

CEB*Focus* Department of Chemical Engineering and Biotechnology



Remembering the late Dr Robin Paul: CEB New Building Pioneer

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Message from HoD Professor Nigel Slater



For several years CEB has operated a successful Summer School for young students from the Beijing University of Chemical Technology, which enhances our international reputation, and events during Lent Term have further focused my mind on the rich cultural diversity that CEB

and Cambridge benefits from and the opportunities this presents for international outreach. Almost a quarter of our undergraduate class are from Asia with China highly represented at both undergraduate and graduate levels. At the invitation of one of our Chinese students my wife and I attended the Cambridge Chinese New Year Gala Event in early February, at which I gave an address on behalf of the University. This was an immensely enjoyable cultural experience that made a deep impression on us. At the end of Term, I travelled to Tianjin in China to give my IIB lecture module on Biomanufacturing to a class of industrial biotechnologists and was again struck by the warmth of their hospitality and their enthusiasm to learn about Cambridge and to work with us. International reputation and reach are vital to CEB and I welcome contact with any alumni that can help us to enhance that. With best wishes for a wonderful summer!

Notes from the Editorial Team



CEB Editorial Team led by Elena Gonzalez (middle) with Jantine Broek, Chensong Gao and Jawad Rehman to her left and Ipshita Mandal and Dr Yungfeng Gu to her right. Jim Ross also a member but not present!

The *CEB Focus* Editorial Team wishes its readers a fantastic end of academic year and a wonderful summer!

The Editorial Team is led by Elena Gonzalez, PA to HoD Professor Nigel Slater, and assisted by fellow editors PhD students Ipshita Mandal, Jantine Broek and Jawad Rehman as well as Undergraduate Rep Chensong Gao and Postdoctoral Researcher Dr Yunfeng Gu.

Team members commitment to the project and enthusiastic ideas are key in further developing the newsletter look and editorial content and 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.

On the *Cover Article*, Department members take a trip down memory lane reminiscing about their past interactions and experiences with Chemical Engineering alumnus and CEB New Building Pioneer, the late Dr Robin Paul, a true friend of the department whose ambitious vision and own generosity laid the foundations for the upcoming move to a new home in West Cambridge. The new column CEB Innovation reveals interesting facts about bio innovation in Cambridge. Graduate Hub brings news from the annual MBE trip to the Boston Bio-cluster. Research Highlights feature CEB researchers' contribution to ChemEngDay UK in Imperial College and the creation of a new CEB research group, P4G, after the friendly merger of the Polymer Processing Group and the Powder and Paste Processing Group. The Research Feature presents a ground-breaking research article on Optimisation of Chemical Engineering Processes by Dr Vassilis Vassiliadis in collaboration with Dr Ian Wilson and PhD student Thomas Pogiatzis. Also worth noting is the Alumni Corner featuring Chemical Engineering alumnus Dr Anson Ma's insights on the value of chemical engineering skills. People Focus welcomes a new appointment, Alexei Lapkin, Professor of Sustainable Reaction Engineering. Finally, Teatime Teaser returns with more CEB celebrity look-alikes and popular comics by PhD student Leo Hurtado!

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

Remembering the late Dr Robin Paul: CEB New Building Pioneer

Elena Gonzalez



Late Dr Robin Cameron Paul CBE - 1935-2008 (Corpus Christi College)

Emeritus Professor Malcom Mackley recalls; "In 2006, Robin Paul invited me to join the Royal Academy of Engineering, McRobert Award Committee for Innovation. This was definitely the most fun committee I have ever served on and some of its work involved zooming around the country in pairs and groups assessing the merits of different UK engineering innovations. One visit took Robin and myself to Stoke on Trent and on a cold and wet railway platform I had a discussion with Robin about the idea of a new building for the Chemical Engineering Department at Cambridge. Robin was a very loyal and true supporter of Chemical Engineering. He did a few calculations there and then and reckoned there should be enough Cambridge Chemical Engineering alumni of his generation who, provided they all chipped in, could go a long way to funding a new department building. Robin was not just an ideas man. He led from the front and soon afterwards he committed some of his own funds to the project. Sadly his untimely death meant that he was unable to complete his campaign with his colleagues, or even know that his ambition for a new department was in fact now being

fulfilled. Robin had felt he had greatly benefited from his Cambridge Chemical Engineering training and he was someone who wanted to put something back into the system. I salute you Robin for being a fine gentleman, for your generosity to Cambridge and also for helping me realise, albeit a bit late in life, that some committee work can actually be fun."

Eminent Alumnus and talented Chemical Engineer Dr Robin Paul, matriculated in 1955, was a great friend of the Department throughout his career. A man of great energy and considerable intellect he became Deputy Chairman of ICI Mond Division before leaving to be Chief Executive of Albright and Wilson and guiding it through a successful stock market flotation in the mid 90s. He took on many other responsibilities within the chemical industry including President of the Institution of Chemical Engineers and of the Chemical Industries Association. He was an early figure in the UK chemical industry to recognise the need to tackle the impact of carbon emissions on global warming and became a steadfast advocate for change within the industry. He was a founding member of the Government's Advisory Committee on Business in the Environment from 1991-93 and took an active interest in the early years of the Prince of Wales' Business and the Environment Programme. He was awarded a CBE in 1996 for services to business and the environment. Dr Paul was appointed to the Board of Courtauld Plc as a nonexecutive director in 1994. He was a senior elder of St Columba's (Church of Scotland) in London and assisted with its music, publications and pastoral work. He was an excellent pianist as well as being an enthusiastic cyclist, photographer and botanist. Dr Paul's environmental interests showed themselves in his early adoption of an energy-efficient vehicle and in his support for nuclear energy as an important form of power generation. He maintained close links with the Department since he graduated and pioneered CEB's fundraising efforts for a new building. He brought energy and drive to the project and encouraged the involvement of alumni as well as industrial partners. His challenging questions, strong support and personal commitment have been missed but his impact will continue to be felt as our fundraising carries on and as the ideas he laid the ground for bear fruit.

Former Head of Department and Robin's supervisor Emeritus Professor John Davidson remembers; "I first met Robin when he was a final year student studying for the Chemical Engineering Tripos, then taken at the end of the fourth year in the University. I supervised Robin in his project work. The project was to measure the rise velocity of a single bubble injected into a fluidised bed, using an 8 mm cine camera taking pictures of the bed and of an adjacent stopwatch. Robin showed great energy, drive and enthusiasm, obtaining lots of data, which was presented to an audience in Manchester, provoking satisfying ovation.

Robin was a co-author of the first paper on fluidisation from the Department: Trans Instn Chem Engrs (1959) 37, 323. He was thus a pioneer in research. Several years later he gave an evening lecture, to the undergraduate Chemical Engineering Society, about his work at ICI where he was rising through the ranks. At question time, one of the students asked 'whether all this theoretical stuff we get in lectures is of any value in industry?' The teaching staff held their breaths for the reply. It was reassuring 'Oh yes' said Robin, 'I keep my lecture notes at the office and look at them once a week or so".

It was prior to the merger with Biotechnology back in July 2008 that the idea for a new building CEB building was born. As his *'alma mata'*, Robin felt closely connected to the Department and his fellow classmates. He was a great ambassador of the Department defending its interests and needs everywhere he went. He was the leader of



the Alumni Fundraising group that included several other alumni advocates like Peter Davidson, Ruurd de Fluiter, Hamish Rankin, Adam Barnes, Tony Gillham, Jaap Brinkert, Bill Wilkinson and the late Malcolm Williams, who sadly passed last year.

Unfortunately, Dr Paul could not take part in the Chemical Engineering 60th Anniversary celebrations in July 2008 due to his illness. He died later on that year but not without leaving an amazing legacy behind as well as a generous sum in his will as a

Latest New Building Design by BDP Architects: North and South Elevations

gesture of thanks for the positive impact chemical engineering education had made on his career and personal life. His gift and others that followed kicked off the race towards a move to a new building in West Cambridge following the merger with Biotechnology.

Dr Tony Gillham, a member of the original alumni fundraising group set up by Robin, nicely remembers; "Most of us, of a certain age, when we look back after retirement on our careers will have come across a very small number of people who from an early stage, looked to be heading for the top of their profession. One such person in my experience was Robin Paul. He made an impressive start academically in Cambridge and quickly rose up the management ladder in ICI. I first encountered him after leaving Cambridge and joining ICI Mond Division where he was my first boss in Castner Kellner Works. He appeared to make an almost effortless rise through the management layers in ICI as a result of his ability to analyse and grasp strategic needs and take the necessary action. Coming into a new job he often had to implement some tough decisions on staffing levels, decisions I suspect that should have been made much earlier in ailing businesses.

He adds; "Our paths diverged after about a year in ICI but we remained good friends. Robin had a racy side and I can remember buying his potent MG sold when his family started to grow. Robin attended my wedding and we would meet from time to time at Glyndebourne and elsewhere through a shared affection for opera. He also acquired a reputation for being determined and purposeful in his business life, but away from business and amongst friends he showed a warmth of character, a wide range of interests and sense of fun. He was modest about his own achievements including his musical ability. I remember reading on one occasion a review in The Daily Telegraph of a concert at which he had played the piano. He seemed to have boundless energy and on retirement some of this was directed towards support for his Church. It was typical of him that where he felt a commitment towards something he would give it wholehearted support. There is no better way of showing this than in his work to raise finance for the new CEB Building. Not only did he throw huge energy into developing the vision and helping the campaign but he also made a large personal donation towards it.

Front Cover Article



Latest New Building Design by BDP Architects: East and West Elevations

When he asked me to help in fundraising I can recall my feeling that because he was heading up the team it was going to involve a lot of commitment and work but it would be successful. The buzz he generated made it unthinkable that anyone would turn down his invitation to help! He was an exceptional and very gifted man and is greatly missed."

Sir David Harrison, former department academic, added; *"When Robin was in his final Tripos year he was not short of offers of*

employment. It was a buoyant time, certainly for talented people. He told me that was grateful for the offers that had come in but then said - 'But they are all beyond the Arctic Circle'. Remembering that he had been at school in Rugby, I ventured the thought that his Circle was perhaps the river Trent (He first started work in Cheshire). He replied - 'Oh no, the Thames'."

Elena Gonzalez, PA to Professor Slater who also looks after alumni matters at CEB, recently met Mrs Catherine Paul (Robin's widow) in Kensington, London. Catherine shared very fond memories of Robin and insights into his drive and character "Robin was immensely proud of having studied at Cambridge, and his passionate interest in ensuring that the Department of Chemical Engineering and Biotechnology should get the building it needed and deserved for the next century was of major concern to him. He was acutely aware of the debt he owed to the Department in Cambridge for his successful career in chemical engineering, hence his desire to be involved in the rebuilding project. His commitment to engineering and the environment extended to his enthusiasm for rail travel – especially the Eurostar (we travelled to Lille on the first Saturday it ran from St Pancras) – and the magnificent engineering of the TGV line to the South of France, an excuse if one were needed for some splendid holidays. But he also loved the slower line to the very far north of Scotland, and it was whilst we were on holiday in Sutherland that he was taken very seriously ill and admitted to hospital in Inverness. There his main concern and disappointment was that he would miss the initial dinner of alumni in Cambridge. When it became clear to him that he would not be able to make this, always conscientious, he was in touch with Cambridge from his hospital bed to ensure that all went well. Robin was a man of many parts – outstanding intellect, huge energy, hard work, constant application, great integrity, committed Christian and, to his family, a loving, caring and wise tower of strength – very much missed. He would indeed be thrilled to see that his vision was now becoming reality, and that construction is about to begin on a stunning new building".

Elena was able to tell Mrs Paul that despite Robin no longer being around us, his vision is finally being materialised as he would have liked and CEB will soon be moving to its new premises on the West Cambridge site. With construction on site due to be starting end of this year, CEB New Building will be ready to open its doors to students for the first time in the academic year commencing October 2015.

However, we are still a considerable way from realising the financial contribution to the New Building costs that the University has asked of us but generous donations like Robin's, as well as that from Johnson Matthey PLC, have demonstrated valuable support for the department that is much appreciated. Their motivation for giving was to ensure that future generations of talented minds can benefit from a Cambridge education in chemical engineering and we are resolute in our determination to ensure that can happen.

CUCES Lent Term 2013

Lent term 2013 was another successful term for CUCES, with a number of varied careers and social events. CUCES would like to thank all those for taking part and hope that you enjoyed it as much as we have.

T-shirt Design Competition



The T-shirt design competition was opened to for students to design the most witty representation of Cambridge for Frank Morton. Many people expressed interest in the competition, but unfortunately, due to a lack of experience in Photoshop editing, many people's brilliant ideas couldn't be realised. In the end, there were a total of 3 entries.

The CUCES committee had a difficult time choosing the most amusing and least offensive design. But in the end, the winning design was Chensong Gao's 'Will & Kate – Royal Plumbers Commando'. This was decided to be particularly witty as Will and Kate are the Duke and Duchess of Cambridge (Royals) and the Royal Navy was a major sponsor of Frank Morton.

Frank Morton Day

Frank Morton Sports Day 2013 took place in Newcastle University on Tuesday 12 March. The department kindly rescheduled all undergraduate lectures this day so that students may attend the event. Despite the long journey needed to get to Newcastle, many people wanted to take part and compete. In the end, Cambridge entered a total of 49 people into 8 different sports including: bowling, dodgeball, football, netball, rounders, table tennis, tag rugby and tennis. The best performing team was the netball team, who made their way into the finals of the competition and lost by a very slime margin to the Royal Marine's team.

Annual Dinner

The Annual Dinner took place in the Royal Cambridge Hotel on Sunday 10th March. A total of 86 people including undergraduates, graduates and members of staff attended the dinner.

Although the quality of food was average, the event was enjoyed by all. Everyone basked in the pleasure of each other's company to celebrate 2 successful terms of learning. Dr Patrick Barrie gave an uplifting and inspiring speech about the accumulation of knowledge that is core and fundamentals of the department.

After the dinner, a Karaoke was set up and people performed in solos, duets, or groups and gave memorable renditions of many famous songs including *A Whole New World, Cry Me a River, Always,* and *I Knew You Were Trouble.* A dance floor was available at the centre of the room and people danced happily into the night.



Chemical Engineering Undergraduates competing in the Frank Morton Games

Undergraduate Focus

New CUCES Committee

The CUCES elections took place on Tuesday 12 March in the tearoom. The New Committee members elected to take charge as from the start of Easter Term are:

President: Phanos Anastasiou Secretary: Supriya Gopinath Treasurer: Jenny Overton Careers Officer: George Qiao Social Secretary: David Moody Webmaster: Kripa Balachandran

Congratulations goes out to the new committee members on winning the elections. The old committee wishes you the best of luck next year and hope you will have a smooth handover. The New CUCES Committee will be organising the much –awaited Summer BBQ sponsored by BP, which will be taking place sometime in June.

Undergrads Shine with Chinese Orchestra Society

Cambridge University Chinese Orchestra Society Annual Concert -- 'Chapters of Life' took place on 24 February at West Road Concert Hall in Cambridge. The event was sponsored by several local Chinese



businesses. The audience included University members and students, who thoroughly enjoyed listening to the incredibly delightful pieces. It was worth noting that at least 10 of the hugely talented orchestra members happen to be

undergraduate chemical engineers from the department with Kok Foong Lee being the conductor and Aylwin Low playing a solo on Chinese Zither (Zheng). If you have ever been to the Fitzwilliam Museum Han Tomb Exhibition you could see the orchestra playing identical Chinese instruments discovered thousands of years ago. Different aspects of Chinese music were featured, *"some profound with a Zen finish and others courageous and powerful like a sword, yet poignantly beautiful";* the Orchestra members commented. Overall, a fantastic musical evening was had by all and an event not to be missed next year's CEB's social calendar.



The Chinese Orchestra Society playing at the West Road Concert Hall

Green Impact Fever hits CEB

Sarah Broadbent and Andrew Cheung, CEB Green Impact Team



Head of Department Professor Nigel Slater supports the initiative on 'Wear a jumper to work day' on Switch off Week

Green Impact University of Cambridge has now been launched and teams across the University including CEB has taken part in this Environmental Accreditation Scheme for the first time. This National Union of Students (NSU) initiative was piloted at the University of Bristol in 2008/2009 and since then over 50 Universities and Colleges throughout the country have signed up to take part. It brings together staff and students to decrease the environmental impact of the departments they work in and earn a recognised environmental award. CEB has joined in the University-wide scheme help increase environmental awareness.

Green Impact Team Leader Dr Sarah Broadbent, CEB Post Doctoral Researcher commented; "As Chemical Engineers we are well placed to minimise our environmental impacts both in terms of pollution and developing greener, more sustainable processes. Here at CEB we are all keen to ensure that the department is running as efficiently and 'sustainably' as possible and so we decided to enter a team into the Green Impact Awards for the 2012/2013 academic year."

CEB's Green Impact team is made up of staff and students from different areas of the department who got the department involved in the *Cambridge Green Challenge Week* working towards getting a bronze award. Throughout 18-24 February the team organised different daily activities to promote energy conservation such as 'Wear a jumper to work day' or 'The Wednesday Lunchtime Switch Off' to encourage lunch-time 'switch off.'

Sarah happily reported that during *Switch Off Week* the University as a whole decreased its energy consumption by 2.1% when compared to the previous week. CEB was above the University average saving 3% and those in Old Metallurgy in Pembroke Street saved a massive 4.75%. The scheme is proving successful as it managed to decrease electricity consumption for the department and also raised awareness. Sarah commented; *"If we kept up this good work all year, under the Electricity Incentivisation Scheme this would equate to a £8,116.68 cheque to the department! As one student suggested to the Green Impact Team – why not make every week switch off week? If we reach the standards expected by NUS we will be attending the Green Impact awards ceremony in June". In the meantime, she has asked for ideas to save energy in the department to be emailed to the Green Impact Team on greenimpact@ceb.cam.ac.uk*

MBE Annual Visit to Boston Bio Technology Cluster



MBE students amazed at robot display in Boston Lab

The recreational highlight of the recent Master's in Bioscience Enterprise (MBE) study tour to the Boston bio cluster was the visit of the worldrenowned MIT Media Labs in. MBE students were introduced to smart prosthesis technology, analyses of the cultural aspects of mainstream media and to a number of humanoid robots destined to provide emotional support to children under-going potentially stressful medical interventions. The students and host companies were also invited to a reception at Beacon Hill, home of the BritishConsular General for New England, an evening of networking and conviviality that further cemented professional connections made during the business aspects of the trip.

The aims of the tour are to provide students with insights into all aspects of the highly successful biotech cluster in Massachusets and to provide a business context for some of the more theoretical aspects of their course. Students also visited world-class research foundations and translations organisations including the Whitehead Institute, Massachusetts Life Science Center and the CIMIT and financial firms responsible for funding early stage ventures like Mass Medical Angels and venture firms SVLS and Third Rock Ventures. Host companies visited provided examples of virtual and fully-supported business models for technology companies such as NKT Therapeutics developing treatments for sickle-cell disease and Sage Therapeutics whose high-finance business model addresses aging. Yet more companies described their innovative approach to drug or device design, as with Avaxia's biopharmaceuticals and ETEX Corporation's bone implant technology.

Deserving special mention is Cubist Therapeutics, employer of 700 people and recognised as an important and expanding player in the acute care space, who provided an afternoon of brainstorming and innovation sessions run by senior executives including Ronnie Farquahar, Director of Discovery and Steve Gilman, Director of R&D. Also Agamatrix, founded and run by Institute of Biotechnology graduates Sridhar Iyengar and Richard Williams, which continues to rapidly build on the success of its diabetes measurement business. The Apple iphone-compatible iBGStar as well as their other devices is available globally under a licensing deal with Sanofi and manufacturing is now carried out in their own state-of-the-art facilities in South Korea and China as well as in their impressive New Hampshire Headquarters. Sales of their devices have topped three million units and strips 20 million units, truly impressive achievements for this innovative team of Biotechnology alumni and their colleagues acknowledged as "inspirational beyond measure" by current MBE students.

MBE students win Jailbreak 2013

Tim Lindsay and Brett Gardiner, MBE students



Cantab convicts at their far away destination Hong Kong

On 25 January, armed only with Jailbreak t-shirts, costumes, an assortment of goodies and ingenuity, over 350 people were released into the world for 36 hours in an attempt to get as far away from Cambridge as possible. Among those were two current Master's in Bioscience Enterprise (MBE) students, Tim Lindsay and Brett Gardiner, who were eager to compete in this unique experience.

After winning the challenge they happily reported; "Our success was purely reliant on the goodwill of others. We have both been overwhelmed by the support given to the Cantab Convicts and are delighted to report that we won first place in the fundraising competition raising £2210 for ten very worth causes in addition to the funds raised for our plane tickets. Furthermore, we ended up in second place in the distance race making it all the way to Hong Kong (5936 miles)."

No travel can be arranged in advance and personal funds cannot be used. There are two methods you can win in Jailbreak: travel the furthest or raise the most money for charity. As we were sponsored by friends and family on a per kilometre basis, we knew the further we travelled the more money we would raise for charity. And how we did it? Well, raising enough money to fly to Hong Kong in 12 hours was not an easy task!

Having prepared their koala costumes with the aim of making it to Australia for Australia day, the night before the start of the challenge they drafted hundreds of emails to small and medium sized travel based start-ups all over the world. This is the story behind their challenge as Brett and Tim recall it *"Rather than asking for donations we asked for help to 'fly us around the World!' Although this set us up for even more abuse it also* got people interested and we suddenly found people stopping to us to ask what we were doing. With conversation (and a little bit of charm) came bigger donations with £10, £20 and even £30 coming from complete strangers"; Brett said "Also, we approached each airline to explain our situation. We had roughly £1000 pounds – an incredible effort - but wanted to get as far away as more distance equalled more money for charity!!" However, begging is illegal at Heathrow and time was quickly running out for them.

Brett adds; "Meanwhile, our story was going viral with Tweets and re-Tweets circulating the Twitterverse with famous Australian rugby stars from the Wallaby's and Melbourne Rebels promoting our cause but still we were short on funds. In desperation we hit the phones and asked our amazing friends for support, who offered their support and our tally increased. Eventually, we made it over to the Cathay Pacific desk where there was a lady working we had spent some time buttering up earlier in the day. She was happy to waive booking fees but could not budge on the price. Agonisingly we were about £100 short and it looked as though all was lost when Tim received a text from a friend who was willing to donate in £110, more than enough to get us on the plane!' Emotionally exhausted and facing the prospect of sleeping on the hard floor of Heathrow, suddenly we realised: We were going to Hong Kong." Though exhausted, Brett and Tim were humbled, overwhelmed and proud at having witnessed the generosity of those around them and seeing what it can produce. They wanted to thank everyone who donated as they couldn't have done it without them.



Jacobs Work Experience

Emma Cull, Jacobs Graduate Process Engineer



I joined the Jacobs in September 2010 after obtaining my Chemical Engineering degree from the Department On my first day at the Port Solent office (then Aker Solutions) I got started on my first Carbon Capture project aimed at striping 1 million tonnes of CO₂ per year from part of the flue gas of a power station and transport it by pipeline for indefinite storage. I enjoyed the steep learning curve of getting familiar with the procedures and guidelines of the company, as well as getting on top of the scope of the project. My role was interesting, the work varied and challenging and gained engineering design experience very quickly. Six months after starting I was given the opportunity to attend the Jacobs Future Graduate Weekend at the Camp Allen Conference & Retreat Centre in Texas, where I met over 100 Jacobs graduates from a variety of fields from all over the world. It was useful to learn about the breadth of work Jacobs is involved in (see Jacobs' company profile in the Industry Business section on p. 18)

Shortly after I was assigned to a very exciting project in Leiden (Netherlands) to reduce operational expenditure of Southern North Sea Joint Development Area by adopting a new operating model and converting from dry to wet gas operation: an AJS off-shore gas project (AMEC Oil and Gas, Jacobs Engineering Netherlands B.V. and Stork Industry Services Netherlands B.V. joint venture organisation). I was given varied and challenging work again with increasing responsibility.

After just thirteen months in Leiden, I was assigned to Dow Technical Center in South Charleston, West Virginia, US. I am now here working on two Dow METEOR[™] Ethylene Oxide/Ethylene Glycol Technology projects and gaining in-depth knowledge of the process technology whilst further increasing my process engineering skills and knowledge.

Jacobs has given me the opportunity to have such a varied career in just 2.5 years and to grow as an engineer as part of a large and diverse company! I have truly enjoyed my experience and I have gained so much from many very experienced and knowledgeable engineers, who have helped me develop. Outside of the busy project schedules I've enjoyed site visits and "Lunch'n'Learn" sessions, a presentation skills training course, and graduate training sessions. As a Graduate Process Engineer I also have an assigned mentor and receive support towards gaining chartered status through IChemE. For job opportunities contact Ian Salmon on ian.salmon@jacobs.com

Exam Tips for Chemical Engineering Undergraduates



Exams are around corner and you will have been thinking about preparation for sitting the exams. For departmental advice on exams look at 'Common Sense Guide to Examinations' on CamTools, a presentation uploaded by Dr Patrick Barrie, Director of Teaching. You can also find it under 'Exam Preparation Guide' on www.ceb.cam.ac.uk/pages/chemical-engineering-tripos.html. If you have any questions consult Dr Barrie or your Director of Studies (DoS).

Some additional thoughts, which you may like to consider, follow:

Before the exams

Do lots and lots of revision. Use your time efficiently. Plan your time to cover the notes, and to do lots of practice questions without the notes – consult them afterwards if necessary. There's never time to do enough - if you think you've done enough you're wrong. Doing past Tripos papers can help you answer exam questions and solving problems. Timing yourself while doing past exams simulates the upcoming exam and lets you know if you need to be faster at completing the questions. It is very important that you make sure you know what each formula is used for and how it is used. You need to be fresh for the written exams. Have breaks in the revision period when you do something different, preferably including some physical exercise. Wind down the revision in the 2-3 days before the start of the exams. However, everyone's different so you need a custom-built study timetable.

In the exams

You're trying to communicate with the examiners and show that you're an engineer, so make it easy for the examiners: write legibly, write on one side of the paper, define symbols, annotate figures, be logical, use sensible numbers of significant figures, use conventional notation, if you can't find the mistake comment on a daft answer, put in those brackets, put in those horizontal lines for fractions, use 1 treasury tag for each script, put questions in numerical order not the order you did them, put page numbers for each question not for the script as a whole.

* Read the question and think about it as a whole. After you've finished a question, read it again to check you've answered all parts and answered what was asked.

* Don't spend much time totting up section marks: use those marks mainly to get an idea of how much work each section might need.

* Don't use Tippex (or other correction fluid): you might forget to go back and fill in the right answer.

* Answer that last section that asks you to make comments. You can do it.

CEB Editorial Team also spoke to one of our graduates Dr Sam Goonerate, now lecturer at Teeside University, who shared her tips on dealing with exams; "Id say not having enough time to revise is a big common concern. The solution to that would be to make the most of the time that you do have, because worrying about not having enough time just takes up more time. Another one is panicking and then forgetting what you thought you understood. The solution is to rotate what you're studying so you don't overthink things, and when you're really stuck, ask a supervisor (not a friend, because there's no guarantee that they've understood it properly). As per tips for tackling the exams – none really! - Each person has their own way of dealing with the exams and it's up to each student to find their own preferred way. Some want to read through everything, some want to do every question available, some want to make short notes, some want to cram. Since they've already had one Cambridge exam they probably already know what works and what doesn't work for them. I'd advise them to use that experience. e.g. if cramming didn't work last time (which would almost definitely be the case), then don't cram this time! Simple". Sam adds; "there is no such thing as a stress-free exam period. You need to have stress. The whole idea of exams is that it tests how you perform under stress. It is a reasonable argument that as a professional engineer, you'll face non-negotiable deadlines and that will create a lot of stress. The sooner you get used to working under those conditions, the better. Don't try and get rid of the stress, instead learn how to work effectively with it."

New Paste, Particle and Polymer Processing group (P4G)



Freezing droplet sequence

The P4G was formed in January 2013 by the, friendly, merger of two of the groups in the Department of Chemical Engineering and Biotechnology with an interest in structured materials and processing: The Paste and Particle Processing group (P3G) is

led by Drs Ian Wilson, Sarah Rough and David Scott and the Polymer Fluids group is led by Dr Bart Hallmark.

Their interests lie in developing the understanding of processing of pastes, particles and polymers, and their flow behaviour in particular. *"We rarely synthesize components: rather, we build from existing materials. We apply that knowledge to manufacture, at industrial scale, products with desired microstructure or function, or, equally important, to resolve problems encountered in processing such materials*" Dr Hallmark commented.

A substantial part of the activities led by Dr Wilson is related to studying the formation and removal of fouling layers on heat transfer and process equipment surfaces. Additional activities led by Bart include the simulation and evaluation of novel process flowsheets.

The group's activities range from fundamental theoretical, numerical and experimental investigations to applied and proof-of-concept studies. Current research projects include investigation of the removal of soft fouling layers, factors affecting the polymorphism in cocoa butter, extrusion of pharmaceutical and hard-metal pastes, simulation of fouling-prone refinery pre-heat trains and the flowsheeting of novel carbon capture systems for coal-fired power stations.

The group is part of the Microstructure Engineering Cluster within Chemical Engineering and Biotechnology. There are shared projects with the Structured Materials, Colloid Dispersions and Process Systems Engineering groups.

CEB Young Researchers Thrive at ChemEngDayUK

On 25 and 26 March, The Chemical Engineering Day UK (ChemEngDayUK) brought together for the first time leading researchers, engineers and scientists from around the UK to discuss and exchange information and present the latest scientific and technological solutions from academia and industry. The two-day event at Imperial College (London) provided a forum for chemical engineers and scientists to explore new technological advances and research results.



From left to right: Front row: Alastair Clarke, Yucy Fang, Mariana Domingos, Filipa Gonçalves de Azevedo, Akin Ali. Back row: Carmine D'Agostino, Alexandre Navarro, Pieterjan Van Uytvanck presenting their research at Imperial College

CEB PhD student Filipa Gonçalves de Azevedo, from Dr Silvana Cardoso's Fluids and Environment Group research group, presented her poster on the "Effects of Natural and Forced Convection on Low Temperature Combustion" and won the Best Poster Prize within the Reaction and Catalysis Engineering session. She commented; *"the session was gratifying and the whole experience definitely helped me to deepen my knowledge and my ability to discuss my research with other chemical engineers from various backgrounds. It is always interesting to share our research with people that specialise in other subjects."*

On the first edition of ChemEngDayUK the event featured 33 talks, over 160 poster presentations and even a Thames River

Dinner Cruise to round off the occasion. Alastair Clarke, another PhD student from Dr Cardoso's group, who had the opportunity to present his research added; "I had a great time and he would recommend current PhD students to attend the next ChemEngDayUK in Manchester. The 'Meet the Faculty' poster presentation appealed to me in particular because I had never presented my research in this way before. Moreover, during the ChemEngDayUK we had some excellent talks in which we were bluntly told what employers are looking for in young researchers". Fellow PhD students Alexandre Navarro and Yucy Fang admitted that ChemEngDayUK "gave them the opportunity to broaden their contact network and to get in touch with the current research themes and works of other universities in the UK". Other students who attended ChemEngDayUK and presented their posters were Mariana Domingos, Samy Yassin and Akin Ali. Highlights of some of the posters presented by CEB young researchers are stated below:

1. Effects of Natural and Forced Convection on Low Temperature Combustion, Filipa Gonçalves de Azevedo (Fluids and Environment Group)

The work used timescales to describe each transport and reaction phenomena and focused on their effects on combustive systems. Two problems in a spherical reactor were analysed: a case with a three-step reaction scheme and natural convection a case with a single-step reaction, forced convection and reaction consumption. Two and three-dimensional regime diagrams were proposed to characterise the oscillatory and explosive behaviour of the systems. These results have important implications for designing safe operation conditions for chemical processes such as chemical storage, waste treatment or combustion in automotive engines.

2. Turbulent Plumes and Thermals with internal Buoyancy Changes, Mariana Garcia Domingos and Dr Silvana S. S. Cardoso (Fluids and Environment Group)

In a large number of industrial and geophysical flows, motion arises in the form of plumes and thermals. Examples include volcanic and nuclear clouds, discharges of smoke from chimneys, and leaks from pipelines transporting chemicals.. The behaviour of plumes and thermals with internal buoyancy changes is investigated in this work. using real case scenarios like BP oil spill plume in the Gulf of Mexico and the Fukushima nuclear cloud in Japan

3. Modelling Gas Leaks in shallow Aquifers, Alistair Clarke (Fluids and Environment Group)

Carbon Capture and Storage projects inject CO_2 at great depths. Leakage of CO_2 from a storage reservoir may lead to gas entering groundwater aquifers. Using deterministic models to investigate a range of leak events, flow regimes and scaling relationships are identified that can guide engineers in the field.



Alexandre presenting his poster at ChemEngDayUK

4. Optimization Environment in high-level Computer Language, Alexandre Navarro (Process Systems Engineering Group)

The poster represents a general-purpose optimization environment that allows the construction of several different interaction structures between multiple solvers and function evaluations in a high-level computer language. To achieve this, the interactions between solvers and problem functions are reinterpreted through a client-server framework that bears similarities to several distributed computing systems architectures, such as operating systems and Internet servers.

5. Modelling AIDS, Yucy Fang (Process Systems Engineering Group)

HIV targets the cells that act to control normal pathogens, resulting in complex interactions with devastating consequences. Although progress is booked in understanding of the disease, many questions remain yet to be answered, such as: What causes the eventual collapse of the immune system, characteristic of clinical AIDS? Accurate computational predictions can assist in explaining clinically-observed phenomena. We adopt a first-principles approach in building a biologically-meaningful model. This will provide clues for prolonging the latency period prior to AIDS.

Business as Usual

Ali Yetisen, PhD student, Healthcare Biotechnology, Institute of Biotechnology

Interdisciplinary research was originally conceived to be useful, that is, to create solutions. For problems such as delivering clean water to the developing countries, discovering effective medicines and saving our polar icebergs, cross-disciplinary approaches could be useful. There are some University initiatives that encourage projects with interdisciplinary teams that prepare students for the real world challenges and enable academics to tackle global issues. However, Academics ought to encourage more projects in which students can work with fellows from other departments to help solve real world problems. Although more scientists around the world encourage interdisciplinary projects, there are still some issues with this approach.



One of the main problems lies at both undergraduate and graduate level. Undergraduate students who participate in an entrepreneurship course show difficulties in communicating their findings to non-engineers. This might be due to the limited exposure to team work and presentation skills. There are a few courses in which students can work together, such as the design project, however, this one lacks the interdisciplinary approach. At the graduate level, principle investigators rarely encourage graduate students to collaborate with fellows in other departments. Often there is not much interaction between Humanities and Social Sciences, School of Clinical Medicine and the Business School.

Where is the missing link? The answer is still not clear but it has been frequently talked about. It is said that Professors are generally not interested in establishing interdisciplinary teams, collaborators have different priorities and conflicts of interest arise about the research outcomes including disagreements about the ownership of intellectual property.

In light of this, current practices could be re-evaluated. The existing academic culture should evolve into an environment in which students of all levels work together with colleagues in other disciplines, hence establishing collaborations to create solutions to today's global challenges. Using an interdisciplinary approach can help the scientific community engage in multi-directional conversations, which might eventually lead to a paradigm shift. By fostering interdisciplinary collaboration, these communities break down discipline barriers and create new identities and relationships that transcend departmental affiliation. See below some of the Universities' interdisciplinary research initiatives:

Cambridge Infectious Diseases is a university sponsored strategic initiative. This is a virtual community of researchers with interests in infectious diseases drawn from across the university and its affiliated institutes. They offer networking events, seminars, workshops and even conferences on infectious diseases and global healthcare. Using their website, one can find enthusiastic academics who are willing to share their expertise and provide guidance. Undergraduates can find research internships, and graduate students and principal investigators can establish academic collaborations. Check out www.infectiousdisease.cam.ac.uk

CamBridgeSens is the Stategic Network for Sensor Research at the University of Cambridge. Their members are based across twenty departments within the University's four Schools of Science and Technology. Since 2008 it has introduced a culture change in sensor related research by successfully eliminating departmental barriers in favour of forming a strong multi-disciplinary research community. Check out www.sensors.cam.ac.uk

Scheduling the Cleaning of Heat Exchanger Networks

T.A. Pogiatzis, D.I. Wilson, V.S. Vassiliadis

Heat exchangers are essential processing units in chemical plants, providing the necessary cooling and heating to process streams. With appropriate design of the heat exchanger networks (HEN) significant savings can be made in terms of energy requirements and improve the energy efficiency of production. Well-designed networks are play a critical role in energy intensive processes and particularly where there are large temperature variations among process streams, such as in the petrochemical industry.

Fouling is a natural and inevitable phenomenon that results from the depositions of materials on the heat exchanger surface, reducing its ability to transfer heat by forming an insulating layer of deposit. Cambridge residents are all too familiar with the crystallisation fouling (mineral scale) generated in kettles from hard water. There are no easy ways to avoid this phenomenon altogether, as removing the minerals at source, or use of special surface coatings would be too expensive and unreliable for bulk processing. It is therefore common and unavoidable in chemical processing to have to clean deposits from heat exchanger surfaces.



Figure 1. Schematic showing the impact of (a) mechanical cleaning, and (b) mixed chemical/mechanical cleaning on heat exchanger duty Q. The mixed cleaning supercycle shows 2 chemical cleaning actions, labelled (1),(2), followed by either a mechanical clean (3) or a third chemical clean (3*). The system starts in the clean state at t = 0. Shading in first cycle shows the energy loss due to fouling when operating and downtime while cleaning. Ts is the supercycle time, i.e. the duration of the repeated pattern of mechanical and chemical cleans (2 shown).

This research examined a further detail of fouling and its remediation by recognising that, in many cases of practical interest (petrochemicals, food processing), the fouling layer is composed of two interdependent layers. The first layer formed may be thought of as a softer deposit ('gel'), which with prolonged exposure to high temperatures transforms into a harder layer ('coke'). In industrial practice there are often two or more ways to clean heat exchangers, for example *in situ* cleaning by recirculating chemicals through the isolated unit, or complete removal of the tube bundle for mechanical cleaning. The former action can remove only the softer deposit, while the latter restores the surface to its clean condition (hopefully). Each cleaning method involves different costs as well as different down times for the unit.



Figure 2. Comparison of total annualised loss, TAL, for different numbers of chemical cleaning action per mechanical clean, j.= 0 corresponds to mechanical cleaning only. The timing of the mechanical clean and each chemical cleaning action is optimised over the period between mechanical cleans.

Each time a unit is taken off-line for cleaning, increases the operating costs of the process in that the loss of heat transfer has to be made up by increasing the duty somewhere else. For a plant involving a large number of heat exchanger units, it is clear that there is a need for sophisticated methodologies to optimise the scheduling of cleaning actions. According to this, the time to clean unit(s) and which method is best to use all have to be identified. The task of optimising such cleaning schedules is combinatorially hard, involving highly nonlinear simulation models of the heat transfer across the entire network at each time.

The ageing-cleaning symbiosis concept was developed in the Department by Edward Ishiyama, working with Bill Paterson and Ian Wilson. The novelty of this work lies in the inclusion of the double-layer fouling models into a generic optimisation framework, which has needed innovations in the optimisation techniques used. In particular, the models lead to Mixed-Integer Nonlinear Programming (MINLP) formulations that involve both binary and continuous

decision variables. The binary decisions, taking only 0/1 values, are used to identify the units to be cleaned, the time at which cleaning is done, and the selection of cleaning method. Continuous variables include temperatures, heat loads, and flowrates through the network. The solution techniques are specialised approaches to solve the MINLP models and several of these have been tried in the course of this research. The methods that showed promise are Generalised Benders Decomposition (GBD) and a new derivative method based on Model Predictive Control (MPC) principles.

This work has resulted in several journal papers and conference presentations.

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Interesting Facts on Bio Innovation in Cambridge

Elena Gonzalez



CEB's Erasmus Professor Sabine Bahn with her team of PhD students researching the molecular basis of schizophrenia and bipolar affective disorder in their lab at the Centre for Neuropsychiatric Research, Institute of Biotechnology in Cambridge

The recent move of Astra Zaneca HQ from London to Cambridge is seen as a 'reaffirmation of one of the world's fastest growing business clusters' (Louise Armistead, Telegraph Chief Business Correspondent, April 2013). Another sign of the rapid development of and commitment to life sciences innovation in the region is the Cambridge Science Park, established by Trinity College in 1970, the UK's oldest and most prestigious science park. Now home to over 100 companies and 1,650,000 sq ft of buildings, it continues to attract new businesses, from small start-ups and spin-outs to subsidiaries of multinational corporations. St Johns innovation is another example. Cambridge has also shown signs of growth around Addenbrookes hospital and south of the city in Babraham both housing start-up firms.

The 'Cambridge Cluster' has now become yet another global attraction in Cambridge. The cluster is made up of 1,535 companies which employ some 53,203 people and generated £12.2bn revenues last year. There are five firms worth more than £1bn and the area has one of the highest concentrations of Nobel prize winners in the world. Founded in 1960 by two Cambridge Chemical Engineering graduates Tim Eiloart and David Southward, who set up *Cambridge Consultants* - the catalyst for the UK's if not Europe's leading technology cluster, prompting a new era of collaboration between academia and the private sector that continues to influence the growth and prosperity of the city. Bioscience spin outs started coming out of the University in the 70s helping give birth to 'Cambridge Phenomenon'¹.

CEB Focus Editorial Team also consulted Cambridge Enterprise Ltd (CE) on the state of biotechnology innovation in Cambridge. CE is responsible for the commercialisation of University research. Sarah Collins, CE's Marketing & Communications Manager, has shared results of recent findings from data compiled back in 2012 revealing some interesting facts on life sciences in Cambridge and Cambridge University spin-out companies:

- The are 156 life science companies in the Cambridge cluster
- IVF specialist company BlueGnome was sold to Illumina for \$95 million, returning £8.5 million to the University, a 92x return on the University's original investment.
- £16.5 million in translational funding was won by University life science researchers with the assistance of Cambridge Enterprise. This funding is being used to develop new therapies for conditions including liver disease, chronic pain and healthcare-associated infections.
- Cambridge has established an open innovation drug discovery initiative with GlaxoSmithKline (GSK), where University researchers will work alongside GSK scientists and other partner organisations to advance drug discovery and the development of new medicines.
- Alemtuzumab (originally known as Campath and based on research carried out at the University in the 1970s) has been shown to be an effective treatment for multiple sclerosis in phase III trials. It is expected that the drug, known commercially as Lemtrada, will be released in late 2013.
- 4 licences were signed in the life sciences in 2012.

Evidence seems to suggest that, Cambridge, being well positioned and connected, is also a prime 'incubating' environment for life science start-ups, which could provide the solution to UK's economic problems. The economic, social and environmental impact of the companies and the people they attract are evident in the city's rapid expansion and plans for future infrastructure development.

¹ a term first coined by Peta Levi in a Financial Times article in November 1980, describes the incredible explosion of technology, life sciences and service companies that has occurred in the city since 1960.

JACOBS

Ian Salmon, Technology Manager

Jacobs Portsmouth office has been a member of the CEB Teaching Consortium since 2006 (when it joined as Aker.) From 2011 we became part of the Jacobs group. We joined as we felt there was value in having a Contracting company join the Consortium to complement the existing Operating company members. Contracting in the process industries is focused on design, construction and project management and the differentiator in our business from general contracting is the key know how, skills and experience of the chemical engineers we employ. We are very happy to contribute, along with other Consortium companies, in supporting design and teaching/ professional skills aspects of the departmental course work.

Jacobs is one of the world's largest and most diverse providers of technical, professional, and construction services. Jacobs' business spans a range of industry sectors including process, energy, pharmaceutical and infrastructure. Our process business covers oil and gas, refining and petrochemicals. In the UK we have major centres in Glasgow, Stockton, Manchester, Reading, Portsmouth and London, plus a number of smaller offices around the country. We also have major centres around Europe and globally, to serve our clients where there is significant investment, and where they want to grow their businesses.



Ian Salmon congratulates CEB Undergraduate Design Project Winners in 2011

Our process engineers at Jacobs tend to do a lot of front end and conceptual designs of new process plants. Activities in the part IIA Design Project are representative of some aspects of this type of work. We work in multi-disciplinary teams in task forces. Creative thinkers, natural problem solvers, good communicators and effective team workers thrive in our organisation. We also engineer and project manage major projects all the way through to construction completion and start up, ie to a state where it is producing the materials and products our clients want to make. With our size and experience we have the capability to do many types of

project all around the world, and this leads to terrific opportunities for our staff to grow and expand their careers within the organisation. We also have accredited training programs to enable our young engineers to become Chartered Engineers.

Jacobs has been actively supporting CEB over the past few years by delivering a number of transferable skills lectures to Part I students on HSE, Risk Management and Project Management and supporting the main Design Project in 2011, which was for a post combustion Carbon Capture plant.

Jacobs have taken a number of summer intern students to give an understanding of their business and the type of work they do, have also participated successfully in graduate recruitment and are always interested to hear from under graduates and new graduates interested in a career in their industry and have set up and taken part in a novel pre combustion CCS study with Dr Bart Hallmark. Ian commented; *"We look forward to continue to support the department as it moves to its new home in West Cambridge in the near future"*.

Any Chemical Engineering and Biotechnology companies wishing to advertise in this section or become sponsors of the *CEB Focus* newsletter can contact the Editorial Team on ceb-focus@cam.ac.uk or +44 (0) 1223 762587 for more information on promotional opportunities and rates available or to discuss your requirements. The revenue raised helps the Editorial Team meet the design and printing costs incurred by the publication but the publisher (CEB) reserves the right to decline or withdraw advertisements.

1K Prize for £1K Competition



CUE £1k Technology Winners including PhD students from the Bioscience Engineering group Ipshita and Matthew (5th and 6th from the left)

PhD students Ipshita Mandal and Matthew Townsend from the Bioscience Engineering group led by Professor Nigel Slater (HoD) recently entered the Cambridge University Entrepreneurs (CUE) competition with their with their work from i-Teams and start-up company Purit Technologies they were among those 11 successful winners of the technology stream £1K award at the CUE 1K Awards Ceremony back in February. They had great feedback from the judges for the commercial development and they are hoping to build their entry for CUE 5K competition.

Purit Technologies (Purit) is a UK biotechnology company that has developed a technology platform that enables a faster, cheaper and more scalable solution for the purification and isolation of biopharmaceuticals. Porous micro-capillary film (MCF) is a versatile, low cost, and robust material which can operate at higher flow rates and pressures than traditional packed bed columns providing a route to the industry's first 'plug and play' (and throw away) downstream processing solution. The market for columns, supports and ancillary reagents in the chromatography sector was \$6.6 billion in 2011 and will reach \$8.9 billion by 2017 (growing at a CAGR of 4.1%). Purit is well positioned to address this market via a business model that comprises OEM licensing, materials supply and direct product supply.

This competition encourages students to turn business ideas into an actual business.

Ipshita commented; "The CUE process has been very useful to run a reality check on running a market analysis

and deciding business model/s for commercialising this technology. It has also been useful for the research behind the project itself, as we get more feedback on how to better characterise the Purit columns from mentors, judges and the startup team."

If you are up for getting your business ideas into practice do check www.cue.org.uk for the many entrepreneurial events and competitions they run on a regular basis.

MBE's Medibeta Wins Enterprise Prize



Former Masters' in Bioscience Enterprise (MBE) students from 2011/2012 tranche, Carrie Yang, Joe Polex Wolf, Harsh Baid and

Stephen Mulgrew, won the 2013 Parmee Prize for Entrepreneurship and Enterprise at Pembroke College for their business idea: Medibeta.

An endowed prize awarded annually to the best business idea from among junior members of Pembroke College, it is intended to encourage young would-be entrepreneurs in the college, and to offer them the expertise, and potential on-going help, of the panel and of the Prize's sponsor, Richard Parmee. Richard, whose company, Cheyney Group, is a Corporate Partner of Pembroke, is an alumnus and William Pitt Fellow of the College and set up the prize in 2007.

Medibeta aims to develop an automated system to mimic the function of the pancreas by continuously sensing glucose levels and adjusting the level of insulin delivered. "Conventional methods of measuring blood glucose levels and self-administering insulin prove to be unsatisfactory and pose many safety issues," describes Stephen, saying that "Medibeta is thus creating the next generation of diabetes solutions." Medibeta also entered the CSSA-UK Entrepreneurship Challenge Event last year.

Medibeta is targeting emerging countries with a specific focus on China, which has more than 92 million diabetes patients and 150 million pre-diabetics. Carrie explains that "Diabetes has become a big public health challenge in China. Most patients, and especially type 1 diabetics, are simply not aware of the disease. Medibeta's solution is to offer a novel product and personalised service to educate patients and simplify diabetes management."



The Team admitted that; *"The value of this competition has been in helping us to get a better understanding*

Joe pitching Medibeta healthcare business ideas

of our own product and business model, as well as uncovering the problems within our plan! The most challenging question asked by the panel was about the difficulty of getting this technology accepted - however, we see it as more of an opportunity rather than a difficulty. What we need now most of is - with little doubt - funding, as we are dealing with really expensive equipment here." Joe added that "Winning this award is a great honour for the Medibeta team. It was a fantastic experience and platform to test our ideas. The judges and the competition's sponsor, Richard Parmee, provided advice on the business model and commercial strategy, such as practical tips for monetising the product offering. The award will be used for conducting research in China and furthering Medibeta's marketing activities."

Diabetes is one of the biggest healthcare burdens faced by economies today. Harsh emphasises that, "Innovative solutions such as the artificial pancreas will revolutionise the way we treat this disease. Medibeta aims to be at the forefront of this healthcare revolution."

CEB Academic Publication



CEB is delighted to announce the publication of the book "Terahertz Spectroscopy and Imaging" co-edited by one of our lecturers Dr Axel Zeitler along with K.-E. Peiponen, University of Eastern Finland, Joensuu, Finland and M. Kuwata-Gonokami, The University of Tokyo, Japan.

Over the past decade terahertz

spectroscopy has rapidly developed gaining an important impact across a wide range of scientific disciplines. Due to substantial advances in femtosecond laser technology, terahertz time-domain spectroscopy (THz-TDS) has established itself as the dominant spectroscopic technique for experimental scientists interested in measurements at this frequency range. In solids and liquids THz radiation is in resonance with both phonon modes and hydrogen bonding modes. It is an ideal tool to study the interaction between molecules in a unique way; hence opening a wealth of opportunities for research in physics, chemistry, biology, materials science and pharmaceuticals.

The book is ideal for scientists, engineers and students who want to understand the theory and applications of modern THz spectroscopy. It presents the state-of-theart of Terahertz spectroscopy and gives a concise presentation of the basics of THz spectroscopy whilst describing important applications of THz technology and providing a comprehensive source of information for beginners and experienced researchers with interests in this field. Aiming to explain the fundamental physics that underpins terahertz technology the book also describes its key applications and highlights scientific research in the field of terahertz science. All in all, the book provides a good overview as well as giving an insight into future directions for research.

The book can be purchased on www.springer.com (£153 hard cover/ £122 ebook)

Patrick Gordon awarded Danckwerts-Pergamon Prize



Former CEB PhD student Dr Patrick Gordon was proclaimed as the winner of the Danckwerts-Pergamon Prize 2012 for his thesis entitled *"Developing greener cleaning Fluids using Fluid dynamic Gauging"*.

The Danckwerts-Pergamon Prize is awarded by the Department each year for the best PhD dissertation on a subject connected with Chemical Engineering. The winner is chosen from those students who gained their PhDs in the preceding calendar year.

Patrick was a member of the Powder and Paste Processing Group (now part of P4G), supervised by Dr Ian Wilson and Dr John Chew (now at Bath). His PhD was a Food Processing Faraday Partnership project sponsored by Procter & Gamble. It developed a new

experimental technique, the scanning fluid dynamic gauge, and used it to study the properties of soft solids. The research is of particular interest for domestic and industrial cleaning, but also has applications in biofilm, microfiltration and other research areas. The project was a Food Processing Faraday Partnership project, and was supported by the EPSRC and Procter and Gamble.

Dr Gordon commented; "I'm delighted to have received this recognition for my Thesis and research work over the last few years. I'm very grateful to the department for taking the time to reflect on the excellent and diverse research that postgraduate students expend so much energy on. Most research in CEB is interdisciplinary, relying and building on the skills and experience of others. My project was no different - in particular, the department workshop and electronics teams, MEng research project students and my office colleagues all helped me hugely. I know that my project supervisors, Drs Ian Wilson and John Chew, will also be delighted at this endorsement of their excellent work.

Patrick added; "I feel like I knew the department well by the end of my PhD, having also studied there for my undergraduate degree. The friendliness, openness and enthusiasm of the staff, students and academics was very important to me, as were the opportunities to get involved in supervising and teaching other students. I also benefited from the many connections that CEB has with other institutions and companies, both in the UK and internationally."

Patrick is now working for Bosch and Siemens Home Appliances in Berlin, looking at the relationship between a washing machine's design and its energy label and performance.

Dr Anson Ma on the Value of Engineering Skills

Assistant Professor of Chemical Engineering, Institute of Materials Science, University of Connecticut Former PhD student, Polymer Fluids Group PhD (Cantab), MPhil, BEng (Hons), AMInstP

Dr Ma, who earned his PhD from CEB in 2009, started as a tenure-track Assistant Professor at the University of Connecticut (USA) in Fall 2011. He recently received the US National Science Foundation (NSF) CAREER Award. This is the most prestigious award for junior faculty, who embody the role of "teacher-scholar" by seamlessly integrating outstanding research and excellent education. The award provides US\$400,000 in funding support for Dr Ma and his team to research on exploiting the shape of nanoparticles to stabilise emulsions. Prior to that, Dr Ma was named a "Distinguished Young Rheologist" by TA Instruments and received the NSF EAGER award, which focuses on understanding the flow dynamics of nanoparticles for improved cancer therapy.

Dr Ma's current research centres on understanding the rheology and processing of structured fluids such as emulsions, foams, biological fluids, and nanoparticle suspensions. Dr Ma is currently advising 2 postdoctoral fellows, 4 graduate students, and 10 undergraduates. He and his team are currently exploring various methods to assemble nanoparticles into multifunctional materials and metamaterials. Metamaterials are hierarchical structures that can be used in cloaking devices, "super lenses", and light-based circuits that may ultimately outperform electron-based computers in terms of speed, power consumption and costs.

Anson commented; "My PhD training at CEB has been instrumental in the pursuit of my academic career. I have had the honour to work for Professor Malcolm Mackley, who has been a great mentor and introduced me to the fascinating world of rheology. It is more than the technical knowledge that I have learnt from Professor Mackley; it is his passion that has inspired me to choose research and teaching as my career. I hope I can do the same for my students." After completing his PhD he spent two years on postdoctoral training with Professor Matteo Pasquali's group at Rice University, where he was named a J. Evans-Attwell Welch fellow. His postdoctoral work focused on spinning carbon nanotube fibres that combine the mechanical strength of carbon fibres with the specific conductivity of metals. The work has recently been published in the journal 'Science'.



CEB alumnus and 'Distinguished Young Rheologist' Dr Anson Ma

"As a junior faculty", he added; "I'm sure that there are still a lot of challenges lying ahead. But personally it is always satisfying to apply my knowledge in chemical engineering to transform the life of many others in a positive way through education and technological advancements."

Anson added as a final piece of advice to CEB younger generations; *"Per aspera ad astra! (through hardship to the stars)"*

CEB in partnership with Oxbridge Biotech Roundtable (OBR) -Cambridge Chapter



OBR-Cambridge chapter has hosted a popular seminar series with industry leaders from different sectors within biotech throughout the year, helped launch the Roundtable Review, and successfully completed its first immersion project. The diverse membership reflects the multidisciplinary makeup of Europe's largest biotech cluster, and currently consists of academics and industry professionals from across many sectors. CEB's Professor Chris Lowe is a member of OBR's Advisory Board and PhD student Leo Hurtado Consulting Project Manager. More info on upcoming events on www.oxbridgebiotech.com

CEB Event Calendar

- 1st year Research Departmental Seminars: 1, 8, 15, 22 and 29 May 2013, Lecture Theatre 1
- CEB Alumni Speaker Series: Thursday 23 May 2013: "Teaching Sustainability to Chemical Engineering students" by Chemical Engineering alumnus Ryszard Pohorecki

Department graduates contribute talks to the CEB Alumni Speaker series talks contributed by return for the 3rd year running in Lecture Theatre 1 at 4pm, Shell Building, Pembroke Street. Alumni/ae interested in contributing to the series or leading your class year reunion contact Elena Gonzalez on eg314@cam.ac.uk

• **CEB-BUCT Summer School** 7 – 24 July 2013 Summer School returns for 3rd year running. CEB will be welcoming 50 students and 2 academic staff from the Beijing University of Chemical Technology. • University of Cambridge Alumni Festival 27-29 September 2013 "Global Cambridge at home" with Cambridge Alumni from all disciplines attending and all CEB members also welcome. CEB is contributing to the programme for the 3rd year running and on Friday 27 September CEB will be hosting two events:

<u>11am</u>: 'Fukushima Today' Talk by Bob Skelton: will cover a basic introduction to fission reactors, the original earthquake, the effect of the tsunami, the escalation of the problem, initial response, current clean up operations, the long term future of the plant and the implications for nuclear power in Japan and worldwide.

<u>12pm</u>: 'CEB Research Showcase: Global Solutions to Global Problems'

Get a true taste of engaged Cambridge learning outside of the classroom whilst touring around Chemical Engineering and Biotechnology labs. Our talented young researchers will be at hand to give alumni a brief overview of the cutting-edge research projects they are involved in. They will also answer any questions about how this ground-breaking research tackling incredibly challenging global problems is benefiting society as a whole.

Socials

CEB Pub Nights: The next Happy Hour will take place on 31 May 2013 organised by COMO group. Meeting at Tea Room for drinks and snacks at 5pm and followed by the usual pub gathering (location to be confirmed). For more information on future Happy Hours and Pub Nights contact the organiser, PhD student Aleks Chmielewski, on ac774@cam.ac.uk



Welcome Alexei Lapkin

Professor in Sustainable Reaction Engineering



CEB's new appointment shares his career highlights and journey before landing in CEB: After studying biochemistry at Novosibirsk State University and working for three years at Boreskov Institute of Catalysis in a membrane separations group (with

Professor Oleg Ilinich), I moved to University of Bath in 1997. At Bath I worked under supervision of Professors John Thomas and Barry Crittenden, developing a high-pressure and temperature membrane contactor for a multiphase catalytic hydration reaction. This was also my first real contact with industry, specifically with an SME MAST Carbons Ltd.

During the project I began developing skills in reaction engineering, real-time non-linear process control and process modeling. Three years of research contract at Bath were great fun - filled with discoveries of new science, new cultures, new places and developing new friendships. A seemingly infinite and accessible travel budget of John Thomas, his enormous enthusiasm for science, and desire to share his substantial knowledge of single malts made those years a remarkable experience! I was most fortunate to start working at Bath as an academic after completing PhD in 2000 and stayed there for another 9 years.

While at Bath I worked on several projects devoted to design of multifunctional catalytic reactors and study of heterogeneous catalysts on structured supports. I began working in close collaboration with physicists, chemists and biologists. My aim was to be able to design new processes on the basis of molecular understanding of the chemistry involved. Now it is a general approach to all projects in the group and we increasingly use in-situ reaction monitoring and predictive modeling to attain a greater degree of process understanding. Working with Chemistry Innovation Knowledge Transfer Network (CIKTN, formerly Crystal Faraday Partnership) I started to be involved in the topic of sustainability assessment. In collaboration with industry we produced several studies of the methods of assessment of 'greenness' of chemical technologies. Today my group has expertise in Life Cycle Assessment and we continue to work on methodology of sustainability assessment. We also began to work on process engineering for biorefining and working with bio-pharmaceuticals industry, in particular extraction and derivatisation of artemisinin – precursor to the current antimalarial drugs.

In 2008 I took a year sabbatical and spent five months at RWTH-Aachen working with Professors Marcel Liauw and Walter Leitner, and four months at Yale, working with Professor Paul Anastas. Work at Aachen gave me a greater exposure to predictive thermodynamics modeling as an integral tool of process design. At Yale I was trying to develop a link between a high-level sustainability assessment and holistic process modeling. Still working on this one ...

In 2009 I moved to University of Warwick to take a position of Professor of Engineering. There my group started working much closer with European partners and with industry. We developed closer links to applied mathematics and life sciences.



It is a privilege to contribute to research and teaching at University of Cambridge and a new challenge that I very much look forward to. Part of my group is has just moved to Cambridge along with their on-going projects. We are also about to embark on two new projects: one on multi-sensor reaction

monitoring for real-time non-linear process optimization, catalytic fine-chemistry in flow, and another on multi-scale modeling for novel catalytic processes.

Rebellion Festival

Roz Williams, Chief Lab Technician (Pembroke site)



Rebellion Fever



Every summer, those with a yearning to revisit the halcyon days of punk go to Blackpool for the Rebellion festival. This year it returns to Blackpool Winter Gardens from Thursday 8 to Sunday 11 August 2013. It is one of the world's biggest punk and alternative festival to celebrate all things Punk Rock 4 Days, 6 stages, over 200 bands Acoustic

Roz and Bart going 'rebel'

Every year, I go to Rebellion Festival, with my good friend and CEB lecturer Bart Hallmark. Rebellion is not just a venue for crusty old punk has-beens; it is so much more than that. It is a celebration of music, art and literature. There are opportunities to enjoy spoken word poetry sessions, punk inspired art galleries, alternative film, and of course, the all-important DIY clothing stalls. One can wander round, people watching, taking in the astonishing displays of creativity and tenacity, manifested in gravity-defying hair sculptures and crazy attire. And of course, a fair bit of beer-fuelled reminiscence does take place, when one's favourite bands from teenage years swagger to the stage, then deliver an energetic extravaganza, despite being in their fifties!!!!

Stage, Punk Art, Cinema, Merchandise, etc.... More info on www.rebellionfestivals.com



Peacock Parade in front of Winter Gardens

CEB Director of MPhil in Advanced Chemical Engineering (ACE), answers your questions:



Dear Dr Sarah,

1. How does one make the most of 3-4 month research projects over the summer in CEB? Dr Sarah replies...

Doing a summer research project, whether for work experience or as part of your Degree, can be a bit of an eye-opener for some people. No doubt you will have to put the hours in – there's no way around that (unless you invent a time machine; if you do, give me a call 17 years ago). And yes, there will be many frustrating days when you feel like you're wasting your time; but then there will be some days when your data points all fall on a straight line, and then it's time to party. But to get the best out of any research, you need to develop some

initiative. One day your supervisor will say to you "So, what do you think we should do next?" Make sure you are ready for that day.

It's also important to have a broad and deep understanding of the published literature in your chosen field. Let's have a closer look at the word 'research'. What does it actually mean? Well, the word is derived from the Latin: *res* = 'things' and *earchus* = 'the finding of'.

No, it isn't actually – I just made that up. And here lies a major lesson – don't ever take things at face value. Always question, double-check, cross-reference, get a second opinion.

Now, go and ask someone else how they think you can make the most of a summer research project.

2. How can you keep such perfect skin?

Dr Sarah replies...

Other people have often commented on my good complexion – I think it must have something to do with my plump rosy cheeks, which have taken a lifetime to perfect. However, I keep a very basic skincare regime: I wash my face twice a day in normal tablet soap, preferably one that has not been smeared into the eyes of cute furry animals; I drink a fair amount of aqueous-based fluid and avoid eating heavily processed foods, especially crisps (which are one of the worse inventions known to mankind, perhaps beaten by those stupid neck-breaking platform shoes that women wear nowadays); and I try to get a decent amount of fresh air on my face, which is particularly difficult with a windowless office. So nothing fancy really. Oh, and at each full moon I bathe in the venom of CET I students.





(a) A bowl of dressed-up lard (desireclothing.co.uk)Just say "No" to (a) crisps and (b) platform shoes.

(b) A cleverly disguised killing device (guardian.co.uk)

Tea-time Teaser

'Celeb' look-alikes





MBE student Timothy Lindsay - Jason Segal "How I Met Your Mother"



Dr Ben Taylor - Steve Austin "The Expendables (Part 1)"















Letters to the editor

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