UNIVERSITY OF CAMBRIDGE

CEB *Focus*

Department of Chemical Engineering and Biotechnology

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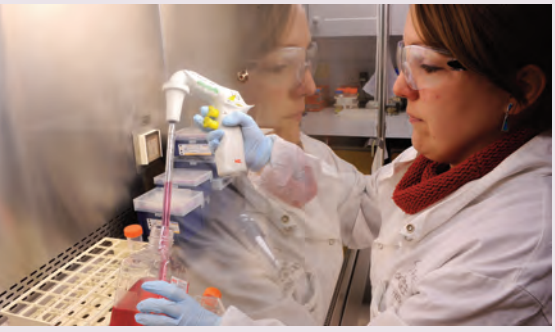

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In this issue

Welcome

Message from HoD, Professor John Dennis

To have been elected Head of Department is a very great privilege. It is with awe that I recall the enormous professional stature of previous holders of this post and therefore the weight of responsibility falling on a new incumbent! The challenge of the post is all the greater at this important and exciting time in which our research, innovation and teaching are particularly vibrant.

My commitment is, first and foremost, to ensure that CEB enhances its position as a global leader and preserves the delicate balance between teaching a substantial flow of high-quality first-degree, Master's degree and PhD students and conducting internationally-leading research. This balance is maintained by our unique blend of (i) gifted academic staff, (ii) freedom to conduct significant, innovative research of interest to individuals and (iii) dedication to teaching fundamentals. Of course, CEB would not be in this position without the commitment of our very dedicated assistant staff, who bring many years of experience to bear on academic research problems, and the generation of innovation, and without whom our activities would be seriously inhibited.

Our core values underpin our activities. In particular, these dictate that there we (i) insist on the highest standards of quality in everything we do, (ii) accept only the very best students (iii) emphasise innovation and radical thinking in our research, and (iv) maintain a very high standard of teaching. At the same time, we shall pay special attention to enhanced management of HR and communications in CEB to support our mission.

CEB Editorial Team from right to left: Chief Editor Elena Gonzalez, CUCES undergraduate rep Hannah Templeman and Research students Geertje van Rees, Noha Al-Otaibi and Aazraa Pankan

Editorial Note

CEB Focus Editorial Team wishes all readers a happy Autumn and a very warm welcome to the new CEB undergraduate intake and cohort of graduate students from our Masters courses MPhil ACE, MBE and CDT Sensors Technology as well as research students.

CEB Focus Newsletter is the product of a joint team effort led by Chief Editor Elena Gonzalez. The Editorial Team of volunteers is fully committed to the project, contributing their enthusiastic ideas to help enhance the editorial content and look of the publication. For department members interested in joining the Editorial Team email ceb-focus@ceb.cam.ac.uk

It has been a hectic summer for the Editorial Team, who have revamped the design of the publication cover and a new fresh look can be appreciated in this issue. The Michaelmas edition *Main Article* focuses on CEB's new leadership with Professor John Dennis taking up post as the new Head of Department. He shares his mission and vision of the Department.

CEB Women in Chemical Engineering and Biotechnology, features Part2B student Rachel Oldham, CUCES Chemical Engineering Society President 2015-2016. In *Industry Business,* Dr Graham Dransfield, CEB Knowledge Transfer Facilitator, reports on the latest exciting collaborations with industry. It also features INVISTA, the latest company addition to the CEB Teaching Consortium of Companies portfolio.

Undergraduate Focus features CUCES plans for the new academic year and pays tribute to deceased undergrad student Rebecca Long. *Research Highlights* tells about early career researcher projects showcased at this year's Graduate Research conference as well as the 'Carbon Brainprint' paper published by Edward Ishiyama. *Graduate Hub* presents a review of CDT Sensor Technologies and Applications course and an update from CEB Postdoc Committee. *The Research Feature* is a contribution by CEB Lecturer Dr Gabriele Kaminski-Schierle, who is investigating the molecular mechanisms causing Alzheimer's. *CEB Innovation* presents a portrait of key innovative solutions and technology developed in-house in the last decade.

Achievements section showcases home-grown talent and academic excellence with success stories from Dr David Fairen's Inmaterial company wining £20k in a Royal Society of Chemistry competition for his MOF technology to MBE Alumni entrepreneurial venture Desktop Genetics achieving success and £1.37m funding. *Alumni Corner* features the obituary of 1955 Chemical Engineering alumnus Hamish Kidd whilst *People Focus* presents the CEB Focus Editorial Team members as well as the selected new Gates Scholars to join CEB Andi Reci, Cassi Henderson and Adeline Klotz.

Meet CEB's new Head of Department: A Leader's Vision and Impressions

Professor John Dennis, FIChemE

My career in Chemical Engineering, and to some extent my research interests, were set when I was an undergraduate in the Engineering Department at Cambridge and attended a talk on third-year options given by the then Head of Department of Chemical Engineering, Professor John Davidson. His lecture, illustrated by some of his research on fluidisation, persuaded me to opt for Parts I and II of the Chemical Engineering Tripos in 1980 and 1981, having previously been set on a career in mechanical engineering. During Part II, I was supervised by Allan Hayhurst and, as a result of his encouragement, stayed on to do a PhD with him between 1981 and 1984. Immediately after that, I was fortunate to be promoted to an assistant lectureship in the Department and undertook teaching and research until 1989. During this period I published on the control of sulphur emissions from fluidised bed combustors and on gas combustion in fluidised beds. During a period in industry, I also worked closely with ICI on the initial translation of the Quorn fermentation from laboratory to production scale.

I left Cambridge in 1989 to become an Engineering Consultant specialising in the solution of detailed process or economic problems, with areas of technical interest including fermentation and downstream separation, heat and mass transfer in reactors, combustion, and fluidised bed reactions. I also developed close links with the UK funding bodies during this period and had close involvement with collaborative research involving academia and industry, being a manager of one of the LINK programmes and also working for BBSRC as a coordinator in biochemical engineering. Towards the end of the 1990s, I returned to the Department and was successively University Lecturer (2002), Senior Lecturer (2004), Reader (2008) and Professor of Chemical Reaction Engineering (2012).

My research interests have in many ways been shaped by those early – and enduring - contacts with Professors Davidson and Hayhurst and my keen interest in fluidisation. I must also thank Allan Hayhurst, and so must generations of my own research students, for his emphasis on clear, correct, succinct and accurate English. My current research group undertakes fundamental research in three broad themes. The first is Chemical Looping for the combustion and gasification of fossil and renewable fuels, with separation of pure CO_2 without energy penalty. Chemical looping, both for combustion and for our current interests in using it for selective oxidation reactions, depends on efficient reaction between gases and moving beds of solids. As a result, the group has a strong interest in gas-fluidised beds, so that our second theme is the Physics of Granular Flows, investigated using combinations of modern measuring techniques (*e.g.* Magnetic Resonance Imaging, MRI, Particle Image Velocimetry *etc.*), underpinned by theoretical approaches (*e.g.* Discrete Element Modelling). The third theme is Sustainable Transport Biofuels, which embraces both system-level studies of sustainability and gas-to-liquids approaches for biomass to liquid fuel as well as the methanation of CO and CO_2 to natural gas. Interestingly, there is now serious industrial interest in converting, at a large scale, synthesis gas to products using organisms engineered with techniques employing the most recent advances in biology. We have undertaken a number of studies of the feasibility of such approaches.

I am amazed at the enormous span of CEB's research portfolio, covering healthcare, processes, materials, metrology and modelling. The strength of our research lies in our commitment to working at a fundamental level at the interfaces among the underpinning disciplines of Engineering, Chemistry,

Professor John Dennis in the Combustion Lab

Biology and Physics, whilst being able to formulate collaborations amongst research groups to work on new problems in sustainable processes, healthcare and materials development.

Moving on to the future, the Department's overall aim will be to continue to address the world's most pressing challenges through our teaching and research, benefiting society by creating world-leading engineering and biotechnological knowledge that fosters sustainability, prosperity and resilience. To achieve this, our absolute commitment is to recruit and retain the very best academic researchers and teachers, and to provide our staff with a supportive and sustaining environment that encourages them to function effectively at the very highest level of academic achievement. Within this mix of busy people and research, teaching and administration, it is inevitable that management problems will arise. As a result, we shall be improving our commitment to HR in future so as to ensure that we are able to offer attractive opportunities for work and study irrespective of gender and to demonstrate our commitment to equality and diversity. I am very pleased that we have just completed the recruitment of four new lecturers, three of whom are female, to enhance our activities.

In addition, the opportunity and impact offered by the new building on the West Cambridge site is substantial. It is disappointing that its complexity has caused further delays in our move, but it is essential to ensure that we move into a building in a proven, working condition. Of course, removal of activities from our three sites to the new building will be complicated, and stressful for staff and students and we shall take special care here. Beyond the opening events, it is critical to plan for show-casing the building and its research over, at least, a five-year time horizon. The contiguity of all the CEB research will enable new ideas and collaborations, and will be an implicit part of the events programme.

As a member of the IChemE's Accreditation Panel, it is clear to me that all Departments of Chemical Engineering are trying to understand the opportunities offered by modern IT in teaching and lecturing. Engineering is a quantitative discipline and the retention of key facts by individuals is always going to be a critical feature of a well-educated professional, as will be the ability to set out arguments, assumptions and calculations succinctly, legibly and intelligibly: skills which are in danger at the moment. I am confident that the current undergraduate course addresses these issues, but mindful that we shall need to review regularly our offerings to ensure that they are responding to the professional needs of our graduates. In the postgraduate area, we shall be developing a suite of courses in biotechnology with the aim of offering a Master's course in the near term covering areas such as synthetic biology, genomics, proteomics and their quantitative implications for engineering. This will run alongside our existing successful Master's courses in Bioscience Enterprise and Advanced Chemical Engineering

Despite the challenges ahead, I am confident that, with the skills, talents and enthusiasm in the Department, we shall remain a strong, innovative, and forward-looking Department. The relocation of CEB on a campus with other Departments in the vicinity with complementary interests is expected to be a starting point for further collaboration and innovation. It is also worth noting that due to the inevitable expansion and spin-out of CEB activities in future, and the increasing desire by many companies to have their researchers working alongside CEB researchers, building an innovation space ("Phase II"), cut from the current building programme, will be a priority and central to future fund-raising activities.

A Message from CUCES

Chemical Engineering Society CUCES Committee Members 2015-2016

Having had our first successful event as the new 2015-16 Committee and with a new year on the horizon, CUCES is looking forward to get stuck in. The BBQ, held in Churchill College grounds, was a highlight of Easter term, with plenty of food, booze and an inflatable that could really knock you over. It also had the highly competitive rounders match, where a certain lecturer stole the show as always. Amongst all the fun, there was the touching tribute to Becca Long, who sadly passed away in June. She will be remembered fondly by all of us.

We have the usual range of events in the planning for the upcoming year. Firstly, there is the Christmas dinner, which will hopefully be held at Browns at the end of Michaelmas. Frank Morton Sports Day, which will be held in Manchester on 16 February 2016 – hopefully we'll be able to get us all there and back smoothly and maybe aim for a podium position next year… Maybe not. Annual dinner is, as usual, in Lent, location to be confirmed. I know we're all looking forward to another great speech from Dr Barrie or whoever else is attending this year.

We are also hoping to maintain the mentoring scheme started by previous committees, with a 'Meet your Mentor' event at the beginning of Michaelmas. Hopefully, plenty of part IIAs will be keen to get involved as mentors. We hope that some of the IIBs will be willing to come along and help everyone get know each other.

Another tradition that is coming up is the pub quiz with part Is and Exxon Mobil. It's always a great way to start the year and let the new part Is get to know each other, and get a view of the new department (hopefully!) for the first time. We'll also be electing a part I representative to the Committee. It's great fun to be part of CUCES (and doesn't look bad on the CV either), so have a think about whether you want to be a part of it.

We hope to continue what is fast becoming a tradition of Chem Eng formals at various colleges. We've already had some great ones at Sidney Sussex, Robinson and Caius. If you go to a college that CUCES hasn't attended yet and are willing to help us secure tickets, give us a shout at chengsoc@hermes.cam.ac.uk. Hopefully we'll be able to get in some pub trips as well for more casual socialising.

A big plan for the upcoming year is to help undergraduates in finding internships by setting up an internship database. It's easy to forget with all these companies coming in and selling themselves to us that getting an internship isn't quite as simple as that, and that there are more companies than those in the teaching consortium. The aim of this database is for students who have already completed internships give us helpful hints about applications, what they enjoyed about the company they worked for and what the worst bits were to help future applicants out. Look out for emails soon about this!

If anyone has any suggestions for activities CUCES can put on or ways for us to improve, please drop us an email at chengsoc@hermes.cam.ac.uk

Have a great term everyone!

Remembering Becca

It is with profound sadness that CEB reports on the tragic death of one of its talented undergraduate students Rebecca Long, 21, who passed away in June as a result of a road accident. In this column Becca's friends pay tribute to her remembering happy moments and celebrating her life.

"Becca was unique in the best possible way. She was kind and trusting to everybody around her – and was loved by anyone lucky enough to get close to her.
It's unfair that the best and brightest of us had to die first – but let's do ourselves a favour and remember her for everything she left with us.
I'll always remember Becca as the girl who loved playing puzzles, the girl who was never afraid to try new things, the girl I always looked up to.I'll always remember her as the girl I fell in love with. And every day, all I can do is to try and be a little more like Becca."

Memories of Becca

Becca's friends in the Department remember her:

"Becca was an incredible person and I will always be glad I got to know her and be her friend. Becca was an amazing friend and so nice to everyone, she was always smiling and laughing and generally making wherever she was a happier place. She always tried to make sure everyone was included and was having a good time."

"I have so many amazing memories of Becca and the times we spent together. I think the time we all spend up in Birmingham for Frank Morton 2015 is a great example of Becca's character and general love of life, the day wouldn't have been the same without her, and I'm sure pretty much everyone on the trip would agree! Right from the beginning of the trip she insisted on going all out for the day, starting during the Christmas holidays by planning our crazy golf team outfits, sweater vests and visors for both of us. Even without the outfit she would've been noticed while we were actually playing – jumping and cheering anytime she got the ball in the hole and going a bit crazy the couple of times she got a hole in one. At one stage there was a group of kids watching her play to see her reactions. Her spirit continued throughout the day and into the night, and she was still her typically lively self on the coach on the way home at 2am. Becca made Frank Morton a great trip I will never forget. I will always remember Becca, for her smile, her laugh and her generally carefree, joyful attitude to life.
Miss you Becca xx."

"During the design project I remember coming to department in the morning and Becca was there after having done an all-nighter. It was about the third week of the design project, so quite a few people already were a bit grumpy. I could see Becca was really tired, but instead of being grumpy, she just started giggling. She kept on giggling for about 10 minutes straight. Then someone told her to get some sleep while she was still giggling. Even when Becca didn't feel very good and really tired, but she still managed to spread so much positive energy. She always managed to make people around her feel happy. After three years I have very rarely seen her not smiling and happy. I will remember Becca for many reasons, but in particular it was her caring and inclusive personality that made her stand out. She was always on hand to tell me what to expect in the coming years and help me overcome any obstacles. She will be missed greatly."

"If someone loves a flower of which there is only one on the millions and millions of stars, it is enough to make him happy when he looks at them for he can say to himself: "My flower is somewhere out there…"

On 16 June 2015 fellow students paid tribute to Becca by releasing balloons with messages at the annual summer CUCES BBQ in Churchill College

Becca always cared deeply about improving support for the mental health of children and young people. Her parents have set up the following JustGiving page in her memory, already raising over £4000. Any donations would be greatly appreciated.
See www.justgiving.com/anne-long1

EPSRC CDT in Sensor Technologies and Applications

A Perspective from the Teaching Team

Dr Oliver Hadeler, Programme Manager of Cam*Bridge*Sens

Sensor CDT Students Isabella Miele and Philip Mair with their Arduino-based Body Temperature Sensor and Blood Oxymeter

The EPSRC Centre for Doctoral Training in Sensor Technologies and Applications, based in the Department of Chemical Engineering and Biotechnology, was announced in April 2014 and after five months of tireless and creative working by a dedicated team of academic and administrative staff, the Centre welcomed its first cohort of ten students in October 2014. Particular thanks must go to Amanda Taylor and Chloe Aust, without whom the venture would have collapsed already before the arrival of the first cohort.

At the beginning, the big question was: Would we be able to deliver anything close to the ambitious programme we had promised EPSRC we would offer to the students?

During Michaelmas and Lent Terms, the students attended course modules relevant to the Sensor Programme in the Departments of Chemical Engineering and Biotechnology, Engineering and Materials Science, which stretched the students beyond their comfort zones of undergraduate learning. A multidisciplinary lecture series was organised, entitled "Principles of Sensing", which was aimed at inspiring the students across all areas of sensor research at our University. It was delivered by more than twenty lecturers, covering technologies such as MEMS, microfluidics, optical and electrochemical sensors and applications ranging from high throughput screening, civil infrastructure and forestry monitoring to mimicking nature's sensors and even highly accurate fertility sensors! Furthermore, a weekly lunch meeting with an industrial partner took place during both terms and students were introduced to external speakers from industry, led discussions, and made connections.

The programme lectures were complemented by practicals and a series of projects, which increased in complexity and scope as the students became more confident in their abilities. The "Guided Sensor Project" started them off with building an Arduino and Raspberry Pi based temperature and blood oxymeter to understand the basics of sensing. Peer- to- peer teaching and learning bonded the students together, which consists of engineers, physical and biological scientists. The students displayed extraordinary skill and imagination and developed a number of impressive devices that not only met the original specifications but also, exceeded these and were, for example, able to connect to the internet and communicate data via smart phones.

Through individual research mini projects, the students gained a first taster of research life in a research group. Mini projects lasted for two months and students fan out to project supervisors across the University, with projects based in Engineering, Chemical Engineering, Physics, Biochemistry and Chemistry. All projects included supervisors from at least two Departments and some form the basis for future PhD projects.

The culmination of the first year is the "Sensor Team Challenge". The CDT teaching team agreed with our industrial partners to give the students the task to develop a sensor system to assist the elderly in living more independently. The project involved market research, the design and development of goal specific technology and the thinking about ethical and consumer acceptance. The students had to manage the project on their own and were given a fixed

budget. Apart from input from the CDT Teaching Fellows and industrial mentors, they were left to themselves to scope and deliver the project - a situation not dissimilar from a start-up company. What the students have come up with has surpassed everybody's expectations: they developed an easy to use communication system, comprising a fall sensor and a suit of sensors to detect abnormalities in the daily routine of the elderly, that automatically trigger a call for help. The students have been extremely impressive and will be presenting this project to an international audience of sensor experts and the new cohort of CDT students at the Sensors Day on 16 October at Murray Edwards College.

Looking back at the first year, the Sensor CDT teaching team has climbed a steep learning curve, facing administrative, logistical and emotional challenge but we believe that the CDT has achieved what it set out to do: inspiring the students, stretching their imagination, developing team and research skills and, most importantly, preparing them for three years of exciting PhD research. It's been a very hard work but has been worth almost every minute of it. The current student cohort has been worth the efforts; they have been spectacular.

CEB Postdoc Committee

Dr Claire H Michel, Post-doctoral Researcher from Molecular Neuroscience Group with some of the members of the CEB Postdoc Committee

The Postdoc Committee, currently composed of Claire Michel, Krishnaa Mahbubani, Belen Gonzalez, Polina Yaseneva, JJ Phillips, Iris Batalha and Chiara Boschetti, has been very active in its first year.

The Committee's showcase event — the departmental Research Day took place in January at Fitzwilliam College. Members of the Department delivered talks as well as presented posters. The Research Day was attended by 150 people, including industrial collaborators. With such success and excellent feedback from the day, the event will be held annually, with the next one being held on 12 January 2016.

To give the opportunity to researchers in the Department to present their work, a new recurrent event was also set up with the GradSoc, called Meet the People. Every fortnight, PhD students and Post-docs have the opportunity to give informal short talks on their research or any subject of interest and to mingle with each other.

The Postdoc Committee organised three in-house-training sessions for Post- docs this year: 'Presenting your Research', 'Making an Impact' and 'Making your Mark'. We have, also, increased and improved the induction material given to Post- docs joining the Department. Post- docs are now represented on various departmental committees, including the Athena SWAN Self- Assessment Panel, the Research Committee and the Organisational Management Committee. Finally, the CEB Postdoc Committee is connected to the University through the departmental Postdoc Committee Chairs Network, where members of our committee communicate information about our Department to the Office of Post- doctoral Affairs and interact with other Post-docs to gain from each other's experience.

We finished the year with the election of Krishnaa Mahbubani as the new chair of the Postdoc Committee and we look forward to another year of activities. If you would like to suggest ideas about events to be organised or to raise any issues or if you even want to join the committee, please visit www.ceb.cam.ac.uk/about/postdoc/

CEB welcomes Four new Lecturers

Dr Gabriele Kaminski-Schierle

My research is focused on uncovering the molecular mechanisms that cause proteins to misfold and aggregate in live model systems of Alzheimer's disease (AD) and Parkinson's disease (PD). In order to understand these diseases at a molecular level, modern biotechnology forms an essential foundation for my research. I am very excited about becoming a staff member at this Department at such an important moment of its existence. The new building will bring excellent possibilities and facilities for everybody to conduct research and to deliver an excellent teaching programme. I am very keen to contribute as much as I can to make the transition a success for all. Having the biotechnology and chemical engineering expertise finally under one roof will bring new opportunities to collaborate. The facilities available at the new Department, such as laser labs, mass spectrometry, micro-fabrication and NMR facilities will greatly support my future research undertakings.

My group will be called the Molecular Neuroscience Group and I want to further expand our capability by gaining further knowledge in micro-fabrication and in the genetic manipulation of small organisms.

I am also looking forward to the new challenges arising as a lecturer and in Michaelmas Term 2015/2016, I will be taking over the Biotechnology lectures from Professor Tunnacliffe, who has recently retired. I am keen to contribute to teaching and to expand on the Biotechnology syllabus that the Department offers.

I have two children, aged 12 and 10 and trying to combine a family life with a scientific career is tough at times, but hugely rewarding. As part of my new role, I will try to encourage women with children to pursue academic careers and to help them achieve their scientific career goals.

I have little time for myself at the moment but I enjoy swimming, reading a good novel or an early hour yoga session. And, being Austrian, I love a week of skiing in the Alps with the whole family!

Dr Alessio Zaccone

During my undergraduate studies of Chemical Engineering at Politecnico di Torino, I was lucky to attend very inspiring lectures where grand challenges were discussed with the emphasis on matter; its fascinating properties and its many transformations. Inspired by my lecturers, I became convinced that the mission of Chemical Engineering might well be the rational control over matter and its phase transitions at the atomic/molecular level, with unlimited opportunities from industrial separation processes to biotechnology. This thought deepened my interest in statistical physics, especially in non-equilibrium statistical mechanics and its application to the properties and transformations of technologically important materials.

My research interests developed in the area of structurally disordered materials, where an apparently random distribution of interacting atoms in space gives rise to solids with unexpected thermal, rheological, optical and electrical properties. Applications of my work in this area range from metallic glasses to photovoltaics. In an allied area, I am very much interested in the molecular-scale dynamics in liquids with an emphasis on chemical reactions and macromolecular self- assembly processes, solvation and crowding effects, and hydrodynamic effects in flowing systems. Applications range from protein aggregation to sustainable reaction engineering in microfluidics devices.

I am, also, greatly looking forward to teaching in the Department and, among others, I hope to contribute to the areas of transport phenomena, rheology, mathematical methods, and possibly offer a new course on statistical mechanics for chemical engineers and biotechnologists. Ideally, I would like to seek an even closer connection between engineering and natural science topics and the associated viewpoints with an emphasis on problem solving.

In my free time, I enjoy fine arts, music and literature. I hope soon to get back to a good shape at playing tennis, possibly with new challenging partners!

Dr Laura Torrente Murciano

I am very pleased to join CEB and be part of this highly dynamic and vibrant community at Cambridge! I shall endeavour to contribute to the exciting research being carried out there. I believe that the current energy and chemical industries need to be deeply transformed to not only sustain our lifestyle but also to enhance it. We need innovative technologies to change the way we are currently doing things and bring scientific progress into real applications. The current scientific environment is so complex that collaborations with other disciplines are critical for success. And this is what we are currently studying in my group by combining aspects of catalysis development, reactor design and process integration. We are developing concepts such as compact reactors for manufacturing of nanoparticles, ammonia-powered fuel cells for renewable energy and unstable emulsions for efficient processes.

My passion about science and research started during my undergraduate research project in Madrid. The memories of that time helped me to make one of the best decisions in my life - quitting the job I had in industry and coming to the UK to do my PhD. Since then, I have been extremely lucky to be surrounded by very good and supportive people, from my PhD supervisor (Professor Lapkin) to Professor Chadwick at Imperial College to the whole Department of Chemical Engineering at Bath where I spent the last 5 years as a lecturer.

Above everything, I have an amazing family who encourages me in every step and decision. Outside the lab, I enjoy painting, travelling and nature.

Dr Ljiljana Fruk

I studied Chemistry at the University of Zagreb then I did my PhD in Biospectroscopy at the University of Strathclyde. Then, I joined Professor Niemeyer's Group in Dortmund in 2004 to work on DNA nano- structuring, nanoparticle bio- functionalisation and artificial enzyme design. I will join CEB, moving on from my role as a "Photoactivable Nanodevices" Group Leader at the Centre for Functional Nanostructures, Karlsruhe Institute of Technology (KIT).

My research interests involve synthesis of linkers for functionalisation of nanomaterials, use of engineered materials in bio-sensing and optoelectronics, DNA structuring and design of catalysts based on nanomaterials and enzymes. My teaching will cover some of these topics within the courses of biotechnology, sustainable/bio-materials and materials chemistry. I am, interested in exploring the cultural and societal impacts of new technologies such as nanotechnology and synthetic biology. I am a co-author of art/science/creativity compilation "Molecular Aesthetics" and a scientific curator of several art/science exhibitions, the latest being GLOBALE: Exo- Evolution at the Centre for Art and Mediatechnology in Karlsruhe.

I am interested in science popularisation and a passionate amateur astronomer. Puzzled by any kind of intelligence, I like to investigate different routes to creative thinking. I love painting and I am a non-published author of numerous semi-finished stories and novels. I followed the advice of one of my Zagreb professors, that nobody can truly be a good chemist without being able to cook. Therefore, I have brushed up my skills in a restaurant. I also mastered the skills of growing my own food and successfully demonstrated that one can have a full Mediterranean garden on a tiny balcony. I love being outdoors and plan going around Cambridge and joining some sport club, preferably one that has nothing to do with a ball.

First Year Seminars 2015

Joanna Starkie, Colloids Group

The Easter term departmental seminars were given by first year PhD students. The students talked about their research projects for a scheduled time of 15 minutes. The presentations started on Wednesday 29 April 2015 and run for five weeks. Joanna Starkie, from the Colloids Group, shares her experience with us.

I found the first year presentations hugely beneficial. I presented on the crystallisation of petroleum diesel and particularly on wax anti-setting additives (WASAs), which are used to limit the sedimentation of wax crystals by reducing the crystal size and improving the stability of the wax crystals suspensions. Initially, I was quite nervous about presenting my work to the Department for the first time. However, the atmosphere was supportive and the questions insightful. This positive experience and practice is a great experience to remember for future presentations. The video was also useful to improve my presentation style as it made me aware that I tend to speak too quickly. The presentation was also very helpful to make links between groups within the Department and share expertise, which has since been very valuable for my research.

GRADUATE RESEARCHERS' SOCIETY

Last academic year the CEB Graduate Researchers' Society – in collaboration with the Postdoc Society – showcased a selection of informal "Meet the People" talks from PhD students and Postdocs within the Department. GRSoc also organised the Graduate Conference last April. CEB welcomes PhD student Petar Besevic (pb607@cam.ac.uk) as the new GRSoc Chair and would like to thanks Jacob Brubert for all the hard work he put into the society last year.

Graduate Research Conference

The Graduate Student Conference took place on Tuesday 21 April and Wednesday 22 April 2015. Second year PhD students presented posters while third year PhD students gave presentations. The Head of Department, Professor Nigel Slater, handed prizes for best posters and presentations.

Second Year Poster Session 2015

The three prize- winners for best posters were Henry Lin, Nathan Curry and Alexandra Grigore. Henry Lin and Nathan Curry illustrated their research as follows:

Henry Lin, Molecular Microbiology Group

Bacterial species of the genera Bacillus and Clostridium form endospores as a protective mechanism in response to nutrient starvation. Bacterial spores are the most resilient biological structures observed in nature, and are able to resist a variety of environmental insults, such as extremes of temperature and pH, in part due to their multi- layered coat structure. My project focuses on exploiting their properties of resistance for use in drug delivery. The approach involves taking a molecule of interest, for example a vaccine antigen, and using molecular-genetic techniques to fuse the molecule to an appropriate spore coat protein. The resultant fusion protein is, then, displayed on or near the surface of the spore where the inherent properties of resistance of the spore are conveyed to the attached drug molecule, that is, the drug is now protected from lytic enzymes, and is stable in response to enhanced temperatures and or extremes of pH. In addition to removing the requirement for cold-storage, costs associated with drug manufacture may be reduced since there are fewer steps involved in downstream processing; not only does the bacterium produce the drug, but it also acts as the vector for its delivery, whether via the oral, nasal or systemic routes. To date,

several candidate proteins of therapeutic interest have been expressed successfully on or within the macromolecular spore coat structure.

Nathan Curry, Laser Analytics Group

I started my PhD in the Laser Analytics Group, led by Professor Clemens Kaminski, from the Photonics Systems Development Centre for Doctoral Training. During my first year, I worked with Dr Pierre Mahou on the development of a super-resolution microscope based upon the principle of stimulated emission depletion (STED – a technique which recently received considerable attention after its inventor was awarded the Nobel Prize).

The microscope system developed during this project improves the resolution of a confocal scanning microscope, typically limited by the diffraction limit to ~250 nm, by overlaying the raster scanning beam with a doughnut shaped depletion beam which "switches off" fluorescence outside of the centre using the process of stimulated emission. The system developed here can achieve resolution down to 35 nm.

The STED microscope is being applied to a wide range of projects and I am focused on applying this system to live cell imaging. In particular, I am investigating how dendritic spines, small structures found on neurons, change shape in neurodegenerative diseases. My poster was based on this application and the development of a labeling strategy to study these structures using STED.

Third Year Presentation Session 2015

The three prize-winners for best presentation were awarded to Julia Manetsberger, Jacob Brubert, and Luke Baker. Julia shares her research as below:

Bacterial endospores, formed by members of the genera *Bacillus* and *Clostridium* in response to nutrient starvation, are one of the most resilient cell types found in nature and are able to withstand various environmental, physicochemical and biological challenges. Due to their extraordinary resistance, these dormant cell types can be found in almost any habitat, including soil, water and mammal hosts and may persist in the environment for thousands or perhaps even millions of years. Considerable research effort has been devoted to understand the role of spore formers in severe diseases such as anthrax (B. anthracis), tetanus (*C. tetani*), antibiotic-associated diarrhoea (*C. difficile*) or food-borne illnesses (*B. cereus*). However, endospore forming bacteria, also, offer various beneficial features, such as their use as green pesticides (*B. thuringiensis*), drug delivery vehicles, probiotic dietary supplements for human and animal nutrition and for the development of new vaccinations.

Julia Manetsberg, Molecular Microbiology Group

The extraordinary stability is conferred to the spore by its unique multi-layered structure, consisting of a DNA-hosting protoplast, surrounded by various protective layers resembling a protective armour around the partially dehydrated core.

My project focuses on investigating the composition, architecture and assembly of the outermost spore layers in the model organism B. megaterium. In particular my research aims to identify and characterise structural and or morphogenetic components of the B. megaterium QM B1551 outermost spore layers with a view to reconstructing these structures in vivo and in vitro. A better understanding of these extraordinary structures could then allow the development of novel (biotechnological) applications in the future.

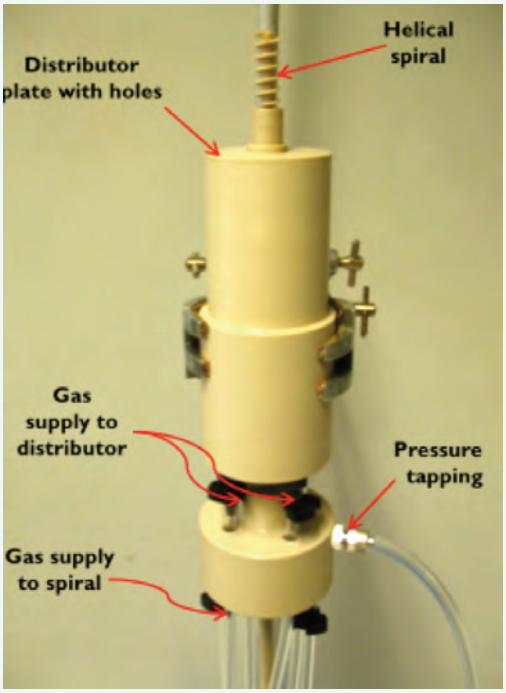
Unconventional Design of a Fluidised Bed Reactor

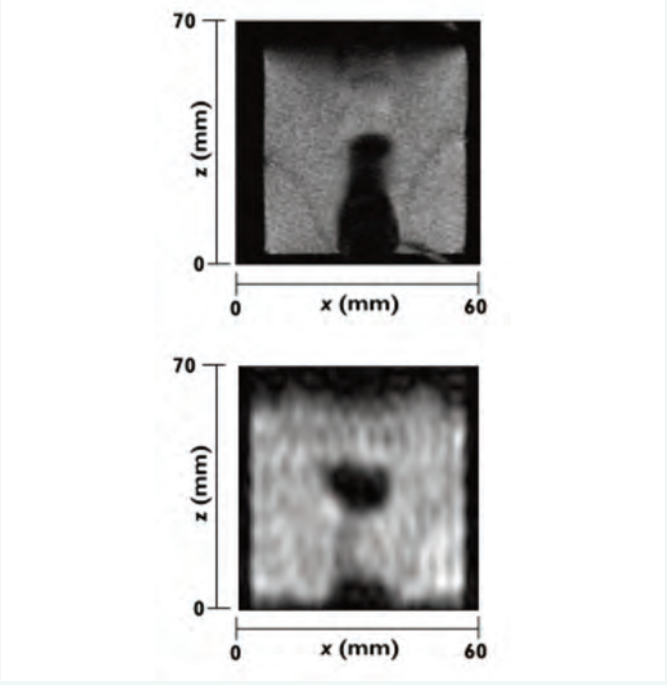
Samson M. Aworinde, PhD Student, Sustainable Reaction Engineering Group

Fluidised beds are used in many large-scale chemical processing operations such as the fluid catalytic cracking of hydrocarbons because of their enhanced heat and mass transfer properties. The design of the gas distributor is crucial since it influences the efficiency of gas–solid contact as well as pressure drop across the distributor. A recent paper published by three members of this department - Sam Aworinde, Professor John Davidson, and Dr Dan Holland† - in collaboration with Huntsman, explored an unconventional spiral gas distributor design for a fluidised bed reactor. The concept involves multiple nozzles in a distributor plate incorporating a helical spiral, which makes the gas swirl as it enters the bed. For a prototype consisting of one such nozzle and spiral, the paper described the use of magnetic resonance imaging (MRI) to study the flow pattern in the bed, including jet and bubble phenomenon, as well as theoretical and experimental study of the pressure drop across the swirling flow nozzle. The authors observed that the swirling flow significantly improved the fluidisation quality but gave much higher pressure drop compared to a conventional fluidised bed distributor without a helical spiral. The findings open the opportunity for further investigation of the spiral distributor concept and potential wider applications in industrial fluidised beds. The paper, titled 'Investigation of a swirling flow nozzle for a fluidised bed gas distributor', was published in Chemical Engineering Science Volume 132, April 2015, Pages 22-31 doi: 10.1016/j.ces.2015.04.001.

The work on which this paper was based was done six years ago when Sam Aworinde was an MPhil student in Advanced Chemical Engineering in this Department. After some years in industry, Sam is back in the Department and is currently a second year PhD student in the Sustainable Reaction Engineering group. He is working on reaction engineering approaches for selectivity improvement in partial oxidation of hydrocarbons with Professor Alexei Lapkin.

† Dr Dan Holland is now at the University of Canterbury, New Zealand.





Left: Illustration of the fluidisation column showing the spiral gas distributor
Right: MRI images of gas jet (top) and bubble (bottom) formation by the swirling flow nozzle

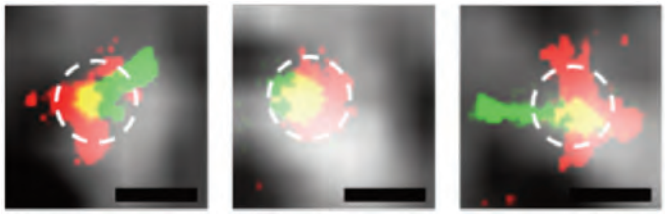
Scrutinising the molecular Mechanisms of Alzheimer's Disease

Gabriele Kaminski-Schierle, Claire Michel and Na Yu - Molecular Neuroscience Group

The newly established Molecular Neuroscience Group (MNG), headed by Dr. Gabriele Kaminski-Schierle, focuses on investigating the molecular mechanisms that can cause Alzheimer's disease (AD) and other neurodegenerative diseases. AD is the main cause of dementia in the elderly population. It has been estimated that over 30 million people worldwide are living with dementia and AD prevalence is projected to increase dramatically in the next two decades.

Proteins are produced in cells as long chains from so called amino acids. They attain their function by folding into 3 dimensional shapes in cells; only if they assume their correct shape can they perform correctly and adopt essential roles that support life. The two proteins thought to cause AD are Amyloid-β (Aβ) and Tau and are part of a group of proteins called amyloid proteins. Amyloids are special in that, under circumstances not yet fully understood, they can 'misfold' and in the ensuing misfolded states they have a tendency to clump together and form clusters which accumulate in the brains of patients suffering from AD (and related diseases, such as Parkinson's and Huntington's). Scientists puzzle over how Aβ and Tau, two completely different proteins, end up in such aggregated states, initially forming small clusters within brain cells or in their periphery. In time, these initial clusters aggregate further and grow until they become so densely packed that they displace, and kill, a significant fraction of brain cells. It is not clear, which of these amyloid species (very small or larger aggregates) are toxic. Conventional techniques to look at amyloid species fail to distinguish between small or large aggregates in live cells, amyloids are simply too small for one to form an image of them in a brain cell with traditional techniques. Only invasive techniques permit us to see their structures, but they require us to destroy the cells and extract their components. How then will we be able to relate aggregate shape to toxic function? Answering this question is critical in the search for possible therapies against AD and related diseases, which devastate lives and human dignity around the world.

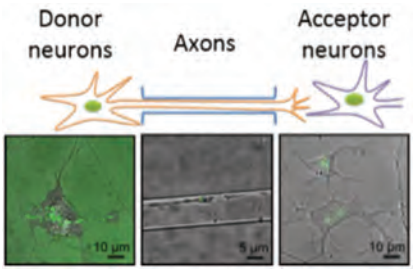
We use visible light in novel ways to form 'images' of protein clusters directly in live neurones. Using such techniques allows us to monitor protein clusters as they form, over time, and to correlate their size and form to the toxicity they exert and the behaviour in affected cells. The methods work in living cells or even in small organisms which serve as more realistic models of the disease than single cells. In particular we have pioneered the study of amyloid formation with advanced microscopy methods in neuronal cells and small earth worms (so called nematodes) which serve as powerful models that permit us to study with molecular level detail the onset and progression of disease.



Tau (red), a protein involved in Alzheimer's disease, co-localises with vesicular markers (green), informing us on the fate of Tau after internalisation by primary neurons in culture. The typical size of a vesicle is indicated by the white dashed lines. Scale bar: 500nm.

We and others have recently shown that amyloid proteins can travel into and out of cells and also between different compartments within a cell. This so called 'trafficking' behaviour has major ramifications for the progression of disease. Trafficking of amyloid proteins between cells may lead to the transmission of their toxicity from one cell to another and thus to spreading the disease to healthy brain tissue. Usually Aβ is present outside of cells and Tau is localised inside cells. Interestingly, we, and others, have found that both Aβ and tau can enter and exit cells. But a large number of questions remain: Which forms exit and enter cells - small or large aggregates? What are the associated mechanisms? Can amyloid proteins enter a neighbouring cell and trigger the 'healthy' protein population present in that cell to misfold and aggregate? If this is the case, as has been recently hypothesised, the disease could propagate from a small region of the brain to another, non-affected, area and therefore provide an explanation of disease progression and worsening of symptoms in suffering

patients. Understanding how Aβ and tau enter and exit cells is therefore crucial if we wish to find ways to halt disease progression as soon as possible after diagnosis.



A microfluidic-engineered cell culture chamber allows us to monitor separately "donor neurons", axons and "acceptor neurons" in our study of Tau misfolded state propagation from cell to cell.

In order to address our questions we use primary neuronal cultures, neuronal cell lines, and small organisms such as the earthworm *Caenorhabditis elegans* as models of disease. We closely work with Prof. Tuomas Knowles and Dr. Florian Hollfelder on the design of microfluidic devices to study amyloid trafficking across neuronal cells. For superresolution imaging of cells and worms we make use of the Laser Analytics Group's facility, headed by Prof. Kaminski. For proteomics we will be applying mass spectroscopy made available by Prof. Bahn's group. We further collaborate closely with Prof. St George Hyslop's headed Neuroscience Consortium involving expert scientists from the UK and abroad, such as Prof. Dobson in Chemistry, Profs. Mandelkow and Jucker in Germany.

Who is part of the MNG team?

Dr. Claire Michel, who has been in the group for 5 years, has a background in Neurosciences. She leads the study of the propagation of Tau from cell to cell and regularly participates in other research projects carried out with collaborators.

Dr. Dorothea Pinotsi joined the group in 2012, she is a trained physicist and works at the interface between biology and physics. She has pioneered the study of intrinsic fluorescence on amyloid proteins and on α-synuclein strain formation.

Dr. Janin Lautenschläger joined the group 2015 after finishing her PhD in Neuroscience. The main focus of her work is to elucidate in primary dopaminergic neurons how mitochondrial dysfunction and α-synuclein aggregation are cross-linked.

Amberley Stephens is a Research Assistant in the group, having almost completed a PhD in molecular biology. Her role includes cloning and modification of genes, construction of plasmids and purification of recombinant amyloid proteins. She works closely with all members of the group.

Na Yu is a third year PhD student who joined the group at 2013. Na's PhD research is focused on developing microfluidic devices to investigate the propagation of Tau in Alzheimer's disease using super-resolution microscopy.

Suil Collins is a second year PhD student working on the identification and development of small molecules capable of inhibiting the aggregation of amyloidogenic proteins, in collaboration with the groups of Prof David Spring and Dr Florian Hollfelder.

Jhalique Jane Fojas is a PhD student working on developing an integrated microfluidic-nanosensor system for neuro-functional imaging and neurotransmission detection.

Philippa Hooper studied Chemical Physics and is now part of the CDT in Graphene Technology. She begins her PhD in October fabricating graphene-based devices to investigate neuronal activity.

Genevieve Simpson will start in Oct 2015 as a Master student. With a BSc in Neuroscience she will be working on Tau propagation using Single Plane Illumination Microscopy and microfluidic devices.

Kevin Llewelyn Batenburg is MSc student at the University of Amsterdam. He will be joining the group in January 2016 to work on the analysis of α-synuclein strains and their related toxicity.

CEB Innovation Highlights of the Last Decade

This article showcases some of the key technological inventions developed in-house in the last decade. As a result of multidisciplinary research activities and collaborations, innovative ideas are being nurtured and converted into commercial reality. CEB researchers' amazing research breakthroughs have on occasions led to the set-up of thriving hi-tech and biotech company spin-outs. These technological devices and inventions, though at different stages of development, also show some great examples of University effectively working with industry. Innovative thinking will pave the way for yet more innovative ideas, forging new collaborations and helping creating the high-tech start-ups of the future. Some more technological advances, fruit of CEB research efforts, will be featured in the next issue.

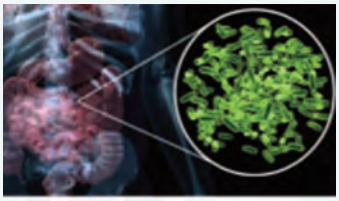
The Polymeric Heart Valve[1]

Over 3 million prosthetic heart valves are implanted worldwide each year to replace dysfunctional heart valves. Roughly half of these prostheses are mechanical heart valves- which require lifelong anticoagulation therapy, and half are 'bioprostheses', using decellularised tissue from a cow or pig - which have a limited durability, up to 15 years. Here the focus is on the design of an innovative polymeric heart valve, and in particular on the optimization of a block co-polymer material with orientation-dependent mechanical properties able to mimic the performance of native heart valve leaflets.

The Nipple Shield Delivery System[2]

The device is a low-cost modified nipple shield used to aid breastfeeding mothers. The tip holds a replaceable insert containing a microbicide, medication or nutritional supplement. The mother can place the device over her nipple and feed her baby. As breast milk passes through the nipple shield and disk, the active agent is released from the insert. This device could be disposable, and contain therapeutics that do not require refrigeration, making it a hygienic method of infant drug delivery that could be especially useful in resource-limited settings. The current application for this product is focused on the prevention of HIV transmission between mother and child during breastfeeding.

Bacteria-Based Oral Vaccine[3]



The technology protects bacteria-based oral vaccines from destruction by the digestive system, to enable their safe delivery to the body's immune system. The technology uses a material called bile-acid adsorbing resins (BARs) to protect bacteria from the destructive effects of bile in the small intestine. BAR is mixed with dried bacteria in a capsule that can be swallowed. The movement of bile into the capsule is held back by the resin long enough for water to rehydrate the bacteria, before the capsule finally breaks open, enabling the bacteria to survive. The current application is focused on the prevention of Delhi belly (traveller's tummy).

Recycling and Environmental Technology Solutions[4]

enval
VALUE FROM WASTE

The UK uses more than 160,000 tonnes of flexible laminate packaging each year, containing more than 17,000 tonnes of aluminium. Enval has created the first solution to recycle laminate packaging and retrieve the valuable resources contained within it. The patented process is based on a technology known as microwave induced pyrolysis, a pyrolytic process in which microwave energy is used to heat and degrade plastics into useful pyrolysis oils. The fragile aluminium foil remains undamaged and can be extracted clean and ready to be reintroduced into the aluminium supply chain. Life cycle analysis shows that the aluminium obtained via this process has a carbon footprint of 72% lower than that of primary aluminium.

References:
1. Stasiak, J., Brubert, J. and "www.ceb.cam.ac.uk/directory/geoff-moggridge" \o "" \t "_self" Moggridge, G.D. UK Patent 1403454.0, Heart valve, filed 27 Feb 2014.
2. www.justmilk.org
3. "www.cam.ac.uk/research/features/clearing-the-bar-to-oral-vaccines-0"
4. www.enval.com

Overview

Initial conversations are taking place with a number of companies, all with significant potential for future research contracts. Significant progress continues to be made with Invista, who have a special feature on the opposite page. There are a number of significant breakthroughs to report, most notably the signing of a research contract for a 2 year PDRA Project with SulNOx.

Company Highlights

SulNOx Fuel Fusions plc were featured in the Lent Edition of CEB Focus. The company has now signed a 2 year Research Contract to support a Post Doc under the supervision of incoming Head of Department, John Dennis. This represents an exciting development. The company aims firstly to make significant reductions to marine diesel pollution through their unique fuel emulsification technology. The company are looking to CEB to provide a scientific explanation for the performance improvements that they have already observed in the field.

MedImmune, the global biologics research and development arm of AstraZeneca, signed a new five-year, multi-project collaboration agreement with The University of Cambridge back in May. The project with CEB will focus on generating breakthrough research in biopharmaceutical development (BPD), a field that includes cell engineering, continuous processing, formulation and analytical science, to support development of potential new therapies. This collaboration falls within a new Framework Agreement between MedImmune and The University, designed to lower barriers to innovation, support rapid implementation of long-term research projects and foster further collaborations between Medimmune and the University.

Impact

On the Road…

Graham Dransfield is making a UK Tour of Business Environments for Science and Technology (BEST Networks) on behalf of CEB. First stop was Hexagon Tower in Manchester in June, kindly facilitated by Dr Mike Anderson the Wilton Centre Business Manager, where he spoke to 3 resident companies. This led to a follow up meeting with a global leader in life sciences. He also gave a talk about CEB to the June Wilton Wednesday Business Networking Meeting. The talk was well received and has led to an invitation to speak to the combined Teesside branches of the RSC and IChemE. Next stop is the Kent Science Park in Sittingbourne in September with meetings with some well -known names in pharma and chemicals lined up.

New Spin-out wins Innovation Prize

CEB Spin-out *Immaterial* was launched to exploit the exciting Metal Organic Frameworks (MOFs) technology. The company has already won a £20K Innovation Prize against hot competition from the Royal Society of Chemistry. Congratulations to Dr David Fairen-Jimenez for this and for a successful bid for £60K of Impact Acceleration Account Follow-on Funding. The company, supported by Cambridge Enterprise, aims to commercialise the enhanced gas adsorption properties, brought about by MOFs, for greener gas transport.greener gas transport.

Research Collaboration with Infinitus

CEB has been awarded a major research contract and a donation from Chinese Health company Infinitus. The deal is worth more than £4.0M and includes a very significant donation towards the construction of the department's new building on the University's West Site (more in the next issue).

Post-Event Review

H2020/MSCA Seminar

The seminar outlined Horizon 2020 (H2020), particularly the Maria Sklodowska Curie Actions (MSCA) scheme. The University of Cambridge has a strong record in making MSCA applications and the aim is to promote higher uptake of this valuable scheme. Renata Schaeffer gave an overview of H2020 and Dr Graham Dransfield presented the seminar and shared his experience as MSCA Evaluator.

Graham Dransfield addresses the H2020/MSCA Seminar

INVISTA - CEB collaboration to pursue Innovation in Biotechnology

Dr Gary Smith, INVISTA, Vice-President of Sustainability

Ramdane Haddouche and Nadia Kadi, research scientists, work at the INVISTA bioscience laboratory in Wilton, UK

While it has been a number of years since I was in the department as a Ph.D. student, it is encouraging to see much of what I valued about my time at Cambridge shine through in the relationship INVISTA has forged with the Department of Chemical Engineering and Biotechnology (CEB).

INVISTA joined the CEB Teaching Consortium in January 2015, and the collaborative nature of our work has me optimistic about potential biotechnology advancements in the supply chain for chemical intermediates.

INVISTA, one of the world's largest integrated producers of chemical intermediates, polymers and fibers, has strong capabilities in biotechnology, in addition to its leading knowledge of the chemicals industry. The goal of INVISTA's biotechnology efforts is to create high-value products out of low-cost feedstocks while also using less energy and creating fewer emissions. To help advance our biotechnology efforts, we also seek out other technical leaders, and that is where the CEB team comes in. By working with the Cambridge team, we can directly integrate into leading processes and talent, both faculty and students, at one of the world's most respected chemical engineering and biotechnology programs, while also offering students and faculty the opportunity to integrate with industry in exciting and innovative sustainability initiatives.

The ability to work with Professors John Denis and Nigel Slater and other members of the department, and gain access to the knowledge base at the University has the potential to help accelerate some of INVISTA's current projects. One of the primary areas we are presently focusing on is gas fermentation-based processes to form industrial chemicals. Through this collaboration, we are currently working on developing process computer models that will allow us to predict the performance of gas fermenters for new feed stocks and organisms, potentially assisting INVISTA in accelerating the commercialization of its processes. Looking further ahead, INVISTA and CEB are in discussions on possibly working together on a variety of developments concerned with taking fermentation broth and isolating and purifying chemical products through a number of different unit operations.

INVISTA also hopes to make contributions to the undergraduate teaching program at CEB by providing inputs to parts of the course focused on modelling; by exposing students to the use of network analysis to solve metabolic pathway problems in micro-organisms, we hope to build an appreciation for how chemical engineering principles are being applied to solve cutting-edge problems in systems biology today. INVISTA and the CEB are also exploring additional ways to maximize the value of the relationship, which may include branching beyond INVISTA's team of scientists and working with our human resources team to help students better understand what many typical industrial employers look for in job candidates, as well as sharing insights into INVISTA's Market-Based Management® business philosophy.

INVISTA's collaboration with University of Cambridge CEB Department is an important step in our pursuit of biotechnological innovation that we hope will be of mutual benefit to students, department, and the University. Since INVISTA established a sustainability team in Wilton, U.K. in 2010, the potential for development and innovation in this field has continued to fuel strategic growth. Today, we have a team of more than 30 scientists, including molecular biologists, metabolic engineers and bioprocess developers, working on a variety of initiatives and the development of bio-derived processes for the manufacture of chemicals and polymers. This is an exciting time for our team, and I look forward to sharing more about INVISTA and our relationship with the CEB during a Lunch and Learn event on 28 January 2016. More information on INVISTA can be found at www.biotechnology.INVISTA.com

RSC Emerging Tech Competition Winning

The spin-off company Immaterial was awarded the first prize in the materials category of the third edition of the Emerging Technologies Competition 2015, organised by the (RSC) Royal Society of Chemistry. The first prize involved, amongst others a tailored business support from partner companies, including access to networks, strategy review, potential commercial partnerships, idea evaluation and a cash prize of £20,000.

The Emerging Technologies Competition is an annual innovation competition. It accelerates the commercialisation of the most impactful ideas in healthcare, energy and sustainability, and materials. The competition is backed by multinational partner companies such as GlaxoSmithKline, Croda, Procter & Gamble, Pfizer, AstraZeneca, GE Healthcare, Schlumberger and Lubrizol. The final was held in London on 29 June 2015.

Immaterial has recently been founded by two members of CEB: David Fairen-Jimenez and Tian Tian, together with Andrew Marsden and Thomas Fry, and is a result of the research from the Adsorption & Advanced Materials Lab. *'Our invention is in the field of a relatively new family of porous materials called metal-organic frameworks, which performs far better than any other class of material at storing and separating gases. Using the material designed in our lab inside a tank, we can store 16 times as much gas compared with the empty tank'.*

Professor Lisa Hall appointed CBE

Professor Lisa Hall

Professor Elizabeth (Lisa) Hall has been appointed CBE (Commander of the Order of the British Empire) in the Queen's Birthday Honours list announced on 13 June 2015. Lisa is Professor of Analytical Biotechnology and Head of the Cambridge Analytical Biotechnology Group. Her research work is based on heterogeneous analytical systems with a primary focus on molecular sensors, directed towards environmental, medical and industrial applications. She is also the Chair of Disability Snowsports UK. She has received the Honours for services to Higher Education and to Sport.

Dr Ian Wilson to be promoted

From right to left: Dr Ian Wilson, Ian's PhD supervisor Professor Paul Watkinson and Ole Mathis Magens

This year, Dr Ian Wilson is to be promoted to a personal professorship following this year's round of senior academic promotions.

Ian joined the Department as a University Assistant Lecturer in 1994 after completing his PhD at the University of British Columbia. He currently leads the Paste, Particle and Polymer Processing Group (P4G) with a diverse range of research interests in the field of soft solids and surfaces.

Ian received the news while attending the International Conference on Heat Exchanger Fouling and Cleaning held in Enfield, Eire. He and one of his PhD students, Ole Mathis Magens, won two of the three poster prizes awarded at the conference.

Ole Mathis Magens presented his paper on *Value pricing of antifouling surface coatings* (co-authors Jurgen Hofmans and Martial Paborn), while Ian Wilson presented work from Vincent Lister's PhD work with John Davidson and Steve Sutcliffe entitled '*Management of acute particulate fouling in a titanium dioxide reactor system'.*

China Scholarship Council Award

Qian Sun

Qian Sun has been awarded a prestigious scholarship from the China Scholarship Council. This award will cover the fees and stipend for three years of Qian's studies in Cambridge.

Qian is currently completing her first year as a PhD student in the Colloidal Dispersions Group led by Dr Alex Routh. Her project looks at microencapsulation and she is making colloidosomes which are then surrounded with an external gold layer. The aim of the project is to attach proteins to this gold layer and thereby enable biospecificity and delivery of the encapsulated drugs to sites within the body.

Qian said *"I am delighted to have received this award. Many thanks to my supervisor Dr Alex Routh for helping me apply for this scholarship and thank you to the China Scholarship Council for providing this opportunity. I, also, want to thank all my group members, who regard me as a family member and help me so much not only in research but also in daily life. I am enjoying my studies in BP Institute in Cambridge very much and am greatly looking forward to the next few years."*

Danckwerts-Pergamon Thesis Award

Dongpin Chen

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.

The 2014 Danckwerts-Pergamon Prize for the best thesis has been awarded to Dongping Chen, for his research thesis "Numerical Investigation of Polycyclic Aromatic Hydrocarbon Clusters". His thesis investigates the clustering behaviour of a series of polycyclic aromatic hydrocarbons (PAHs) using the molecular dynamics method and presents detailed surveys of the clusters to explore their morphologies and surface reactivities as the precursors of soot particles. He was supervised by Professor Markus Kraft, head of the Computational Modelling Group.

Professor Bahn elected RSB Fellow

Professor Sabine Bahn

Professor Sabine Bahn has been elected as a Fellow of the Royal Society of Biology (RSB). The Royal Society of Biology is a single unified voice for biology: advising Government and influencing policy; advancing education and professional development; supporting members, and engaging and encouraging public interest in the life sciences.

Fellows of the Royal Society of Biology will have made a prominent contribution to the advancement of the biological sciences, and gained no less than five years' experience in a position of senior responsibility.

Professor Bahn is a practising psychiatrist, Chair in Neurotechnology and Director of the Cambridge Centre for Neuropsychiatric Research within the Department of Chemical Engineering and Biotechnology, University of Cambridge. Her main research interests are to understand the molecular basis of neuropsychiatric disorders, with a focus on schizophrenia and mood disorders. She is also one of the two gender equality champions for the School of Technology.

Deskgen Raises £1.37m Funding

From left to right: Riley Doyle, Victor Dillard and Edward Perello

Three M.B.E. University of Cambridge postgrads: Riley Doyle, Victor Dillard, and Edward Perello set out to find a better way to do Biology. Founded in 2012, they called themselves Desktop Genetics.

Desktop Genetics Ltd, a UK bioinformatics company aiming to revolutionize the way genetic researchers work, announced that it has secured an investment of £1.37M GBP ($2.15M USD) from a syndicate of VCs and angel investors, including IQ Capital Partners, London Business Angels, the London Co-Investment Fund, Dr Jonathan Milner (Deputy Chairman and Founder of Abcam plc), Dr Martin Murphy (CEO of Syncona Partners LLP) and Dr Darrin M Disley (CEB Alumnus and CEO of Horizon Discovery Group plc). This investment will enable Desktop Genetics to commercialize its proprietary DESKGEN genome editing software platform, which allows researchers to expertly design and perform CRISPR-based genome editing experiments in virtually any cell line or species.

Riley Doyle, CEO and founder of the company, commenting on the close of the investment, said: *"To date, the DESKGEN platform has enabled over 4,000 gene editing experiments and has assisted thousands of users in designing and accessing the best reagents for their research. We are grateful to our investors for making the next stage of development possible, and I am excited to lead the company through this phase of growth."*

Alumnus receives Arthur Metzner Early Career Award

Assistant Professor at University of Connecticut School of Engineering Chemical & Biomolecular Engineering Department

One of our past post graduates, Anson Ma has been awarded the prestigious 2015 Society of Rheology, Arthur Metzner Early Career award for his work on carbon nanotubes in the field of rheology. Anson won a Hong Kong scholarship[1] to study for a PhD at Cambridge and in 2006 came to work with the Polymer Fluids Group run by Professor Malcolm Mackley. Mackey proudly commented; *'Anson was the glue that made the link between experiment and some high level suspension rheological modelling. It is very satisfying for the department to see past members of the department going to other Universities and doing so well. Anson is one of a number of our alumni who have very successfully made the transition to USA University life'.*

Whilst carrying out his PhD, Anson founded, with the help of others, a very successful Cambridge CNT Society, which brought together CNT activity from a number of separate different Cambridge Departments including; Engineering, Chemical Engineering, Material Science, Physics and Chemistry.

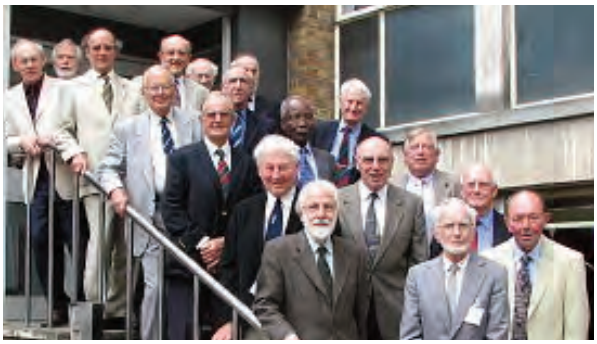
Anson added; *'I'm honoured and thrilled to be receiving this award. I would like to thank my PhD advisor, Prof Malcolm Mackley, for being an inspiration and above all introducing me to the wonderful world of rheology!'*

In 2011 Anson was appointed as an Assistant Professor at the University of Connecticut and since then he has built up his own Group that applies rheology principles to enhanced colloidal stability of rod like particles, blood flow and the application of ink jet processing to bio cell application.

[1]www.malcolmmackley.com/apparatus/cambridge-shear-cell

Alumnus Obituary: Hamish Kidd

CEB regrets to announce the death of Chemical Engineering alumnus Alexander Hamish Kidd, who passed away on 29 April 2015 aged 80 after a short illness. He was Chemical Engineering student at Gonville and Caius College



1953-55 He attended National Service, 2Lt Royal Corp of Signals, i/c two signal troops (144 men) and civilian exchange in Germany, latterly i/c independent troop in Hook of Holland

1955-59 Hamish also helped Tim Eiloart make a hydrogen generator for The Small World flight balloon in which he made an attempt to cross the Atlantic. He was also a member of the infamous Caius team who put an Austin 7 egg van on the roof of the Senate House in Cambridge in 1958.


That's how they did it!

Revealed after 50 years, the secret of the greatest-ever student prank

Getty: 1958 car on Senate House roof[1]

Hamish was last in the Department in 2009 when he attended the 50th anniversary reunion led by classmate Mike Bennett (see Hamish in photo above, top row 4th from the bottom, on the very far right). His defining life moment, as he revealed in 2009; *'I was met by two sergeants when I joined 2L of C in Dusseldorf, who said very nicely "If you do as we suggest you'll be alright!".* I have always remembered this - delegate to those who know what they are doing (In my case abrogate!)'

[1]www.telegraph.co.uk/news/uknews/2210696/Cambridge-Universitys-1958-car-on-roof-prank-secrets-revealed.html

Department Events: Michaelmas Term 2015

CEB (CUCES) Careers Panel Event

Monday 26 October 2015: CEB, in collaboration with Cambridge Chemical Engineering Society (CUCES), presents the annual Careers Panel Event. Experienced graduates and corporate representatives from leading chemical engineering and biotechnology fields share their experience with undergraduate students giving them valuable insights about working in industry and advice on a variety of relevant career options available.

More information on www.ceb.cam.ac.uk/news/events/ceb-careers-panel-event-2015

CEB Lunchtime Career Talk Series 2015 - 2016 (Michaelmas Term)

- **Thursday 29 October 2015:** Alumna Katie Coull, Consultant at Arthur D. Little Ltd, on *"Managing safety in high hazard industries"*. Katy has worked with several international companies across a range of industries such as rail, construction, oil and gas and chemicals. She specialises in safety risk consultancy including safety leadership assessment, strategic safety management, safety culture assessment, risk modelling, risk management, HAZOP, SIL and QRA.

- **Thursday 26 November 2015:** Edward Cardy, JM Davy Technologies, on *"Insights into Process Technologies"*. Edward joined JM Davy as process engineer in early 2014. He is a specialist in the field of industrial processing engineering.

More information on upcoming talks and speakers on www.ceb.cam.ac.uk/alumni/events/talks

CEB Research Open Day, Tuesday 12 January 2016

Last years Research Open Day at Fitzwilliam College

The Department of Chemical Engineering and Biotechnology is organising its Research Open Day on Tuesday 12 January 2016 in Robinson College. The annual event aims to bring the department research groups together and share the department's scientific talent with the outside world whilst helping encourage further collaboration and global links with other global departments and industry partners. The flagship event will consist of a series of talks, seminars and poster presentations with an aim to showcase the CEB's active research groups and their projects. Follow regular updates on www.ceb.cam.ac.uk/news/events/research-day-2016

CEB Focus new Editors

Geertje van Rees

Being a *CEB Focus* editor is a wonderful opportunity to meet great people whilst discovering amazing achievements and research within the Department. So, when someone asked me to join the team, I did not hesitate! Currently, I am a second year PhD candidate in the Cambridge Centre for Neuropsychiatric Research group. My main focus is the identification of potential biomarker candidates in serum of schizophrenic patients. This would allow improved diagnosis and potentially improved treatment of these patients. This is very important, as current average misdiagnosis is 10 years. Also, the earlier proper treatment is given, the better the outcome will be. Therefore, it is very important to be able to distinguish the disorder, for instance, bipolar disorder in an early stage.

Aazraa Oumayyah Pankan

I am a second year PhD student, working in the bio-energy area. With the dwindling fossil fuel reserves and the environmental consequences that have come with the dependence on fossil fuel, the world faces the challenge to develop alternative sustainable sources of energy to meet its escalating energy demands. My project is based on a photo- bio- electrochemical technology, called bio-photovoltaics. The latter harness solar energy by using the photosynthetic activity of micro-organisms. I was interested in joining *CEB Focus*, as I saw it as an opportunity of contributing to the Department as well as discovering the various research activities taking place. *CEB Focus* has a wonderful team of editors, with the unrelenting support of Elena. We are looking forward to carrying on the good work that the previous team has put in.

Noha Al-Otaibi

I am a research associate in King AbdulAziz City for Science and Technology and currently I am doing my PhD in the BioScience Engineering group. I am conducting my research on the cryopreservation of red blood cells (RBCs), aiming to contribute in the development of a safe and efficient method to protect the RBCs for a prolonged period of time. I have always been interested in science communication and in delivering complex science to the public. Therefore, I am excited to be a member of *CEB Focus* editorial team. *CEB Focus* is a great opportunity to explore different interesting research fields, various events and communicate with many interesting people. The comprehensive and excellent coverage of *CEB Focus* make it a wonderful read to learn about the diverse activities and events occurring within CEB. Without the Editorial Team effort, it would not be possible to achieve such success and joy.

Hannah Templeman

I am a Part IIB student in the Department and the IT and Publicity Officer of the Cambridge University Chemical Engineering Society (CUCES). As part of this role, I am the undergraduate representative on the *CEB Focus* Editorial Team. I am looking forward to taking over from the wonderful work that Chang did. I hope to share with you all the great things the undergraduate community are involved in.

New Gates Scholars joining CEB

Andi Reci

The Gates Scholarship gives me the opportunity to continue working in research; the field that I enjoy and where I believe my contribution could be the largest. My research will focus on the development of the next generation, ultra-fast and high spatial resolution Magnetic Resonance methods. This could eventually reduce resource and energy intensity through its wide application in the recovery processes of hydrocarbons and downstream catalytic conversion of chemicals. The program will certainly enhance my understanding of MRI techniques, but will, also, equip me with new skills in image processing, experimental techniques and potentially machine learning. I look forward to starting the course and plan to be involved in various aspects of university life.

Adeline Klotz

It is truly a great honour to have received the Gates Cambridge Scholarship, exposing me both in the Department and the wider Gates Cambridge community. I am thrilled to work and share ideas with such intellectually stimulating groups. I feel that the ideas shared and skills developed within these groups will be unparalleled by most universities. Forming such strong, significant global networks is personally important, as I am interested in helping to solve some of the global issues we currently face, whilst at Cambridge, and beyond. Working with Professor Lynn Gladden's team, my research will be based on building a magnetic resonance tool. This tool aims to understand how catalysts behave on a local level, during reactions, with real operating conditions. Currently, reactors containing catalysts are designed in an inefficient manner due to this lack of understanding. The research will ensure that our current resources will be used efficiently. It will also ensure catalysts can be designed and operated effectively to handle future challenging feedstock.

Cassi J Henderson

I am honoured and deeply grateful to have been selected as a Gates Scholar. I look forward to joining the community, as it is a unique opportunity to engage with global scholars to better tackle the world's challenges. With a background in biomedical engineering and medical device development, I have a passion for harnessing engineering advancements for the improvement of health. My doctoral research will investigate novel materials and printing techniques, which will allow optimal structures and function to be fulfilled, by combining abiotic and biotic materials to produce elements for biosensors. It will involve manufacturing expertise together with advanced electrochemistry, optics and biochemistry. My hope is that the integration of functional materials, assay development and manufacturing design will enable diagnostics to be produced for affordable, rapid, and point-of-care detection of diseases. This will help ensure that patients get the right care, especially in resource-limited settings.

www.gatescambridge.org

GATES Cambridge

CEB Women in Chemical Engineering and Biotechnology

Rachel Oldham, Chemical Engineering Part 2B and CUCES President

Recently being elected as CUCES president, I was asked to write this article about my experiences as a female ChemEng student and president. I have been very fortunate in my life in that no one has ever told me I can't be an engineer because I am a woman. My father is a civil engineer, my uncle lectured in aeronautical engineering and my aunt was a researcher in ceramics and their use in engineering, so I guess you could say it's in my blood and no one in my family is going to have an issue with it. I think they'd probably worked it out by the time I was 7 years old and was experimenting with different ratios of mud to gravel to sand in my mud pies I was making behind the garage all summer.

I think the largest problem I have faced with studying engineering is more how I think than what others think of me. Naturally, I am a very confident person – always one of the first to jump up on stage or give my opinion on something, but when it comes to my ability to be confident in my work, I tend to let myself down. I like to be very organised and see my way through problems and I find in engineering things are not always as structured and logical as I want them to be. Having to rely on 'fudge factors' and 'well, within 10% is good enough' isn't how my brain works. I like to be certain of something before I jump into it, and sometimes engineering feels like I'm rummaging around in the dark for answers.

When I see my colleagues just leaping into trying different things until a solution comes to them as if it's the easiest thing in the world to them, I wonder if it is something that is inherently me or if I just need a little more faith in my ability to get there in the end.

Getting my head around this way of thinking has taken time and a fair amount of effort on my part, but I think I am finally succeeding with it. It's something I've definitely improved since being in Cambridge. My college has always been a supportive place in that regard. I think that studying at an all female college gives a different atmosphere - one that is less competitive and more supportive.

That being said, my propensity for being organised is something that is going to help me in planning events for CUCES and the like. I always have an idea of where I am going and planning how I'm going to get there is the fun of it. I think my confidence in my abilities inside the classroom is slowly catching up to that outside of it by recognizing it and making myself believe that I am as capable as anyone else out there.

Cambridge AWiSE

Connecting and Inspiring Women in Science, Technology, Engineering, Mathematics and Medicine.

Cambridge AWiSE is a regional network for women in science, engineering and technology (SET) in both industry and academia and for women who wish to return to a SET career after a break. We bring together women with common interests and act as a source of support, information and inspiration. We aim to help women stay in SET and make the most of their careers. They provide regular talks, workshops, networking opportunities and information – see more info on www.camawise.org.uk

Happy 5th Birthday to *CEB Focus*

CEB Focus AGM and 5th anniversary celebration, Trinity College, June 2015

CEB Focus, the department newsletter, has now been in circulation for 5 years. The 1st issue was published in October 2010 to coincide with Professor Nigel Slater, our former Head of Department, coming into office.

The termly publication is put together by an Editorial Team of volunteers led by Chief Editor Elena Gonzalez. 20 information-packed issues have been published so far, with *CEB Focus* going from strength to strength and becoming an important external and internal communication tool for the Department.

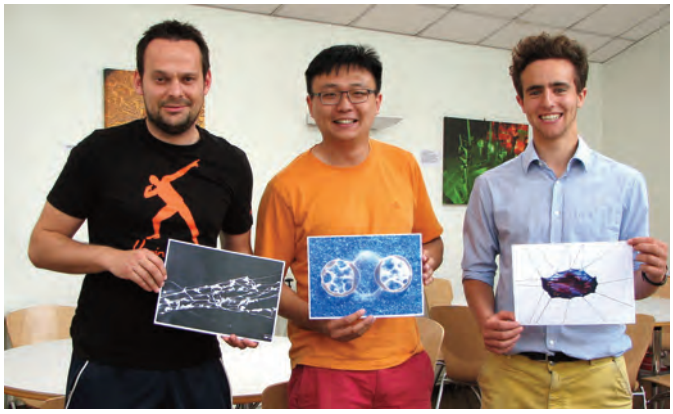
Elena comments; *'CEB Focus has helped communicate our Department mission and values to our members and the outside world as well as share our commitment to education, teaching and research, whilst showcasing our talent and academic and scientific achievements. Over the last 5 years CEB Focus publication has gathered increasing popularity among alumni, friends and collaborators alike'.* A toast to *CEB Focus*, long may it live!

Race for Life

Vanessa, Michaela and Amanda setting off from Parker's Piece

Each year, thousands of women take part in the 'Race for Life' event to raise funds for cancer research. During the summer CEB Research Secretary Amanda Taylor, Receptionist Michaela McNeill and Webmaster Vanessa Blake took part in the 5k run on 19 July in Cambridge. Admin Assistant Chloe Aust played her part in Luton and MPhil ACE students Sara Saheb Kashaf and Yingda Liu ran the 10k race in Cambridge. Around 6000 people took part in the Cambridge event. There was a 10k and 5k run around the scenic city to choose from with some running or jogging whilst others just walked it. Altogether, our six ladies raised over £1200 for Cancer Research UK.

Photo Competition Winners



Winners from left to right: Felix Donat, Ke Xu Zhou and Jacob Brubert

Congratulations to the winners of the annual CEB Photography Competition. *CEB Focus* is delighted to announce that the first prize winner went to *"Magnetic spores aligning with the field lines of permanent magnets"*, taken by Ke Xu Zhou. The second winning entry was *"Carbon nanotube web from a floating catalyst chemical vapor deposition reactor with embedded catalyst nanoparticles"* by Felix Donat. The third winner was Jacob Brubert's *"Heart valve of pig"*. All three winners have been awarded Amazon vouchers for the value of £150-£50.

The winning entries will also be printed onto canvas to adorn the department social spaces. They will also be used in CEB web pages and several department publicity materials including *CEB Focus* newsletter. In addition, these images will be featured in the CEB Communications Toolkit currently being designed (more on this in the next issue).

FoodCycle Cambridge

A group of volunteers on a Saturday morning in St Pauls' kitchen

Food waste is a huge problem. We are producing more than enough food for us all – too much, in fact – yet there are almost one million people a year relying on food banks, and this figure looks set to rise even further. The scale of food waste can be totally bewildering. 1.4 million bananas, 5.8 million potatoes, 24 million slices of bread, 1.1 million eggs – the list goes on. Faced with waste on this sort of scale, it can be impossible to know what to do for the best. Getting involved with FoodCycle Cambridge is one way to help.

FoodCycle is a national charity with 19 hubs across England, and the Cambridge hub has been serving Saturday lunch at St Paul's on Hills Road for the past four and a half years. Every week a volunteer goes to Sainsbury's on Sidney Street where they pick up as much surplus produce as the Outspoken cycle courier can peddle through the Friday afternoon traffic, often stopping off at the Farmers Outlet on Lensfield Road as well. At 9.30 the next morning, a group of five volunteers meet in the St Paul's kitchen to finalise the menu and then get chopping, frying, roasting and grating! By 12.30, around 40 kg of food that would, otherwise, have gone to landfill is transformed into a three course vegetarian feast.

'We never know each week what we will be cooking, so it can be quite a challenge to come up with a menu – and to keep it varied,' explains Alex Collis, one of the FoodCycle hub leaders. *'It's a bit like a mad version of Ready, Steady, Cook: we look through what Sainsbury's has sent us, then we have around £10 to spend on an extra ingredients such as milk butter, eggs and cheese – although we have just found a dairy supplier which has helped to keep our costs down quite a bit. We also work really closely with St Paul's and Cambridge Food Bank, who donate lots of dry goods. After all, we are all working with the same people, and all have the same goal – to tackle food poverty and help reduce social isolation."*

This year FoodCycle has also started cooking on Wednesday evenings at Barnwell Baptist Church in the Abbey area of the city. As Alex told us, *"We have been talking about this for the past two years and really if we cannot do it now, when people are so tuned in to the issues of food waste and food poverty, then when can we? We also knew we were not really seeing young families at our Saturday lunches, so we thought we would go to them instead. And it has worked – we are slowly starting to see a new group of regulars – including kids – each week. For me, that is what it is about – families and communities eating together and eating well. There is enough food being produced in this country that nobody should be going hungry."*

Anyone is welcome to come to a FoodCycle meal (there is a *suggested* £2 donation). They also have some extra events planned for this Autumn – they are taking part in the Cambridge Pumpkin Festival, running a pop- up restaurant at St Paul's with a pumpkin- themed menu (25 October and 6 November) and they are also organising a fundraising dinner for the charity Street Child United (22 November). For more information on these events, or how you can get involved, email cambridge@foodcycle.org.uk or drop by one of our meals! For more information on Pip's Pumpkin Pop-up, or to reserve your ticket, visit www.eventbrite.co.uk/e/pips-pumpkin-pop-up-tickets-18174230613

Everyone is welcome to join in for a 3-course FoodCycle meal

CEB Teaching Consortium of Companies

For more information on the CEB Teaching Consortium visit www.ceb.cam.ac.uk/undergraduates/teaching-consortium

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