies of pure hydrogen and oxygen for the rockets. Thus the hydrogen-oxygen fuel cell fitted perfectly with the logistic needs of the spacecraft.

Tom Bacon was an unlikely candidate to promote the fuel cell, a complex and challenging piece of equipment. Tom was a direct descendant of Sir Nicholas Bacon, Lord Keeper of the Great Seal in the time of Queen Elizabeth I. He was a man of private means, who could have spent his life as a gentleman of leisure. But he perhaps recognised that 'happiness is activity': after graduating from Trinity, he became an apprentice engineer with the Newcastle firm of C A Parsons & Co Limited. This must have been a rough experience e.g. shovelling sand in the foundry. Sir Charles Parsons, the founder of the firm, invented the multi-stage steam turbine, which revolutionised ship propulsion and the large-scale generation of electricity. Bacon was subsequently employed as an engineer by C A Parsons and tried to get the company interested in his fuel cell. But, perhaps because of the depression, very severe in Newcastle in the 1930's, the company was not interested in fuel cells, so Bacon left.

Bacon then had support from a variety of sources and worked in a variety of places: Dr Merz, a consulting engineer in Newcastle, provided funding. Working space was at King's College London. The work was interrupted by the War: Bacon worked for the Admiralty on underwater submarine detection. After the War, Bacon was funded by the Electrical Research Association and worked in the Cambridge Department of Colloid Science, a Department subsequently suppressed by the University, one of its worst decisions. At that time, Professor Rideal, Head of the Colloid Science Department, suggested what proved to be a crucial feature of the Bacon Fuel Cell, the biporous electrode. The problem was to get stable interfaces between the gases, hydrogen or oxygen, and the electrolyte which was strong caustic alkali. Each electrode was about 4 mm thick with 30 micron pores on the gas side and finer pores on the electrolyte side. A small pressure difference, about 0.1 bar between gas and electrolyte, created an interface between gas and electrolyte, without the need for a diaphragm.

Bacon then moved to the Department of Metallurgy (no Materials Science then) and developed a fuel cell with biporous nickel electrodes. The electrolyte was strong potassium hydroxide solution at 200°C and 40 bar pressure, giving safety problems. In later years, Pratt and Whitney engineers, who developed Bacon's cell, claimed that if a screwdriver was dropped into Bacon's electrolyte, it would dissolve before hitting the bottom of the container!

In the early 1950's Bacon got funding from the Admiralty and the Ministry of Power. A motivation was energy storage. The idea was to electrolyse water during the night, when the demand for electricity is low; the pure hydrogen and oxygen thus generated would be used in fuel cells during the day for peak loading demand. The idea is still with us: it may provide energy storage when more of our energy is from renewables, e.g. windmills and

solar panels, which need energy storage to give a continuous supply of electricity.

In the early 1950's, Bacon moved his research into the newly established Shell Department of Chemical Engineering, housed in temporary buildings in Tennis Court Road. It was remarkable that the first Shell Professor, Terence Fox, accepted Bacon. Fox was, rightly, very conscious of safety. He had worked at ICI Billingham, in the early days of the ammonia synthesis process. He said it was wise to walk quickly past a stop valve; the spindle might become a projectile because of the 200 bar gas within.

Bacon assembled, in the Department of Chemical Engineering, a team of electrochemists, metallurgists and technicians; the latter were crucial, as always. In the 1950's he developed, in our Department, a reliable six cell fuel battery using five inch diameter electrodes at 200°C, 30 bar giving 150 W, having solved problems of electrode corrosion.

The next step was to build a bigger unit. He obtained Government funding and was fortunate in getting space and facilities from Sir Arthur Marshall at Cambridge Airport, which has big engineering workshops, used for example to supply flight refuelling equipment for the Falklands War. A 6 kW forty-cell battery was demonstrated in 1959. The big breakthrough was when Bacon's fuel cell was taken up for the Apollo moon-shot. There were competing fuel cells: Bacon's was chosen because it had higher efficiency (75% thermal) than its competitors. Development work was done by Pratt and Whitney, the great American aircraft engine builders (Their motto was: 'Dependable engines'). The resources were massive - Pratt and Whitney employed 1000 engineers on the fuel cell project and the final cost was around \$100 million (several hundred million at today's prices). The power plant rating was 563 – 1420 W between 27 and 31 volts, 2300 W at reduced voltage. The electrolyte, potassium hydroxide solution, was solid at ambient temperatures: it had to be heated before take-off of the space craft.

Bacon's fuel cell was a tremendous achievement, the result of a lifetime's hard work, persistence and ingenuity. But Bacon was the most modest of men. The epitome of an English gentleman, he was always polite, never flustered or cross. Always smartly dressed, with an old Etonian tie, he worked long hours in the laboratory except in July, on Founders' Day when he was at Eton.

His single-mindedness was evident: on being introduced to a scientist or engineer, he would enquire about their work: if it had any bearing on the fuel cell, he was deeply interested: if not, he switched off. As inventors must be, Bacon was a perpetual optimist; *'We've just overcome a problem which has been holding up the work for years'*. Of course he took a keen interest in the Apollo launches to the moon. I met Bacon soon after one of these launches failed and the astronauts had to be riskily retrieved from the spacecraft. Bacon was emphatic *'It wasn't the fuel cell'* he declared.

It is a pity that Bacon's fuel cell never found other practical applications. The technology has progressed: fuel cells may be widely used in the future for electric cars or energy storage. But I hope it will be remembered that Bacon's was the first cell that really worked, and that key developments were in this Department. During the Apollo 8 mission of 1968, Bacon is reported to have told a BBC reporter how excited he was to see "a real genuine use for a fuel cell" (*'Apollo's fuel-cell power legacy'* by Richard Hollingham, BBC News 16 July 2009).

The success of the Apollo mission is history and on a subsequent visit made by Bacon to the United States, President Richard Nixon put his arm around Tom's shoulders and said, 'Tom, without you, we wouldn't have gotten to the moon'.

References: *Biographical Memoirs of the Royal Society*, 1993



In 2006 the Department donated one of the fuel cell electrodes (see inset) to the Whipple Museum of the History of Science

Hydrogen from Sunlight

Ning Xiao, PhD Candidate

2007-2011 BA and MEng in Chemical Engineering, Cambridge
and research visitor in CoMo Group in CEB Cambridge
2012 up to now, PhD in Chemical Engineering, Cambridge
2013 Vice president in Energy Sector, 'Innovation Forum'



Rhodospseudomonas palustris grown on glycerol to produce hydrogen gas

Research student Ning tells CEB Editorial Team about her latest piece of research innovation put together with the help of Dr Krishnaa Mahbubani and CEB HoD Professor Nigel Slater (BioScience Engineering Group) using a photosynthetic bacterium as a biocatalyst for hydrogen production.

• **What made you embark on your current course of research study?** Since I was little I've always wanted to be a world class engineer and solve global problems. A few years ago, I came into CEB Cambridge as an

undergraduate. Now, I am a PhD student still working in the department and getting closer to achieving my dream.

• **Are green energy solutions important nowadays?** The depletion of liquid fossil fuels, growing concerns related to greenhouse gas (GHG) emissions, and increasing demand for transport fuels require rapid development and implementation of large scale sustainable biofuels. There is still a long way to go but I'd like to join other researchers around the world to try to address this problem and maybe offer some possible solutions in the future.

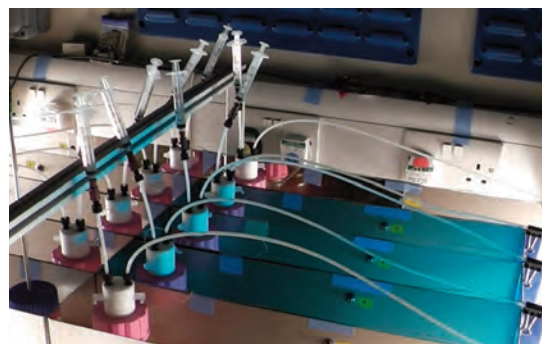
• **What are the highlights of your innovative research project on bacteria for hydrogen production?** Nature is the smartest engineer, and it offers great solutions to problems in the world. Currently I am cultivating a bacterium, *Rhodospseudomonas palustris*, widely present in the natural environment, to produce hydrogen from industrial waste. *R. palustris* is a nitrogen fixing bacterium. It is capable of converting molecular nitrogen (N_2) into ammonia (NH_3) and generating hydrogen as a side product from electron donors such as organic waste in the industry. As hydrogen is a clean fuel with zero carbon emission, and has a high specific energy, with its lower calorific value being 122 kJ/g; this project therefore has great potential to solve the energy problem.

• **How can your project help deliver viable product solutions in an environmentally-challenged world?**

The overall goal of this project is to assess the process feasibility and process potential for using *R. palustris* to utilise glycerol (waste product from biodiesel industry), and other potential waste streams, to produce hydrogen as well as other useful chemicals. Based on current research findings, concentrated bacterium can be used as a biocatalyst for continuous hydrogen production, and the bio-hydrogen production will be economically feasible in scale-up commercial applications. Hydrogen is easily converted to electricity with fuel cells, and only yields water as the final product on combustion. In the future, we might have a hydrogen car with hydrogen fuel generated by this bacterium on request.

For more information on the hydrogen production process see video on www.ceb.cam.ac.uk/news/news-list/hydrogen-from-sunlight

Research student Ning Xiao presented her work at the 16th International Biotechnology Symposium and Exhibition (Biotechnology for the Development of a Green Economy session) that took place in Brazil 15-19 September 2014.



Overview



CEB's Knowledge Transfer Facilitator Graham Dransfield

I have been in post CEB since February 2014. Previously I had an industrial career with companies such as ICI, Lucas and Tioxide. The post has been made possible by Impact Acceleration Award (IAA) Funding from the EPSRC. My main responsibility is to increase engagement with industry for the Department.

So far, variety has proven to be

the spice of life. Some personal highlights include arranging a broadcast on BBC Radio Cambridgeshire (see article in last issue 'CEB Academics go on Air'), organising a workshop with UNICEF and Oxfam on emergency water supplies and the preparation of flyers for our recent CEB Research Open Day that took place on 14 January 2015.

Company Highlights

Conversations have started with over 25 companies. The following is a very interesting example of a small company, which is trying to make the world a better place: SulNOx Fuel Fusions Plc.

SulNOx could have a very significant role to play in reducing global pollution and dangerous NOx emissions. The company, founded in March 2013, has new technology that allows the production of emulsions of all hydrocarbon fuels and up to 20% water, which have very long term stability and are very cheap to produce. This has remarkably led to over 90% reduction

in environmentally dangerous soot particulate matter and over 60% reduction in NOx, for an AEC 1959 Routemaster bus, when trialled at the National Bus Museum. SulNOx are now targeting the maritime diesel market, where one supertanker can produce the same pollution as 7 million cars. They are seeking CEB's help in understanding the full science and benefits of their products and in improving them further. For further details, including a brief TV appearance for Chris Lowe and myself, please go to www.sulnox.net/2014/09/watch-bbc-south-today-report-on-sulnox-demonstration-at-london-bus-museum/

New Spin-out Company - Cambridge Simulation Solutions Ltd



Dr Vassiliadis's Process Systems Engineering

Spin-out companies are set to be the future life blood of the Department. Cambridge Simulations Ltd, launched on 26 November 2014, is the latest example.

Cambridge Simulation has been formed to exploit technology developed by Dr Vassilios Vassiliadis, a

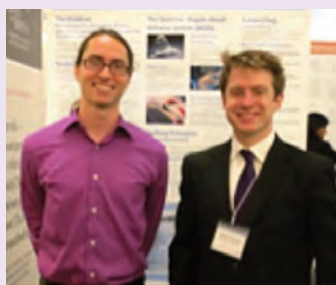
Senior Lecturer at the Department. Vassilios has developed a method to simulate and control complex chemical processes. The potential is huge, with a wide range applications including Chemical Engineering, Biotechnology, Biomedical, Pharmaceuticals, Aerospace and Microelectronics.

Frontier IP, a company specialising in the commercialisation of university IP, will support the licensing and commercialisation of this technology, in return for a stake in the company.



Past and Future Events

UNICEF/Oxfam Engagement Workshop, 9 September 2014 at Hauser Forum



Dr Stephen Gerrard from CEB's Bioscience Engineering group presenting his JustMilk project at the UNICEF Forum

The UNICEF challenge was to create an effective household level water treatment product that could be used in emergency settings, that was affordable, durable, fail-safe and easy to use – a difficult challenge that has yet to be met in the field.

The day proved to be lively and stimulating, generating numerous ideas. Four of these ideas are now being actively considered for further research. These are a microfluidics device, a solar thermal device, a biofilm filtration device and a flexible adaptation of Oxfam's currently used container. Follow-up discussions continue with UNICEF. More to report in the next issue.

Stevenage Bioscience Catalyst 21 January 2015



Stevenage Bioscience Catalyst campus is a unique bioscience community, which provides a nurturing

environment for small biotech and life sciences companies and start-ups, where they have access to expertise, networks and scientific facilities, traditionally associated with multi-national pharmaceutical companies. Many of the companies already have strong links with Cambridge. The workshop will try to tackle some of the most difficult challenges facing the Catalyst companies, with the goal of increasing mutual understanding and identifying future areas of collaboration. Themes to be discussed will include funding, scale-up and targeted drug delivery.

Catalysis@Cambridge Showcase Event 14 April 2015



Watch out also for this event, jointly organised by CEB (Professor Alexei Lapkin,

Sustainable Reaction Engineering) with Chemistry and Materials Departments, with help from Syngenta. The event will include talks by researchers from all three departments and a round table discussion. It will take place at Wolfson College and promises to be a most fruitful exercise in open innovation.

Impact

IAA Follow on Funds

The Department has been the beneficiary of three short project awards from the IAA Fund. There is one Follow on Fund (FOF) project entitled 'Identification of novel targets for neuropsychiatric disorders', involving Professor Sabine Bahn and PhD student Santiago Lago from CEB's Cambridge Centre for Neuropsychiatric Research. There is a Partnership Development Award (PDA) project entitled 'Monolithic MOFs for Gas Adsorption and Sensing' involving David Fairen Jimenez and Tian Tian, with support from Johnson Matthey.

Congratulations now go to Dr Geoff Moggridge for beating off strong competition to gain an FOF award for 'A polymeric Transcatheter Heart Valve (THV)', to be carried out by Dr Joanna Stasiak and Marta Serrani.

Teaching Consortium News



GlaxoSmithKline GSK have decided to re-join the CEB Teaching Consortium. Many thanks

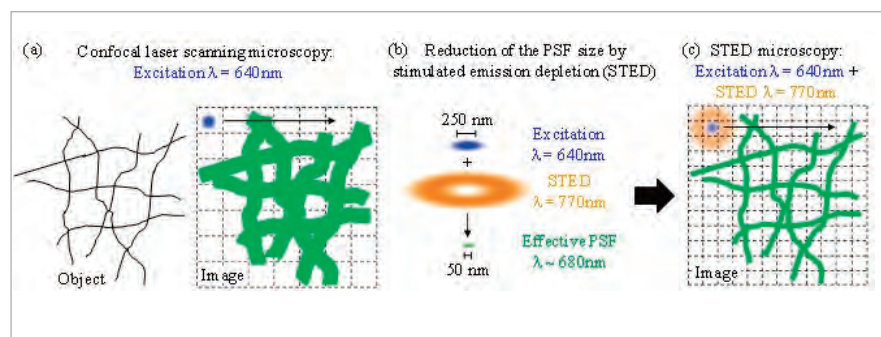
to alumna Lorraine Reddington (2000-2006) for her efforts in making this happen.

Publicity/Marketing

'Thanks to all the CEB academics, who have contributed flyers, describing their research activities. The flyers are undergoing final editing will prove invaluable for the promotion of the department on the CEB website, for industrial visits, workshops and the Research Day that took place on 14 January 2015' - Dr Graham Dransfield

Optical Microscopy Nobel Prize

The 2014 Nobel Prize in Chemistry was awarded jointly to Eric Betzig, Stefan W. Hell and William E. Moerner for their development of the super-resolved fluorescence microscopy. The super resolution technique or nanoscopy is a key enabler for research conducted by the Laser Analytics Group of CEB and they were the first to apply this technique to visualise protein dynamics. Professor Clemens Kaminski has pioneered the use of single molecule localisation microscopy in the study of protein aggregation reactions that cause neurodegeneration, which was presented in the Journal JACS in 2011.



Principles of Stimulated Emission Depletion (STED) Microscopy
(from: <http://laser.ceb.cam.ac.uk/news/in-the-spotlight-super-resolution-microscopy>)

Super-resolved fluorescence microscopy are techniques with a resolution far beyond Abbe's limit. Two far-field principles that lead to fluorescence-based microscopy are "super-resolved ensemble fluorophore microscopy", such as stimulated emission depletion (STED), and "super-resolved single fluorophore microscopy".

These techniques are described in the scientific background on the Nobel Prize in Chemistry 2014 www.nobelprize.org/nobel_prizes/chemistry/laureates/2014/advanced-chemistryprize2014.pdf

The work that the laser lab performs using high resolution methods is motivated by challenging demands from biological research where processes occur over a huge range of temporal and spatial scales. For more information about super-resolution microscopy and how this is being applied to the study of the molecular mechanism of disease please see www.laser.ceb.cam.ac.uk/news/in-the-spotlight-super-resolution-microscopy

BioBeat: Movers and Shakers in Bio-Business

As the global biobusiness sector undergoes rapid transformation, there are growing opportunities to tap into female talent and bring more success for men and women working together. This project follows on from the 2013 conference, Beating the Odds: growing biobusiness today. Bio entrepreneurs, graduates and members of multinationals gathered at Clare College, University of Cambridge to hear from women at the top of the industry about responding to global healthcare challenges, building companies in new markets, the essentials of funding and creating effective teams and boards.

BioBeat published a report called "50 Movers and Shakers in BioBusiness 2014" that identifies inspirational women in biobusiness in the UK. One of these 50 women is CEB Professor Sabine Bahn.

The report was reviewed by Dr Andy Richards, serial Biotechnology Entrepreneur and Business Angel, Dr Richard Seabrook, The Wellcome Trust, and Professor Heather Wallace, University of Aberdeen.



Professor Sabine Bahn, leading the Cambridge Centre for Neuropsychiatric Research

Young Researcher Wins Engineering Impact Award

Rebekah Scheuerle was awarded the 2014 National Instruments (NI) Engineering Impact Award (Biomedical category). She and her colleagues have used LabVIEW and NI DAQ hardware to verify devices that prevent HIV transmission between mother and child during breastfeeding.

Rebekah says *“Winning the Biomedical NI Engineering Impact was quite an honour. The award recognises the technical work done here in the department with support from National Instruments of developing systems for validating a novel device for delivering life-saving medicines and nutrients to infants.*



Francis Griffiths, Senior Vice President Regional Sales & Marketing for NI, Rebekah Scheuerle, Stephen Gerrard, Eric Starkloff, Executive Vice President Global Sales and Marketing for NI



The Nipple Shield Delivery System

Our device, the Nipple Shield Delivery System, when worn by a mother during breastfeeding, releases medications directly into milk consumed by an infant. This device could be disposable, and contain therapeutics that do not require refrigeration, making it a hygienic method of infant drug delivery that could be especially useful in resource-limited settings (see justmilk.org).

This award highlights the efforts of many people and organisations who have worked on this project including JustMilk, a non-profit organisation supporting the project; the University College London School of Pharmacy, which supports formulation development of potential medications to deliver with the device; and the University of Venda, which supports end-user acceptability studies in Limpopo, South Africa.

We are especially grateful for the generous support of the Saving Lives at Birth partners: the United States Agency for International Development (USAID), the Government of Norway, the Bill & Melinda Gates Foundation, Grand Challenges Canada, and the UK Government. In addition we are thankful for support from the Gates Cambridge Trust. Many thanks also goes to my many colleagues who have contributed in the past few years including Rob Courtney, Furgus Kulasinghe, Neil D'Souza-Mathew, Arron Rodrigues, Nigel Slater, Stephen Gerrard, Wei Yao Ma, Chris Rutt and John Gannon.”

Dr Cai awarded Masao Horiba Award



Dr Cai accepts award from Dr Massao Horiba, founder of Horiba Ltd

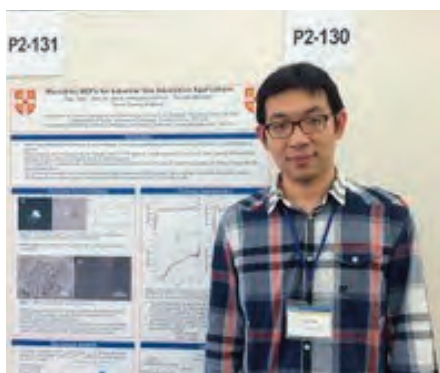
The Masao Horiba Award is a prestigious prize for young scientists in analytical science. This award is intended to support researchers and aims to strengthen the position of analytical and measurement technology within scientific and industrial world.

Dr Weiwei Cai was awarded the 2014 Masao Horiba Award for his pioneering work in the theory of “*nonlinear tomography*” and also his overall excellent track record of scientific innovation.

Dr Cai’s research concerns combining “*nonlinear tomography*” with the latest laser gas measuring techniques to enable the simultaneous spatial distribution analysis of the multiple parameters including the temperature, pressure, and concentration of several gas components. An example of tomography application is CT scans used in hospitals to obtain internal information of the patient. Refining this technique will also bring great benefit to the combustion industry such as automotive industry.

Dr Cai is a Post-Doctoral By-Fellow of Churchill College and works at the CEB Laser Analytics Group.

PhD Student wins Poster Award



Tian Tian

Tian Tian, a second year PhD student from the Adsorption & Advanced Materials and the BioScience Engineering groups, has won the Micromeritics poster award at the fourth International Conference on Metal-Organic Framework and Open Framework Compounds (MOF2014; www.kitagawa.icems.kyoto-u.ac.jp/MOF2014/). MOF is an international conference held twice a year in different locations across the world. The conference aims to address all questions concerning metal-organic frameworks, metal coordination compounds and covers all aspects of MOFs. Their cover ranges from synthesis and characterization of new materials to all manner of potential applications. The September 2014 conference in Kobe, Japan covered all of the related areas of MOF chemistry and other developing porous materials, benefitting not only

specialists in the field but also scientists in other areas, stimulating an exchange of new ideas and leading participating students toward future breakthroughs.

Tian's poster, titled "*Monolithic MOFs for industrial gas adsorption applications*", focuses on the synthesis of mechanically robust monolithic MOFs without using binding agents or high pressure while increasing the volumetric capacity of the original powder material by a 3 times factor. This approach, carried out under the supervision of Dr David Fairen-Jimenez, was recently filed for patenting and is a very promising alternative for gas adsorption technologies and industrial applications such as carbon capture and hydrogen storage.

Whitaker Fellow wins outstanding Research Award



Amanda Chen

Amanda Chen, a Whitaker International Fellow, has been awarded the Student Award for Outstanding Research 2015 (Undergraduate Category) from the Society of Biomaterials (SFB) for work done at her undergraduate institution, the University of Rochester. The Whitaker International Program allows U.S. biomedical engineering (or bioengineering) students to go overseas to undertake a self-designed project. Amanda says "*I was very surprised when I received the award and am eternally grateful to Danielle for always believing in me and pushing me to be my best.*" Currently, Amanda is an MPhil research student from the BioScience Engineering group.

Established in 1974, SFB is a multidisciplinary society of academic, healthcare, governmental and business professionals dedicated to promoting advancements in all aspects of biomaterial science, education and professional standards to enhance human health and quality of life. The Student Award for Outstanding Research from SFB is a prestigious award specifically given to student researchers who have shown outstanding achievement in biomaterials research. This 2014 award will be given during the SFB's annual meeting in Charlotte, North Carolina in April 2015.

Their award programme seeks to recognise significant contributions to the field of biomaterials science from industry, academia, regulatory agencies, and students.

Her award-winning manuscript called "*Disruption of Cell-Cell Contact-mediated Notch Signalling via Hydrogen Encapsulation Reduces Mesenchymal Stem Cell Chondrogenic Potential*" is to be published in the Journal of Biomedical Materials Research. Moreover, her research will be presented at the SFB's annual meeting during the presentation session called "Stem Cell and Biomaterial Interaction" and in a poster at the exhibition hall.



Biotech graduate and
Executive Coach and Trainer

Biotech, Business and Beyond

Dr Jan Onno Reiners PhD MPhil Dipl. Phys

Interviewer: *Ok. Would you like to give us a quick overview of your career so far?* **Jan:** I was born and raised in Northern Germany, studied physics for five years in Kiel, and then moved to Cambridge for four years doing research for an MPhil and a PhD in biotechnology. Next were 6.5 years of strategic management consulting work with The Boston Consulting Group, based in Hamburg. Then, about ten years ago, I became self-employed as an executive coach and trainer. I now live in and work from Berlin.

Interviewer: *What is it you do exactly as a coach?* **Jan:** As an executive coach, I get hired by high-level executives to either address a particular leadership issue they're struggling with, or they are looking for someone to provide leadership supervision.

Interviewer: *As in PhD supervision?* **Jan:** Well, maybe not quite like that. As a top executive, the number of people you can trust within your own company is rather limited. So is the number of people who dare to criticise your actions. Thus, you hire an external professional to discuss these kind of issues in a safe and protected environment.

Interviewer: *Is that all you do right now?* **Jan:** I also do team and organisational development work. And I teach leadership at a local university and at the Hertie School of Governance, Berlin.

Interviewer: *In Cambridge, you worked in Lisa Hall's¹ group, right?* **Jan:** Yes, in her biosensors group. I researched the potential of combining a biological detection system, like an enzyme, with a chemoluminescent transducer system.

Interviewer: *Why didn't you stay in science?* **Jan:** At the beginning of my final PhD year, I saw four potential career paths ahead of me: 1) Staying in academia, 2) taking the results of my PhD and turning them into a spin-off, 3) join the science-related industry, or 4) doing something entirely different.

Interviewer: *You went for option 4. Why not option 1, 2 or 3?* **Jan:** Regarding option 2, I felt the results of my PhD weren't stunning enough to be market relevant. For option 1, you need to be totally committed to climbing the steep path further up the ivory tower, which I wasn't. I contemplated option 3, however, I decided to try option 4 first. Which for me was management consulting.

Interviewer: *Was getting into management consulting difficult?* **Jan:** "Getting into consulting" is a two-step process: First, you have to get hired. Then, you have to hit the ground running.

Interviewer: *Which one was the most difficult step?* **Jan:** The second one. Getting through the recruitment process is hard, however, you can rehearse that bit fairly well. Add in some luck - and I got hired.

Interviewer: *Hitting the ground of management consulting running ...* **Jan:** ... was a steep learning curve indeed. You suddenly find yourself in unfamiliar surroundings - and you are expected to quickly deliver substantial insights. Otherwise, you will become an ex-consultant pretty quickly. However, on top of some intense initial training, I did benefit from my Cambridge experience and learnings: To work hard and to keep trying. To ask questions. Not to settle for the easy and most obvious answers. And to enjoy working with and learn from some of the best people in their respective fields.

Interviewer: *Anything else?* **Jan:** In Cambridge I sang with the Choir of Trinity College. Apart from the fantastic music, I did learn a great deal about working in teams. Another must-have in consulting. Also, some of my favourite words of wisdom stem from Lisa such as 'If it had been easy, someone else would have already done it.' Or 'You don't ask - you don't get.' Not to forget: 'Horses for courses.' They may sound simple, but you'd be surprised how often they proved very, very helpful. Thanks, Lisa!

¹Professor Lisa Hall, his former PhD Supervisor

Professor Fox's Slide Ruler Returns Home

A cylindrical slide ruler¹ owned by Professor Fox, the first Head of the Department of Chemical Engineering at Cambridge, has been passed from Professor Jim Wilkes, Emeritus Professor at the University of Michigan, on to Dr Patrick Barrie within the CEB Department.

During a recent visit, Professor Wilkes gave an informal seminar to the Department recounting his personal memories of the time he spent here. He commented; *'I was a student (1953-1955) and faculty member (1956-1960) in the Cambridge Chemical Engineering Department. Those were wonderful, stimulating days - the Department was young, developing, and friendly. My teachers were Armstrong, Danckwerts, Davidson, Denbigh, Fox, Gray, and Sellers. Margaret Sansom, cheerful and helpful to all, was the head secretary, and she subsequently became a close friend of my wife, Mary Ann, and myself. As a faculty member, I supervised two superb doctoral students - Don Nicklin and Ronnie Nedderman'.*



Professor Wilkes presents Dr Barrie with the slide-ruler belonging to Professor Fox, first Shell Professor and first Chemical Engineering Head of Department

the CEB Department, so after my talk I presented it to Patrick. He's the ideal recipient—Deputy Head of Department (Teaching), recipient of a Pilkington Prize for Excellent Teaching, and World Tiddlywinks Champion. I have been welcomed back graciously into the CEB Department, which I hope will continue to thrive'.

The slide ruler is to be displayed in CEB's new building in West Cambridge and then passed on by Dr Barrie to a young member of academic staff in about 25 years' time.

Jim took the opportunity to present Dr Barrie with a valuable gift – a slide ruler owned by Professor Fox. Professor Wilkes said; *'Terence Fox was a shy but exceptionally brilliant person and quickly brought the Department to a pre-eminent position. In 1959, he quite unexpectedly gave me a large, magnificent antique cylindrical slide ruler in a mahogany box, saying, "Wilkes, I would like you to have this." The Department is Fox's prime legacy, but the slide ruler may be his only significant personal possession that we have.'*

This particular cylindrical slide ruler was made in 1901 and is of a design patented by George Fuller in 1878. Normal slide rulers have a length of 12 inches or so which limits the number of divisions and the precision of calculations. By wrapping the logarithmic scale around a cylinder, the Fuller slide ruler has an effective length of 500 inches with 7250 divisions. This means that calculations can be performed to 4, sometimes 5, significant figures.

Professor Wilkes added; *'I was flattered to be invited by Patrick Barrie to give an illustrated talk on my reminiscences of early days in the department. Being of a certain age (OK, I'm 83!), I wanted to ensure that the slide ruler was reunited with*

¹ W.F. Stanley, "Mathematical Drawing and Measuring Instruments", 7th ed., 1900.

CEB Lunchtime Career Talks

Lent Term (CEB, Pembroke St, LT1, 1.00pm)

Thursday 29 January 2015: Dr Rachel Cooke, Manufacturing Development Manager (SABMiller), “A Career in the Food and Drink Industry: Sweet Success and Travelling the World to find the perfect Pint”

Thursday 26 February 2015: Harry Claxton, Technology Development Manager, Johnson Matthey Davy Technologies, “A Career in Design”



The Cambridge Innovation Leaders Conference (ILC)
16-17 April 2015, Cambridge University

The Innovation Forum is a student-led initiative that seeks to build bridges between academia, industry and policy makers. It focuses on the future and the evolution of today's technologies, which range from the nascent stage to the cusp of commercial application.

Professor Nigel Slater, CEB HoD, will be giving the welcome opening talk on 16 April, 9.00am. The ILC 2015 is the Innovation Forum's marquee annual event, bringing together approximately 300 of the UK's leading innovators from across sectors with Cambridge innovators as key speakers.

In its second year, the Innovation Forum is bringing together a renowned group of leaders across pharmaceutical, energy, bio-tech and clean-tech sectors, with the aim of highlighting innovation and entrepreneurship in these high-tech industries. Venture capitalist, angels, student entrepreneurs, young professionals, professors, government officials and industry captains will assemble in order to bridge gaps between academic, government and industry. The ILC is among the largest events of its kind in Europe. To register for the ILC 2015 see www.inno-forum.org/#!registration-2015/c1pu3 and to contact the team email info@inno-forum.org

Visits to the New Building



CEB academics and support staff had two opportunities on 7 November and 5 December to visit the new building to see for themselves their new home as it develops. The outer shell of the building is

now virtually complete and the focus is on fitting out the laboratories and work spaces. The building is a fully operational building site, so all visitors were kitted out in full PPE for the tour of the building led by Dr Tom Matthams from CEB and Charlie Norris, Project Director from Morgan Sindall. Staff were impressed with the scale of the new building and are looking forward to beginning work in their new home in Michaelmas term 2015.

Professor Clemens Kaminski commented; *‘Walking through the building gave me a real sense of what it might be like to have all ongoing activities in the department finally united under one roof. It really looks set to be a spectacular building in which to do research and will help us to confirm our position as one of the top departments world-wide in the discipline.’*

CEB New Appointments

During Michaelmas term, the following changes were confirmed to roles of some existing staff. These changes reflect the move to both a new building and single-site operation, and also the broad teaching and research remit of our Department:



Roz Williams has been appointed to head up the single team of Technicians and Manual staff that will support research and teaching in the Department's laboratories. The team will be made up of staff brought

together from both the Tennis Court Road Technical Team and Pembroke Street Lab Section. The team will continue to provide practical assistance and teaching in undergraduate laboratories, expert safety advice, and technical support and advice to graduate students and staff in their research work.

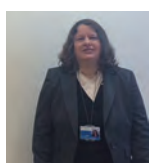
Peter Claxton and Maggie Wallduck (not pictured) have both been appointed to the new roles of Deputy Chief



Teaching/General Laboratory Technician. Whilst continuing with their existing Technician duties supporting CEB's teaching and research, they will deputise for Roz Williams in her absence and also provide her with administrative support and technical advice.



Alistair Finlayson, who currently works for both CEB and Cambridge Stem Cell Institute as Senior Chief Building Services Technician, has been appointed to the position of Facilities Manager in CEB. He will be responsible for management and maintenance of all facilities, fabric, plant and services in the new building and will be supported by Building Services Technician, John Sparrow. Alistair will also oversee the Department Custodian and the Domestic Section.



Debby Singh has been appointed to the post of Senior Technical Officer (Safety Officer). Debby will continue to provide CEB with extensive biological safety knowledge and will also lead the initiative to review the Department's safety culture. Debby, working together with Sharada Crowe, will provide the Department with a broad scope of safety knowledge and expertise.

Many congratulations to all staff on their new appointments.

Fond Farewells - A Goodbye Note from Dr Jim Thompson

I arrived in the Shell Department of Chemical Engineering on 1 September 1976. I was employed as a post-doc by Dr Nigel Kenny to assist him with computer-controlled catalyst characterisation. This was my first regular employment since graduating from Bath University with a PhD in Chemical Engineering.

When I arrived, Dr Kenny had just started a year's sabbatical in the US, the Department has just re-opened after two-weeks' shutdown and, at 9.00 in the morning, it seemed as though the only other person in the Department was Professor John Davidson's secretary, Miss Margaret Sansom. Fortunately, this was not unexpected and I had spent a week in the

Department in July with my predecessor, Dr Chris Pounder, who had left for a post in the computer department at Birmingham, so I knew where to find my office.

My first introduction to morning tea was in The Board Room, Level 1, Shell Building, underneath the photographs of Professors Terence Fox and Peter Danckwerts, names I had encountered in my undergraduate days at Bath. In the room were such people as John Davidson, David Harrison, Denys Armstrong, Ron Nedderman, Robin Turner, Roland Clift, Stephen Richardson and John Perkins.

The Department had one computer in those days, a PDP 11/45. This occupied an office the size of C1 and had a memory capacity of 256 kilobytes and 10 megabytes of disc space. Data input was via two teletypes, a very early Tektronix vector graphics display unit, a card-reader and a punched paper-tape reader, the whole lot probably having less computational power than a digital watch.

Over the years, I have witnessed many changes in the structure of the Department, including the installation of mezzanine levels in various areas, the acquisition of the laboratories in the adjoining building, the construction of the Magnetic Resonance Research Centre (MRRC) and the merger with the Institute of Biotechnology, effectively more than doubling the size of the Department.

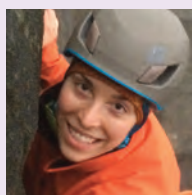
In my time, I have met and worked with many interesting people and I have had a fantastic working life. I wish the Department the best of luck with the forthcoming move to West Cambridge and every success for the future.



Jim Thompson with his wife Liz

We would like to thank Dr Jim Thompson, Dr Alan Tunnacliffe and Dr Dan Holland, for all their hard work and to wish them the best on all their future endeavours.

CEB Gates Scholars



Hilary Fabich

My interest in MRI started as a researcher at Montana State University, where I

completed my undergraduate degree in Chemical Engineering. Since coming to Cambridge I have worked to adapt and develop a technique previously used in medical MRI for rapid imaging of solid-type materials in Chemical Engineering systems. I have recently published these developments in the Journal of Magnetic Resonance and am now using the technique to image the solid phase of a bubbling fluidised bed.

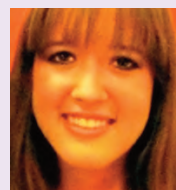
The friendly communities made immediately available to me through CEB and the Gates Trust helped me to make a fluent transition to life in Cambridge. A few days after my arrival, I left for the Gates orientation program in the Lake District. There were around 100 scholars on the trip and such a large social network made me feel comfortable in my new home. In addition, the orientation program in the Lake District gave me high hopes for the outdoors in the UK, which have been realized on frequent hiking and climbing trips to the Lakes, Peak District, Wales and Scotland. From the beginning, my colleagues have found space in their busy schedules to discuss collaborations or just chat about research and life. With their support, my time here has been, both socially and academically, very rewarding.



Ashley Fidler

I studied Chemistry and Biology as an undergraduate at the College of William and Mary,

a liberal arts college and research institution on the eastern coast of the United States. There, I was fortunate to develop relationships with several professors who not only engaged with me in the lecture hall, but also allowed me to experience independent research in their laboratories. Under their guidance, I undertook several research projects that spanned a broad spectrum of subjects from developmental biology to physical chemistry. As I worked to understand the mechanisms regulating stem cell maintenance or to develop a sensor that assesses small molecule-microRNA interactions, I grew to appreciate the power of scientific research to not only reveal new information about our environment, but also to incorporate ideas from disparate disciplines to generate novel solutions for our world's most difficult problems. Now, because of funding from the Gates Cambridge Trust, I have the fantastic opportunity to experience cutting-edge research at the interface of biology and physics as an MPhil by research student in Dr Kaminski's Laser Analytics Group. I am so grateful for the warm welcome accorded me by both CEB and the Gates Scholars community and I look forward to growing as a researcher here over the coming months.



Rebekah Scheuerle

I am pursuing a PhD supervised by Professor Slater in the BioScience Engineering Group,

where I am supporting the development of the Nipple Shield Delivery System, a medical device for dosing breastfeeding infants. I collaborate with a non-profit organisation, JustMilk (www.justmilk.org), to support the device's commercialisation.

I am passionate about using engineering principles to develop medical devices, diagnostics, and medications, particularly aimed at improving public health in resource-limited settings. I have previously contributed to projects in these areas, specifically at the University of California, Berkeley, supporting development of affordable microfluidic HIV-1 diagnostics; at Merck Sharp & Dohme commercialising a paediatric pneumococcal vaccine product; and at Genentech performing protein purification process development. As an undergraduate at the University of Texas at Austin, I researched novel oral drug delivery carriers for anticancer and Crohn's disease therapeutics.

I am very humbled to be a Gates Scholar. I currently serve as President of the Gates Cambridge Scholars' Council, which hosts numerous events year-round. I am grateful to the Trust for not just providing funding and networking opportunities, but more significantly for enabling its community to be the welcoming, motivational, and empowering one that it is.

Emergence of Chemical Engineering Profession



George Davis is regarded as the founding father of the discipline of Chemical Engineering. Davis worked as a chemist at Brearley and Sons, an inspector for the Alkali Act of 1963 (a very early piece of environmental legislation) as well as many other roles. Throughout his long career, he identified broad common features to all chemical factories and clarified the necessity for a new branch of engineering that was equally comfortable with both applied chemistry and traditional engineering.

In 1880, he proposed the unsuccessful formation of a "*Society of Chemical Engineers*". In 1887, he presented a series of 12 lectures on the operation of chemical processes (now called "*unit operations*") at the Manchester Technical School. In 1901, he published the influential "*Handbook of Chemical Engineering*", which is regarded to define the emerging profession of "Chemical Engineering". In this handbook he stressed the value of large scale experimentation (the precursor of the modern pilot plant), safety practices, and a unit operations approach. Davis' original lectures in 1888 also played a role across the Atlantic. Only a few months later, Professor Lewis Norton of the Massachusetts Institute of Technology introduced "*Course X*" (ten), thereby uniting chemical engineers through a formal degree. Colleges such as University of Pennsylvania and Tulane University soon followed the lead and started their own programs. These pioneering programs often grew from Chemistry departments with a dedication to fulfilling the needs of industry.

Reference: www.pafko.com/history/index.html

How to read a Professor's door

Closed



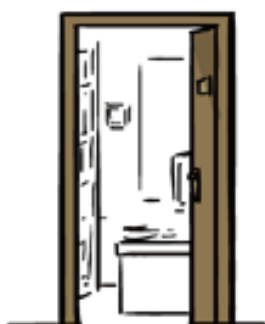
"I may or may not be on this continent."

Half-open



"I'm probably in a meeting."

Wide Open



"I just walked in to get a few things before I have to run to my next meeting."

Slightly ajar



"Proceed with caution."

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Letters to the editor

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