Cambridge
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Device Successes

The Royal Academy of Engineering has recognised Judith Driscoll with the award of a Chair in Emerging Technologies, a scheme designed to identify and promote global research visionaries. The awards, championing disruptive innovations, have been given to just nine pioneering, world-leading researchers across the UK. They provide long-term (10 year) research support for the advancement of emerging technologies from basic science, through to deployment and commercialisation.

The areas chosen are those with the potential to considerably benefit society and the UK economy, and enable the nation to remain at the global forefront of engineering innovation by tackling some of the biggest industrial and societal challenges of our time. Judith's work will focus on the development of scalable, ultralow-power non-volatile memory storage through the application of highly innovative materials. This is essential to a wide range of growing data-centric technologies including the Internet of Things, transport, medicine, and AI. A range of materials, compositions and nanostructures will be trialled in different forms of memory device. Liaison with industry will then bring the devices to commercialisation.

Image, top-right:
2019 Photo Competition Winner "Versatility" sputtering system in the Device Materials Lab © Juliet Thompson

Giuliana Di Martino has been appointed as a fixed-term University Lecturer in Device Materials, and will work with Judith during her tenure as Chair of Emerging Technologies. Giuliana was awarded a prestigious Winton Advanced Research Fellowship in 2018, through the Winton Programme for the Physics of Sustainability, and has already built up a dynamic research group working on innovative memory devices.

Further recognition of Judith's work has recently been announced, with an ERC Advanced Grant of nearly €2M to design and engineer new forms of nanostructured oxide films for efficient, robust switching in ultra-dense, ultra-low power computer memories.

Goldsmiths' Students

The gift from Goldsmiths' Company Charity to fund a number of studentships was recorded in Issue 33. The first two of those students, Ayush Prasad and Owain Houghton, have embarked on research in the Department. Having studied Chemistry at Oxford and then the Nano MPhil here, Ayush is working on precious metals in shape-memory alloys with Nick Jones. Owain took Part III in the Department last year and now works with Lindsay Greer on metallic glasses based on precious metals.

Editorial

As I write this Editorial, the Covid-19 pandemic has transformed our lives. The Department and most of the University's buildings are physically shut, except for Covid-19 research, and the country is in lockdown. We are living through extraordinary times and although, by the time this reaches you, the lockdown may be easing we will almost certainly have to adjust to a 'new normal' both in our social and working lives. In this period, the Department operation continues remotely and it's been remarkable how well all staff and students in the Department have reacted and adapted to our new way of working. During Easter term, lectures and supervisions will be delivered online, and formal exams replaced by alternative online assessments. There have been regular University updates during this period and you can read more at www.cam.ac.uk/coronavirus.

On a more positive note, last term we were delighted to welcome to the Department two new University Lecturers, Bartomeu Monserrat and Giuliana Di Martino, together with Nalin Patel as the Department's Research and Business Development Manager.

Before I end I must say an enormous thank you to John Leake who has been Editor of Material Eyes for many years and who now hands the editing baton to Zoe Barber – thank you again John for your huge efforts and help. Lastly, I hope you and your family are keeping well and safe at this anxious and uncertain time – we look forward to brighter times ahead.

Professor Paul Midgley,
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Inside:

Meeting Nobel Laureates: Three key learnings

In July 2019, I was grateful to be selected to attend the 69th Lindau Nobel Laureate Meeting (LINO19), an annual meeting connecting 580 leading young scientists with 39 Nobel Laureates. The meeting is a week-long opportunity designed to foster the exchange among scientists of different generations, cultures and disciplines. LINO19 took place on the banks of Lake Constance in Germany; an inspiring setting for an awe-inspiring meeting. My three key learnings from the week centre around diversity, community and possibility.

Diversity – With representatives from 89 countries, I met many people with diverse stories of interdisciplinary and international collaboration - Rainer Weiss told how the LIGO project for the observation of gravitational waves required the collaboration of 1000 people from 100 institutions worldwide. Ada Yonath attributed her overall success in research to the women in her life, and sent a strong message that although men have dominated the field of scientific study and it is steeped in a patriarchal bias historically, women can – and must – be part of this story now and in the future.

Community – I was fortunate to spend time walking, eating and talking with prominent leaders in my field. For example, I discussed the future of the field of spintronics with Albert Fert over lunch, and met Donna Strickland, the third female physicist to be awarded a Nobel Prize, and Professor in my university in Canada.

Possibility – The opening lecture by Brian Schmidt stayed with me throughout the week. Schmidt spoke of political instability and uncertainties, technological advancement at an unprecedented scale, and unsustainable use of the Earth's resources. He advised that we can work together, participate in areas outside of our existing fields, and use the scientific framework to make a positive impact in the world.

Samer Kurdi

More about Samer's experiences at LINO19 can be read at:

www.lindau-nobel.org/blog-eight-lessons-from-the-69th-lindau-nobel-laureate-meeting/

History Commemorated

On 30 September, as part of the celebrations of the 150th anniversary of the IOM3 and its precursors, Serena Best, currently President of the Institute, presented a "plaque" to Head of Department Paul Midgley in recognition of the long period (37 years) over which the Department's undergraduate courses have been accredited by the Institute. Those currently most heavily involved with running the Department's undergraduate teaching joined them to celebrate this achievement.

GAPSTI

The Gianna Angelopoulos Programme for Science, Technology and Innovation (GAPSTI) is a major new research and teaching programme focused on the intersection of academic research and industry. In collaboration with the Department of Physics, it will drive the generation of new scientific knowledge and industrial collaboration in the fields of Computational Multiphysics, and Energy Materials and Devices. The Programme will additionally strengthen research and educational connections between Cambridge and Greece. The programme currently supports PhD studentships within the Centre for Doctoral Training in Computational Methods for Materials (directed by James Elliott) and four new University Lectureships, one in our Department (Bartomeu Monserrat, in Computational Materials Science), two in Physics and one in Engineering.

Equality, Diversity and Inclusion (EDI)

The Department is actively committed to providing a supportive environment where all students and staff feel able to succeed. In recent years, the EDI forum has stimulated discussion and sparked new initiatives such as Materials Faces and the establishment of a postdoc committee. Moving forward, the forum will be supported by a formal EDI committee and our Wellbeing advocates (James Hope, Tony Fox and Sohini Kar-Narayan), as we continue to value and nurture our diverse community.

In parallel with this Rachel Oliver has been appointed one of two EDI Champions for the whole School of Physical Sciences. Their role is to help promote equality and diversity across all the school's activities including teaching, research, recruitment, promotion and external relations.

Welcome

At the beginning of January we welcomed Nalin Patel to follow Rachel Hobson in overseeing Industrial Relations, helping with Material Eyes and doubtless other tasks that will come his way in due course! Nalin is already very familiar with the West Cambridge Site; he joins us from the Winton Programme for the Physics of Sustainability where he was Programme Manager.

Making MSM Green

A committee including students and staff members has been assembled to address sustainability in the Department. They are working within the framework of the Cambridge Green Challenge to reduce the environmental impact of life and research in the building. First actions included the clarification of the procedures for waste collection and recycling, the trialling of a recycling scheme for laboratory gloves, and the provision of more vegetarian food options in the Common Room. More initiatives will be underway soon and the committee welcomes suggestions of other issues to work on, as well as people interested in contributing: get in touch at green@msm.cam.ac.uk!

Weathering Change

When Penny Endersby (then Penny Corran, Newnham [1988]) graduated in Materials Science & Metallurgy in 1991 she did not anticipate that by the end of 2018 she would be Chief Executive of the Meteorological Office. As an undergraduate she was sponsored by British Gas and worked for them each summer, twice in marketing and finally on corrosion of heat exchangers for boilers with synthetic flue gas condensate. Following graduation, she continued with British Gas, working on solid oxide fuel cells. She joined the Royal Armament and Research Development Establishment (RARDE) in 1993 and, acquiring a qualification to fire explosives, she developed expertise in so called electric and intelligent armours, which react very rapidly to an attack to minimise its effectiveness. This work involved hydrodynamic modelling of the response of metals to explosions. Slowly but surely she and others began to recognise that she had managerial as well as scientific strengths and in 2009 she became a department manager at the Defence Science and Technology Laboratory (DSTL), an organisation created from RARDE and a number of kindred establishments.

At DSTL her focus moved to cyber security and in 2015 she became head of the Cyber and Information Division of DSTL, later becoming Acting Chief Technical Officer. Along with honing her managerial skills this provided significant background in high-level computing, important preparation for her (then unanticipated) move to the Met Office. One of her early achievements there has been to win funding for a new super-computer. This will enhance the Met Office's use of advanced mathematical modelling techniques which use very large amounts of data to increase the accuracy of weather forecasts. With ever-increasing understanding of the processes underlying global weather the principal model is upgraded two or three time a year. The new supercomputer will also enable the Met Office Hadley Centre to continue to investigate the potential consequences of climate change by developing and using models that look very much further ahead than the coming weeks. Acquiring data for predicting the weather, be it tomorrow or in a century, involves collaboration with colleagues around the world and the Met Office is a major player on the global meteorological stage. Overseeing the smooth running of this essential activity is just one of Penny's many duties and in this connection she is the UK's Principal Representative to the World Meteorological Organisation. Within the Met Office she is seeking to develop a unifying strategy focusing on ends, not means, giving the Office a new purpose "helping you to make better decisions to stay safe and thrive", which necessitates always thinking about what the users of their forecasts are going to do when they receive them. Another of her aims is to increase the diversity amongst Met Office personnel in respect of numbers of women and numbers of BAME staff. As in her previous leadership roles, alongside these aims she will seek to create "conditions wherein scientists and scientific excellence can thrive". She also recognises that encouraging people to aim high carries with it a responsibility to advise about possible failure. One great change in moving to the Met Office that she aims to exploit is that public engagement about the organisation's work is encouraged.

Looking back on her undergraduate days Penny recalls that perhaps the greatest shock was having to tackle questions for which there was no "right answer" and she regrets the lack of encouragement for women to learn about becoming leaders, a lacuna she has impressively overcome. She has an on-going connection with Cambridge as an Honorary Associate of Newnham College. The Associates, who become "Honorary" after completing ten years in post, offer members of the College help in a range of ways including advice about careers or arranging work-shadowing. She is also a member of a group of the Associates who are advising the College on ways in which it can contribute to the University's overall Cambridge Zero target. A Royal Academy of Engineering Visiting Professorship of Electronics and Computer Science at the University of Southampton provides another connection with the academic world. In addition, as part of her work at Southampton, she is a mentor for the university's start-up incubator Future Worlds, for which her experience as a non-executive Director of Ploughshare, the MoD's technology transfer organisation, is particularly helpful. Between academia and the wider world she has served a stint on the Council of the Institute of Physics.

Penny is married to Alastair (Corpus Christi [1987]), a History teacher, whom she met on her first summer vacation job with British Gas; they have two children of university-age, both keenly musical. As the photograph illustrates, she greatly enjoys outdoor activities including walking on Dartmoor - for which accurate weather forecasts are highly desirable! Her interest in wildlife, especially birds, and the response to seasonal and climatic variations, was one of several factors that attracted her to the Met Office job; its location in Exeter provides an excellent base. It also led to her becoming a trustee of the Wiltshire Wildlife Trust. A much enjoyed indoor activity is choral singing, not least as a volunteer in Exeter Cathedral.

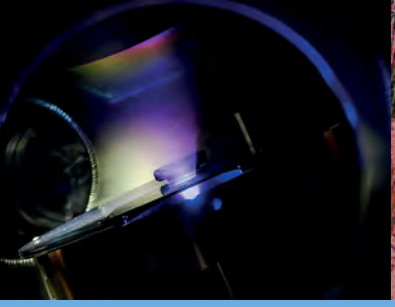
In short, notwithstanding the highly competitive application process, she describes her (inevitably demanding) Met Office job, as fulfilling many of her criteria: "the perfect job at the perfect time".

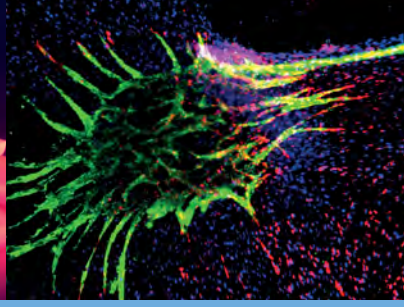
Beyond Materials Science

Members of the Department continue to contribute at a high level to co-curricular activities. Larkin Sayre and Tricia Smith were again selected for the CUWBC squad that had been preparing to face Oxford in this year's Boat Race (cancelled alas) while Gates scholar Jamie Cyr has played regularly for the Women's Blues soccer team.

Sustainability & Packaging (CAMatNet)

The use of fossil-based feedstocks for over 90% of plastic packaging represents a significant problem from both waste management and energy usage viewpoints. The most common methods of disposal, incineration and land fill (a.k.a. "cold incineration"), both release carbon back into the environment, albeit over different timescales, and usually do not recover a significant fraction of the energy used in the synthesis and processing of the plastics. For food packaging, in particular, contamination from food waste, dissimilar plastics and non-plastic materials can cause problems with the quality of recycled material produced. To discuss how to overcome these problems and move away from our current reliance on fossil-based feedstocks, the Department had planned a CAMatNet meeting in April to discuss the role of sustainable materials and packaging but it has been postponed because of Covid-19.



Process Control

The Process Laboratory is an essential component in the Department, used by many in their research and teaching. Key to its facilities is Sue Gymer, who maintains equipment and assists users, as well as holding some broader roles within the Department.

Sue lists an impressive and varied range of previous scientific experience. For example, she has worked as an analytical chemist, has run science laboratories in secondary schools, and has been employed by Goodfellow Metals, and by Marconi. This diversity has given her a broad and strong knowledge base, as well as experience with students (and those who teach them!). She has a long history of working within the University, including a stint as Chief Technician in the Chemical Engineering Department when it was in close proximity with our own Department on the New Museums Site. This sometimes involved collaboration (and disaster mitigation, in the case of occasional flooding!), and she has happy memories of working with our former, much-loved, Chief Technician, Dave Duke.

The Nanoscience Centre and various Groups in the Physics Department have benefitted from Sue's employment, and she has gained some core expertise with, for example, electron microscopes, X-ray diffraction and lithography equipment, alongside general vacuum technology, gases, chemical handling, plasmas, and furnaces. Her move to the Process Laboratory here in the Department, replacing Kevin Roberts on his retirement, required some new skills (just for example, vacuum plasma spraying), and she now takes great satisfaction in helping and supporting others to use the lab and the equipment there.

Besides directly supporting many groups in the Department whose larger equipment is located in the Process Lab., Sue finds herself deluged once a year with nearly 300 first-year students (not all at once, but in batches of about 50!) to demonstrate swaging. There's also metal casting with the third-years (see figure below from a casting practical), and much interaction with Part III students working on their projects.

She's the 'go to' lady for gases across the Department (cylinders, regulators and all the fittings), for the use of heat treatment facilities, and for much, much more! She's also a valued First Aider, and has held the qualification for working with HF for many years, allowing the Department to maintain a facility for its use.

Passionate about equality of opportunity, Sue is a very active member of the Department's Equality and Diversity group. She is happy to acknowledge that her own career was greatly boosted by the 'Springboard' course (a personal development programme for female staff) which gave her the confidence to apply for her earlier post in Chemical Engineering. She is very keen to encourage others to be confident and to go for the opportunities available to them. Her own experience has informed her that the perception of the University as a place for only high-flying academics can be off-putting, and is quite wrong. On the contrary, it is absolutely dependent upon the employment of a wide spectrum of non-academic staff.

Outside of work Sue has been a busy County Councillor, and is a trustee of Cottenham Community Centre. She has three children, of whom she is deservedly very proud, and lives with her husband and their 'rescue' dog, Coco, from the Wood Green Animal Charity. She loves gardening (and has an agreement with Coco about a dog lawn for the necessities!).

Congratulations

Thomas Bennett, Philip Leverhulme prize for Chemistry
Serena Best, Royal Academy of Engineering Armourers and Brasiers' Company Prize, 2019
Anthony Cheetham, Knighthood for services to Material Chemistry, UK Science & Global Outreach
Manish Chhowalla, IOM3 Griffith Medal & Prize; and The Charles Hatchett Awardt
Judith Driscoll, ERC Advanced Grant
Robert Hoye, Institution of Engineering and Technology Sir Henry Royce Medal; Lectureship at Imperial College, London
Tahmida Huq, Margaret B. Day Prize, from the British Federation of Women Graduates
Bartomeu Monserrat, JPhys Materials Emerging Leaders 2020

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Images, top from left to right: Plasma Laser Deposition of Lithium for solid state batteries, © Adam Lovett; Dried solvent deposits on an in situ TEM chip, © Jedrzej Morzy; Luminescent solar concentrators for solar-harvesting, © Morton Lyu; Structures created by human dermal microvascular endothelial cells co-cultured with primary human osteoblasts, © Nima Meyer