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When St Mary's Medical School alumna Dr Jean Alero Thomas sadly passed away in 2015, she left a legacy gift to set up a research Scholarship for students in the Faculty of Medicine.

Eleanor Sabey is a Research Postgraduate in the Department of Metabolism, Digestion and Reproduction. In 2021, she was awarded the Dr Jean Alero Thomas Scholarship to study for an MRes in Biomedical Research.

Eleanor grew up in a town near Gatwick with her mum who was an NHS dietician. She says, "at secondary school, classroom disruption was abundant and resources were few and far between. This made me even more grateful for access to outstanding facilities and equipment once I reached university. My family always taught me to appreciate the value of education, therefore they were very excited when I told them I would be studying at Imperial."

The impact of legacy gifts

She goes on to say, "Legacy gifts are such a generous form of donating and are deeply appreciated by those who are supported by them. The Dr Jean Alero Thomas Scholarship has had a profound effect on my ability to study and live in London.



Eleanor, Research Postgraduate in the Department of Metabolism, Digestion and Reproduction

It has furthered my personal independence and allowed me to meet a vast range of people. This has made my time at Imperial so much more immersive. When I received the support, I was elated, relieved, and felt more confident in my ability to pursue a career in STEM. This gift has given me access to an excellent education, opportunities and a promising career in the future."

Eleanor plans to continue pursuing a career in biomedical research and hopes to study for a PhD in the future.

“When I received the support, I was elated and felt more confident in my ability to pursue a career in STEM.”

Eleanor, MRes in Biomedical Research

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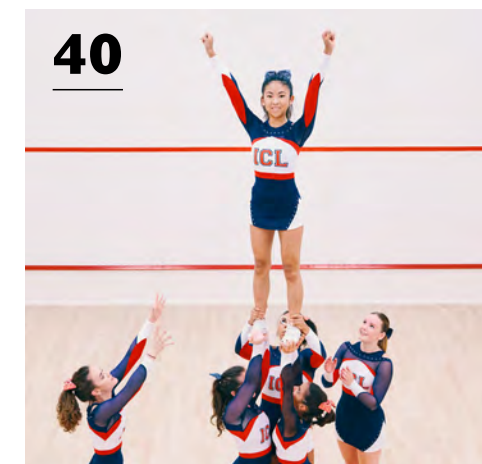
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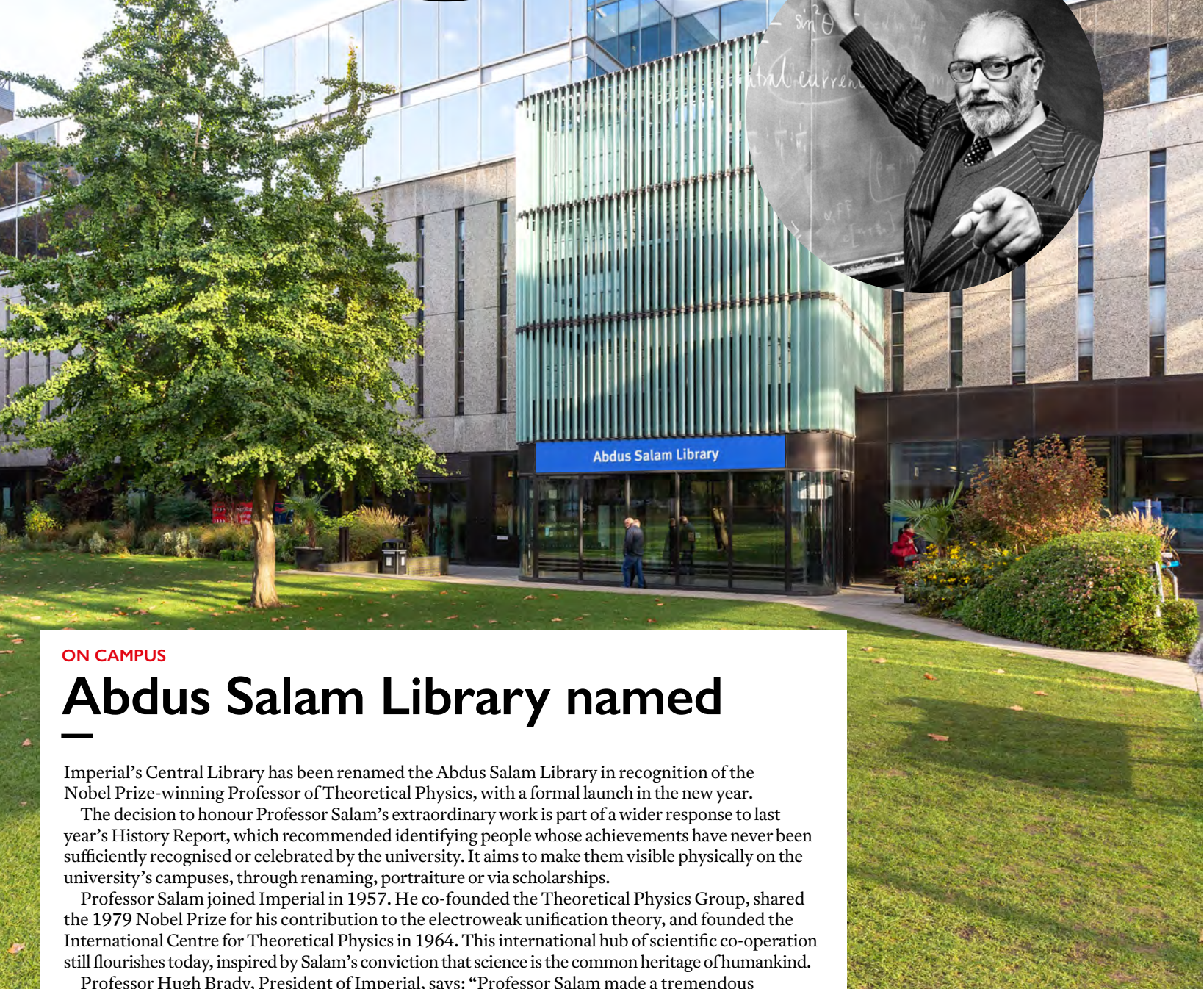
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DIGEST



ON CAMPUS

Abdus Salam Library named

Imperial’s Central Library has been renamed the Abdus Salam Library in recognition of the Nobel Prize-winning Professor of Theoretical Physics, with a formal launch in the new year.

The decision to honour Professor Salam’s extraordinary work is part of a wider response to last year’s History Report, which recommended identifying people whose achievements have never been sufficiently recognised or celebrated by the university. It aims to make them visible physically on the university’s campuses, through renaming, portraiture or via scholarships.

Professor Salam joined Imperial in 1957. He co-founded the Theoretical Physics Group, shared the 1979 Nobel Prize for his contribution to the electroweak unification theory, and founded the International Centre for Theoretical Physics in 1964. This international hub of scientific co-operation still flourishes today, inspired by Salam’s conviction that science is the common heritage of humankind.

Professor Hugh Brady, President of Imperial, says: “Professor Salam made a tremendous contribution to Imperial, as well as to the world of physics and science more generally. It is right that we do more to celebrate this legacy. I hope the new Abdus Salam Library inspires many more people in the years to come.” ♦

WRITE TO US

Letters

Join the debate and share your news and views.



Reflections on AstroSoc

Reading about AstroSoc (Imperial 54) reminded me of time spent on the Blackett Laboratory roof with what looks very much like the same telescope during April/May 1983, in my first year Physics project.

We were taking pictures of the sun, with a 99.9% reflecting filter on the front of the telescope, using ultra-slow black and white film in an old Soviet Zenith SLR camera. The aim was to use the movement of sunspots on the sun’s surface to estimate the rotation period of the sun.

It was surprisingly hard to spot the sun and I think the clouds only parted for four or five days, but the data collected was enough to get a reasonable estimate. I remember, after several difficult calculations using a rudimentary homemade radio telescope, my friend worked out that he had located the sun – which I enjoyed pointing out to him on a rare cloud-free day.

Since leaving Imperial, I qualified as a physics teacher, a fabulous job that has taken me all over the world, facilitating learning in highly motivated, able learners in the subject I love.

*Neil Hodgson
(Physics 1985)*



PHOTOS: ALAMY; THOMAS ANGUS. ILLUSTRATION ABOVE RIGHT: MIKE LEMANSKI



Farewell to Nicola Pogson

This autumn, Nicola Pogson, Director of Alumni Relations, retired after 17 years of service at Imperial.

During her time here, Nicola helped to nurture the vibrant and welcoming alumni community we know today, including through this magazine. She instigated the launch of Imperial’s Alumni Awards, oversaw more than 1,244 alumni events (with more than 20,000 attendees), and through the Alumni Visitor Centre, welcomed more than 37,000 alumni visitors back to campus.

She has been a tireless advocate for alumni at Imperial, and has always gone the extra mile to make sure that they feel valued and appreciated. She will be missed by her colleagues and the alumni community alike.

We hope she continues to enjoy reading the magazine in retirement and look forward to her visits here on campus.

*Michael Murphy
Vice President (Advancement)*

Corrections and clarifications

In Issue 54 (Trailblazers), we said that Carolyn Hansson studied at the “Royal College of Mines”. Of course, as many of you emailed to tell us, this should have been the Royal School of Mines.

And from Imperial on X....

✂ *We’ve been awarded Gold in the 2023 Teaching Excellence Framework (TEF) in recognition of our quality of teaching. 🏆👏 This would not be possible without our community, who through innovation and support, have transformed Imperial’s educational experience.*

✂ *It’s finally here... Commemoration Day 2023! Have fun, take lots of photos, and celebrate – today is your day. We wish you every success as you embark on a future filled with endless possibilities. 🎉🎓*

CONTACT US

Keep up with the latest from Imperial and share your thoughts and news. Please mark your message ‘For publication’. Messages may be edited for length.

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FROM THE PRESIDENT / PROFESSOR HUGH BRADY

Excellence, commitment and ambition – we have a lot to be proud of



My first year at Imperial has been truly inspirational. Our dedicated community seeks to answer some

of the world’s toughest questions, and this issue shines a light on the fascinating and important work of our students and staff.

As you’ll read further, they are investigating new ways to prevent preterm births and how to create sustainable new catalysts. You can also see inside our state-of-the-art Facility for Imaging by Light Microscopy, where scientists are using the very latest imaging technology to investigate malaria parasites, cancer treatments, brain neuron biology and nanoparticles, to name but a few applications.

We have a lot to be proud of. Earlier this year, Imperial rose to eighth in the world in the *Times Higher Education* world rankings, complementing our sixth place in the QS World University Rankings, and was awarded Gold in the Teaching Excellence Framework. These accolades are testament to the excellence, commitment and ambition of our entire community.

You’ll remember from experience, as I do, that university is about more than formal education and research. It provides a wonderfully rich and exciting environment for students and staff to try new things and make new friends. At Imperial we have student clubs, societies and projects, such as cheerleading (page 40) and inline skating (page 48), that add to our spirit of community and collaboration. I am proud to celebrate their successes alongside our academic achievements.

We love hearing stories from your time at Imperial. In this issue there are some fascinating anecdotes from alumni who managed to get down in the underground service tunnels –

including Alun Kimbur who was there in 1980 when the nearby Iranian Embassy was stormed by armed men. Today, these tunnels are inaccessible to students and are the site of a transformative decarbonisation programme for the South Kensington campus.

I’ve enjoyed meeting many of our alumni around the world this year. Your success stories serve as an inspiration for our current students, and I thank you for your continued advocacy and support for Imperial. In this edition, you can read more about three inspiring alumni who are using their experiences in STEM to engage, educate and empower others. Lean In are empowering women in male-dominated sectors to build a sustainable future; BBSTEM are campaigning for balance and representation of Black individuals in STEM; and Native Scientists are connecting scientists and children, particularly children from underserved communities.

Our dedicated community seeks to answer some of the world’s toughest questions

Imperial is a future-focused university looking to solve the major challenges facing humanity and our planet. Our overarching ambition is to build on Imperial’s past achievements and impressive current international positioning to realise our full potential as a force for good in the UK and wider world. Imperial’s star is rising with great momentum, and we have a powerful story to tell the world as we launch our ambitious long-term strategy in the first quarter of 2024. ♦

> *Professor Hugh Brady is President of Imperial College London.*

PHOTOGRAPHY: IMPERIAL COLLEGE LONDON/THOMAS ANGUS

APPEAL

Fleming Centre appeal launch

Imperial College Healthcare NHS Trust and Imperial College London have launched an appeal, with Prince William as its patron, to build a centre devoted to tackling antimicrobial resistance. Named the Fleming Centre, it will be based at St Mary’s Hospital in London – where Sir Alexander Fleming discovered penicillin a century ago.

Antimicrobial resistance is an urgent global threat that already kills around a million people every year – and could lead to ten million deaths a year by 2050 if no solution is found.

Evidence and co-design will be at the heart of the Centre, says Professor the Lord Darzi of Denham, Chair of the Fleming Initiative. “We’re making behavioural science and public involvement the cornerstones of the radical change that’s needed to influence individual behaviour and policy decisions.”

We’re making behavioural science and public involvement the cornerstones of the radical change needed

OBSTETRICS

UK’s first womb transplant

A team co-led by Imperial Professor Richard Smith has performed the UK’s first womb transplant. Both the woman who received the womb and her donor are recovering well.

The operation has given the recipient the possibility of getting pregnant and carrying her own baby. She is one of the one in 5,000 women in the UK who are born without a viable womb and are unable to conceive and carry their own child. Many other women have had to have their womb removed following illness.

Professor Smith (below), who is based at Imperial’s National Heart and Lung Institute, paid tribute to the donor. “This is only possible thanks to the recipient’s sister, who came forward and was willing to donate.” All being well, the recipient will undergo an embryo transfer later this year.



PHOTOGRAPHY: WOMB TRANSPLANT UK



The Hitchhiker’s Guide to the Galaxy says 42 is the answer. But what is the question? For Dr Chris Timmermann, it is: Can psychedelic compounds help us better understand the human mind?

The past few years have seen increased interest in using psychedelic drugs to treat conditions such as PTSD, anxiety and depression. But if these drugs are to be effective, says Dr Chris Timmermann (PhD Brain Sciences 2020), we must first answer fundamental questions about how they work.

Timmermann’s DMT Research Group examines the effects of dimethyltryptamine (DMT) – a hallucinogenic drug that induces highly vivid, visual worlds in which people feel they are in an alternative universe, dimension or reality. “We found that DMT disrupts the systems and networks in our brains related to the way we interpret the world,” says Timmermann. “By finding out how to deconstruct these networks, we can potentially work out how to build new ones.”

Researchers no longer see the brain as a passive receiver of the external world, he points out. “In fact, our brains construct narratives – for example, our sense of self and identity, the stories we tell ourselves about ourselves. We can think of depression, for example, as harmful narrative that has become crystallised over the years. Psychedelics are capable of radically altering those narratives. So when we learn about these things, we also understand better how we can develop further tools with psychedelics to help people with depression, anxiety or PTSD, or potentially increase wellbeing in already healthy individuals.”

Timmermann will investigate a similar compound, 5-MeO-DMT, found in the venom of *Bufo alvarius*, the Colorado River toad: the drug is reported to ‘dissolve’ the self. “It can disturb the system so that people just have an experience of being alive and nothing else,” he says. “So it could allow us to understand: what are the minimal requirements in the brain for us to have an experience at all?”

> *Dr Chris Timmermann is a Research Associate at the Centre for Psychedelic Research.*

ADVENTURES IN... MAGIC

Tricks of the trade

As Imperial's Magician in Residence, Dr Will Houstoun is working with students on the crossovers between magic and medicine.

Words: **Clare Thorp** / Photography **Angela Moore**

Below:
Dr Will Houstoun is on a mission to show that magic can be much more than trivial light entertainment.



As a professional magician, Dr Will Houstoun is used to people thinking that he's in the entertainment business. "People often think that magic can only be trivial light entertainment," says Houstoun, Magician in Residence at Imperial. "Being able to show that there is a depth to it, and that it's something that can inform very different practices

in a beneficial way, feels really exciting to me." Houstoun — who fell in love with magic as a child — originally pursued a 'proper' career, studying for a degree in mechanical engineering. "At the end of my degree, I decided that I liked magic more than engineering." He later completed a PhD on the use of magic as an educational tool in the Victorian period. "All of the work that I now do flows out of the idea of using magic as a tool to achieve something other than mere entertainment," he says.

For the past decade, Houstoun has been working with Imperial's Professor of Surgical Education, Roger Kneebone, to explore the intersection between magic and medicine. The starting point? Both magicians and surgeons practise a complex, technical and dexterous skill. But over the course of their collaboration, a more significant parallel has emerged: that of interaction with an audience, whether that's somebody watching a magic trick or a patient in a medical consultation. In fact, magic performances and medical consultations often have a similar dynamic. "One kind of magic is done close up, for one or two people. There's a massive power imbalance because you know how the trick is done and your audience doesn't. To engage meaningfully you have to quickly build rapport and let them know that magic will be a safe and fun experience." Likewise, in a five-minute consultation, a GP needs to build trust with their patient and build a connection quickly to generate the best outcomes.

The doctor-patient relationship is a vital part of being a GP, but one that can be challenging to teach. Students need to

realise that having all the required medical knowledge is only part of the equation — just as, in magic, knowing the secret of the trick is just one part that must be supported by being able to perform in a way that everyone can enjoy. Houstoun and Kneebone run sessions where students learn to perform a magic trick for an audience, then think about what they can take away from the experience and put into a medical context. "It allows people to make discoveries about the way they interact in a playful environment," says Houstoun.

As well as his work at Imperial, Houstoun also works with Breathe Arts Health Research, an organisation that uses magic to help young people with hemiplegia, a condition that causes a partial paralysis on one side of the body and issues with fine motor skills and co-ordination. "They come for a ten-day magic programme, and each trick they learn includes actions that will help them in day-to-day life. For example, they might practise a trick that involves picking up things with their first finger and thumb, which translates into being able to do up buttons on a shirt."

Performing magic and medicine has similar dynamics — although the practitioner holds all the power, without trust neither works properly

When he's not working in the medical sphere, Houstoun also uses magic to help film, TV and theatre practitioners tell stories. He developed the magic for Martin Scorsese's *Hugo*, taught Mark Rylance to perform a card trick for BBC1's *Wolf Hall* and is co-designing the magic for The National Theatre's production of Road Dahl's *The Witches*.

"There are always interesting problems to solve in my job. One day it might be helping students to think about the importance of doctor/patient interaction, the next it might be working out how to change children into mice onstage." ♦

> *Dr Will Houstoun is Imperial's Magician in Residence.*

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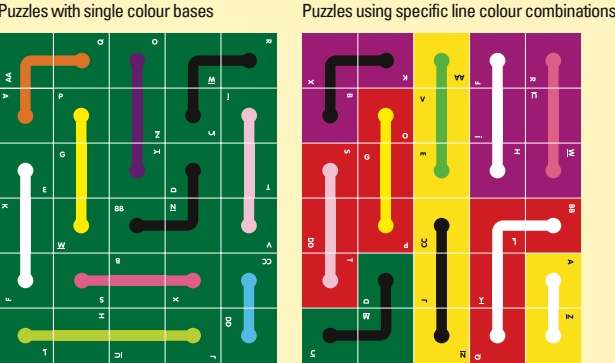
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Martin Gardner, a world-famous mathematician and scientist once wrote an article in 'Scientific American' magazine, expressing his regret that the '30 colour cube' principle had never been turned into a commercial set of challenges. At around the same time, one of the world's leading puzzle inventors, Ivan Moscovich, created a series of picture puzzles that used the 30 cubes.

Moscovich sent his creation to Gardner, who responded by saying that it was his belief that every puzzle lover and mathematician would one day play Moscovich's creation with their children, family and friends. In March 2017, Moscovich, at the age of 91, and founder of The Happy Puzzle Company, Gavin Ucko, sat in a London hotel looking at ways to turn

Moscovich's original idea into a commercial puzzle for generations of parents and children to enjoy. The result, less than six months later, was this extraordinary collection of colourful challenges that will improve the mathematical and thinking skills, logical reasoning, spatial awareness, sequencing and visual perception skills of both adults and children.

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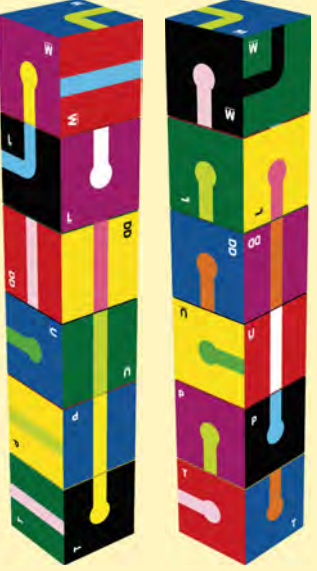


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EDUCATION – JOYCE KADIBU, SOFTWARE DEVELOPER APPRENTICE

I chose an Imperial apprenticeship – and amazing things happened!



When I was about 17, I remember thinking my life was at a bit of a crossroads. I was being pushed into applying for university – I was offered a place to study law at Warwick University – but I wasn't convinced it was for me, and I saw it as a bit of a safety measure. Instead, I took a gap year to try and explore various different industries and avenues and figure out my options.

After researching the tech industry, the idea of an apprenticeship really started to grow, and I was drawn towards Imperial's software engineering scheme. I kept hesitating to apply and would say to myself: 'No, I'm not smart enough to get in; they'll never accept me.' And then on the day of the deadline, I couldn't sleep at all. I woke up at 3am, finished the application, sent it off and went back to bed. The same day they sent me an interview offer.

I'm now just over a year into the 18-month scheme, a blend of practical on-the-job experience and studying, and I couldn't be happier. I'm heavily involved in designing, building and deploying websites and apps, and recently I am one of the main developers on a project to build a new website for Imperial's Summer School. It's so exciting to know that people will be interacting with my work even if they don't know who's behind the building of the app or website. It means I have to spend time thinking about what the perspective of the children using these products is like, and it's pretty cool to know that what I'm creating is going to be part of their educational journey.

Sometimes seeing my friends who live on campus reminds me of how different the path I took could have been. It feels like I'm still doing the university experience – I'm in the gliding and surfing societies, for example, a great way to get away from my computer and into the outdoors – but with a few more added responsibilities. The sports are fun but I really value the chance to meet other

Imperial people outside of the campus and maintain friendships that way too. There are so many different communities – I'm quite mixed in with them all and I've made so many friends on campus, including students as well as other staff.

Also, obviously I have the benefit of studying in a university environment while being paid for it. This gives me a lot more reassurance about my future, as it means I can build something financially comfortable from the beginning of my career. When I do think about what it would have been like to go to university,

I'm still doing the university experience – but with added responsibilities

it's the financial part that reminds me that I made the right decision.

The apprenticeship programme I'm doing is fairly new and I've had to explain how it works to many people, but everyone has been really open to the idea that you don't have to follow a conventional academic path and there are other avenues you can take on your educational journey. That's a key message, and I'd urge others to explore the options.

Initially apprenticeships were never really in the foreground for me, but when I started exploring what career options there were, I quickly realised that gaining experience alongside the learning was the most viable option for me. And the apprenticeship has also changed the way I approach life in general. Every time I hesitate, I remember that I got this opportunity and so it doesn't hurt to try and put my name forward for something else. Amazing things have happened, and I hope that doesn't stop any time soon. ♦

> *Joyce Kadibu is a Software Developer Apprentice, Information and Communication Technologies.*

INTERVIEW: DHRUTI SHAH

IN BRIEF

Imperial researcher awarded £1m for magma-mapping project
Dr Fiona Simpson has won an Independent Research Fellowship from the Natural Environment Research Council to produce new models of magma flows beneath Scotland, Iceland and Greenland. It aims to solve questions about how Iceland's volcanism originated. bit.ly/imperial-55-magma

Imperial celebrates London top spot
Imperial is now the top London Russell Group university for student satisfaction with teaching, and second among all Russell Group institutions nationally for teaching, according to the 2023 National Student Survey. The university has also ranked first in overall student satisfaction among London Russell Group universities. bit.ly/imperial-55-nss

Maths School opens
The Imperial College Maths School, which aims to ensure that brilliant young people from all backgrounds have the chance to excel in maths and science careers, has welcomed its first group of Year 12 students. bit.ly/imperial-55-maths

OVERHEARD ON CAMPUS

***FireDrone:** this heat-resistant drone can withstand temperatures of up to 200°C for ten minutes, allowing it to enter burning buildings or woodland. Currently in prototype at the Aerial Robotics Lab, it could be sent into fires to assess danger and provide crucial data to first responders.*

***Bisexual monkeys:** male macaques frequently mount each other, a study from the Georgia Mace Centre for the Living Planet has found. It also observed that same-sex macaque partners supported each other when conflicts arose, giving them an advantage within the group.*

***Creative thinking:** more than 400,000 learners across the globe have now enrolled on Imperial's Creative Thinking MOOC. "Creativity is a resource," says course creator Professor Peter Childs. "We are all creative and have scope to be more generative and effective in our activities."*

MAIN PHOTO: DAVID PRATT

A WORKING LIFE

Under the surface

Volcanologist Professor Sir Stephen Sparks says technology is a brilliant help, but he still can't do without just two simple tools.

Interview: **Helen O'Hara**



The technology around monitoring volcanoes has developed significantly over the years I've been studying them, but there are two simple things I can't do without: a hammer and a hand lens. Seismometers, GPS and all sorts of wonderful instruments are brilliant, but I'm a geologist, so I'm always collecting rocks and looking at minerals, which I take back to the lab and analyse.

I got my first hammer when I was going around North Wales and Chester as a teenage schoolboy. You can buy them on the internet these days, of course, but there used to be a geology store in London where you could buy a hammer and get a good hand lens. Or camera shops sometimes have lenses. But a hammer for breaking rocks is essential.

My favourite days are when I go out to work on volcanoes, as you're often in wild places. I worked a lot in the high Andes – in Chile and a little bit in Argentina – where the landscape is truly spectacular. And for different reasons, working on the eruption of the Soufrière Hills volcano in Montserrat was another favourite period of my career.

The first trip I ever did to an active volcano, as an undergraduate at Imperial, was to Iceland to do some mapping. During my PhD I visited southern Iceland on the little island of Heimaey when it erupted. That was a fantastic opportunity to do some really interesting science. I also worked on the lava flows at Mount Etna and a little bit on Stromboli. But the eruption of the Soufrière Hills volcano was such a major event. I spent several months on the island in the first three years of

the eruption. That was the first time I'd really been involved in applying the science, in helping set up a volcano observatory and being in the forefront of the management of the emergency.

Strangely, I never felt in danger on the Soufrière Hills. We got used to the patterns of volcanic activity, so that meant we could identify periods when the risk would have been too high, and other periods when we thought the risk was low that we could get quite close to take samples and make measurements. During an eruption, rocks offer tell-tale signs of change, so my hammer came in useful.

I worked in a university setting for most of my career, so I did the usual combination of teaching and research. But I've always built in fieldwork, and I've been lucky because the applied side of my work is not just the active volcanoes. I have also researched radioactive waste disposal, and worked with the mining industry. A lot of metals and minerals are mined from old volcanoes and the structure of the volcano determines where the minerals are.

The fantasy version of volcanology says that we do lots of dangerous things and dress up in silver suits and abseil into craters. But you don't achieve a lot of particularly useful science by doing that. Nowadays, drones or satellites can make many measurements for you, so you don't need to take risks. Just head out with a hammer – at a safe distance. ♦

> **Professor Sir Stephen Sparks** (*Geology* 1971, *PhD* 1974) is one of the world's leading volcanologists and winner of Imperial's Distinguished Alumni Award 2023.



Clockwise from top: Fieldwork in northern Chile in 2002, repairing a road with postdocs and PhD students; Sir Stephen during fieldwork in Dominica in 1977; explaining geology in the Lake District in 2009.

Below: Laurence Gesman on the corner of Cromwell Road in front of the Natural History Museum.



A doctor who left school aged just nine. A mathematician determined to continue her work against the backdrop of a brutal war. A design engineer longing to gather the world's expertise. And a neuroscientist trying to unlock the secrets of dementia on a laptop so old it's falling apart. What do they have in common? All of them want to change the world – and none of them would be at Imperial had it not been for a scholarship or bursary.

Words: **Lucy Jolin** / Photography **Dunja Opalko**

“As a world-leading university, but also the UK’s only specialist university in science and technology, our success relies on our ability to attract the very best people to work and study here,” says Professor Peter Haynes, Vice-Provost (Education and Student Experience). “That’s why we offer opportunities to talented students from all backgrounds – whether that’s students in the UK who come from under-represented communities, international students who excel in their field but may not have the funds to study here, or students from displaced communities. We spend more than £10 million a year on our Imperial Bursary for UK undergraduates alone, and have numerous other schemes for both undergraduates and postgraduates from all over the world.”

The life-changing chance to study at Imperial is, of course, the central reason why scholars come here. But scholarships and bursaries allow them to do so much more. “They can experience London and all its opportunities, and play a vital role in the life of Imperial,” says Haynes. “We don’t want them to have to work alongside their studies, and while they enrich their lives, they in turn enrich university life. Our message is simple: if you are the brightest and best, we want you at Imperial, no matter where you come from.” These are their stories. ►

LAURENCE GESMAN ▲
(Medicine, Third Year)

I was 14 – and hadn’t been to school since I was nine – when I decided I wanted to become a doctor. I became fascinated with the Ebola epidemic and read everything I could find about it. But I was living with my father, who had not taken good care of me. I had no qualifications and no education.

Three years later, when I was 17, I left my father and went into care. But I was still determined to follow a career in medicine. Throughout all the adversity and disadvantage I faced, that dream was what drove me on. I went to sixth form college and took the GCSEs I needed, then the A-levels. It was hard work. When I got the offer from Imperial, it made all the effort worth it – but being awarded the Imperial Bursary made it possible.

As a care leaver, I receive £5,000 a year – the UK’s most generous bursary. Having the bursary has meant, for example, that I can join the rowing team – the first time I’ve ever been able to join a sports team in my life. It’s helped me with housing costs, so I didn’t have to work so much over the summer. So having the bursary has been very important to me.

The more I study, and the more clinical exposure I get, the more I know that medicine is what I want to do. I’ve never made friends like the friends I’ve made on my course. I’m in such a great place with my life, thanks to doing medicine with people who have similar ambitions, and who want to do good things in the world. Right now, I’m considering going into oncology and cancer research – but that may change, as I’m discovering new things every day!

Bursaries like this are so important, as they open up the medical profession to people like me. But, of course, the Imperial Bursary isn’t just for medics, it’s for any student at Imperial who fits the criteria. It means we can be part of this ambitious, visionary community – and we can worry a lot less and do a lot more.

RASIN WURIE ►
(MSc Applied Biosciences and Biotechnology 2023)

I’ve always been fascinated by the brain, the nervous system, and understanding the biological functions that make us who we are. That’s why I chose to study neuroscience at the University of St Andrews in Scotland where I became interested in neurodegeneration, and especially how it can affect so many different parts of the nervous system, from memory to movement. That led me to the exciting emerging fields of bioinformatics and synthetic biology – and to Imperial’s DeepMind Scholarship.

When I heard that I had won the scholarship, I just felt ecstatic, because I know how stressful it is when you’re trying to study under financial pressure. I had to work part time throughout my undergraduate degree and had just enough to cover my rent and basic living costs. Knowing that I wouldn’t have to worry, and could just focus on the science and my studies, was an amazing relief. The scholarship not only covers the full course and living costs, but also support for equipment – my ancient laptop was literally falling apart! – and conference attendance. I was able to attend the British Neuroscience Association’s conference in Brighton, which was fantastic: it gave me the chance to network with leading figures in neuroscience and learn more about advances in the field. Plus, it was inspiring seeing just how science happens and is communicated.

What I’ve loved most about my Imperial experience is engaging with people from different backgrounds and scientific disciplines and seeing how they approach a problem. I’m passionate about how interdisciplinary research can be used to advance science. In the future, I want to do a PhD exploring the genetic basis of neural degeneration, looking at understanding the causes and progression or identifying targets for treatments. And beyond that? Perhaps to go further into the question of whether ageing is a natural process or a form of disease. But above all, I want to do solid, useful research that will help improve lives. ►



When I heard I had won the DeepMind Scholarship I felt ecstatic – knowing that I could just focus on the science was amazing

Below: Rasin Wurie outside South Kensington Tube Station, where he grabs food after studies.



Below: Oksana Vertsimakha standing by the Serpentine in Hyde Park, where she enjoys hanging out.



I am so grateful to those kind people who donate to scholarships like Sanctuary, making it possible for me to contribute to research



OKSANA VERTSIMAKHA ◀
(MSc Statistics 2023)

I took my undergraduate and Master’s degrees in Mathematics and Statistics at the Taras Shevchenko National University of Kyiv. But I really wanted to pursue my academic career and study abroad. I was eager to experience an international scientific community and international-level research. So I applied to Imperial to do a second Master’s, and was accepted.

Then the war broke out. It was a very hard decision to continue studying, but I believed that as a researcher I would still be able to make the most of my abilities and life. It was already difficult arranging to study abroad: there were many administrative issues. But now, I couldn’t even get a student visa, as there were no visa centres operating in Ukraine. I just kept looking for a way and hoping. Luckily, I was accepted on to the British government’s Ukrainian sponsorship scheme, which allowed me to come to the UK, and I was awarded Imperial’s Sanctuary Scholarship – it felt like a miracle.

I have loved studying at Imperial. It has been fantastic to see such a high level of research going on, and to meet so many people involved in pandemic studies and biomedical research. But, of course, it has been a stressful year for me. Being able to live in London and not having to work in order to keep afloat has been wonderful. And I have had the opportunity to sing in the Imperial choir, volunteer, and to explore this great city. Having the Sanctuary Scholarship has been very reassuring for me in very difficult times.

Now, I have been offered an academic scholarship. I am about to start my PhD at Imperial, and I’m so excited about staying connected to the College in the future. I’m hoping to stay in academia, focusing on biomedical or environmental statistics. I am so grateful to those exceptionally kind people who donate to scholarships such as Sanctuary, who make it possible for people like me to contribute to scientific research.

CASSANDRA SEAH ▶
(PhD Design Engineering, Fourth Year)

When my beloved grandpa was diagnosed with dementia, I wanted to do something to help him. I was studying Product Design at Nanyang Technological University in Singapore, and doing undergraduate research on dementia games. Realising that such interventions could be improved, I set up a company to create multisensory rehabilitative games and installations aimed at enhancing the lives of seniors with dementia in nursing homes, hospitals and day care centres.

Wanting to research and develop interventions for people like my grandfather, I hoped to study at Imperial. However, it was extremely expensive, but my dream was realised when I was awarded the President’s PhD Scholarship.

I realised that mindfulness could bring benefits to both the caregiver and the person with dementia, and I wanted to bring them some form of comfort and reduce their stress and worries. As both go through each stage of the disease, it is demoralising on the emotional, intellectual and physical level, with more challenging and extremely stressful, uncertain situations to cope with.

So for my PhD, I’ve developed innovative interventions, using conversational agents such as Alexa to bring mindfulness to dementia patients and their caregivers. I have worked alongside them for the past four years, and developed five mindfulness activities, carefully designed to consider content, difficulty level, diction, tone, flow and resulting experience.

It’s been an eye-opening experience to be exposed to so many different cultures and, at the same time, find so many like-minded people to connect with. I made so many close and dear friends who I speak to every day, even though I’m now back in Singapore. Without the President’s Scholarship, I would not have had the opportunity to go deeper into this work, which I believe will add to the growing field of improving the lives of persons living with dementia, and their caregivers. ♦

**YOUR SUPPORT
FUELS EXCELLENCE**

Imperial relies on the generosity of donors to give outstanding scholars the opportunities they deserve. Such donors include, of course, Imperial’s incredible alumni community, who continue to support Imperial long after graduating. We work closely with donors to find the best and most effective ways to use your gifts to provide life-changing opportunities for students and enable them to flourish at Imperial. If you are interested in donating to an Imperial scholarship or the Imperial Bursary, please contact Anna Wall (giving@imperial.ac.uk) to find out more.



Above: Cassandra Seah, who is writing her thesis in Singapore, outside the Thian Hock Keng Temple with her golden doodle.

Words: **Ute Eberle** / Illustration **Lisa Sheehan**

Agents of change

CATALYSTS ARE ONE OF CHEMISTRY'S MINOR MIRACLES: SAME RESULTS IN

HALF THE TIME. BUT COULD THEY ALSO BE THE KEY TO OUR FUTURE SUSTAINABILITY? ►

When Professor James Wilton-Ely (Chemistry 1994, PhD 1998) ran an experiment on catalysts recently, he started on eBay. There, his team bought an assortment of old phone SIM cards. They were cheap, with 30 cards costing around £1.30. Yet for Wilton-Ely's purpose, they were invaluable.

"That shiny golden contact button on every SIM card has a very high gold content," says the Professor of Inorganic Chemistry at Imperial. The team ground up the cards, separated out the plastic and extracted the gold using an environmentally friendly organic compound containing sulfur. The result was not pure gold, but a gold compound.

Then, they tested the recovered gold in reactions that the pharmaceutical industry uses to manufacture drugs such as anti-inflammatory and pain relief medications. "To our surprise, the compound turned out to be a very effective catalyst for a whole host of important reactions without needing any further transformations," says Wilton-Ely.

Catalysts – from the Greek *καταλύειν*, meaning 'loosen' – are the hidden miracle workers of science. Simply put, they are substances – often metals – that jump-start chemical reactions. In ways that even scientists don't always fully understand, a catalyst enables other elements and compounds to form chemical bonds that would otherwise require a lot of energy or time to happen, and the catalyst itself emerges unchanged at the end. ►

FRESHLY MINED ELEMENTAL GOLD
Gold is an exceptionally effective catalyst, but mining 1kg of gold produces 12,500kg of carbon dioxide.

GOLD COMPOUNDS RECYCLED FROM SIM CARDS
The Imperial team extract gold from previously discarded sources, such as SIM cards, as a more sustainable alternative.

ANTI-INFLAMMATORY PAIN RELIEF MEDICINES
The resulting gold compound is used as a catalyst for reactions that could be applied to future medicines.

“It’s often said that 90 per cent of all man-made products have a catalytic step in their production,” says Wilton-Ely. Catalysts nudge inedible plant oils to form luscious margarine; they break down wood to produce paper; and they change petrochemical compounds into plastic. The human body, too, runs on catalysts – although we call them enzymes. They help us digest, breathe and move.

At Imperial, scientists, including Wilton-Ely, are now finding ways to use these chemical miracle workers to push the world towards better sustainability. They are doing so by creating innovative catalysts from waste products, by making green energy more affordable, and by using catalysts to jump-start an “artificial photosynthesis” that pulls climate-damaging carbon dioxide straight from the air.

Many of the best catalysts are rare metals such as palladium, rhodium and gold. They are often only found in certain parts of the world, such as Russia, making supply chains problematic. Mining these metals tends to heavily damage the environment, leaching toxins into the soil and climate-changing gases into the air. “The mining of one kilogram of gold produces 12,500kg carbon dioxide,” says Wilton-Ely.

This is particularly troubling since the world has already mined vast amounts of these metals – only to carelessly throw them away. In Europe alone, every person produces 20kg of e-waste a year – including computers, printer cartridges and phones. And the numbers keep growing, even though our old gadgets are full of precious substances. “The amount of gold found in computers is many times higher than in even the richest seams of mining,” says Wilton-Ely. “You have to process 30 to 40 tonnes of rock to find as much gold as in 20 or 30 computers.” Yet very little e-waste gets recycled.

So when one of his collaborators, Angela Serpe at the University of Cagliari in Italy, developed a low-energy process that recovered gold from e-waste using environmentally benign reagents, Wilton-Ely set out to find a use for it. Serpe’s recovery method results in a compound of gold – not elemental gold – that would cost too much energy to reuse in electronics. But the compound works as well, or even better, than catalysts derived from newly mined gold in pharmaceutical reactions, Wilton-Ely found.

His group is also working to repurpose another precious catalyst metal: palladium, which sits in the catalytic converters of vehicles and reduces harmful emissions. “Every car with a combustion engine drives around with about four grams of palladium. That’s 200 times the concentration in mined ore,” says Wilton-Ely.

But palladium, whose natural deposits are mostly located in Russia, is also an important catalyst in the manufacturing of pharmaceuticals and agricultural chemicals such as fertilisers and fungicides. And like the gold from SIM cards, the palladium compound that Wilton-Ely recovered from exhaust emission converters has proven to be “a very well-behaved catalyst”, he says. “We don’t see any difference in durability compared to metals sourced from mining. We can reuse them again and again and again.”

Ninety per cent of man-made products have a catalytic step in their production

Professor James Wilton-Ely

Besides mining and geopolitical complexities, rare metal catalysts have another downside: they are expensive. Platinum, for example, trades at close to \$1,000 per ounce. It’s used as a catalyst in hydrogen fuel cells, a sought-after form of green power, in which hydrogen gas reacts with oxygen gas to create water and electricity.

“Currently, around 60 per cent of the cost of a fuel cell is the platinum for the catalyst,” says Professor Anthony Kucernak in the Department of Chemistry. “To make fuel cells a viable alternative to, for example, fossil fuel-powered vehicles, we need to bring that cost down.” Kucernak has discovered that the much more common and affordable iron can replace the platinum – provided you finesse its configuration.

Many rare metals are effective catalysts because they’re built in a way that attracts neighbouring atoms enough to make them break their existing bonds with other atoms – but not so much that they will then bond with the catalyst itself. Rather, the newly freed atoms go on to react with other chemical partners. And a lot of these metals “sit in this Goldilocks zone,” says Kucernak. But he and his team have found that if they disperse iron into a single-atom structure, it acts similarly. “We started thinking about what was holding it back from being a usable catalyst. It seemed to us that we needed to modify the chemistry to allow for more active sites,” he says.

An important trick was to prevent iron atoms from forming clusters, “which aren’t really active for reactions”, so the team has developed a process called transmetallation, which disperses individual iron atoms within an electrically conducting carbon matrix. Once this was achieved, the common iron started to rival platinum’s performance as a fuel cell catalyst.

Kucernak’s approach resembles the way catalysts work in the human body. “The body doesn’t use rare elements for catalytic processes,” he says. “Instead, it modifies the electronic structure around much more ubiquitous metals to change the properties. It’s very similar to what we are doing.” ►



EXPENSIVE PLATINUM

To make hydrogen fuel a viable alternative, the price must come down. Currently, 60% of the cost is the platinum used as a catalyst in a single fuel cell.

SINGLE-ATOM IRON

The Imperial team has created a catalyst using only iron, carbon and nitrogen – materials that are cheaper and more readily available.

HYDROGEN FUEL CELL CAR

The cheaper catalyst design could allow deployment of significantly more renewable energy systems that use hydrogen as fuel.

Your gifts helped me realise my dreams

When MSc student Zoya moved from Pakistan during the pandemic, generous donations from Imperial supporters took away her financial worries so she could focus on her studies.

Growing up in Pakistan, it was Zoya's dream to study at a top university in the UK. When her father passed away, her mum became a school teacher to make ends meet and support Zoya's education. Zoya and her two siblings helped out by taking up jobs alongside their studies. Inspired by her father, who had a degree in health sciences, her ambition was to be a scientist. Her dream came true when she was admitted to Imperial to study an MSc in Advanced Chemical Engineering.

Yet when the pandemic hit, Zoya had to put her dreams on hold. When the day came to start her course at Imperial, she had to find money for the mandatory 10-day hotel quarantine – even though she had “barely saved up enough to survive”. It blew a hole in her savings before she had even started.

Your generosity changes lives

“I had days of extreme stress,” she says. “I was new in London with no contacts or friends, and I had the money shortage looming over my head.” She tried to figure out a way to get a part time job, but it was really difficult. Zoya's dream hung in the balance. That's when generous donations from Imperial alumni and supporters like you made all the difference.

Thanks to your gifts, Zoya was able to access student hardship support to cover her rent and bills so she could settle into London and her new life at Imperial free from worry. “I was very relieved,” she says. “It took a huge burden off me. I was able to give my course my full attention and explore all that Imperial has to offer.”

Opening doors to the future

Now, Zoya can focus on developing her research skills and building her knowledge, so she can change the world for the better, “I want to assure donors to the College that the support was put to good use,” she says. “To realise my dream is something that will always be my proudest accomplishment.”



Will you help more students like Zoya?

No one knows the life-changing impact of an Imperial education better than the College community. Your support can remove financial barriers, so that students from all backgrounds can afford to come to Imperial and excel. If you would like to support more students like Zoya, please make a gift today using the form enclosed or online at www.imperial.ac.uk/giving/winter-magazine-23

PORTRAIT PHOTOS: TEMPEST PHOTOGRAPHY

We're asking: ‘Can we use all this carbon dioxide in the air instead?’

Professor Camille Petit



Professor Anthony Kucernak
Professor of Physical
Chemistry in the
Department of Chemistry.



Professor Camille Petit
Professor of Materials
Engineering in the
Department of
Chemical Engineering.



Professor James Wilton-Ely
Professor of Inorganic
Chemistry in the
Department of Chemistry.

Currently, Kucernak is working on increasing iron's catalytic durability. If the approach can be commercialised, “our cheaper catalyst design should allow deployment of significantly more renewable energy systems that use hydrogen as fuel, ultimately reducing greenhouse gas emissions and putting the world on a path to net-zero emissions.”

Kucernak's method could also prove useful for something that interests Camille Petit, a Professor in the Department of Chemical Engineering. Petit is working to pull carbon out of the air or more concentrated sources to use it for new chemicals and fuels. “Typically, the carbon in our everyday products comes from fossil fuels. But we have all this carbon dioxide in the air, so we're asking: ‘Can we use this instead?’” says Petit.

Already, she and other researchers have found materials that can efficiently capture carbon dioxide (CO₂) from factory flue stacks. Now she wants to add a second step that converts the harvested carbon in a process which resembles the photosynthesis of plants. “In actual photosynthesis, you convert CO₂ and water to carbohydrates and oxygen. We use CO₂ with hydrogen or water, and convert it to carbon-based fuels or chemicals,” says Petit.

Since CO₂ is a highly stable molecule, the conversion requires a catalyst. Petit is testing possible candidates, including nitrides, metal organic frameworks and hypercrosslinked polymers. She wants her catalyst to be photoactive, meaning that just like plant-based photosynthesis, her artificial one will only need the sunlight to function.

It's early days. Petit has already managed to get the process to work on a small scale in the lab, and says it's only a matter of time before the output is big enough to make a difference. And once it does, catalysts will become even bigger miracle workers – transforming climate pollution into a source for sustainable and carbon-neutral living. ♦

TUNNELS

THERE'S A SECRET WORLD UNDER
IMPERIAL STUDENTS' FEET, THE
'HEART AND LUNGS' OF THE
UNIVERSITY. BUT ONLY A FEW
LUCKY SOULS HAVE EVER SEEN IT.

Words: Peter Taylor-Whiffen / Photography: Finbarr Fallon

Midnight, early summer. Mid-1990s. Jiten Patel and three friends are testing a rumour. They've been told by a friend in the know that beneath the South Kensington campus lies a vast network of secret tunnels, enabling access to almost any part of the campus. And apparently there's a way in – if you know where to look. "It seemed absurd that you could go through a hatch and walk under all the buildings, but we decided to investigate," Patel (Physics 1999) recalls.

The group met at their designated rendezvous and waited for the coast to clear. They located the access point and entered the tunnels – grimy, dark but surprisingly spacious; filled with control panels, junction boxes and hot pipes that carried steam and water to heat the campus. While Patel focused on not getting lost, one of the group tried to record the layout into a map – but soon ran out of space. "We must have been in there for four or five hours," he says. "At one point we found a stepladder and poked our heads out of the middle of Exhibition Road with a car coming towards us."

Patel and his fellow explorers had discovered Imperial's service tunnels, which although now inaccessible, date back to the 1851 Great Exhibition. Filled with wires, cables and pipes, the tunnels contain water, data, phone, security and power and extend under the entire campus and are believed to have once connected to the basements of the nearby museums. Extremely hot, the tunnels are nevertheless surprisingly well lit and tidy.

Among students in the know, myriad rumours have arisen: they were used to store radioactive waste; they were the locations for love trysts (a makeshift bed and empty bottle of wine were once discovered in one tunnel) or drinking clubs; they were protected by armed guards.

Actually, there's the faintest ring of truth to that last claim. Alun Kimber (Chemical Engineering and Chemical Technology 1982) was a student at Imperial in 1980, when the nearby Iranian Embassy on Princes Gate was stormed by gunmen. Kimber was in his student accommodation watching the snooker in the TV lounge when it was interrupted by a live broadcast from the siege. He and friends decided to get a closer look via the tunnels, as the police had closed the conventional route onto the main road.

"You just needed to know the right door and then you were in," he says. "We followed this guy through these musty brick tunnels and popped up very close to the back of the embassy. It was on fire as the SAS had just gone in and a policeman saw us and came running towards us telling us to get inside." Kimber and co ►

rapidly retreated into the nearest safe building. “What I found strange at the time was that the policeman didn’t know what was going on – although I since realise that the SAS would have taken full control, including communication.”

Sixteen years after Kimber’s adventure, Patel and his friends would spend several hours under Imperial, but it still didn’t allow them to visit the entire network. “There were huge areas we couldn’t explore because they were blocked or we didn’t have time,” he says. “We didn’t need to crawl on hands and knees, we could walk quite easily – sometimes in single file – and it was easy enough to get round. I don’t know if other students knew about it. We didn’t make a big noise about it; it was a secret for the group of us.”

Back then, the tunnels contained Imperial’s old steam heating system – Patel noted the occasional warnings of hot steam – but this is now being replaced as part of a major refurbishment programme. For decades, buildings on campus were heated through two overlapping heating systems – one used hot water and the other steam. This was something that had developed over time and which nobody had ever got round to correcting.

“Intuitively and from an engineering perspective, there was no benefit to having two,” explains Andrew Caldwell, the Energy Manager. “You double all the costs – infrastructure, expense and potential for failure – but individually each was too small to take the entire load, so we had to live with this thing. Steam is an amazing way of transporting heat because you don’t need to pump it, it moves itself through the pressure and you can get a lot of energy down a small amount of pipe. But there are also many drawbacks. It is thermally inefficient and there are a lot of daily checks and legislation that requires compliance. There are fewer losses in a low-temperature water district heat network than a saturated steam heat network.”

Now, the steam is all but gone – but the tunnels remain, used for miles of cables and pipes that carry water and electricity from Imperial’s Energy Centre around the campus. The Energy Centre is the ‘heart and lungs’ of Imperial, generating electricity through two combined heat and power generators, each of which can generate 4.5MW of electricity. Believed to be the biggest privately owned power station in London, the Energy Centre generates almost all the electricity needed to run the South Kensington campus. The generators are now being joined by three new gas boilers which, along with the

**At one point we
climbed a stepladder
and poked our heads
out in the middle
of Exhibition Road**

PHOTO FAR RIGHT: THOMAS ANGUS

removal of the steam heating network, will cost around £40 million, £12 million of which will come from a government grant.

“We don’t know what to call the project,” admits Caldwell. “Some call it decarbonisation and others call it de-steaming. Technically, we call it the Removal of the Central Provision of Steam – because we want to reflect that there are some assets out there that still need steam, but it’s easier to call it de-steaming.

“We essentially operate our own power and heat network here. We generate the heat centrally and then distribute it around the campus from the Energy Centre. We have our large tunnel network to distribute heat and power through the buildings. If you visit a similar sort of campus like a large hospital, you will see all the pipes above ground – we are able to store it all under the streets. It is very discreet and out of sight.”

The project makes significant carbon savings of around 2,400 tonnes a year. Caldwell is proud of the efficiency of the two gas-fired combined heat and power engines, from which waste heat generated by the exhaust is captured and fed into the boilers, where it is turned into water to heat the buildings. The three new boilers are replacing three steam boilers that, after 25 years’ service, had reached the end of their lifespan. At the same time, the water pipe network – which carries about 132,000 litres round the campus – is being increased in size to take the additional heat load. Heating units in the plant rooms beneath each individual building are also being upgraded. In the handful of places where steam is still needed – for autoclaves or steam sterilisers, for example – it is now generated locally.

As the Energy Centre comes back online in December, the changes will make for far greater environmental and economic efficiencies. The financial savings that Imperial receives from generating its own electricity are already substantial, but Caldwell believes even more can be done in conjunction with net zero planning that is in development. “I am now looking at the next phase of the project, which is going back to grassroots and reducing demand,” he says.

“I believe that rather than creating innovative new ways to generate heat, we should reduce the need in the first place. There are a lot of huge and complex research projects that go on in our buildings and these require a lot of heat and a lot of power – but there can be a lot of waste that goes along with that. We are seeking the most efficient and optimised solutions for these buildings.” ♦

ENERGY REVAMP

In line with Imperial’s Net Zero 2040 ambitions, three new boilers (which are much more efficient than the old ones in converting natural gas to useful heat) were delivered to campus in August and installed in the underground Energy Centre. The long-term strategy is to move the whole of the South Kensington campus to a low temperature hot water system running at 80°C, in preparation for further heat decarbonisation.

> To find out more, visit imperial.ac.uk/estates-projects/construction-projects/current-projects/. And if you have any stories about ‘underground adventures’, let us know at imperialmagazine@imperial.ac.uk



De-steaming in progress:

The vast network of cables and pipes carry water, electricity and now gas from Imperial’s Energy Centre around the campus, reducing reliance on steam.

BORN TOO SOON

DESPITE EXTRAORDINARY ADVANCES, PRETERM BIRTH IS STILL THE BIGGEST CAUSE OF DEATH OF CHILDREN UNDER FIVE. IMPERIAL RESEARCHERS ARE SETTING OUT TO CHANGE THAT.

Words: **Lucy Jolin** / Photography **Wilson Hennessey** / Styling **Vicky Lees**

Every minute, somewhere in the world, 25 babies are born early.

That's 13 million babies a year born preterm, or one in ten. And while there have been extraordinary advancements in their care and treatment, and acceptance that preterm babies – even those delivered many weeks early – can survive, that number isn't coming down.

“Being born preterm is the single biggest cause of the death of children under the age of five anywhere in the world,” says Phillip Bennett, Professor of Obstetrics and Gynaecology and Director of the Institute of Reproductive and Developmental Biology. Globally, he says, there are huge discrepancies in survival rates. In high-income nations, a baby born at about 32 weeks has around a 95 per cent chance of survival, but of those born in a low-income country at the same gestational age, only half will survive.

Babies that survive being born preterm can spend long periods in neonatal intensive care units, separated from their family. They're at risk of various long-term health problems, including physical and learning disabilities, and are subject to behavioural, emotional and educational difficulties.

One of the challenges with preterm birth is that it can be caused by a wide range of different problems, and doctors aren't currently able to predict who is at risk. But now, researchers at Imperial are working, as part of the Imperial NIHR Biomedical Research Centre, to understand what causes babies to be born prematurely – and what treatments might be effective to prevent this.

A vital part of their work lies in partnerships with two charities. Professor Bennett directs (with colleagues Tom Bourne and Lesley Regan) the Tommy's National Miscarriage Research Centre at Imperial, and (with Lynne Sykes, who is funded by the Parasol Foundation, and David MacIntyre) the March of Dimes Prematurity Research Centre (PRC). Established in 2018, the March of Dimes PRC has already made significant discoveries. The centre has focused on the connection between preterm birth and the maternal microbiome: the community of microorganisms inside a pregnant woman's body. ►

All in the timing:

One of the challenges of preterm birth is that it can be caused by a wide range of problems: doctors aren't currently able to predict who is most at risk.



The study has become the benchmark for the management of early growth restriction. We understand small babies much better now

Christoph Lees, Professor of Obstetrics



Professor Neena Modi
Professor of Neonatal Medicine, School of Public Health.



Professor Phillip Bennett
Director of the Institute of Reproductive and Developmental Biology.



Professor Christoph Lees
Professor of Obstetrics, Department of Metabolism, Digestion and Reproduction.

“In the past 30 or 40 years, it’s become increasingly recognised that infections are a significant cause of preterm birth,” says Bennett. “But it’s not a classical infection, it’s more a relationship between the bacteria that normally live in the genital tract, and a woman’s immune response to it. Our work has focused on those bacterial immune system interactions, and we’ve made two important findings.”

The March of Dimes team has developed a diagnostic test to simultaneously determine if a mother’s microbiome is healthy or not and if the mother is mounting an adverse immune response to it. The test could help identify women at risk of preterm birth sooner, allowing obstetricians to closely monitor them. They are also developing the use of live biotherapeutics (“A bug that is a drug,” says Bennett) to change the bacteria present from an unhealthy spectrum to a healthy one.

Another arm of the research focuses on when to deliver babies that are not growing at the rate they should be in the womb. “In about ten per cent of pregnancies there’s a small baby, and two to three per cent are genuinely growth restricted,” says Christoph Lees, Professor of Obstetrics. Fetal growth restriction (FGR) accounts for half of the cases of stillbirth in the UK, so working out when to deliver these babies is important. “Deliver them too early and you can cause potential harm and days or weeks on the neonatal unit,” says Lees. “But delivering too late can lead to stillbirth. It is a difficult balancing act.”

A BENCHMARK STUDY

Currently there are many different methods and tests to monitor FGR in women but no consensus on the optimal timing of delivering such babies in late preterm pregnancy. To try to clarify this, Lees leads the Trial of Randomised Umbilical and Fetal Flow in Europe 2 (TRUFFLE 2) study. It follows the successful TRUFFLE 1 study, which looked at the same issue in babies born extremely early, between 26 and 32 weeks. The results of that study inform how those pregnancies are treated globally. “It has become a benchmark for the management of early growth restriction,” says Lees. “We understand small babies much better now.”

While TRUFFLE 1 made a significant impact on our understanding of very early preterm birth, there are many more babies close to term – 32 to 36 weeks – that are growth restricted. “Fortunately, they’re far less likely to have severe illnesses and far more likely to survive, but they do end up on the neonatal unit for quite a long time, and the decision on when to deliver is very important to avoid stillbirth,” says Lees.

TRUFFLE 2 works with pregnant women whose babies are smaller or growing more slowly than expected between 32 and 37 weeks. Their babies are closely monitored with ultrasound scans, computerised heart rate tests and Doppler tests for blood flow to the placenta and brain. “The reason we monitor blood flow to the brain is because we know that when babies are not growing as well as they should be, they redirect more of their blood flow to their brain to try and protect it from damage,” explains Dr Bonnie Mylrea-Foley, Clinical Research Fellow and study coordinator for TRUFFLE 2. “We know that this is associated with worse outcomes, so once we see that change, we know that the baby may be compromised.”

At that point, women will be randomly assigned to one of two groups. In one group the babies will be delivered immediately; in the other group they will be monitored closely and delivered if the baby’s heart rate or scans show signs of deteriorating health. All babies in the study have their newborn outcomes recorded and are followed up until they are two years old to assess their neurodevelopment. ►

Weighed in:
The median weight of a baby at 32 weeks is 1,800g – roughly a bag and two thirds of sugar – but just 700g at 24 weeks.



Our work has focused on bacterial immune system interactions, and we’ve made two important findings

Phillip Bennett, Professor of Obstetrics and Gynaecology

Born too soon?
In high-income nations, a baby born at about 32 weeks has around a 95 per cent chance of survival, dropping to just 50 per cent for those born in a low-income country.



What is the turning point, where the balance of the risk of remaining in the womb is greater than the risk of being born slightly early?

Bonnie Mylrea-Foley, TRUFFLE 2 study coordinator



Jenny Goodier
Lead Research
Midwife on
the TRUFFLE 2
research study.



Dr Bonnie Mylrea-Foley
Clinical Research
Fellow and TRUFFLE 2
study coordinator.

“What we’re trying to understand is: do babies do better if we deliver them earlier or do they do better if we continue to monitor them and try and get the pregnancy to go on as long as possible?” says Mylrea-Foley. “What is the turning point, where the balance of the risk of remaining in the womb is greater than the risk of being born slightly early?”

The study has recruited women in dozens of hospitals across the UK and Europe. As Lead Research Midwife on TRUFFLE 2, Jenny Goodier liaises with patients taking part. “When women become eligible for the trial, they are often dealing with the new knowledge that their baby is small, which can be a worrying and stressful time,” says Goodier. “However, I think the main reason women do decide to take part is that they want to help other parents in their position in the future. They tell me that if their participation can help how we manage pregnancies like theirs for other families, that they would like to do anything to help.”

A common worry of patients is that they will be put into the ‘wrong’ group. “A lot of women do struggle with that,” says Mylrea-Foley. “However, we explain that both of the delivery options are things that are already happening as part of standard care and that might be recommended to them anyway, and we genuinely don’t know which one is better.” That’s something they hope will change once the study is completed.

A QUEST FOR INNOVATION

Another aspect of Imperial’s work into premature birth is the Neonatal Data Analysis Unit, led by Neena Modi, Professor of Neonatal Medicine. One way her team works to improve preterm care is the creation of the globally unique National Neonatal Research Database (NNRD), a national resource holding real-world clinical data captured on all admissions to NHS neonatal units in England, Wales, Scotland and the Isle of Man.

“We use the NNRD to drive service change, evaluate health services and test treatments and new approaches to care,” says Modi. “For example, we showed that newborn outcomes improve with one-to-one nursing, and worsen if babies are transferred between neonatal units immediately after birth. We also showed that births of extremely preterm babies fell during the COVID-19 pandemic. This is an extremely important finding as no medical treatment in the history of medicine to date has successfully reduced preterm births.”

For all the impressive science behind the research into preterm birth, those involved are driven by the knowledge that their work has a huge impact on people’s lives. “It’s very important to remember that there are real people on the end of this and they need a lot of help and support,” says Bennett. “Many parents don’t know anything about preterm birth until it happens to them; then they might feel guilt or shame, and they certainly worry a lot about what’s going to happen in the future for them and their families. Being able to help people in most situations is a very fulfilling part of the role.”

Each scientific breakthrough is just one piece of the puzzle. “If we as a research group can do something that leads to better outcomes for women and babies, then I’m enormously proud of that,” says Lees. “It’s a constant quest for innovation and improvement, and one must never assume that you’ve come up with the final answer. But you can keep taking steps towards much better answers.” ♦

> For the latest news and updates on the TRUFFLE study, visit truffle-study.org

Tripping the light fantastic

MEET THE UNSUNG HEROES OF IMPERIAL'S
MICROSCOPY FACILITY – MAKING RESEARCH VISIBLE

Words: **Mark Frary** / Photography **Alecsandra Dragoi**

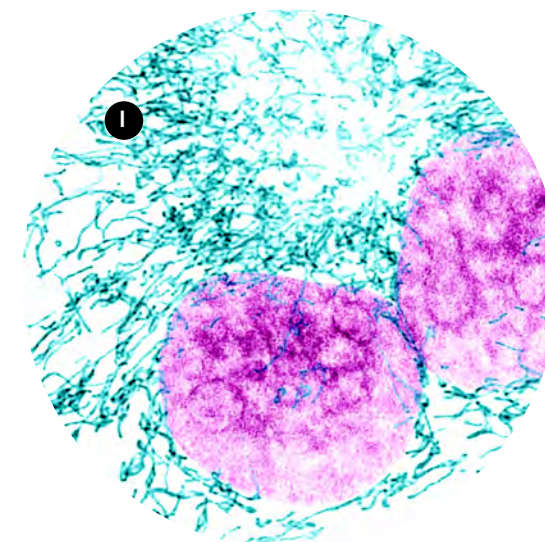


Step into the ordinary looking, glass-fronted modern building just around the corner from the main entrance of the Science Museum and you could be in any workplace in the city. Ranks of wooden desks are populated by workers staring intently at their computer screens. Dotted around the desks are pictures of loved ones, a pair of once-used trainers, the full life and death cycle of a number of houseplants and, more incongruously, a red tricorne hat and yellow flower garland, perhaps from some vaguely remembered office party.

But the name above the main entrance – Sir Alexander Fleming Building – hints that this is no ordinary office. In fact, groundbreaking and potentially Nobel Prize-winning research takes place within its walls, because this is the Facility for Imaging by Light Microscopy (FILM), offering a suite of 15 state-of-the-art microscopes to support breakthrough research across Imperial. Last year, FILM microscopes were used for more than 11,000 hours by 400 scientists and other researchers from 160 different groups around Imperial. And the scope of its work is breathtaking.

“We can be working across five or six different areas every day,” says Dr David Gaboriau, a microscopy specialist at FILM. “In the morning we might image malaria parasites, heart cells and cancer treatments, and then in the afternoon, take movies of live neurons and other cell types in brain sections and nanoparticles inside cells. It is incredible to be on the cutting edge of such world-leading science every day. Sitting alongside Imperial’s scientists as they make their innovative discoveries is like seeing a work of art for the first time.”

The FILM team is composed of Professor Cristina Lo Celso, head of the facility (together with Professor Vania Braga), Dr Volodymyr Nechyporuk-Zloy, facility manager, and two microscopy specialists, Gaboriau and Dr Ana Ferreira Da Silva. And the list of people and departments the Facility has worked with reads like a who’s who at Imperial. Many projects ▶



Far left:

Professor Cristina Lo Celso at the Facility for Imaging by Light Microscopy (at the Imperial Centre for Translational and Experimental Medicine (ICTEM) building on the Hammersmith Campus) with the Leica Stellaris 8 STED-FALCON.

Microscopic imagery – continued overleaf:

1) Human fibroblast cells, stained for mitochondria (magenta), microtubules (orange) and actin (green), imaged on a confocal microscope.

2) Human fibroblast cells, stained for mitochondria (cyan), microtubules (green) and actin (cherry), imaged by three dimensional structured illumination microscopy.

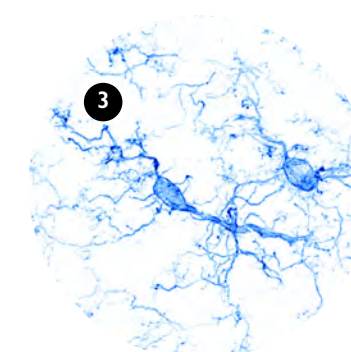
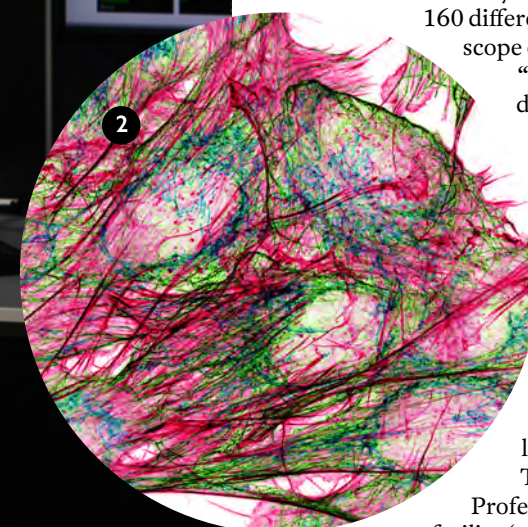
3) Microglia cells in a mouse brain section, imaged on a confocal microscope.

Sample: Dr Mathieu Nollet.

4) Human fibroblast cells, stained for mitochondria (magenta), microtubules (cyan) and actin (grey), imaged by three dimensional structured illumination microscopy.

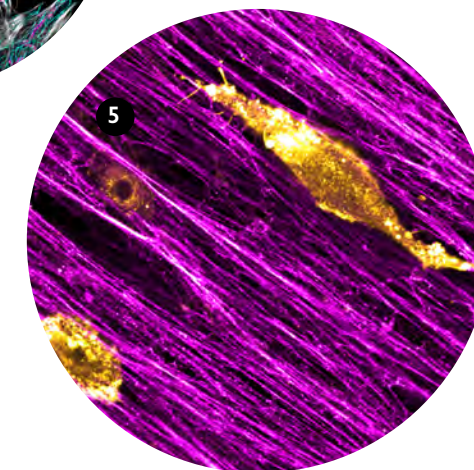
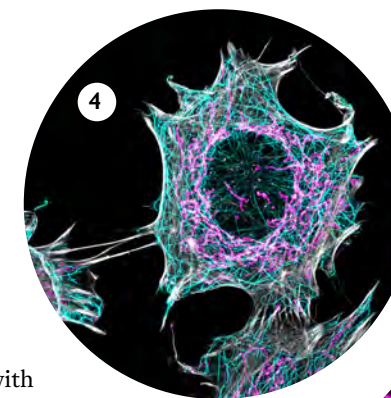
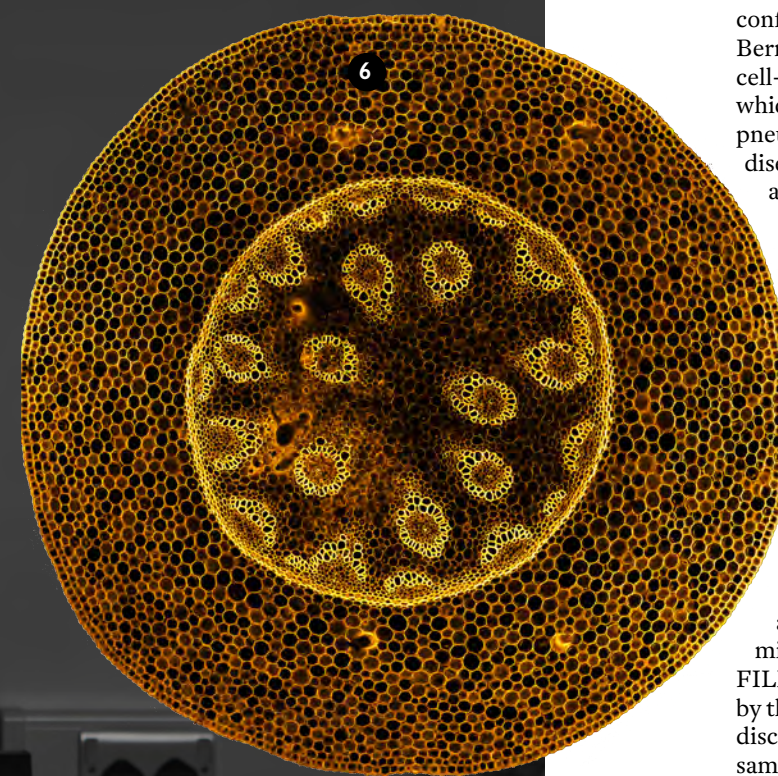
5) Cell migrating on extracellular matrix, grabbing at filaments, imaged on a confocal microscope.

6) Full cross-section of the stem of *Convallaria majalis* (Lily of the Valley), imaged on a confocal microscope.



Sitting alongside Imperial scientists as they make their discoveries is like seeing a work of art for the first time

Dr David Gaboriau



Far left:
Dr David Gaboriau at the FILM lab at the ICTEM building on the Hammersmith Campus.

are being developed with the National Heart and Lung Institute, such as Dr Charlotte Dean's work with confocal microscopy of lung slices; Dr Jorge Bernardino de la Serna's work on understanding cell-cell interactions at the molecular levels, which promises better drugs to treat diseases like pneumonia and chronic obstructive pulmonary disease; and other collaborations on diseases such as idiopathic pulmonary fibrosis and asthma.

"When we capture something never seen before we're helping prove a hypothesis or confirm that a paradigm is wrong," says Lo Celso. "When I first visualised blood stem cells in the bone marrow of anaesthetised mice, for example, the working hypothesis was that they sat adjacent to osteoblasts (bone making cells). Instead, we found the two cell types rarely interacted directly – and indeed several cell types interact with blood stem cells in a very dynamic fashion. This indicated why it has been so difficult to maintain and grow blood stem cells in vitro."

Users are fully trained, supported and encouraged to be hands-on with the microscopes, following expert training by the FILM team. "Users pay for time on the microscopes by the hour but are also offered extra time to discuss the type of science they are doing, the sample they want to use and the hypothesis they plan to investigate," says Gaboriau. "This helps the microscopy specialists in choosing the best microscope for their experiments."

A widefield instrument works like a standard camera – the sample is illuminated, the shutter opens and the light emitted by the fluorophores is captured by a sensor. It's very fast, but the camera collects slightly more out-of-focus light than a confocal system. A confocal microscope uses lasers to excite the cells – the laser moves along the sample to create an image, pixel by pixel. It can also acquire a stack of images – rather like slicing up a tomato – and then reassemble them to make a three dimensional model of the sample. The resolution of the image is better, though it is slower to obtain.

And then there is the super-resolution equipment. The level of detail resolved by these microscopes would be considered as almost magical by early scientists. Details measuring around 50 nanometres can be resolved – a typical plant or animal cell is around a hundredth or tenth of a millimetre while a tiny virus might be around 100 nanometres. Super-resolution microscopes in FILM have enabled the visualisation of hormone receptors on the surface of live cells becoming activated upon binding to their ligands, and the discovery of the localisation of single molecules of other receptors on the cell membrane.

As well as individual images, FILM's microscopes can also be used to create 'videos' made from taking

a series of still photographs at regular intervals, sometimes as much as thousands of times a second for very fast processes. This allows Imperial's scientists to study the division or movement of cells, the growth of cellular structures, and even the ultra-fast flux of ions such as calcium in and out of the cells, leading to changes in cell fate.

Lo Celso has her own research programme studying blood stem cells and other cells in the bone marrow. Her expertise is in intravital microscopy, which involves implanting an imaging window into the tissue of a mouse, all subject to the UK's strict animal research controls. Mice are used because their bone marrow and hematopoiesis – the development of blood cells – is very similar to that of humans.

Lo Celso uses FILM's microscopes to look directly at stem cells in the mouse's bone marrow while it is anaesthetised. After they wake up, they show no signs of discomfort. "The aim is to understand what the relationship is between where a cell is and what function it is going to have, and we have made several unexpected discoveries along the way," she says.

"For example, we saw that chemoresistant leukaemia cells literally run across bone marrow space without ever taking a rest. We also found that blood stem cells that have been exposed to certain infections remember this and remain more actively motile when transplanted in an infection-free environment," says Lo Celso. "These findings promise much for the development of better leukaemia treatment, but also for strategies to preserve stem cells and healthy blood cells during severe infections."

It's typical of the research being done at FILM, something Fleming himself would have been proud of, and Lo Celso laughs off the burden of expectation at having the St Mary's Hospital School grad's name over the front door. "We get so used to what we are doing because we do it every day," she says. "We almost forget how exceptional it is – until somebody from outside comes and says simply: 'Wow.'"



A two-week residential programme specifically designed for 16- and 17-year-olds with a passion for science, technology, engineering and medicine. Taught by Imperial academics, students will take their subject knowledge to the next level and gain practical skills alongside likeminded peers from across the world.



JULY &
AUGUST
2024

DATASET – PROFESSOR RALF TOUMI
CO-DIRECTOR OF IMPERIAL'S GRANTHAM INSTITUTE – CLIMATE CHANGE AND THE ENVIRONMENT

Harnessing the winds of change to supercharge cyclone modelling



Context

Early in 2023, Cyclone Freddy emerged off the coast of Australia and travelled 5,000 miles to Southeast Africa, making it the longest-lasting and most intense tropical cyclone in terms of lifetime energy ever recorded. Along the way, it claimed 1,484 lives. It was just the latest example of climate change rendering cyclones increasingly destructive, as the rise in sea temperatures gives them more heat, energy and water; making for even stronger winds and even heavier downpours.

Background

Communities are better prepared when they know the probability of a cyclone occurring. However, both observational data and global coarse resolution modelling skills are limited. So an Imperial team, led by Professor Ralf Toumi (Chemistry 1987), Co-Director of Imperial's Grantham Institute – Climate Change and the Environment, has developed the Imperial College Storm Model (IRIS) to create synthetic cyclones. They teamed up with Vodafone to run it on DreamLab – an app that combines phones into one giant computer processor – and model millions of tropical cyclones globally.

Method

Vodafone's app, previously used to analyse data on COVID-19 and cancer research, harnesses the processing power of idle smartphones that are signed up to the programme, tapping into the phones' processors while they're charging to create a network of devices and create a virtual supercomputer, capable of processing billions of calculations.

"IRIS works out the probability and likely intensity of a cyclone at any time anywhere in the world," says Toumi. "IRIS creates millions of tracks and landfalls of cyclones. We build algorithms based on historical observations but also informed by our physics understanding – for instance, knowing the sea surface temperature enables you to forecast the potential maximum intensity and then the decay towards landfall. And phone users need to do nothing except charge their phones."

Below:
The Imperial College Storm Model harnesses the power of Vodafone's DreamLab app to model millions of tropical cyclones globally.

Results

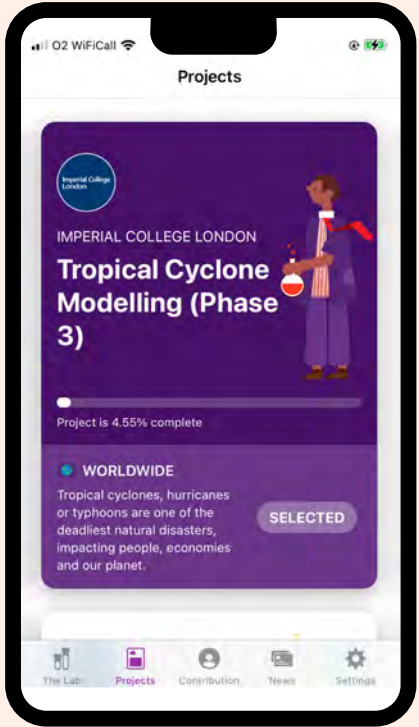
As well as creating an enormous database and rolling record of the impact of climate change, the phone mega-power database has also advanced our understanding. "Historically, modellers have taken an end-to-end approach, saying: 'We need to predict the genesis of the storm and the location of where it's born,'" says Toumi. "From there we'd predict the track, and then where it intensifies, decays and makes landfall. Our results have confirmed that we can predict landfall much better just by simulating the last leg from maximum intensity to decay. We were very encouraged that we could simplify the problem and create a higher quality of result."

And while the concept of synthetic cyclone modelling is not new – such tools are used regularly in the insurance industry – unlike most commercial ventures, Imperial's work is open source. "There are many interested in this type of information: countries, cities, individuals and businesses. To have the widest possible impact, we can't be proprietary," says Toumi. "We need to be completely transparent about the data and how we have processed it."

Outcome

This research has a range of applications for the benefit of countries and communities devastated by cyclones. It can, says Toumi, open up conversations on loss and damage – for example, if a nation suffers a stronger cyclone that formed because of atmospheric conditions caused by global warming in another country. "But it also informs how much you spend on climate adaptation," he adds, "such as sea defences, how strong you make the walls, or whether you invest in mangroves, for instance. You can say: 'If the intensity will be ten per cent stronger, then the damage will perhaps be 20 per cent greater over a greater area. If that probability is significant then I should spend X on defences – but if it's only a little change, I'll build a hospital instead.'" ♦

> imperial.ac.uk/grantham/research/climate-science/modelling-tropical-cyclones





IMPERIAL CHEERLEADING SOCIETY

SUPPORT NETWORK

Stunts, jumps and dance – cheerleading at Imperial is a seriously fun business.

Words: **Megan Welford** / Photography: **Joe McGorty**



Mention Sport England to Rita Correia (Bioengineering 2023), the outgoing president of Imperial's Cheerleading Society, and her mood darkens. "It's very insulting that they say cheerleading is not a sport," she says, "even though it has been classed as a sport for the Los Angeles Olympics in 2028!"

Cheerleading, she explains, is a demanding, competitive performance sport involving synchronised acrobatics, stunts, jumps and dance. There are no pompoms (though there are in non-competitive cheerleading), and it's not something that happens on the sidelines of another sport. "We are aligned with the American Football Society because we both came out of the American Society," says Correia. "We socialise with them, but we don't cheer for them." The two cheerleading teams at Imperial – Titans Ice and Titans Ignite – train for three hours a week, as well as two hours of strength and conditioning. "I also run and do pilates," she adds.

The Cheerleading Society takes everyone who tries out – most don't have experience – but Sport England's decision impacts on the team. "Not being classed as a sport means we're eligible for VAT," says Correia, "so it's quite expensive." The team coach local primary school children in exchange for using their mats, and this year the committee has spent time applying for grants and fundraising to keep costs down and stay open to all. "We are competitive, but mostly it should be fun," Correia says.

She used to be a gymnast, which is related to cheerleading but with one crucial difference: "In gymnastics, the movements are individual, but in cheerleading we work as a team. We rely on each other. If one person isn't there, we can't perform."

A stunt group of four is made up of two bases, a backspot and a flyer. Incoming president and flyer Patricia Acha Zamora (Electrical and Electronic Engineering with Management, Final Year) says she was initially scared of flying. "As a flyer you're the most visible and you get thrown in the air. When I told my mum she was terrified! So I tried out as a base, but a previous committee member suggested I might be a good flyer, because I love performing and I have a big smile. The cheerier you are, the more points you get!" However, you do get thrown in the air. "It is a dangerous sport, certainly at a higher level," says Acha Zamora. "You have to trust the others. Once the stunt groups are formed we do a lot of team-building – and a lot of socialising.

"Cheer is both physical and mental," she says. "If you think you won't hit a stunt, then you probably won't. A week before our first competition there was something I just wasn't getting. It was an inversion, with my hands on the floor, where I had to do a forward roll and land on the backspot's shoulders, and she'd bring me over. There was a lot of frustration and fear for me. But I talked to my group and the coach and Rita said: 'Don't think about it. You're doing everything right, just trust yourself and your bases.' And the day before the competition, I landed it, and I landed it in the competition too! I fall in love with it a little bit more every time I perform." ♦



In cheerleading we work as a team. We rely on each other. If one person isn't there, we can't perform

Top left image from left to right:
Hollie Preston (Fourth Year, BSc Biochemistry with Management); Patricia Acha-Zamora (Final Year, MEng Electrical and Electronic Engineering); Rosanne Choong (Second Year, BSc Medical Biosciences); Lauren Hine (Fourth Year, Medicine BSc in Remote Medicine); Rita Bernardo Correia (completed MEng in Bioengineering, starting PhD in Bioengineering with focus on Biomaterials); Clodhna O'Toole (MSc Biomedical Engineering, specialised in Neurotechnology).





PUZZLES

Test your brain power

Ready to test your little grey cells? Imperial’s top quizzers set the ultimate puzzle challenge to find out just how much you know.

Hard: Give the sequence that joins: a deceptive clupeid; the Merry Monarch’s favoured accompaniment to eggs; Sir Gawain’s first adversary.

Harder: What do Wi-Fi, SOS and Marcel Duchamp’s LHOOQ have in common?

Fiendish: Only Connect wall. Rearrange the wall into rows – each row has a unique common link that must also be identified.

Sinbad the Sailor	Night on Bald Mountain	Scheherazade	Morgiana
Monsieur Zaccone	Abbé Busoni	Ali Baba	Alice in Wonderland
The Sorcerer’s Apprentice	Dance of the Hours	Lord Wilmore	The Nutcracker
Aladdin	Rite of Spring	Prince of Persia	Robin Hood

Set by the Imperial Quiz Society.
Find the answers on our website at:
imperial.ac.uk/be-inspired/magazine/issue-55/brain-power

FOR ISSUE 54 SOLUTIONS:
imperial.ac.uk/be-inspired/magazine/issue-54/brain-power

PHOTO: MIA KAYSER. ILLUSTRATION: MIKE LEMANSKI

IMPERIAL INNOVATES

Believe in a bright future

A conviction in the future of solar energy is the driving force behind Christopher Hopper’s success.

Interview: Lucy Jolin

Back in primary school, we were all obsessed with computer games. My friend’s dad had taught him a bit of programming, and I thought it would be amazing if I could make a game as well, so my father and I signed up for an adult education class in programming. It turned out to be the perfect hobby for someone like me: a creative outlet that demanded a scientific approach to solving problems. That’s what brought me to Imperial’s MEng Electrical and Electronic Engineering – which, in turn, got me thinking about how to apply my new engineering expertise to pressing challenges outside the classroom.

A group of us wanted to improve people’s access to electricity. We founded e.quinox, a student-led humanitarian project that aims to uplift rural Rwandan communities through research and technological innovation. The best solution, we found, was solar electricity generation. In my time with the group, we completed projects in four villages, electrifying 600 homes. It was a formative experience, giving me a deep insight into the practical side of energy projects and showing me how engineering can have a tangible effect on people’s lives.

Then, when studying for my MBA at Stanford University, I met my co-founder Sam. He pointed out that you don’t have to go far outside a major city in a country like Kenya for energy access to be an issue. So we launched a solar business together, with a boarding school in Nairobi as our first client. The project was a success, and other people started reaching out to ask if something similar could work for them.

But solar is so specific to each project that it was impossible to give a simple answer. There were so many variables involved that scaling our business without sophisticated software tools to support us seemed an insurmountable challenge. For example, how much energy does the building consume? And when? What does the roof structure look like? What orientation is it? Are there trees casting shade, or a mountain range that could impact



I believe the world is better off powered by abundant, cheap, clean energy, and I think that’s a future worth fighting for

Looking up: Christopher Hopper (MEng Electrical and Electronic Engineering 2011), co-founder and CEO of Aurora Solar.

production at a certain time of day? How are you going to finance it – cash, loan, PPA, lease?

We realised that the software tools we needed to do these projects at scale didn’t exist. So we put our solar business aside to create them – and Aurora Solar was born. We brought on a software developer and an adviser with experience in the solar industry. We had some startup funding and an initial seed round raised \$925,000, but renewables were not hot – a lot of investors were intrigued but not willing to commit.

There’s a famous quote from Ernest Hemingway’s *The Sun Also Rises*, where Bill asks Mike how he went bankrupt. Mike replies: “Two ways. Gradually, then suddenly.” Aurora Solar was like that – but, luckily, in reverse. We grew slowly and steadily, knowing that the tipping point for solar was coming. Now, the world has finally caught up to renewable energy.

We now have a team of more than 500, supporting clients who make more than 100,000 solar designs every week using our AI-powered software. Aurora Solar was the only climate tech business named in the 2022 Forbes AI 50, and was voted as the top solar sales and design software by *Solar Power World* in 2022.

In the end, solar energy is simply something I believe in and it’s not something I can put aside. I fundamentally believe the world is better off powered by abundant, cheap, clean energy and I think that’s a future worth fighting for. There were plenty of challenges along the way – and there will be more – but it’s that conviction that keeps me going. ♦

> **Christopher Hopper** (MEng Electrical and Electronic Engineering 2011) is co-founder of Aurora Solar and winner of the Alumni Entrepreneur Award 2023.

Leading by example

Members of the Imperial community are working to increase diversity in STEM and inspire the next generation of scientists and engineers.



DR KAYISHA PAYNE
(MSc Chemical Engineering 2017)
Founder of BBSTEM,
Associate (Healthcare and Life Sciences),
Alvarez & Marsal,
London

Q. What inspired you to set up BBSTEM soon after finishing your MSc?

A. I have long felt that young Black British people need to see successful people on similar journeys to themselves. Though if my mum hadn't been bragging about me to one of her old school friends one evening when we were out shopping together, BBSTEM would probably never have happened! Through that conversation I met a Black guy in his early 30s who had studied engineering at university and was now doing well in business. It was the first time I had met someone with a similar background to me doing what I hoped to do. It was inspirational and I thought there should be a network to help promote career opportunities in STEM for young Black people.

Q. How did your time studying at Imperial help you personally on your journey?

A. Getting to study at Imperial made me realise I, too, was deserving and could occupy a space that other respected individuals would notice. And, of course, being at Imperial is a big advantage in entering the job market, as I didn't struggle with job offers. Imperial became one of the first universities to join the BBSTEM University Alliance and continues to be one of our biggest supporters.

Q. BBSTEM will be six years old in December. What does the future hold?

A. Black British individuals are as likely as the dominant domicile ethnic group to choose to study and strive for a career in STEM. BBSTEM is self-funding, and it succeeds because of the individuals who have freely given their time and shared their experience. We organise events for Black British graduates, provide a job board and are creating a corporate network. Our mission is to have Black parity in the UK's STEM workforce, from school to the highest level in industry. So while I do still question the lack of opportunity for young Black British people, I am also determined to continue to do something about it.

> *Dr Kayisha Payne was the STEM Rising Star Winner at the Black British Business Awards (BBBAwards) 2019.*
bbstem.co.uk



LAMÉ VERRE
(MBA 2015)
Co-Founder and
Board Co-Chair
of Lean In Equity
and Sustainability,
Head of Strategy,
Innovation and
Sustainability –
SSE Energy
Customer Solutions

Q. Your career started in 2000 as a Corporate Planning and Development Officer for the Nigerian National Petroleum Corporation in Abuja, Nigeria. What led you to your MBA 13 years later?

A. I constantly push myself against the boundaries. I took my MSc in Energy and Environmental Management and Economics at ENI Corporate University in Milan with no knowledge of the language and no friends or family nearby – it was tough. It became one of my best decisions, though. Choosing to do my MBA at Imperial a decade later was a much easier decision. Having built the technical depth as an economist at that point in my career, I sought to broaden my scope and subject matter expertise. So, I moved into consulting and did the MBA in parallel.

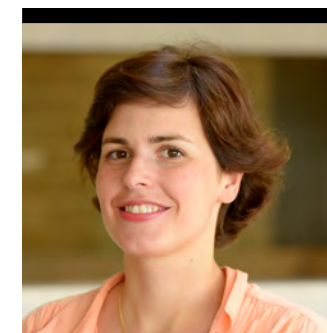
Q. What lessons did you learn from your MBA?

A. Doing an MBA means you meet people who have self-selected to be there to study, learn and meet new people – that gives a different vibe, energy and relationship within the cohort. Imperial nurtures your innate DNA, and being sector-agnostic also expanded our frame of references and networks beyond our sectors. My time at Imperial set me on a journey, using my new tools and building blocks to become an entrepreneur and cultivate my three passion points – gender diversity, energy and the African continent.

Q. What led you to set up Lean In during the recent pandemic?

A. Women were disproportionately impacted by job losses during the pandemic and the crude oil price depression of spring 2020, especially women in middle management. This, unfortunately, resulted in a regression of some of the gains in gender parity made in previous years. I wanted to do something tangible to support women in acquiring the tools and strategies needed to navigate the inevitability of bias in the workplace.

> *In March 2023, Lamé Verre was appointed as a Global Future Council Member 2023/2024 – The Future of the Energy Transition for the World Economic Forum.*
leaninequity.org



DR JOANA MOSCOSO
(PhD Life Sciences 2013)
Co-Founder and
Director of Native
Scientists, Co-Founder
and Co-Director
of Chaperone

Q. When did you first become interested in science?

A. I grew up in the peaceful medieval town of Valença do Minho in the north of my native Portugal. When I was nine, we had a school lesson about bacteria. I was immediately fascinated and told everyone I wanted to become a scientist. 'Don't be crazy' was the reaction, right up until I was 17. It was the first barrier I felt as a child and one I was determined to break.

Q. You became a scientist and set out to encourage others on the same path. When did you start volunteering?

A. I only really felt I was a scientist at the end of the first year of my PhD, when my first paper was published. I wanted to give something back to society and, through the volunteering service at Imperial, I helped out in a local primary school. At the time, I had no experience of teaching science to children, English is not my native language, and the class was very multi-cultural. Then I met Dr Tatiana Correa, and we started organising workshops that connected scientists and children to spark interest in science among Portuguese-speaking primary school children in London.

Q. Together you founded Native Scientists. How did that happen?

A. After the first successful workshop, we entered four social entrepreneurship contests and won them all. But if it wasn't for Imperial's nurturing environment, Native Scientists – our non-profit organisation connecting scientists with schoolchildren across Europe to reduce inequalities, promote quality education and celebrate diversity – would probably not exist. I had never before felt the encouragement I experienced at Imperial; I could be a scientist, and I did not have to hide my entrepreneurial side. It finally felt normal to have ideas outside the box!

> *Founded by Dr Joana Moscoso and Dr Tatiana Correa, Native Scientists has a network of more than 3,000 scientists across Europe, and their educational programmes have established more than 20,000 connections between scientists and children.*
nativescientists.org

INTERVIEWS: SARAH WOODWARD. IMAGE: ALAMY. PHOTO OF DR MOSCOSO: EGÍDIO SANTOS

POLICY AGENDA – PROFESSOR DAVID MILES, THE OFFICE OF BUDGET RESPONSIBILITY

When the Treasury want to know the implications of a decision, they call us



Managing Britain's economy is challenging for any politician, especially as most have no background in economics. Inevitably they need help, and much of it comes from Imperial's Professor of Financial Economics, Professor David Miles, a member of the Office of Budget Responsibility (OBR), whose three experts provide the government with independent economic forecasts and analysis of the public finances.

"We do not tell the Chancellor what to do," says Miles. "Government makes its own plans on taxes and spending – but it asks us for our objective assessment on the likely implications."

For instance, the government's current financial priority is a rolling five-year plan to reduce the nation's debt relative to gross domestic product, so underpinning all Miles' analysis is the probability of hitting this target.

"The UK has an unusually high level of debt to GDP," he says. "The pandemic, the war in Ukraine and the energy crisis have left the government trying to grapple with issues beyond its control. If the debt relative to national income keeps rising, the world's investors will become more wary of lending the UK government money, so it's sensible to prioritise reducing it and paying less interest."

So the government sets out plans and the OBR uses modelling to forecast the potential impacts on spending and tax revenue. "There's a lot of data on the effect of interest rates on mortgage rates, the impact of mortgage rates on people's disposable income, the knock-on hit to consumption and the effect of consumption on demand

for firms' output," says Miles. "Our mathematical models, based on many decades of data, give us a guide – but no more than that – as to how things will play out."

But other factors mean models have to be created from scratch. "Some things are not so easy to forecast. UK net immigration last year was 500,000, but you have to calculate the proportion of those that are of working age and who will find jobs, and whether their immigration is permanent or more transitory. The more who work, the more that reduces the welfare bill and raises income tax receipts, which can hugely impact fiscal debt. Then there are longer term domestic demographic factors such as fertility rates and an ageing population."

On top of that are economic shocks to factor in, such as COVID-19, whose legacies include longer NHS waiting lists. "There's an enormous increase in people whose poor health prevents them working," says Miles, whose research has included several meetings with UK chief medical officer Sir Chris Whitty. "Is this temporary because of COVID-19 or down to longer term health problems, such as mental health or obesity?"

Equally unexpected was a 500 per cent increase in gas prices. "Before Russia invaded Ukraine, gas prices had pretty much flatlined for ten years," says Miles. "But we've recently had to work quickly on economic analysis of a shock whose scale and magnitude had seemed implausible."

Other recent events have also proved why his team's analysis is so vital. The fiscal chaos of Liz Truss's brief tenure as Prime Minister came after she ignored the OBR. "We were prepared to carry out analysis to be published alongside the government's

mini-budget, but we weren't asked," he says. "We can't force the government to do anything. But when Jeremy Hunt became Chancellor, we were asked for input and a full OBR report was published alongside his budget."

But forecasting the future isn't easy. "The biggest challenge is the slowing rate of productivity," says Miles. "From the end of the Second World War to 2008, labour productivity – the key driver of wages – was rising at just over two per cent per year, meaning people's standard of living rose around 50 per cent every 20 years. But since the 2008 financial crisis, productivity and wages have risen annually barely half a per cent. That means GDP is 25 to 30 per cent lower than you'd have predicted 20 years ago."

"Is this just an unlucky run of blips – the financial crisis, COVID-19, war – meaning things will return to previous levels? Or was the blip

Government makes its own plans on spending, but asks for our objective assessment

actually the whole of the 20th century, an exceptional period of increased standard of living through inventions, discoveries and developments, and should we just get used to the fact we are returning to what was normal before that?

"And that leads us to another question: what impact will today's technological developments, such as AI or ChatGPT, have? The answer will have significant implications, and an important role of the OBR is to assess their magnitude. They will affect how we all live in the future." ♦

WORDS: PETER TAYLOR-WHIFEN

ILLUSTRATION: NICK CHAFFE



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> *Whether it's at an event, online or over a coffee on the campus, we can't wait to be in touch with you again. So don't miss out – update your contact details and preferences at imperial.ac.uk/alumni/contact-us/update*

MY IMPERIAL

A skate way to travel

Dariusz Duszynski (*MSci Physics 2023, PhD in Laser Amplification for Plasma Experiments*).

Words: Greer McNally / Photography: Joe McGorty



On the edge:
Dariusz inline skating
in Hyde Park.



I've always been a skater – and for the longest time, Imperial was the only university in the country with its own skate society. It was a big draw for me. In my first week, I was able to meet people with the same hobby and by my third year I was the society president. We meet in Hyde Park and there's a real sense of community.

The main thing I'm into is freestyle slalom. It's like combining figure skating and dance battle. It involves equally spaced cones and you have a set amount of time to do your most impressive routine around them. At the other end of the skating spectrum, I also do speed skating. We've actually entered a couple of competitions while I've been here, and I ended up organising two of those.

The first was the Berlin skate marathon, which is exactly as it sounds – a marathon but on inline skates that happens two days after the Berlin Marathon. It's great fun and takes you past all the landmarks. The other one was in Le Mans. It's a 24-hour relay race on the two days of the year when there isn't any motorsport there. It was a fantastic experience.

We didn't get on the podium, but we placed higher than some of the other teams in their matching outfits, with their on-site massages. We were very proud of ourselves!

Inline skating is actually one of the *two* reasons I chose Imperial. The Outreach science labs, a STEM potential programme that introduces schoolchildren to the idea of attending university, was the other. It's typically for kids from backgrounds who aren't likely to go on to higher education.

I was encouraged to take part in it when I was at school, and it changed my life for the better. I wanted to do the same for other kids like me, so now I volunteer with the Outreach labs. I love showing them that there's this really cool, different life out there that they didn't think they could access.

One of my favourite experiments is when I make a superconductor levitate above a magnet. There are always oohs and aahs. You can grab a piece of paper and show there's no strings attached. The kids love it and it's nice to see them happy with the real physical explanation. Just as I was when I was in their shoes. ♦



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GREAT EXHIBITION ROAD FESTIVAL JUNE 2024



Exploring the extraordinary

The 2023 Great Exhibition Road Festival was a huge success, welcoming over 50,000 visitors. Across a jam-packed weekend, South Kensington's science and culture institutions presented the power of awe and wonder through a series of inspiring talks, wondrous workshops and innovative events.

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