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CEB *Focus*

Department of Chemical Engineering and Biotechnology

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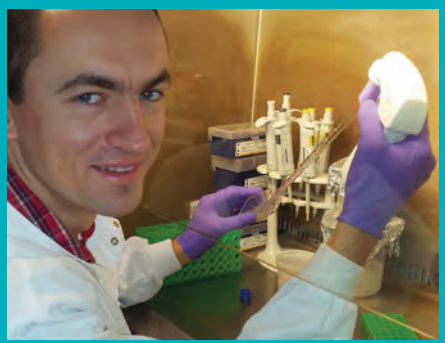

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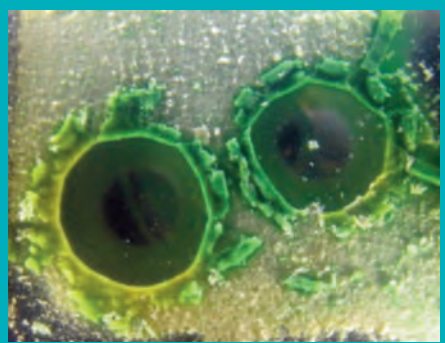

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Message from HoD Professor Nigel Slater

Happy New Year to you all! It is certainly a happy and busy season for CEB. In 2013 we shall welcome the arrival of Professor Alexei Lapkin, who has been elected to a new chair in Sustainable Reaction Engineering, and Dr Eric Rees, who is newly appointed as a Lecturer in Chemical Engineering. Simultaneously, we shall wish Professor Kraft well as he moves to Singapore to take up the Directorship of the Cambridge CREATE initiative and start work on our collaboration with NUS and NUT. We shall continue with the detailed planning for our new home in West Cambridge and like all removals, start planning the relocation. Finally, we shall shift our preparations for the Research Excellence Framework (REF) into top gear. Despite all these activities we hope that we shall still find time to welcome many of you back to CEB throughout the year.

Notes from the Editorial Team

CEB Editorial Team led by Elena Gonzalez (middle) with Jantine Broek, Chensong Gao and Jawad Rehman, to her left and Ipshita Mandal and Dr Yungfeng Gu to her right.

The *CEB Focus* Editorial Team wishes its readers a Happy New Year 2013!

The Editorial Team is led by Elena Gonzalez, PA to HoD Professor Nigel Slater, and assisted by fellow editors PhD students Jawad Rehman, Jantine Broek and Jim Ross and Undergraduate Rep Chensong Gao. We would like to welcome to the team PhD student Ipshita Mandal and Postdoctoral researcher Dr Yunfeng Gu and also thank former editorial member Marijke Fagan for her previous contribution to the Teatime Teaser. She has now finished her PhD studies and moved back to South Africa.

Team members commitment to the project and enthusiastic ideas are key in further developing the newsletter look and editorial content and we are always keen to see new faces so please email us on **ceb-focus@ceb.cam.ac.uk** if you are interested in joining us.

The *Cover Article* focuses on CEB innovation and successful spin-out Enval with insights on the innovation process from department researchers and Cambridge Enterprise colleagues on how they handle commercialisation arrangements for University discoveries and support new technology ventures technology. Graduate Hub offers advice from Anthony Haynes (The Professional and Higher Partnership Ltd) on How to Write Your PhD *Thesis* Creative Director *Research Highlights* feature interesting research projects by PhD students Jakub Tomasik on Deciphering schizophrenia and David Robbins on Developing CFD Codes to Predict Two-Phase Flows and Reaction in Heterogeneous Catalytic Reactors. The *Research Feature* presents ground-breaking research article in the field of electrochemical sensors by Drs Adrian Fisher, Yunfeng Gu and Chencheng Dai. Also worth noting is the *Alumni Corner* featuring Chemical Engineering alumnus insights into his experience in the social enterprise and environment fields. Finally, *Teatime Teaser* returns with its popular comical twist now also featuring a comic by PhD student Leo Hurtado!

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

CEB Innovation Success: Enval Limited

Elena Gonzalez and Ipshita Mandal

Cambridge is celebrated as a 'technology hub' with a high-tech cluster encompassing over 1,500 companies that collectively employ about 53,000 people. The Chemical Engineering and Biotechnology (CEB) community at Cambridge has a long tradition of attracting academics from across the fields of chemistry, biochemistry, physical chemistry, molecular biology, engineering and mathematics. The Department's groundbreaking research also spans the scientific disciplines. The Institute of Biotechnology, which was fully integrated in 2008 to create CEB, has been awarded the Queen's Anniversary Prize for bio-entrepreneurship – work that has since been translated into a number of successful spin-out companies.

CEB has a track record in technology transfer with strong science and engineering underpinning the disciplines of biotechnology and chemical engineering. Some of the benefits of developing new technologies lie in the creation of spin-off companies and intellectual property, offering solutions to global problems. The development of highly trained commercially-savvy technological personnel and ultimately CEB's breakthrough technologies are contributing to the country's economy through employment and wealth creation.

CEB's strengths lie in the multidisciplinary research that meets grand challenges as well as research impact through technology translation and exploitation. Professor Nigel Slater, Head of Department commented *"We are keen to tackle the 'Grand Challenges' that face society in Manufacturing, Health, and the Environment. In addition, CEB has prioritised the exploitation of their research and have contributed significantly to the Cambridge Phenomenon."*

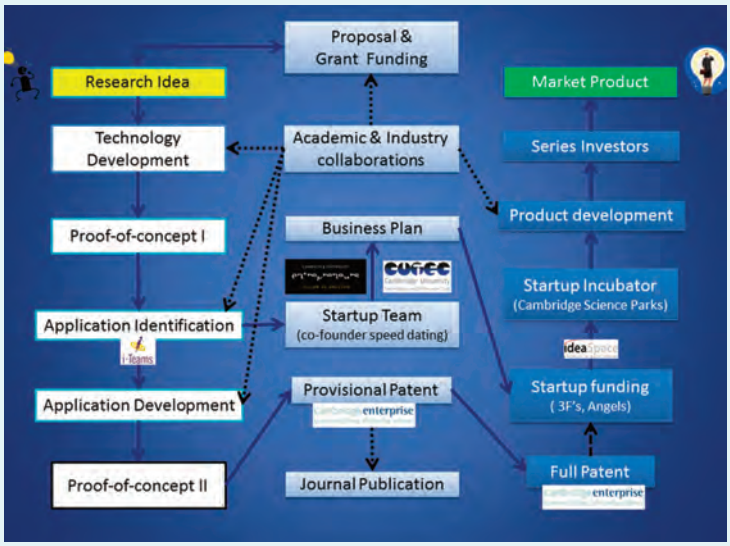
The lack of available funds for new technologies developed within the University often poses a challenge to many who want to put their business ideas into practice, with many promising ventures failing in the process of launching their product into the marketplace. In order to address the funding gap, last November Business Secretary Vince Cable announced the creation of 'Impact Acceleration Accounts', to be awarded to 31 universities across the UK. Cambridge will receive close to £4m under the scheme, which is funded by the Engineering and Physical Sciences Research Council (EPSRC). The £60m investment in UK universities will help encourage the development of new industrial collaborations, products and companies based on University research. This is certainly wonderful news much welcome by CEB and Cambridge University as a whole.
(Source: www.cam.ac.uk/research/news/60-million-boost-for-science-innovation)

Cambridge Enterprise Limited (CE) was formed on 1 December 2006 as a wholly owned subsidiary of the University, responsible for commercialisation arrangements for University discoveries. The bulk of Cambridge Enterprise's work is focused on licensing intellectual property rights to organisations in the UK and overseas to support researchers in commercialising their technology. Their work is spread over three areas: Technology transfer services including intellectual property licensing and bespoke marketing, Consultancy services including negotiation of contract terms and Cambridge Enterprise seed funds to help commercialise innovative research through the creation of new ventures. Its main role is to help University of Cambridge inventors, innovators and entrepreneurs make their ideas and concepts more commercially successful for the benefit of society, the UK economy, the inventors and the University.

CEB Focus Editorial Team caught up with Sarah Collins, CE Marketing and Communications Manager, who commented; *"Financial support for new companies from seed funds is just one of the ways that Cambridge Enterprise helps University researchers commercialise their research. CE can provide advice and assistance at all stages of the commercialisation process. Department staff can get assistance from Cambridge Enterprise in submitting translational funding applications to research councils, charities and other funders. In the last year, more than £17 million in translational funding was won by University researchers with the assistance of Cambridge Enterprise. And another way for early career researchers to get involved in commercialisation is through consultancy. CE offers a consultancy service which enables the University to share its knowledge with government, industry and the public sector."*

Incidentally, Cambridge Enterprise made its third investment in Enval in 2011, alongside business angels from both Cambridge Capital Group and Cambridge Angels. The funding will be used to construct Enval's first commercial plant, which will be located at Alconbury (refer to Enval Case Study overleaf).

All being well, no funding in the world would be enough to develop new technologies without faculty members who are key to provide the leadership needed for any technology initiative. The role of CEB academics and their research teams is fundamental and not to be underestimated. Similarly, he role of hugely talented CEB researchers is key to help their Principal Investigators (PIs) developing new technologies.



Flowchart Innovation cycle from idea to product by Ipshita Mandal

Ipshita Mandal, a very active PhD student passionate about innovation and also CEB Focus Editor, is currently working in Professor Slater's Bioscience Engineering Lab on a research project on microporous capillary film matrices for bioprocessing applications. Ipshita has come up with a research innovation flowchart that shows the key steps involved in the innovation process starting from a research idea culminating in an actual market product. She also consulted other fellow research colleagues who have shared the following insights into the innovation process with her.

PhD student Chris Boyce working on *Chemical looping techniques for the combustion of coal* and supervised by Dr Dennis commented, *"I came up with the idea to start Inno-hub in the CEB entrepreneurship course, when it struck me that there were many opportunities to learn about entrepreneurship and make valuable connections at Cambridge, yet these opportunities were dispersed and inconvenient for busy students. It's been a great experience creating Inno-hub as an online platform to help aspiring entrepreneurs at Cambridge and other top entrepreneurial universities who are in the same situation I was one year ago."*

Post-doctoral researcher Krishnaa Mahbubani talks about her experience of research innovation within the department adding, *"In a world where many decisions revolve around budget cuts, innovation is a key factor that makes researchers stand out and thrive. There is always a need to be clear about the rational drivers behind our research, be it fundamental or application based. Many entrepreneurial opportunities for innovative ideas exist but not everyone is aware of their value in teaching researchers how to make the utmost with our technology and not be bound by current ideologies or limitations. Great innovation develops through great research."*


Dr Carlos Ludlow-Palafox in wasteland

Enval Limited – *Value from Waste*

CEB's exceptional research strengths particularly in the core areas of Sustainability, Healthcare and Energy has lead to successful spin-out companies such as Enval. The Editorial Team has caught up with its founders Professor Howard Chase (Former Head Chemical Engineering and Head of The School of Technology) and Dr Carlos Ludlow-Palafox.

Enval is one of the many examples of CEB successful business ventures developed from ideas and research in the department. Enval is committed to tackling the increasing problems presented by materials that are currently unrecyclable or unrecycled with the aim of diverting them from landfill or incineration. CEB Focus Editorial Team spoke to Professor Chase, who shared the highlights of his experience of innovation as well as very valuable insights on the creation of Enval.

What's Enval's main product function and the technology breakthrough that led to it?

The product is a chemical engineering process to recover aluminium and hydrocarbons from waste laminate packaging. Our laboratory based research on small scale microwave driven pyrolysis of plastics and plastic containing wastes had indicated that this was technically possible.

How did the initial product idea come about?

It was well known that the large amounts of laminate packaging that are used mainly in consumer products are not recyclable by conventional means and this material was being routinely sent to land waste. The ability to recover from waste chemicals which have value was obviously an intriguing objective and an attractive business opportunity.

How did you establish that market launch for your idea was feasible?

We had the impression that a solution to this problem was always going to be of interest to a number of stakeholders in the laminate packaging chain. This chain includes the manufacturers of the bulk packaging materials, those that form it in to empty packaging containers, those that package their product in these containers, the retailers that sell these products to the public, the consumers that choose to buy the products, and the municipal waste authorities who have to deal with the consumer waste generated. All these stakeholders have a clear interest in the establishment of a technology that makes this type of packaging truly recyclable and sustainable.

What was your aim for the business?

To develop and sell commercial scale processes that achieve the above aims.

What challenges did you encounter in the process?

The area of waste treatment, now more profitably known as "green technology", is an area in which venture capitalists and other funders of commercialisation are in general unfamiliar and very few were prepared to invest in this area.

How were you able to finance the business?

The Enval process story began over 15 years ago when I started investigating potential environmental applications arising from the microwave heating of carbon. In 1997 Carlos Ludlow-Palafox started his PhD course supervised by me and, over the next four years, he conducted a substantial amount of research into the microwave pyrolysis of plastics and plastic-containing wastes in batch systems. From 2001 to 2003, partially supported by a grant from the EPSRC under the WR3 scheme, development of the

technology continued, which led to the design of Enval's continuous equipment and a successful worldwide patent application. Aided by investment from the University of Cambridge Challenge Fund, the initial design stage concluded in 2005, when Carlos and I together with Dr Alex Domin (another Cambridge research student but from a different department) won the Cambridge University Entrepreneurs' Business Creation Competition, founded Enval Ltd and, following the construction of the first bench scale prototype of the process, received in 2006 a significant investment from a syndicate of investors. In 2007 Enval received a Research Grant from the East of England Development Agency that allowed the Company to continue the development of its technology for different applications and in 2008 the successful completion of the first pilot-plant of the process led to completion of a funding round in 2009 and a subsequent funding round in 2012.

How has your level and role of involvement changed from idea conception to established start-up? Tell us about the support team behind you. What help did you need to set up?

The initial team consisted of Dr Carlos Ludlow Palafox and Dr Alex Domin, who were pivotal in the preparation of the initial business plan for the technology, and myself as Chairman. Carlos in his pivotal role as Chief Technology Officer has demonstrated relentless enthusiasm and perseverance in overcoming the many initially unfamiliar problems involved in establishing a business of this nature. Once we were in receipt of significant external funding, it was necessary to find a professional chairman for the company and Mr Martin Lamb, one of our investors, has been a hugely important influence in the development and growth of the company as a result of his many years' experience in the commercial spin out of university technologies. The team led by Carlos as Managing Director now includes a full-time Business Development Manager. We also needed to employ technicians to construct and operate prototype and demonstration equipment and we have benefited greatly from the employment of Catherine White, a graduate from the department, as our R&D Engineer.

Were you prepared for the ups and downs and how did you deal with the challenges and doubters?

The main thing that we were not prepared for was the length of time necessary to bring the technology to commercial status. It is now over 7 years since we set up the company and our first commercial plant is now in advanced stages of construction in one of the Government's New Enterprise zones near Alconbury in Cambridgeshire; we hope to be operational beginnings of this year.

Would you have done anything differently looking back on how you built the business?

No, the benefit of hindsight does not really identify anything that would have helped us build the business more quickly.

Enval pilot scale pyrolysis equipment installed at Enval's site in Luton

As a final piece of advice to next-gen entrepreneurs in the department Professor Chase adds, "*We were enormously helped and aided by close interactions from the start with Cambridge Enterprise, the institution responsible for commercialisation arrangements for University discoveries. There is no doubt that Enval would not have come into existence and fruition without their active involvement. I would recommend anyone in the department who thinks they have something that could be commercialised to get in touch with Cambridge Enterprise at the earliest opportunity. A second piece of advice is that anyone interested in the general area of entrepreneurship should also investigate the activities run by the Centre for Entrepreneurial Learning situated within the Judge Business School.*"

For more information on Enval visit www.enval.com

Summer Internship with Mars

Chensong Gao, CUCES IT & Publicity Officer 2012-13

Let's face it, who really likes pipes? Isn't the only reason that we're all doing Chemical Engineering so that we can get a decent job when after graduation? Well, before you can get one of these jobs, you almost certainly need to do one of these pseudo-jobs called internships. Most of us would tend to go for the old oil or consumer goods companies, but Part IIB student Clementine Chambon had a different, more exciting and more edgy experience in a distant and remote part of Europe working for the chocolate giant, Mars Incorporated (producer of Mars, Twix, Snickers, Galaxy, M&Ms, Minstrels, Maltesers, Revels, etc), making pet food…

Clementine recounts the experience; *"Over the period July-September 2012, I had the opportunity to undertake an internship in the research and development sector of Mars Petcare (Pedigree, Whiskas, Royal Canin), the pet food and pet care products branch of Mars, most famous for its chocolate bars. Based in the town of Verden in northern Germany, I was responsible for conducting experiments within the pilot plant in order to improve the drying process of dog food chunks ("kibble").*

We also had one chance to visit the Mars Chocolate factories ...

As it is the largest pet research centre in Europe, I was able to meet many other interns and work with colleagues from every corner of the world. The work was fast-paced and wide-ranging, as I also did research and presented new ideas related to my project to my team (five of us, including myself). It was interesting to apply basic ideas gained in Part I/Part IIA, and see how these could be used in an industry that produces 220,000 tonnes of pet food each year. We also had one chance to visit the Mars Chocolate factories and meet interns from other sites.

It was a very different office environment from what I expected, as people in the office were very approachable and discounted chocolate was always on offer! Additionally, we shared the Verden site with 90 dogs and 200 cats who were the factory's culinary experts, responsible for tasting and approving all the new products created by Petcare employees.

Overall, having spent twelve weeks there and consumed 12,000 Snickers, it was a really enjoyable experience and I gained valuable insight into how a brand-owning global company operates."

Michaelmas 2012
CUCES Careers Events

Chensong Gao, CUCES IT & Publicity Officer 2012-13

Michaelmas term has always been the busiest term in the CUCES calendar. Starting from the first week of term, various companies came into the department to give presentations about they do and how to apply. Fuelled by their love and passion for these companies, students rushed to the presentations despite the fact that they would be forced to consume copious amounts of Domino's Pizza. People often wonder, why do companies stress so much on compulsory pizza-eating? Well, as always with these events, the presentations are in fact a two-way benefit process – whilst students learn more about a company, the company representatives are constantly assessing potential future employees from the audience. Everyone knows that one's hunger for pizza is directly linked to hunger for success; the size of one's mouth to communication skills; the willingness to fight for pizza to drive and ambition; the speed of consumption to efficiency; and the eating of that one more slice even after being stuffed to perseverance. So for those of you who are not accustomed to the corporate style of pizza-eating, well, you definitely missed out on some prime opportunities to impress these company men by showing them how many slices of pizza you can fit into your mouth at once. But do not fret - there will be more opportunities in Lent term!

Christmas Dinner

Chensong Gao, CUCES IT & Publicity Officer 2012-13

The term was successfully rounded off with the annual Christmas Dinner sponsored by BP at Brown's Restaurant. The dinner brought together the whole department including, undergraduates, MPhils, MBEs, PhDs and Dr Sarah Rough. The dinner was announced 4 weeks prior to the event, and the enthusiasm for the dinner is shown in *Figure 1*.

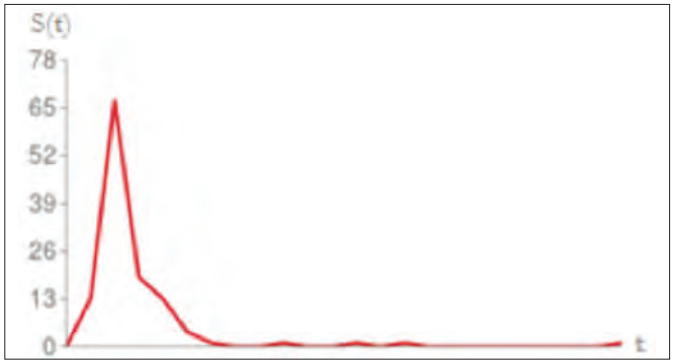


Figure 1

Figure 1 shows the distribution of the number of sign ups, S(t), as a function of time. As can be seen, there is almost zero dead time in S(t), suggesting that this event was extremely well publicized. Therefore a special commendation goes out to the CUCES Publicity officer.

The total number of people is the area under the graph and is therefore given by $T = \int_0^{t_{\text{Christmas Dinner}}} S(t)\,dt$

Figure 2

After the dinner, about 60% of attendees moved onto the Vaults to relax for the rest of the evening, where everyone had a great time, as shown by *Figure 2*.

In conclusion, the CUCES committee would like to thank BP for sponsoring the dinner, and everyone who attended. We hope you had a good time and we look forward to having you for the Annual Dinner this term.

Frank Morton T-shirt Design Competition

Chensong Gao, CUCES IT & Publicity Officer 2012-13

Get excited! Frank Morton Sports Day 2013 is taking place on Tuesday 12 February in Newcastle! For those who do not know what Frank Morton is, Google it.

CUCES will be fielding a strong team of 50 to represent Cambridge at this year's games. Every team has to wear identical t-shirts, so if you have an idea for a witty design that's relevant to Cambridge, don't hesitate to submit it. The winner will receive honor, a guaranteed place to attend Frank Morton Games, and a surprise gift.

Please submit all entries to Chensong Gao at cg472@cam.ac.uk

Clinton Global Meeting 2012

'Turn ideas into action' is the mission of the prestigious Clinton Global Initiative (CGI). The CGI organize annual meetings in the USA that bring together heads of state, Nobel Prize laureates, leading CEOs and heads of NGOs, with last year's keynote speakers including former-president Clinton and president Obama. Participants analyse pressing global challenges, discuss the most effective solutions and build lasting partnerships that enable them to create positive social change. Last September, Stephen Gerrard, a PhD student at BioScience Engineering, received an invitation due to the work that he performed at UC Berkeley, using the Outstanding Commitment Award Fellowship. We asked Stephen a couple of questions concerning this outstanding accomplishment.

Could you describe your research?
I work on developing a drug delivery system for breastfeeding infants. It is a thin discrete disposable device which delivers drugs and nutrients to infants whilst they breastfeed. My work at CEB focuses on considering various drugs formulations and pre-clinical experimental work to determine the physiological factors that would influence the release characteristics of those drugs when the device is used.

How did you come up with the idea?
The idea was conceptualised by myself and five others at the 2008 International Design Development Summit (IDDS) [iddsummit.org]. Since then, the team, now known as JustMilk (justmilk.org), has expanded to collaborate with partners around the world and one year after the invention we had a personal meeting with Bill Gates! JustMilk has been awarded funding from numerous sources including the Gates Foundation Grand Exploration Challenge Fund and Clinton Global Initiative University.

Why was your project chosen by the Clinton Global Meeting 2012?
I received an Outstanding Commitment Award from the Clinton Global Initiative University (CGIU) in 2010. The CGIU selected the most promising projects from the Outstanding Commitment Awardees to benefit from attending the Clinton Global Meeting in order to build a network of potential supporters for the project, and to create links to aid implementation through funding and technical and logistical advice.

What were your expectations on starting your PhD?
I invented the concept whilst an undergraduate at CEB, proposed it to Professor Nigel Slater as a PhD who was extremely enthusiastic to take on the project as my supervisor. The BioScience Engineering group was a fantastic fit for developing the work. My ambitions were to bring active scientific science research into the project and give it the credibility to allow large scale funding be brought into the work to allow clinical scale development to begin, and to hone my skills as an experimental scientist in the field of medical technologies.

Using your experience as a PhD, what would you advise fellow PhD-students?
If I look back at my PhD, I would not change anything. Everyone makes mistakes in experimental research and as long as you learn and build from those mistakes PhDs can be a very rewarding experience. Furthermore, there are numerous grant awards and scholarships to expand on your research in various directions – it is worth searching for them. Moreover, supervising undergraduates is a great opportunity not to be missed, which will give you experience in vocational skills.
Email: Stephen.gerrard@justmilk.org

Stephen Gerrard (middle) with other Outstanding Commitment Award Winners and Chelsea Clinton, Bill Clinton's daughter, who works for the Clinton foundation (last row, fourth from the right)

Writing Research: Practical Guides for Graduate Researchers

Anthony Hayes
Creative Director The Professional and Higher Partnership

Fact: most people doing research in this department are more interested in Chemical Engineering than in writing. Second fact: to develop a successful career as a researcher, you need to communicate your research in writing.

Here's some good news: there are plenty of sources of support and guidance to help you. Hers is an introduction to six of them.

1. *Write Your Research:* this website (http://writeyourresearch.wordpress.com), which is sponsored by the department, is aimed at early-career researchers. It provides a series of concise, practical, resources on such matters as how to write abstracts, presentations, and posters. The resources have all been co-authored or reviewed by current or recent PhD students (Amy Chesterton, Krish Mahbubani, Ipshita Mandal, and Ting Yueh-Liu). Resources are being added regularly: we plan to build it into a comprehensive suite.

2. A straightforward (and, I hope, fun) resource is *"10 resources, mostly online",* to help academic authors (http://scriffon.com/Monographer/10_resources,_mostly_online,_for_academic_authors). The web page enables you to click through to a range of tools and sources of information.

3. Cambridge University Press publishes a great list of resources on scientific writing. The one I find gets the most enthusiastic reception from early-career researchers in this department is Bjorn Gustavii, *How to write and illustrate a scientific paper.* It's a short book providing sound, crunchy, advice on the craft of scientific writing – on matters such as how to write legends, design tables, and present statistical results. Jack P. Hailman & Karen B. Strier, *Planning, proposing, and presenting science effectively* is also helpful. It focuses on research proposals, reports, presentations (including posters) and CVs.

4. Bart Hallmark has kindly provided me with a series of short courses in the department. Forthcoming events include: 'How to write a report' (24 January); 'Editing your own work (and other people's)' (7 March); 'How to write a poster' (28 March) and 'How to write an abstract' (23 May).

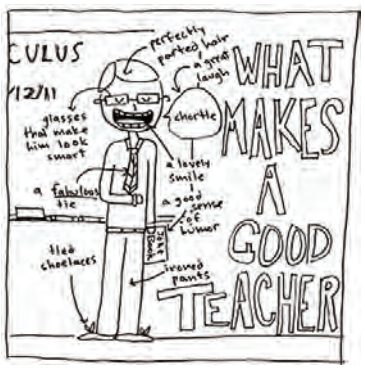
5. Writing for non-specialist audiences forms an important part of a researcher's repertoire. It can be rewarding in its own right, as well as helping to developing your ability to write such key documents as fellowship applications and grant bids. One outlet for writing for a wider audience is the university's science magazine, *Bluesci* (www.bluesci.org). The magazine has developed a skilful, knowledgeable, editorial team that provides constructive feedback. *Bluesci* also organises a programme of talks on science communication.

6. Recently, there's been a rapid growth in writing groups in Cambridge run by early-career researchers. Some are organised by college, some by department or discipline. Details are available here: http://schreiberin.de/writers. The explanation for the burgeoning of groups is simple: they boost their members' productivity. Do feel free to contact groups beyond your own college or department: organisers of current groups are generally keen to help new groups to get started.

Although writing is not everyone's favourite task, many resources are available to help and support you during writing. www.thumbs.dreamstime.com

What Makes a good Teacher?

Dr Patrick Barrie, Director of Teaching



What makers a good teacher by Niki Chen (www.stuyspectator.com)

I've been asked to give some tips on how to teach from a lecturer's point of view… which can then be compared to what a student might expect. The following are the five key things that I think a lecturer needs to do:

1. See things from a student's point of view
2. Communicate and explain ideas clearly
3. Show some enthusiasm for the topic being taught
4. Stimulate the student to do some work on the topic
5. Give the impression of being on top of the material without "showing off".

There isn't a single "best" way of lecturing. A course can be taught in different ways, and what works well for one course might not work so well for another topic. There are plenty of guidelines on how to deliver a lecture.

Three things worth considering are:

1. Include clear "sign posts" telling the students what's been covered and what's about to be covered.
2. Make sure that all material presented in a lecture is there for a reason – and consider telling the reason(s) to the students.
3. Include something to keep students attentive. This may be a demonstration, a YouTube clip, a story, or a bit of humour. It might be an interactive discussion (rare in this Department because of time constraints) or some rhetorical questions which make the student think before the answer is given.

Concise notes that cover the subject matter for examination purposes are valued by students regardless of whether the course is on a "trendy" topic or a "boring" one. Well-planned problem sheets, in which each question has an educational objective, are also appreciated by students because they help develop understanding.

Finally, it's worth pointing out that a lecture may be where **teaching** takes place. However, it's normally the hours that a student spends on problems and projects which is where the **learning** takes place.

What the students say:

"I think it's really good when the lecturer asks loads of questions to make sure everyone's on the ball.

I think sometimes you've actually got to ask individuals as if it's opened to the floor often you'll get no response (everyone's a bit shy!)"

"It's also really good when the lectures are very concise ... but comprehensive. Generally speaking, if the notes have been prepared with LATEX they are very well presented as the code forces the user to have very clear structuring. Occasionally, the notes can have very poor structure and this is really bad for clarity (sometimes I don't even know what order to file them in!). Very clearly labelled figures is also helpful."

"If any equations are presented, it's very useful to have the equation explained in words. Sometimes, we are only presented with a series of derivations and this can be hard to follow.
Also, plenty of examples (particularly from tripos) is always welcome."

"A good lecturer is someone who is excited about what they're lecturing and who explains things clearly, without assuming you remember everything from last lecture!"

MBE Course: Field Fisher Waterhouse meets Budding Entrepreneurs

Dr Beatriz San Martín
Senior Associate Intellectual Property

Since 2007, law firm Field Fisher Waterhouse (FFW) has been providing a set of legal lectures for the Masters in Bioscience Enterprise course after Ian Craig, a partner at the firm who has since retired, was asked to do so by Professor Chris Lowe. I joined FFW in 2004, following a previous but short-lived life as an academic in the Zoology department at this University (and some necessary re-training). Armed with the knowledge that my background was in the life sciences and that I had studied at Cambridge, Ian asked me whether I might be interested in coordinating the lecture course.

Beatriz San Martin (middle of front row) with other contributors to MBE course.

The aim of the legal lecture series that we teach is to provide the students with an overall framework of legal issues relevant to biotech and pharmaceutical businesses. Thus whilst there is naturally a focus on intellectual property (particularly patents), which is key in this sector, we also cover other relevant areas such as competition, data protection and company law. Over the years we have refined the course to make it current and relevant for the students and to include any important legal developments. Where possible, we invite speakers from business and industry bodies giving the students an insight of how law is applied in practice. So, for example, this year the Chairman of the Ethical Medicines Industry Group, Leslie Galloway, joined Dr Cord Willhöft one of my German colleagues specialising in pharma regulatory law to give a lecture on pharmaceutical pricing in the UK and Germany.

Many of those teaching in the course have a personal link with Cambridge whether it is that they studied in Cambridge, lived in Cambridge or have developed strong business relationships within the Cambridge community. We are keen to be part of the Cambridge biotech community as we see this as an exciting growth area and our involvement in the MBE course is an important part of this. This fits well with the philosophy of the firm which is to focus on industries that are highly regulated and with intellectual property and technology driven business models. I asked colleagues that teach in the course to give me an insight of why they personally valued teaching on the course.

For Eduardo Ustaran, a leading practitioner in data protection and privacy law it is the fact that *"being in front of highly motivated, extremely inquisitorial, out-of-the-box thinking students gives us a different and very valuable opportunity to consider how to get our legal knowledge across".*
For Hastings Guise, a trade marks specialist: *"there is no better way to deepen your understanding of your own discipline than by teaching it to a lively and incisive audience -- the MBE students are just that and it is great to have the opportunity to engage with them on these topics".*
For Sarah Ellson, our head of the Public and Regulatory Law Group it is *"the opportunity to share and discuss with some of the world's future leading entrepreneurs the legal challenges and opportunities that the biotech sector faces".*
And for me? Well my interests in the course are wide and varied but I particularly get a kick from helping the next generation of entrepreneurs to navigate through the regulatory, legal and commercial landscape to achieve their goals.

We like to stay in touch with the MBE alumni and see how they progress in their careers. We have recently been assisting Desktop Genetics, an exciting company set up by founder Riley Doyle and co-founders Victor Dillard and Edward Perello, 3 MBE students from the 2011/2012 cohort after they won the 'Life Sciences Start-Up of the Year' award in the Cambridge University Entrepreneurs business creation competition.

Development of CFD Methods for Multi-phase Flow

David Robbins
PhD Student, Magnetic Resonance Research Centre (MRRC)

Computational fluid dynamics (CFD) is a simulation tool in which the governing equations of fluid flow are numerically solved over a predefined geometry. It is becoming increasingly important as an engineering tool, as the computing power required for the simulation is now abundant and cheap. In chemical engineering, CFD is used as part of the design process or to optimise or investigate existing units. However, it is vital that the CFD codes are validated with high-resolution data in order to ensure that the simulation gives an accurate representation of both the global and local hydrodynamics.

Our research is focused particularly on simulating flow through packed-bed reactors, which are widely used in the oil and gas industry, and increasingly in biochemical applications. These pose a challenge for simulation due to the low flow speeds, multi-phase interactions and the lack of a dominant force. Starting with single-phase flow, an in-house code from the Department of Engineering was adapted for low-speed liquid flow by utilising a preconditioning technique. The simulation data, presented in (1), compared very favourably with high-resolution NMR experimental data and served to validate the density-based approach.

Current work is focussing on multi-phase flows by starting in an idealised system, the falling-film column. This system tests the extreme gradient in volume fraction generated by the gas-liquid discontinuity, which is well-defined and measurable with NMR experiments. We have developed a new single-pressure, multi-phase CFD algorithm in (2) which facilitates the use of accurate liquid equations of state. Recent work has been developing a hybrid compressible-incompressible solver for acceleration of the system. Two codes have been written to test the algorithm (one- and two-dimensional) and work is ongoing to implement the algorithm into a fully parallelised three-dimensional solver. This will serve to fully explore the local hydrodynamics of packed-bed reactors.

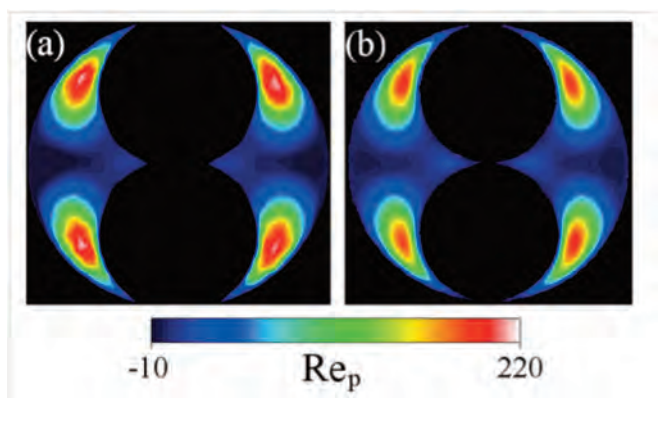


Fig. 1. CFD simulation (left) and MRI data (right) for inlet Re¬p = 27.

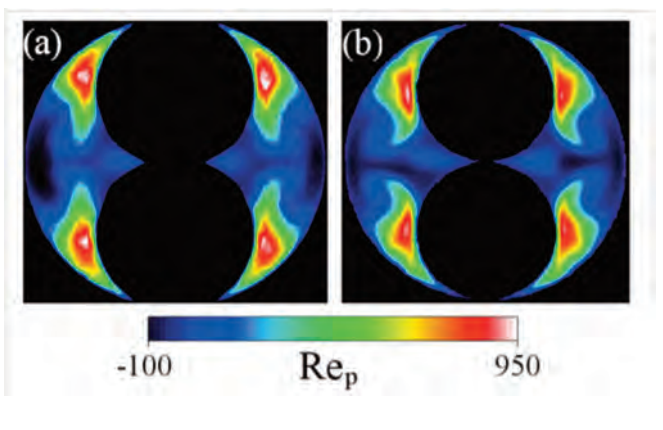


Fig. 2. CFD simulation (left) and MRI data (right) for inlet Re¬p = 111.

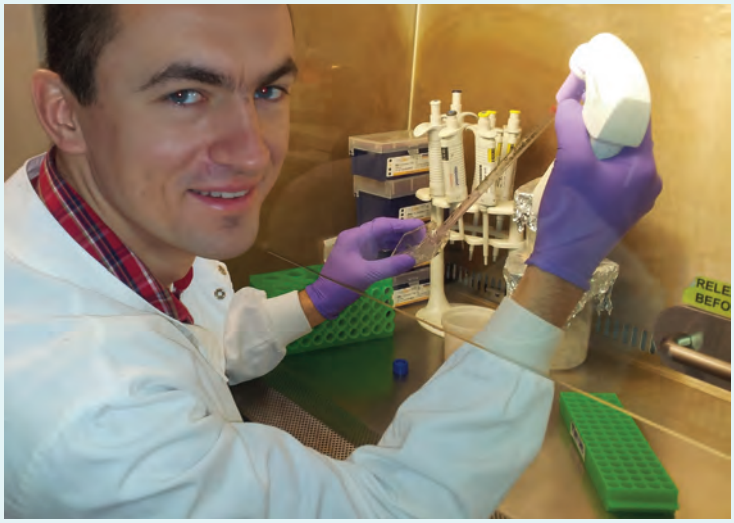
References

1 DJ Robbins *et al.* (2012). *AIChE J,* 58(12), pp.3904-3915.
2 DJ Robbins *et al.* (2012). *Comput. Fluids* (submitted 05/12; revised 10/12).

Deciphering Schizophrenia

Jakub Tomasik
PhD student, Cambridge Centre for Neuropsychiatric Research (CCNR)

Schizophrenia is a psychiatric disorder severely affecting quality of life. The affected individuals display fluctuating symptoms which can consist of delusions, hallucinations, blunted emotions, lack of motivation and cognitive deficits. According to the World Health Organization, schizophrenia affects approximately 24 million people worldwide, mostly between 15 and 35 years old. Although it has been recognized for more than a century, accurate diagnosis and effective treatment have still not been achieved. Current diagnostic guidelines classify schizophrenia into 5 subtypes termed paranoid, disorganised, catatonic, undifferentiated and residual. However, this classification is based on symptoms which overlap with other psychiatric disorders and does not necessarily reflect the underlying pathological mechanisms. This results in a subjective "trial and error" drug selection process, which involves administration, titration and switching of antipsychotic drugs multiple times until an adequate response is achieved. Understanding the biological mechanism of the disease would help to overcome these issues.



Jakub preparing culture of primary human peripheral blood mononuclear cells

With this in mind, we have developed a blood test aiding diagnosis of schizophrenia. Blood carries important molecules that regulate functions in the brain and throughout the body, and we found that by measuring levels of 40 blood molecules we are able to improve classification of schizophrenia patients compared to psychiatrically-normal control subjects. These markers are involved mostly in immune, metabolic and hormonal regulation. However, not all of these molecules are changed in all of the individuals. In fact, only 8 of them were altered in more than 15% of the patients. This suggests that schizophrenia may be caused by different biological mechanisms.

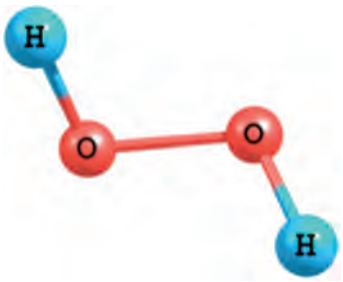
Currently, we focus on identifying distinct schizophrenia subclasses solely by investigating blood molecular profiles in patients rather than observation of symptoms. The molecules are measured using state-of-the-art technologies including mass spectrometry and multiplex immunoassay profiling platforms. These allow measurement of hundreds of proteins, peptides and small molecules simultaneously in a single sample. The screening nature of these approaches make them more likely to lead to identification of novel pathways. By profiling blood from treated patients, our results suggest that the standard medications are not fully effective, and that patients could benefit from add-on treatment with anti-inflammatory agents, anti-diabetic drugs or hormonal modulators. We hope that our research will improve the quality of life of schizophrenia patients and their families by making drug selection process more rational and thereby resulting in better therapeutic outcomes.

Film Au Electrodes based Electrochemical Sensing Platform for Hydrogen Peroxide

Chencheng Dai, Minyu Zeng, Adrian Fisher and Yunfeng Gu

Introduction

Being firstly recognised by Thenard in 1818, hydrogen peroxide (H_2O_2) has then found its essential roles in human society. Hydrogen peroxide is the simplest peroxide and an electroactive compound with environmental friendly reduced products (water). Its unique oxidization property helps H_2O_2 adapt itself into lots of different applications. One of the most important applications is being used as the replacement of chlorine based bleaches to avoid the presents of halogenated products in the waste water in pulp and paper industry. Other industrial applications include using as the detergents in food industry, using as an antimicrobial agent in hospital and surgery, wastewater treatment for hydrogen sulfide and BOD/COD removal, purification of uranium and recovery of gold in metallurgy, etc. Apart from the industrial applications, the biological role of H_2O_2 in human body also attracts a lot of research interests these days. It plays important roles in host defence, oxidative biosynthetic reactions and aging. In addition, at low concentration levels, H_2O_2 also functions as a signalling agent, particularly in higher organisms. Therefore, the reliable, accurate and rapid sensing H_2O_2 is of practical significance for both academic and commercial purposes.



Hydrogen peroxide 3D structure

In chemistry, H_2O_2 easily decomposes into water and oxygen gas spontaneously. In electrochemistry, H_2O_2 involves in oxygen reduction reaction as an intermediate product in "two-electron" pathway mechanism, where the adsorbed O_2 is first reduced to H_2O_2 via the two-electron transfer process, then reduced to water via the addition of two further electrons or disproportionation of H_2O_2. Recently, a number of techniques from traditional titrimetry, spectrophotometry, fluorimetry, chemiluminescence to novel electrocatalytic H_2O_2 sensors using modified electrodes have been developed for quantitative H_2O_2 detection. However, traditional methods are often complex, costly and time consuming. Novel methods, such as biosensors using electrodes with immobilized enzymes, exhibit a good electrocatalytic activity of H_2O_2 reduction but require multiple steps electrodes modification and lack long term stability due to enzymes inherent instability. Alternatively, electrodes with transition metals or their nanostructures have been proposed for nonenzymatic H_2O_2 detection. Transition metals have been demonstrated a good capability of adsorbing H_2O_2 molecules on the surface and activating them in the electroreduction process. With their nanostructures, H_2O_2 sensing benefits from enhanced mass transport, large surface to volume ratio and effective utilization of expensive materials. Nowadays, one of most intensively studied transition metals is gold (Au) because of its promising electrocatalytic, electrical, chemical and physical properties. It was reported that film Au, nanoporous Au, nanopyramidal Au, Au nanoparticles, Au nanowire assembling architecture and Au nanocage have been employed for quantitative electrochemical detection of H_2O_22 in various conditions. H_2O_2 concentrations typically vary from μM for in vivo conditions, residual levels in foodstuff and drinking water to mM for waste treatment applications and tens of mM for bleaching applications. In this work, we present a simple lab-on-a-chip design using film Au disc (D=1.5mm) electrode for stationary H_2O_2 electrochemical sensing. H_2O_2 has been successfully detected in a wide concentration range from μM to mM using linear sweep voltammetry and amperometry. One of the key advantages of film Au electrodes system is that many electrochemical analytic techniques and further step Au electrode modification are applicable to this sensing platform, which enables a simple, sensitive, accurate and rapid H_2O_2 detection.

Experimental

Sensing platform fabrication: The fabrication process for lab-on-a-chip sensing design consists of Au electrodes fabrication and insulation layer (silica film) coating. The Au electrodes were constructed on a glass wafer, which were initially cleaned using Piranha solution (H_2SO_4:H_2O_2=3:1 in volume), rinsed in deionized water, and dried with nitrogen. A positive photoresist (Shipley, S1828) was then spin coated (Karl Suss, Delta 10TT) onto the wafer and prebaked at 115 °C as per the manufacturer's guidelines. Next, the photoresist was exposed to UV light through a computer designed mask; subsequent development in EC 351 solution (Microposit, Rohm and Haas) removed any photoresist which had been exposed, thus revealing the electrode design. The wafer was then coated with thin layers of titanium and Au (approximately 50 and 150 nm, respectively) using a thermal evaporator (Edwards Auto 306). Development of the wafer in acetone removed any remaining photoresist and finally exposed the electrodes. Silica thin films (thickness 100 nm) were deposited onto Au electrodes coated glass slides by electron beam evaporation (BOC EDWARDS Auto 306 vacuum coater with EB3 electron beam power supply) at room temperature. Chamber base pressure of 1x10-6 Torr was attained by cryopumping and rotary pumping. The deposition rate was set at 1.0–2.0 Å s-1 using a SQM-160 deposition rate/thickness monitor (film density ρ=2.648 g cm-3). Fig.1. shows an image and a schematic illustration of the sensing design. The dimensions of the Au disc working electrode and the chip are 1.5mm in diameter and 1cm x 3cm (LxW) respectively.

Figure 1. Schematic illustration of the chip highlighting the arrangement of three Au electrodes system

Result and discussion

Electrocatalytic reduction of H_2O_2 at Au electrode

Fig. 2a shows linear sweep voltammograms (LSV) of the standard three electrodes system and Au electrodes system in the presence of H_2O_2 with different concentration, respectively. The H_2O_2 reduction starts at approx. -0.50 V vs Au and corresponding reduction peaks were observed at approx. -1.05 V vs Au. With increase the H_2O_2 concentration from 1mM to 5mM, the peak currents were proportional to the H_2O_2 concentration. The peak current i_p is given by the Randles-Sevcik equation (at 25 °C)

$$i_p = (2.69 \times 10^5) n^{\frac{3}{2}} A D^{\frac{1}{2}} C v^{\frac{1}{2}}$$

Where n is number of electrons transfers in reaction, A is electrode surface area (cm^2), D is diffusion coefficient ($cm^2\ s^{-1}$), C is bulk concentration of electroactive species ($mol\ cm^{-3}$) and v is scan rate ($V\ s^{-1}$). Thus, peak currents increase linearly as a function of the square root of the scan rate as well as the concentration. Moreover, A good linear relationships (R= -0.99995) between peak currents and H_2O_2 concentration obtained using Au electrodes system reveals a fast electrode kinetics and good electrocatalytic activity towards H_2O_2 reduction of film Au working electrode. The reduction peak was observed at approx. -1.05 V vs Au, and -0.93 V was selected as the detection potential in following amperometric studies.

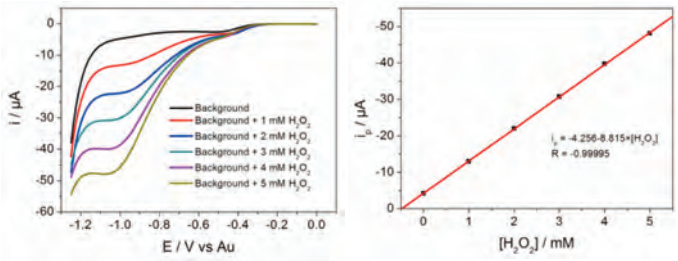


Figure 2. Linear sweep voltammograms of acetate buffer measured at different H_2O_2 concentration and scan rate is 50 mV s-1 (a); Plot peak currents obtained Au electrodes system vs H_2O_2 concentration (b)

Conclusions

It has been shown that a sensing platform using film Au electrodes (Ø=1.5 mm) was employed successfully to detect H_2O_2 in acidic condition. The fast electrode kinetics (1.5 s) and large linear H_2O_2 detection range (100 µM-200mM) enable promising applications in vitro or environmental studies. The good stability and reproducibility, simple fabrication, rigid structure and reasonable cost make this lab-on-a-chip design more practical than many biosensors.

Granherne – Another Route into the Oil and Gas Industry for Process Engineers

Alan Williams, Regional Director EAME

Granherne is one of the new companies join to join CEB Teaching Consortium (TC) to support the development of the Chemical Engineering course at Cambridge in 2012. TC companies have a history of supporting teaching in the Department and recruiting its graduates also financially supporting the Chemical Engineering course at Cambridge. The Consortium companies enhance the Chemical Engineering course by supporting the design project and teaching aspects of professional practice. Their support also enables the Department to provide travel bursaries for graduate students. Further information about the Teaching Consortium can be obtained from CEB Lecturer Dr Bart Hallmark on bh206@cam.ac.uk

As one of the world's foremost engineering consultancies specialising in the hydrocarbon and energy industry, Granherne's experience spans all types of offshore, onshore, and downstream projects. Alan Williams (Granherne Regional Director EAME) tells CEB Focus readers about the main activities Granherne is involved in and the exciting opportunities this company offers.

The Role of Consultancy

To many people, the oil and gas industry is synonymous with the large oil companies, the names of which are on garage forecourts everywhere. What is less well known is that much of the engineering and construction in the industry is carried out on behalf of the oil companies by a variety of organisations ranging from specialist consultancies through to large contracting companies running fabrication yards and fleets of installation vessels.

Formed in 1984, Granherne is a medium sized engineering consultancy specialising in the early stages of oil and gas projects and comprises some 250 personnel operating from three offices in the UK, USA and Australia. It is owned by KBR, a major design and project management contractor with some 27,000 employees in over 70 countries on five continents.

Granherne's typical studies range from supporting oil company acquisitions and 'farm-ins' through to traditional Appraise/Select studies, evaluating potential development options and project viability before the owners decide to make an investment. Studies can cover either completely new "greenfield" prospects or "brownfield" developments modifying existing facilities to extend production lives. Projects range from small developments of a single well tied back to an existing facility through to some of the largest and most complex developments undertaken by the oil and gas industry with many hundreds of wells in geographically challenging locations. As a result of the front end focus, a large proportion of Granherne's engineers and senior management are process engineers by training.

Through its involvement in the initial stages of projects, Granherne acts as an early indicator of industry trends and likely future areas of focus. Whilst commercial sensitivities mean that the details and clients of the studies are often confidential, it is perhaps useful to highlight some general trends and changes in focus for the company and hence the industry. These have generally resulted from changes in global politics opening access to new geographical areas, and technological advances, allowing access to previously unexploitable reserves.

Recent Trends

Perhaps the most notable aspect of the workload of Granherne's UK office in the past ten years is the change in geographical focus. Up to 2000, much of its work was centred on the North Sea. Since then, studies have increasingly been for other areas as the oil industry moved into new locations including West Africa, Brazil, Russia and the former Soviet Union to the extent that for five years Granherne had an engineering office in Moscow and

the proportion of work in the North Sea was very much in the minority. During this time subsea technologies developed such that the maximum water depth for exploitation increased from a few hundred metres to several kilometres opening up reserves off West Africa, Brazil and in the Gulf of Mexico. As a result in Granherne now, after process engineers, subsea engineers form the largest single engineering discipline.

Although Granherne's UK office continues to work on projects worldwide, from as far west as Brazil to the eastern limits of Russia, a very noticeable trend of the past three years has been the resurgence of the North Sea with well over half of Granherne's UK workload again centred on the UK and Norway. These projects reflect the appearance of a number of technologies allowing difficult and what were often previously stranded reserves to be accessed. These include developments of high pressure, high temperature gas fields (HP/HT), heavy oil and the use of enhanced oil recovery (EOR) technologies such as CO_2 injection all of which place a premium on process engineers when developing the associated facilities.

The Future

The trends described above are all indicative of areas and projects that may be developed within a few years. However, some of Granherne's work is associated with the early stages of projects and locations that have a more distant horizon.

The first of these is the Arctic. Studies have been carried out for major International Oil Companies (IOCs) as well as National Oil Companies (NOCs) covering both basin level access studies (e.g. answering the question of "what could we do if we discovered oil or gas here)?" through to detailed development of facility designs for the Russian and US/Canadian Arctic. However there are many technical and logistical challenges to be solved before these developments can become reality.

The second horizon is also technology driven. There has been increasing mention in the media recently of "unconventional hydrocarbons." Whilst this term is often used to describe shale gas from low permeability reservoirs, it also covers a wider range of developments of other forms of hydrocarbon reserves including coal bed methane (CBM), underground coal gasification, novel reserves of hydrocarbons and most recently, light tight oil. Since 2009, Granherne has carried out studies for most types of unconventional oil and gas. Studies continue, particularly in respect of coal bed methane and light tight oil with the latter an especially exciting area for the future. Once again, as they are developed, these will take the industry to new geographical areas.

Summary

The preceding sections have provided a very brief overview of Granherne's role in the oil and gas industry and how the geographical location and technical focus of the projects have changed with time. In particular the role of technology in allowing the industry to reinvent itself and open up new geographical areas is a key theme and is reflected in Granherne's work. This constant change continues as does the demand for high calibre graduates with the skills necessary to solve the challenges of the future.

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Young Scientist Award

Professor Gladden, Pro-Vice Chancellor for Research and Carmine with his award

Dr Carmine D'Agostino has received the "Young Scientist Award" at the 15th International Conference on Catalysis, which was held in Munich, Germany, from the 1st until the 6th of July 2012. The conference is the main international event in the field of catalysis and was attended by more than two thousand industrial researchers and academics from around the world.

Dr D'Agostino was encouraged by the recognition afforded to his research: *"I am delighted to receive this prize, as it has been awarded at one of the largest and most important events in the field of catalysis and it is a recognition of my work at an important international event. I think this award emphasises my commitment towards research and will certainly be a further encouragement to carry it on with enthusiasm and extra engagement. I would also like to thank Dr. Mick Mantle and Professor Lynn Gladden for their support during my work at the Magnetic Resonance Research Centre."*

Carmine's work deals with application and validation of advanced Nuclear Magnetic Resonance (NMR) techniques to study adsorption and diffusion in heterogeneous catalysts. The work aims to develop protocols for catalyst characterisation and to further understanding of the catalytic behaviour in chemical reactions.

Professor Lynn Gladden, former CEB Head of Department and current Pro Vice-Chancellor for Research, who heads up the activities at the Magnetic Resonance Research Centre, also gave a keynote lecture at the conference.

Dr Mitchell Wins Giulio Cesare Prize

Dr Jonathan Mitchell was recently awarded the 2012 Giulio Cesare Borgia Prize for the best presentation at the bi-annual 11th International Bologna conference on Magnetic Resonance in Porous Media (MRPM). The conference was held at the University of Surrey, Guildford, UK.

The prize is in honour of Giulio Cesare Borgia - a founding member of the Bologna conference series. It is awarded to a young researcher working in the field of magnetic resonance in porous media who shows considerable promise for a future career in academia.

Dr Mitchell was delighted to receive the award: "Being awarded the Giulio Cesare Borgia prize at this year's conference was both a great honour and a very pleasant surprise. This prize reflects the many contributions that I have made to the field of magnetic resonance studies of porous media over the past decade. Furthermore, the award is intended to inspire a distinguished scientific career and continued contributions to the knowledge and understanding in this area of materials science. I hope I can fulfill the aspirations of this award, and look forward to many more years of scientific research and discovery."

Dr Mitchell receives his award

Jonathan Mitchell was awarded the prize after his presentation "Relaxation analysis of porous media: the influence of internal gradients," co-authored by Thusara Chandrasekera and Professor Lynn Gladden. Next year, the International Conference on Magnetic Resonance Microscopy (ICMRM), which alternates with MRPM, will be hosted here in Cambridge.

Interdisciplinary Sensor Research facilitated by Cam*Bridge*Sens

Dr Oliver Hadeler
CamBridgeSens Programme Manager

Cam*Bridge*Sens is one of a small number of Strategic Networks at Cambridge University. Its remit is to connect academics, research staff and graduate students with interests in sensor technology across the whole University and provide them with tools and support to enable cutting edge research.

Cam*Bridge*Sens was initiated in 2008 by Professors Clemens Kaminski and Lisa Hall through an EPSRC grant awarded to this department under the Discipline Bridging Programme. Cam*Bridge*Sens was used to fund student research competitions, provide seed funding for research projects, to run workshops in specific cross-departmental sensor research topics and to offer training in widely used research tools, such as Matlab, microscopy, wireless technology, etc. The value of Cam*Bridge*Sens was recognised by the University and in 2011 the initiative was granted Strategic Network status. Its organisational hub is still based in CEB with Professor Clemens Kaminski acting as Programme Director and Dr Oliver Hadeler as its new Programme Manager. Together with a steering committee of senior academics from across the University we are embarking on an ambitious track over the coming years.
As a Strategic Network the remit of Cam*Bridge*Sens is to enable researchers at all career levels to fulfil their research potential. Interdisciplinary workshops, e.g. on advanced microscopy, microfluidics, wireless sensing etc, bring together bright minds from across the University to discuss their work and to explore new avenues for collaborative research and future grant applications. Cam*Bridge*Sens is working together with other Strategic Networks and Initiatives at Cambridge to promote a culture of cross-departmental research and innovation. Through frequent contacts with the Development and Research Offices we work to form new links between researchers, and to research councils, industry and charities. Long term industrial partnerships in the growing area of sensing are explored together with Cambridge Enterprise.

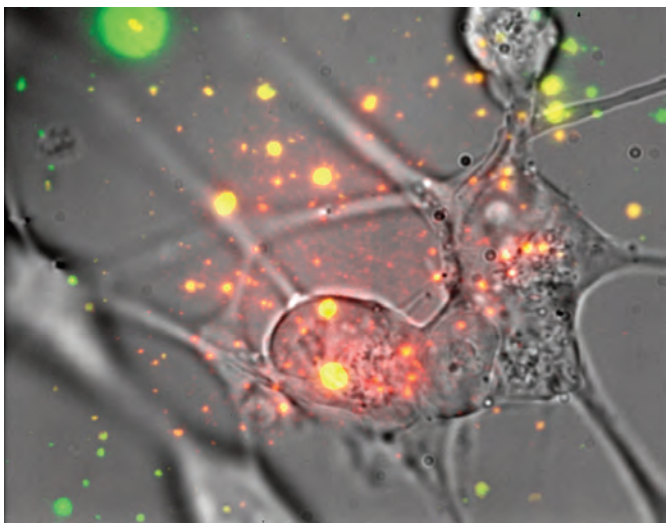
Today the Cam*Bridge*Sens network counts nearly 600 members from a large number of departments across the Schools of Physical and Biological Sciences, Technology and Clinical Medicine. Major topics of research include, but are not restricted to:

- Sensor technologies, e.g. new physical and chemical sensor concepts, sensor hardware, MEMS, imaging, etc.
- sensor applications, e.g. in healthcare, environmental sensing and smart infrastructure
- sensor middleware, i.e. data and signal processing, network infrastructure.

The idea is to provide a common forum where network members from different disciplines are able to talk and learn from one another, to share infrastructure, and to match up technological advances with end user needs.

If you would like to become a member or learn more about Cam*Bridge*Sens visit our website www.sensors.cam.ac.uk or contact Oliver directly on oh209@cam.ac.uk

For more information visit www.sensors.cam.ac.uk



High resolution fluorescence imaging of individual cells is used to study the development of neurodegenerative diseases on a molecular level

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Oxbridge Biotech Roundtable (OBR)

Oxbridge Biotech Roundtable (OBR) organizes the **Biotech Idea Competition ONE START.** The competition will be organized over four UK campuses - Oxford, Cambridge, London and Manchester. The winning prize is £100 000 and one year of incubator space at the Stevenage Biocatalyst site, with access to business development and other facilities. The target participants are young academics (particularly from the Department of Chemical Engineering and Biotech) teamed up with MBA students. OBR will facilitate this via a speed networking event. ONE START will be focused on 4 areas: drug discovery, medical devices, diagnostics and health IT. Ideas will be assessed on potential impact on the lives of patients, commercial potential, technological innovation, supporting evidence and demonstration of a clear path to success.

Public Open Biotech Debate

Thursday 14 March 2013 Department of Chemical Engineering and Biotechnology, New Museum Site, LT2: 6:30 – 8pm; Cambridge Science Festival & GBR 'Why does developing drugs cost so much? Why does it take so long? What is the difference between branded and generic drugs?' In a public panel discussion including Professor Gerard Evan (HoD Biochemistry), Sir Gregory Winter (Master Trinity College) and Iain Scott (Senior Analyst, Ernst & Young), these dilemmas are pondered and a fundamental understanding of drug development is developed.

ChemEngDay UK2013

25-26 March, Imperial College London
A new research innovation event for the chemical engineering community. Poster abstract submission deadline 31 January.
More details on
www3.imperial.ac.uk/chemicalengineering/news/chemengday2013
For more information visit
www.oxbridgebiotech.com/onestart

Alumni Speaker Series Talks

The series talks contributed by Department graduates return for the 3rd year running in Lecture Theatre 1 at 4pm, Shell Building, Pembroke Street.

- **Thursday 31 January 2013: Trevor Hill, E&P Engineering Technical Authority – Flow Assurance, BP Exploration Operating Co Ltd**
- **Thursday 25 April 2013: Dr David Soderberg, Technology Execution Manager BP**
- **Thursday 23 May 2013: Ryszard Pohorecki, Teaching Sustainability to Chemical Engineering students.**

If you are an alumnus/alumna interested in contributing to the series in the future or organising a reunion for your Class Year – please contact Elena Gonzalez, PA to Professor Nigel Slater, HoD, on eg314@cam.ac.uk

CEB Pub Nights

There are two Happy Hour and Pub Nights to look forward to this term. Come along to the Tea Room for drinks and snacks followed by the usual pub gathering (location to be confirmed).

- **Friday 8 February 2013: MBE Happy Hour**
- **Friday 8 March 2013: MPhil ACE Happy Hour**

CUCES

The Cambridge University Chemical Engineering Society (CUCES) organizes student-related social and career activities for students at the department of Chemical Engineering and Biotechnology. Upcoming events are

- **Tuesday 12 February 2013: Frank Morton Sports Day, Newcastle.** Frank Morton Sports day is an annual sporting competition between chemical engineering students across the country.
- **Annual Dinner and Brewery Trip**

dates to be confirmed.

Biotechnology Research Event

Wednesday 20 February 2013, 1 - 6pm; Biotechnology Research Themed Department Event, LT2 at Pembroke Street. For any enquiries ask the organiser Professor Sabine Bahn (sb209@cam.ac.uk)

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Chemical Engineering Reunion

Official alumni photograph, 21 September 2012

On 21 September 2012, to coincide with the University of Cambridge Annual Alumni Weekend, CEB opened its doors to a group of Chemical Engineering alumni graduates from Class Year 1993 mainly, who came back to the Department to reminisce about their time here and catch up with old friends after graduating more than 20 years ago. The group was led by alumnus and former CUCES President Patrick Lord who commented, *"it was great to visit the department and meet up with some old friends".* The reunion kicked off with a welcome from the Head of Department, Professor Nigel Slater, who shared the department's latest developments including plans for the future move to the West Cambridge Site. Dr Patrick Barrie, Director of Teaching, then talked about *Chemical Engineering in Cambridge: Past, Present and Future.* Alumni were also very impressed about the large scope of research activities being housed in the department.

Former Department Academic Sir David Harrison took alumni on a trip down memory lane. He shared anecdotes of his time in Cambridge and also reflected on his time teaching chemical engineering in Cambridge including some amusing anecdotes. Professor Slater, Dr Barrie and Elena Gonzalez (Alumni Relations) joined the alumni for a truly enjoyable dinner at Gonville and Caius rounding off a very special day for all involved. Lucy Wakeford added *"Both Mark and I thoroughly enjoyed the opportunity to catch up with old friends, take a wander through our old haunts in the department and generally soak up the Cambridge vibe once more."*

If you would like to organise a reunion for your Class Year in the future please contact Elena Gonzalez on eg314@cam.ac.uk or +44 (0)1223 762587 to discuss your requirements.

'Young Scientific Explorers' Story

Chemical Engineering Alumnus Dr Yunus Yasin

Yunus at the School Science Fair Launch

Alumnus Dr Yasin is the founder of a project called Science Fair for Young Children. The project started from another project called Young Scientific Explorers (YSE). Yunus recalls how it all started, *"I am a Chemical Engineer. I was away from home for over 4 years during my PhD at Cambridge. No sooner I had got home, my mother was already getting me to do lots of house work. One day I was cleaning the store-room as I had to get rid of stuff we no longer needed. This is when I came across a book which I had as a child -one that teaches you how to do simple experiments with household objects. That brought on many memories from the past. I realised that this is what got me interested in science as a child. I enjoyed doing experiments and seeing the results with my own eyes. I then decided I would like other children to have the same experience."*

Rule n. 1: Always keep your eyes wide open; inspiration comes from the most unlikely places. Even something that may irritate you like cleaning the closet: I then asked around about science programs in the education curriculum in Malaysia but they did not exist. Malaysia is still a firm believer in the 'rote' learning methodology. Force education down the throats of people and hope something good comes out the other end.

Rule n. 2: Research before you start something but do not be afraid to make assumptions, particularly when it is something you believe in. Life is about taking risks: I then went onto writing up my proposal clearly stating what

is it I wanted to achieve and how I would measure success (a simple two-pager with half page on budget. I wanted to do a pilot with nine schools (as I was born on the 9). I visited nine schools with simple experimental apparatus (favourite experiment involved just using a ruler). The cost of all the apparatus was about USD 10. If I had the budget I could take the kids to the National Science Centre.
Rule n. 3: Always keep your cost low and start with a pilot test. The most amazing things sometimes happen with the least amount of money. Buddha or Ghandi didn't have lots of money.
Rule n. 4: Do not be afraid to choose something with a sentimental value. Humans are sentimental creatures – I go for number 9! It may not make logical sense but not everything in life is logical.
With the proposal in hand I approached NGOs including a friend working with one focused on education. He was interested as long as I could take charge of it as they were very much understaffed. I agreed, and the YSE project was born.
Rule n. 5: Start working with people you trust with the same values as you: The word "I' became "We" as it was no longer only about me and what I wanted.


Schools Science Fair

A core team of four volunteers started working on a booklet with ten experiments to be given to all young students taking part in the project. We also visited the National Science Centre and produced a tour map listing the exhibits to take the kids on based on their level of 'amazingness' and difficulty.
Rule n. 6: Have detailed description of what you want to do almost like an "Idiots Guide to…". Distribute this to all key stakeholders so that they clearly know what the project requires of them: We approached the schools to take part in the pilot. There was lots of resistance at the beginning as teachers were overworked and did not want another 'thing' to do. We approached teachers, headmasters, parents-teachers organisations and the primary students and after much persuasion, we managed to get nine schools to do the pilot. In some schools the initiative champions were teachers, in other headmasters and even parents.
Rule no 7: Get a champion in each location you are planning to implement approaching the problem from all angles: Some other volunteers visited the school and acted as tour guides at the science centre. The pilot project did not need many volunteers: four persons to visit a school at a time and four guides at the National Science Centre. We got about 14 and divided the team into three groups. Each group would visit three schools. The original core group of four including myself would act as back up.
Rule no 8: Make sure the implementers know what they have to do. It is important that volunteers truly believe in the cause.
Rule n. 9 (my favourite number): Once you have a core group of true volunteers support them, motivate them and defend them with your life: This being the number 9 rule, a very spiritual number in Buddhist philosophy, it is also a spiritual rule. Humility is the key to project success and sustainability.
Rule n. 10: Document everything and write reports on each implementation phase. Share the results with all stakeholders and have adequate follow ups when necessary.
Rule n 11: Know when to retire, do not hold onto the project forever and learn to let go: Despite this being a science project it has actually been more a spiritual journey for me. More than 3000 students have participated in the project so far. Its success got me to write and implement two more proposals: "Young Scientific Discoverers" and "Science Fair for Young Children" – the latter now in its 6th year. Last year we helped conduct about 250 school science fairs along with nine regional and one national fair. 200,000 have participated so far making it one of the biggest projects of its kind run by non-government organisations in the history of Malaysia.
However, I have now moved on slowly retiring from the project and only play an advisory role.

Dr Sohini Chakrabortee
Former researcher Cell and Organism Engineering Group
After spending a fantastic and memorable part of my research career in Professor Alan Tunnacliffe's lab in CEB working on disorder proteins relevant in desiccation stress (where I also got a chance to collaborate with the Kaminski lab), I moved to Professor Susan Lindquist's lab at the Whitehead Institute for Biomedical Research, MIT in the summer of 2011 to work on prion proteins in yeast.
I am employing a combination of genetic, cell biological and biochemical tools to search for beneficial prions that provide a growth advantage to yeast when exposed to harsh conditions. The ~30 candidates identified so far in this project are highly enriched in disordered regions. Most known prions in yeast (~35) are dependent on the chaperone HSP104 for their propagation. I have identified a class of new prion candidates that are not HSP104 but HSP70 dependent instead; I am also looking at how many of them are non-classical in structure, i.e., do not form amyloids. In future I am going to investigate the mechanism by which these new prions confer growth advantage under altered environmental conditions. In another project I am trying to establish the breath of this type of extreme form of epigenetic inheritance by investigating the prionogenic ability of disordered regions from plants by modelling the candidate prion domains in yeast.

Dr Anna Stephenson
Former researcher Combustion Group
I started my PhD at the Department of Chemical Engineering and Biotechnology in 2006, with Dr John Dennis as my supervisor. My project involved using the method of Life Cycle Assessment (LCA) to determine the overall carbon impacts of different biofuels processes, including '1st generation biofuels' from food crops, and more advanced biofuels such as biodiesel from algae. As well as modelling the processes to determine their energy requirements and greenhouse gas emissions, I worked with the Department of Plant Sciences and the Department of Biochemistry to perform lab work, in order to optimise the conditions required to accumulate oils in algal cells. This lab work allowed me to use real data in my LCA models, and the mix of experimental and desk-based work suited my interests well.
I now work for the Department of Energy and Climate Change in the Chief Science Advisor's team, where I provide technical advice to policy makers. The skills I learnt during my PhD have proved invaluable; for example, I am currently working on a project to develop a tool to assess the carbon impacts of different bioenergy pathways - very similar to the work I did during my PhD!

Sara Gomez
PhD student Catalysis Group
My experience in the UK started in 2008. I was accepted to do my Master's Thesis at the University of Nottingham where I worked on the hydrothermal synthesis of metal oxide nanoparticles. This was my first contact with the British culture and I had the chance to meet people from all around the world. And what I thought it would be a stay of only 9 months, turned out to be almost three years now!
After graduating in Spain at University of Valladolid I was determined to go into industry and got an internship at P&G Newcastle Technical Centre. I did experimental work combined with modelling on the atomisation process of droplets applied to the washing powder manufacturing. At this stage, the idea of doing a PhD came into my head. And so I was lucky that Cambridge accepted me in the Catalysis group very kindly supported by Professor Lynn Gladden and Dr James McGregor.
My research is focused on understanding the role of carbonaceous deposits in catalytic transformations of hydrocarbons like FCC related processes. I'm currently applying an approach based on tailored carbon deposition to improve catalytic activity and selectivity of zeolites and metal-supported catalysts.

Multisockets: Sinner or a Saint?

A word of advice from Roz Williams, our Chief Lab Technician on the Pembroke Site:

Whilst inspecting and working in various laboratories, she has frequently encountered multi-sockets being used dangerously. Multisockets are all PATested by Electronics before they are used, but sometimes people place them in potentially dangerous locations afterwards due to lack of experience. Multisockets are meant to be a temporary fixture and should not be overloaded or used in areas where water is likely to be spilled, i.e. a lab, an area where drinks are consumed or outside when it is raining/damp, unless they are designed for this. They should also be kept away from heat sources.

WRONG: On bench top in vulnerable position. Liquids could easily fall inside. Water and electricity do not mix!

WRONG: Underneath or flat on floor. Liquids could easily fall inside

RIGHT: Multi-socket mounted high on bench, in upright position. Liquids cannot fall inside

RIGHT: Multi-socket mounted on leg, in upright position. Liquids cannot fall inside.
Trailing cable protected with rubber guard.

Remember also: multisockets must never be 'daisy-chained', i.e. one plugged into another. One socket: one multisocket.

Another option that you might like to consider on the bench, where safe wall mounting is not possible, is an upright multisocket like this:

Dear Dr Sarah

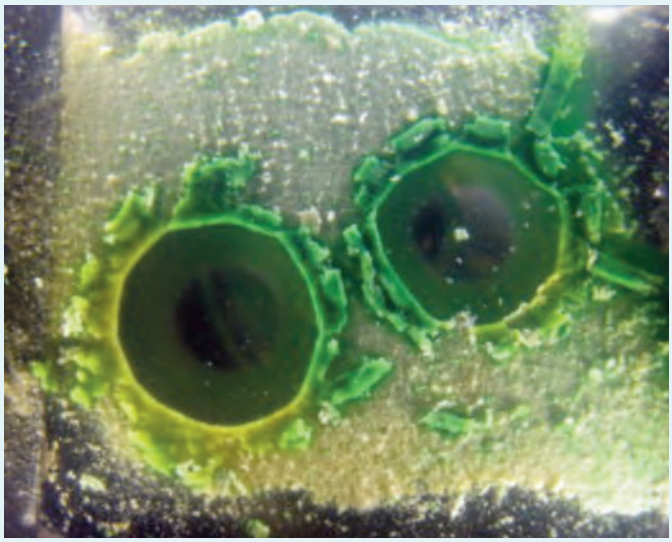
"Dear Dr Sarah, if you get with another ChemEnger in a club how can you mitigate the tea room awkwardness in the following days/weeks? Chapped-lipped-undergrad."

Dr Sarah says...

Completely deny that anything ever happened. Unless of course there is photographic evidence. In which case, contact your lawyer.

NEW: Photo Competition Returns: Imagine an Image .....

We challenge you to describe the innovation and excellence of the research in CEB in pictures, an image that portrays the dynamic and innovative research in CEB that will excite the reader to discover more about us.



'E-Wall' by Baptiste Salley – 2012 winning entry

We are searching for an image and caption that relate to research in the Department with the following strategic themes: Energy, the Environment, Sustainability and Healthcare or within our research fields: Biotechnology, Measurement, Microstructure Engineering, Modelling and Processes.

We are especially interested in images that show how we bridge the gap between groups in CEB to realise these themes. It might be a photograph, or an SEM image, or a graphic that you have produced. The image may be drawn, downloaded from a camera, created from several sub-images or it may be enhanced. The competition is open to all staff and students in the Department to create a picture that tells 1000 words about our world-leading research.

The image must be submitted by email to Vanessa Blake at vsb1001@cam.ac.uk by Thursday 31 January 2013. The first prize will be a £125 Amazon voucher and the second prize will be a £50 Amazon voucher.

The winning image will feature on the Department's website and CEB Focus newsletter and may receive national and international press coverage. It will also be printed on canvas and displayed in the Department.

Uxbridge English Dictionary – Part 2

Professor Howard Chase

BBC Radio 4's anecdote to panel games, *I'm sorry I haven't a clue,* makes reference to the **Uxbridge English Dictionary,** which records the changing meanings of commonly used words. In the event that the dictionary would benefit from a technical supplement, I offer the following entries for chemical engineering.

Mathematical methods section

Algorithm - a U.S. procedure to abate global warming.
Extrapolate - the additional arrival from Warsaw has been delayed.
Integrate - throw your cigarette ends into the fireplace.

Entries sponsored by companies

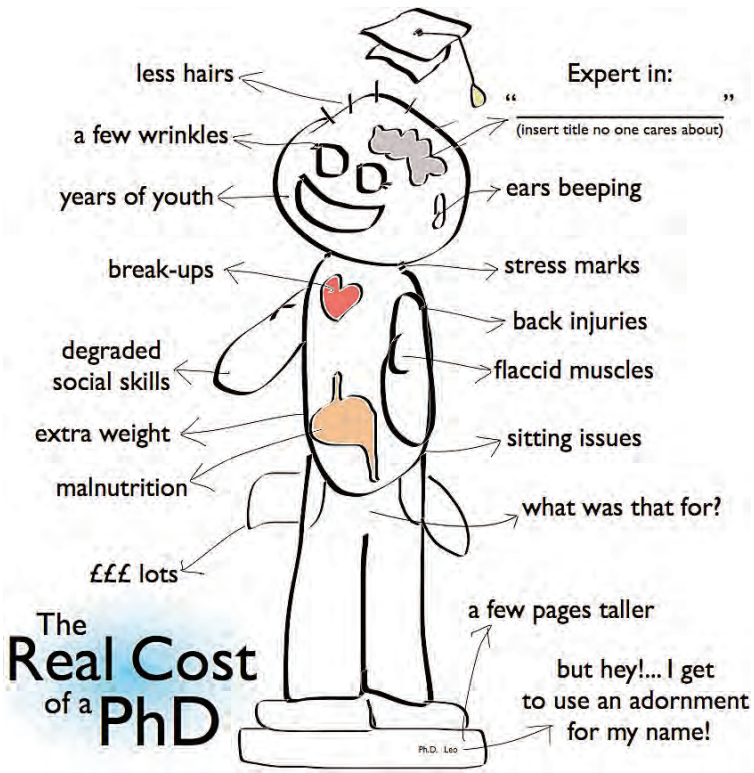
AkzoNobel - grievous bodily harm to a prize winner.
BP - a highly calorific biofuel obtained from insects.
ExxonMobil - part of the keypad of an iPhone.
ICI - an incorrect French word for "here".
Procter & Gamble - to get official University permission to visit the casino.
Sigma - an upper class way of asking one's mother whether she wishes to smoke.
Unilever - a recent graduate.

The same programme also features a Toast Master's announcements of the identities of guests arriving at a formal event. Here are some late arrivals at the CUCES annual dinner:

Mr and Mrs Poration and their daughter Eva.
Mr and Mrs Mer-Fluids and their daughter Polly.
Mr and Mrs Latory Flow and their son Ossie, who have arrived with their cousins the Ular Flows who brought their elderly relative Gran.
Mr and Mrs Robic Digestion and their daughter Anna.
Mr and Mrs Rowaves and their son Mike.
Mr and Mrs Hancement and their daughter Imogen.

and from overseas…

From Ireland, Dr and Mrs O'Graphy and their son Tom.
From Germany, Herr und Frau EinProject and their son, who was conceived in England, Des.



Comic by Leonardo Hurtado, Phd student Healthcare Biotechnology

Letters to the editor

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

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