

CEB*Focus* Department of Chemical Engineering and Biotechnology



CEB Milestone: New Building Topping-out

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Message from HoD Professor Nigel Slater



I am pleased to report that CEB starts its last academic year on the Pembroke Street site in good shape, but am even more pleased to report that the best is yet to come. The QS World Rankings in Chemical Engineering 2014 place us top amongst all departments outside of the US

and fourth overall in the world behind MIT, Berkeley and Stanford. Creditable perhaps, but whereas during my term at the helm we have maintained our dominance outside of the US, we have slid backwards against our US competitors who outgun us with the firepower that their endowments provide; firepower to provide the best facilities and attract world class academic staff. From 2015 the balance of firepower changes. CEB will be relocated to a truly world class facility at West Cambridge that will unleash its full potential in research. The age profile of academic staff will by then be substantially younger and CEB will be revitalised with outstanding young academics. Time then for the next generation of CEB academics to turn the tide and I have no doubt that with a new laboratory, new Head and a new vision of youth the best is yet to come. Game on I believe!

Editorial Note



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

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

The *Cover Article* focuses on the CEB new building toppingout ceremony that took place back in May and gives a progress update on new building work in West Cambridge by construction firm Morgan Sindall. *Graduate Hub* tells of recent academic interview with BBC radio 'Naked Scientists' discussing ways to protect biological things through harsh environments. *Teaching Matters* shares recent changes to Tripos Part IIB syllabus and wonderful news about the new addition of MRes in Sensor Technologies to the CEB Programme portfolio. Its Programme Manager Dr Oliver Hadeler talks about sensor technology in *CEB Innovation. Research Highlights* presents research projects by talented young researchers including CEB prize winner, our very own Fanny Yueng (Colloids and Cell Organism Engineering Group) with 'Life in Extreme Environments: The Role of Intrinsically Disordered Proteins Under Conditions of Abiotic Stress'. *Industry Business* tells about Shell, one of our Teaching Consortium Member of Companies, and their support of CEB students and teaching activities. *Achievements* worth noting are the recent academic promotions of Dr Axel Zeitler and Dr Sarah Rough and the success of CEB students' business ideas at CUE £5K Grand Finale. Our *Research Feature* presents an account of the birth of the Portable Extensional Rheometer device idea in Borneo from a conversation about Rheology in the Chemical Engineering tea-room. *Alumni Corner* announces the 'Amy Li's Memorial Fund' recently set up by DNVGL in honour of our deceased alumna.

A couple of important announcements: 1) Sadly Dr Sarah Rough will be leaving her post as CEB Focus 'agony aunt' and her very much-loved 'Dear Dr Sarah' column to focus on other professional commitments. CEB Focus Editorial Team would very much like to thank her for her fantastic contribution to the newsletter for the last four years, her comical streak and valuable advice will be greatly missed by all. 2) The date for **CEB Research Open Day** has been confirmed for Wednesday14 January 2015 in Fiztwilliam College in Cambridge, more on this in the next issue.

Finally, we'd like to credit professional photographer Phil Mynott for the new building images in the main article and thank our webmaster Vanessa Blake for regularly providing photos as well as department members, alumni and corporate partners for their article contributions, which are much appreciated. Please keep sending them to ceb-focus@ceb.cam.ac.uk. To receive a regular e-copy of CEB Focus subscribe by sending a message to ceb-news-request@lists.cam.ac.uk with '**Subscribe**' as the subject of the message.

CEB Milestone: New Building Topping-out

Elena Gonzalez



CEB HoD Professor Nigel Slater (centre) with former HoD and Pro-Vice Chancellor for Research Professor Lynn Gladden (right) andf Professor Chris Lowe (far left)

A new milestone in CEB history has now been reached with the Department now one step closer to its move to West Cambridge by the end of next summer 2015. Despite the gloomy weather, the much-awaited new building topping out ceremony took place at West Cambridge on 27 May 2014 and the celebration of this breakthrough went ahead as planned. Construction firm Morgan Sindall has confirmed that the new building construction is on target and expected to be finalised by June 2015.

Bob Ensch, Morgan Sindall Area Director, commented on the project; 'This is a £ 41 million building project and it is a privilege to be part of it. Morgan Sindall has a great reputation in the marketplace not just locally but nationally as well. We are seen as one of the players in the industry and in this field, in the complex bioscience research sector, laboratory projects like these. There are a limited number of contractors who can actually deliver and we have some great experience not just in construction but we have a professional services team and they knew they could trust us to deliver this very complex project. So we had national credibility, we've got capability too, people who've got experience in constructing projects of this nature, and they believed in the local and national teams' experience that we had'.

The event hosts were Bob Ensch, Angus Stephen (Director of Operations at the University of Cambridge Estate Management) and Professor Nigel Slater, CEB Head of Department, who commented; 'This is a very complex building because we have a very diverse set of research interests...so all these different requirements within the same building have made this an extremely complicated building to design and put together. I think it is progressing fantastically. It is fantastic to be here today, we can see it coming up and I never thought for a moment that it would be as large as it clearly is. The next stage is very challenging as that is when they put all the mechanical equipment in to control these environments (research labs)...so far so good and we are looking forward to being here next year and I think the Department will do some great work here.'

Guests in attendance gathered around the University Sports Centre foyer to share CEB's story of success and progress and listened to the speeches from the three hosts. Distinguished Guest of Honour, University of Cambridge Vice-Chancellor, Professor Sir Leszek Borysiewicz, added; 'to be a competitive University in the 21st century we need absolutely top-quality facilities for most of our scientists to be able to be competitive in the wider world. This £41 million facility is vital for the University so that they can really make the discoveries that change the world of tomorrow...Creating the right environment for academics to really be able to thrive is essential, to have good ideas and the facilities where you can test these ideas out.'

Former Heads of Department Professor Lynn Gladden (now Pro-Vice-Chancellor for Research), Professor Howard Chase and Professor John Davidson were also present as well as all-time friends of the Department and alumni, including Peter Davidson and Sir David Harrison. A small 'roof party' led by Charlie Norris (Operations Director at Morgan Sindall) included Professor Slater, Professor Sir Leszek Borysiewicz and Professor Gladden, as well as Bob Ensch and Angus Stephen, who in their full Personal Protective Equipment (PPE) attire were escorted into the construction site. They then ascended to the roof area for the main topping out ceremony. CEB New Building Fund benefactors Dr Andy York from Johnson Matthey and Mrs Catherine Paul (widow of late alumnus Dr Robin Paul, pioneer of the new building fundraising campaign) were also taken on a tour around the building.

Front Cover Article



External risers installed on the facade

Angus Stephen, Director of Operations at Estate Management, added; 'a project of this nature really needs a contractor that can be proactive and solve problems... I think the project is going really well so far, we've just had the topping-out ceremony and we've got a year and a bit to go so will be looking forward to finishing on time within budget.' As per the progress made on the new building site over the summer Morgan Sindall have moved on with the external façade and internal services, despite the often testing weather experienced back in August.

Professor Slater added; 'Since last year the Department has followed the building progress through the CCTV-internet link and our excitement has grown steadily as it has sprouted ever upwards. We appreciate that the diverse research and teaching activities of the Department, and the specialised facilities that these require, make the building extremely complex yet we have been amazed by the pace of progress. Our excitement is heightened by today's topping out ceremony, and we are grateful for what has been achieved on the project to date'.

Morgan Sindall has more recently reported that further progress has been made on site with the zinc cladding now covering up ductwork and pipes going out of the building up to the plant room. The researchers' house is quickly catching up on the laboratory building with its curved façade now taking shape. The large roof light over the researcher's house atrium has also been installed with some quite impressive scaffolding inside providing safe access. A large proportion of the Mechanical & Electrical (M&E) has been placed in the raised access floor on a few of the levels. Within the lab area, the screed has been installed and finished and the painters have come in and start some of the work. With the internal finishes moving forward, door frames are expected to go up in the next few weeks. In fact, one room is being completed early as a sample room so that one can see how the labs will look once complete with the floor being laid, furniture being fitted and ceilings being installed. Finally, the floating floor has been raised - a painstaking process with well over 100 springs having to be turned 7 times each!

With regards to preparation for the move into a new building, CEB has appointed Sweett Group (global provider of professional services for the construction and management of building and infrastructure projects) to support preparations to move to West Cambridge and help with the complex logistics that a project of this nature entails. They will be coming up with a 'Transition Programme' to capture CEB key activities and responsibilities leading



Researchers' house curved western façade shaping up

up to the move and a 'Move Sequence' to define the sequence and timescale for the activities during the move into our new building. Sweett has been meeting leads of the various Groups and Service Functions within CEB to discuss their individual situation and needs.

Preparation activities for the big move are now underway with a focus on minimising potential disruption to work, which will be ongoing close to the time of the move, as well as best preparing for the move itself in order to become quickly operational by the start of next academic year 2015. For new building regular updates and a video on the topping-out ceremony see

www.ceb.cam.ac.uk/about/vision2015 and www.youtube.com/watch?v=BC2mpw1zltM respectively.

Summer in Style

Andi Reci, Statoil ASA Internship



After 4 months of waiting for the VISA to be granted from the Norwegian authorities, I finally got to start my internship in Heavy Oil Processing with Statoil in Porsgrunn at the end of July. The only thought I had on my flight to Norway was "This better be worth it!" And it did not disappoint.

My project involved creating a model on how polymer degradation varies with size and pattern of fractures in the rock during polymer injection in Enhanced Oil Recovery. This is something I had never read about or studied before, as some of the students might recognise. But, it is actually true that if you use your common engineering sense you can make significant contributions to the project.

What has made the difference for me this summer is the quality of life. The working hours may be a bit awkward (7:30-15:30), but it gives you plenty of time to use your afternoon wisely. There are enough hikes to do and fjords to see to fill every day of your life. Living is expensive and professional people complain they are not being paid enough, but to my standards (and probably any British one's), it is not bad at all.

Would I want to have a job there? Probably at the start and end of my career.

Beth Jones, Production Delivery Summer Student at ConocoPhillips



This summer, I undertook a ten week placement with ConocoPhillips in Aberdeen. ConocoPhillips (COP) is the world's largest independent exploration and production oil and gas company and, in the UK, has assets in the Central and Southern North Sea and East Irish Sea. I was placed in the Production Delivery team which is responsible for ensuring that forecast production figures, i.e. the quantity of hydrocarbons exported from offshore, stated in the annual long range plan are delivered on a daily basis. The role is challenging and diverse as informed decisions need to be made quickly in order to safeguard production, which involves the constant need for communication between onshore departments and offshore. I was able to gain a clear understanding of oil and gas extraction as a result of being involved in such a varied department, which I found very enlightening. My project was demanding but engaging, looking at ways in which barium sulphate scale could be removed and inhibited from one of the wells so that the downhole safety valve could remain operational and the well's production secured. I had the opportunity to go offshore (the highlight of my placement!) to see the well and processing facilities which was invaluable in giving me perspective to frame the work I was undertaking onshore. I really enjoyed my time at COP and learnt a great deal both from a technical and personal perspective. I feel that, with a chemical engineering background, the work opportunities are far more varied in operators than service companies (I have previously worked for Wood Group and Subsea 7) and thus I am confident that this is the route I would like to pursue once I graduate next June.

Mehdi Goudarzi, Research Intern in CML Innovations



I like computers and in fact I am mainly interested in the intersection between the computer science and engineering (computational modelling or data analysis

for example). This summer I was working with the CMCL Innovations which is run by a few guys who used to be in the Computational Modelling (CoMo) Group before. I was doing some back-end development (this is the core of the software whereas front end is the interface that user is working with) in C++. The more tech savvies amongst you might have heard of a term called 'machine learning' which is basically writing codes that enable a computer to learn from experience. This is a big field (check Andrew Ng online if interested!) and many different methods are applied to teach computers. What I was precisely working on was called an artificial neural network (ANN) which as you might have guessed already uses the structure of neurons to create the learning process (check blue brain project from EPFL if you are interested). Now what is the use of this? For example imagine you have a very complicated unknown curve (e.g. a 20th order polynomial) but it shows the behaviour of flow of a fluid as a function of a temperature. To scientifically look into the process might be an impossible process because you don't know how that liquid behaves but if you give a few experimental data points to this algorithm it would automatically learn the pattern of your points and would create what is scientifically referred to as a "surrogate". Then by using that surrogate you can predict the behaviour of the liquid at any given point in the domain of inputs that you have trained your network for.

Message from CUCES



Current Cambridge University Chemical Engineering Society (CUCES) Committee from left to right: Betsy-Ann, Beth, Samuel, Charles, Xian and Chang

Here is hoping that everyone has had an enjoyable summer and is returning to Cambridge ready to get back to work. Firstly, a huge thank you from CUCES to everyone who attended the Chem Eng BBQ at the end of last term that proved to be a roaring success. We were lucky enough to get the best out of the weather and had an awesome afternoon, featuring tasty food and drink, enjoyable sports and of course the fantastic bungee-run. CUCES would like to thank BP for once again being willing to sponsor the event and I would like to give some deserved credit to the rest of the committee for their hard work in organising our first major social event.



CUCES Summer BBQ fun, June 2014

With exams now out of the equation (for a while at least) CUCES has plenty of plans to keep you educated and entertained this Michaelmas term. Companies are currently lined up ready to give insider industrial knowledge to help in preparation for future interviews - ABB, GSK and a Bavarian master brewer just to name a few. In terms of social events we are planning on kicking things off with the Perry's Presentation for the Part IIA's and a quiz night for the Part I's. Following this we're hoping to restart the Meet Your Mentor's Scheme that should result in another fun outing to Spoons; more details on how to become a mentor from CUCES soon. After that things are planned to get bigger and better with an afternoon of paintballing and a long awaited trip to a chocolate factory in the pipeline. There are also plans to ensure that postgraduates are more included in CUCES activities from now on, and a social an event exclusively for them is also on the cards.

I am sure everyone will also be glad to know that plans have already been made for this year's Christmas Dinner. CUCES have already been in contact with Brown's which will undoubtedly lead to another delightful evening of great food and the chance to let your hair down once lectures have finished. As widely promised in our manifestos, we are aiming to make the committee more approachable in order for your views to be heard easily this term and we have even started work on the promise of Frank Morton 2015 for the department. So, all in all, lots to look forward to and many great experiences to be had this Michaelmas. Sam Wibberley CUCES President

IIB Research Project Winners



IIB research project winners: Back row, left to right: Martin Chan, Meichen Lu, Samuel Choo, Dharshan Vadivelu. Front row: Kadi Liis Saar, Lauren Atherton, Sophie Duffield and Beatrice Ku

Research projects are a major part of the coursework for Chemical Engineering students in their fourth year at Cambridge, leading to the MEng degree. The students are required to undertake a piece of original research in pairs or singly. Two sessions of presentation & poster were held on Tuesday, 25th February and Tuesday, 4th March 2014.

On the first day, the First Prize winners were Kadi Liis Saar and Martin Chan for their project on investigating protein fibril growth and protein aggregation. The Second Prize was taken by Beatrice Ku and Dharshan Vadivelu for their study of metal-organic frameworks for the purpose of drug delivery. On the second day, there were two joint First Prize winning teams: Meichen Lu and Yanlong Choo, who developed a framework to systematically assessing the validity and use of the inverse Laplace transform (ILT); Sophie Duffield and Lauren Atherton, who studied Spheronisation behaviour of pharmaceutical pastes.

IIA Design Project Winners



From left to right: Csaba Katai, Jenny Parkin, Andrew Lowson, Simon Fox from Mondelez, Beth Jones and Kaichen Gu

The Design Project is a major part of the coursework for Chemical Engineering students in their third year at Cambridge and this year, the project was supported by Mondelez International. The brief was to design a process to produce 3,000 tonnes per annum of freeze dried instant coffee from a feedstock of coffee green beans. In groups of 5 or 6 people, the students devoted five weeks to designing the plant. On Friday, 6 June 2014, the day after they handed in the final reports, they gave 10-minute presentation.

The winners for the presentation were Andrew Lowson, Csaba Katai, Beth Jones, Kaichen Gu and Jenny Parkin. The Second prize was awarded to Mohsina Sultana Bashir, Anqi Huang, Matthew Chadwick and Kert Pütsepp and the third prize was awarded to Nattapat Chaimanowong, Harry Glover, Jiayi Hu, James Nguyen, Myrice Palor and Henry Wiles. The guest judge was Simon Fox, Associate Director for coffee process technology at Mondelez International. He congratulated all the groups on their designs and then presented the winners with huge chocolate hampers.

New Graduate Researchers' Society!



GRSoc BBQ: left to right: Matthew Bryan, Jacob Brubert, Madalena Lemos, Vincent Lister, Leonard Chan, Akin Ali, Michael Sargeant, Petar Besevic

We are pleased to announce the creation of a society for graduate research students in the department. The Graduate Researchers' Society (GRSoc) has been formed in order to foster the graduate research community at all sites within the department. The society's committee have a set of research, training and social events for graduate researchers in the pipeline.

"I am very excited to be able to present our founding committee to the society and rest of the department. We are a society run by students and researchers, and we are here to facilitate events which boost the research culture of the department." Jacob Brubert - Chair of GRSoc Committee and 3rd Year PhD student.

The first GRSoc event was a barbecue held at the beautiful island of Darwin college. Blessed with fortunate autumn weather the 'bring-your-own-meat/halloumi/vegetable' proved remarkably popular. Countless reunions were made between students who had barely made contact since being inducted, the occasional flash of inspiration from synergetic research, never previously discussed, and the hum of potential for 2014-15 might bring!

The Committee were pleased to be able to welcome the incoming October cohort of students. Despite a rapid turnaround between the committee's formation, and the student's arrival, the committee were able to supplement the Induction Pack with some FAQs and an introduction to the GRSoc.

The minutes of the Committee's meetings will be posted on a noticeboard on the Pembroke Street site. The committee welcomes any ideas for events, as well as feedback on the PhD experience within the department that can be brought to the SSCC and Graduate Education Committees. The committee has endeavoured (though not yet fully succeeded) in ensuring representation from every location and year cohort, if your voice is not being heard, tell us! Further information on the committee and society can be found at:

https://www.ceb.cam.ac.uk/about/graduates and the committee can be contacted using GRSoc@ceb.cam.ac.uk

CEB Academics go on Air



Dr Krishnāa Mahbubani (left) and Dr Graham Christie (right) with Naked Scientists Chris Smith and Kat Arney

Three of our lecturers were on BBC Radio Cambridgeshire on Sunday 8 June 2014, talking about different ways to protect biological things through harsh environments.

Krishnāa Mahbubani, Graham Christie and Alex Routh were interviewed by Naked Scientists, Chris Smith and Kat Arney.

Graham discussed how his group are engineering bacterial spores - nature's most resilient cells - to produce biopharmaceutical proteins that are stored inside the protective capsule of the spore. If realised, this could deliver therapeutic products with essentially indefinite ambient-stable shelf-lives.



Coagulated latex particles forming single particle layer shell

Krish has been looking at ways of getting bacterial vaccines to developing countries without having to keep them refridgerated. Unless kept cool, there is a danger that the bacteria will multiply and so the patient could be given the disease rather than a vaccination against the disease. Removing water by vacuum drying puts bacterial vaccines into suspended animation so that they are stable at higher temperatures.

Alex discussed his group's work on encapsulation of biological matter in colloidosomes. They have shown the protection of bacteria through stomach conditions and enzymes in washing liquids. The technique is easily adaptable to any biological material and will hopefully be extended to look at oral vaccines.

CEB Focus Interview with Dr Alex Routh:

- How does it feel to get interviewed?

The interview itself was just fine – the build-up is the problem. Because I've never been interviewed before I didn't know what to expect. In the end the producer turned up with what looked like a very small Dictaphone – and an enormous microphone. But she was incredibly relaxed and easy to talk to so. It just turned into a gentle chat about the research and she edited the interview to make me sound far more coherent than I actually was.

- Did you find it challenging to discuss your research to a broad audience and with only audio? It is always difficult to describe research without using technical language and also without any pictures. In this case the

interviewer was very good at describing everything she saw in the lab and so trying to put a picture across to the audience.
Were the sound effects (walking, doors, equipment, etc.) real? Or were they added post production?

I think the sound effects were real recordings from the lab - although whether they happened in the order that they are in the radio show I don't know.

- What is your reaction listening to the interview when it was broadcasted? I never like hearing my own voice. My wife heard the interview and said "oh you put your posh voice on then".

- Any tips for anyone who gets a radio/Naked Scientist interview in the future? Do it! The whole experience was really fun and it's a huge and valuable dissemination route.

The programme was also broadcast nationally on BBC 5 Live, issued as a podcast under the banner "5 Live Science" and it went out across Australia on ABC Radio National.

Cambridge University Energy Conference



Energy Network poster display

On the 9 June 2014, the Cambridge University Energy Network (CUEN) hosted its 8th Annual Energy Conference at Jesus College at the University of Cambridge. This year the conference entitled: **Gas – An (Un)conventional pathway to a smart energy future** focused on the challenges associated with natural gas technology and the role it will play as an energy source in the future.

The conference attracted around 100 attendees from diverse backgrounds and 14 prestigious speakers who

Graduate Hub



Daniel Sanchez (University of California, Berkeley) presenting at the CUEN Conference 2014

engaged in multifaceted discussions. Over four sessions speakers from academia, industry and policy offered perspectives on both unconventional and natural gas technologies addressing the risks and concerns associated with the exploration and discussed its potential as an energy source to provide a bridge to a low-carbon future.

This year, for the first time, a poster session for early career researchers was held in which PhD students and Post Doctoral researchers from Cambridge, University of California Berkeley and Manchester, presented their work on a range of topics associated with energy. The poster session was sponsored by Energy@Cambridge and prizes for the best poster were presented to

Qingyuan Zhang (CEB) and Alex Evans (BP Institute), by Professor Lynn Gladden, Chair of Energy@Cambridge and Pro-Vice Chancellor Research and Professor Andy Woods, Head of the BP Institute.

To find out more about CUEN and its events over the coming academic year, please visit our website www.cuen.org

BUCT Summer School Returns

3 – 24 July 2014



BUCT Summer School class 2014



BUCT Team and delegates celebrate the completion of the taught programme with a formal dinner at Christ's College

The Cambridge - BUCT Summer School (CBSS), was hosted by the Cambridge Centre for Carbon Reduction in Chemical Technology (C4T), situated on the Campus for Research Excellence and Technological Enterprise (CREATE) in Singapore and the Department of Chemical Engineering & Biotechnology, Cambridge. The broad aim of the course was to expose the undergraduate delegates to living and studying overseas as a research student, and offered the opportunity to visit leading university research laboratories at National University of Singapore, Nanyang Technological University and University of Cambridge. Specialist lectures from academics gave the technological background and future challenges for the global economy with a focus on Chemical Technology. The formal academic course was complemented by visits to industrial laboratories, CREATE partner Universities: University of Berkeley & Technische Universität München and the A*Star Institute of Chemical and Engineering Sciences.

New MRes in Sensor Technologies

Senior Teaching Fellows, Dr Tanya Hutter and Dr Fernando da Cruz Vasconcellos



CEB's new Master by Research (MRes) in Sensor Technologies and Applications forms part of the training programme within the new EPSRC Centre for Doctoral Training in Sensor Technologies and Applications. The Sensor CDT builds on the foundations of Cam*Bridge*Sens, the University's strategic network to unite sensor research in Cambridge. It brings together world-leading expertise, infrastructure and academics from more than 20 departments across Cambridge. The MRes course consists of a one-year taught component, with the first cohort of 10 students starting this October. The first-year course will consist of a number of taught lectures, lab rotations and

team projects to lay the foundations on which to build a successful PhD research programme, which students undertake in years 2-4 of the course.

Students will be taught topics ranging from the physical principles of sensing to the application and management of sensor innovation. In addition to this technical knowledge, students will learn transferable business skills and the fundamentals of entrepreneurship in a science and technology environment with a strong emphasis on developing team and leadership skills.

Professor Clemens Kaminski, Director of the CDT, says; 'Sensor research has become a vastly complex and multidisciplinary activity and has to be recognised as an academic discipline in its own right. The CDT will function like a virtual super-department in Cambridge, providing training for more than 50 outstanding PhD students to produce the next generation of leaders in the field. I am delighted with Dr Hutter and Dr Vasconcellos as they will play a crucial role in delivering the CDT teaching programme as they have years of experience in sensor research and teaching'.

Putting Energy into our Course

Dr Patrick Barrie, Director of Teaching

One of the Department's advantages is that it is usually straightforward for us to update our Chemical Engineering undergraduate course. Our teaching doesn't normally affect that of other Departments in the University. This means our course can evolve relatively quickly when we see the need. Energy technology is a hugely important topic for the 21st century. Quite a lot of energy technology is already embedded within our undergraduate course, but it is now felt appropriate to have a specifically labelled module on the topic. This is partly based on student input – yes, we are aware that many people choose chemical engineering because they're interested in energy-related issues. It also links in with some of the Department's research activities. Energy technology is therefore being introduced as a compulsory module to be given in Lent Term of Part IIB replacing the States of Matter module.

We hope that it will be a useful, popular addition to our Chemical Engineering Course. Most large-scale methods for converting energy from one form to another, including generation of electricity, depend on chemical engineering principles. The aim of the new course is to use chemical engineering principles to perform calculations of relevance to the energy industries. In the first half I will show how the principles previously learnt in heat & mass transport and thermodynamics can be used to understand and improve combustion processes. Then I will use principles learnt in fluid mechanics to look at some renewable energy technologies such as hydroelectricity and wind power. In the second half, Dr Carmine d'Agostino will describe the fundamentals of nuclear power involving some nuclear physics and also chemical engineering principles related to the design and operation of a nuclear reactor. The emphasis of the new Energy Technology module will be on the 'how' rather than the 'why'.

PhD Student Prize Winners



Professor Nigel Slater with winner Fanny Yuen and runners up Maria Luisa Botero, Chris Boyce and Felicity Bartholomew

The annual graduate student conference was held on 22 - 23 April 2014. The event concluded with a drinks reception where prizes were awarded to postgraduate students.

The winner of the award for best talk for the third year graduate conference was Fanny Yuen. She was presented with her prize by Head of Department Professor Nigel Slater. Fanny spoke on *The role of intrinsically disordered proteins under conditions of abiotic stress.*

The second prize went to Chris Boyce, for his talk on *Fundamental studies of the physics of gas-solid fluidisation* and in joint third place were Maria Luisa Botero, with *Sooting characteristics of liquid hydrocarbons in diffusion flames*, and Felicity Bartholomew, *Dynamics and structure: a study of gelation in a non-aqueous colloidal system*.

The winner of the best second year poster at the graduate conference was Michael Gottschalk for his project, *System based proteomic enrichment analysis of major psychiatric disorders.*

There was a three way tie for second place between Christian-Pierre Guyader, *Novel peptide mediated siRNA delivery*, Jiyeong Chun, *Functional silk-like protein* and Hilary Fabich, *Imaging of heterogeneous systems using ultrashort echo time (UTE) MRI*.

Life in Extreme Environments: The Role of Intrinsically Disordered Proteins Under Conditions of Abiotic Stress

Fanny Yuen, PhD student, Colloids and Cell Organism Engineering Groups

The ability of extremophile organisms to survive hostile conditions has caused us to reassess the requirements for life. Scientists and engineers strive to elucidate extremophile survival mechanisms that might allow the development of new technologies for preserving biological materials. LEA proteins are linked to the acquisition of cold and desiccation tolerance in plants and animals. As intrinsically disordered proteins (IDPs), LEA proteins are inherently tolerant to stress-induced denaturation, and LEA proteins have been shown to protect globular proteins, such as pig heart citrate synthase (CS) and rabbit muscle lactate dehydrogenase, and a human cell proteome from abiotic stresses.

The mechanism by which LEA proteins protect folded proteins is still unclear. Leading models of LEA protein protection include chaperone- and shield-like interactions. However, our aggregation assays, isothermal titration calorimetry experiments, and small angle neutron scattering experiments demonstrated that such bulk interaction mechanisms are insufficient to fully explain the observed aggregation protection of CS by LEA proteins.

Interfaces are known to nucleate and accelerate protein aggregation. Our dynamic surface tension and neutron reflection experiments showed that LEA proteins are surface active, and these new results have led us to hypothesize that LEA proteins act by preferentially



Schematic showing protection of CS from denaturation at the interfaces by preferential adsorption of LEA proteins.

adsorbing onto surfaces generated during the freeze-thaw process, thereby excluding folded proteins from interfaces where they would otherwise undergo irreversible aggregation.

Sooting Characteristics of Liquid Hydrocarbons in Diffusion Flames

Maria Botero, PhD student, Computational Modelling



Fossil-derived transportation fuels (gasoline, diesel, jet fuels) are complex mixtures of hydrocarbons. The soot particles formed by the combustion of these fuels are widely regarded as pollutants, and are increasingly regulated both in terms of number and mass of particulate matter emitted from on-road vehicles. This motivates the study the sooting characteristics of different fuels in terms of soot particle sizes and numbers.

Toluene sooting flames

Paraffins and aromatics are one of the major components of commercial fuels. Our aim is to study the influence of the chemical structure on the sooting characteristics of some paraffin and aromatic class hydrocarbons. The experiment involves the combustion of the hydrocarbon in a laminar diffusion flame and measurement of the soot particle size distribution using differential mobility spectrometry.

We observed that for paraffins the mean soot particle diameter increases with flame height until a height where a maximum is achieved and sustained. Instead, aromatics exhibit a continuous soot particle growth at all flame heights. Among each paraffin class (cyclic, branched or straight), a systematic decrease in the maximum mean soot particle diameter was observed as the number of carbon atoms in the molecule increased. Between aromatics, it was found that aromatics substituted with larger aliphatics chains tend to produce smaller soot particles.

At all flames studied, comparing fuels with the same carbon number, aromatics hydrocarbon produces soot particles with larger sizes compared to paraffins. Cyclic paraffins presented the larger mean soot particles sizes, followed by iso-paraffins and the smallest particles for normal paraffins. These results are very important to develop chemical mechanisms that can adequately predict pollutant emissions from engines.

Molecular Phenotyping of Psychoaffective and Anxiety Spectrum Disorders

Michael G. Gottschalk, PhD student, Cambridge Centre for Neuropsychiatric Research

Epidemiological studies have estimated that in 2010 every third European citizen suffered of at least one mental disorder. In terms of years lost due to ill-health, disability or early death, neuropsychiatric disorders account for approximately 25% of the entire disease burden of the EU.

One part of my PhD focuses on the identification of overlapping molecular disease signatures across the major psychiatric disorders covering schizophrenia, bipolar disorder and major depressive disorder with and without psychotic features. Employing an orthogonal system-based proteomic enrichment approach based on Label-Free liquid chromatography mass spectrometry (LC-MSE), prefrontal human post mortem brain tissue was analysed in order to identify significantly altered and overrepresented biological pathways. Labelled Selected Reaction Monitoring (SRM) was used to validate these findings, by quantifying representative surrogate proteins.

In silico analyses of biological annotations revealed common pathways across the disorders, with independent signatures reflecting psychotic and affective traits. Presynaptic glutamatergic



Frontal view of the triple quad time-of-flight (Q-TOF) instrument. Lines from the nano-HPLC deliver solubilised peptide samples for electro spray ionisation.

Research Highlights

neurotransmission and energy metabolism were the top hits. Finally, the outcome of the non-hypothesis driven screen was confirmed via SRM and potential effects of post-mortem confounders were excluded.

These findings support recent investigations which have focussed on the therapeutic potential of glutamatergic modulation in psychotic and affective episodes. This suggest a disease model in which disturbances of the glutamatergic system and interrelated adaptations of neuronal energy metabolism are linked to distinct psychiatric symptom dimensions, delivering novel evidence for targeted treatment approaches.

The next step in this project will include a comparison of the generated post-mortem disease signatures against preclinical proteome profiles, aiming to identify the most suitable model for bench to bedside translation for each of the major psychiatric disorders.

Imaging of Heterogeneous Systems using Ultrashort Echo Time (UTE) MRI

Hilary Fabich, PhD student, Magnetic Resonance

Magnetic resonance (MR) has applications in many fields; however, to the general population it is most commonly associated with measuring the structure of molecules in chemistry or imaging patients in medicine. The same equipment can be used to acquire non-invasive, two- and three-dimensional images of opaque chemical reactors. Measurements of the liquid phase in chemical reactors are well established; measurements of the solid phase, such as in a gas-solid fluidised bed, are more challenging.

Solid materials are difficult to study because their rigidity limits the lifetime of the MR signal. Ultrashort echo time (UTE) MR permits measurements of samples with very short signal lifetimes and therefore extends the range of materials that can be imaged using MR. Examples of materials that can be image with UTE include plant matter such as cork and seeds, rubber, and



19 mm 50 ms UTE MR image of rubber particles around a glass bead

bone. UTE is a well-known technique in medical MR, however the implementation of the sequence remains challenging.

We are currently using UTE to acquire non-invasive measurements of the solid phase of a fluidized bed. UTE permits measurements of solids

with a variety of properties, such as shape, size and coefficient of restitution. We will therefore be able to explore how changing the characteristics of the particulate phase results in changes to the bubble size and rise velocity upon fluidization. The UTE sequence we have developed may also be of interest to study, for example, drying processes, or rock cores – systems that are currently difficult to image using conventional MR.

"We have developed a method to implement this sequence on a wide range of MR systems with the intent of applying the sequence to samples relevant in chemical engineering and materials science. Furthermore, by combining the sequence with a compressed sensing algorithm for image reconstruction, we have reduced the data acquisition time for UTE to as little as 50 ms. This acquisition time is sufficiently short that it can permit the study of transient phenomena"

'From the Tea Room to the Tropics'

Dr Ian Wilson and Dr Bart Hallmark, Paste, Particle and Polymer Processing Group (P4G)

So much at Cambridge starts as a conversation in the Tea Room, over lunch, or, in this case, at a College Feast. Dr Ulrike Bauer, Henslow Research Fellow at Robinson, was enjoying Jesus College hospitality as a guest of Dr Walter Fedele (Zoology) and describing her work on pitcher plants in Borneo to Ian Wilson and his guest, Professor Francis Gadala-Maria from the University of South Carolina. The topic? Rheology, and how do you measure the stickiness of natural biopolymer solutions in the field, literally, in Borneo?

The problem is that filament rheometers such as the Trimaster developed by Professor Malcolm Mackley and Dr Tri Tuladhar in Chemical Engineering don't travel very well, but neither do pitcher plants. It's probably time to tell the reader that pitcher plants grow in areas with soils poor in nitrogen and phosphorus. They get these minerals by attracting insects into their liquid-filled pitchers, trapping them and dissolving the prey in the liquid. For those of your familiar with the Ice Ages movies, this fate almost befalls the mammoth Manny and his sabre-toothed sidekick Diego. The fluid is a viscoelastic polysaccharide solution that has a high extensional viscosity that clings to the insect as it tries to leave its last bath (think of a cheese fondue with a terminal forfeit as in Asterix in Switzerland).

Francis and Ulrike obtained some samples of fluid from the Botanical Gardens (courtesy of the greenhouse superintendent Alex Summers) and showed that the Trimaster device could measure these samples. All you need is a portable one ... which was the task that Cathy Collett and Alia Ardron accepted for their IIB Research Project. Armed with some crazy suggestions from supervisors Barts Hallmark and Wilson (both were born on St Bartholomew's Day), they came up with a design and went to see one of the wizards of the basement. Gary Chapman transformed the sketches into Seymour (see photo, on location with Ulrike in Borneo) and named after a character in the movie Little Shop of Horrors. Alia and Cathy spent the rest of their project commissioning the system. They observed that the fluid's rheology changes demonstrably over time after it is removed from the pitcher, confirming the need for a portable device.



Seymour (S), Ulrike (U) and pitchers (P) on location in Borneo, July 2014

By Easter 2014 Ulrike had moved to a lectureship in Bristol and was preparing for a field trip to Borneo in July. The task to turn Seymour into a field instrument passed onto Elodie Chaudan from ESPCI, Paris, as her internship project aided by Drs Loly Torres Perez and Simon Butler. Elodie commissioned robust fittings, developed new

imaging software with Bart and sourced spares. Elodie and Cathy (funded by a Sidney Sussex summer studentship) delivered Seymour to Ulrike in Bristol on 7 July (the day that the Tour de France descended on Cambridge). Seymour duly arrived in Borneo and has conducted his first experiments, with data checked in real time back at CEB by Bart and Elodie.

Plans are in place for Son of Seymour, an inexpensive filament extensional rheometer, once Ulrike and Seymour return from their adventures. Our thanks go to all those mentioned here, for their willingness to take part in this largely unfunded adventure in scientific serendipity. Talking of funding, we must mention that Ulrike's Fellowship from the Cambridge Philosophical Society commemorates John Stevens Henslow, Professor of Botany at Cambridge and mentor to another biological adventurer, one Charles Darwin.

For more info on P4G activities see www.ceb.cam.ac.uk/research/groups/rg-p4g

CEB Supplies Demand for Sensor Innovation

Dr Oliver Hadeler, CDT Programme Manager



Pulse oxymeter sensor: Non-invasive, continuous blood oxygen level sensor, used in many healthcare settings

CEB's New Sensor Technologies and Applications CDT (Centre for Doctoral Training) has received £3.7m funding from EPSRC with a further £2.5m pledged by Cambridge University and six industrial partners, Alphasense, Cambridge Display Technlogy, Costain, Rolls-Royce, Nokia, NPL and Shell. This will allow the CDT to train at least 50 PhD students over the coming eight years in sensor technology, management and interpretation of sensory data and sensor applications. Around 50 principle investigators from 20 departments in the University of Cambridge are involved, covering the physical and biological sciences, technology and clinical medicine.

The participating PIs will not only supervise their own PhD students but will be contributing to the CDT lectures, practicals and projects. In exchange they will be working with some of the most talented PhD students and be able to collaborate with other academic and industrial partners.

The need for a Sensor CDT is clear as sensors have become ubiquitous over recent years with a huge impact on every aspect of our life, from consumer products such as smart phones to personalised healthcare, from controlling industrial processes to remote monitoring of crops — the list is endless as their cost advantages have boosted the utility and demand for sensors. According to John Saffell, CTO of Alphasense, the estimated global market for sensors exceeds £200bn. For industry and consumers, better sensors ensure better product quality, process safety and shorter downtimes. In healthcare, better sensor technologies will save lives via more accurate and personalised diagnoses, enabling more efficient and targeted treatments. Similarly, high-impact academic research, e.g. in the natural and biomedical sciences, is reliant on ever-more sophisticated methods of acquiring and interpreting sensory information. Sensing molecules - one at a time or in an ensemble - is critical to all fields of sciences. New technologies, such as rapid prototyping and open-source microcontroller platforms, such as the Raspberry Pi or Arduino platform, open up completely new possibilities for everyone to develop powerful sensing platforms, enabling new and better science.

In 2012 EPSRC, together with stakeholders from UK industries and academia, had identified *"Measurement and Sensing"* as one of several priority areas with a skills gap which would benefit form a more focussed CDT approach, i.e. a centre of excellence in research training aligned to and embedded within an existing centre of excellence in research. The pillars of sensor research are in highly diverse fields and traditional single-discipline research is particularly poor at catalysing sensor innovation and application, as these typically fall in the 'discipline gaps'. Furthermore, the underpinning technology is advancing at a phenomenal pace. These developments are creating exciting opportunities, but also enormous challenges to UK academia and industry: Traditional PhD programmes are centred on individuals and focused on narrowly defined problems and do not produce the skills and leadership qualities required to capitalise on future opportunities. Industry complains that skills are waning and sensors are increasingly being treated as 'black boxes' without an understanding of underlying principles.

When the EPSRC call for a new round of CDTs came out at the start of 2013 Cambridge University was well placed to submit a proposal in the *"Measurement and Sensing*" priority area through Cam*Bridge*Sens, the Strategic Network for sensor related research at Cambridge University. Funding for the Sensor CDT was finally announced in April 2014, leaving only five months to implement the proposed ideas and recruit the necessary high calibre students. The Sensor CDT is one of ten CDTs at Cambridge University, the others being Ultra Precision Engineering, Nanotechnology, Photonics, Photovoltaics, Graphene, Analysis, Future infrastructure, Computational material science and Gas Turbines.

CEB Innovation



Scanning electron microscope (SEM) image of a highly sensitive micro-electro-mechanical mass balance for chemical/bio-molecular detection.

The Sensor CDT now allows to extend the existing cross-disciplinary research culture in sensing to the PhD level benefiting the whole University. It will deliver an interdisciplinary, research focused, training programme to outstanding students, ranging all the way from physical concepts of sensing, interpreting and managing sensory data, to application-focused sensor development. Students will explore the state-of-the-art in sensor technology (e.g. MEMS, optical and electrochemical transducers, lab-on-chip, etc...), in sensor middleware (e.g. sensor networking, systems development, signal processing, etc.), and in sensor end use (e.g. healthcare, environmental and process monitoring, manufacturing etc.) supported by leading experts in academia and industry.

The MRes, consisting of a foundation course, specialisation modules and a sensor team challenge, will focus on sensor research and impact providing the students

from different science and technology backgrounds with the necessary knowledge and skills to "speak the same language". From the beginning they will be immersed in state-of-the-art sensor technology and applications and experience first-hand exposure to the vast range of sensor-related research carried out at the University and industry. Optical sensing, microscopy, solid state sensors, lab-on-a-chip devices, sensor networks, biosensors, MEMS design, remote environmental and infrastructure sensing are just some of the topics covered.

Projects will allow students to design working sensors from concept to application, and, in the process, equip them with key practical skills that will enable them to embark efficiently on their PhD projects later on, including programming Raspberry Pis, collecting and analysing data with Matlab and LabVIEW, and presentation, research and management skills. An individual three months mini-research project will provide intensive research training in a working laboratory environment and might lead to a full PhD project later on.

The sensor team challenge will be the culmination of the MRes course. Here the students will work together full time for three months on a pre-competitive sensor project that will be co-developed every year with the industrial partners, e.g. building and testing an autonomous vehicle for detecting volatile gases or an air pollution monitoring network around Cambridge. During the sensor team challenge CDT students will put their technical knowledge into practice and develop team building, project-management and research skills as they will have technical as well as management tasks to fulfil. A mix of academic and industrial mentors will supervise the technical, management, and team aspects of the project. Away days at the beginning and end of the sensor team challenge will provide opportunities for networking between the students, academics and industrial partners. Individual reports and presentations will form part of the overall MRes assessment. The involvement of all students

and the industrial partners in this cross-disciplinary sensor team challenge will bring everybody together, generating synergy between all partners and driving the Sensor CDT forward. Thus the Sensor CDT, together with Cam*Bridge*Sens, will be the focal point of sensor related research at Cambridge University, forming a "virtual sensor research institute".

The Sensor CDT is led by its Director Clemens Kaminski, Professor of Chemical Physics and Head of CEB's Laser Analytics Group. He is supported by Professor Stephen Elliott (Co-Director teaching, Department of Chemistry) and Prof Kenichi Soga (Co-Director research and industrial relations, Department of Engineering), two CEB Senior Teaching Fellows, Dr Tanya Hutter and Dr Fernando da Cruz Vasconcellos and the Programme Manager Dr Oliver Hadeler.



Network of fibre optic sensors for monitoring deformations of tunnel walls.

Industry Business



Royal Dutch Shell

Shell Uncovered

Chang Yi, CUCES IT & Publicity Officer 2013-14

In February, CUCES Annual Dinner sponsored by Shell was held in City Hotel (Cambridge), which was a great success. Guests from in and outside of the Department were brought together and celebrated

the Department reunion with industry leaders. CEB and The CUCES Committee would also like to express their greatest gratitude towards Shell, a CEB Teaching Consortium Member, for sponsoring the CUCES Annual Dinner and for supporting the Department.

It was a pleasure to have the company of two Shell representatives, Laura and Dorota, both ex-students and department alumni. As a member of CEB Focus' Editorial Team, I had the opportunity to ask Shell representatives a few questions regarding the relationship between Shell and CEB.

Q: Would you give us a brief introduction and history of Shell to help readers set the scene, and in a nutshell, what is Shell's main business focus?

Royal Dutch Shell Plc is incorporated in England and Wales, has its headquarters in The Hague and is listed on the London, Amsterdam, and New York stock exchanges. Shell companies have operations in more than 70 countries and territories and approximately 92000 employees with businesses including oil and gas exploration and production; production and marketing of liquefied natural gas and gas to liquids; manufacturing, marketing and shipping of oil products and chemicals and renewable energy projects. The objectives of the Shell group are to engage efficiently, responsibly and profitably in oil, oil products, gas, chemicals and other selected businesses and to participate in the search for and development of other sources of energy to meet evolving customer needs and the world's growing demand for energy.

Q: What is Shell – CEB relationship currently like and how does Shell value this relationship?

Shell has an association with Cambridge University dating back to the early 1900s, including building the

Chemical Engineering department, being a member of the Teaching Consortium in the department and giving an endowment of a Shell Chair of Chemical Engineering in 1945. Shell's continued commitment to building and strengthening this relationship culminated in the signing of a strategic framework agreement in October 2013 and a £3.8 million donation to support the establishment of a laboratory for research into magnetic resonance imaging. Overseen by Professor Lynn Gladden (CEB's former HoD and now Pro-Vice Chancellor for Research), this laboratory will undertake research dedicated to developing and exploiting magnetic resonance (MR) and latest visualisation and imaging techniques in application to chemical engineering research and oil and gas recovery.

Shell was also instrumental in the founding of Churchill College and seeks to draw on the collegiate environment to enrich and enhance the experience of those working under the Shell Gift as Teaching Fellows, Shell Professorial Fellows and PhD students admitted into any of the Shell-sponsored projects.

Q: Shell does support several projects in the

Department. Could you please elaborate on this? In addition to the donation mentioned above, Shell has the following agreements in place with the Chemical Engineering department:

• Support for Materials for Life (M4L) initiative - Shell participates in the steering group of the consortium between Cambridge, Cardiff and Bath Universities and provides direct sponsorship for a PhD student at Cambridge.

• As part of an EPSRC initiative to fund Centres of Doctoral Training, Shell has offered support for two centres; Sensor Technologies & Applications and Computational Methods for Materials Science.

• Shell funded PhD studentships within the Cavendish Laboratory, the Department of Chemistry, and the Department of Chemical Engineering;

Over the past year, three Chemical Engineering and Biotechnology graduates became Shell employees with roles across R&D and businesses. They joined a structured two to three-year learning programme that enables them to gain the skills and experience necessary to become future company leaders and contribute to Shell's delivery of global operational excellence.

Academia meets the Arts



Dr Carmine D'Agostino with his wife, Chen Xi

A recent paper authored by Dr Carmine D'Agostino, has won an award for the 'highest quality article' for *Catalysis Science & Technology*, a peer-reviewed journal of the Royal Society of Chemistry. The paper discusses the reusability of heterogeneous solid catalysts in the sustainable production of value-added chemicals from renewable resources, a topic that has become very relevant in recent years in order to develop cleaner, environmentally benign chemical processes.

"Catalyst reusability and deactivation is a central issue to understand if such novel processes are to become industrially and economically viable. It is therefore important to understand how this occurs in order to adopt strategies to mitigate loss of catalytic activity."

The work was done in collaboration with Dr Mick Mantle and Professor Lynn Gladden, Pro-Vice Chancellor for Research for the University of Cambridge and Shell Professor of Chemical Engineering in a joint project with the Cardiff Institute of Catalysis.

The paper was selected to feature on the front cover of the journal. The artwork for the cover of this issue of the journal transformed the scientific context of Carmine's paper into a quirky, imaginative picture - it was a hand-made drawing by Carmine's wife, Chen Xi, who is an artist working in Cambridge and whose other works can be seen at www.chenxi.carbonmade.com/about

Carmine explains; "This hand-made drawing represents the essence of our article. There are fishes (reactant molecules) that swim under water (the solvent for the reaction), in marine caves (porous catalyst matrix) looking for pots of gold and platinum (the active components of the catalyst). A cave is accessible (the catalyst mesopores) despite the presence of obstacles (the deposits formed during the reaction) and the smiling fishes rush happily towards the precious metal pots! The other cave (the micropores of the catalyst) is much narrower and the path is blocked by the deposits. What a pity for the fishes, who are unable to access the precious metal pots, showing disappointed faces!"



Cover of 'Catalysis Science & Technology' journal

CUE £5K Grand Finale Success

Two teams from this department have won the £5K Cambridge University Entrepreneurs (CUE) business creation competition, and two other teams containing our students were runners up. The award ceremony was part of the Grand Finale on 15 May 2014 and followed keynote speakers from industry and pitches to a panel of angel investors.



SimPrints team: Daniel Storisteanu, Alexandra Grigore, Jolyon Martin, Tristram Norman, Toby Norman. © Cambridge News

The winners were Radial Genomics and Simprints. Radial Genomics, a team including students from our MBE course, has won the CUE Carpe Diem Life Science Business of the Year Award. The winning team is Alasdair Thong, Hind Kraytem, Grecia Gonzalez, Nikolaus Wenzl and Tim Xu.

Following this success and their previous accolade in the NIH / Avon Breast Cancer Challenge, members of the 'Radial Genomics' Bioscience Enterprise postgrad student team have the impetus to further their development of in situ hybridization gene visualisation technology, together with integrated with image collection and analysis software. Their ultimate aim is to offer diagnostic, prognostic and predictive capabilities in the treatment of cancer through a quantitative method of assessing changes in patients' genetic material in response to the disease.

SimPrints, co-founded by Alexandra Grigore, who is a PhD Student in the Healthcare Biotechnology Group won in the Social Enterprise category. Building on the wide use of mobile phones and the uniqueness of a fingerprint, SimPrints is developing mobile phone software and a hand-held scanner that frees biometric identification from computers, helping link patients to their medical records anytime, anywhere.

Two other teams containing Master's of Bioscience Enterprise students were runners up in the software and social enterprise streams, MyFit and HandsOn.

MyFit's team included Max Jamilly, Premal Kamdar, Lauren Machin, and Ian Goon. HandsOn's team included Erela Dana, Cobi Gantz (Master's of Public Policy) and Cassi Henderson.

Radial Genomics



Radial Genomics team - left to right: Tim Xu, Grecia Gonzalez, Hind Kraytem and Nikolaus Wenzl

Radial Genomics, winner of the International National Institutes of Health (NIH)/Avon Foundation/Center for Advancing Innovation 'Breast Cancer Startup Challenge', is a UK-based molecular diagnostics company focusing on detecting early-stage breast cancer using FISH technology.

Since being awarded Carpe Diem Life Science Business of the Year, the team took the Mathys & Squire prize at the CUTEC Technology Venture Conference, marking the end of a successful academic year.

Over the summer, the team has put a lot of effort into scientific due diligence and collaborating with the original inventors at the NIH, which will be mainly supported through grants. For the next two years, the development plan is focused on achieving proof-of-concept, and mainly revolves around scientific progress. This has allowed two members of the team – Hind Kraytem and Nikolaus Wenzl, graduates of the Master's in Bioscience Enterprise programme 2013/2014 – to focus on another project, inspired by the images of FISH technology.

Enter UPROSA, a marketplace that enables scientists, engineers, and architects to translate their discoveries into exciting lifestyle products accessible for everyone. UPROSA sources images from cutting-edge research institutions worldwide, and transforms them into consumer products such as iPhone cases, canvases, and T-Shirts. UPROSA's mission is to promote scientific innovation, communicate breakthrough developments to the public, and support innovators in their work.

The young company is currently sourcing images from students and staff from leading universities worldwide, and hopes to launch its digital marketplace and e-commerce platform in October 2014.

The department's own photography competition, which showcases the remarkable research being conducted in-house, has been a source of inspiration to the team. It is our hope that such images can be promoted on the UPROSA platform, if any researchers are interested in showcasing their work, get in touch at hello@uprosa.com

Achievements

SimPrints at Saving Lives 2014



SimPrints biometric system including a fingerprint scanner and Android SDK. © Cambridge News

Having official forms of identification is something we take for granted in rich countries. Not being able to formally identify ourselves would hinder our access to basic rights and services— we use formal ID to access financial, healthcare, and welfare services. However, such a debilitating lack of identification is pervasive in the developing world.

It is with this challenge in mind that Cambridge students have founded SimPrints, a company developing an identification system already recognised by influential institutions, such as the Bill and Melinda Gates Foundation, as having the potential to revolutionise healthcare in the developing world. To this end, SimPrints was

recently awarded \$250,000 US in the 2014 Saving Lives at Birth competition, matched to the tune of \$150,000 US by Cambridge-based ARM Ltd.

SimPrints has built an inexpensive, highly accurate and secure mobile fingerprint scanner for low-resource settings, a device to empower community health worker programmes and strengthen their service delivery. The accompanying software will soon be able to seamlessly integrate with many pre-existing development tools to overcome identification challenges. With this technology in hand, a community health worker visiting a child could place his or her finger on the pocket-sized scanner and immediately use a synced cellphone to retrieve the child's past vaccinations and identify present needs.

In partnership with Johns Hopkins University's Global mHealth Initiative (GmI) and with BRAC, the world's largest NGO, SimPrints will use its Saving Lives at Birth and ARM funding to optimise the system and conduct a pilot study in Bangladesh. This study will assess the ability of SimPrints technology to reduce maternal and newborn deaths.

Academic Promotions

Congratulations to Dr Axel Zeitler on his promotion to Reader and Dr Sarah Rough on her promotion to Senior Lecturer. They will take up their new appointments on 1 October 2014.

Dr Rough mentioned; 'I am delighted to have secured this promotion. There's no rest for the wicked though, and this October sees me looking after a new intake of M.Phil. ACE students in the Department, as well as becoming a Tutor at Hughes Hall. I shall also be continuing as CEB's Athena SWAN Academic Lead.'



Dr Axel Zeitler and Dr Sarah Rough

In Memoriam: Amy Li Cambridge Scholarships



A new scholarship programme has been established at the University of Cambridge in memory of a former Chemical Engineering student, Amy Li. Amy was born in China but attended school in the UK and won a place to study Chemical Engineering at Emmanuel College, Cambridge. After graduating in 2010 she took up a post as Safety Engineer with DNV-GL, a leading organisation in the maritime, oil and gas, and energy industries. She died only three years later, whilst working in Aberdeen.

Her colleagues at DNV-GL determined to remember her by establishing a scholarship that will enable international students to follow in her footsteps at Cambridge. Their generous donation will be matched by funding from the

Cambridge Commonwealth, European & International Trust, which exists to support international students at the University.

The scholarships will be awarded to undergraduates from any country outside the EU and will be available to outstanding applicants in Mathematics, Physics, Engineering or Chemical Engineering. Selected scholars will benefit from interaction with the staff of DNV GL, including possible summer vacation placements.

CEB Director of Teaching Dr Patrick Barrie was Amy Li's Director of Studies while she was at Cambridge. He says *I remember interviewing Amy for admission and supervising her. I was deeply saddened by the tragic news of her death last year at such an early stage of her life and career. The establishment of these scholarships, aimed at helping students like Amy, mean that her name will be remembered.*²

If you are looking for an opportunity to study at the University of Cambridge see www.cambridgetrust.org/scholarships For more information on DNV-GL see www.dnvgl.com

Last Alumni Festival at current CEB Headquarters

Elena Gonzalez

Once again on 27 September 2014 CEB made its regular contribution to the annual Cambridge Alumni Festival programme by opening its doors to Cambridge alumni and hosting a talk and lab tours. This occasion, however, marked a special milestone as it was the very last time CEB would be hosting Alumni Festival activities in its current sites. With CEB relocating to a new home in West Cambridge as from next October 2015, this is certainly a time for change with a new generation of academics and researchers on board, marking 'a before and after' in CEB history. Professor Slater commented; *'the merger with Biotechnology in 2008 has developed the Department in many varied interesting ways, our vision is to be leaders in the fields of sustainability, energy and healthcare and our talented researchers are our main product in the department and the key to our success*'. He highlighted that a home will house all teaching and research activities under one roof, allow better research interaction and provide a good platform for all department members to easily get together, share and develop ideas about science and innovation.

The talk 'CEB Vision 2015: A Trip down Memory Lane', was a double act by former HoD Emeritus Professor John Davidson and current HoD Professor Nigel Slater. Professor Davidson shared his recollections from the past and early days in Chemical Engineering, including highlights like the discovery of the 'Bacon' fuel cell and the birth of the 'tearoom togetherness' culture in the Department. Professor Slater focused on the post-2008 period, following the merger with Biotechnology, the department's achievements, its increased interdisciplinary research interests and rapid growth leading to the future move. Following the talk, Cambridge alumni were taken on a last tour round the Pembroke St site. Tour leaders showed them around some laboratories. Alumni also the chance to fire questions at talented young researchers. Check Alumni Festival at CEB highlights on www.ceb.cam.ac.uk/news/news-list/alumni-festival-2014

CEB RESEARCH DAY

Save the Day: 14 January 2015

Fitzwilliam College, Cambridge

The Department is organising a Research Open Day to bring the Department together around its research, with talks and posters from research groups involved in the different strategic themes. The objective is to promote a better understanding of the departmental aims in research and to foster collaborations between groups and industry. This day will not only be an occasion to publicise the breadth of research carried out across the three departmental sites but also an opportunity to socialise with group leaders, postdocs and PhD students as well as to share ideas, engage students and early career researchers, forge new and innovative links and to explore opportunities for cross-disciplinary collaboration. Participants will be encouraged to present and discuss the most pressing or stimulating research, and to identify new and emerging challenges. Lunch and coffee breaks will be provided; the event will be closed by a drink reception. More information will be available on the departmental website soon; participants are welcome to contact the organising team (Dr David Fairen-Jimenez, Dr Claire Michel and Elena Gonzalez)

Department Socials

Undergraduates: CUCES on Facebook

www.facebook.com/groups/121361787936091/ - also see www.cuces.soc.srcf.net

CEB Party Nights Join the group

www.facebook.com/groups/cebpubnights for updated information on regular pub nights and socials!- a group open to all post-grads, post-docs, researchers and whomever works in CEB.

CEB Lunchtime Career Talks 2014-15

(LT1, 1.00pm)

For information or to make a contribution contact Elena Gonzalez on eg314@cam.ac.uk

Our graduates, professional leaders in key industry and academic positions, can offer great career insights. Their experience is also an invaluable source of advice to our students as they search for information to help them make better informed decisions about the career choices available to them These talks are aimed at giving current undergrads and more mature students a better understanding and taste of what it's like to work in different Chemical Engineering and Biotechnology fields. • Thursday 23 October 2014 Mridula Pore, Head of Retail at Sandoz Ltd: "How Chemical Engineering prepared me to lead a £ Multimillion Pharma Business" • Thursday 27 November 2014 Alice Elder, Chartered Process Engineer at Mott MacDonald: "Water for Life: From Source to Tap"

• Thursday 29 January 2015 Dr Rachel Cooke, SABMiller, "A Career in the Food and Drink Industry -Sweet success and travelling the world to find the perfect pint"

• Thursday 26 February 2015 Harry Claxton, Technology Development Manager at Davy Process Technology, "A Career in Design"

• Thursday 23 April 2015 Dr Matthew Cahill, Dow Agrosciences, "Purpose, Mastery, Corporate Agricultural Science – and why supporting Arsenal is good for your Career"

• Thursday 28 May 2015 Dr Dan Cooney, J A Kemp, Patent Attorney, "Careers in IP"

There will be a sandwich lunch for all registered prior to the talk. After the talk students attendees are free and encouraged to network. For more information or to make a talk contribute contact Elena Gonzalez, PA to HoD on eg314@cam.ac.uk

BioBeat14: 50 Movers and Shakers,

Thursday 23 October 2014, 5.30 - 8.30pm, St Catharine's College, Cambridge

The Centre for Entrepreneurial Learning in partnership with BioBeat and the Innovation Forum is hosting a special evening event for bio entrepreneurs looking to challenge the *status quo*. There will be a panel debate entitled "Leading in a collaborative world" which will explore leadership in teams, funding, operations and business models. This will be followed by networking and the opportunity for attendees to meet with many of the 50 women movers and shakers, open up new contacts for mentoring, business development and network. In addition, a special report on the '50 Movers and Shakers in BioBusiness 2014' will be published at the event. Visit www.inno-forum.org to register.

People Focus

PostDoc Committee



President of the CEB Postdoc Committee

Following a talk by Professor Chris Abell, newly appointed Director of Postdoctoral Affairs for the University of Cambridge, to postdocs in the department, the Head of the Department, Professor Nigel Slater, asked Claire Michel to set up a CEB Postdoc Committee. The first

meeting took place on 13 March and the current members of the Committee are the following: Claire Michel (Chair), Chiara Boschetti, Jethro Akroyd,Krishnaa Mahbubani, David Fairen-Jimenez, John Suberu, Adam Colbourne, Cara Bootman (Admin Liaison) and Daniel Holland (Academic Liaison). The aim of the committee is to improve the experience of postdocs in the department in terms of research, development and social activities. To this aim the Postdoc Committee will identify areas where postdocs feel they lack support or information, feedback to members of the department and make suggestions for improvement. The first actions taken have already improved information given to new postdocs joining the department.

Claire commented; 'the CEB Postdoc Committee which exists to represent postdocs in the department and feedback concerns and suggestions to the Head of Department. The postdoc committee, over the past few months, has improved information given to postdocs when they join the department, added a postdoc webpage to the departmental website, organised two days of training for postdocs and has representatives on the Athena SWAN committee and the Organisation Management Committee'.

A Research Day will also be organised during Michaelmas term. All minutes of the Postdocs Committee meeting are available on pin boards in the department and a webpage is currently being set up to efficiently disseminate information. Postdocs who wishes to discuss particular points, or who wish to join the committee, are invited to contact Claire Michel (chmm2@cam.ac.uk).

Community Outreach Talk: 'Time' from a Humanist Perspective



Dr Vassiliadis, a senior lecturer of our CEB department and the leader of the Process Systems Engineering research group, has been a member of the Cambridge Humanist Group (CHG) for some years. In June, he gave a community outreach talk on "time". According to him, the talk was

CHG talk presenter Dr Vassiliadis

meant to "present cutting-edge research results in an entertaining and informative way for the first time in public". The talk explored the interesting concepts of time from multiple perspectives - philosophy, perception and mathematics. It was presented in three major parts. The first part was largely the paradigm in modern physics to resolve the circularity in time definitions. The second part presented key ideas behind computational algorithms that do not treat time as an independent parameter. The third final part concluded with a speculative discussion of multiple timescales and parallel timelines.

Cambridge Humanist Group



"A first Humanist Society was formed in 1955 in Cambridge as the outcome of discussions amongst members of the University. The Cambridge Humanist

Group as it is presently constituted was reformed in 1993 by a small number of local Humanists, including Sir Hermann and Lady Bondi. It is now a thriving local Humanist community with members from all walks of life." www.cambridge.humanist.org.uk

CEB Pink Angels Race for Life



From left to right: Michaela, Vanessa, Amanda and Sandra

Back on 20 July 2014, a hot and sticky summer day, CEB receptionist, Michaela McNeill joined by Vanessa Blake (Computer Officer), Sandra Crawford (Accounts) and Amanda Taylor

(Graduate Admissions) joined more than 6,700 women in Cambridge to raise money for the fight against cancer. The Race for Life is a women-only 5km event weaving its way around the city's landmarks to raise money for Cancer Research UK. It started at Parker's Piece finishing on Jesus Green.

Vanessa and Sandra have personal reasons for wanting to give something back to Cancer Research as they were both diagnosed and treated for breast cancer last year. Luckily this time were they were well enough to walk the course themselves.

Vanessa said; "A year ago, I went down to Parker's Piece to see Michaela off. I had just completed chemotherapy and was about to start radiotherapy. I had no hair and after seeing her off at the start line, I didn't even have the energy to take the short cut to the finish line to see her come in. This year, I feel so much better. There were people all round the course, cheering us on and encouraging us. I am grateful to everyone who supported us and to the staff at Addenbrooke's hospital and cancer researchers who made my treatment possible."



Members of the Department and friends and family of the team were very generous and they have already surpassed their target of $\pounds 1000$ ($\pounds 1152$).

Pink Angels on the Start Line

An Ode to 'Dear Dear Sarah'



CEB Editorial Team is saddened to announce that, unfortunately, Dr Sarah Rough has now left her post as CEB Focus 'agony aunt' to focus on her ever-growing academic commitments. Her very much-loved 'Dear Dr Sarah'

column was always a clever, satirical piece of writing and a fun read that will be greatly missed by all as well as her comical streak and the valuable advice regularly given to students and colleagues alike. The whole Team would very much like to thank Sarah for her fantastic contribution to the newsletter over the last four years. The Team will be looking for a replacement column to be featured as from January 2015. If you have any ideas for alternatives please contact the Team on ceb-focus@ceb.cam.ac.uk

Now, to honour Sarah, the Team has asked Zlatko Saracevic, CEB's Lab Technician and amateur poet, for an inspirational note about her. He started working in the Department back in November 1993, when young Sarah was a Post-doctoral researcher for Professor John Bridgwater in the Paste Group. Zlatko has then improvised an 'Ode' to Sarah, CEB's dearest agony aunt:

Thanks to Dr Sarah Rough for letting us do an eloquent Semantic Analysis. Sarah is Hebrew for 'Little Princess' delivered in a small boat at sea. Rough, Whoops! Rough indeed but not with a derogative, pejorative meaning... 'Rough' as a diamond sparkling bright and reflecting the storage weasel of light, so bright that is only obscured by placing it in the bottom of a void. It has a universally geometrically-organised morphology of a vibrantly embedded crystal, a nano-Universe, the dome of Quantum Mechanics and an ideal travel companion into the unknown, the musical magic of perfect spheres (Richard Wagner's Walkure*).



*The Valkyrie is an opera in three acts by Richard Wagner with a German libretto by the composer. It is the second of the four operas that form Wagner's cycle Der Ring des Nibelungen (The Ring of the Nibelung). The story of the opera is based on the Norse mythology told in the Volsunga Saga and the Poetic Edda. In Norse mythology, a valkyrie is one in a group of female figures who decide which soldiers die in battle and which live. Die Walküre's best-known excerpt is the "Ride of the Valkyries".

Zlatko Saracevic

Science Crossword



Across

1. First name of the first Shell Professor of Chemical Engineering

- 2. A simple strategy of control
- 3. A popular technical software designed by Honeywell
- 6. Derived from Greek, meaning "no change in boiling"

9. The process of dispersed particles sticking to each other

10. Acronym for the research group sitting next to Cavendish Laboratory

Down

1. A fundamental subject of engineering

4. A beloved drink which gave IIA engineers some fun memories this year

5. The country in which the Cambridge Centre for

- Carbon Reduction in Chemical Technology is based
- 7. A type of solid-liquid separation process
- 8. Name of our library

For solutions check the Tea-time Teaser folder on www.ceb.cam.ac.uk/news/ceb-focus

Comic



WWW. PHDCOMICS. COM

Letters to the Editor

Elena

Saw all your publications for Chemical Engineering/Biotechnology department. You are doing a great job getting our dept.name out there :-) Always happy to help as an alumnus! All the best. Dr Abhishek Desphande, CEB alumnus (Oil Markets Analyst at Natixis), PhD, Chemical Engineering and Biotechnology

Greetings!

Hope everything is in the department is going well. Reading *CEB Focus* issues brings back fond memories of my wonderful time spent in the editorial team! Kind regards (Dr Rashmi Tripathi, CEB alumna)

Dear Nigel and Elena,

Thanks so much for your very prompt reply to my email your speed is indeed impressive! *CEB Focus* gives me a strong feeling of a department that is "on the move" (not necessarily a physical one like the move to the West Cambridge site, but of a department in which exciting and important things are happening).

For some reason, not entirely clear to me, I was appointed a "bye-fellow" of my alma mater, Emmanuel College, and I haven't had the courage to ask what it means, apart from year-round dinners at High Table (they're pretty safe on that one) and an expense allowance for entertaining guests (I've invited both my contemporaries David Harrison and John Davidson in the past two or three years). Emmanuel also gives me a free parking space in the college, surely worth more than an honourary degree! Thus, I know Patrick Barrie quite well - he's a fine person, and I was glad to see in *CEB Focus* that he's now deputy head for teaching.

I have two items that may interest you:

1. A complete set of Cambridge ChE Tripos and Qualifying Examinations from about 1949 through 1970. 2. For some reason, shy and retiring as he was, Professor Fox was very kind and friendly towards me and my wife, Mary Ann, and he gave me a very fine cylindrical slide rule in 1959. I'm appending a couple of photos of it, and you can see that it's almost of museum quality. Although I'm not quite ready to part with it, I would like it to have a good home one day. I don't know if you have a display cabinet planned for the new building (I think you have one at the Pembroke site?), but if you had a permanent exhibit, part of which is dedicated to Fox, then that would be a possible home for the slide rule. And so would the Whipple Museum, which was suggested to me by Dr. Sarah Bendall, Development Director at Emmanuel.

My first PhD student was Don Nicklin, taken over by John Davidson when I left. Don eventually returned to his native Brisbane, and rose to Pro Vice-Chancellor of the University of Queensland. I inherited from Professor Fox (and saw to completion in 1960) my second PhD student, Ronnie Nedderman. Both Don and Ronnie did superb experimental work in two-phase flow and turbulent fluctuations, respectively.

Since I left your department in 1960 to come to Michigan, we visited Cambridge quite often, the main attraction being the legendary Margaret Sansom (until her death in 1999), who did valiant work in keeping Professors Fox and Danckwerts under control. Best regards to you both, Professor Jim Wilkes, Ex-Faculty

Dear Elena,

You (and your team) have done it again - congratulations on another excellent *CEB Focus*. I was, of course, particularly interested in the article by Peter Davidson and the appreciation of Denys Armstrong - he was both my teacher from 1953 - 1955 and a colleague from 1956 -1960

Best regards, Jim

Blast from the past! (Letters to Editor from 2010, CEB Focus first year of circulation)

Many thanks Elena - and congratulations on a fine looking first issue. The algae biofuels article looks and reads well, and I'm delighted to have secured a by-line! Thanks & regards, Richard Scrase, ExxonMobil (UK & Ireland Public & Government Affairs)

Dear Nigel,

My congratulations to the editorial team for putting together such an interesting, engaging and thoroughly professional-looking newsletter - it certainly puts some of IChemE's subject group newsletters to shame! Danckwerts' research on biscuits in particular made me laugh out loud, if you don't mind I'll show this to my colleague Adam Duckett, who's responsible for the light-hearted Residue page in TCE. There were also several other items that perked my interest and which I'm minded to suggest picking up in TCE. For example, if someone could forward me an email address for Stephen Gerrard I'd be grateful - I was most intrigued by his idea for an anti-viral nipple shield.

Best regards, Claudia Flavell-While, Director of Publications IChemE

Letters to the editor

We welcome comments from our readership. Please email us your views and suggestions for future articles on ceb-focus@ceb.cam.ac.uk

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