

Department of
Engineering Science

news

Issue 6
2016-17



THE QUEEN'S
ANNIVERSARY PRIZES
FOR HIGHER AND FURTHER EDUCATION
2015



Queen's Anniversary
Prize – pioneering work
in biomedical engineering

Welcome

Welcome to the 2016-17 issue of "Department of Engineering Science News".

Published once a year, the newsletter brings to life the work of the Department. This year we have particularly exciting news to report as you will see from the front cover.

I hope that you enjoy reading the newsletter and welcome your comments on its content. Please feel free to send your comments to: newsletter@eng.ox.ac.uk

Eva Williams
Editor

INSIDE THIS ISSUE:

- President Obama praises DPhil student...2
- Reaching out to state schools...5
- Information Engineering collaborations...6 and 7
- Oxford Engineering Alumni Prize... 8
- Queen's Anniversary Prize... 9
- Jaguar Land Rover Centre of Excellence...10
- Special tribute to Lord Avebury...11

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The best Engineering Department in Europe

We are delighted to report that the Department has risen from 6th to 3rd in this year's Times Higher Education World University rankings, behind Caltech and Stanford but ahead of MIT (4th), Cambridge (5th), Princeton (6th) and Imperial (7th).



News from the Head of Department

Last year I began with the news that the Department had been ranked first out of the 62 General Engineering Departments in the UK in the 2014 national research assessment exercise. Many of you will know that this year Oxford came out top in the Times Higher Education World University Rankings. Subject rankings were also published in September 2016, when we discovered that we had risen from 6th to 3rd place, behind Caltech and Stanford, but ahead of MIT (4th), Cambridge (5th), Princeton (6th) and Imperial (7th). Research accounts for 30% of the ranking, citations for 27.5%, teaching for 30%, with international outlook and industry income accounting for the rest. League tables are not infallible, but it is very gratifying to know that Oxford Engineering is ahead of MIT Engineering, if only for this year...

There was further good news for the Department in October when self-driving vehicles equipped with autonomy software developed in the Mobile Robotics Group were successfully tested in public for the first time in the UK. The week-long trials in Milton Keynes were featured on the national news on the BBC, ITV and Sky, an unparalleled demonstration of the world-leading research that takes place in our Department.

The Mobile Robotics Group is expanding so fast that it has morphed into the Oxford Robotics Institute, under the joint leaderships of Professors Paul Newman and Ingmar Posner. We have raised the first £5M for a new Information Engineering building to accommodate the growth of our research activities in robotics, machine learning and computer vision. We also have plans for new buildings in Osney (near Oxford railway station) to house exciting developments in energy research (including renewables).

I often get asked what alumni can do to support the Department. There are several ways in which you can get involved: firstly, by spreading the good news about the standing of the Department; secondly, if you work in industry in the UK, by offering internships to our undergraduates; thirdly, by helping with fund-raising for our new buildings or by putting us in touch with potential donors.

Please e-mail me, head@eng.ox.ac.uk, if you are able to help in any way, large or small; I am very keen that the Department should be in regular touch with as many of its alumni as possible.

Professor Lionel Tarassenko

Surprise mention by President Obama

In April 2016, Maryam Ahmed, a DPhil student studying at the Department's Institute of Biomedical Engineering Centre for Doctoral Training in Healthcare Innovation, had a surprise mention by President Obama.

US President, Barack Obama told 500 young people in London to 'reject pessimism, cynicism and know that progress is possible.' In the question and answer session were A-level students and people selected for a US Ambassador's young leaders' project in the UK - some of whom got a special mention from the President. Maryam Ahmed was one who was surprised to hear her name.

The President said of Maryam: '*[Leadership] is the impulse to say, I may have grown up one of eight in a small west London house, but I'm going to use the education I got at Oxford to help any child have the same opportunities that I have.*'

Maryam Ahmed said: '*Obama name checking me in a speech is not something that I imagined would ever happen in my wildest dream. He talked about what I've done to try to improve access to education, which is a subject very close to my heart.... At my comprehensive school, it wasn't really pushed for people to apply for the best possible university, and I think there's a big stigma about Oxford and Cambridge that it's elitist. I've participated in a lot of outreach programmes which encourage more people to apply to Oxford. Education is the big social leveller. I want everyone to have the same opportunities to access the best possible education, and at the moment, that's not the case.*'



Paving the path for human space exploration: the challenges and opportunities



Lauri N. Hansen, Director of Engineering at NASA Johnson Space Centre, delivered the 42nd Maurice Lubbock Memorial Lecture, titled 'Paving the Path for Human Space Exploration: The Challenges and Opportunities'. Over 350 representatives from industry, academia, the University's alumni community, and government attended. In addition, 40 pupils, aged 15 to 18, attended from UK schools.

In her Maurice Lubbock Memorial Lecture, Lauri Hansen discussed the challenges of human space exploration, as well as the engineering solutions to complex problems such as the design of heat shields for spacecraft.

She said: 'There are many challenges in designing spacecraft including safety, complex vehicle design, and mass challenges. Together, NASA and the European Space Agency (ESA) will provide the capability to take humans further than we have ever been before – 70,000 km past the moon. This will be the next big step in expanding the frontiers of human exploration, eventually leading to human footprints on Mars.'

Prior to this lecture, guests had enjoyed three mini-lectures on the theme of hypersonics and cryogenics, the 4th Year project competition and a research exhibition focusing on space. Lauri Hansen also held a special Q&A session with pupils from local schools.

'I thought Lauri Hansen's lecture was the most captivating ever. The topic was fascinating, but also her presentation was superb.' **Alumnus**

'Many thanks for a great event. I have been thinking about space problems far too much since those interesting lectures.' **Sponsor**

'I came to the schools Q&A with Lauri and I found it invaluable to have someone with first-hand experience in this industry to give us advice.' **School participant**

To view Lauri Hansen's lecture please visit:

<http://www.eng.ox.ac.uk/about/news/the-42nd-maurice-lubbock-memorial-lecture-a-day-to-remember>

With special thanks to the Trustees of the Maurice Lubbock Memorial Trust for their continued support of this lecture.

Special tribute to Lord Avebury, Eric Avebury (1924-2016) – please see page 11. For 50 years he was chairman of the Lubbock Trust that sponsors the Maurice Lubbock Memorial Lecture, held almost every year since 1964.



Lauri Hansen with Engineering Science graduate students and researchers.



The mini-lecturers: Paul Bailey; Dr Anna Orlowska; Professor Matthew McGilvray.

The mini-lectures

Guests were treated to three fascinating mini-lectures on the topics of 'Hypersonic to Hypervelocity Spacecraft Heat Transfer', given by Professor Matthew McGilvray from the Department, 'Space engineering at Harwell', delivered by Dr Anna Orlowska from the Science, Technology and Facilities Council, and 'Cooling the Mid-Infrared Instrument' by Paul Bailey, also from the Department.

Project Exhibition

Established in 2001, the exhibition this year included a range of posters and hardware. The judges, all of whom were alumni of the Department of Engineering Science now working in industry, were: **Samir Maha** (Babcock International); **Francesca Golding** (Atkins); **Mamadou Wane** (Jaguar Land Rover); **Simon Banfield** (Ramboll UK).

'I found the 4th year students very impressive; their ability to present and discuss complex, specialist research work was a credit to both them and the Department. I am glad to see undergraduate research is in such a healthy state at Oxford.' **4th Year Project Exhibition Judge**

Guest speaker, Lauri Hansen presented ten prizes to the following 4th Year Engineering Science students:

- **BP** - The BP prize for best chemical and process engineering exhibit
Student: Claudia Hill
Project title: 'Polymer Coating of Vaccinia Virus for Enhanced Blood Stability'
- **Ecrin Investments** - The Ecrin Investments prize for best information and control engineering exhibit
Student: Piotr Czaban
Project title: 'Learning a Human-like Procedural Knowledge Representation'
- **GlaxoSmithKline** - The GlaxoSmithKline prize for best biomedical engineering exhibit
Student: Oliver Vince
Project title: 'Magnetic nanodroplets for targeted drug delivery'
- **IBEX Industrial Brushes** - The IBEX Industrial Brushes prize for best mechanical engineering exhibit
Student: Dale Line
Project title: 'Surgical tool development for hip revision surgery'
- **Osborne** - The Osborne prize for best civil engineering exhibit
Student: Charlie Cornish
Project title: '2D Discrete Element Method Modelling of Pipelines'
- **Rolls-Royce** - The Rolls-Royce prize for best thermo-fluids and turbo-machinery exhibit
Student: Talbot Kingsbury
Project title: 'Aerothermal Investigation of Rifle Tubes for Power Stations'
- **Siemens** - The Siemens prize for best energy engineering exhibit
Student: Chengzhi Zhou
Project title: 'Wireless charging through Magneto-inductive wave'
- **Sony** - The Sony prize for best electrical and electronic engineering exhibit
Student: Zain Khawaja
Project title: 'A Visual Motion Magnifier'



Our thanks to all judges and 4th Year undergraduates who took part.



Lauri Hansen with Project Exhibition winners.

About the new EEM course

In last year's newsletter we announced the restart of the EEM course with Entrepreneurship replacing Economics. This year we are delighted to inform readers that in October 2016 we successfully restarted EEM. Here Professor Steve Sheard, the Department's Associate Head (Teaching), outlines some key updates about the new EEM course...

'The new course is quite different from the Honour School of Engineering, Economics and Management that you may remember; the new format is a combination of third and fourth year options within the MEng degree of Engineering Science. Students graduate with a degree in Engineering Science having taken a specialisation in entrepreneurship and management, and completed a 24-week project placement within a company.'

'In partnership with the Saïd Business School we are trying something completely new. Engineering students are paired with students taking degrees in Economics and Management, they attend lectures and small-group classes together at the Business School; the brand-new course is entitled Entrepreneurship and Innovation. The style of teaching has been designed to promote innovative thinking and creativity.'

'We are providing further opportunities for new EEM students to establish an entrepreneurial mind-set and develop their enterprising skills through a third year group design project. This project provides a forum within which student teams learn how to take an engineering product through the stages of raising capital and launching a viable business. The project is jointly supervised by staff in the Department and the Business School, drawing on the expertise of academics who have previously spun-out companies from Oxford.'

'Perhaps the most exciting opportunity for EEM students is the project placement with an engineering company. Students spend 24-weeks at a company between years three and four of their degree gaining valuable experience.'



There are a three main ways in which alumni and non-alumni can get involved:

- contribute to a syllabus advisory board for further curriculum development
- draw on the wealth of your experiences by giving an occasional lecture to our students in new fourth year options in entrepreneurship
- host or help us to find host companies for students on their 24-week project placement.

Student Achievements

Institution of Structural Engineers Prize for Best Presentation

Congratulations to Giuseppe Del Gobbo (St. John's College), a 3rd year DPhil student in the Department's Structural Dynamics Research Group, who achieved the 2016 first place oral presentation award at the Institution of Structural Engineers' Young Researchers Conference.

Giuseppe's DPhil research focuses on assessing the earthquake performance of structures. His studies are funded by the Clarendon Scholarship and Natural Sciences and Engineering Research Council of Canada, and his supervisors are Professors Tony Blakeborough and Martin Williams.

Giuseppe was one of 24 presenters. The Young Researchers Conference has been bringing young researchers together with industry professionals and academics for the past 18 years. A shortlist of young researchers is invited to present their work to an audience of peers and industry professionals. Delegates have the opportunity to network with other PhD researchers and industry professionals and discover other cutting edge research in the field of structural engineering.



Major British Geotechnical Association (BGA) Awards

Congratulations to Helen Dunne (Mansfield College) who was awarded the prestigious 2016 Cooling Prize for her paper submission and oral presentation.

Helen was presented with her award at the BGA's annual conference in London by Professor Stephan Jefferis, Chair of the BGA and a Visiting Professor in the Department. Helen, and Iona Richards from the Department (now St Peter's College and formerly St Catherine's College), who was awarded the BGA MSc Prize, gave presentations describing their research to a packed auditorium, generating significant interest amongst the attendees.

Helen's DPhil research topic is *'Foundation optimisation using finite element limit analysis'*. Her studentship is being funded by the offshore engineering firm Subsea 7, and her supervisor is Professor Chris Martin.

Helen's success follows that of William Beuckelaers, another DPhil student in the Department's Civil Engineering Research Group, in the same competition last year. This is only the third instance of consecutive winners from the same institution since the Cooling Prize was established in 1970.



Reaching out to state schools

Oxford University and the Department of Engineering Science have invested in a number of outreach projects and initiatives to encourage applications from students with a wider range of backgrounds and challenge pre-conceptions about Oxford elitism.

With a generous gift from alumnus Michael Hill (St Edmund Hall, 1985), the Department appointed its first Access Officer in June 2015. Consequently, we now have our first cohesive access strategy with the twin aims of improving the focus of our existing activities and prioritising new opportunities to engage with pupils. In the past year the Department's outreach activity has reached and inspired over 1,800 school participants. Our new outreach events (Looking Forward and six masterclasses) accounted for 1,258 of these attendees alone, with 786 (62%) of these being female delegates.

ABOUT OUR OUTREACH INITIATIVES

UNIQ

UNIQ is a programme of free summer schools at Oxford University open to pupils who are based at UK state schools/colleges. Pupils apply for a specific course that aims to give them a realistic view of Oxford student life.

This year 48 students from across the UK came to learn about Engineering Science. The packed programme included lectures on civil engineering; CAD and rapid prototyping experience; designing and building bridges; learning about robotics in the electronics lab; and a tour of the BMW Mini plant.

Commenting on the success of this year's course, Professor Steve Collins, the Department's Admissions Co-ordinator, said: *'For the first time this year our Access Officer, Gabrielle Bouchard, assisted in the selection of participants for the UNIQ summer school to help ensure that the selected participants have the correct combination of A levels and interests. We then made our UNIQ course as close to the Oxford student experience as possible, with pupils undertaking a combination of lectures, labs and tutorials.'*

For more details about UNIQ please visit: <https://www.uniq.ox.ac.uk/>

Headstart

Headstart is a residential programme of activities aimed at inspiring Year 12 students to consider a career in engineering. On this year's course, delegates participated in practical challenges; a design competition; demonstrations; tours of laboratories; team projects; and specialist lectures by academics.

The 2016 Headstart supervisor from the Engineering Development Trust (EDT), Cliona Healy, was extremely impressed by the 2016 Headstart course. In her feedback to EDT she commented: *'This course has been outstanding. All of the academic work was pitched at the right level. The student ambassadors were enthusiastic, passionate and extremely attentive.'*

Dragonfly

By demonstrating how exciting engineering can be, our annual Dragonfly Day encourages Year 10 girls to consider a future in engineering. The Department hosted a full day of activities for 30 girls, which included designing, building and testing a solar vehicle, with prizes being awarded for the cars that travelled the furthest when using the same amount of stored energy.

Details of Oxford University's bursaries and help for funding to study can be found by visiting:

• <http://www.ox.ac.uk/students/fees-funding/ug-funding/oxford-support>



UNIQ students outside Wadham College.

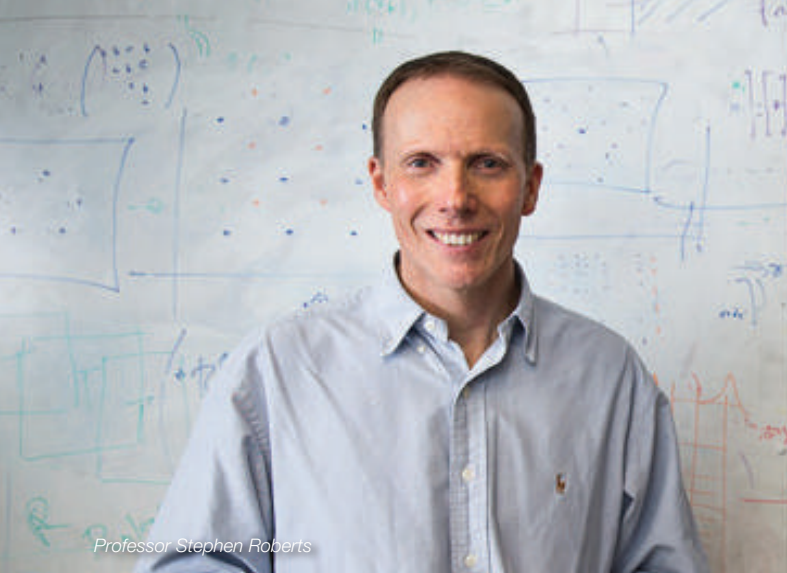


Masterclass students discover how Magnetic Resonance Imaging (MRI) works.

New initiatives

Following two successful grant applications in 2016 to the National Network of Collaborative Outreach, the Department participated in two new initiatives to encourage state school pupils to apply to Oxbridge:

- The departments of Engineering Science, Computer Science, Materials, Physics, Statistics, and the Mathematical Institute came together for "Looking Forward" – a three day series of themed lectures and workshops. Over 200 girls attended.
- The departments of Engineering Science (Oxford) and Engineering (Cambridge) came together to deliver a series of six masterclasses on 3D imaging, cryptography, digital vision, electromagnets for fusion, geotechnical engineering, and medical imaging.



Professor Stephen Roberts



Professor Michael Osborne

Academic innovation and external engagement

According to Professor Stephen Roberts, the Department's Professor of Machine Learning and Director of the Oxford-Man Institute (OMI), 'We are in the midst of an information revolution, where advances in science and technology, as well as the day-to-day operation of successful organisations and businesses, are increasingly reliant on the analysis of data.'

Professor Roberts said: 'Driving these advances is a deluge of data, which is outstripping the increase in computational power available to process it. Research in data science is already transforming our ability to work with large amounts of complex information. Over the next few years these trends will revolutionise how we think about data, how we process and visualise it, and how we put it to use. The OMI aims to be at the crest of this wave, pushing back the boundaries of what can be achieved with data.'

In August 2016 the OMI, a world-leading academic institute for research into quantitative finance, became part of the Department of Engineering Science and has expanded its focus on machine learning and data analytics.

This collaboration creates a hub in Oxford comprising OMI and the Department's Machine Learning Group (a body of around 30 faculty, research students and postdoctoral researchers). The aim is to foster a stimulating environment composed of researchers focused on machine learning techniques, whereby machine learning and data analytics expertise can be shared and leveraged.

Professor Roberts said: 'This is a unique combination of academic innovation and external engagement. We attract distinguished experts and brilliant young researchers to an environment that stimulates collaboration and communication. We are creating new tools and methods that can give deeper insight into financial markets – how they behave, how they become stable or unstable, how to extract value from data at scales beyond human and how they could be made to work better.'

Sandy Rattray, CEO of Man AHL, sees the potential to enhance business and deliver value to clients with the enhanced focus of the OMI on machine learning, which will be 'strongly supportive of the on-going evolution of quantitative investment strategies.'

For more information please visit:

- **Oxford-Man Institute (<http://www.oxford-man.ox.ac.uk>)**
- **Man Group (<http://www.man.com>)**
- **Man AHL (<http://www.ahl.com>)**

Spin-out unlocks big data insights

Oxford University spin-out Mind Foundry is developing software that will help organisations solve problems by unlocking insights hidden deep within their data. The company's technology is based on advanced algorithms and techniques developed by Professors Stephen Roberts and Michael Osborne, who lead Machine Learning research at the Department.

Professor Osborne said: 'Mind Foundry will enable decision-making from insights generated while the data is being created. This will take organisations beyond business intelligence query tools towards predictive modelling. This is particularly applicable to real-time business recommendations, high-frequency trading, or warning of potential problems or maintenance requirements in industrial systems.'

Oxford University Innovation Managing Director Linda Naylor said: 'We expect Mind Foundry to be at the forefront of what has been dubbed the 'algorithm economy' – the use of algorithms to manage data and guide decision-making.'

Man Professorship of Quantitative Finance

In October 2016, Mihaela van der Schaar was appointed to the Man Professorship of Quantitative Finance. This post is funded in perpetuity by a substantial gift made by the Charitable Trust of Man Group plc.



Professor van der Schaar has an international reputation for excellence in scholarship and research in the area of quantitative finance, encompassing data science, data-driven decision making and machine learning. Professor van der Schaar comes from the University of California, Los Angeles (UCLA), where she was the Chancellor's Professor of Electrical Engineering, a Professor in the Electrical Engineering Department and Director of the UCLA Centre for Engineering Economics, Learning and Networks which she founded in 2011.

Professor van der Schaar also brings significant industry experience, having been a Senior Member of Research Staff in the Philips Research Wireless Communication and Networking Department (1998-2003). There she led research projects resulting in 33 patents and developed algorithms implemented in a number of Philips products, including the USB PVC camera for which Philips received a design award.

Autonomous vehicles on the move



The ORI (Oxford Robotics Institute, formerly the Mobile Robotics Group), together with Oxbotica, a spin-out company from the Department, has developed Selenium – a new software system for making regular cars into driverless vehicles. Given raw sensor data from a number of sensing modalities such as cameras and laser scanners, it uses a series of algorithms to establish where the vehicle is, what surrounds it and how to act next.

Paul Newman, Professor of Information Engineering at the Department, Director of the ORI and Co-Founder of Oxbotica, said: ‘Selenium takes any vehicle and makes it into an autonomous vehicle. We plan for the software to be used to control not just autonomous cars, but warehouse robots, forklifts, and self-driving public transport vehicles.’

Interestingly, a recent KPMG study forecasts that by 2030, in the UK alone, autonomous vehicle technology will add £51billion in value to the economy, create over 300,000 jobs, save 2,500 lives and prevent 25,000 serious road accidents.

Shell Eco-Marathon Europe

In 2016, the Selenium software was deployed in real-world trials in Greenwich, London and in Milton Keynes. The software was also showcased at the Shell Eco-Marathon Europe, part of Make the Future London – a unique competition that challenges students around the world to design, build and drive the most energy-efficient car. This event included a special showcase of autonomous technology, featuring an ‘Autonomous UrbanConcept Vehicle’ equipped with cutting-edge software developed by the Department’s robotics experts. Among the passengers trying out Oxbotica’s technology was Formula 1 racing driver Kimi Räikkönen (pictured).

Based on this success Shell aims to introduce the new Autonomous UrbanConcept Vehicle category into Shell Eco-Marathon in 2018, when students will be invited to develop their own autonomous vehicles to take part in the competition.



Minister visits MRG

In 2016 the Department welcomed Jo Johnson, the Minister of State for Universities and Science, who visited the Department’s Mobile Robotics Group (now the ORI) to see world-leading research at first-hand. This visit coincided with the announcement that Oxford University is to receive £13.5 million from the Government to support DPhil students in engineering and physical sciences, as well as significant funding geared towards boosting the UK’s research into quantum technologies.

Jo Johnson said: ‘We are committed to securing the UK’s position as a world leader in science and innovation. This new funding builds on our protection for science spending by supporting research in our world-leading universities and helping to train the science leaders of tomorrow.’

For more information about MRG please visit: <http://mrg.robots.ox.ac.uk/>

Inspiring the next generation of engineers

Professor Ingmar Posner, Deputy Director of the ORI and Co-Founder of Oxbotica, said: ‘We have been fortunate to receive tremendous support from the Engineering and Physical Sciences Research Council, which has allowed us to develop this technology to the stage where we are able to demonstrate it at a high-profile event like the Shell Eco-Marathon. But for us, the most important thing is that we are able to inspire the engineers of the future, who will be taking on challenges such as developing, testing and refining the autonomy technology that is set to revolutionise the worlds of mobility and transport.’

First public trials

Selenium is the same technology that underpins the Oxford RobotCar – the UK’s first autonomous car approved for public trials. In the summer of 2016, as part of the GATEway driverless car project, Oxbotica, Westfield SportsCars and Heathrow Enterprises developed new iconic automated pods capable of operating fully autonomously and safely on the streets of Greenwich in London.

The ongoing shuttle trial, which is one of three automated vehicle tests within the GATEway project, investigates public acceptance of automated shuttle vehicles within the urban mobility landscape. Other trials include autonomous valet parking and automated deliveries.

For more information please visit: <http://www.GATEway-project.org.uk>

The LUTZ project brought autonomous pods to the pavements of Milton Keynes. This trial was coordinated by the Transport Systems Catapult (TSC) and marked the conclusion of the LUTZ Pathfinder project, which ran for 18 months.

This vehicle demonstration took place on pavements around Milton Keynes train station and business district. In the future, it is expected that vehicles like the one demonstrated in Milton Keynes will be used for local transportation in urban areas.

Neil Fulton, Programme Director at the TSC, said: ‘This team of UK-based scientists, mathematicians and engineers has worked incredibly hard to develop this ground-breaking technology, which is bringing self-driving vehicles yet another a step closer to deployment across the world.’



Photo: courtesy of John Cairns.

Oxford Engineering Alumni (OEA)

The OEA comprises all Oxford Engineering graduates, and present and past members of teaching and research staff of the Department. If this applies to you and the Department has your contact details, you are already a life member. If the Department does not have contact details for you, or if you are unsure, you are very welcome to join – simply e-mail: alumni@eng.ox.ac.uk There is no membership fee.

We also have a dedicated OEA website page – please visit: <http://www.eng.ox.ac.uk/alumni>

OEA Committee changes

The 2016 OEA Annual General Meeting, which was held during the University's Alumni Weekend in September, saw several changes to its committee. Martyn Hurst (Merton, 1962) stepped down after eight years as President (see below), while Professor Roderick Smith (St John's, 1967) became the new President. Rod is former Chief Scientific Advisor at the Department for Transport, and Past President of the IMechE. Adam Cary (Queen's, 2001) and Gordon Lord (former staff member) left the committee, while John Carter (Keble, 1969) and Richard Ashton (Balliol, 1995) joined as new members. Since the AGM, the committee has also co-opted David Jeffcoat (Pembroke, 1968), Sai Lakshmi (Trinity, 2003) and Vaughan Michell (Magdalen, 1983).

Alumni to sponsor new student prize

At the 2016 Annual General Meeting of OEA, members agreed that OEA would sponsor a new prize for Oxford student engineers, for the best final year project presentation at the Department's Open Day in May, as judged by a panel of alumni. The prize will be worth £500, with an invitation for the prize-winner to show-case their work to alumni in a short talk at the following University Alumni Weekend. There will also be two runner-up prizes each of £250. OEA members welcomed the new prize as an opportunity for more interaction between alumni and the work of current students.



The 2015 Jenkin Lecture: Global Water Issues

Our Jenkin Lecturer for 2015 was alumnus Mark Enzer (Pembroke, 1982), who is the Group Practice Manager for Water and the Environment with Mott MacDonald.

He reviewed an enormous challenge facing humankind, and how it may be solved: provision of sufficient clean fresh water for the planet's growing human population.

Mark discussed in stark terms the scarcity of resources facing humanity, especially shortages of water, energy and food, illustrating the problem with some startling statistics, especially in relation to water supply. He explained that the search for solutions faces four adverse 'mega-trends': *climate change* – already happening; *resource limitation* – getting worse as global water consumption rises; *population concentration* – increasingly in vast cities; and *investment constraints* – finding the funds to pay for solutions.

However, Mark pointed to another pervasive, but positive, mega-trend: *digital abundance* – the explosion in information available, and in the technologies for processing it. It will enable water industry infrastructure to become much more intelligent, and this is how water supply problems will ultimately be solved. Future investment will focus on improving performance of the infrastructure: using information technology to transform both asset information management and decision-making based on it. Mark's message was that this will be essential in enabling water supply resilience and water quality to continue to improve, to meet the needs worldwide, while costs are also contained.

Martyn Hurst, Alumnus Merton College (1962)

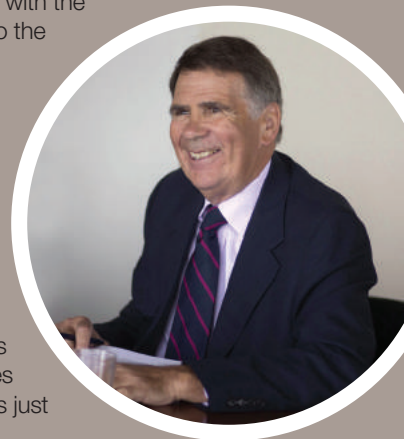
Martyn left Oxford University and joined the Engineer Branch of the Royal Air Force. After a number of interesting postings he specialised on the Harrier. Managing the scheduled maintenance activity at RAF Wittering preceded a posting to Germany and responsibility for the airworthiness and development of the Harrier airframe and systems. His final tour was as engineering authority for the team procuring the Mk2 Harrier from McDonnell Douglas in St Louis.

Challenging tasks included moving a Vulcan by road from Lincolnshire to the RAF museum in Hendon and the winter maintenance of the Spitfires, Hurricane and Lancaster of the BBMF. A highlight was a trip with the Red Arrows on a practice display.

Retiring as a Wing Commander, he joined British Caledonian as Chief Engineer responsible for Engineering and Maintenance of the BCal fleet and third party aircraft, which included Richard Branson's first Boeing 747. When British Airways bought BCal, he moved to Heathrow and ran the Heavy Maintenance Department for the BA fleet. This included the Concorde operation and he was lucky enough to fly on this iconic aircraft several times.

He moved to Dowty Aerospace which merged with the French company Messier resulting in a move to the new HQ in Paris. As Senior Vice President, he was delighted when Messier-Dowty won the Boeing 787 Dreamliner landing gears. With its portfolio of gears on all Airbus aircraft, the company became the world Number One supplier of landing gear. Every two seconds an aircraft touches down on a Messier-Dowty landing gear somewhere in the world.

Since his retirement, Martyn has served on the Royal Aeronautical Society Council and has enjoyed helping a number of smaller enterprises develop and grow their businesses. Martyn has just completed eight years as President of OEA.



Excellence in Biomedical Engineering

Queen's Anniversary Prize

Representatives of Oxford University visited Buckingham Palace in February 2016 to receive the Queen's Anniversary Prize, awarded for the Department's pioneering work in biomedical engineering. Awarded every two years, the Queen's Anniversary Prizes recognise universities and colleges which have demonstrated excellence, innovation, impact and societal benefit.

The award was presented to the University's Vice-Chancellor, Professor Louise Richardson, and Professor Lionel Tarassenko, Head of the Department of Engineering Science and Director of the Institute of Biomedical Engineering (IBME) when it opened in 2008, by the Prince of Wales and the Duchess of Cornwall (ref: front page photo). Members of the IBME and the University's Chancellor, Lord Patten of Barnes, also attended the ceremony at the Palace.

Since opening in 2008 the IBME has been at the forefront of innovation in medical technology. It has more than doubled in staff, raising substantial research funding. Its 16 academic staff and 220 researchers have completed more than 20 clinical trials, from pregnancy screening and diabetes self-management to organ preservation. A new medical technology company has been spun out each year.



In the top 50 Women in Engineering List



Professor Eleanor Stride (pictured above), from the Department's Institute of Biomedical Engineering (IBME), has been included in the top 50 Women in Engineering. The inaugural list, compiled by the Daily Telegraph in collaboration with the Women's Engineering Society, features the UK's top influential female engineers chosen from almost 900 nominations.

Professor Eleanor Stride (Fellow of St Catherine's College) joined the Department in 2011. She holds a BEng and PhD from University College London. Professor Stride's research is focused on two complementary activities: drug delivery systems and biomedical ultrasonics.

Major NHS research funding

The University of Oxford and local NHS partners won a major grant to support medical research. The money, from the National Institute for Health Research (NIHR), includes £113.7 million for the existing University of Oxford/Oxford University Hospitals Biomedical Research Centre (BRC) and £12.8 million for a new Biomedical Research Centre specialising in mental health and dementia, run by the University and Oxford Health NHS Trust.

NIHR BRCs bring together expertise within the NHS and leading research organisations to turn the latest discoveries into fundamentally new treatments for patients.

Professor Lionel Tarassenko, who leads the Technology and Digital Health theme in the BRC, said: *'The next five years of funding will enable us to integrate our risk estimation algorithms for secondary care with our technology for the management of chronic conditions such as diabetes and heart failure in primary care and in the community, to enable real-time patient management which is agnostic of patient location.'*

Other IBME researchers receiving BRC funding include Professors Alison Noble, Constantin Coussios, David Clifton and Maarten de Vos.

Healthcare Technologies Challenge Awards

Professors Antoine Jerusalem and David Clifton are among the first nine researchers to receive the "Healthcare Technologies Challenge Awards" from the Engineering and Physical Sciences Research Council (EPSRC). Award winners will work with clinicians, companies and charities to improve healthcare diagnosis and treatment across a wide spread of issues.

The award winners, working on innovative projects that promise to improve healthcare diagnosis and treatment across a wide spread of issues, will share in a £9 million fund to work with clinicians, companies and charities.

EPSRC's Chief Executive, Professor Philip Nelson, said: *'These Healthcare Technologies Challenge Award winners are our future research leaders who will be instrumental in ensuring the UK can meet the 21st century healthcare needs and thrive as a healthy nation.'*

NeuroPulse

Research by Professor Antoine Jerusalem and his team in the Department will focus on electrophysiological-mechanical coupled

pulses in neural membranes: a new paradigm for clinical diagnosis, prognosis and therapy of neurodegenerative diseases (NeuroPulse).

Professor Jerusalem (pictured right) said: *'This endeavour is set to benefit the medical community in the diagnosis, prognosis, and treatment of Traumatic Brain Injury and Spinal Cord Injury, both major, global public health issues.'*

Intelligent healthcare technologies

Professor David Clifton, who leads the Computational Health Informatics (CHI) Laboratory in the IBME, is developing a programme of "big data" healthcare technologies based on machine learning.

The aim of the Challenge Awards is to provide flexible funding to support "the next generation of research leaders in healthcare". Professor Clifton's award subsequently led to two large grants from the EPSRC in 2016 to build upon his Challenge Award, to translate research results into hospital wards and into the home.



Jaguar Land Rover Centre of Excellence

In April 2016, the Jaguar Land Rover Centre of Excellence for Compression Ignition Engine Combustion Research was officially opened here at the Department. The Centre, a joint venture between Jaguar Land Rover (JLR) and the Department, was formally opened by JLR Powertrain Research Senior Manager, John Hoyle, and Head of Department, Professor Lionel Tarassenko.

Guests at this prestigious event included senior representatives from the Advanced Propulsion Centre UK, the Engineering and Physical Sciences Research Council, JLR, University of Oxford and Imperial College London. They were shown new state-of-the-art diesel engine test facilities and introduced to existing JLR/Oxford engine research projects on a tour of the Department's Thom Building laboratories by Professor Richard Stone and Dr Martin Davy, who hold responsibility for the Department's engine research activities.

Dr Davy said: *'The Jaguar Land Rover Centre of Excellence represents all that is good about academic partnership with industry. With strong technical support from JLR and financial investment from the Oxford University Press John Fell Fund and the Department we have been able to build a highly sophisticated single-cylinder diesel engine test facility that rivals any of those found in the leading automotive consultancies worldwide. The Oxford facility now houses a single-cylinder version of the class-leading Jaguar Land Rover Ingenium AJ200D engine.'*

'Working closely with JLR powertrain research engineers on new operating strategies and hardware for this engine gives our students and researchers invaluable experience and opportunity. They are addressing real world problems on current and future engine technologies with a direct route into production vehicles. For JLR, the specialised instrumentation and numerical modelling techniques that we are able to develop and apply in the university environment add to their in-house capabilities and the understanding of their engine. This is a real partnership with tangible benefits for Oxford and JLR.'

The Department's combustion engine research activities will be expanded still further in 2017 when Professor Stone and Dr Davy will be joined by Dr Ben Williams. Dr Williams, a graduate of Oxford University's Department of Physics, is a world-expert in the application of laser diagnostics on two-phase and reacting flows.



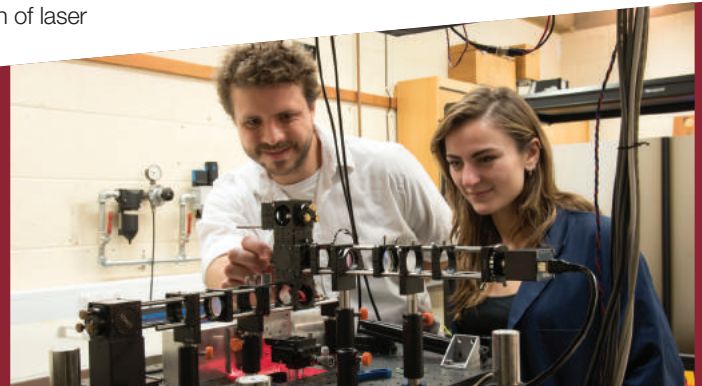
Touring the new JLR laboratory are (left to right): Dr Felix Leach (University of Oxford), John Hoyle (Senior Manager, JLR Powertrain Research), Steve Richardson (Manager, Collaborative Research Strategy, JLR Powertrain).

New MSc course

The Department is delighted to announce the launch of its new, two-year MSc conversion course for those with an honours degree in science or mathematics. Starting in September 2017, this course has been designed to minimise time away from the workplace to study by combining an online learning environment with six residential weeks spread over the two years. These residential weeks will consist of a mixture of tutorial classes, practicals and revision lectures. The part-time course, which is also applicable to graduates from other disciplines in engineering, is run by the Department and Oxford University's Department for Continuing Education. It aims to cover both current and future trends in three key electrical engineering sectors: Microelectronics, Optoelectronics and Communications.

Course content will focus on:

- Fundamentals of Microelectronics and Communications
- Advanced Microelectronics
- Wireless Communications
- Fundamentals of Optoelectronic Devices and Applied Optics
- Optical Communications
- Organic Electronics and Nanotechnology for Optoelectronic Devices
- Engineering in Society



The first year consists of the Microelectronics and Communications modules, which includes the principles, theories and methodologies underpinning the design of both analogue and digital electronic systems. For the Communications module, MSc students will learn about technologies used in the wireless communications industry as well as a critical awareness of their limitations and the new insights gained by looking at the forefront of current research. The second year of the course will focus on the Optoelectronics units, which will cover the fundamentals of applied optics and semiconductor physics that are required to understand the performance and design of optoelectronic components and devices. Students then have the option of choosing the Organic Electronics and Nanotechnology course or the Engineering in Society unit before they embark on a research project. Please do pass on this information to anybody that might be interested in enrolling in the new MSc course.

For more information about the new MSc part-time course please e-mail Professor Stephen Morris: stephen.morris@eng.ox.ac.uk

The life and work of Lord Avebury, Eric Lubbock (1928 – 2016)

In June 2016 over 430 guests joined the family of Lord Avebury to celebrate his life and work at the Royal Institution in London. Speakers from all walks of life shared their moving and personal memories of Eric Lubbock – among them Sir Drummond Bone, Master of Balliol College where Eric first studied Mathematics and then Engineering.

Eric Reginald Lubbock, the 4th Baron Avebury, died on 14 February 2016 following a long struggle with myelofibrosis. Lord Avebury's devotion and commitment to the Department of Engineering Science spanned over fifty years. During these years he played a pivotal role as Chairman of the Maurice Lubbock Memorial Fund, a trust fund set up in 1957 in the memory of Eric's Father who was also an undergraduate at Balliol College. The Fund was of special importance to Lord Avebury – 'only ill-health or a clash with a sitting of the House of Lords would ever cause him to miss a meeting of the trustees.'

The Maurice Lubbock Memorial Fund supported the Lubbock Scholarship, the senior Scholarship in Engineering at Balliol College. There are now over 50 Lubbock Scholars and Lord Avebury showed interest in them all individually. He was always eager to meet them and hear how their lives and careers were progressing.

The annual Maurice Lubbock Memorial Lecture, held in the Department of Engineering Science since 1964, was initiated, and continues to be supported by the Maurice Lubbock Memorial Fund. This Lecture remains the Department's major public event, and is instrumental in showcasing a wide range of topical issues in engineering.

After the memorial event Lyulph Lubbock, Eric's eldest son and the 5th Baron Avebury, posted this on Facebook: *'Thank you to everyone who contributed and attended my father's memorial service today. Every speaker was very moving and I feel humbled by everyone coming to share their memories. Although we are in troubled times, it was great to see people from all walks of life come together to celebrate the great idea of turning to help those less fortunate than ourselves. Whilst it is invidious to pick out any individuals, I would especially like to thank Damian Le Bas from Travellers Times who referred to Eric in the warmest of terms, Jeremy Corbyn, who despite the difficulties he is now facing gave a very personal view of Eric and why human rights really matter (and stayed for the whole proceedings) and Dr Saeed Shehabi who really gave us an appreciation of how loved Eric was by many Bahrainis who admired his incorruptibility. It was also really gratifying to see so many of his liberal friends present as he never wavered in his commitment to the party. Stephen Claypole was a great and very engaging MC and my sister Victoria did extremely well representing the family. The whole proceedings were a lovely humorous celebration and not sombre at all. The tributes did make me feel quite emotional though.'*

There must be a huge community of organisations and individuals greatly in debt to Lord Avebury – the Department of Engineering Science is certainly among them.



This tribute gives a short snapshot of Lord Avebury's life and work:

- 1945** Maths and Engineering (Balliol College)
- 1951** Graduate apprentice at Rolls-Royce Derby
- 1955** Production Engineering Ltd management consultants
- 1957** Set up the Maurice Lubbock Memorial Fund
- 1960** Charterhouse in the City (nominee director on engineering subsidiaries)
- 1962** Winner of the Orpington by-election (one of the biggest by-election upsets in British political history)
- 1964** Chief Whip and party spokesman on science and technology for Liberals in the House of Commons
- 1971** Became 4th Baron Avebury (Liberal Democrat peer for 45 years)
- 1976** Founded the parliamentary human rights group (chair until 1997)
- 2004** Honorary Fellow of Balliol College.

Pictured below are members of the Lubbock family with Professor Lionel Tarassenko at the Department's Lubbock Day in 2016.



Networks

The University of Oxford's Alumni Office provides a range of opportunities for alumni of the University to come together. Throughout the year there is an exciting mix of social and professional networking events and presentations by leading academic speakers, as well as the chance to get involved in student recruitment and outreach activities.

To find out more please visit:
<http://www.alumni.ox.ac.uk>
or e-mail: enquiries@alumni.ox.ac.uk

The Oxford University Engineering Society (OUEngSoc) is one of the largest undergraduate societies in the University. It promotes the engineering profession within the University and provides students with a wider overview of the profession that is otherwise outside the scope of the degree course. Talks, debates and trips as well as socials and networking opportunities are offered to undergraduates.

To find out more please visit:
<http://www.ouengsoc.org>

The University of Oxford Careers Service is for life. The dedicated alumni careers adviser, Dr Mike Moss, is also the key Careers Service contact with the Department of Engineering Science. He offers 30 minute Skype appointments for alumni all over the world; these can be booked on-line on the Career Connect portal. Alumni can also post job vacancies, offer internships and volunteer to be mentors.

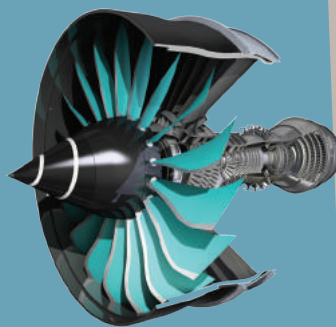
To find out more please visit:
<http://www.careers.ox.ac.uk/>
or e-mail: alumni@careers.ox.ac.uk

Jet engine research soars to new levels

The Department's Turbomachinery Research Group, housed in the Southwell building at Osney, has been awarded significant grants that will propel its research into the 2020s. As part of the national 2014 Research Excellence Framework exercise, UK higher education institutions submitted 6,975 impact case studies demonstrating the impact of their research on wider society – 20% of the Department's Impact case studies were submitted from our Turbomachinery Research Group and the Department was ranked 'the best engineering department in the country'. Analysis found that engineering research often has wider benefits, for example on the economy, health, the environment and quality of life.

Aerospace Technology Institute (ATI)

A major capital investment grant from the Aerospace Technology Institute will enable the Oxford Turbine Research Facility in the Osney lab, which is able to test turbine rotors at engine representative conditions, to test for extended periods of several minutes, and the new metals parts facility (ECAT) to measure vane temperature fields.



Recent ATI-funded work has addressed the problem of rotor tip clearance control for both compressors and turbines to improve the efficiency of engines for future civil airliners.

Other research programmes are investigating the cooling, thermal management and sealing of high pressure and temperature cores of the next-generation engines – such as the Rolls-Royce UltraFan™. Its sponsors include: Rolls-Royce Aerospace (formalised in the founding of the Rolls-Royce University Technology Centre (UTC) in Heat Transfer and Aerodynamics in 1990); Mitsubishi Heavy Industry; the EPSRC; Innovate UK; Siemens.

Engineering and Physical Sciences Research Council (EPSRC)

A prestigious Programme Grant from the EPSRC will enable the Department's researchers in the Osney lab to solve the problem of 'transpiration cooling' of both turbine blades and hypersonic vehicles, in collaboration with colleagues at Imperial College and Birmingham and Southampton universities.

Our investment in Hypersonic Flow research culminated in membership of the EPSRC/ATI supported National Wind Tunnel Facility and the combination of the High Density Tunnel, T6 Stalker Tunnel and the Low Density Wind Tunnel, which offer the broadest range of hypersonic flow test conditions in Europe.

The UTC is a partner in the EPSRC Centre for Doctoral Training in Gas Turbine Aerodynamics, which will educate 85 doctoral students in partnership with Cambridge and Loughborough universities.

Warren East CBE, CEO Rolls-Royce

In July 2015, Warren East became Chief Executive of Rolls-Royce, succeeding John Rishton. Warren is a Chartered Engineer who is an alumnus of the Department of Engineering Science (Wadham College, 1980). He is a Fellow of the Institute of Engineering and Technology, a Fellow of the Royal Academy of Engineering, and a Distinguished Fellow of the BCS, the Chartered Institute for IT. He was awarded the CBE in 2014 for services to engineering and technology.



Before joining Rolls-Royce, Warren worked for ARM Holdings plc and he was the company's CEO from 2001 to 2013. Under his leadership the company became the world's leading semiconductor IP licensing company, and one of the UK's most successful companies.

In 2007, Warren was named Business Leader of the Year at the National Business Awards and he was subsequently named in Barron's list of the world's best 30 CEOs in 2011 and 2013.

Warren became a non-executive director of Dyson Limited and Rolls-Royce in 2014. In 2015 he was appointed as a member of the UK Government's business advisory group. Rolls-Royce is one of the world's leading producers of aero engines for large civil aircraft and corporate jets, and the second largest provider of defence aero engines in the world.

Warren is passionate about engineering and is a frequent visitor to both the Department and Wadham College. He gave the 32nd Maurice Lubbock memorial lecture in the Department in 2006.

Rolls-Royce and the Department have had a close relationship for the last 40 years. The Department houses two Rolls-Royce UTCs (one in the Osney lab and one in Solid Mechanics). 40% of the REF 2014 impact studies submitted by the Department featured collaborations with Rolls-Royce.

To find out more about Rolls-Royce, a global company providing highly-efficient integrated power and propulsion solutions used in not only in aerospace, but also in marine, energy and off-highway applications, please visit:

<http://www.rolls-royce.com/>

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Thank you for your support

We would like to acknowledge the important role played by our individual and corporate supporters, and we thank them for the invaluable contribution they have made to the Department.

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