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CEB *Focus*

Department of Chemical Engineering and Biotechnology

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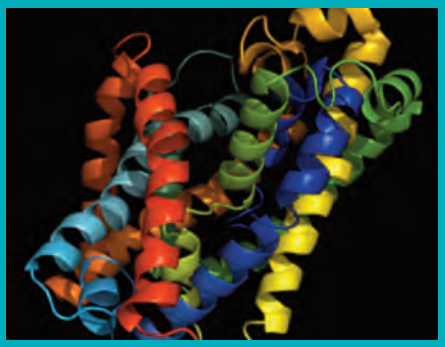

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Welcome

Message from HoD Professor Nigel Slater

With the New Year it's time for a State of the Union report: 2011 saw remarkable progress for CEB with exceptional contributions from all members of our staff, on whose behalf I am extremely proud and grateful.

CEB continues to achieve global recognition and was ranked second overall in the QS World University Rankings of Chemical Engineering Departments. We are continuing to rejuvenate our staff profile and in turn, our graduates are making their mark at other academic institutions.

Also, UK biotech industry and CEB have continued to build the globally recognised Master's in Bioscience Enterprise which has the active participation of over 100 external entrepreneurs and industrialists and continues to recruit to our limit of 25 MPhil students per year.

CEB sadly waved goodbye to Professor Malcolm Mackley and to Mr Barrie Goddard who both took early retirement, to Miss Linda Craft, who had worked in the department for 28 years, Mr Surinder Sall, Mrs Sabine Deering, and Mr Phil Salway. We wish them well for the future.

As per New Year's resolutions my own priorities are that CEB should continue to develop the new building in West Cambridge and to pursue the exciting sponsorship leads that are emerging, which will likely involve us in new collaborations and partnerships overseas. I look forward to encouraging our new Lecturers to build their profiles in teaching and research and to the continued growth of our Teaching Consortium. We realise that the new fees structure for undergraduates may affect student recruitment but we must endeavour to maintain access for highly able students irrespective of background and financial circumstances. Finally, 2012 will be critical as we prepare for the Research Excellence Framework exercise in 2013 and position our case as advantageously as possible. So, another exciting year in prospect and one in which I hope that CEB can work closely with our friends and alumni.

Notes from the Editorial Team

***CEB Focus* Team wishes all our readers a very warm and happy New Year 2012!**

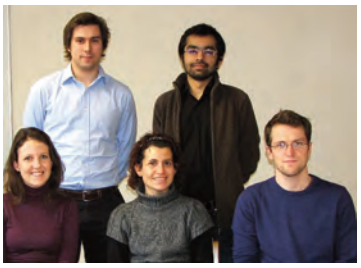
CEB Focus Editorial Team is led by Elena Gonzalez, PA to HoD, assisted by fellow editors: Alastair Clarke, Jawad Rehman, Nick Ramskill and Marijke Fagan. We would like to welcome Jawad to the Editorial Team. Jawad is a PhD student working on Bioelectrochemistry and Nanomaterials under the supervision of Professor Lisa Hall.

In this issue we have talked to some of our graduates and asked them about how their own careers and how they think the job market or their own choices may be affected by the ongoing recession. Our research sections deals with hot and fascinating topics like molecular microbiology and re-vegetating contaminated land. Achievements in the areas of CO_2 capture and the prestigious Donald and William S. Hancock awards given to Department members are worth noting.

Alumni Corner presents Peter Varey's insights into the life of Peter Danckwerts, former HoD and Shell Professor from 1959 to 1977, in his soon-to-be published biography book 'Living on the Edge'.

Staff Room highlights some of the talents of our staff members from poetry writing to radio DJ-ing and even interior design! Finally, Dr Sarah answers your questions in her regular column and Alastair returns with a tea-time teaser on "sustainably-financed" institutions.

CEB Focus would like to thank Vanessa Blake for providing photos and department members, alumni and corporate partners for article contributions. Please keep sending them to ceb-focus@ceb.cam.ac.uk



Editorial Team: From left to right Marijke Fagan, Elena Gonzalez and Alastair Clarke; back row: Nick Ramskill and Jawad Rehman

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CEB Graduates - What happened next?

Marijke Fagan
Editorial Team Member

Every year the CEB Department produces yet another group of budding chemical engineers – but what do they decide to do after graduating? The Department's undergraduate degree equips students with an excellent grounding in core chemical engineering, from scientific fundamentals to plant design. It would be logical to assume that many graduates choose to apply these skills in a traditional chemical engineering role. The financial prospects for new chemical engineering graduates has also never been better, with *The Times Good University Guide* finding that chemical engineering graduates had the 3rd highest starting salary in the UK at £28,415, lower only than medicine and dentistry. However, not all chemical engineering graduates choose to follow the pure chemical engineering route. The degree also teaches students advanced analytical, management and problem solving skills which make them highly employable in sectors such as finance and management consulting.

Every year, the outgoing chemical engineering undergraduate students fill out a form where they inform the Department of their next career move. This information was used to explore the question of graduates' career choices and to see if any significant changes had occurred over the years.

Figure 1 summarises the survey responses for the period 2005-2011. The results show that approximately half of the students chose to work in the chemical engineering industry after graduating. Figure 2 shows how this percentage has varied each year. The most popular sectors within the chemical engineering field were oil and petrochemicals (17%), engineering consulting and manufacturing (11%), oil and gas exploration (8%) and food and consumer goods (7%).

The majority of students who did not enter a chemical engineering job chose to work in finance and management consulting or continued with their higher education by enrolling for a Masters or PhD programme. The past few years have seen a slight increase in the percentage of students who have chosen to continue their education. This may have been linked to the recession, which saw many companies cutting their graduate intakes. As a result many new graduates in the UK at this time chose to continue with their studies rather than enter the job market. Overall, 2011 saw the largest proportion of students entering non-chemical engineering jobs, with 34% of this class choosing to follow a career in finance or management consulting.

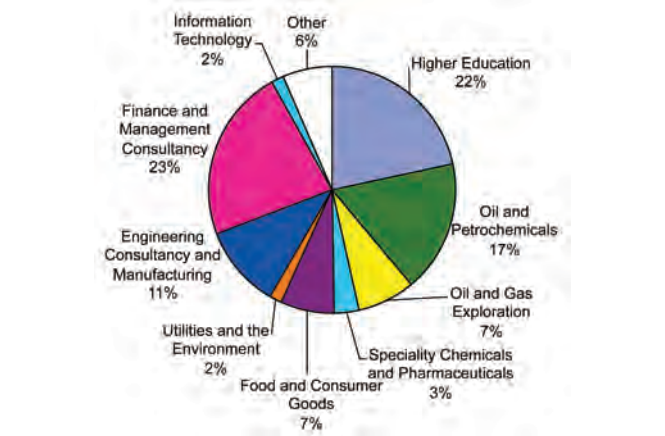


Figure 1. Career choices of CEB graduates in 2005-2011

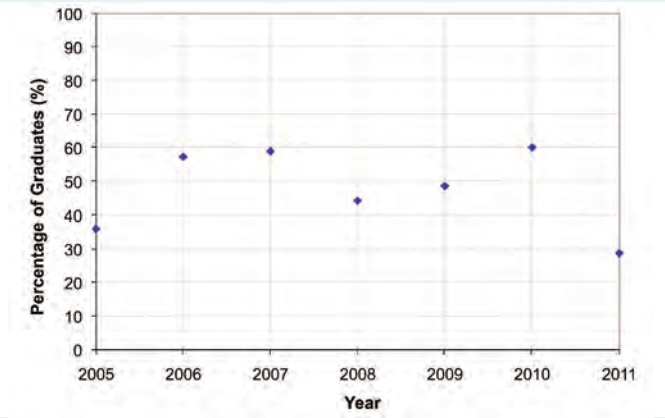


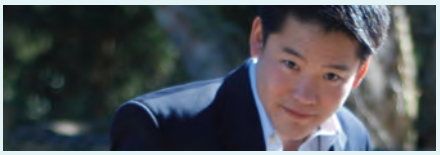
Figure 2. Percentage of students who went into chemical engineering jobs following completion of their degrees

CEB Focus have been in contact with some recent alumni in order to see how chemical engineering graduates have found the workplace. Here they give their impressions of the job market, tell us how and why they chose their next career and inform us of how their chemical engineering degree has helped them.

The PhD Student
Rachel Myers

After graduating in 2009 I started work as a process engineer for Davy Process Technology (DPT) in London designing chemical plants in Saudi and China. Quite a lot of the work was very similar to the dreaded design project, just on a bigger scale. After a year I realised that I missed intensive learning. Consequently I applied to the Centre for Doctoral Training in Healthcare Innovation programme at the University of Oxford. It is a four year PhD with the first year being a foundation year in biomedical engineering. I have now begun the project that will hopefully turn into my PhD thesis. The topic is "active targeting of sonosensitive nanoparticles for cancer therapy". I intend to bioconjugate cancer targeting agents onto the surface of drug-loaded nanoparticles. These nanoparticles should cavitate when exposed to unfocused ultrasound thus releasing the drug as well as causing localised high temperatures and pressure shockwaves. So far it has been a lot of fun but I don't yet know how successful it will be. My impression of the job market for recently graduated chemical engineers is extremely positive. DPT are still working flat out and seem to be desperate for new recruits as their work is not dependant on the UK market. Funding for biomedical research still seems to be available as well.

The Business Consultant
Chris Khoo



My degree started in Engineering right after my National Service in Singapore and concluded in 2008. These university years were the era of unsustainable economic expansion when solid interview preparation and a Cambridge degree was a ticket to a top job. A love for solving problems and facing new challenges led me to choose consulting. I work with Schlumberger Business Consulting, a firm that is rapidly growing; one that I can shape; solving a variety of Strategic, Operational and Capability challenges for our clients; and it specializes in an industry that I am passionate about: Energy. My projects in Singapore, Bangkok, Kuala Lumpur, Perth, Brisbane, Dubai and Paris were a mixed bag that can all be described as hard work, fun, interesting, mundane or frustrating. I have stayed in top hotels of all those cities and eaten at some of the top restaurants. I have also worked through the Bangkok riots and had to evacuate when Brisbane's streets were flooded. I found the real lessons from my time at CEB invaluable: thinking on my feet, taking a step back from complicated issues to rework the solutions from first principles, conviction in my recommendations, keeping an open mind, chilling over food with teammates and toughing it out through crunch times. I don't know what life in 10 years looks like, but I know Monday is bright!

The Entrepreneur
Tom James

On graduating in 2008 I joined an operations and efficiency consultancy. I worked mainly in nuclear submarine yards and the NHS. The job was a great opportunity to take on a high level of responsibility at a very early stage in my career, and also understand how both my own organisation and others in which I worked. After two years I formed the biodiesel company Organic Drive with two colleagues, Duncan Morrison and Geoff Cunningham, both ex-Cambridge engineers, at the end of 2010. Our aim was to become a leading player in the UK renewable fuels market producing biodiesel from used cooking oil. On the 1st March 2011 we signed the lease on a 4,500 sq ft unit in the West Midlands, and within a few months had built, commissioned and tested a plant designed completely in house. My background in chemical engineering proved invaluable during the design and build stage, as the process required the use of chemical engineering staples like vacuum flash separators, heat exchangers, as well as novel sawdust-based adsorption columns. The plant is currently producing around a road tanker of fuel a week, with this set to increase by two - four fold in the New Year. I received third place in the Young Chemical Engineer of the Year Award at the annual IChemE Awards in November 2011.

The Trader
Yaoyao Liu

I graduated in 2009 from Trinity to work as an energy trader at Goldman Sachs. My role involves providing liquidity and risk management solutions to clients such as airlines, refiners, and oil producers, in addition to taking advantage of market opportunities through proprietary positions. Having interned with the firm in 2008 I found working in financial markets rewarding not merely in remunerative terms. The intellectual challenge of keeping abreast with price evolution in a market that is different everyday and the interpretation and prediction of current events as they unfold is both engaging and motivating. The downsides are potentially long hours, high stress, and on occasion verbal abuse from a banker-bashing public. The current job market is tough; firms are downsizing to cut costs. However, most cuts are aimed at senior levels where the potential savings are more significant - graduate recruitment shouldn't be too dissimilar to previous years. Graduates entering finance come from a variety of, but most commonly quantitative disciplines. Chemical engineering subject knowledge is not directly applicable to most day-to-day work. However, in my case understanding refinery operations and physical processes has proven useful, e.g. when trading diesel or naphtha and unscheduled hydrotreater shutdown at a large refinery...

The Lecturer
Dr Samantha Gooneratne

When I stayed on in Cambridge after my undergraduate degree, it was with the intention of doing a PhD so that I might get into lecturing. During my PhD, I tried to get as involved in teaching as I could. I supervised a number of subjects, and in my final year, I enrolled in the Graduate Development Programme's Teaching Associate Programme. This gave me the opportunity to explore different teaching and learning methods, and to look at teaching processes objectively and revise my own techniques. At the end I was awarded Associate Fellow status of the UK Higher Education Academy. My post-PhD job hunt was difficult for a number of reasons. The main problem was that there didn't seem to be many lecturing posts available, presumably due to the prevalent economic climate. Furthermore, the posts that were available were directed at applicants with a lot more experience. I also felt that that being a non-EU citizen put me at a disadvantage. After six to nine months of searching, I was invited to my first interview for a lectureship at Teesside University (a post I had seen advertised in the IChemE's *TCE*) and after a second interview, I was offered the job. I have been working at Teesside University for almost four weeks now and I am wholly convinced that the path I've chosen is the right one.

The Petroleum Engineer
Deviyani Misra-Godwin

I supervise the day-to-day running of a Higher Olefins plant. The job covers a range of areas, including plant optimization, daily trouble shooting and improvement projects. I chose to work in the oil and gas sector because it's an enormous industry, with a range of job opportunities across the globe. There is also satisfaction to be derived from making a tangible product that serves a genuine purpose. I enjoyed my degree, so wanted to use it after graduation! I use it to design heat exchangers, optimize distillation towers, simulate plant operations etc. The degree at Cambridge provides a great theoretical understanding of how things *should* work. The challenge is then to convert theory to practice! In the current climate, I think many graduates are looking to go in to industries like this which provide excellent pay, good work-life balance, and a broad range of jobs to challenge them. Where many industries have been hit hard by the economic downturn, the oil and gas industry is one of the few areas actively recruiting new graduates. The important thing is to remember that you have to go to work *every single day*, and you spend more time at work than you do at home! So do something you enjoy. I'm lucky to say that my work is varied, interesting and challenging. And I have only just begun to glimpse the variety of opportunities available!

Nuria leads Spanish Innovation

Last October, Dr Nuria Rodriguez was named one of Spain's leading young innovators by *Technology Review*, a magazine published by the Massachusetts Institute of Technology. Nuria is a postdoctoral researcher in the Department's Combustion Group. She is working on 'Calcium Looping', a method of capturing CO_2 emissions from power plants through the carbonation of calcium oxide. *CEB Focus* caught up with Nuria to discuss her award, her future ambitions and the role of innovators in her field.

CEB Focus: Congratulations on receiving a 'TR35' award; what does being a winner of this award mean to you?
Nuria: It is a great recognition to the entire work carried out during my PhD in Spain. I feel very happy for myself, but also for the Calcium Looping Technology which I have been working on. TR35 awards valuate promising technologies that are able to change the world, and I believe in the high potential of Calcium Looping to mitigate CO_2 emissions.

You have attended conferences in Boston, USA and Malaga, Spain to receive your award. How was that experience?
The whole experience was really inspiring. Very smart and well-known people working in different fields gave amazing talks in the EmTech Conference in Boston, USA. I also had the opportunity to visit the MIT facilities. If you have the chance, I recommend visiting the MIT Media Lab. It's like a technology playground where researchers have the space, tools, and toys to think freely — just how a child would do. The EmTech in Malaga was the week after Boston. It was the first edition of this conference in Spain and the result was very exciting.

Why do you think *Technology Review* chose Spain for its 2011 regional award?
The TR35 global awards were launched in USA twelve years ago to recognize the world's most outstanding innovators who are younger than 35. The awards span a wide range of fields, including biotechnology, materials, computer hardware, energy, transportation, and the Internet. In 2010, a regional TR35 was launched with TR35 India. Now there are regional versions of the TR35 in Singapore, Italy, and Spain. China, Brazil, and Mexico are planned for 2012. As you probably know, Spain is going through hard financial times. For this reason, it was stimulating to see many people wanting a big change in the country by using technology research and development. Many institutions spoke up for supporting young researchers and entrepreneurs in order to create jobs and build a better future for Spain.

Could you describe your research?
Calcium looping is a technology based on the use of CaO to mitigate CO_2 emission of highly energetic processes like power plants, biomass boilers or cement manufacturing factories. There are several possible configurations, but I have been mainly working on the application of Calcium Looping to existing coal power plants. My research has been focused on the assessment of this process regarding mass, heat and economic balances. The experimental work carried out in a 30 kWth pilot plant led the scaling up of the process. Currently a 1.7 MWth pilot plant is commissioning in the North of Spain to clean gases from a real power plant.

Where is the greatest potential for innovation in this field? Is reducing the cost of capturing CO_2 the greatest need?
The cost of a new process is always a key factor. We all know how to get affordable energy, what we don't know is how to get clean affordable energy. Although the CO_2 capture technologies are becoming a necessity, it is essential they are as cheap as possible; otherwise developing countries, and even developed countries, would keep rejecting its implementation.

What ambitions do you have for 2012?
I would like to keep working in the energy field. We are facing the huge task of finding a source of efficient, clean energy that is able to supply global needs, and I want to be there as a researcher.

Dr Ken Seamon receives CASSS Honourable Award

Dr Seamon, lecturer on the MBE course at the Institute of Biotechnology is the first recipient of CASSS' William S. Hancock Award for Outstanding Achievements in Chemistry, Manufacturing & Controls (CMC) Regulatory Science. This annual award by CASSS (International Separation Science Society) recognizes outstanding and sustained contributions to the field.

His achievements have been instrumental in enabling the availability on a global basis of high quality life-saving medicines derived from recombinant technology. Ken accepted the award at the annual WCBP Symposium in San Francisco on the 21st January, when he was thanked in public for his life-long contributions to the advancement of the field as a regulator, an industry professional and now in academia.

He told *CEB Focus* "It is a huge honour to be recognized by such an organisation. It has been a privilege to be able to work with so many bright and dedicated scientists representing the regulatory authorities, the industry, and academic research to help bring new drugs and biologics to patients. Over the years we have been able to advance the field of biotechnology by a collaborative effort based on good science and patient benefit. I hope to be able to continue to contribute to these efforts as we try to realise the benefits of the significant investment and innovation in the pharmaceutical industry for public health in all regions. In particular, these are the values we want our students to understand as they move forward in their careers. I have recently taken on an additional role at the Cambridge Cancer Centre where I will continue my efforts to help facilitate cross-cutting science for the detection, diagnosis and treatment of cancer."

Donald Medal for Professor Howard Chase

The Donald Medal is awarded by the Biochemical Engineering Subject Group of the IChemE for outstanding services in Biochemical Engineering and is named after a long-serving Honorary Secretary and former Ramsay Professor at University College London where biochemical engineering was first established in the UK.

Professor Christopher Hewitt of Loughborough University presented Professor Howard Chase with the Donald Medal of the Institution of Chemical Engineers, 2 November 2011

Professor Chase was Head of the Department of Chemical Engineering (1998-2006) and is now Head of the School of Technology. Although known principally for his activities in bioprocessing, downstream processing and bioseparations, he has also led productive research in biological waste treatment and the use of microwave heating in process engineering applications.

CEB Focus asked Professor Chase about his feelings on receiving this prestigious award. He commented, "I am delighted that my research in biochemical engineering over a 30-year period has been recognised in this manner. It is indeed an honour to join a group of distinguished biochemical engineers who have helped forge the UK's reputation in this important area of biotechnology. My work on biochemical engineering started in the department at the end of 1981 when I was employed as a research assistant under the direction of the late Dr Nigel Kenney." He added, "My overall aim has always been to apply 'traditional' chemical engineering approaches to biological issues and this has enabled my work to span a number of areas. Thanks to the research students and post-doctoral workers who have enabled my ideas to be tested; this award would not have happened without their valiant efforts in the laboratory!"

CEB Rewind: 2011 Highlights

Some specific highlights from 2011 are particularly noteworthy:

- **Young University Lecturers were appointed:** Dr Axel Zeitler who works on applications of terahertz spectoscopy in pharmaceutical formulation, Dr Dan Holland who works on MRI imaging applications in reaction engineering, Dr Graham Christie who is working on the control of sporulation and Dr Sabine Bahn who works on medical metabolomics.
- **CEB researchers moved to academic positions** at other universities: Dr Rongjun Chen to a tenure track Fellowship at Leeds, Dr Alex Edwards to a Lectureship in Pharmaceutical Sciences at Reading, Dr Nuno Reis to a Lectureship in Chemical Engineering at Loughborough and Dr Samantha Gooneratne to a Lectureship in Chemical Engineering at Teeside.
- **Dr Sabine Bahn** has been granted a $5M extension of funding from US medical charity Stanley Medical Research Institute in recognition of her groundbreaking research on metabolomic biomarkers for schizophrenia and other neurological disorders. She was also awarded a Professorship at Erasmus University in the Netherlands.
- **The University awarded personal Chairs** to Professor Clemens Kaminski and Professor Alan Tunnacliffe and a Readership to Dr Geoff Moggridge.
- **Professor Chris Lowe,** Director of the Institute of Biotechnology, was awarded an OBE and won the BBSRC Commercial Innovator of the Year (2011) award.
- **Professor Howard Chase** won the Donald Medal of the IChemE for outstanding services to Biochemical Engineering.
- **Dr David Scott** won the University Pilkington Prize for excellence in teaching.
- **CEB's Teaching Consortium** remains a vital link between undergraduate teaching and industry. In 2011 it expanded its membership with the addition of ABB and we are in final stage discussions with three other companies in the process industries sector.
- **Detailed architectural design** and development has begun on CEB's new building in West Cambridge, which has involved consultation with all CEB staff.

CUCES Michaelmas Review

As ever Michaelmas 2011 was an exciting couple of months for the Cambridge University Chemical Engineering Society (CUCES). The term began with a succession of careers events, each affording students the opportunity to explore some of the most successful engineering companies in the world and network with their representatives. The CUCES committee and visiting companies would like to thank undergraduate and postgraduate students across the Department for the attendance and enthusiasm consistently shown at careers events throughout the term.

In keeping with tradition, the term was rounded off with the CUCES Christmas Dinner 2011, an evening made possible by the kind sponsorship of BP. The Christmas Dinner, held for the first time at Browns, brought together the entire spectrum of Department members, from undergraduates, MPhil and PhD students to lecturers and staff. The enthusiasm for the dinner was evident from the 50% sign up within the first 24 hours and the evening itself continued to reflect the social spirit of the Department. The CUCES committee would like to thank all those who attended for truly brightening the evening and making it a pleasure to organise.

Moving into Lent 2012, the CUCES committee aims to shift its focus to the Frank Morton Games 2012, a very social national sporting event, and the Annual Dinner 2012. In addition, the committee is hoping to organise sponsored clothing for Department members and yet more careers events, so please do stayed tuned…

The Cambridge University Energy Network

Jin Yang Lim, Paul Liu, Saquib Sultan, Giulia Privitera, Irufan Ahmed

The Cambridge University Energy Network (CUEN) is a student-run society, with a focus on sustainable energy. The objectives of the society are to inform and to raise awareness of the ever-important field of sustainable energy, from technological, financial and political viewpoints. Activities of CUEN include lectures and discussion groups, presented by speakers from the University of Cambridge and elsewhere, and film and documentary screenings. Our main event of the academic year is an Annual Conference held at the end of Easter Term. The programme for this topical conference includes talks by leading figures both from industry and academia.

The executive committee reflects the multi-disciplinary nature of the world's energy problems, with its members having different academic backgrounds, ranging from engineering to economics. Indeed, the society aims to bring together diverse disciplines to address the social, technical, political, economical, geological and environmental challenges in energy generation. A high proportion of our committee members is based in the Department of Chemical Engineering and Biotechnology, often taking up very important roles in CUEN.

This year, the Annual Conference was held at the Faculty of Law, University of Cambridge, on 28th June 2011. Entitled 'Gale Force: Offshore Wind Power', the conference focused on the generation of electricity using offshore wind, successfully bringing together 100 industry leaders, professionals, academics and students, who share a common interest in offshore wind energy.

A more recent talk was held at the Department of Engineering on 21st November 2011. The lecture, titled 'Some inconvenient economics of energy and climate policy', was delivered by Dr. Michael Pollitt from the Judge Business School and attracted an audience of more than 150 students and academics. More talks on energy and environment related issues will be scheduled during Lent and Easter terms.

Dr Michael Pollitt delivering his talk to CUEN, Michaelmas 2011. Photographer: Irufan Ahmed

We are continuously looking for chemical engineers to contribute to the society, as we strongly believe that chemical engineering students share a deep interest in sustainable energy amongst all disciplines within the University. In order to follow up on our forthcoming events and subscribe to the CUEN mailing list, please visit our website, www.cuen.org.uk, and join our Facebook group (The Cambridge University Energy Network). We look forward to seeing you at our future events!

Prof Peter Tavner from Durham University delivering an opening speech at the CUEN Annual Conference on offshore wind energy. Photographer: Jin Yang Lim

Some members of the Department attending the CUEN Conference. Left to right: Saquib Sultan, Marco Saucedo, Tzu-Ching Chu, Jin Yan, Nuria Rodriguez, Wen (Paul) Liu. Photographer: Jin Yang Lim

Engineer Ethics: A 'Hot' Subject

Dr David Scott
Director of Teaching

We considered explicit coverage of engineering ethics into the Tripos after helpful comments from the IChemE Accreditation Team during their visit in May 2010. They emphasised that coverage of engineering ethics was a requirement of IChemE accreditation, and that it should be embedded in our teaching. The Department has always had some coverage of ethical issues in courses such as Safety, Health and the Environment, and more recently in Sustainability in Chemical Engineering. For example, following the David Nutt issue, I have been asking the class attending the CET I Safety lectures which they consider the more dangerous of horse riding or taking ecstasy, with the intention of provoking discussion about the meaning of "dangerous", "horse riding" and "taking ecstasy".

The Royal Academy of Engineering is promoting the teaching of engineering ethics. They state that the study of ethics in an engineering course helps students prepare for their professional lives, develop clarity in their understanding and thought about ethical issues and practice, and develop widely applicable skills in communication, reasoning and reflection, which could help them engage with other activities such as group work and work placements. All good learning outcomes.

Courses on engineering ethics are given in a number of other Chem Eng departments, including Imperial College, where Esat Alpay, who gained his PhD in this Department in 1992, working with Nigel Kenney and me on rapid pressure swing adsorption processes, currently gives courses to IC's Chem Eng, Bioprocessing, Computing and Aeronautical Engineering Departments. Esat kindly gave me a lot of advice and information, including recommending the book by Harris, Pritchard and Rabins[1], which is an interesting read. I've stumbled across lots of websites indicating much activity, including the Online Ethics Centre of the US National Academy of Engineering, and IDEA, the Inter-Disciplinary Ethics Applied centre at Leeds University.

We decided to approach this in two ways. Lecturers were encouraged to ask some ethics-related questions in their courses, such as "How would you check that your reactor model works?" In addition, two sessions were held near the start of the CET IIA year in which we considered IChemE accreditation guidelines, the nature of ethics, what is a profession, codes of conduct, how ethical issues might arise in the workplace, impediments to ethical behaviour, some topics in engineering, and how one might address ethical issues. We looked at the code of Hammurabi (the engineering aspects, of course), the Hippocratic oath, the clip of Paxman interviewing Sting about South American rain forests. We wondered about the monarchy, Rhianna, foxhunting and badger culls. We noted, with pride, that engineering is a great profession … though there can be downsides. We finished with some scenarios including considerations of bribery and conflict of loyalties. Use of scenarios seems to be a popular way of teaching ethics - see the articles by Shallcross[2, 3] and Parkinson[2].

Some students may have come across much of this before, and most students will have already seen some of it. But I think that exposure to, or reminder of, this material is valuable. I certainly had fun, and I'd welcome (constructive) suggestions of improvements for next year's course.

Further Reading

1. Harris, Jr, C.E., Pritchard, M.S., Rabins, M.J., 2009, Engineering Ethics: Concepts and Cases, Wadsworth, Cengage Learning.
2. Shallcross, D.C., Parkinson, M.J., 2006, Teaching ethics to chemical engineers. Some classroom scenarios, Education for Chemical Engineers, 1, 49-54
3. Shallcross, D.C., 2010, Teaching ethics to chemical engineers 2. Further classroom scenarios, Education for Chemical Engineers, 5, e13–e2

CamStent: A History of Success

Dr Dave Hampton
MPhil Graduate - CEO of CamStent Ltd

London Eye Pitch back in 2006

CamStent Ltd is an emerging medical materials company founded by members of the MBE class. It set about a three-year effort to develop a improved urinary catheter. By now, discussions with exit partners who might manufacture and distribute the finished product ('cardiac stents') have already began.

CamStent raised £350K ($570K) Seed Funding from a Consortium of Business Angels back in September. A recent study has demonstrated that the company's first product from its surface coating platform exerts strong antimicrobial effects against the organisms primarily responsible for hospital-acquired urinary-tract infections.

The funding will be used to optimise this product for licensing and clinical use to demonstrate impact on infection rates.

CEB Focus caught up with MBE graduate Dr Hampton who highlighted the importance of preparation and the connections that MBE course gave them, "It really could not have happened without that launch pad and the great support from EEDA and our angel investors that provided the funding to propel us forward."

Dave is a biomedical research scientist and entrepreneur with global experience in medical device innovation and new business development. Dave leads the Medical Diagnostics and Devices course at the University of Cambridge (UK), and is a Medtronic Bakken Fellow, a Senior Member of the IEEE, and a Fellow of the AIMBE.

Dave recalls, "I came to the Bioscience Enterprise programme with a goal of becoming a better research manager. But the course helped me to see that product is not developed in isolation, but in the context of a business plan and financial resources. It gave me the tools and confidence to take an idea, just a clinical problem and a technology that might solve it, and build a growing business around it. The course gave me the methods and the confidence to pitch my ideas to investors and to recruit the very best people to drive the process forward. It continues to provide me with the network of contacts and the access to resources that are, today, building CamStent and its products. And it give me ongoing opportunities to return to work with each new class of students, sharing our experiences and encouraging them to build successful new companies based on the principles and skills that they are learning"

He added, "Our group of five students proposed a Cambridge-based business, CamStent, to commercialise the polymer for medical use. With guidance from course advisors, we prepared a business plan and pitched it in the Cambridge University Entrepreneurs competition. The panel of business angels judged us as first runner-up for 2006: we created the business with the £5000 prize and began to refine our development plans and investment pitch."

Cardiac stents required extensive testing and clinical trials in order to reach market with antibacterial applications on disposable products another possibility. CamStent secured an East of England Development Grant to test the two market alternatives. The elements of the business opportunity came together like a case study: urgent need, effective technology, exit partners and economical development path.

And, in Spring 2010, CamStent demonstrated a coating suitable for use with catheter materials that impacted 90% of the *P. Mirabiius* organisms responsible for urinary tract infections.

Spores to Dine For

Dr Graham Christie
Lecturer

It is fair to say that as a group of organisms, spore forming bacteria have an image problem. They have been associated with the post 9/11 anthrax attacks in the US, which are *still* being cleaned-up 10 years after the event, and are regularly brought up in media reports concerning the hospital "superbug" *Clostridium difficile.* Assuming that you have personally managed to avoid the really bad guys – and we should also throw *C. botulinum* into that category - there is still a fair chance that you've encountered at some point the deleterious aspects of spore-former biology in the shape of Bacillus cereus (my own "cream cake incident", Egypt, 2007) or *Clostridium perfringens*-associated food poisoning.

It's not all bad news, however, as several species of *Bacillus* have found useful industrial applications, particularly for the production of recombinant enzymes, vitamins, antibodies and other pharmaceutical products. Additionally, the *Bacilli* and *Clostridia* are of considerable interest from a fundamental biological perspective, since their ability to form dormant spores - by far the most durable cell-type on earth - upon sensing nutrient limitation, represents a simple cell differentiation cycle that has served as a model developmental system for genetic regulation during microbial growth.

Research conducted within the CEB Molecular Microbiology group is concerned with both fundamental and applied aspects of this group of bacteria. A major focus of our work has centred on elucidating the molecular details that underpin the process by which dormant spores break their dormancy and re-enter the vegetative state. This is crucial, since it is only vegetative cells that are associated with the production of toxins and/or pathogenesis; hence if we can develop strategies to keep the spore locked indefinitely in the dormant form – by developing inhibitors of spore germination, for example – then we can reduce risks associated with the presence of spores in a number of environments e.g. hospital wards, food-processing plants etc.

A major contribution to the field by our group concerns the application of molecular-genetic and biochemical techniques to identify the receptor protein responsible for binding germinant molecules that subsequently trigger spore germination (Figure 1).

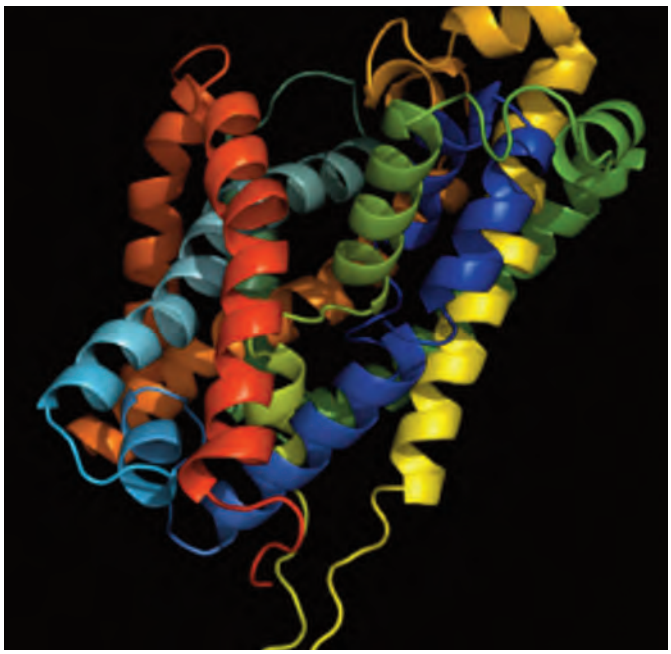


Figure 1. Molecular model of the spore germinant receptor protein responsible for binding germinants (courtesy Dr Ricardo Nunez Miguel).

In the absence of crystal structure information - which we are pursuing currently following successful over-expression of receptor proteins in the heterologous expression host *Lactococcus lactis* – we have conducted molecular modelling and systematic mutagenic analyses to begin to elucidate structure-function relationships in spore germinant receptor proteins. Elsewhere, we have been applying HPLC-MS techniques to examine germination-associated changes to the molecular structure of the thick layer of peptidoglycan that serves to keep the spore in the dormant state. The dissolution of this structure by so called cortex-lytic enzymes (CLEs) is essential for the spore to complete the germination process; hence there is considerable applied interest in elucidating the mechanisms by which CLEs are activated during spore germination, since if this could be stimulated prematurely then the subsequent loss of resistance properties would, for example, permit reduced thermal processing of food products.

Finally, in more recent work that is complementary to existing research being conducted within CEB, we have begun to examine the potential application of spores as vectors for oral vaccines or as probiotic food supplements. As bizarre as this may seem in light of earlier comments regarding pathogenicity, the molecular tools and genomic information are now available to engineer spores of various species to display fragments of antigens on the outer surface (Figure 2), deliver drugs upon germination and/or serve as heterologous expression systems for therapeutic molecules that are protected within the spore and which can then be stored for indefinite periods under ambient conditions. Who knows, perhaps progress with some of the latter research objectives will lead to a revised perception of this unique group of microbes as tough, but essentially beneficial and useful microbes?

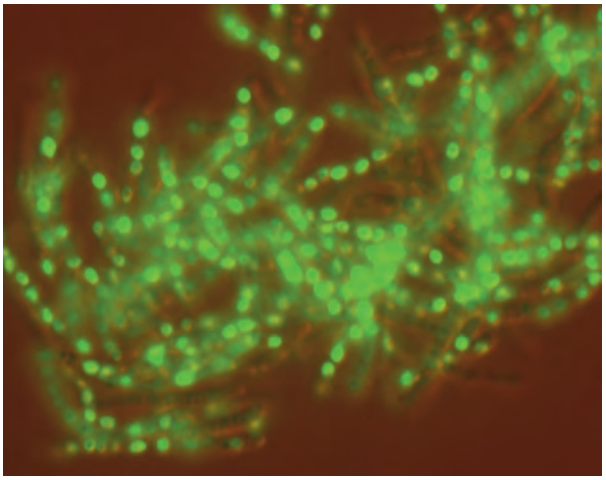


Figure 2. Co-DIC/Fluorescence image of sporulating Bacillus megaterium cells displaying GFP on the outer surface of the developing spore.

Further Information

"Initiation of Germination in *Bacillus* and *Clostridium* Spores", Graham Christie, in Bacterial Spores: Current Research and Applications, Caister Academic Press (2012).

Acknowledgements

Thanks to Chris Lowe and all CEB spore biologists who have contributed to this research programme!

Why Paste Ram Extrusion using Multi-holed Dies?

Min Zhang
PhD student, Powder and Paste Processing group

Pastes, which are highly dense suspensions of particulate solids in a liquid phase, are commonly used in pharmaceutical manufacturing processes, such as extrusion-spheronisation (E-S). In extrusion, the pastes are compacted and pushed through dies or screens to generate cylindrical extrudates. These extrudates are then spheronised on a rotating friction plate to produce pellets with relatively uniform size, shape and density. The dried pharmaceutical pellets, typically in the size range of 500 to 1500 µm, can be filled into capsules or compressed into tablets.

Industrial extruders usually employ screens and the pastes are pushed through the holes by blades or cylinders passing over the hole entrances, whereas ram extruders, which compact the paste in the barrels and force the material through a concentric, cylindrical, single-holed die by the movement of a piston, are more popularly used in the labs. The screen extrusion enables the high throughput since it allows the shift of the production line from batch to continuous processing. In comparison, the single-holed die ram extrusion aids analysis of the paste flow behavior as its geometry is in essence a capillary rheometer. Academic workers use the ram extrusion to characterise the paste rheology and investigate how the paste flow affects the final pellet quality.

The work published in this paper investigated the paste behaviors in the multi-hole die ram extrusion systems and compared the results with those obtained from the single-holed die extrusions. The multi-holed dies have been identified as effective tools to produce pharmaceutical pellets with acceptable size and shape properties. On top of that, we also find that the multi-holed dies can avoid some processing problems which may be encountered in single-holed systems. Study of the multi-hold die ram extrusion gives useful information about many holed (mesh-like) configuration and that helps us gaining a better understanding of the industrial screen extrusion.

Reference

Zhang, M., Rough, S. L., Ward, R., Seiler, C. & Wilson, D. I. A comparison of ram extrusion by single-holed and multi-holed dies for extrusion-spheronisation of microcrystalline-based pastes. Int. J. Pharm., 416, 210-222.

Re-vegetating Contaminated and Marginal Land

Peter J Leggo[1], David MC Bailey[2]
[1]Department of Earth Sciences, [2]Department of Chemical Engineering and Biotechnology

Former advances, developed at the Department of Earth Sciences and Botanic Garden, University of Cambridge have lead to a new strategy for sustaining plant growth on contaminated land. This technology will enable contaminated and marginal land to be re-vegetated.

By using the microporous properties of natural zeolites, it is possible to grow and sustain plants on contaminated sites which in the past have not been able to support any vegetation. In this way waste and marginal land can be used to cultivate energy crops such as oil seed rape (B. *napus*), ossier willow and a large number of other plants that could provide biomass for combined heating and power.

Figures 1 and 2 show the growth stage of plants after 44 days since germination. All plants were grown under identical green house conditions.

Figure 1. B. napus growing on acid mine-waste.

The technology is an in-situ method that requires only surface amendment by an organo-zeolitic mixture (biofertilizer). This material is made by composting crushed zeolitic rock with animal or plant waste. During composting, ammonia is generated by the microbial degradation of the organic material and stored as NH_4^+ ions in the zeolite pore space thus preventing lost to the atmosphere by volatilization or leaching by rain water. In a soil environment the NH_4^+ becomes available for oxidation by nitrifying soil micro-organisms providing a supply of nitrate and other nutrients elements that are readily taken up by the plant.

This research has shown that plant growth can now be sustained on sites that in the past have remained barren for tens of years or longer.

Figure 2. B. napus growing on amended acid mine waste.

This research has shown that plant growth can now be sustained on sites that in the past have remained barren for tens of years or longer. These sites can now be treated to provide a healthy top soil upon which it will be possible to establish parkland or grow "bio-fuel" crops. This will help overcome the potential health hazards and create a land surface that could be redeveloped in numerous ways.

In recent work using coal waste from a former colliery in the Nottingham coalfield, a series of plant growth experiments has shown that waste of this type can sustain the growth of plants such as maize (*Zea mays*), sugar beet (*Beta vulgaris*), miscanthus, (*Miscanthus giganticus*), ossier willow (*Salix viminalis*), oil seed rape (*Brassica napus*) and linseed (*Linum usitatissimum*). Figure 3 and Figure 4 show examples of the maize and sugar beet grown in these experiments.

Figure 3. Maize ears from mature plants that have grown in coal waste amended with the biofertilizer shown below those grown in un-amended coal waste.

Research currently conducted in the Institute of Biotechnology by Dr David Bailey involves biofilms that form on the zeolite crystal surfaces. This work will enable a better understanding of the way in which the biofertilizer functions. It is thought that the speciation of soil nitrifying organisms, that are known to be sponsored by the biofertilizer, are important to the phenomenon. It is hypothesised that enzyme reactions that enable nitrification to function supply hydrogen ions that protonate the soil pore-water forming hydronium ions. These highly unstable ions, on re-equilibration, react with the plant substrate to release a wide spectrum of cations. In this way a supply of essential and beneficial cations are made available for plant uptake.

Figure 4. Sugar Beet grown in amended coal waste above those grown in un-amended coal waste.

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Life on the Edge

Peter Varey

Peter recalls one fine morning in March of 1984, "I knocked on the door of Abbey House in Cambridge and waited. In due course an elderly-looking and rather over-weight man opened the door. Peter Danckwerts was expecting me; he invited me into a darkened lounge. Did memories of those glamorous and generous parties of yesteryear still hang in the air? Not at all. It was nerve-racking. I was a new Editor of *TCE* lacking in background; he was a legend in the science of chemical engineering".

"The idea had been to write about famous men in the profession. My new colleagues at IChemE told me Danckwerts might help. He was reluctant at first, but eventually persuaded himself to tackle Dudley Newitt, Senior Professor at Imperial College when Danckwerts had spent three years there, and Terence Fox, his boss in Cambridge in the early 1950s. He wrote with wonderful and delicate irony."

"Danckwerts himself scared me stiff. I didn't realize he was a dying man. Back at the office I dug up the brief autobiographical sketch that fronted a collection of his best papers, published as a thank-you for Danckwerts' 24-year stint as executive editor of *Chemical Engineering Science.* Reading it, I realised I had met the theory of residence time distribution – just one area that Danckwerts revolutionized – in the industrial processes laboratory I had taught in Caracas for five years. A seed was sown."

"I knew that Danckwerts had a good war record and was a great innovator, but when I started to research his biography in 2008 I found there was rather a lot I didn't know. The George Cross for disarming unexploded parachute mines during the London Blitz, when life expectancy in the role was measured in weeks; his account was buried in a 1945 copy of *Blackwood's "Maga"*. In a later issue Danckwerts was in Gibraltar in 1942 countering Italian frogmen using midget submarines and limpet mines. When one mine floated to the surface, Danckwerts sent the first full description back to Portsmouth and got an MBE for his efforts. Handing over in Gibraltar to the infamous 'Buster'

Peter Danckwerts (nearest camera) in the summer of 1933, aged 16 and engaged in dental hygiene at a German-English youth camp near Heidelberg. Next to him is his friend from Winchester College Michael Mackenzie Smith. Peter wrote home 'we set out to demoralise the Germans by not getting up until 10am'

Crabb, Danckwerts invaded Sicily on 10 July 1943. He never spoke of what happened next, but an American reporter in Bangor, Maine, got it out of him in 1947. Absent-mindedly taking a stroll on D-day + 1, he walked into a minefield and broke bones in both legs."

"Back in Blighty aged 27, on crutches and sporting his medal stripes, he provoked atavistic impulses in women. This happy attribute, and his Germanic good looks led to dreams of a career in films. But Hollywood had to wait. In a third *Maga* piece Danckwerts recorded elements of his next two years with Combined Operations. This led to 1946 talks on the BBC Home Service (now Radio 4) about things like launching recovered V2 rockets and how man might get to the moon. Demobbed, he took a chemical engineering practice course at MIT and toured the USA in a Dodge. What he learned in America informed the rest of his professional life."

Alumni Corner

"As a teenager Danckwerts had spent a gap year in Austria between Winchester College and Oxford. He learned passable German and loved the mountains and skiing. His tutor at Balliol College thought he would be the last person ever to make a success of research: 'This life of cultured leisure Mr Danckwerts…' Yet after MIT he spent six years of 'academic indolence' in Cambridge thinking and writing. The research made him a huge reputation. After a break from academia with UKAEA, he arrived at Imperial College in 1956 and met an aristocrat on the dance floor. Danckwerts may have looked like one, but Lavinia Macfarlane was the real thing, related to Lord Lucan. Then came the summons back to Cambridge, traveling the world and holding court in the most sought-after department of its kind. He died prematurely at 68, still in his intellectual prime."

"There's no archive; Danckwerts had no time for paperwork. The dusty drawers of his relations and the (marginally) better-ordered memories of his contemporaries and pupils yielded enough to piece together a story. Shy with all but his family and close colleagues and always laconic, he could be very amusing. I quote a lot of it verbatim or as friends recall it."

Peter Varey was brought up as a chemist, took an interest in industrial chemistry and then switched to writing and editing. Eventually he ran what used to be called *The Chemical Engineer (TCE)* as well as IChemE's publications. Then, after ten years as a freelance, he turned – at least in this first instance – to biography.

***Life on the Edge,* his biography of Peter Danckwerts, will be available in hardback in the spring of 2012 at an estimated price of £28.**

Department Events

Alumni Speaker Series
Thursday 26 January 2012, 4pm
Alumna **Deborah Grubbe** (Former VP - Group Safety, BP; Corporate Operations Director - DuPont Member, NASA Aerospace Advisory Panel) will be contributing a very interesting talk on "Looking at Safety in NASA; Lessons to Learn"

CEB Careers Event
Thursday 26 January 2012
5.30pm- 6.30pm:
Careers Panel Discussion
Following CEB students request CEB will be hosting an event in collaboration with Cambridge University Chemical Engineering Society for Part IIB and Masters' students. This career event will be focused on opportunities after graduation from the Chemical Engineering and Biotechnology department.

Department alumni representing chemical engineering/biotechnology disciplines and career paths popular with our graduates (from all programs) will take part in a discussion panel moderated by a current graduate student.

6.30-7.30pm:
Informal networking session with alumni over light buffet/drinks

****All Department members are welcome and encouraged to attend.*

CEB Pub Nights
Every second Friday of the month: starting at 5pm with *Drinks and Snacks* in the Tea Room provided by Research Groups (New Museums Site). This is followed by the usual pub gathering (Location TBC). Next one Friday 10 February 2012

Scientia Scientie Femininum-Epistemology
The Universal Canon of Collective Knowledge

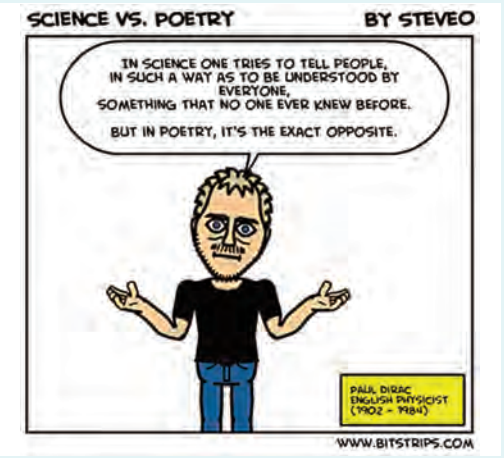
A poem by Zlatko Saracevic

Science is the light, a very quantum of light indeed-
a dichotomy between particles and waves:

I was borne in 1947 and I am now 64, too old
for rock & roll but too young to die.
I got married to the "Uni" in 1993 and we have
had so many children: mainly undergrads, then more
advanced PhDs and some new relatives Profs and
academics like our darling JFD and LFG, who can take
the silly jokes of mine only because she likes me!

So what is the science all about?
To me, being involved with industry, research
and education for the last thirty years,
it has been an interactive process. Gaining the angle
of collectiveness it can be bad like Hiroshima
or good like "wine fly" project. The choice can be
very large or narrow depending on how you look at it.
But knowledge is all about thinking and resolving
using the mightiest weapon we have, the brain.

So here is the puzzle, one of the most famous
poems of its time, "The Sick Rose" by William Blake.
On first glance the rose is dying and all previous scholars
did not recognise that, in fact, the title is an anagram
of "eshotericks". Spelt in its own way like "esoteric",
Greek "esoterikos" (esoter – inner + ikos).
It means cryptic, enigmatic and arcane.
All these scholars through the years did not see it
but I did, and that is why I do
Science and Research at CEB.



www.bitstrips.com

A Passion for Radio

John Gannon
Electronics Engineer

My love of radio began when, as a teenager living in London, I listened avidly to all the 'Pirate' Radio Stations that began broadcasting in 1964 from offshore, giving us a constant diet of music – almost 24 hours a day.

Thankfully they had now broken the BBC's monopoly of the airwaves, where up until then we were lucky to hear half a dozen or so 'pop' records a day. How I envied those Pirate DJs having access to and playing all that great new music, I just wanted to be out there and be a part of it – it was a really exciting time, music-wise. It helped to firmly establish the careers of such 60s artists as The Beatles, The Rolling Stones, The Kinks, The Who and hundreds more besides.

I applied to join one station called Radio Caroline but to no avail. So here my dream seemed to end.
Now, however in my later years, I have the chance to fulfil that dream and I feel very fortunate to be able to relive that marvellous period of my youth. I became involved with local radio here in Cambridge and produced and presented a show "The 60s Scene" on "Affinity Radio", a Community Radio Station. Incidentally, I am now moving onto another Show on "Envision Radio", another Community Radio Station, Listen live every Sunday 10am - 12 noon over www.envisionradio.co.uk/shows/that-60s-feeling/ and email me your requests directly on sixities@envisionradio.co.uk

ENVISION RADIO

All the music used on the show comes from my own personal collection. I like to be fairly selective in my choice of material and I tend not only to play classic tracks but a great deal of the rare and forgotten stuff

too! The basic idea of the show is to try to play the music that helps to recreate the spirit of the 60s for everyone to enjoy, to jog people's memories who were around at the time, and possibly, for younger people who may not have heard a lot of the music to hear more than just tried and tested classic 60s hits!

Art in the Department

Alastair Clarke
Editorial Team Member

Take a look around when you next walk through the Department. Collages, expressionist oil paintings, industrial photography, and even sculpture are all on display. These objects do more than just fill voids and cover walls, they enrich our environment.

In the corridor that leads to the Computing Suite is a print of Matisse's *L'Escargot*: a sparse collage of brightly-coloured paper depicting a snail. In representing the essence of reality with minimal effort, Matisse has achieved the aim of any good modeller. In the Design Project Room are photographs of oil refineries; an homage to the industry that funded research and teaching in the Department. These photographs of precision engineering should be contrasted with the painting of a rural scene that hangs in the Tea-room. Its impressionist style reflecting the wildness of nature.

Painting by Helen Moggridge

In Room S3C, are three paintings: one painted by Dr Sarah Rough, and two by Dr Moggridge's grandmother, Helen Moggridge. The artists have made different examples of abstract art. Dr Rough's painting is of vibrantly coloured, simple geometrical shapes, whilst Helen Moggridge's paintings are an example of a softer, more expressionist style.

Untitled by Dr Sarah Rough

Recently, the Department was approached by Kelsey Grant, an interior designer and the wife of current MBE student Matthew Grant. Kelsey has professional experience in residential interior design and has volunteered to help improve the Department's décor. "There are a few areas that I will attempt to de-clutter in order to free-up space and improve functionality," she told *CEB Focus*. "Hopefully we will be able to make these spaces more visually appealing, perhaps by incorporating colourful artwork or photographs." Kelsey would like to hear any suggestions that you have for improving the working environment of the Department.

Kelsey with husband Matthew

Kelsey vows to "produce design and décor concepts that complement the high calibre of the education that takes place within this Department". Consider then the painted, model heat exchanger on the first floor of the Shell Building. It is a visual treat and an example of sculptural art that not only complements but also contributes to our education.

Ipshita Mandal

PhD Candidate
Graduate Rep Syndicate

Kia Ora! I have come from the far South from a country with endearing landscapes, barbeques in Christmas, and a sheep: man ratio of 6:1; the country furthest from England and often called "God's own country"- take a guess!

As a new PhD student in Prof. Slater's Bioscience Engineering Group, I am developing a novel matrix by chemically modifying porous Micro-Capillary Films into a bio manufacturing system. This matrix will substantially improve purification of biopharmaceuticals.

It is a privilege to be joining one of the very top research institutions in the world. I would like to thank the department for recognising my potential and helping me secure an EPSRC International Doctoral Scholarship and Prince of Wales Cambridge Commonwealth Scholarship. I sincerely wish to contribute back and help grow the department as a Graduate Rep in the Syndicate Board this year, and over time with other opportunities.

Dr Fernando J R Abegão

Research Scientist
Johnson Matthey, Royston

After having completed my PhD in MRI studies of trickle bed reactors, I was not sure that an academic career would be the best option. I considered several other options, such as science communication, teaching, engineering, consultancy and research in industry. There was always something lacking in all of them, except in research in industry as it would combine science and engineering with experimental work, project management and team work. A position for Research Scientist in the Chemical Catalyst business of Johnson Matthey came along and I joined the development team in August. It has been an incredible experience where I have learnt a lot about how science and business go together. I have been widening my knowledge in catalysis synthesis and formulation, and I make full use of the skills I have gained during my first degree and PhD to develop manufacturing processes and analytical methods. I could not be more satisfied!

Dr Nuno M Reis

Lecturer
Loughborough University

I joined the Department as a post-doctoral research fellow in 2007. In 2008, I was awarded a Marie Curie Intra-European Fellowship by the European Commission to explore the use of plastic MicroCapillary Films (MCFs) in the intensification of biopharmaceutical separations. Initial trials were promising and resulted in the development of MCFs as an immunoassay diagnostics tool.

In August 2011, I became a permanent Lecturer at Loughborough University.

I will always remember Cambridge not just for the good collection of scientific achievements but mainly as the city where I built a family (my two children, Ema and Edgar, were born at the Rosie maternity, and my wife Cassie worked in the department for few years), met fantastic people, made good friends, and had the opportunity to work with a true innovator who acted as my supervisor, line-manager, mentor and friend: Professor Malcolm Mackley.

Dear Dr Sarah

The brilliant doctor is back again to help you with more of your chemical engineering dilemmas. In this edition we're treated to a double dose of her infallible wisdom! If you have a question that you would like addressed in the next issue, email ceb-focus@ceb.cam.ac.uk

Dear Dr Sarah…
A PhD is of course a huge commitment – especially if nothing seems to work at times – how do you stop yourself from becoming some sort of weird engineering hermit who mumbles to themselves constantly?
Thanks,
A weird engineering hermit

Dr Sarah says…
It would be irresponsible for me to say "try sex, drugs and rock 'n' roll", since these are fairly dangerous pursuits nowadays, especially the drivel that passes for rock music – Ozzy Osbourne would be turning in his grave. What? He's not dead? Blimey, he should be …

Taking 3+ years (HoD wants less of the + please) to undertake a PhD requires dedication, but it doesn't mean that the rest of your life has to be on hold. It's all about achieving the correct balance. I once saw a TV programme where a guy did some crazy martial arts to crack open a block of concrete with his toes, and then to balance out this violent act he immediately did some calligraphy whilst standing on a layer of unbroken duck eggs. You don't have to be as extreme as that, but personally I like to keep in mind that wacky image.

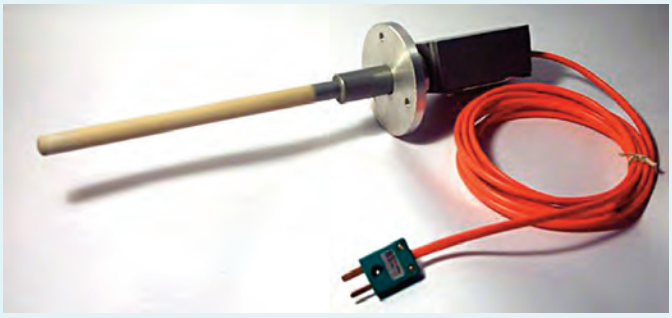
Enjoy using the other side of the brain for a change – do something that cannot be appreciated in a rigorous scientific way, such as poetry, or management consultancy. Try to become more in tune with nature as well – I'm not suggesting you go out and hug a tree or dig a vegetable patch, but just be more aware of what's happening around you. I once spent five minutes staring at a patch of grass; admittedly I'd had six pints of snakebite and black, but it felt like the right thing to do at the time.

Also, it's important to meet lots of different people. Unfortunately most of the humanoids you'll socialise with here in Cambridge are complete loony-weirdos anyway, so try to go further afield in your quest – and I don't mean just signing up to some interweb FaceLink chat room and seeing how many 'friends' you can collect. Have face-to-face conversations with people; talk but also *listen*, otherwise you may as well just mumble to yourself.

Yes, one can get despondent when things don't work out in a PhD, but isn't that true with most aspects of life? In the end the winners learn to deal with it, so stop being a loser and get cracking!

Dear Dr Sarah…
I have been pining for a particular thermocouple for a long time in order to advance my education. It's reliable; it's precise; it's perfect for me. But recently, a different thermocouple has made itself available. I am starting to like the new thermocouple but I've heard that it is popular with many users and I may not be able to have it for too long. I have to choose one. Which thermocouple should I go for?
Lady Kelvin

Dr Sarah says…
The answer is easy – the one with the larger heat transfer coefficients.



A thermocouple – size does matter. (www.thermocoupless.com)

A Student's Process Flow-sheet

Alastair Clarke
Editorial Team Member

In 2009, the government requested a review. Their goal was to ensure that our higher education institutions are "sustainably-financed", "accessible to anyone who has the talent to succeed", and provide world-class teaching[1]. As a consequence of the review, led by Lord Browne, in the next academic year the tuition fee cap will rise from £3,225 (in England) to £9,000. With higher fees, come greater debts so students have had greater pressure on them to consider the economic value of their degree. The government should recognise that the task of scaling-up a process constrained by economics is well-suited to chemical engineers. Imagine you were the Education Secretary: how would you mass-produce high-calibre chemical engineering graduates?

Brief: Given a raw feed of engineers and natural scientists from Part IA you must produce graduates with "advanced chemical engineering knowledge and skills"[2]. Each student can spend three years in the process.

Findings: We find that the conversion process requires various unit operations to be performed. A process flow-sheet is sketched in Figure 1 to aid our discussion.

Students enter the lecture theatres (LT1 and LT2) distributed around a mean time of 9am. They experience a residence time of two hours, before they leave, exponentially-decaying towards the Tea-room. The lecturers act as catalysts to aid the conversion process. Not all students are adsorbed by lectures, and not all catalysts have large effectiveness factors. We are not sure what happens in the Tea-room but it seems to benefit the process. Students reside for an average of twenty minutes, gossiping, discussing supervision work and telling tales of college life. A large pressure drop is experienced here before students are recycled to lectures and practicals. Supervisions then follow, giving a chance for the un-reacted to be converted. The heated debate prepares the students for boiling point in the final stage called 'Tripos'. Here product quality is evaluated, and students are graded, with the older, loftier minds going to the Senate House and younger products being recycled.

References

1. Browne, J., 2010, Securing a Sustainable Future for Higher Education: An Independent Review of Higher Education Funding and Student Finance, London, p. 2.
2. IChemE, 2011, Accreditation of Chemical Engineering Degrees: A Guide for University Departments and Assessors, accessed 12th December 2011, from URL www.icheme.org, p. 3.

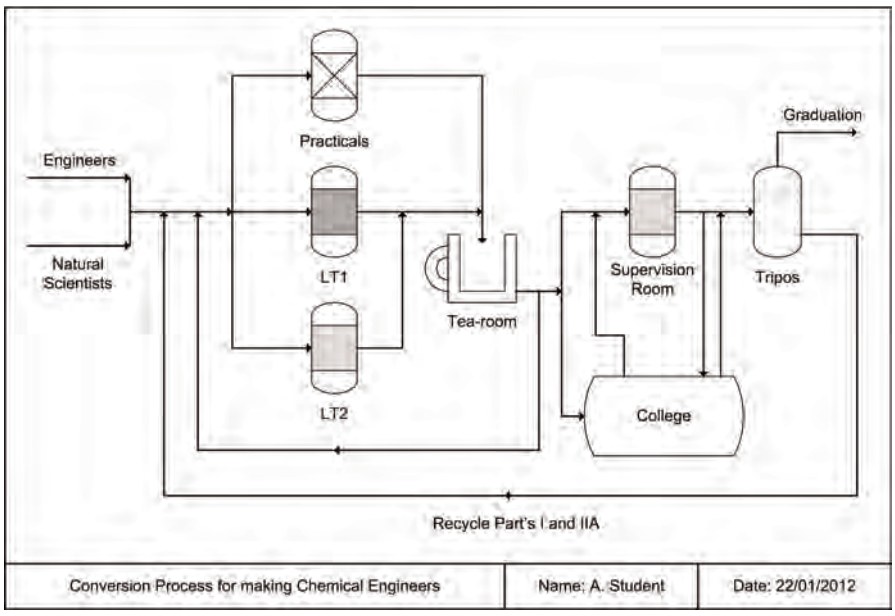


Figure 1. Process Flow-sheet of the Chemical Engineer Conversion Process

Letters to the editor

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