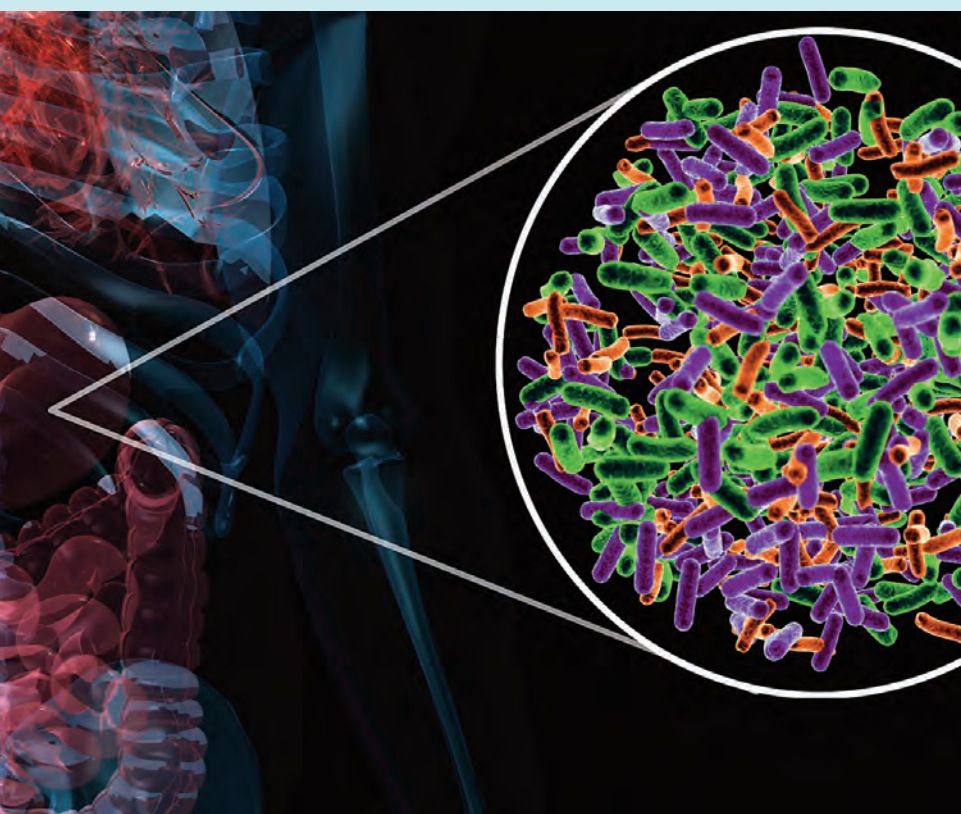


CEB *Focus*

Department of Chemical Engineering and Biotechnology



Oral Vaccine Breakthrough: End to Delhi Belly p.3

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Nicola Rooney: CEB's first female Chemical Engineer p.20



Charter for women in science
Recognising commitment to advancing
women's careers in STEM academia

CEB Academic takes Athena Swan Lead p.23

Message from HoD Professor Nigel Slater



With the summer “Research Period” drawing to an end our thoughts are again turning to the new academic year and the arrival of fresh cohorts of undergraduate and graduate students. From this perspective I want to share with you a comment in the report of the assessors in our recent General Board “Learning and Teaching Review”. They say: *“The Review Committee is impressed with the standards of the courses managed by the Department. The academic staff are clearly highly committed to its teaching*

activities, and students are most enthusiastic and supportive of the Department and its teaching, administrative and resource provision. The quality of teaching is demonstrably at the highest level, and the teaching and research environments are clearly extremely positive and endorsed by staff and students.” And we can add another cohort this year, professional practitioners who will attend the new week long “Bio-pharmaceutical Pricing and Market Access” professional development course that will be run in September. This is a challenging yet exciting development that takes our teaching activities into an entirely new direction and will provide feedback that will strengthen our student offerings.

Editorial Note



CEB Editorial Team from left to right: Kripa Balachandran, Ning Xiao, Elena Gonzalez and Jantine Broek

The *CEB Focus* Editorial Team wishes you a wonderful start to the new academic year! Editorial Team is led by Elena Gonzalez, PA to HoD Professor Nigel Slater, assisted by fellow editors PhD students Jantine Broek and Ning Xiao with Undergraduate representative from CUCES Committee Kripa Balachandran.

We would like to thank former editorial members Ipshita Mandal and Dr Yunfeng Gu for their valuable contribution to previous issues. Ipshita is now involved with several bio initiatives and also focused on writing up her research thesis; Gu is planning to move onto new ventures and we wish them both best of luck in future endeavours. The Editorial Team’s commitment to the newsletter project and their personal contribution along with their enthusiastic ideas help further develop the publication look and editorial content. We are always keen to see new faces so please email us on ceb-focus@ceb.cam.ac.uk if you are interested in joining us.

The *Cover Article* focuses on ground-breaking oral vaccine

technology developed by a team of young researchers led by Professor Nigel Slater, our Head of Department. *CEB Innovation* column features an interview with Professor Chris Lowe on bio innovation in Cambridge. *Industry Section* includes the corporate sponsors of the Global Biotech Revolution Summit.

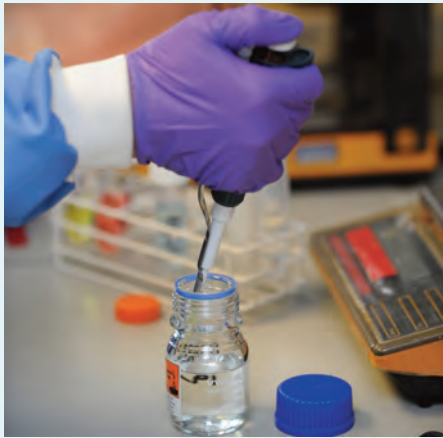
Research Highlights tells about projects by CEB young researchers with huge impact such as a polymeric heart valve or the conversion of glycerol to hydrogen by a photosynthetic bacterium. The *Research Feature* presents a very interesting piece of research on cell preservation systems using umbilical cords undertaken by PhD student Jessica Ocampos in Chile. Also worth noting is the profile in the *Alumni Corner* by our very first ever female Chemical Engineering alumna Nicola Rooney, who tells about her bookshop venture.

Among some of CEB’s latest and most noteworthy achievements deserving a mention are MBE students’ ‘Start Up of Year’ Win and MBE’s Desktop Genetics Ltd receiving £375,000 funding (more on this on the next issue). Finally, *People Focus* presents the latest additions to CEB’s academic team and tells about fundraising campaigns led by CEB staff.

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.

ORT-Vac Live Bacterial Oral Vaccine Technology: A Dry Solution to Global Diseases

Elena Gonzalez



BAR incorporated into the capsules enable live dried bacteria to colonise the gut to provide an efficacious vaccine

A new technology developed in A CEB lab protects bacteria-based oral vaccines from destruction by the digestive system to enable their safe delivery to the body's immune system.

Developed by Dr Alexander Edwards, Dr Krishnaa Mahbubani and Professor Nigel Slater, this 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 a micro-chromatography technology in which an adsorbing resin is mixed with dried viable 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 and colonise the gut.

CEB Focus Editorial Team recently met Professor Slater, who felt in his element very passionately talking about the technology behind the oral

vaccine, a highly valuable innovation that could very well make an end to serious global diseases much closer in sight: *“This is a great example of the University working with industry, interpreting needs to create a viable product using real science. We think this formulation has the potential to be distributed to the four corners of the earth irrespective of supply chain considerations.”*

A team of young researchers led by Professor Slater started working with biotechnology company Prokarium (a spin-out of Cobra Biologics). Professor Slater, formerly a director of Cobra recalls; ‘Cobra was primarily interested in gene protein therapies and we first hit on this idea on 2006.’ *‘However, it was not till 2009 when funding from the Technology Strategy Board (TSB) made the development of the oral vaccine technology possible.’*

With funding from TSB and the Biotechnology and Biological Sciences Research Council (BBSRC), the Cambridge scientists have been working with BioPharma Technology Ltd, Microbial Developments Ltd, Cobra Biologics Ltd, and now Prokarium Ltd, as well as Professor Simon Cutting at Royal Holloway College.

Professor Slater explains further; *‘We knew we could deliver this dry vaccine using ‘live’ attenuated salmonella bacteria – that is, ‘live’ salmonella but without the toxins into which an heterologous gene has been placed to express a vaccine antigen peptide on the bacterial surface. With the aid of BAR the bacteria travel down to the intestine where they are rehydrated to a viable state. They then pass through Peyer's Patches in the wall of the gut to trigger the immune system. In effect, the modified salmonella bacteria act like a ‘needle’ in a conventional injection.’*

They then moved onto testing the delivery of the oral vaccine in mice. The problem they faced was how to get these organisms into the gut in a viable form as well as being able to protect them from bile in the stomach for a key couple of minutes before they re-hydrate.

Professor Slater adds; *‘the digestive system presents a series of challenges to biotechnologists as the toxic fat-emulsifying bile acids in the small intestine are designed to protect us by killing ingested bacteria. However, not all bacteria are pathogenic invaders intent on wreaking havoc. There are ‘friendly’ bacteria – such as those used in oral vaccines or as probiotics – keeping them alive long enough to exert their benefits.’*

A coated gelatine tablet with the BAR inside gets in the stomach and dissolves in the intestine and it is the BAR resin in the capsule that binds the bile so it cannot penetrate the stomach.

Nigel also reveals how genetic engineering is used to trick the body to generate double immunity. He comments *‘The delivery mechanism itself has been a success as the modified salmonella immunise simultaneously against Typhoid and enterotoxigenic Escherichia coli (ETEC) with developing countries being the prime target.*

Professor Slater comments; *‘The oral vaccine dried into a BAR capsule is very stable and can easily be circulated in developing worlds without the need for a cold-chain distribution network’. Dr Mahbubani backs him up; “Oral vaccines are part of a new generation of needle-free vaccination strategies. These strategies are especially suited for use in developing countries, where needle-based vaccination can pose logistical challenges due to the lack of a cold supply chain, hindering the roll out of vaccination programmes’*

The technology has been licensed by Prokarium through Cambridge Enterprise Ltd, the University’s commercialisation arm. Prokarium now has exclusive rights to use the delivery mechanism (‘needle’) and has licensed 50% from the Cambridge Enterprise, University of Cambridge’s research commercialisation arm. The University and Prokarium have patented it (only for salmonella) and Phase I clinical trials are planned for the very near future.

Prokarium Chief Scientific Officer Dr Rocky Cranenburgh has recently confirmed that they are focusing on the development of the dual oral vaccine against Typhoid and ETEC – a major cause of diarrhoea for travellers and developing country markets. This latest development gets scientists closer to finding a cure for the much-dreaded ‘Delhi Belly’ travellers disease, which has raised an enormous amount of interest worldwide and India is already trialling it. Considering that there is currently no dedicated vaccine against ETEC, considered responsible for 300,000–500,000 deaths per year, interest in this potential development is extremely high.

Professor Slater and his research team have also found other applications for the dried pro-biotic bacteria, a powder can be formulated into capsules.

Nigel comments *‘you could also have your cornflakes sprinkled with this ‘friendly’ bacteria for a health boost’. “Oral vaccines are part of a new generation of needle-free vaccination strategies.”*



Professor Slater with his research team in CEB's Bioscience Engineering Lab © Cambridge Newspapers Limited



Dr Mahbubani doing experiments in the lab

As we approach the end of the interview Professor Slater highlights that any commercial interest to patent the ‘friendly’ powders would be much welcome- ‘we’d definitely be very interested in hearing from them’; he adds.

Research breakthroughs are certainly making a positive impact on society and improving the way we live. And it is all thanks to a powerful cocktail of good science and technological advances, facilitated by fantastic collaboration between industry and academia, together with much-needed investment. CEB young researchers led by senior scientists are making this possible and they recently had the

chance to share the secrets of their successes with the CU Vice- Chancellor (VC) Professor Sir Leszek Borysiewicz at a recent School of Technology research showcase. The VC then commented;

‘the School of Technology is home to the remarkable creativity and drive that are the hallmarks of the entrepreneurial spirit. Across the School, researchers and students are working together, and being inspired by one another, to overcome challenges in diverse fields, and to promote the practical application of Cambridge-designed solutions’.

A Welcome from the CUCES President

Phanos Anastasiou, CUCES President 2013-14

The Cambridge University Chemical Engineering Society (CUCES) is composed by George Qiao (Careers Officer), Jenny Overton (Treasurer), Supriya Gopinath (Secretary), Kripa Balachandran (IT & Publicity Officer) and David Moody (Social Secretary) and myself, Phanos Anastasiou. CUCES is soon to include a keen Part I and hopefully, for the first time in recent years, a post graduate representative as well.

Additionally, we are hoping to launch a new mentoring scheme to help inaugurate new Part Is into the department with the help of our older and wiser undergraduates. I would also like to congratulate Lauren and the previous committee on such a successful CUCES year.



The CUCES Committee 2013/2014 from left to right: George Qiao, Supriya Gopinath, Kripa Balachandran, David Moody, Phanos Anastasiou and Jenny Overton

This year we are planning to host even more socials and attempt to bridge the gap between undergraduates and graduates. We already have an interesting line up of career events as well which will hopefully help students to explore their options whether they are interested in internships or graduate schemes.

Make sure to keep an eye for CUCES emails and have a look at our website www.cuces.soc.srcf.net for more information upcoming events and internship help. We are always keen for feedback and willing to answer any questions you may have, so don't hesitate to stop us in the department for a chat or drop us an email at chengsoc@hermes.cam.ac.uk.

Lastly I would like to wish everyone a successful year, especially to all the newcomers in the department. See you around,
Phanos

BP Barbeque

Kripa Balachandran, CUCES IT & Publicity Officer 2013-14

Last Easter, CUCES held its annual May Week Barbeque, kindly sponsored by BP. The event took place at the now-traditional venue of Churchill College on Thursday 20 June and as to uphold this age-old tradition, it also poured down with rain. Despite the rain and the venue being on the outskirts of Cambridge, the barbeque was a huge hit.

This was the first year that the committee experimented with signing up in advance for the barbeque – this proved to be a great success, ensuring the event boasted a turnout of over 50 people ... including surprise celebrity appearances from Dr Barrie and Dr Vassiliadis. Let's not forget the special guest appearances from a handful of keen freshers and grad students, too! An array of snacks, dips, sausages and burgers were served whilst there was also free flowing Pimms on offer. Even vegetarians were catered for and delicious "beef" burgers, consisting of 85% onion content were present. Admittedly the majority of the event took place under a large tree which provided shelter from the torrential downpour that ensued. Entertainment was not just limited to vast amounts of food and drink – guests took part in ultimate Frisbee and even a game of cricket, the latter of which included Dr. Barrie displaying his skills with the ball and bat.

Overall the afternoon was a great success as students recovered from the intensity of exams and May Week – we hope to be able to carry over this enthusiasm to our next major social event: Christmas Dinner!

Careers Events

CUCES had the pleasure of welcoming two consortium companies, P&G and BP, over two separate lunchtime careers sessions at the end of April. Despite the looming threat of exams, the events were well attended with well over 60 students at both events. The lunch provided students with the opportunity to chat to representatives from the two companies in an informal setting while consuming a colossal amount of pizza and soft drink. The representatives, most of whom were proud alumni of the Chemical Engineering and Biotechnology department, gave all the students an insightful look into their respective industries and the realities of working life.

For more information regarding upcoming careers events this Michaelmas, please visit the CUCES calendar: <https://cuces.soc.srcf.net/wordpress/current-students/events-calendar/>.

Third Year Design Project



Bill Cotton from Johnson Matthey with winners Arthur Kissin, Sam Wood, Aidan Devane, Mike Smith, Stephanie Oliver and Fleur Siswick

The Third Year Design Project is a major part of the coursework for Chemical Engineering students, requiring a group of 6 students to design plant in under 5 weeks. The project was generously supported by Johnson Matthey.

This year, the brief was to design a process, which produced 260,000 tonnes per year of ammonia, which adhered to strict health and safety guidelines whilst ensuring the operation was energy efficient.

The design project also includes a 10 minute presentation in which students detailed all aspects of the design. This presentation brought to light several very interesting and innovative takes on this well-established process. As a result, guest judge, Bill Cotton from Johnson Matthey, commended all the groups on the high standard of their designs and extolled the professionalism and honesty of the presentations. During the course of the project, Dr Mark Williamson from the University of Cape Town (UCT) acted as a consulting engineer to the groups as part of the on-going collaboration in process design teaching between Cambridge and UCT.

The winners of this year's prize for the best undergraduate design project presentation were Arthur Kissin, Sam Wood, Aidan Devane, Mike Smith, Stephanie Oliver and Fleur Siswick. The winners, who were presented with a cash prize of £240 to share between them.

CUCES Mentor Scheme 2013-14

This year, we're launching a new mentoring scheme for the undergraduate community of the Chemical Engineering and Biotechnology department. The scheme is aimed at helping new Part I students (the babies of the department) settle in both socially and academically. To help do this, we are looking for Part IIA's and Part IIB's (the older and "wiser" ones) to help out and smoothen the transition into CEB.

Commitment required will be minimal and you will only be expected to meet them and be a point of contact in case they need some advice. So sign up and get your own (well depending on numbers) Part I!

Annual MBE Symposium



MBE Class 2012-13

As is the tradition, the Master's in Bioscience Enterprise (MBE) students' studies concluded in late June with a formal Symposium held at The Nucleus, Chesterford Research Park and a celebration Dinner. The Symposium was the culmination of three months internship in the life sciences commercial sector. This activity is designed to complement the more theoretical aspects of the course and the projects addressed, and which students' presented at the Symposium, typically reflect a great breadth of commercial interests. This year was no exception, with placements hosted by pharmaceutical companies (for example Takeda Cambridge, Pfizer

Neusentis and MedImmune), business consultancies (Pope Woodhead Associates, Access Partnership, IMS Consulting) and biotech firms (Horizon Discovery, Bicycle Therapeutics, Arecor, Kymab).

Together with Dr Simon Barnes, External Examiner, Chris Lowe, Dr Darryl Gibbings-Isaac, Dr Maria Maldonado and Nadia Jesus Perez certificates in recognition of their attainment of MPhil with Distinction. Darryl was also presented with the RSA Dissertation Excellence Award for his dissertation, conducted with Applied Strategies Consulting in California. Chris Lowe also acknowledged that members of the class have again been very successful in business plan competitions. An MBE team took the top prize in the Cambridge University Entrepreneurs Technology competition; an individual up against very strong competition won the 'Entrepreneur of the Year' award; a team won a small business development grant in the Downing Enterprise Competition, and two groups were successful in reaching the finals of the Chinese Students and Scholars Association business plan competition. All in all, another interesting year!

Fresh Water for the Developing World

By Johanna Ernst and Ali Yetisen

Water is a fundamental human need and, as such, it is being used extensively in all areas of our day-to-day existence. Whilst fresh water is taken for granted in most developed countries, there is a large need for clean and sanitised water in developing countries: 884 million people lack access to safe water supplies and approximately 3.5 million people die from water related diseases every year. The mission of Engineers Without Borders (EWB) in Cambridge is to facilitate human development through engineering and their Cameroon Water Project opens the tap for those who need it the most.



What is EWB Cambridge?

EWB-Cambridge is a student run charity, which focuses on International Development. Although they are based in the Engineering Department, anyone with an interest in using appropriate technologies to help alleviate poverty or just wanting to find out more about how to use Engineering to make a difference to people's lives is more than welcome to join! EWB's main activities include Outreach, Talks and Training Workshops and Branch Projects. For more information on EWB-UK and how to get involved visit www.ewb-uk.org

'Not-to-be-Missed' Summit: Bringing together Global Biotech Talent



Co-founders Ipshita Mandal and Christian Guyader at the annual BIO Convention in Chicago in April this year

Global Biotech Revolution (GBR) was founded in 2012 by two PhD students from this department Ipshita Mandal and Christian Guyader. It is a student led not-for-profit that connects biotech think-tanks, industrial leaders and research pioneers to young bio-leaders of tomorrow. GBR's flagship event is the Gap Summit 2014, the world's first inter-generational inter-cultural leadership summit in biotechnology. The Gap Summit will be held between 31st March to 2nd April 2014 in one of the leading biotech clusters of the world in Cambridge UK, at the University of Cambridge. Caption: Co-founders Ipshita Mandal and Christian Guyader at the annual BIO Convention in Chicago in April this year.

- 100 future young bio-leaders (students, researchers, professionals and entrepreneurs) will be selected from across the world from 9 divisions of North America, LATAM, UK and Europe, Africa, Middle East, South Asia, East Asia, South-East Asia and Australasia.
- In the 3-day summit the young-leaders will be discussing the current global bio-economy, the grand challenges biotech will need to solve by 2050, as well participate in a Voices of Tomorrow competition.
- The summit will have talks and debates from world leaders in and out of the field with confirmed speakers some of which include Steven Burrill, Dr Severin Schwan CEO Roche Group, Dr Anna Lisa Jenkins Executive VP Merck Serono, Sir Leszek Borysiewicz Vice-Chancellor University of Cambridge amongst others.

Applications to come to the Gap Summit are already open and close 15 December 2013.

More info on www.gap.globalbiotechrevolution.com and www.facebook.com/GlobalBiotechRevolution

Twitter: Follow @GlobalBRev



CEB Student Feedback Mechanisms

Dr Patrick Barrie, Director of Teaching



Students have many ways of giving feedback to staff on teaching and learning. It may be by informal conversation, by formal representation on committees, or by completing questionnaires. The informal method – talking to lecturers – is often the most effective. Discussion between interested parties helps clarify what are the problems with a course. Contact Dr Barrie if you wish to chat about teaching matters or tell the course organiser if there's something in a course that you think can be immediately improved, do not need to wait until the end of the course to tell a lecturer that the writing is too small or that you can't hear what is being said.

The Staff-Student Consultative Committee meets every term. This is the formal mechanism for students to raise issues with the Department, and it is also used by staff to solicit views of students on Department matters. This committee has inspired a number of course improvements over the years. An example was the decision in 2012 to introduce 10 minutes of reading time at the start of written examinations. There are also student representatives on the CEB Syndicate which is our equivalent of a Faculty Board.

Questionnaires solicit anonymous feedback from students but sending many are likely to cause “survey fatigue” and a decrease in the number of respondents as well as a reduction in the quality of answers. The hope is that students will appreciate that surveys are useful to the Department, and that they will take the time to complete them properly during the year.

Department surveys for undergraduates

These are completed on-line questionnaires at the end of each lecture course. The responses are summarised, sent to lecturer(s) concerned and also inspected by Dr Barrie. At the end of the academic year, members of staff complete a teaching unit review in which they are asked to comment specifically on issues raised by the student feedback. All academic staff are notified of those courses which achieved an average “mark” of more than 4 out of 5 for the question “did the course achieve its aims” as an incentive to achieve this benchmark.

Student responses enable particular issues – whether with the course material or with the lecturer's presentation – to be identified. If there are major problems, then a plan is formulated on how to address the issues next year. If problems persist, then further action may be taken. Constructive criticism from students is genuinely welcome. The most useful comments are specific in nature. For example, the comment “*You went too fast at the start of Section 3*” is more useful than “*Poor lectures*” without any explanation as to why the lectures were poor. Please don't make personally offensive comments – while your comments are made anonymously, a respectable standard of courtesy should be maintained. CEB also issues end-of-year questionnaires after examinations to get feedback on department matters and how the overall course fits together. The responses are circulated to all academic staff and reviewed by Undergraduate Teaching Committee members.

National surveys

The National Student Survey (NSS) is completed in Lent term by final-year undergraduates. The main part of this survey is identical for all undergraduates on all courses in the UK. The results are published nationally at www.unistats.ac.uk. A summary of responses is often used by national newspapers to help them compile league tables for undergraduate courses. Students may not realise that their answer to question 22, “*Overall, are you satisfied with the course (1-5)*”, has a major impact on league table position and the reputation of our undergraduate course. In the last set of results, 93% of Cambridge chemical engineers answered 4 or 5 to this question. While NSS is important, the local mechanisms described earlier are far more effective in getting improvements made.

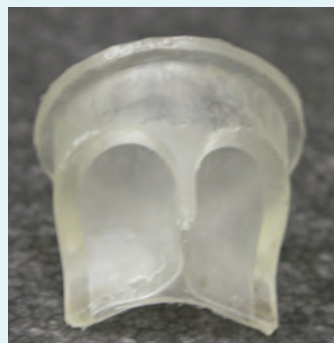
There are also now two national surveys for graduates, which are likely to become increasingly important in years to come: 1) National Postgraduate Research Experience Survey (PRES), aimed at PhD students and Masters students who have a large research component of their course, and 2) National Postgraduate taught Experience Survey (PTES), aimed at Masters students who have a large taught component of the course.

Novel Prosthetic Heart Valve design

Jacob Brubert, PhD student, Structured Materials Group

Heart valve replacements play a significant role worldwide. Degenerative valve diseases in developed countries, and rheumatic fever in developing countries coupled with increased access to cardiac surgery, is driving demand.

Currently, prostheses fall into two groups, *biological* and *mechanical* valves. Biological valves consist of fixated porcine or bovine heart tissue. *Mechanical* valves typically consist of 2 simple carbon flaps. There are shortcomings to both prosthesis; *biological* valves suffer from a lifetime of 10-15 years, which many could patients outlive. Mechanical valves require lifelong anticoagulant therapy, which brings further risk factors and a detrimental effect on patient quality of life.



Novel polymeric heart valve design

Our research requires a block copolymer to be chosen which can overcome the hurdles of biocompatibility and biostability. Furthermore, the polymer must be processed in the valve to ensure the nanoscale cylinders mimic collagen fibres in the natural valve. Finally, the valve structure must be optimized to realize the collateral goals of improved durability and reduced need for anticoagulant therapy.

Our work is kindly funded by the British Heart Foundation, and we collaborate with Papworth Hospital, Politecnico di Milano and University Clinic Tubingen.

Development of a Novel Stochastic Approach for the Solution of Generally Constrained Global Optimization Problems

BiYu Li, Mphil Student, Process Systems Engineering Group

Global optimization is an important field in applied mathematics as well as scientific, technologic and engineering practices. The significance of the global solution in some cases is ‘non-negotiable’, as it could signify “profit or loss” for chemical manufacturers, or “make-or-break” functional properties of proteins in drugs research by predicting their conformational structure. However, optimization problems are often nonlinear, nonconvex and involve numerous variables and constraints, which results in a large number of local optima.

Our research is focused mainly on the development of the approach to find the global solution for constrained optimization problems by using a novel stochastic method. The proposed method, named the ICRS-Filter method, is based on the Iterated Control Random Search method (ICRS) that serves as an initial point determination method for launching a local search converging to the nearest local minimum. The issue of constraint handling is addressed via the use of a filter based methodology. The novelty of our proposed methodology is that general constraints can be handled without resorting to the use of penalty methods as is commonly used in other stochastic methods.

The ICRS-Filter has been used to successfully solve many practical problems. One typical application is the pooling and blending problem. The objective is to minimize the overall cost while satisfying the quality constraints on the products. The results are very encouraging, with all the solutions obtained matching the corresponding global solutions reported in the literature. In addition to the pooling and blending problem, over 120 case studies were tested and successfully solved by the ICRS-filter method. Overall, this method is proven to be very robust to solve constrained global optimization problems.

High Sensitivity Liquid Absorption Spectroscopy Measurements Featuring a Low Cost WebCam based Prism Spectrometer

Qu, Julia Engstrom, Donald Wong, Meez Islam and Clemens F. Kaminski, Laser Analytics Group



Schematic diagram of experimental apparatus

Cavity enhanced techniques enable high sensitivity absorption measurements in the liquid phase but are typically more complex, and much more expensive, to perform than conventional absorption methods. The latter attributes have so far prevented a wide spread use of these methods in the analytical sciences.

We demonstrate a novel instrument that is sensitive, yet simple and economical to set up and operate. We use a prism spectrometer with a low cost webcam as the detector in conjunction with an optical cavity consisting of two dielectric mirrors and a white light LED source for illumination. High sensitivity liquid phase measurements were made on samples contained in 1 cm quartz cuvettes placed at normal incidence to the light beam in the optical cavity. The minimum detectable change in absorption was determined to be 6.5×10^{-5} cm⁻¹ at 527 nm and was limited only by the 8 bit resolution of the particular webcam detector used, thus offering scope for further improvement. The instrument was used to make representative measurements on dye containing solutions and in the determination of nitrite concentrations in a variation of the widely used Griess Assay. Limits of detection were obtained of ~850 pM for Rhodamine 6G and 3.7 nM for nitrite, respectively. The sensitivity of the instrument compares favourably with previous cavity based liquid phase studies whilst being achieved at a small fraction of the cost hitherto reported, thus opening the door to widespread use in the community.

Converting Waste into Hydrogen

Robert Pott, PhD student, Combustion Group



R. palustris grown in bottles

In light of increasing political, economic and environmental pressures to move away from fossil fuels, much effort has been devoted on the development of alternative, potentially carbon neutral, energy sources. One such energy carrier is hydrogen, which can be produced from waste organic material by *Rhodospirillum rubrum* (*R. palustris*). This bacterium can utilise carbon sources that many other organisms find toxic, making it exceptionally versatile and robust; an ideal candidate organism for industrial application. My PhD research has focused on the conversion of crude glycerol from the biodiesel industry – a massive waste stream which is currently simply discarded. With glycerol as a substrate we have seen exceptional hydrogen production, reaching conversion efficiencies of 90% of theoretical maximum.

While the utilisation of waste glycerol is an application of this bacteria's metabolism with a great deal of potential, it is only one of a large number of feasible substrates, including industrial waste waters, hydrolysed biomass, food wastes and anaerobic digestate. This system has been shown to have great potential, and so research is continuing in several key areas: i) the optimisation of the organism's metabolism through genetic modification, ii) the investigation of biomass products, such as carotenoids, proteins or other high value chemicals, iii) the development of a suitable, novel photobioreactor (PBR), which takes advantage of this organism's photosynthetic properties, which differ significantly from the algal systems on which most PBRs have been based and iv) the design of a fully integrated process, for larger than bench scale operation.

Investigation of Preservation Method for Vitrification of Human Spermatozoa for Reproductive Medicine

Jessica Ocampos, PhD student (Bioscience Engineering) in collaboration with Dr Raúl Sánchez G., Vice Chancellor of Research and Graduate Studies, UFRO, Director of Centre for Excellence in Reproduction Biotechnology (CEBIOR)

The aim of this project was to investigate the current preservation methods applied to animal and human cells in Chile focusing on the development and improvement of methods for mammalian cell preservation as well as to understand the different applications and current technologies used in Chile; their limitations and opportunities; evaluating the potential of improvement or development of new solutions and understanding the regulatory framework of regenerative medicine in the context of the Chilean health system with the impact on private and public systems.

The research project was developed in CEBIOR facilities in Chile from January-March 2013, in the laboratory of Andrology: the focus was the application of cell biopreservation in reproductive medicine, particularly in fertility preservation programs. Investigation and experimental research was undertaken looking into the current preservation methods developed in the “Universidad de La Frontera” (UFRO) for the cryopreservation of human sperm, embryos and oocytes of patients with cancer.

Background

Many cell based applications have arisen in recent years because of the increase of the aging population and the consequent high demand on healthcare treatments. Three main cell based applications have gained great importance: regenerative medicine (particularly stem cell applications), biotherapeutic production (recombinant proteins, products from cells), and cell biobanking. Those application fields require reliable preservation systems that guarantee high cell viability after preservation, with predictable recovery of normal cell functionality. However, to date those conditions are not often accomplished and hence the requirement for improvements or changes in their preservation protocols.

The only cell protectant technology that provides reliable long term cell stabilization is cryopreservation,

using temperatures below -80°C to minimize degradation [1]. This process is traditionally accomplished using high concentrations of permeant cryoprotectant agents (CPA). This technology presents several limitations that have stimulated the search for improvements in biopreservation.

The most commonly used cryoprotectant, DMSO, has been associated with different negative side effects. In the case of regenerative medicine, the high concentrations of this protectant can adversely affect transplant patients. Therefore it is necessary to remove it before transplant to the patient, which implies a costly process [2].

In terms of reproductive medicine, several investigations have suggested that the use of DMSO and traditional cryopreservation method by freezing and thawing is not innocuous for human spermatozoa, impairing sperm motility and decreasing fertilization rate by detrimental effects on acrosomal structure, morphological alteration and membrane integrity of human spermatozoa [3].

All these limitations have led to develop new preservation technologies or to improve the current ones, such as research on new compounds to be used as alternative cryoprotectant or by avoiding the freezing step. Among those alternative molecules, sugars have gained particular interest. Several studies have shown that in the absence of traditional cryoprotectants, comparable levels of cryoprotection can be achieved by using low concentrations of intracellular sugars, such as trehalose [4].

The group of Dr. Sanchez has developed a cryopreservation method for human sperm, embryos and oocytes of patients with cancer. The method allows the preservation of the fertility of young Chilean patients with cancer and similar disease, by using vitrification as cryopreservation method, an sugars as cryoprotectant, in a patented vitrification medium, called Vitrisperm®, which avoids the use of DMSO as cryoprotectant [5].

Project results

Methodology:

Spermatozoa Selection by Swim-Up

Before vitrification, spermatozoa were separated from seminal liquid through swim-up. Firstly, seminal samples were aliquoted in 600 uL in Falcon tubes. 5 mL of human tubal fluid medium (HTF) were added to the samples, and centrifuged for 5 min at 400 g. After spinning, for spermatozoa selection, HTF supplemented with 1% HSA (human serum albumin, Sigma, St Louis, USA.) was gently added to the pellet, incubated at 37 degree C for 45 min. Finally supernatant was gently removed and poured in a sterile Falcon tube.

Vitrification:

After spermatozoid selection by swim-up method, spermatozoa were vitrified. In an eppendorf tube were aliquoted 200 uL of HTD with 1% HSA containing approx 1- to 1.5 millions of spermatozoa. Then 200 uL of Vitrisperm® medium were added and the solution was left to equilibrate for 5 min. The volumes to be vitrified are of 100 uL containing 1.5 million spermatozoa. The volume is then injected to the vitrification straw (Fig. 1) and the filled straws are then directly immersed in liquid nitrogen (LN2) where they are stored for preservation.

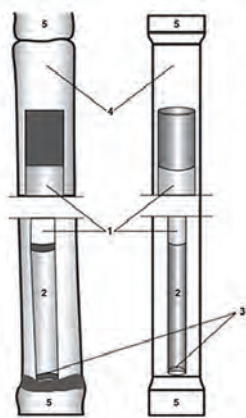


Fig. 1. Aseptic vitrification method developed in CEBIOR. 1. Inner straw of 0.25 mL, filled with 0.01 mL of vitrification medium. 2. Spermatozoid solution. 3. Suspension meniscus. 4. External straw of 0.5 mL. Sealing. (Figure adapted from Sanchez R, et al., 2013 [5]).

Devitrification

After vitrification, straws are immersed in water bath at 37 degree C for fast thawing. Then spermatozoa are assessed for parameter mentioned earlier. Results obtained by using the Vitrisperm include cell viability over 80%, with a standard deviation of 4%, with a sperm concentration between of 2.4 and 4.5×10^6 motile spermatozoid/mL. In terms of motility it was reached over 60%, and DNA fragmentation, determined by TUNEL techniques, was low than 10%.

Discussion

Through this method developed by CEBIOR, it has

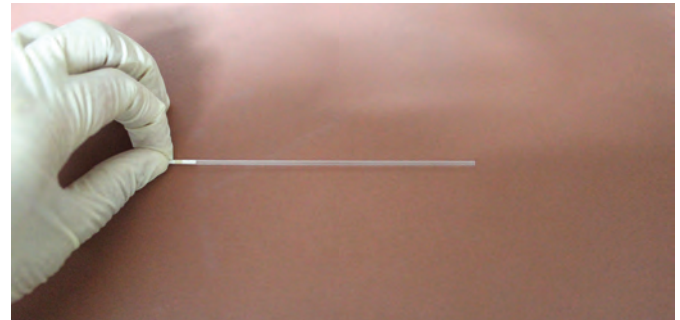


Fig. 2. Vitrification straw: 0.25 mL straw for vitrification of human spermatozoa. After sperm selection by swim up, selected sperms are incubated in vitrification medium (Vitrisperm®) and injected in the straw for direct immersion in liquid nitrogen.

been possible to store spermatozoa post spermiatic selection, until obtaining the minimal required number for performing intrauterine insemination cycles. This method overcomes the limitations observed by traditional freezing and thawing of spermatozoa, which have demonstrated to reduce the viability and DNA integrity post thawing, by the effect of freezing rate and the presence of toxic permeant cryoprotectant (DMSO), which must be then removed of the semen including additional centrifugation steps which increase ROS production. The system developed by CEBIOR relies on sugar as impermeable cryoprotectant and in vitrification. Currently clinical trials are being made in patients, who were inseminated by cells preserved by this method, to obtain success pregnancy, results which show that a successful intrauterine insemination can be achieved with aseptic vitrification of spermatozoa [5].

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Serial Entrepreneur Professor Chris Lowe on Biotech Spin-outs

Elena Gonzalez



Professor Lowe at the "The Future Starts Here" Cambridge Phenomenon 50th Anniversary Conference at Hinxton Hall (5 October 2010)

CEB Focus Team caught up with Professor Christopher Lowe, Director of CEB's Institute of Biotechnology (IoB), one of the UK's most prolific biotech entrepreneurs and the driving force behind the establishment of 10 spin-out companies including ProMetic BioSciences Inc, Purely Proteins Ltd, Affinity Sensors Ltd, Cambridge Sensors Ltd, Smart Holograms Ltd, Psynova Neurotech Ltd, Paramata Ltd and Rebha Ltd. He is also renowned for cooking up new ventures far and beyond with the Anglo-Jordanian venture, Bio-Jo, and the Anglo-Chinese venture, Quantz Medical, being the latest additions to his start-up collection.

Professor Lowe is a Fellow of Trinity College, the Royal Academy of Engineering, the Institute of Physics and the Royal Society of Chemistry. He has supervised over 80 PhD students and has won a number of national and international prizes including "Queen's Award for Technological Achievement", "Queen's Anniversary Prize for Higher and Further Education" and "Most Entrepreneurial Scientist of the UK". On January 2011 he was awarded an OBE in the Queen's New Year Honours for his services to life sciences. More recently, he also picked up the 'Innovator of the Year award' in 2011 from David Willets, UK Minister of State for Universities and Science. The principal focus of his biotechnology research over the last 35 years has been the healthcare biotechnology sector covering

aspects of biochemistry, microbiology, chemistry, electrochemistry, physics, electronics, medicine and chemical engineering and also covering the entire range from pure science to strategic applied science.

Professor Lowe spends a large part of his time travelling around the world in search of research funding but given his wide experience and entrepreneurial spirit, I was determined to pin him down to get his opinion on important matters that have long been subject of hot debate in bio circles, just before he jets off again in search of new science commercialisation ventures.

Firstly, I read out the statement he made back in 2011 upon receiving an OBE from the Queen; "We want to demonstrate good science and take that through to patents and creating wealth," ... 'did I really say that?; he wonders. I can tell by the startled expression in his face that he cannot quite remember having said this but this talented scientist has 345 publications and 8 books to his name, monographs and over 100 patents in his portfolio as well as a number of collaborations worldwide. He is an editorial board member of many academic journals, a member of research council, grant awarding and government committees and extremely active in various legal and entrepreneurial roles.

The process of developing good science in the lab, filing a patent and launching a bioscience product into the market is a complicated affair. Still, university research fulfils a vital role in helping the country's economy and benefiting society as a whole, which cannot be underestimated. Furthermore, it was recently confirmed that, as of January 2013, £1 billion follow-on funding was raised by University of Cambridge spin-outs in the Cambridge Enterprise (CE) portfolio - CE being the commercialising arm of University of Cambridge research.

The role of the University in supporting innovation is vital. Institutions across the University such as the Hauser Forum or Cambridge Enterprise are creating the perfect culture, environment and business support to help

incubate and promote academic-led innovation. Considering the fantastic success of 80% of CE investments on 3-year survival rate, it is no wonder that Cambridge science has gained such popularity, with references to the city as ‘science incubator’ or ‘Silicon Fen’. However, there are challenges that particularly the younger generations of scientists and entrepreneurs need to face.

In your eyes, what’s the role that bio spin outs play within the University of Cambridge, UK and globally?

I’ve been involved in funding bio enterprises for over 10 years myself and I can tell you that new ventures in the IT and Telecoms industries tend to attract funding more easily, having a greater chance of being successful as a result. However, it’s a different story with Bioscience enterprises as these are seen as more risky investments and scientists need to demonstrate good results before VCs even consider investing in them. As an enterprise funder you want make financial returns from your initial investments very quickly but it’s so much harder in the biological sciences. Bioscience enterprises have certainly lost out on much-needed funding as a result of the established view that investment in the biological sciences is far riskier option. Still, corporate and government support is essential as funds injected into commercialising university bio research are vital to boost UK and global economy by helping create new jobs and wealth.’

Commercialisation activities have long suffered from a poor image in the UK but what’s it like in Cambridge these days?

It has not been an easy road due to ‘old attitudes’ rooted in research councils, etc...’ he comments; ‘There is no doubt that the image of Cambridge commercialisation activities has greatly improved, mainly thanks to Cambridge Enterprise, the impact of research case studies submitted to Research Excellence Framework (REF¹) and government support.

Commercialisation activities are now generally seen in a better light, mainly thanks to the younger generation of entrepreneurial scientists and the positive impact of research and benefit of science on society as a whole. However, he warns; ‘there are very intrinsic old attitudes still around. Many great pieces of science have sadly been turned down by research councils. Also, the most detrimental conservative element to the scientific community itself is its older generation of scientists’.

It’s not all about being a scientist but also about being a highly motivated individual with an entrepreneurial mind, one who wants to make a difference and a positive impact in the world.

“Forward and innovative thinking is necessary to move ahead of the game’, younger scientists are a breath of fresh air – many are very switched-on researchers who truly understand the way science and technology is moving into the future, which is critical.”

Another way to get your venture off the ground is by getting corporate funding, it is easier to obtain from industry. Companies operate with fewer restrictions and are more willing to inject funding into new business ventures. Company seniors don’t have to deal with as much politics as that present in research councils. They are not too fussed about what ventures to fund but more interested in exploiting new technologies that can deliver commercial value. ‘In addition, the fact that Bioscience Innovation networks led by younger scientists are now being backed up by some ‘old fogies’ like myself, has definitely helped enhance the image of science commercialisation activities.

Furthermore, recent surge of bio popularity is mainly down to young researchers like the enthusiastic scientists leading influential science innovation networks such as OBR (Oxbridge Round Table) and GBR (Global Biotech Revolution). They are the voice of tomorrow, relentlessly pushing the science and technology agenda. Their tenacity is helping raise the image of bio commercialisation activities not only in Cambridge but the whole of UK and round the rest of the world.

¹ a method of assessing the research of British higher education institutions. It is currently planned to take place in 2014 to assess research that has taken place during the period 2008–2013 inclusive.



Professor Lowe Chris Lowe at recent MBE Symposium, The Nucleus, Chesterford Research Park, ©Phil Mynott Photography

What are the success factors of a new business?

There are currently 156 Life Sciences companies in the Cambridge Cluster. Despite the difficulty experienced by biological sciences ventures in raising funding Chris mentions; *‘fortunately, Cambridge University’s latest brief allows for slightly more risky ventures to be funded’.*

Chris also seemed to be of the opinion that one of the principal success factors of a Biotech start up is luck itself, which I challenged. He explains further; *‘It is useful to have the technology but good technology often fails’* – he admits *‘People, people, people are key’* he adds *‘the people in your team starting from the very top ultimately make the company a success or failure: You need a good team led by a good CEO with the right attitude. A good business plan with well-defined business functions is*

also key. The problem these days is that many people do not really understand the sophisticated technology they buy in the market or the science behind it’.

How can you best attract funding for University bio spin-outs

‘It needs to be a venture with a sound business plan that makes financial sense. The people behind the business idea are very important too, a team of people who are enthusiastic about their innovation and enthusiastic about delivering it. Forward and innovative thinking is necessary to move ahead of the game’, younger scientists are a breath of fresh air – many are very switched-on researchers who truly understand the way science and technology is moving into the future, which is critical.’

How to create success from a University spin-out?

Broadly smiling he comments; *‘It’s not all about being a scientist but also about being a highly motivated individual with an entrepreneurial mind, one who wants to make a difference and a positive impact in the world. Considering the challenges involved in setting up a new business venture, looking into licensing opportunities is also a good viable option. This avenue involves less work and may have more impact and commercial success in the market.’*

How can start-ups work with more established larger companies?

Chris Lowe also has a long track record of working with industry himself and admits that he prefers companies approaching him. *‘The way to go about it is’*; he adds; *‘You first have to hold talks to decide what project to work on, a project proposal would then need to be drafted, submitted and approved by both parties before any collaborative work starts. I’m way ahead of the game as I provide the science and technology that can help companies achieve their aims.’*

“People, people, people are the key ... the people in your team starting from the very top ultimately make the company a success or failure”

Global Biotech Revolution (GBR) Propels forward

GBR is a registered student-led foundation whose mission is to inspire young people and support the next generation of leaders to ensure the sustainability and growth of the global bio-economy. GBR confirms some of its proud sponsors of the **GapSummit 2014**, GBR's flagship event. This will be taking place between the **31 March to 2 April 2014** in Cambridge, one of the leading biotech clusters of the world. It is a 3-day conference where 100 future leaders from across the world are selected to attend through a competitive multifaceted process. More details on www.gap.globalbiotechrevolution.com

Ipshita Mandal, CEB's PhD student and GBR President commented on the GapSummit vision and industry support; *'GapSummit is bringing to life an ambitious vision of connecting the next generation of leaders in biotechnology from across different regions of the world, and from diverse walks of life as students, researchers, professionals and entrepreneurs- to debate with the leaders of today. The success of the establishment of GapSummit would not have been possible without the financial and non-financial support that has been provided by world leading companies, universities, media and student organisations. It has been a rare opportunity to see these diverse stakeholders working together to make a global impact in biotechnology.'*

The GapSummit sponsors have recently been announced:



Merck Serono combines its complementary expertise in new chemical entities (NCEs) and new biological entities (NBEs) to offer innovative prescription drugs of either origin. With comprehensive skills in all areas from research and development to manufacturing, marketing and sales, the division offers its world-class products in over 150 countries worldwide.



AstraZeneca (AZ) is a global innovation-driven biopharmaceutical company specialising in the discovery, development, manufacturing and marketing of prescription medicines that make a meaningful difference in healthcare. AZ recently moved its global HQ to Cambridge Biomedical Campus, a growing and thriving hub for world-renowned biomedical activity. MedImmune, AZ's biologics division, will also be moving with the parent company at the biomedical campus with 500 staff expected to be transferred by 2016.



MedImmune is a pioneering biotechnology company with a legacy of innovation that spans more than 25 years. At the heart of our success are our people, whose innovative spirit, intelligent risk taking, and sense of accountability produce medicines that change patients' lives.



EuropaBio is the European Association for Bioindustries and was created in 1996 to provide a voice for the biotech industry in Europe. EuropaBio's mission is to promote an innovative and dynamic biotechnology-based industry in Europe.

Also confirmed are Gap Media Partners The Economist and Npg and other Gap Supporters such as the University of Cambridge, One Nucleus, EAPB, Chiasma, yebn and YoungBB.

MBE Team Desktop Genetics Ltd Receives £375,000



Proud MBE DeskGen Founders Riley, Victor and Edward

Desktop Genetics Ltd (DeskGen), a UK bioinformatics company aiming to revolutionize the way genetic engineers work together, recently announced that it has secured an equity investment of £275,000. DeskGen (www.deskgen.com) was founded by MBE grads Riley Doyle, Victor Dillard and Edward Perello whilst completing their MPhil in Bioscience Enterprise at Institute of Biotechnology.

The investment comes from Boundary Capital Ltd, Execute Technologies Inc, and angel investors Richard Youngman, Michael Martin (both of Anvil Partners LLP), Dr Jonathan Milner (CEO, AbCam Plc) and Dr Darrin M Disley (CEO, Horizon Discovery Ltd), a Biotechnology alumnus and former PhD student of Professor Chris Lowe, who is a great supporter of the Department.

The receipt of the investment further unlocks a Technology Strategy Board grant for an additional £100,000, bringing the total funds raised to £375,000.

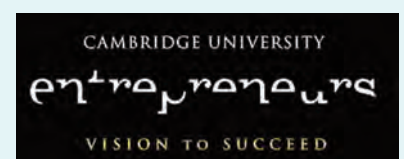
DeskGen has also announced the appointment of Dr Darrin M Disley as non-executive chairman. CEB Focus will be soon interviewing MBE graduates and alumnus Dr Disley on the importance and challenges of funding new enterprising ventures.

MBE's 'Start-up of Year' Win

CUE wrapped up with yet another incredibly successful business competition. CUE's Entrepreneurs Challenge is a year long, three phase battle of the startups where the rewards increase in parallel with the maturity of the business idea. The Grand Finale presents hopefuls with the opportunity to win £5k investment from the panel of angel investors. This year, over 300 entries were received by the Cambridge University Entrepreneurs (CUE) and just a few of them made it to the Grand Finale. In the Grand Finale, 14 teams got the chance to pitch their ideas hoping to win £5K prize. This year, OpSolva Medical Device won the 'Technology Start-up of the Year', a project of MBE students Timothy Lindsay, Xiaofeng Li and Alexander Fleming, a Mphil in Management Student from Judge Business School.

Their product will enable clinicians to monitor the health of a flap from the inside out, changing the way reconstructive surgery is performed forever. Through the use of an implantable device, surgeons receive real time feedback on the health of their patient's reconstruction. This in turn would enable highly informed clinical decision making leading to better patient outcomes. Find more details about Cambridge University Entrepreneurship scene on www.cue.org.uk

Cambridge University Entrepreneurs (CUE) run one of the most successful business creation competitions in the world. Since 1999 CUE has evolved to being a key part of the University's ecosystem for supporting and accelerating entrepreneurship and innovation.



CEB's new Home Building starts



Digger groundworks under way on the new building site on the West Cambridge site

Work has begun on the new Chemical Engineering and Biotechnology building in West Cambridge! The building should be operational for the start of the new academic year in October 2015 and will provide state of the art facilities for the whole Department under one roof. The site is located to the south of Charles Babbage Avenue between the Institute for Manufacturing and the Department of Materials Science. The building includes facilities for Biological, Physical and Chemical Research. Dedicated spaces are provided for the Magnetic Resonance Research centre and the Laser Analytics Group. All the teaching at both undergraduate and Masters level will be housed in the building as well as the social spaces

It is worth noting that CEB will move out of its three current buildings into the new purpose built department on the West Cambridge Site: Pembroke Street and Tennis Court Road sites, which are in the city centre and Magnetic Resonance Research Centre (MMRC), which already lies on the West Cambridge site.

Several other departments have already moved onto the site and the new sports centre is under construction.

Professor Nigel Slater, Head of Department, commented; *'behind the scenes the designers are completing the detailed design in close consultation with the department and the drawings that the architects have produced are truly stunning. We are excited about our relocation to an iconic new home.'*

Green Impact Fever

CEB is fully committed to finding ways to reduce its environmental impact and recently took part in The Cambridge Green Challenge. The University is supporting any department interested in sponsoring carbon-related projects or initiatives.

As a result of CEB's 'green' efforts, the Department received a Bronze Green Impact Award at a ceremony on 13 June 2013. CEB Green Impact Team (staff and students from the Department led by Postdoc Dr Sarah Broadbent) worked through the 20 tasks outlined in the Green Impact Bronze Workbook. These ranged from raising awareness of environmental issues to providing staff and students with easy ways to decrease their environmental impact. They also organised daily events during the University-wide 'Switch Off week' on 18-24 February which included 'Wear a jumper to work day' and 'Lunchtime Switch Off' to raise awareness throughout the Department. These simple measures led to the Department saving 3% on its energy consumption when compared to the previous week. This was well above the average University saving of 2.1%.



First Chemical Engineering female Undergrad: Life after Graduation



Dr Nicola Rooney, CEB's first ever Chemical Engineering female Undergraduate in her bookshop

I joined the Chemical Engineering Department as its first female Undergraduate in 1968. I got married to a PhD student in Electrical Engineering at the beginning of the fourth year, so as the end of that year, I wanted to stay in Cambridge. I was offered the chance of a one

year Research Assistantship, sponsored by the National Coal Board, studying fluidization for pulverized coal boilers for steam generation, so I took it, and worked under David Harrison's supervision. After the first year, the results were encouraging enough for the project to be upgraded to PhD status and I completed my thesis in 1975.

Job hunting in 1975 was not easy, but as a married couple it was even more difficult. My husband and I were both offered jobs with Pilkington's Glass R&D Labs in Lancashire. At first, I was developing cables for early fibre optics, but I was soon transferred to a project to toughen glass for windscreens using a fluidized bed of alumina as the quenching medium. The project was awarded the MacArthur Award for Innovations in Technology. (Professor Davidson was a consultant for us.)

Eventually, the use of seatbelts eliminated the need for a laminated windscreen with a toughened inner layer to prevent facial cuts in a crash, so the project came to an end.

In 1978, my first baby was born, and I intended to become a stay at home mother, but a long dormant job application to ICI came to fruition, so I thought I would test the role of working mother. We moved to Runcorn, where I worked for Mond Division on precipitated calcium carbonate, and vinyl chloride monomer production. With downsizing in 1982, I emigrated to Canada, taking my "Dependent spouse" and two children with me. I worked first as a Development Engineer on the production of styrene, then became the head of the Technical Support Department, with around 40 engineers reporting to me, responsible for process improvement projects for

synthetic rubber. My next career move was to Marketing Manager for Nitrile Rubber, and I saw the world of sales and outside customers for the first time. My final position was back in R&D, running the research group responsible for EPDM production. Once again, fluidization was in the picture, with a dream of being able to produce rubber in a fluidized bed, something I was never convinced would be feasible. I now had four children, and the company had arranged for me to work 90% full time, with 90% pay and benefits, but I could spend the extra time off at home. I had pretty much the perfect job in my view – Technology Director, with a small group of scientists working for me, a member of a Business Team with Production, Marketing and Sales, not too much managerial bureaucracy, and time with my family. It didn't last!

In 1994, the company having been taken over by Bayer AG, and R&D was being consolidated to Germany. I took a buyout, not wanting to move to Germany. The company did not have much experience with, or tolerance of dual career couples, or senior women in technical fields. At this point, I still needed to contribute to family finances, so retiring was not an option. I had four children in full time private education, with University in England as foreign students looming. Purely by chance, I saw an advertisement for a bookstore in Ann Arbor, Michigan. My husband's job as a consultant meant he flew out of Detroit Airport to visit clients, so the geography worked. I bought the store in 1995, as a Franchise, and spent six years growing the business. By 2001, chain superstores and Amazon were eating into independent bookstores, but by now I had learned to run the business more efficiently, so it remained profitable. Ann Arbor was the headquarters for Borders Book & Music, with three superstores in the town, so when they declared bankruptcy in 2011, our sales increased dramatically. This year, Nicola's Books (www.nicolasbooks.com) won the Pannell Award for excellence in Children's Books. With five grandchildren, I am now ready to think of retirement, so the next project is to find a buyer for the bookstore.

Note: Nicola Rooney has owned and operated Nicola's Books in Ann Arbor, Michigan since its opening 18 years ago.

Department Social Events



Undergraduates: CUCES on Facebook

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

CEB Party Nights Join the group www.facebook.com/groups/cebpubnights for updated information on - a group open to all post-grads, post-docs, researchers, and whomever works in the Chemical Engineering and Biotech department for regular pub nights!

NEW: CEB Career Talks



This initiative is launching in Michaelmas Term and will be replacing the former 'Alumni Speaker Series'. Talented graduates will be invited to come to the department to share their expert knowledge and insights into their career experience. Professional leaders in key industry and academic positions in the CEB alumni community are also hugely knowledgeable in their fields of expertise. Graduate experience can be an invaluable source of career advice to our students as they search for valuable information to help

them make better informed decisions about the career choices available to them.

When/Where: Career talks twice a term at 4pm in Shell Building, Pembroke Street site.

Purpose: These talks are aimed for the benefit of current undergrads and more mature students; giving them get a better understanding and taste of what it's like to work in different Chemical Engineering and Biotechnology fields.

Following the career talk there will be a networking session over drinks and nibbles to allow students to ask alumni more specific questions in an informal setting. This will also allow students to connect with graduates, who will in turn have the opportunity to re-connect with their department and their alma mater. For more information, to contribute or suggest particular career fields, contact Elena Gonzalez, PA to HoD, on eg314@cam.ac.uk or 01223 762587

Michaelmas Term

- Thursday 24 October 2013 Energy Engineering and Carbon Management (David Hart)
- Thursday 28 November 2013 Science & Engineering Research Policy (Jo Frost)

Lent Term

- Thursday 30 January 2014 – Careers in Rail (Anthony Hyde)
- Thursday 27 February 2014 - Project Engineering in the Hygienic, Biotechnology & Pharmaceutical Process Industries (Tim Oakley)

Easter Term

- Thursday 24 April 2014 Venture Capital (Stephen Capsaskis)
- Thursday 29 May 2014 Communicating Biotech and Life Sciences (Fay Weston)

CEB Seminar Series (Pembroke Street site, LT1, 2pm)

23 October 2013 Prof Eric May, University of Western Australia, Chevron Chair in Gas Process Engineering, Accurate CO₂-CH₄ Dispersion Measurements in Sandstones for Enhanced Gas Recovery Simulations

4 November 2013 Prof Ken Morison, University of Canterbury, NZ, Fluid Flow and Fouling in Falling Film Evaporators



Oxbridge Biotech Roundtable (OBR)

A student - led organization that fosters conversations between academia and industry in the biotech and community aiming to move ideas forward. Since launching in Oxford and Cambridge in the summer of 2011, they have grown to eight chapters (in the US and UK) and over 10,000 members while working with pharma, science publications, academia, and launching the world's largest idea competition. The Cambridge chapter offers opportunities to get involved with consulting projects from Pharma and Venture Capital as well as organising events for the biotech community in Cambridge or science writing. OBR needs Ambassadors and students to help with events and consulting projects. If you think you might be a good match, check out www.oxbridgebiotech.com/jobs and email your CV and Cover Letter to karolina.zapadka@oxbridgebiotech.com

OBR Debate “This house believes research is better done in Industry”

28 October 2013 7-7.30pm, Cambridge Union

Academia vs. Industry: The two main speakers are CEB's Prof Chris Lowe and Thomas Saylor, who will open the debate aiming at questions such as “are we training too many scientists?” and “is academia essential to make scientific discoveries?” Representing the academic view point, Prof Slater and others will be opposed by high-ranking industry members. In addition, there will be students, post docs and recent graduates involved in the debate as well. This will last for about 90 minutes followed by a networking session.

OBR “Nanotechnology in Medicine: The Smallest Parts Making the Biggest Difference”

Wednesday 27 November 2013 @ 7.00pm, Wolfson Lecture Theatre, Department of Chemistry, Cambridge, Lensfield Road, CB2 1EW

More info on www.oxbridgebiotech.com/events

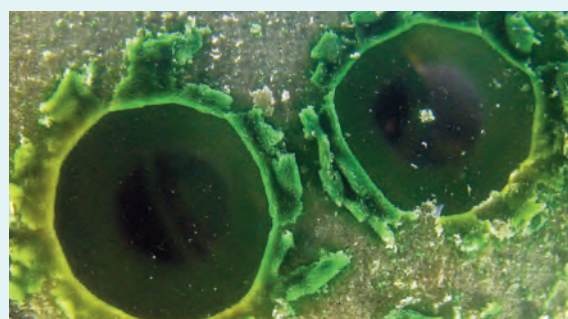
Conference at CEB

Fouling and Cleaning in Food Processing: ‘Green Cleaning’

31 March – 2 April 2014, Jesus College, Cambridge

The meeting is organised by the Departments of Chemical Engineering at Bath and Cambridge. Supporters include the IChemE Food and Drink and Fluids Separations Special Interest Groups.

Contact: Dr Ian Wilson, Congress Secretary (diw11@cam.ac.uk).
Further details can be obtained from
www.ceb.cam.ac.uk/FCFP2014



The conference sessions will be held at CEB and continues the series of meetings started in Lund in Sweden in 1981.

The conference proceedings will be published in book form and as a CD.

Selected papers will be invited for submission to the January 2015 issue of the IChemE/EFCE journal Food & Bioproducts Processing.

CEB on Athena SWAN Mission



The Athena SWAN Awards recognise and celebrate good practice in recruiting, retaining and promoting women in Science, Technology, Engineering, Mathematics and Medicine (STEMM) within Higher Education.

CEB Lecturer, Dr Sarah Rough (MPhil ACE Programme Manager) was appointed CEB's Athena SWAN Academic Lead. A Self-Assessment Panel was formed in July and CEB academics, young researchers and mature students are among panel members: Professor Nigel Slater, Head of Department, Professor Sabine Bahn, RCUK Fellow and Director of the Cambridge Centre for Neuropsychiatric Research; Lecturer Dr Axel Zeitler with guest members Dr Patrick Barrie as *Consultant to Panel on teaching matters* and Dr Tom Matthams as *Consultant to Panel on HR/administrative matters*. Also, Post-doctoral researchers Dr Sarah Broadbent, Dr Krishnaa Mahbubani and Dr Claire Michel; Mr Kevin Coutinho as Equality and Diversity assigned contact; Dr David Fairen-Jimenez (Royal Society University Research Fellow) and PhD students Claudia Orellana and Jessica Ocampos will be assisting Dr Rough as CEB aims to submit an application for an Athena SWAN Bronze Award in April 2014.

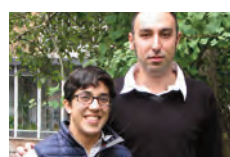
STEMM subjects have traditionally suffered from an under-representation of women, meaning that education and research in key scientific disciplines are not reaching their full potential. The Athena SWAN awards process enables departments and faculties to develop an action plan aimed at improving the recruitment, retention and promotion of female academic and research staff, therefore playing a significant role in helping departments perform at the highest standards of international excellence. The University's Department of Chemistry and the Department of Materials Science and Metallurgy received bronze awards from Athena SWAN back in April and were recognised for their good employment practices for women working in STEMM subjects.

In order to achieve this award CEB needs to demonstrate particular challenges and plan activities for the future and use quantitative and qualitative

assessment to identify challenges and opportunities as well as have a plan that builds on this assessment, and lessons from any activities already in place. The success of the submission will be the responsibility of a CEB self-assessment panel, which will undertake a rigorous and thorough process of self-review of the Department with respect to areas of good practice, as well as areas of improvement and develop an action plan to ensure the Department can progress gender equality. Professor Slater commented; *'I'm proud that almost a third of our students are women and of the achievements of our female academics. We are keen to build on this number and to support women at all levels to build outstanding careers in science and engineering. We hope then that our journey towards an Athena SWAN Bronze Award will enable us to identify ways in which we can most effectively achieve this objective.'* The Inaugural Athena SWAN Network event took place on 3 October, Pitt Building (Cambridge). For more information on this initiative contact Dr Rough on slr1002@cam.ac.uk visit www.ceb.cam.ac.uk/pages/athenaswan.html



CEB Grads Land Teaching Roles



Krishnaa and Carmine

Congratulations to Dr Eric Rees, Dr Mark Williamson, Dr Krishna Mahbubani and Dr Carmine D'Agostino, the new additions to CEB Academic Team. Krishnaa is taking up a

temporary 12-month post made available by funding from the Leverhulme Trust to relieve Dr Geoff Moggridge. She will be teaching Biotechnology (Part I), jointly with Dr Alan Tunnacliffe; Laplace Transforms and Computing Classes and Exercises, jointly with Patrick Barrie, Design Project (Part IIA) and Chemical Product Design (Part IIB), jointly with Dr Graham Christie. She will also be doing Molecular aspects of Biotechnology for the MPhil programme. *'My background is in Chemical Engineering though for my PhD, I leaned heavily towards biotechnology, which puts me in a very exciting position balancing out the experimental biotechnology with the theoretical engineering. I hope that my enthusiasm for the subjects comes across to the students and builds in them an excitement for the vast opportunities available to chemical engineers'*; she says. Carmine, a Postdoc researcher at

Magnetic Resonance Research Centre (MRRC) will be teaching Equilibrium Thermodynamics, Homogeneous reactors and dynamics.



Eric's position started in April and he will be teaching Engineering Maths (Part I) - Numerical Methods and Linear Algebra (Part I), jointly with

Dr David Scott, and Corrosion and Materials (Part IIA), jointly with Axel. Our new lecturer in Quantitative Imaging told CEB Focus about his background, projects and teaching plan. He comments; *'After finishing my doctorate in Materials Science in the dusty autumn of 2009 I joined CEB as a post-doc, working for Clemens Kaminski and Geoff Moggridge on a range of projects. I started by working on nonlinear "white lasers," and in the last three years I have helped build advanced microscopes based on the same white lasers and other cutting edge technologies – such as cameras sensitive to single molecule fluorescence, and software to refine their measurements into nanometre-scale images. The motivation for building our super-resolution instruments was biomedical research, and it still is – Alzheimer's Research UK continues to support our research on amyloid protein plaques. I am now concentrating on software techniques that will leverage the same hardware to study structure and transport in synthetic polymers. I look forward to teaching Corrosion in October: this has given me a chance to get back to grips with the electrochemistry I learned during my PhD in Materials. Engineering Maths seems to be a dryer subject, figuratively as well as literally. But it has an interesting history. Did you know, for example, that the solution of matrix maths by Gaussian Elimination was first recorded in 263 AD, by the great Chinese mathematician Lui Hui, who called it the chenghang or "merging columns" method? Meanwhile the "Hundred Fowl Problem" (c. 500 AD) is the prototype for underdetermined equations.'*



Mark is taking on a 3-year temporary lectureship which has been made available whilst Professor Kraft is seconded to the Directorship of CARES (Singapore). Mark was in the department in the 70's as an undergraduate, more recently for his PhD working with Ian Wilson, and for the last few years assisting Bart Hallmark with Design Project. He'll be teaching

'Introduction to Fluid Mechanics' Part I, Process Synthesis (a new course) and Design Project on Part IIA, and various design-related mini-projects. He commented: *'I am very much looking forward to starting as a lecturer at Cambridge in October! Quite a few of you may have seen me in the building before..... Having spent most of my career in industry - where I was involved with starting and growing engineering design companies – I should confess that university teaching is a relatively new challenge for me. For the last four years I have been teaching 'Mass Transfer' and 'Chemical Engineering Design' at the University of Cape Town in South Africa. It has been very interesting, and I have been particularly involved in a number of initiatives to make teaching more efficient. Their 'Mass Transfer' course needed completely reformatting so that it could be run effectively by just one person - what a challenge! -A full semester of 13 weeks during which I needed to deliver 48 lectures, 11 3-hour tutorials, a project, and preparation/marking of two written exams, all for a class of 135 students! Their 'Design' course also had to be restructured, and I worked with Bart Hallmark to base it on the successful Cambridge format. I've been told that the Fluid Mechanics course hasn't changed for 40 years (which means I survived it in its existing format!), so I'll probably be leaving that as it is for now..... However with the new 'Process Synthesis' course there is an opportunity to do something of my own and I'm looking forward to incorporating into it some of my experiences as a design engineer.'*

CEB's PdOC Communication Rep



Dr Claire Michel (Laser Analytics Group) is the new PdOC Communication Rep for the Department. *'I wish to improve the*

communication between the University and postdocs of CEB. The Postdocs Of Cambridge (PdOC) Society aims to bring the post-doc community together both on a social and intellectual level as well as improve post-doc representation within individual departments, colleges and the University as a whole. Specifically, in CEB, there will be regular open lunchtime meetings for all post-docs to collect ideas and concerns about post-doctoral life in the department and the University. The aim is to improve the day-to-day experiences of CEB postdocs, practically, intellectually and socially'

If you wish to get involved email her on chmm2@cam.ac.uk and for more info visit www.societies.cam.ac.uk/pdoc

CEB Fundraising Heroes



Start Line at Tower Bridge: Dr Ben Taylor, who recently completed a PhD here, posing with his wife Amanda Taylor, Research Secretary, and Dr Bart Hallmark, a lecturer who runs the annual design project.

On 10 July 2013 Amanda and Ben Taylor and Bart Hallmark set off on bicycle from Tower Bridge in London all the way to Paris to raise money for the Breast Unit at the Addenbrooke's Charitable Trust. They arrived at the Arc de Triomphe 4 days later after having cycled 220 miles/ 354 km! They rode in honour of Vanessa Blake, one of the Computer Officers at the department, and Sandra Crawford, from Accounts. Both were diagnosed with breast cancer this year and both being treated at Breast Unit, where the money raised has been donated to aid in research and patient support.

On the first day, they cycled from London to the coast. Then on the second day, they took the ferry from Newhaven to Dieppe, and remembering to cycle on the other side of the road, they started the journey through France along the Avenue Verte—an amazing cycleway through the French country-side. The second night was spent in Gournay-en-Bray. The third day saw the longest leg of the journey as they cycled for 84 miles/135 km, ending at Versailles. From Versailles, it was a short hop into Paris on Saturday morning, and they ended their ride triumphantly at the Arc de Triomphe, safely completing the obligatory victory lap around the massive traffic circle.

By the generosity of members of the department and other friends, they exceeded their target of £2000 for ACT before even setting off! The cyclists, along with Vanessa and Sandra, wish to send a very hearty thank you to the Department for your amazing support!

There are other CEB colleagues who also deserve recognition for their fundraising efforts in aid of extremely valuable causes:

Our receptionist, Michaela McNeill, ran The Race for Life in July - a women-only 5km event around the city's landmarks. Cancer Research UK has raised close to their target of £480,000 to help advance research to battle cancer and help sufferers.



Michaela about to start her run in support of Vanessa

Back in May Post-doctoral Research Associate and member of the Bioscience Engineering Group, Dr Krishnaa Mahbubani, cycled from London to Cambridge to raise money for the British Red Cross's International Disaster Fund.



Krish and ET, after completing the course

Congratulations to Professor Lisa Hall and John Saffell

On Friday 14 June 2013 family, friends and colleagues joined Professor Lisa Hall and John Saffell to celebrate their marriage ceremony in Queens' College Chapel, Cambridge. Lisa was given away by her father and accompanied down the aisle by her sister Susan and John's daughter. Following the ceremony, a garden party was held in the secluded and elegant President's Garden. Guests from around the world enjoyed listening to musical soloists and a string quartet performing in traditional

medieval setting. The more energetic then took to punts for a tour of The Backs, before later gathering for Dinner in the sublimely beautiful candle-lit Old Hall. The whole department wishes Lisa and John every happiness as they continue their lives together.





Question 1: Dear Dr Sarah,

With the new academic year looming, I am determined to start the Term with good intentions. However, last year my energy levels started to drop around week 4 of Michaelmas, and I found it more and more difficult to get up in the morning to attend lectures. What can I do to get back on track?

Dr Sarah says...

The university environment can be tough. It doesn't take much to knock your diurnal routine out of sync, becoming a creature of the night. Many distractions can keep you from the realms of sleep – unfinished reports, incomprehensible supervision work, money worries, late night partying – before you know it, you are climbing into bed when the birds are singing, and crawling out of bed when the ice cream van comes tooting around. You can try to snap out of it with a magnum of espresso, but whatever you do, you just can't get rid of that damn tiredness in your eyeballs. You start thinking, "I'll just skip that late morning lecture, have a bit of lunch, then make it into the Department for that afternoon supervision". And down the slippery slope you go...

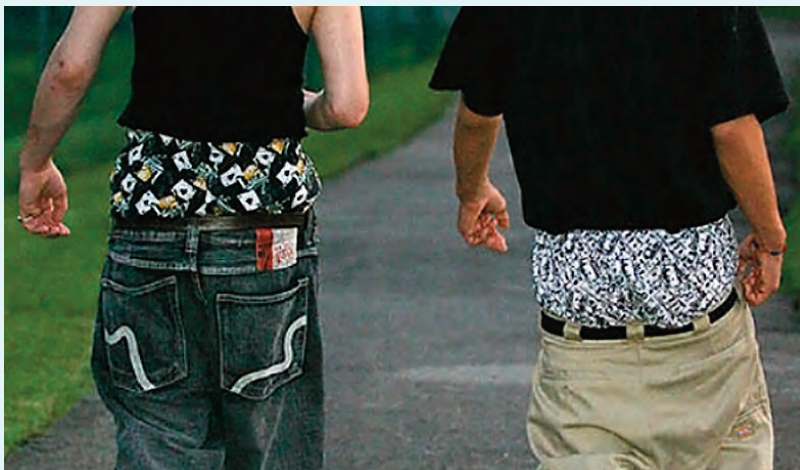
But enough about me.

Some people find that the only way to stay with it is to adopt a very strict regime, whereas others find this way of life totally abhorrent and demeaning. Prevention is certainly better than a cure, i.e. stand well back from the slippery edge in the first place, but that's easy to say in hindsight. Indeed, all work and no play makes Jack a dull boy. However, all play and no work makes Jack leave university without a degree. It was Paracelsus who said that everything could be a poison – it just depends upon the level of dosage. So "everything in moderation" is a good maxim to heed. Trouble is, humans are inherently greedy, especially ones that begin with 'b', end in 's', and have 'anker' in the middle.

So to all classified humans reading this, grab hold of your greed and direct it towards attaining knowledge. Else just carry on being meat popsicles.

Question 2: Dear Dr Sarah,

How important do you think undergraduate appearance and self-presentation is in the process of applying for a job?



Source: www.theguardian.com

Dr Sarah says...

Fairly important, so best make sure your trousers cover all of your knickers.

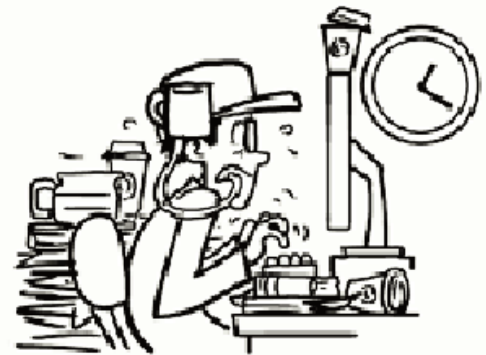
Not a good look for job interviews, unless you want to be a rapper.

How to Write Your Thesis in Ten Minutes a Day

It's that simple!



Step 1. Spend ten minutes each day for the first X number of years filled with anxiety, stress and doubt about whether you'll ever finish your thesis, what you're doing with your life, and whether you made the right decision to come to grad school.

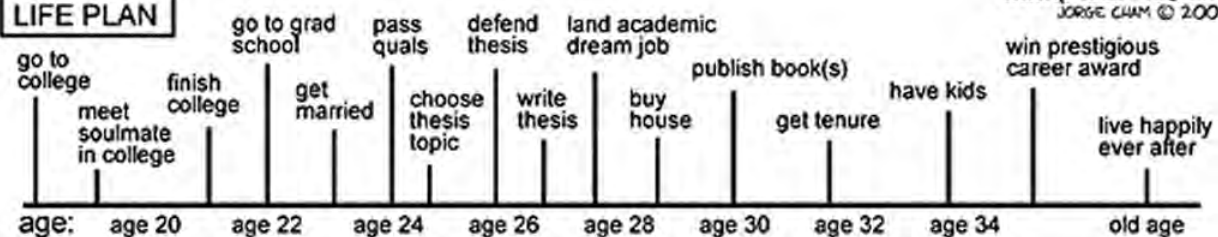


Step 2. On your last year, sleep for ten minutes a day and spend the rest of the time writing your thesis.

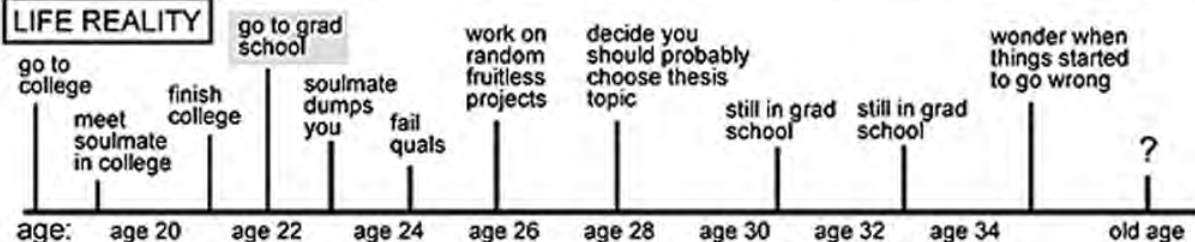
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