SEA CHANGE

HOW IMPERIAL'S DEEP DIVE ON CLIMATE CHANGE COULD HELP SAVE OUR OCEANS

Imperial/53

THE MAGAZINE FOR THE IMPERIAL COMMUNITY

WINTER 2022/23

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."

> **Support from Alumni like you took a huge burden off me.** I was able to give my course my full attention and explore all that Imperial has to offer.
>
> Zoya, MSc Advanced Chemical Engineering

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 bit.ly/ICL-Magazine-3szDnGp

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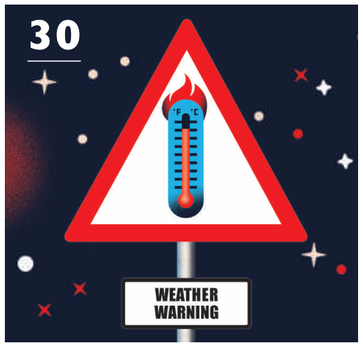

Regulars

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If you enjoy reading *Imperial*, we hope you will consider supporting the College through a voluntary subscription to the magazine, using the form enclosed with this issue. As long as your address details are up to date, you will continue to receive *Imperial*, regardless of whether you choose to donate.

YBM

DIGEST

GIFTS

ALERT! Gormley unveils new sculpture

A new work of sculpture by world-renowned artist Antony Gormley has taken pride of place on the revitalised Dangoor Plaza. The 6m-high work, ALERT, uses stacked and cantilevered blocks of weathering steel to evoke the human form. This material naturally forms a stable oxide coating and will take on a deep orange rust-like appearance.

Gormley says: "Through the conversion of anatomy into an architectural construction, I want to reassess the relation between body and space. Balancing on the balls of the feet while squatting on its haunches and surveying the world around it, the attitude of this sculpture is alive, alert and awake."

ALERT was gifted by alumnus Brahmal Vasudevan (Aeronautical Engineering 1990), founder and CEO of private equity firm Creador, and his wife Shanthi Kandiah. Vasudevan's previous support includes £25 million – one of the largest gifts in the College's history – to establish the Brahmal Vasudevan Institute for Sustainable Aviation.

"I am deeply proud of my connection to Imperial and have fond memories of my time on campus as a student," he says. "I share the College's vision for a vibrant public space, and am proud to bring this iconic, world-class piece of art by Antony Gormley to the heart of campus." ◆

High alert
Antony Gormley, Shanthi Kandiah, Brahmal Vasudevan and Professor Hugh Brady in front of 'ALERT'.

PHOTOGRAPHY LEFT: IMPERIAL COLLEGE LONDON/THOMAS ANGUS. ILLUSTRATION ABOVE RIGHT: MIKE LEMANSKI

WRITE TO US

Letters

Join the debate and tell us your news and views.

Reinventing capitalism

I very much enjoy reading *Imperial*, learning about innovative research and attempts to solve big problems with big ideas. However, occasionally, I am left feeling that the bigness of the ideas verges on hubris. For example, in *Imperial 52*, you published Prophets of Profits, which asks "is it now time to disrupt and reinvent capitalism itself?".

Let's think about that for a moment. Let's start by calling "capitalism" by its other common name: "free enterprise". This is expressed as a phrase, "free enterprise", because both freedom and enterprise are important parts of the meaning, inextricably linked in this context.

Given that link, I don't think it's too much of a stretch to now reword the question addressed in the article as "is it now time to disrupt and reinvent freedom itself?". I'd respectfully suggest your researchers tread very carefully here.

Roo Davison
(MSc Computing 1985)

Lysergic acid

The piece on yeast use in dementia research (issue 52) referenced D-lysergic acid. In the expansion of Biochemistry at Imperial in the 1960s, ergot and lysergic acid were key drivers in research.

Of course, the vast physical expansion of Imperial and science since tends to obscure connectivities; the recent fascinating *Nature* item makes no mention that striving towards similar outcomes has been endemic here for more than 60 years.

Emeritus Professor Peter Mantle,
Centre for Environmental Policy

More love stories

More than 10 years after graduating, it was written in the stones. Here are the players: Ken, my flatmate and Sub-Warden at Mining House (and, spoiler, best man at our wedding); Helen, a geology PG in Ken's lab and the first female Sub-Warden of Willis Jackson House; me, an American chemistry PG and the last person northerner Helen would want to meet.

But, I kept showing up like a bad penny, helping Ken (and Helen) with their duties, and eventually we hung out as a group at the pub and other student things. Then Helen made a fatal mistake and invited me to spend Christmas with her family in Altrincham, out of pity that I was "alone over the holidays".

I got along well with Helen's mother and didn't irritate her dad. He said I wasn't bad for a Yank. High praise. I played Mastermind, drank my beer out of a straight glass and talked cricket with Helen's father because I'm, like, 80 per cent blarney. Forty-five years, two careers and three children later, we are still together.

Bill Farrell
(PhD Chemistry 1979)
and Helen Moore Farrell
(PhD Geology 1980)

My parents, Noel and Barbara (née Wright) Strachan (Chemistry PhD 1943 and Mech Eng 1942), met at the IC Christian Union and married in 1945. As the youngest of their four children, I studied Mech Eng at Guilds from 1978 to 1981. My father's name is written in gold leaf on a wooden board in the Beit Building, as he was Secretary of ICU. They were married for 58 years until parted by death.

Ken Strachan,
(Mechanical Engineering 1981)

Paper stock

You say (in issue 52) that the different look of the magazine is temporary. Why should it be? It uses (wastes) less of the world's resources. Please keep it as per issue 52!

Philip Nalpanis
(Physics 1982)

As always, I thoroughly enjoyed reading the latest issue (52) of *Imperial* magazine.

I noticed the lighter paper, and read with interest the note regarding the global paper shortage and hence this change.

I hope you continue to use this lighter paper as it made it so much easier to fold the magazine and read it. I'm hoping this paper is more cost-effective too – and can I assume that as it is thinner we may also be saving more trees?!

Shadi Kelly (née Khoroushi)
(BSc Zoology 1990,
MSc Environmental Technology 1991)

CONTACT US

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

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@imperialcollege, #OurImperial

For the latest news from the College as it happens, and to be a part of the Imperial community, visit our Imperial alumni Facebook page and LinkedIn group.

fb.com/alumni.imperialcollegelondon
www.linkedin.com/groups/87488

FROM THE PRESIDENT / PROFESSOR HUGH BRADY

Why I couldn't resist Imperial's cocktail of focus, passion and impact.

It is a great honour to serve as President of Imperial, and to open this latest edition of *Imperial* magazine. My connection to Imperial goes back to 1981 when a medical student elective in 1981 at the Hammersmith Hospital, one of Imperial's clinical partners, inspired me to pursue a career as a clinician-scientist in nephrology.

I have admired Imperial from afar over the years. It is a world-changing institution with a unique history, magnificent track record of achievements and enormous potential.

Over a century and a half, a series of bold and visionary moves paved the way for the creation of today's Imperial – a global powerhouse that is truly distinctive because of three powerful elements: Imperial's focus on business, engineering, medicine and science; its passion for innovation, translation and impact for societal benefit; and its location in one of the world's greatest cities.

It was this alluring cocktail that attracted me to Imperial, and that attracts the brightest minds – students and staff – from across the world. It is the cocktail that makes Imperial unique among the world's leading universities.

I have been inspired by how many staff and students tell me that they chose Imperial explicitly because they want to make a difference. They are constantly striving to generate and harness new knowledge and technologies to make our world healthier, smarter, safer and more prosperous and sustainable.

Our Imperial community's recent performance has been outstanding. However, the world of higher education and research is changing rapidly, and our global competitors continue to invest and evolve. We are acutely aware that Imperial cannot afford to rest on its laurels if we are to play our full part in addressing the challenges facing society and our planet. Over the next year we plan to refresh Imperial's vision and strategy to strengthen our position among the top tier of global universities and maximise our potential as a force for good. Imperial's fundamentals are very strong, and it has extraordinary potential thanks to our fantastic staff, students, alumni and friends.

I hope you learn as much as I did about Imperial when reading this issue of the magazine and discover more about what our students, staff and alumni love about the place. The Cinema Club and the Harry Potter Society are brilliant examples of the warmth and creativity of our community. I was also thrilled to read about the Pathways to Medicine programme and to hear from Nagad and Sophie about how the programme has inspired them to give back and support the next generation of medics.

All the Imperial researchers and alumni featured in this issue are helping to make the world a better place – from revolutionising batteries and understanding the causes of allergies, to regulating space, providing better healthcare for women, and using maths to study the impact of climate change on our oceans. It's wonderful to see the impact that our community is making across disciplines and around the world. I hope their stories inspire you as they have me.

> Staff and students say they chose Imperial explicitly to make a difference

I hope to meet more of you in the year ahead and to hear first-hand about your relationship with Imperial. I look forward to thanking you in person for your steadfast support. ◆

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

PHOTOGRAPHY: IMPERIAL COLLEGE LONDON/THOMAS ANGUS.

Below from left: Notpla founders Pierre Paslier and Rodrigo Garcia Gonzalez.

SUSTAINABILITY

Seaweed 'plastic' startup shortlisted for Earthshot Prize

A startup founded by Imperial graduates has been named as one of the first UK finalists of the Prince of Wales's Earthshot Prize.

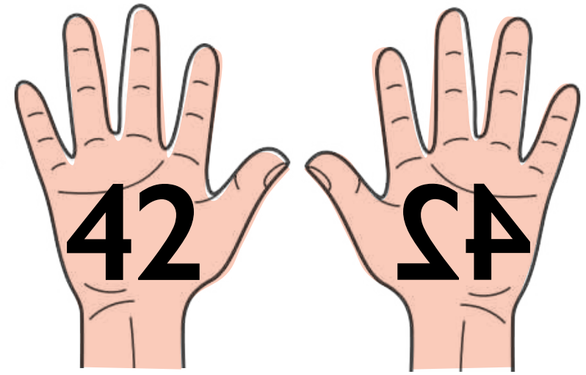
Notpla, founded by alumni Pierre Paslier and Rodrigo Garcia Gonzalez in 2014, has been shortlisted in the 'Build a Waste-Free World' category for their seaweed-based biodegradable alternative to plastic.

The prize was launched in 2020 by the Prince of Wales and Sir David Attenborough. It awards a grant of £1 million to individuals or organisations for work to address one of the five Earthshot categories: protect and restore nature; clean our air; revive our oceans; build a waste-free world; and fix our climate.

The pair met while studying Innovation Design Engineering, offered jointly by Imperial and the Royal College of Art. During their time at Imperial, they received support from Imperial Enterprise Lab and were previously based at the Imperial White City Incubator.

The winners of the Earthshot Prize were announced in December at earthshotprize.org.

PHOTOGRAPHY: SAM SCALES



The Hitchhiker's Guide to the Galaxy says 42 is the answer. But what is the question? For Dr Jess Wade it is: can chirality revolutionise developing technologies?

From corkscrews and spiral staircases to snail shells and a DNA helix, there are plenty of examples of curves in the natural and human-made world. And what sets some of these apart is their 'chirality' – the fact that they cannot be mapped directly on to their mirror image. Think left-and right-handed scissors or golf clubs.

Chirality matters, says Dr Jess Wade (MSci Physics 2012, PhD 2016), Research Fellow in the Department of Materials. Take the methamphetamine molecule, for example: twisted one way, it's the illegal drug crystal meth; twisted the other and it's an over-the-counter nasal decongestant. Now Wade is figuring out how to exploit this molecular twist, with huge applications for advanced technologies.

"For a long time people didn't recognise chirality as important or useful," she explains. "Then we had a revolution in the world of semiconductors, and scientists realised it was possible to create tailor-made electronic devices from carbon-based molecules." The result was the development of organic light-emitting diodes – or OLEDS – the technology that makes possible the super-light, super-thin, super-bright phone, television and laptop screens we all take for granted.

Chirality makes these organic semiconductors more awesome. It's all to do with how molecular shape impacts the electrons that pass through them, or the light that is emitted from them, says Wade; the molecules' chirality, or how they're twisted, make electrons and photons spin a particular way. Current and future technologies depend on the precise control of that spin.

Established strategies to achieve control in these applications rely on expensive materials and ultra-low temperatures. But Wade's Chiral Materials Team have pioneered an alternative approach to control photon and electron spin in organic materials through the development of new organic semiconductors.

As well as winning them the Royal Society of Chemistry's Materials Chemistry Division Horizon Prize this year, their work has potentially far-reaching implications. "Take brain imaging: as electrical signals are sent between your neurons, your brain generates really small magnetic fields. If you want to monitor these weak signals, you perform magnetoencephalography, which currently relies on bulky and expensive superconducting quantum interference devices to generate the required sensitivity. If you could develop flexible, lightweight room temperature operable devices that can detect super weak magnetic fields, you could completely revolutionise healthcare.

"There are so many extraordinary applications of chiral molecules, which can make existing technologies more environmentally friendly, as well as opening the door to technological innovations that don't even exist yet."

> ***Dr Jess Wade** is a Research Fellow investigating spin selective charge transport through chiral systems in the Department of Materials.*

Below:
Professor Shanahan's task involves simple object permanence exploration – hiding a ball and seeing if the dog can find it. Such tests are still challenging for AI, and must be resolved to create more general forms of artificial intelligence.






ADVENTURES IN... ARTIFICIAL INTELLIGENCE

Living in a virtual world

Murray Shanahan, Professor in Cognitive Robotics, has developed an AI environment that provides a model for artificial intelligence.

—

Words: **Megan Welford** / Photography **Emli Bendixen**

Professor Murray Shanahan (BEng Computing 1984) was a questioning sort of child. "Aged around 10 or 11, I would lie awake at night wondering how we knew if anything really existed," he remembers. "Was it down to information we received through our senses? I enjoyed these slightly alarming, weirdly exciting questions. But if I talked to my parents about it, they looked at me as if I was from Mars."

As the young Shanahan played with Lego, he thought about the idea that if you could take your minds to bits, you would discover how it worked. Later, at sixth form college in Weybridge, he would discover like-minded souls who were also into Asimov, *Star Trek*, robots and aliens. "It seemed to me that science fiction was trying to address these deep philosophical questions, such as what it meant to be human," he says. "Robots fascinated me, and I found the idea that we might be able to create artificial minds absolutely extraordinary. I was programming computers and getting these dopamine hits from making something that functioned, something tangible. It happened inside the computer, but it was a bit magic."

He still feels that magic today, as he mentors AI students or directs the Cognitive team at Google DeepMind. And he's still trying to build a mind, but is pretty sure that you can't do it without a body, quoting the quantum physicist Richard Feynman: "If I can't build it, I can't understand it." It's this concept of embodiment that interests him most.

"Nature built our brains to interact with our environment – 3D objects and space," he explains. "It's really important for cognition and intelligence. And it links into my idea of 'foundational common sense', the idea that humans can understand key environmental concepts in relation to objects – things like motion, solidity, holes, containers, flow and growth – from a very early age, often before we are two years old."

To explore the concept of embodiment further, Shanahan's lab ran a competition at Imperial called the Animal-AI Olympics – and in the process, created a virtual environment that is so useful and challenging it has since been adopted by other labs.

"Embodiment doesn't have to be literal or physical, it can be in a games world," he says. "So we created a virtual environment of rooms, boxes and walls, and set various tasks to explore concepts such as object permanence. This is one of the most fundamental aspects of common sense in humans – an understanding that there exists a world that is independent from ourselves, a world that is spatially organised and contains enduring objects, one of which is our own body."

The challenge, then, was to build AI that can do things like find an object hidden behind another or pick up an object using a rake. "These are often simple tasks that children and some animals can do, but they require relating to the physical world, and it's proving incredibly hard to design AI to do that!" says Shanahan.

Embodiment doesn't have to be literal or physical, it can be in a games world

"When the founders of AI were working in the 1950s, they thought it would be really easy to build human-level artificial intelligence, that it would just take a few years. But this is what's holding us up. You can train technology to do one thing – drive a car, play Go, autocomplete words or recognise faces in photos – really well. But until AI can transfer its knowledge across different domains, which humans do by interacting with the physical world, it will never achieve human-level intelligence."

The Animal-AI testbed is another way of benchmarking AI and its ability to transfer knowledge from one task to another. "We know that if you teach AI enough words, it can talk. But it's talking before it can walk," he says. "Until it has general intelligence, like humans, it'll never be any good. People want to build sophisticated tech. My motivation is, if you're going to have a driverless car, it had better work properly!" ◆

What comes next?

When you leave a gift in your will to Imperial, you can help talented researchers like Tanith tackle our future challenges.

When Imperial alumna and donor Angela Mawle sadly passed away in 2019, she left a generous legacy of £50,000 to Imperial. Her gift is now supporting Tanith, a young scientist who is furthering our understanding of our environment.

"I am a first-generation student, and the first in my family to undertake a PhD," says Tanith. "Coming from a low-income background, this legacy gift has given me the financial security to pursue my passion and take the next step in my career."

Leaving a legacy

Angela Mawle's life was committed to social justice, the environment and supporting women in the workplace. She graduated from Imperial in 1989 with an MSc, and worked at the College between 1990–1994 in the Centre for Environmental Technology.

> "Coming from a low-income background, this legacy gift has given me the financial security to take the next step in my career."
>
> **Tanith, Life Sciences Research PhD**

When she died, she dedicated a gift to fund half a PhD at the Grantham Institute at Imperial, helping to create effective action on climate change and the environment.

Tackling future challenges

Angela's gift is funding Tanith's PhD in Life Sciences, where she is exploring how invasive alien species affect biodiversity, and how society can tackle this current and future challenge.

"I'm very excited," Tanith says. "I can't put into words how much this means to me! Creating more opportunities like this for enthusiastic students who may not otherwise have access to a PhD or to the excellent support at Imperial is so important."

"I couldn't have done this PhD without this gift," she adds. "I am incredibly grateful and honoured to have been given this opportunity."

Leave a gift in your will to Imperial

A gift in your will can give future generations of students and researchers like Tanith the chance to thrive at Imperial and beyond. You'll also be playing your part in research breakthroughs that tackle tomorrow's biggest global challenges, such as the climate crisis or future health threats.

For more information on leaving a gift in your will, get in touch with Anna Wall, Head of Regular Giving and Legacy Giving, on **+44 (0)20 7594 3801** or email **a.wall@imperial.ac.uk**

www.imperial.ac.uk/legacy-giving

EDUCATION: HOLLIE PRESTON IS A THIRD YEAR BIOCHEMISTRY STUDENT AND MENTOR ON THE INSIGHT2UNI PROGRAMME

Wanted: a clearer career path and access to more relatable role models

Attending a top-tier university is the dream for many aspiring medics, engineers and scientists, to name but a few. But studies show that there's a problem – frustrated by a lack of a clear career path and access to relatable role models, too many pupils of Black heritage are failing to realise that dream.

That makes me one of the lucky ones, and it's why I'm so keen to be part of Imperial's Insight2Uni mentorship programme. I am the first in my family to go to university, so initially I learned about what to expect from things like YouTube. But the best information I got was from talking to actual students when I went to a summer school up in Edinburgh. Those students embodied what I wanted to be. They were only a couple of years older, but they seemed like adults, and I felt like that could be me one day. I loved being able to ask them questions and find out what university life was really like.

It was natural, then, that once I made it to Imperial, I signed up to support the outreach programme. I chose the Insight2Uni mentorship programme because it means I get to really know the high schoolers I'm mentoring throughout the year. I'm currently working with three London sixth formers; I met them in person earlier in the year, we have monthly catch-ups online – either one-to-one or as a group – and I'll support them with their university applications through to December.

They are a talented bunch – sometimes I think they should be mentoring me! – but though they have the ambition and drive, they don't quite believe in themselves. They'll tell me the incredible stuff they're doing but end with "whatever" or "it's not that impressive". My role is to help them feel more confident and help them figure out what they want. They might be feeling pressure from their family to study Medicine, for example, but they have to really want it for themselves.

I also ask them what their hobbies are outside of science. Obviously, universities are on the lookout for well-rounded candidates, but burnout is real. In sixth form you feel invincible, but the earlier you learn you need to take time to relax, the better. And I'm learning too – mentoring makes me reflect. For example, I'll tell them to do something fun, and then I'll go and spend 12 hours in the library! That's not OK.

I love feeling like I'm making a difference, seeing students go from quiet and timid to sure and confident. One girl initially confessed she absolutely didn't want to take entrance exams, then she came on a call recently and said: "I'm taking the University Clinical Aptitude Test next week!" I love seeing them gain in confidence, and I feel very proud of them.

As a girl growing up in an incredibly White area of Worcestershire, it wasn't really until I got to London that I saw people who looked like me. Imperial is very international, and it would be easy to think that therefore everything's fine, but of course the number of Black-heritage students at UK universities generally is very low. The real discrepancy I see, even at Imperial, is the lack of Black lecturers. Maybe we need a programme like Insight2Uni for Black professors? ◆

> The students embodied what I wanted to be – I loved being able to ask them questions

> ***Hollie Preston** (Biochemistry, Third Year) is an Insight2Uni mentor.*

INTERVIEW: MEGAN WELFORD

IMPERIAL INNOVATES

A salty solution

AquaBattery's Dr Jiajun Cen wants to revolutionise the energy storage market.

Interview: **Clare Thorp**

The need for long-duration energy storage is often overlooked in the rush to move towards more renewable energy sources. Energy supply from sources such as solar and wind can be intermittent, and if the energy is not stored at the time of capture, it is lost. So what's the answer?

Traditionally, batteries are the primary method of renewable energy storage, but battery technology has lagged behind advances in things such as wind and solar production. Batteries can store energy, but most conventional ones are toxic, expensive and unsafe. Which is where AquaBattery comes in. Our process sees a saltwater solution flow through a specialised membrane stack during charging, which produces acid and base under an electric field. The acid and base are then stored in separate tanks to keep energy. During discharging, these two solutions are recombined to form saltwater, and this process generates electricity.

The idea came to me and my colleagues after we attended Fujifilm's innovation competition for desalination. There we did some brainstorming and figured out that you can use energy to purify water and get salt out of salty water – but you can also do the reverse and get energy out of salty water.

Fast forward to 2022 and we are commercialising the technology. There are several advantages to our battery. Firstly, it's safe. It is also very affordable and it allows you to store energy using local resources. Once the power unit is onsite, water and salt can be bought locally. There's no need to ship heavy toxic chemicals, meaning a much lower carbon footprint. By storing excess energy in the batteries and then supplying it back when demand is greater than supply, we can help make the whole system more efficient.

Imperial have been integral to the AquaBattery journey. First, my studies – which focused on the dynamics and physics of fluids going through a porous medium – gave me the expertise to understand very complicated fluid element problems. I also benefited from being part of the Grantham Institute, where I met many inspirational and entrepreneurial-minded peers. The whole ecosystem has taught me how to present ideas and apply for funding, which is vital in transforming an idea into a reality.

Earlier this year we were awarded €2.5 million in grant funding from the highly competitive European Innovation Council's Accelerator, and if we do well, they can co-finance investment rounds up to €15 million. The money will help us grow from the small-scale pilot stage to being a commercial product. Our aim is to have an official launch in 2025.

The ecosystem taught me how to present ideas and apply for funding – vital in transforming ideas into reality

My long-term goal is to revolutionise the energy storage market. I don't expect AquaBattery to do it alone – and I hope we don't. It's great if we end up having competition, because I want others to be invested in making the transition to renewable energy happen, too.

> ***Dr Jiajun Cen*** *((PhD Chemical Engineering 2020) is CEO of AquaBattery.*

Electric field
During charging, a saltwater solution flows through a specialised membrane stack, which produces acid and base under an electric field.

Generating electricity
The acid and base are then stored in separate tanks to keep energy. During discharging, these two solutions are recombined to form saltwater. This process generates electricity.

Sustainability
AquaBattery's flow technology has been developed with sustainability in mind from the start. The battery stores electricity in only table salt and water, which are abundant, environmentally friendly and cheap.

IN BRIEF

Rowers take on prisoners
A team of student rowers competed against inmates from Wandsworth Prison as part of a programme set up by Imperial's Head of Rowing, Peter Hardcastle.
bit.ly/imperial-53-rowers

Imperial Enterprise guide
Ever thought about investing in an Imperial startup, sharing your expertise with students, or using Imperial's vast network of experts to benefit your business? Imperial Enterprise can help you do all that, and much more. Find out who we are, what we do and we can help you make things happen.
bit.ly/imperial-53-enterprise

Africa Seed Fund launched
Imperial has launched a new seed fund to help kick-start innovative research and education projects with partners in Africa. The Africa Strategic Research and Education Partnerships Fund is available for academics, researchers and students at Imperial and partner organisations.
bit.ly/imperial-53-seed

OVERHEARD ON CAMPUS

Dual robot: *a drone that can fly through the air and land on water to collect samples and monitor water quality, developed by the Aerial Robotics Lab and officially called the Multi-Environment Dual robot for Underwater Sample Acquisition (MEDUSA).*

Self-organising lasers: *a laser that can reconfigure and reorganise itself when conditions change, in the same way that biological structures such as bone and muscle reorganise. Projects such as Imperial's first-ever spontaneously self-organising laser device could help develop the next generation of responsive materials.*

Adoptive cell therapy: *a new microfluidic device designed in the Department of Bioengineering that could drastically speed up the process of identifying effective cells. It works by isolating, modifying and growing immune cells that grow naturally in the human body, then reintroducing them to kill cancer cells.*

CANCER RESEARCH

New myeloma research centre at Imperial

Science has made huge strides in its understanding of the biology and treatment of multiple myeloma – but the condition remains incurable. Now, the newly-opened Hugh and Josseline Langmuir Centre for Myeloma Research will consolidate, expand and intensify research into this form of bone marrow cancer, thanks to benefactors Hugh and Josseline Langmuir.

In 2019, they gave £10 million to establish the Centre, which is part of the College's Hammersmith Hospital Campus. Professor Tassos Karadimitris, Director of the Centre, says: "Our ambition is to make the Centre a physical and spiritual home for researchers studying the biology of multiple myeloma, in pursuit of new treatments that will hopefully improve the outlook of this incurable blood cancer and, eventually, cure it."

Our ambition is to make the Centre a physical and spiritual home for researchers studying the biology of multiple myeloma

Dairy Yeast Pollen Nuts Dander

It's easy to dismiss allergy as just another trend. But as Professor Adnan Custovic's work demonstrates, that could not be further from the truth. ▸

Words: **Victoria James /** Photography **Thom Atkinson**

Professor Adnan Custovic, Leader of the Paediatric Allergy group and Director of the Imperial College London/ Imperial College Healthcare NHS Trust Allergy Centre.

Pollen, dust, nuts, milk, fur… allergens are everywhere. We use various treatments to keep them under control, but for me that's not enough. I'm much more interested in achieving health, rather than just treating the disease. So, understanding what causes the allergy in the first place is fundamental, not just in treating it, but also in helping us to get to grips with the bigger picture. I firmly believe that by understanding what is causing the increase in allergic diseases, we may ultimately come to understand the causes of the increase in a number of other complex non-communicable diseases, such as diabetes, arthritis or even leukaemia.

A good place to start is to gather a realistic and accurate picture of the change in prevalence of different allergic diseases and the consequences of living with them. For example, hay fever was extremely rare in the 19th century, but by the mid-1950s it was declared a public health emergency in New York. The allergy clinic at St Mary's Hospital in London had thousands of patients on pollen immunotherapy as early as the 1960s, and today, around 25 per cent of our UK population suffers from it.

An increase in hay fever was followed by a rapid increase in cases of asthma from the 1960s to the end of the 20th century. Now its prevalence stands at nearly 15 per cent. Finally, in the past couple of decades, we've experienced an extraordinary rise in the number of children developing food allergies. When I was running allergy services in the north-west of England in the 1990s, I could see all my young patients with nut allergies in just three or four clinics. It's vastly different today. And for me, that poses a remarkable challenge.

A SPECTRUM OF DIAGNOSES

My efforts to grasp what triggered this huge increase took me outside the UK. I believed we would learn more by observing a part of the world where those changes might be in the process of happening. So, for more than a decade, from the early 1990s to 2005, we conducted a series of studies in Ghana.

It was important not to take the approach of simply asking people whether they had allergies or asthma, because at that time awareness of these conditions was growing. Instead, we used a spectrum of objective diagnostics – such as skin testing and exercise challenge testing – across more than a thousand children. The results were staggering. In the course of just a decade, the prevalence of airway hyperreactivity, asthma and allergic sensitisation among the children doubled.

Interestingly, in the UK, asthma is strongly associated with allergic sensitisation and increased body mass index. But what we saw in Ghana in the early 1990s was different, and children with asthma were not allergic. And yet, the "new asthma disease" that emerged there over the subsequent decade looked precisely like the one we have in the UK. It was a 'wow!' moment – there was a brand new phenotype emerging, not a simple increase in the disease that was already there.

FINDING ANSWERS

And it has got me thinking about another question. We observe the symptoms of asthma – but could 'asthma' actually be an umbrella term for a number of very different sets of disease mechanisms? You quickly see in clinical practice that patients with asthma may be very different from each other, and that their disease is caused by fundamentally different mechanisms.

By extension, they will respond differently to different treatments, and the only way to deliver personalised management is to understand which mechanism gives rise to symptoms in an individual patient, and administer treatment that targets that specific mechanism.

Say you have a child with a fever. The fever is what you can see – a phenotype. But what is the cause of that fever? It could be bacterial, in which case, give them antibiotics. But it's more probably viral, in which case antibiotics are really counterproductive. In certain regions of the world, it's quite likely to be malaria. Three different causes, all manifesting in fever. What that tells us is that unless you understand what process is contributing to the expression of an individual's symptoms, you won't be able to treat them appropriately.

Sometimes gaining a realistic and accurate picture of the consequences of living with an allergy can be helpful itself. A diagnosis of food allergy can be frightening for both child and parent, and lead to all sorts of unfortunate results: a child feeling excluded by their peers, an anxiety that can hugely impact the quality of life for all involved.

One problem we are facing is that we can't yet accurately identify those who are at greatest risk from severe allergic reaction. The tools simply aren't there yet, although colleagues in my group, such as Dr Paul Turner, are working hard on them.

The core of my own work in the past 20 years has been the use of machine learning to help interrogate all these questions. In the paediatric allergy field in the 1980s and 90s we had relatively small datasets – you could look at the data and see patterns. Then technology kicked in and we were suddenly able to collect vast amounts of data. But in that situation, you risk no longer quite knowing what question you're asking, because what's available to you for interrogation is so huge. So, I knew we needed to invest in ways of understanding patterns within these very large datasets. Machine learning and AI are ▶

We observe the symptoms of asthma – but could 'asthma' actually be an umbrella term for different sets of disease mechanisms?

Eye-watering stats
The NHS estimates that there are more than 10 million people with hay fever in England.

Danger zone
Peanut allergy is the most common cause of food-induced anaphylaxis.

extremely powerful tools to achieve this, and we're harnessing them to understand the complexity underpinning common complex diseases such as allergic diseases, and to help tease out the mechanisms. This is challenging, but I am convinced it's solvable.

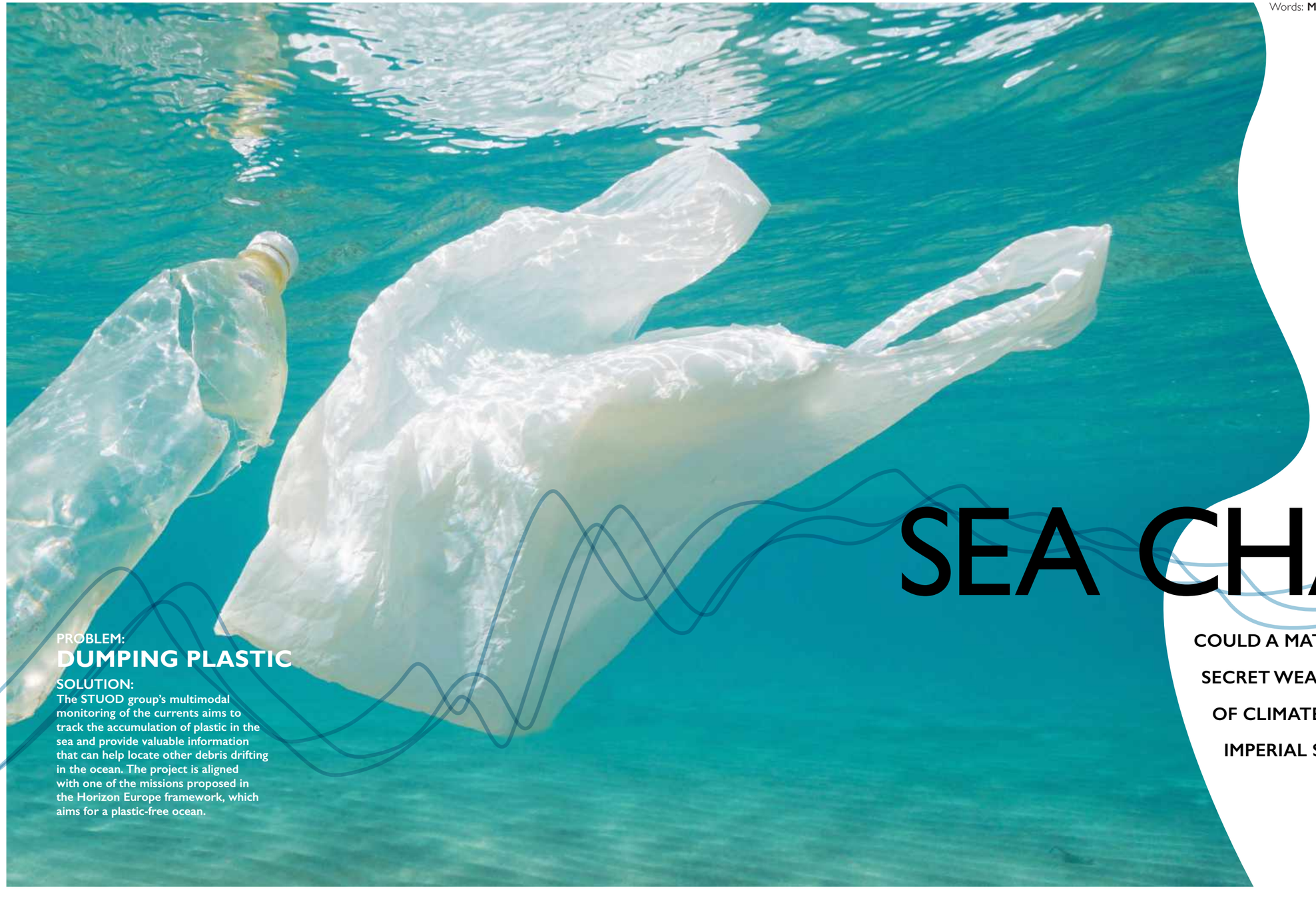
People still want answers to those fundamental questions of causation, of course. The hygiene hypothesis broadly proposes that as a species we have evolved over millions of years, and our immune system has been fine-tuned to expect a certain kind of environment. Environmental exposures play a crucial role in educating the immune system as to how to develop properly. If you suddenly remove all these exposures, or most of them, the biodiversity disappears, and so it's no surprise that your immune system does not mature as it should. That's a given, and it's one with consequences – allergic diseases.

Asthma and allergic diseases are probably the least of the problems arising from this ecosystem change. For the first time ever, we're getting into a situation where life expectancy may be going down. We're seeing a vast increase in inflammatory diseases, such as arthritis and diabetes. There could be catastrophic consequences unless we do something because it's entirely due to lifestyle and environmental factors. A fivefold increase in a disease incidence in 50 years? Genes are not responsible for that.

But amid the pessimism, there is hope. Because it is the sheer commonness of these diseases that now gives us the best chance of understanding them. We're seeing a welcome move toward viewing patients as individuals, requiring individual treatment approaches. But our goal as physicians should not be to have our patients' symptoms well controlled by taking drugs for the next 50 years of their lives. If 100 years ago there were almost no allergic diseases and precious little asthma, then there's no reason why our goal shouldn't be to return to a world without allergies and asthma. By understanding the changes that have contributed to this, we can reverse the trend. You could say that my career goal is to put myself out of business. ◆

There's no reason why our goal shouldn't be a return to a world without allergies and asthma

Words: **Mark Frary**



SEA CHANGE

COULD A MATHEMATICAL MODEL BE THE SECRET WEAPON AGAINST THE IMPACT OF CLIMATE CHANGE ON OUR OCEANS? IMPERIAL SCIENTISTS THINK SO. ▶

PROBLEM:
DUMPING PLASTIC

SOLUTION:
The STUOD group's multimodal monitoring of the currents aims to track the accumulation of plastic in the sea and provide valuable information that can help locate other debris drifting in the ocean. The project is aligned with one of the missions proposed in the Horizon Europe framework, which aims for a plastic-free ocean.

WHAT DO YOU NEED to study the impact of climate change on the oceans? Flow cytometer? Sediment trap? Large ship? Well yes… and no. At Imperial, Professor Darryl Holm, Chair in Applied Mathematics, and Professor Dan Crisan, Professor of Mathematics, reckon what you really need is… a supercomputer.

The team are working on a mathematical model to help understand the major issue in oceanography – principally how our oceans are changing. It matters because the world's oceans cover 71 per cent of its surface and they have quietly absorbed 93 per cent of the heat trapped by greenhouse gas emissions from human activity. The problem is that absorbing all this heat has caused the oceans to change in dramatic ways and we may no longer be able to rely on them to keep the Earth from overheating.

The Stochastic Transport in Upper Ocean Dynamics (STUOD) project brings together mathematicians, physicists, computational scientists and oceanographers. The results are set to provide decision-makers with a means of quantifying the effects of sea level rise, heat uptake, carbon storage and change of oxygen content and the acidity of the ocean. It should also support better understanding of the transport of marine debris, including the accumulation of plastic in the sea and the tracking of oil spills.

"Five years ago, we decided to put our heads together to try to collaborate on the major problem in oceanography, trying to predict the evolution of the top 200 or so metres of the planet's oceans where most human activity happens and which regulates the climate," says Crisan. "We then applied to the European Research Council along with our partners and were granted €10 million in 2019. Partnerships with the French National Institutes for Research in Digital Science and Technology, and for Ocean Science (Inria and Ifremer) place us in a strong position to engage with global challenges."

The dynamics of this upper ocean layer are influenced by many external factors, including atmosphere fluxes, rain, ice, river runoff and the action of waves, as well as biological processes. Rather than simulating each of these complex processes individually, the project looks at their combined effect. Stochastic processes – those with a random probability distribution – involve noise and uncertainty, such as the flow of currents in an ocean. While the movement of currents cannot be predicted, their average can be worked out statistically. And that's where the modelling comes in.

"It's a bit like the static white noise you get on a television with bad reception, where the television signal is hidden by the noise," says Crisan. "Previous attempts to model the upper ocean have tried to create a mathematical model of the signal itself. They came up with more and more sophisticated models that characterised the evolution of the signal. We have shifted our attention onto the noise itself, creating models that satisfy the physical constraints."

"The noise models what we don't know," adds Holm. "There is so much we can't resolve, so we have to admit there is a part of this that we don't know. What we do know is that there are spatial correlations of the fluctuations – that is, there will be interdependence between the fluctuations at neighbouring locations in the ocean and sometimes even distant ones." ▶

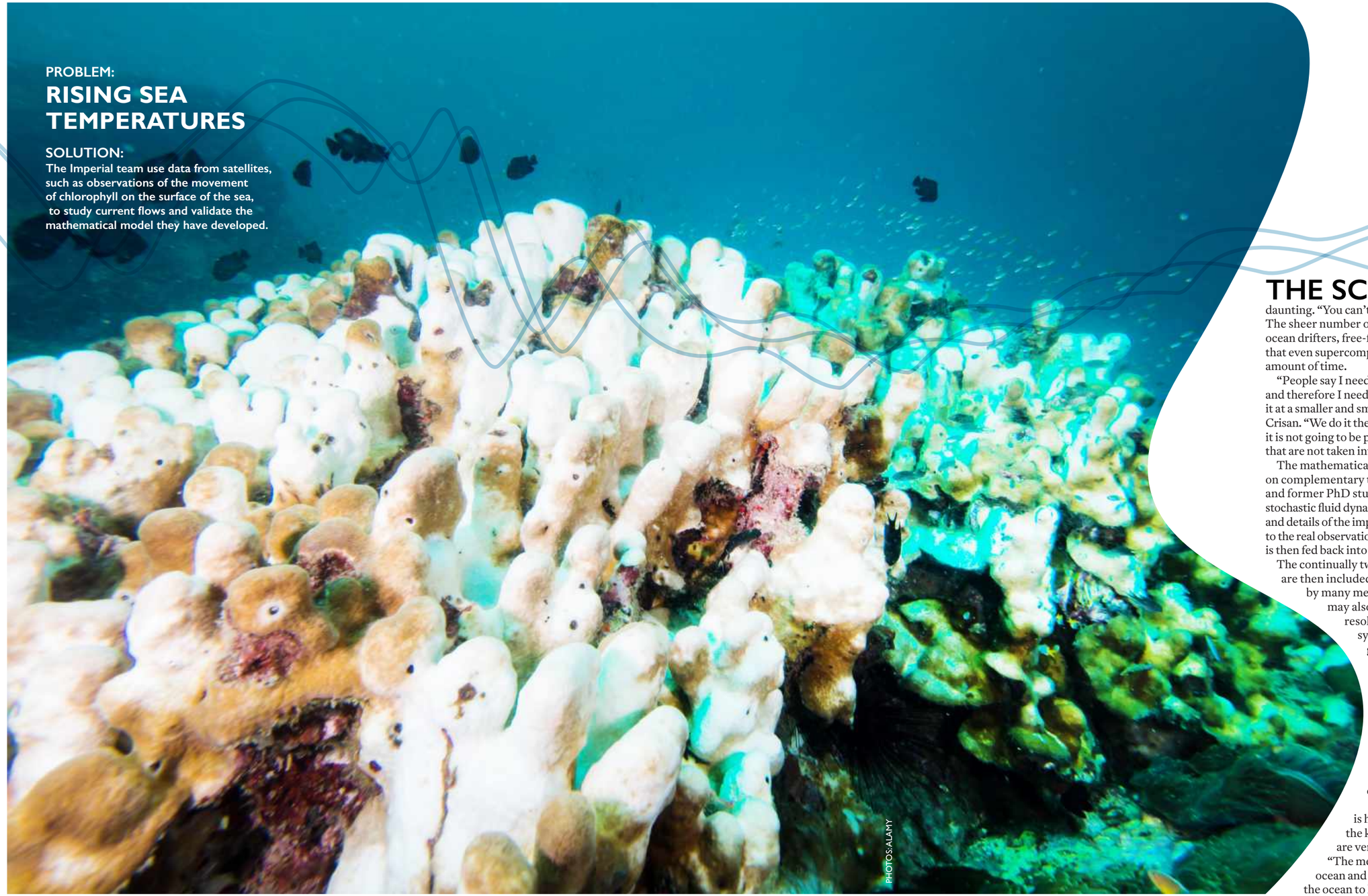
PROBLEM:
OIL SLICKS

SOLUTION:
Climate change increases the risks of oil spills because of higher sea levels and the increasing frequency of storms. Imperial's modelling of data from satellites, drifters and floats will help predict how slicks develop and help target responses.

PROBLEM:

RISING SEA TEMPERATURES

SOLUTION:
The Imperial team use data from satellites, such as observations of the movement of chlorophyll on the surface of the sea, to study current flows and validate the mathematical model they have developed.



PHOTOS: ALAMY

Professor Darryl Holm
Chair in Applied Mathematics, a Laboratory Fellow in the Computation and Computer Science Division at Los Alamos National Laboratory.

Professor Dan Crisan
Professor of Mathematics at Imperial and Director of the EPSRC Centre for Doctoral Training in the Mathematics of Planet Earth.

THE SCALE OF THIS challenge is daunting. "You can't just do these things on pen and paper," says Holm. The sheer number of data points – gathered by satellite, floats and ocean drifters, free-floating buoys that can measure currents – means that even supercomputers struggle to crunch the data in any reasonable amount of time.

"People say I need to have a better and better approximation of model and therefore I need bigger and bigger supercomputers to approximate it at a smaller and smaller scale. But it is never going to be enough," says Crisan. "We do it the other way: we work on a very coarse scale and accept it is not going to be perfect with the additional influence from the parts that are not taken into account added to the noise."

The mathematical model of the ocean used in the project is based on complementary theories of turbulence created by Holm, Crisan and former PhD student Valentin Resseguier, whose thesis focuses on stochastic fluid dynamics. The outputs are combined with a wave model and details of the impact of the atmosphere on the ocean, then compared to the real observations from the network of satellites and drifters. This is then fed back into the model for the next round of calculations.

The continually tweaked outputs from the team's mathematical model are then included in ocean-modelling software called NEMO, used by many meteorological offices around the world. The model may also be of use in the shipping trade, providing high-resolution information for use in route optimisation systems to reduce fuel consumption and greenhouse gas emissions of ships.

All this cannot come a moment too soon. The heating of the ocean by global warming is making the ocean far more energetic than it was, meaning the currents flow differently than they did previously. "The ocean has thermal fronts, with a warm part sliding over a colder part, just like in the atmosphere. It means the ocean is developing its own kind of fast 'weather' and it is occurring at smaller and smaller scales that cannot be studied numerically by computational simulations," says Holm.

Meanwhile, continuing to understand exactly what is happening is becoming ever more vital. "The ocean is the key to predicting the climate, because ocean timescales are very long compared to the atmosphere," says Holm. "The melting of the polar ice caps is changing the flows of the ocean and that is going to change the climate. We cannot rely on the ocean to keep absorbing more and more heat indefinitely." ◆

Reel Life

COMING TO A SCREEN (VERY) NEAR YOU – THANKS TO THE IMPERIAL CINEMA CLUB.

Words: **Kat Brown**
Photography **Thom Atkinson**

2023

There's a scene in *Cinema Paradiso* where the ageing projectionist Alfredo tells the departing Salvatore: "Whatever you end up doing, love it. The way you loved the projection booth when you were a little squirt." This is cinema as metamorphosis: a place where watching a great story played out on the silver screen can transform your reality.

Of course, Imperial students know all about the power of dreams. Which is why in a quiet corner of SW7, for more than five decades, they have been busily conjuring them up on the big screen from their very own projection booth.

While it is not quite Cinema Paradiso, the 250-seat cinema located in the Union Building is not far off. Home to, and run by, the Imperial Cinema Club, it's open to the general public, and gives students the opportunity to immerse themselves in every aspect of running a cinema. From selecting releases and handling the publicity, to manning the projector and taking care of the box office – where they sell tickets at a bargain price – it's a chance to revel in the sights and smells of a working cinema.

Above from left:
A detail of the 35mm Kinoton Projector. Adam Ladds in the projection booth; one of the cinema's lighting and automation arch panels: two plastic awards (won by members of the club in a Film-in-a-week contest run by the STOIC TV club in 2013).

The club itself was formed in the 1970s as FilmSoc, a name that ran until the 90s when a schism in the society resulted in a new FilmSoc (which continues successfully to this day), while the Imperial Cinema Club focused on the nuts and bolts of running screenings. In 2001, the Union gave the club a loan to buy a new 35mm projector, based on its earnings from previous years. Unfortunately, the digital boom was around the corner and the investment about to become all but obsolete.

By the time Alex Yong (MEng Electrical and Electronic Engineering 2008) joined the club, mostly to occupy himself while his girlfriend – now wife – went on her Erasmus year, the old guard had left. As incoming Chair, he also inherited a staggering £18,000 debt. "As the Chair, the buck stops with you, so I had to be able to do all the jobs. I went into that year thinking I wasn't very good at anything, and came out of it going, 'I can run a cinema'."

"I ended up working in startups and have become used to wearing many hats and working really hard to achieve a goal. I'm pretty sure a lot of that comes from those days at the Cinema Club – or maybe I was just always like that and that's what attracted me to the cinema in the first place!"

Either way, entrepreneurial skill proved a necessity. High-speed internet was available in halls and DVDs were released closer to the cinema date, with a knock-on effect on audience numbers. Yong and his small team ▶

There are a few weird and wonderful solutions that I don't think can ever be replicated

Adam Ladds, Imperial Cinema Club Secretary 2011–12, Chair 2012–13

Far left from top:
The main projection booth door at the cinema in the Union building; the automation patch panel; the Barco Digital Projector.

Above middle:
A 35mm film made up on the tower, with the labels from previously played films behind it.

Far right:
Alex Yong in the new raked seating installed in 2021.

worked on increasing membership, raised ticket prices to £5 and marketed the cinema's advantages (not least, that no pirated film could offer a 30-foot screen with a quality sound system).

"There's something to be said about seeing a film in a place set up exactly how the director wanted you to see it," says Yong. "The other part of it is about group experience and the pomp of it all; you don't get that at home on your own. Plus, I really like eating popcorn."

Thanks to changes in strategy, Yong's year made more money than they lost. "We were able to pay back some of our loan, and that hadn't been the case for a little while. It was very small numbers, but we tried to turn things around a bit." Upgrading to digital remained out of reach, however. Whereas showing a film digitally at a cinema is now relatively straightforward, in Yong's day it was more complex. "I remember asking the person in finance, 'So if we needed £65,000, how would you react to that?' and he laughed in my face."

Jump forward a few years and Adam Ladds (BSc Electrical and Electronic Engineering 2009, Club Secretary 2011–12, Chair 2012–13) replaced Yong in the hot seat and was able to build on his efforts.

"We applied for £30,000 to get the bargain-basement budget option and then went about hooking up the existing equipment with the new. There are a few weird and wonderful solutions that I don't think will ever be replicated anywhere else again, and probably rightly so," says Ladds.

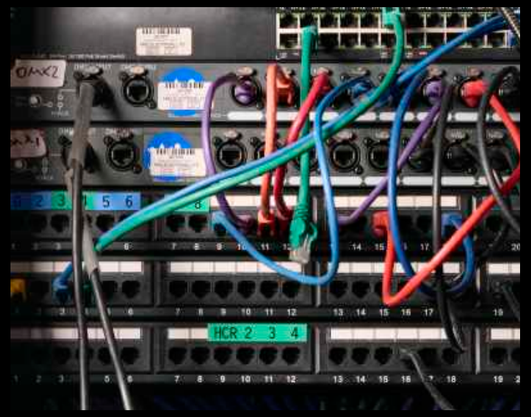
Indeed, the Club owes much to its engineers. The film tower that ran the 35mm reels was built by the Department of Mechanical Engineering in the 90s, while the box office was a literal box on wheels, custom-built to fit a touch screen (with software written by Ladds) and a cash box.

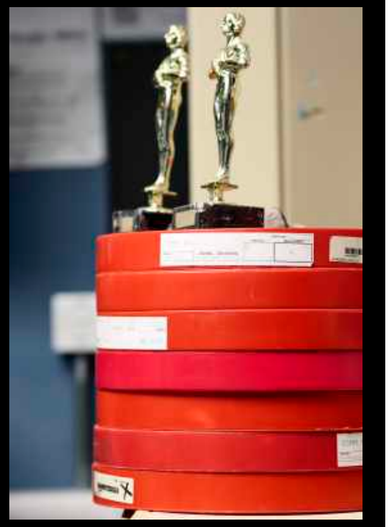
I have become used to wearing many hats and working hard to achieve a goal

Alex Yong, Chair 2007–08

"We were just sort of cobbling things together with whatever bits and bobs we could find, and a lot of things got replaced," he says. "Fitting the new digital projector into the cinema booth meant sliding the existing projector over by a few feet in order to make space, so neither of them is actually in the proper place to project onto the screen anymore. But they've both got a bit of a lens tilt, so they do still work."

Actually keeping the cinema running, however, remained a challenge – if for less technical reasons. "Having enough people was always a problem. At certain times of year, you'd find people on a particular course were doing exams, or the geologists might all be abroad. If you'd committed to four showings a week, you kind of had to deal with that ▶





and work out the best way." Working with 35mm took at least two people to run screenings. "Sometimes that would mean both of you starting on the box office, closing it, running upstairs to start the film, then rushing back down to see if there were any stragglers. By the end of my time, however, there were enough people that we thought it was doing pretty well."

Arguably the most difficult time for the Cinema Club was during lockdown. After closure in 2020, the cinema was allowed to open during the summer term of 2021, historically the slowest time for custom, but was given a makeover and reopened with a bang in autumn 2021, ready for a full complement of audience members.

"Raked seating was installed, and that has been a godsend," says Rebecca Vickery (MEng Biomedical Engineering 2018),

It's nice that we are out and about in the Imperial community at all levels

Rebecca Vickery, Chair 2021–22

outgoing Chair of the club. "We used to have to set up chairs by hand – now we press a button and the chairs come out." This has also proven extremely useful for the dramatic societies with whom the cinema shares its space, and external hire – the BBC Proms have put on concerts there thanks to its proximity to the Royal Albert Hall. "It makes scheduling slightly complicated, but it's great because other groups can use our speaker system for various events, which makes a lot more sense because of the quality," says Vickery.

The cinema has also become popular for showing NT Live screenings more cheaply than its mainstream rivals. "That's when we end up with lecturers attending, and it's nice to see that we are out and about within the Imperial community at all levels," says Vickery, who is now studying for a PGCE at Oxford and says that the cinema gave her a valuable preparation for the many challenges of school life. "I'll miss meeting all the different people across the College; all the levels of the industry that cinemas interact with."

That feeling of having gained invaluable life skills from a stint at the Cinema Club is shared by Ladds. He admits that on a recent signalling project he recently completed on the Piccadilly line for London Underground, he called on past experience to help adapt equipment from the 1960s.

"I've gone from, 'How do we use the bits and pieces that are still good from the 35mm cinema and put a digital projector on top of it?' all the way up to, 'Okay, now we've got this signalling system that's been in place for 40 years and we'd like to replace the bits that we can't get spares for anymore'," he laughs. "Very much the same sort of work, which is kind of weird." ◆

Above far left clockwise from top: The President's Award presented to Imperial Cinema Club; network wiring; the Cinema Club tankard served at the Union Bar; Rebecca Vickery, Chair 2021–22.

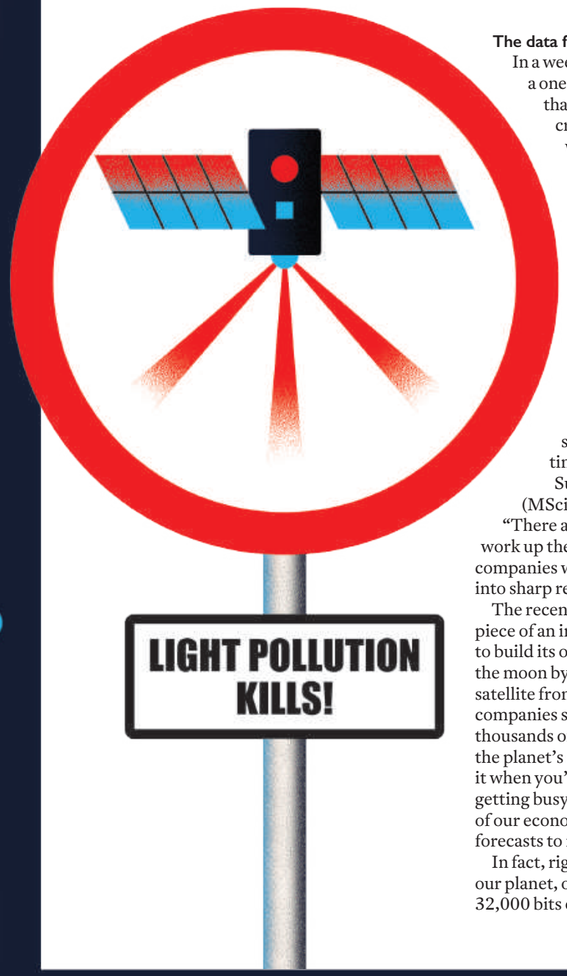
Middle: Alex Yong and Adam Ladds sitting in the raked seating.

Above right from top: A 35mm print in its "cans" with two plastic awards on top); the rewinding bench.

THE FINAL FRONTIER

The big problem with space is that there just isn't enough of it. Imperial is working on a plan.

Words: **Tom Knowles** / Illustration **Andrea Manzati**



The data from the 18th Space Control Squadron of the US Air Force was clear. In a week's time, two satellites travelling at speeds of up to 17,500mph had a one-in-a thousand chance of smashing into each other – 10 times higher than the normal threshold for moving a spacecraft to avoid a potential crash. If a collision occurred, a vast field of space debris would be created, with every piece of twisted metal ready to cause yet another collision.

The European Space Agency (ESA), which owned one of the satellites, Aeolus, saw the data and got worried. It tried to contact SpaceX, billionaire Elon Musk's company that owned the other satellite, Starlink 44. For four days, they heard nothing. SpaceX said a bug in their system meant they missed the increasingly urgent emails from ESA.

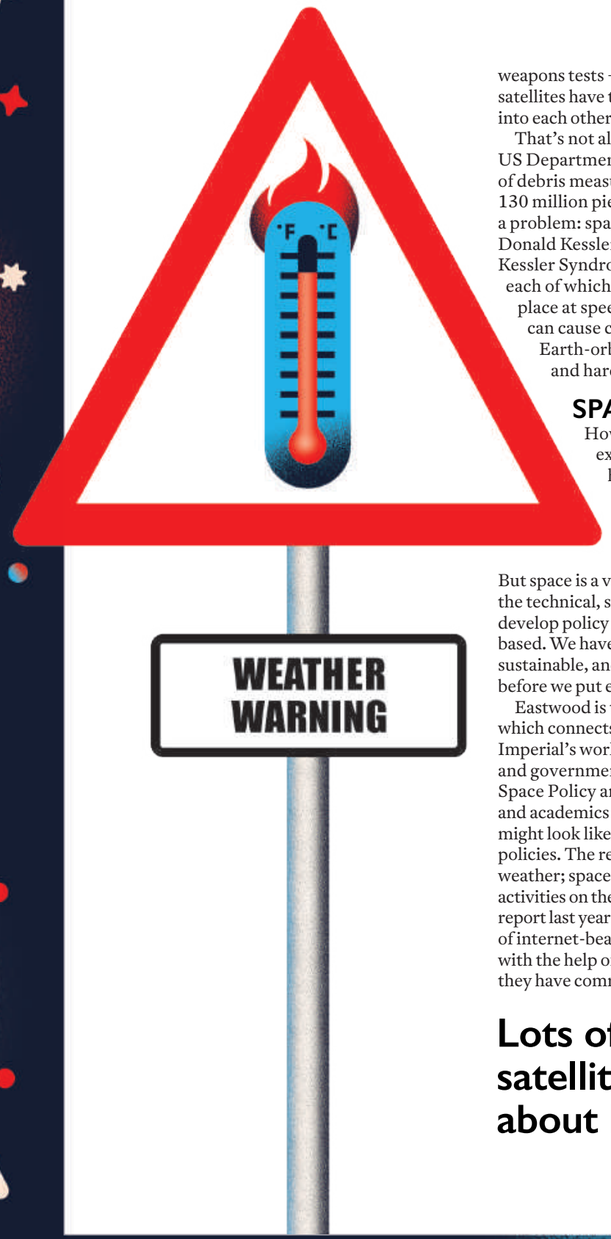
When SpaceX finally responded, it said it had no plans to move its satellite. So, on 2 September 2019, ESA sent commands to Aeolus that triggered a series of thruster burns just a few minutes apart, moving it out of the way half an orbit before the potential collision. Everyone breathed a sigh of relief. Yet even if the two satellites had collided, there would have been no legal repercussions for either party. Operators simply have to rely on goodwill and self-preservation – in the hope that one party will get out the way in time – because in space, there are almost no rules.

Such a scenario is no longer acceptable, argues Dr Jonathan Eastwood (MSci Physics 2000, PhD 2003), a Reader in Space Physics at Imperial.

"There are actually very few rules and regulations about how things should work up there," he says. "We're now standing on the precipice of lots of companies wanting to launch thousands of satellites into space, and that throws into sharp relief how we look after the space environment."

The recent rejuvenation of NASA's moon and Mars programmes are just one piece of an increasingly hectic schedule of activity. At the same time, Russia wants to build its own space station and China aims to have put its first astronauts on the moon by the end of the decade. Even the UK is getting on board, sending out a satellite from British soil for the first time from Spaceport Cornwall. Then there's companies such as SpaceX, Amazon, OneWeb and Telesat, who are launching thousands of new satellites into low Earth orbit – the area 500 to 2,000km above the planet's surface – to improve global internet access. It may not look like it when you're stargazing on a clear night, but the area around planet Earth is getting busy. Space-based systems are beginning to affect almost every aspect of our economy, security and day-to-day life, from GPS systems and weather forecasts to mobile communications, high-speed internet and military uses.

In fact, right now, there are around 8,840 man-made satellites in orbit around our planet, of which about 6,300 are still functioning. And there are just under 32,000 bits of debris – from failed satellites, discarded rocket boosters and ▶



weapons tests – hurtling around Earth at up to 17,000mph that these functioning satellites have to dodge, while simultaneously making sure they also do not bash into each other.

That's not all the man-made debris in space, just the bits big enough for the US Department of Defense to monitor. There are also around one million pieces of debris measuring between 1 to 10cm circling around Earth, and an estimated 130 million pieces measuring between 1mm to 1cm. This might not seem like a problem: space, is, after all, pretty big. But in 1978, former NASA scientist Donald Kessler published a seminal paper outlining what's now known as the Kessler Syndrome. Collisions, he pointed out, produce orbiting fragments, each of which increase the probability of further collisions. Each collision takes place at speeds of around 15,700mph in low Earth orbit, so even small pieces can cause considerable damage. This cascade could create more debris in an Earth-orbiting belt than natural debris from meteorites, making it harder and harder for spacecraft and satellites to operate.

SPACE DEBRIS DANGER

How do you solve such an inherently global problem? Imperial experts think that the first step is to create a robust framework for how to think about safety in space that works in a UK context – and that other nations can take inspiration from.

"We are using space more and more," says Eastwood. "It's what's now known as a critical national infrastructure, in the sense that it is part of what we need to make everyday life work. But space is a very, very unforgiving environment. You really have to understand the technical, scientific and engineering constraints of it all. So if you want to develop policy in the UK around space that is sensible, it has to be evidence-based. We have to approach this area in a way that's ultimately going to be sustainable, and we have a relatively short window of opportunity to define it before we put even more stuff into space."

Eastwood is the director of Space Lab, an Imperial Network of Excellence, which connects all the College's space expertise together and will ensure that Imperial's world-renowned work and research can be easily accessed by industry and government. Space Lab recently teamed up with the London Institute of Space Policy and Law, an independent institution that brings together lawyers and academics in the field of space law, to examine what a UK Space Safety Policy might look like and how Imperial can play its part in enabling evidence-based policies. The report identified five key areas of space safety: space debris; space weather; space traffic management; planetary defence; and the impact of space activities on the Earth's environment. The two organisations produced a further report last year outlining the specific safety issues around the 'mega constellations' of internet-beaming satellites that companies such as SpaceX are creating. And with the help of Imperial Forum – the College's policy engagement programme – they have communicated this work to MPs and a Parliamentary inquiry.

Lots of companies want to launch satellites, but there are few rules about how things should work

Out of the five areas outlined in the report, the issue of space debris is causing the most international attention, with all 193 countries at the UN declaring it a "concern of all nations". And Eastwood points out that, with the sheer volume of traffic up there, satellite operators will soon no longer be able to manually move their spacecraft out of the way of debris and other objects. He cites machine learning and AI as the possible best solutions to enable spacecraft to autonomously track and avoid collisions, something Imperial has a solid pedigree in, and particularly now that Imperial-X, Imperial's new digital teaching and research initiative, has a specific initiative focused on the sustainable use of space.

"We have people in physics, civil engineering, aeronautics, computing and the Centre for Environmental Policy working on these areas. With problems like this you need to ask: what should we do, and then what is sensible and economically feasible to do; and for that, you really need to have technical understanding."

Eastwood also believes an international Space Traffic Management system will be required for mega-constellations of satellites and their services to co-exist with other systems, both in space and on the ground. New laws also need to be created to determine what happens if a company running a constellation of satellites goes bankrupt, and who would take over to ensure their continued safe operation.

EARLY WARNING

There is also a risk that satellites could be rendered useless by space weather, such as solar storms, that could transform them into space debris that is then impossible to move out the way of other objects. Imperial, however, is already making a significant impact in forecasting what space weather events are on the horizon, working with both the Met Office and ESA to build computer models that can give a better real time understanding of what the space environment is like.

"If you can give satellite operators earlier warning of what the conditions are likely to be, then they can operate their constellations in different ways to minimise the risk. So, for example, you might decide to put them in safe mode or not do a software patch during that time," Eastwood says.

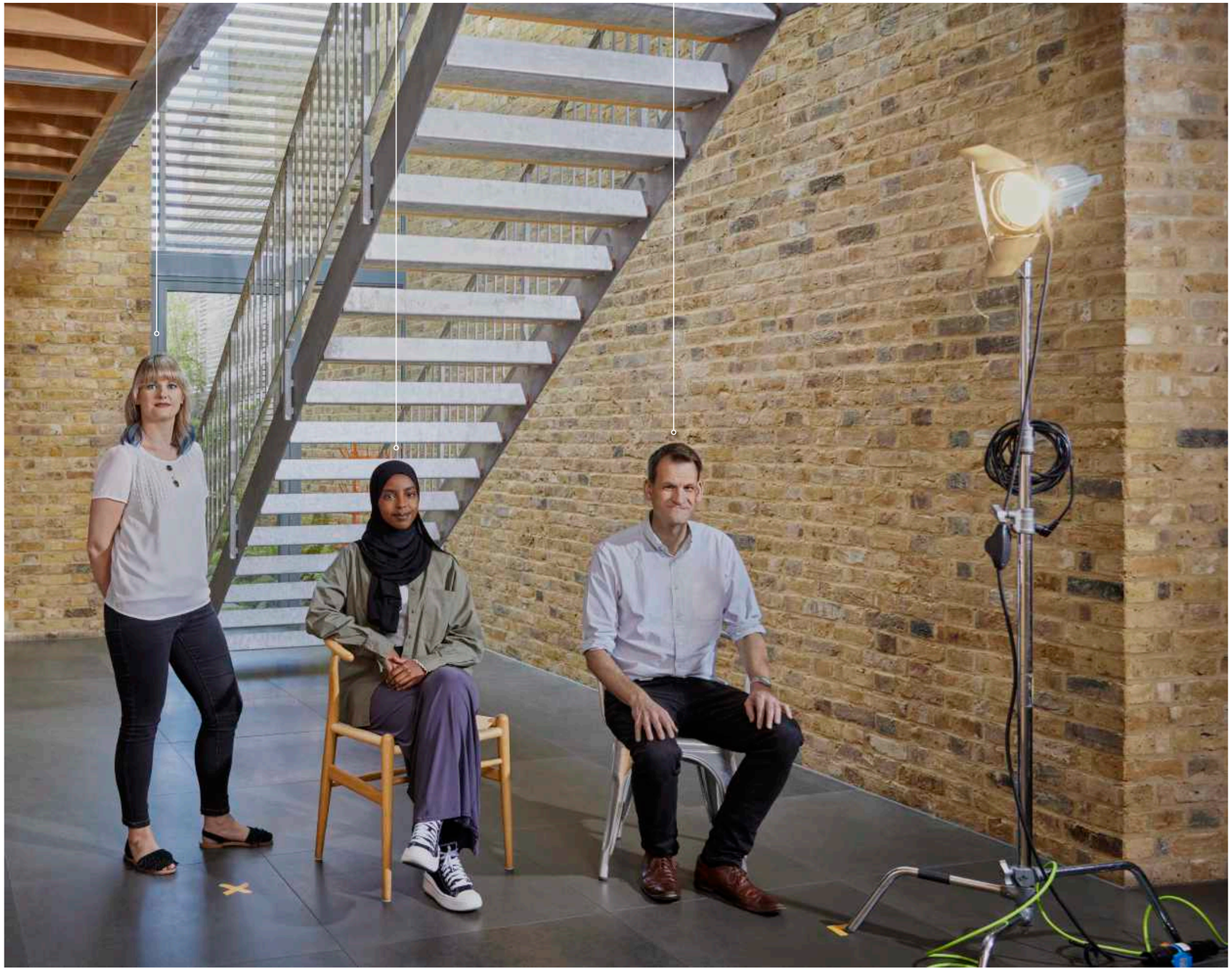
And it's increasingly clear that what we do in space can have a powerful effect on what happens here on Earth, too. For example, there have been calls to make the satellite constellations of SpaceX and other companies darker to ensure they do not affect ecology on Earth, such as animals navigating by star patterns. The report warns that constellation satellites will soon be so plentiful and bright that they will hamper astronomers' observations and could even stop them spotting dangerous asteroids. However, at the same time, satellites need to give off some form of emission so operators can keep track of where they are and ensure they do not collide with anything else.

Space Lab is aware that the UK making new policies or laws around space safety will make little overall difference if other nations also do not improve their regulations. However, it believes if the UK can show success in this area, it will inspire other countries. "Nobody really wants the space environment to become polluted, but the risk is that it happens through a tragedy of circumstances," says Eastwood. "My feeling is that a lot of this then depends on being able to work with others to demonstrate how things can be done. If we can generate the political momentum and will to all recognise that this is something we all need to deal with, then there should be a path through this. That's not to say it will be easy, but I think we owe it to everybody to try." ◆

THE LEAD
Dr Melanie Bottrill
Imperial's Head of Outreach Programmes.

THE MENTOR
Nagad Bille
Second year medical student and an e-mentor.

THE ACADEMIC
Professor Kevin Murphy
Academic lead for the Pathways to Medicine programme.



Words: **Claire Thorp** / Photography **David Vintiner**

ON THE RIGHT TRACK

How a new programme is delivering a taste of Imperial's medicine for students of all backgrounds.

Even as a young child, Sophie Rainbow (MBBS Medicine 2022) knew she wanted to be a doctor. "I actually can't remember ever wanting to do anything else," she says. "I only started realising how difficult it would be or how much work I need to put in when I got a bit older – but I still wanted to do it."

Rainbow didn't have any friends or family who were doctors – and it had been a few years since anyone at her school in Enfield, north London, had applied for Medicine. But by the time she started sixth form, she was both more determined and more daunted than ever about achieving her dream. "I didn't even know where to start. There were exams, interviews, work experience – I just had no idea how to go about any of it."

But one of her teachers suggested Imperial's Pathways to Medicine, a two-year widening participation programme, delivered in partnership with the Sutton Trust and with support from Health Education England and philanthropy. It aims to diversify and widen the pipeline of prospective medical students and support young people from state schools and colleges in their application to medical school.

Throughout Years 12 and 13, sixth formers participate in a series of activities, including taster sessions on different strands of medicine, talks by admissions tutors, academics and practising doctors, and opportunities to meet and chat with current Imperial Medicine students.

"We did practise for medical school interviews, which I found very useful," says Rainbow. "I completely screwed up the first mock interview and was ▶

From left:
Dr Melanie Bottrill, Nagad Bille, Professor Kevin Murphy.

so upset, but I had another go and it got better, and that definitely set me up for the for the real thing." She attended a summer school – "that was fun because I'd never been in a proper lab before" – and Imperial also helped organise a work experience placement. "They arranged for me to go to Hammersmith Hospital on one of the children's wards, which I don't think I would have ever been able to get without them."

Taking part in the programme convinced Rainbow to apply to Imperial, where she was offered a place. "Our head of year came into my form room to personally congratulate me in front of the whole class. It was really embarrassing. But it was a big deal. I was a bit of a celebrity that week. I still had to get the grades though – luckily I did!" This year she graduated from Imperial and is now working in an ICU in Manchester.

LEVELLING THE FIELD

Nearly 600 students have benefited so far, across nine cohorts, but the programme gets far more applications than there are places – in 2020 there were 900 applications for 60 spots. The aim is to choose those most in need of the support. "We're looking for students who might be on free school meals, who might be the first generation to go to university, those who live within postcodes that have low participation in higher education or fit multiple indices of deprivation," says Dr Melanie Bottrill (MSci Chemistry 2004; PhD 2009), Imperial's Head of Outreach Programmes.

"A lot of students come from low-income families or have caring responsibilities at home. All of these are barriers that can potentially limit their aspiration to go on to higher education," she says. "For students who don't know anyone who has studied Medicine, don't have those role models, but who aspire to do this incredibly vocational subject, it can feel slightly impenetrable."

Professor Kevin Murphy (PhD Investigative Science 2001) is the academic lead for Pathways. "I was quite conscious, looking across the sector, that students coming in from more selective schools perhaps had a better chance of getting into Medicine – but that didn't necessarily mean they were going to be the best doctors," he says. "And I was very conscious of the fact that for people from non-selective state schools, it wasn't always easy to understand what medical schools were looking for and how they could best increase their chances."

Another three medical schools are now part of the Pathways to Medicine consortium, and Murphy says that everyone is aware of the issue and trying hard to diversify their intake. "But in many cases you're dealing with 18 years of social, economic and educational imbalance before you apply to university. It's very difficult to level that playing field. So, anything we can do to give students who had fewer opportunities a greater chance to get into Medicine the better."

And having a more diverse selection of medical students isn't just the morally right thing to do, he says – it's for the benefit of the health service. "Outside of the social justice argument, the NHS is serving the general population, and it makes sense that the make-up of the NHS reflects the population it's serving. There's some evidence that having people who come from a similar background or ethnicity as you can also help patients engage with the health service and improves their care."

Nagad Bille (Medicine, Second Year) is another to have benefited from the Pathways programme. "At my school there was always talk about how hard Medicine is and how difficult it is to get in, so I was expecting it to be really competitive," she says. "But I wasn't expecting there to be so many entrance exams, and I didn't know about interviews until I joined Pathways. So that was a shock!"

Besides enjoying the mock interview practice, there was also support and practice for the University Clinical Aptitude Test and BioMedical

HAIR AND MAKE-UP: SADAF AHMAD

When I was offered a place it was a big deal. I was a bit of a celebrity that week

Sophie Rainbow (MBBS Medicine 2022)

Admissions Test entrance exams. But one of the most useful parts, says Bille, was the e-mentoring scheme, which connects participants with current medical students for help and advice. "Just having someone that I could always message if I had any queries about Medicine was great," she says. "It was a lot of help during interview season and the application process as well – just to know someone who had been through it was there if I needed to ask anything."

Now in her second year, Bille is returning the favour and acting as an e-mentor to new cohorts on the programme. "I just felt like I got so much support from my mentors, I wanted to give that to someone else. It's really pleasing when I'm able to help someone out with some advice, or just to share my experience." Seeing members of past cohorts like this come through medical school and then give back to others hoping to follow their lead is incredibly rewarding, says Bottrill. "Role models are so important."

Sophie Rainbow, who is just setting out on her dream career, is happy to be an ambassador for Pathways. "I think one of the hardest parts of medical school is getting in, and I didn't know anyone who had done it who I could ask for advice," she says. "The Pathways Programme was so important for just giving me that step up." ◆

THE GRADUATE
Sophie Rainbow
Sophie graduated from Medicine in 2022 having been in one of the first cohorts of the Pathways to Medicine programme.

DATASET – MR DANIEL LEFF, READER IN BREAST SURGERY

Better sequence, better outcome

Mr Daniel Leff
Reader in Breast Surgery working in the Department of Surgery and Cancer and Hamlyn Centre for Robotic Surgery.

Context It's a happy fact that millions of people now survive breast cancer. Many breast cancer patients who need a mastectomy also require radiotherapy – and request a reconstruction. Yet even the most expert treatment doesn't just bring inevitable physical changes. It can also leave emotional scars leading to lifelong anxiety and mental health issues.

Background Traditionally, hospitals have offered patients a mastectomy and then radiotherapy after surgery. In some centres, reconstruction is only offered at a later date, meaning many patients will have to wait – sometimes years – for a reconstruction; some don't get one at all. Some hospitals offer reconstruction at the time of mastectomy, and then give radiotherapy to the chest wall (including to the reconstruction itself). However, this pathway can lead to complications such as damage to healthy tissues used to do the reconstruction – including shrinkage, firmness and loss of symmetry. Mr Daniel Leff, surgeon and Reader in Breast Surgery in Imperial's Department of Surgery and Cancer, wondered if changing the sequence – giving radiation therapy to the breast before it's taken away, and then doing the mastectomy and reconstruction – would be safe in the short term and reduce complications in the long term?

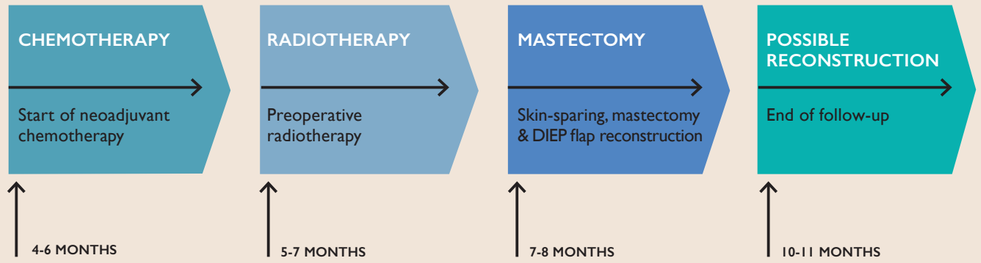
Methodology Leff, fellow Imperial College Healthcare NHS Trust Consultant Surgeon Mr Paul Thiruchelvam (MBBS Medicine 2000; PhD 2010) and their team joined colleagues at London's Royal Marsden Foundation Hospital NHS Trust to recruit 33 patients dependent on their symptoms, size and spread of their tumour. They then gave the patients the radiation treatment first, followed by the mastectomy and reconstruction.

Findings The study found that changing the sequence of the treatment was safe and technically feasible. The rates of complications were similar to those reported in other studies – four patients developed an open wound greater than 1cm, and one patient required a re-operation to tackle dead skin. "We also asked patients about their experience of reconstruction three months and 12 months after surgery and found a high level of patient satisfaction – and none of the patients' cancers returned in or around the reconstructed breast 12 months after treatment."

Outcomes The alternative sequence was demonstrated as safe, but the results also suggested significant benefits. "It appears to be reducing recovery by a month," says Leff, "meaning health benefits but also potentially cost benefits – we detected a reduction in longer term complications of the reconstruction and fewer hospital visits and procedures to correct downstream impact of radiotherapy on reconstructions."

Leff emphasises that the small study was merely to look at risk in sequencing. "We're not going to change practice from a paper that says it's safe to change the sequence," he adds, "but comparing long-term qualitative data to gold standard is now an urgent priority. As a clinical community we need to get funding to demonstrate that reversing the sequence has added advantages. The current order of treatment means that in many parts of the world women who need radiation therapy won't get a reconstruction – we're currently effectively denying them these quality of life benefits, which is utterly unfair. The alternative sequence is likely to enable more women to access reconstructive surgery, and may completely change their lives in survivorship." ◆

PROPOSED SEQUENCE OF TREATMENT FOR BREAST CANCER PATIENTS



WORDS: PETER TAYLOR-WHIFFEN

IMPERIAL HARRY POTTER SOCIETY

Potterheads unite

If you don't know your Parseltongue from your Imperio, the Harry Potter Society is here to help.

Words: **Lucy Jolin** / Photography: **Angela Moore**

Whisper it quietly (or perhaps cast a quick Silencing Charm): Harry Potter Society President Natakala Dakshesh (Physics, Third Year, Gryffindor) has a secret. "I'm not a super-super Harry Potter fan," he confesses. "Of course, I've read all the books. Multiple times. But I joined the society because Harry Potter is great to bond around and make friends. So many people know it, and it lends itself to so many different things."

It certainly does: the Wizarding Chess Tournament, for example. "It's exactly the same as normal chess," says Dakshesh. "Except we're wizards." Hats are a popular theme, as one would expect with wizards, particularly when events were taking place online in pandemic times and fun was a little thin on the ground. But there's no pressure to acquire a particularly wizardly hat: Dakshesh chose a green bucket for an online quiz. A Sorting Ceremony also took place online, with members being assigned to one of wizarding school Hogwarts' houses: Gryffindor, Slytherin, Hufflepuff and Ravenclaw. "I'm a straight arrow: a very typical Gryffindor," says Dakshesh.

Now that events can be in-person again, the Society has a lot of fun thinking of Potter-themed events. A recent treasure hunt took place in the suitably occult surroundings of Brompton Cemetery and saw members solving riddles to find Horcruxes – objects where a Dark Wizard or Witch has hidden a fragment of their soul in order to achieve immortality. "That was great fun, particularly going to a café afterwards," says Dakshesh. "It was probably my favourite thing that we've done so far."

Food plays a big part in the wizarding world of Harry Potter: not just magical Potterverse specialities like Butterbeer and Fizzing Whizzbees, but also traditional British boarding-school fare like treacle tart, steak and kidney pie, spotted dick, kippers and Yorkshire pudding. "Once we were back on campus, we held a feast," says Dakshesh. "The brief was just to make Harry Potter-themed food. It was fantastic, but one problem with the Harry Potter films is that they show desserts more than actual food. So we only ended up with one main course – Pumpkin Pasties – and absolutely loads of Potter-themed sweets like Cockroach Clusters, which you make by covering Rice Krispies with chocolate." For his contribution, Dakshesh paid tribute to Harry's loyal owl companion and created a Hedwig-themed cake, though he's at pains to point out that it was 'only in 2D'.

If by now you're wondering why you haven't seen wand-wielding wizards around the campus, you haven't missed them: the Society haven't gone in for dressing up so far, though Dakshesh did make a wand for his presidential pitch. "It was from a rosemary tree and somehow it became infested with ants and spiders, which are supposed to hate rosemary, so I destroyed it. I'm not sure it was that magical. But now we're discussing having a dress-up event – maybe even a Yule Ball." And next year, he's hoping to get a team together to play Quidditch – a game played on broomsticks which requires the players to retain possession of a leather ball called the Quaffle and catch an enchanted winged ball known as the Golden Snitch.

We're hoping to get a team together to play Quidditch next year

Few books have the power to inspire university societies, so what makes the Harry Potter series different? "I think it's the shared experience," says Dakshesh. "There are those who have only watched the movies, and those who have read the books, and those who have done both, and who argue which one is better – it's always the book, of course. And all these different groups come together in this place where we can go to pretend." ◆

Above from left:
Dana Weetman (Maths, Fourth Year);
Kishor Sureshkuma (Maths, Second Year);
and Natakala Dakshesh (Physics, Third Year).

A WORKING LIFE

Racing ahead

Peter Rawlinson, electric car engineer, still lives by the basic principles he picked up at Imperial.

I thought: If I go to art school, no one will believe that I could have gone to Imperial!

My philosophy when I'm engineering is "to hell with what anyone's done before". I'm just interested in distilling it all down to fundamental principles. I often feel that experience is almost a burden. That might sound strange, but some of the biggest problems that I've encountered at work are people who've put experience before first principles. Sometimes it's better to have someone super-smart who's straight out of university and is absolutely embodying those first principles and is unhindered by experience. If you've got really pertinent experience, that's invaluable, that's the icing on the cake. But the cake is the first principles knowledge.

As CEO at luxury electric car manufacturer Lucid Motors, I always use the principles that I was taught at Imperial. We're not talking advanced stuff: it's basic principles of structures and stress and strain and how materials deform and deflect elastically and plastically; and simple maths. So what focusing on first principles looks like in practice for me is not putting targets on the vehicle. My only target is wanting to be amazed by what it does.

We reach for the stars to do something extraordinary but we balance that with a healthy dose of pragmatism. Because otherwise it can turn into some never-ending science quest. I'm not looking at what can we do in ten years' time. It's much more pragmatic than that – what can we do in two years' time?

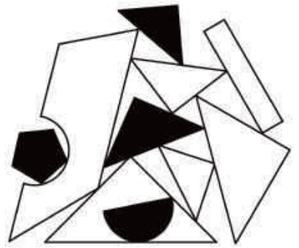
The first things I designed were in my dad's shed, where I'd make my own toys – buildings for my toy farm and things like that. I couldn't use the tools so my dad would make them for me. But it was a very creative upbringing – my mum was an artist and a potter. I originally thought I might go and do art because I wanted to fuse the artistic design with the technical. And then I realised that I was capable of winning a place at Imperial and I thought, "If I go to art school, no one will believe me that I could have gone to Imperial!"

Above, from left: Production line for Lucid electric cars; Peter Rawlinson, CEO and CTO of Lucid Motors.

I once built my own house. I cut the stones and became a reasonable stone mason. That pragmatism – cutting the stones and mixing the mortar, the practicality of doing things with your own hands – is what I balance with the engineering side. The Lucid Air, one of the most advanced electric vehicles in the world, is a science project that was realised in production.

We've done amazing things but we've got a long way to go yet. I'll only be satisfied when we make a million cars a year, and I'd love to do that by 2030. We've got to change human beings' behaviour, though, and move mankind to a sustainable mobility model, because global warming is an extraordinarily serious challenge. It's for this generation of engineers to do something about it. ◆

> *Peter Rawlinson (BEng Mechanical Engineering 1979) is Chief Executive Officer and Chief Technology Officer of Lucid, designers and manufacturers of luxury electric cars.*



PUZZLES

Test your brain power

Ready to test your little grey cells? Imperial's top quizzers set the ultimate puzzle challenge.

1) What links: opera featuring golden calf; Austen work consisting of letters from Laura; 2009 Iñárritu film starring Bardem; album featuring "Care of Cell 44"?

2) What links: speech production area; film formed by oxidation; Yorubaland king title; monster buried under Etna; portraitist of The White Cloud; most recent Metroid game?

3) What number has been replaced by a question mark in the following sequence: 1887, –, 1800, –, 1801, ?, 1900, 1912.

Set by Adam from the Imperial Quiz Society.

Find the answers on our website at:
www.imperial.ac.uk/be-inspired/magazine/issue-53/brain-power

FOR ISSUE 52 SOLUTIONS:
www.imperial.ac.uk/be-inspired/magazine/issue-52/brain-power
Congratulations to: *Fergus Dignan (MBBS Westminster Medical School 1979); Jon Tyrrell (BSc Mathematics 1974); Joe White (MSci Chemistry 2021); Katherine Papakyriacou (MEng Aeronautical Engineering 2021); Kevin Ridout (Civil Engineering 1979); Ian Pawson (PhD Mathematics 2002); Richard Smith (Chemistry 1964, PhD 1967); Chris Glover (Chemical Engineering 1974); Adrian Tottenham (MSc Chemical Engineering 1981); and Alan Green (Environmental Studies 1988).*

INTERVIEW JO CAIRD. PHOTOS: MATT YOUNG. ILLUSTRATION: MIKE LEMANSKI

OUR IMPERIAL

IN GOOD HEALTH

Meet the alumni committed to delivering a positive future for women's health.

DR ANNA STEJSKALOVÁ

(PhD Bioengineering 2018), Postdoctoral Researcher at Harvard

What galvanised your interest in women's health?
A really big factor is just being human. While I was finishing my PhD, I started thinking about having a family. You hear stories from friends about the issues they had through trying to get pregnant – or even just menstruating – and about treatment; there's a huge mismatch. I felt it was great that I gained all these skills at Imperial and that I can contribute to solving these problems. I wanted to do something in endometriosis specifically because I heard other bioengineers were working on the disease, but there are very few labs specialising in it, which makes it harder for trainees to learn. I found a really nice lab in Germany, but after that, it was hard to find one somewhere my husband and I could both find jobs. Now I'm studying the cervix, which is also under-studied. So little is known about it, which also seems to be the case for women's health in general.

How did your time at Imperial shape you?
The Department of Bioengineering made sure to hire young principal investigators with diverse backgrounds and also of all genders, which was really refreshing. The department would really make an effort to foster this collaborative atmosphere. It was easy to stay excited because you could see the details of your own research and then the stories of how problems end up being solved.

What's next?
Currently, I'm focusing on better understanding how the cervix is affected by bad bacteria; how different vaginal infections and other factors might affect preterm birth. I feel like there are many ways that this can be expanded to improve the quality of life for women. For example, a hysteroscopy could be done non-invasively through the cervix if we knew how to modulate how it opens. I'm interested in how many of the procedures that are currently done can be made more precise, less invasive, and generally gentler to the female body.

> ***Dr Anna Stejskalová*** *is a Postdoctoral Researcher at Harvard University and an expert in women's health. She was awarded Imperial's Emerging Alumni Leader Award in 2021.*

DR LARISA CORDA

(MBBS and BSc Obstetrics and Gynaecology 2007), NHS obstetrician and gynaecologist, ITV's This Morning*'s fertility expert*

What attracted you to obstetrics and gynaecology?
When I was a junior doctor, I noticed the disproportionate impact that chronic disease has on women. Women are generally more disadvantaged and discriminated against in society, and that's also the case in the medical field. I felt a great sense of injustice that someone wouldn't have the same access to healthcare just because they were female. But I've also always found women's bodies fascinating – this complex symphony of different hormones, and how it shapes health and disease and every part of a woman's body.

Why did you choose to become a TV fertility expert?
It used to be that women's health issues weren't discussed openly. I wanted that to change. It felt that so many women desperately needed help but weren't necessarily able to access a doctor – or, indeed, adequate healthcare. When I'm with a patient, I'm only reaching one person. When I'm on TV or social media, I can potentially reach millions. A platform like *This Morning* is accessible to so many people, who might not have the money or time to see a doctor, or prioritise their own health over that of their children or elderly parents. It's something I never take for granted.

How did your time at Imperial shape your thinking?
These days, I'm thinking more and more about how to bring together Western medicine and Eastern philosophies: treating the whole person. I've always felt that Imperial values different approaches. It always felt like a cutting-edge place that challenges the norm and the status quo, and I incorporate elements of that thinking into my practice. The experience at Imperial helped to shape my holistic approach to health and wellbeing, combining the allopathic and alternative, as well as teaching me the importance of thinking laterally to expand current paradigms and help shape the world we live in today.

> ***Dr Larisa Corda*** *is a Women's Health and Reproductive Specialist at Concept Fertility and the Hale Clinic, London, and regularly appears in the media, as well as being the resident fertility expert on ITV's* This Morning.

DR THEODORA KALENTZI

(MSc Health Management 2004), Founder of Medical Prime and member of the Imperial Entrepreneurs' Pledge

What drew you to specialise in menopause care?
When I was a medical student in Greece in the late 1990s, I saw my mother suffering from menopausal symptoms. I felt helpless. There wasn't much in terms of training – menopause was something women had to 'put up with'. It was the same when I came to the UK for further training. Eventually, I shadowed a top menopause specialist who ran a clinic at Queen Charlotte Hospital and, in time, I became a British Menopause Society Accredited Menopause Specialist.

How did the Medical Prime Perimenopause and Menopause Clinic come about?
I have held senior positions in the NHS and I hoped to be able to establish an NHS community menopause centre, but the support was not there. My studies at Imperial College Business School taught me to be resilient, purposeful and entrepreneurial and, as a result, I decided to found my own menopause clinic, Medical Prime, in 2017. The support I received and still receive from Imperial and its alumni is positive and empowering, and the clinic today is well-established and we are growing strongly.

How did you become involved in the Imperial Entrepreneurs' Pledge?
The MSc in Health Management was one of the best times of my life and I thought, if I do sell my business, I'd be more than happy to give some of that money back to younger students, or even to older people like myself, because I'm an 'older-preneur'! If we all contribute, we can help some of the less fortunate students to learn and perhaps even take a risk. I wasn't a student who had financial support, so I did my full-time Imperial course and three days working as a hospital doctor. I understand the challenges, I understand the finances and if somebody can be helped through this initiative, that's a good thing. ◆

> ***Dr Theodora Kalentzi,*** *Founder, British Menopause Society Accredited Menopause Specialist and GP, is a clinical teaching fellow at Imperial and an advisory board member of the Sleep Council.*

INTERVIEWS: KAT BROWN/LUCY JOLIN. PHOTO OF DR STEJSKALOVA: HAILEY MILLAR

POLICY AGENDA – PROFESSOR MATTHEW FISHER,
CO-DIRECTOR OF THE GEORGINA MACE CENTRE FOR THE LIVING PLANET

A matter of life or death: why biodiversity must be taken seriously – now

THE LANDSCAPE

The urgent need to slow climate change is well understood, but what's less appreciated is the need to save the biodiversity that underpins it. "As scientists, we're interested in the opportunities biodiversity lends us, but also in the threats," says Matthew Fisher, Professor of Fungal Disease Epidemiology. "COVID-19 is an obvious example of biodiversity gone bad, but it's also essentially a marker of a much wider process – the world's ecosystems are being rewired by the rapid environmental changes we humans are imposing."

THE CHALLENGE

Fisher points out that, as a planet, we've been through five mass extinctions and we're now in the sixth. Industrialisation and globalisation have put humans into very close contact with certain ecosystems for the first time, leading to threatening interactions. "Industrialisation is also changing our environments and we start to lose species either because they've been eaten or there's nowhere for them to live. How do we bend the curve of biodiversity loss to get away from that extinction rate?"

THE SOLUTION

Fisher and his colleagues examine the complex macro-ecological processes causing these impacts, often using libraries based on millions of DNA markers alongside in-the-field monitoring. "Using big data genomic technologies, we can produce readouts of what's out there, which enables us to set down very complex baselines of biodiversity. So we can tell when something's changed, or if we're losing species. We then try to translate that information into action the world needs to take."

THE COLLABORATION

Key to all of this, says Fisher, is sharing scientific knowledge with people who can effect the necessary change. "When you understand biodiversity is being lost and you have some form of metric, you have to engage with policy-makers to argue why this is important. They're the only ones who can change the trajectory of society, most notably through the use of law and subsidy."

> **How do we bend the curve of biodiversity loss to get away from that extinction rate?**

This was a focus of a debate hosted by Professors Fisher and Vincent Savolianen at Imperial's Georgina Mace Centre for the Living Planet, bringing together key figures from across the worlds of science, academia and politics. "When dealing with something as intrinsic as biodiversity you need all those voices in the room, you need the scientists to speak with the politicians," says Fisher, "because otherwise it's just an echo chamber.

"Encouragingly, there were no surprises – in that everyone recognised the absolute importance of biodiversity for our cultures and economies to continue. It's understood that the problem of biodiversity loss is not an extreme stance or a hippy idea – we all understand that the ecosystem functions provided by intact biodiversity is an essential underpinning of a healthy human-dominated planet. We all have some level of eco-anxiety because we all understand the scale and depth of the problem."

THE FUTURE

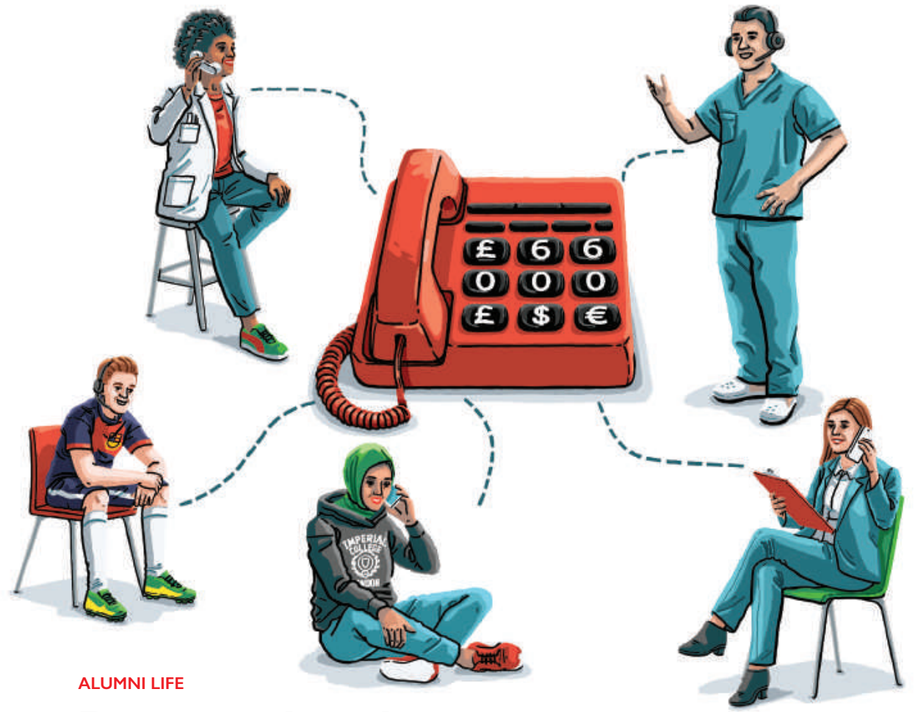
Fisher says that there is widespread consensus that for the UK to achieve its net zero gains, it's essential to address biodiversity. "The two key processes – the need to decarbonise our economy and the need to strengthen our biodiversity and its ecosystem functionings – are interlinked, but scientists are consistently saying it's not happening fast enough.

"People are realising the link, however. After the summer we had – a 1 in 500-year drought – I doubt the public would push back against policies to preserve biodiversity. People have seen shrubs dying and biodiversity lost in their own gardens.

"It's a massive challenge but I'm optimistic. I believe in the angels of our better nature, that humans essentially will accept sacrifices for the greater good. We're locked into some pretty desperate trajectories, but we will win through." ◆

> ***Professor Matthew Fisher*** *is Professor of Fungal Disease Epidemiology and co-director of Imperial's Georgina Mace Centre For The Living Planet.*

WORDS: PETER TAYLOR-WHIFFEN



ALUMNI LIFE

Ringing the changes

From telethons to Giving Days, how will you get involved?

When Sarat Alabidun (PhD Chemical Engineering) heard that the Imperial Telethon was looking for student callers, she didn't hesitate to sign up. "I am a beneficiary of a scholarship at Imperial and wanted, in my own little way, to contribute to making similar scholarships available to other people in the future," she says. "What I liked most about the job was contributing to raising money for student support, making valuable connections and learning a lot of life and career lessons from alumni."

And the alumni who answered her calls were happy to pay it forward, too. The Spring Telethon, which took place in March, saw student callers reaching out to more than 800 Imperial alumni across the globe, raising more than £39,000 to support students. "I support all efforts to assist Imperial," says alumni donor Nelson Kardos (MSc Biochemistry 1974). "My time at Imperial was life-changing. I always believe that gaining success in life requires getting the right key to the right door. And Imperial is the right key to unlock the door to the future."

In fact, alumni donors have helped support more than 2,500 students via scholarships, bursaries and hardship funding over the past two years. The Telethon is just one example of the incredible impact Imperial's students and alumni can have when they come together.

Another example is the recent Alumni Weekend, where alumni and students gathered to celebrate their time, past and present, at Imperial. Attendee Anuraj Bismal (BSc Physics 1987) was inspired to give a generous gift to celebrate 35 years since his graduation. "I enjoyed meeting students at the Union bar and at the donor reception," he says. "As we bumped into students during our time there, we were filled with pride and hope for the future."

Supporting Imperial's students to do their best work has always been vital. But the cost of living crisis is creating an even more challenging environment, making alleviating student hardship more important than ever. The work never stops, and next up is a new event – the Business School's first Giving Day. It will take place in March 2023, with the entire Imperial College Business School community coming together to raise funds for students with limited financial resources. ◆

> *If you'd like to take part or find out more, visit www.imperial.ac.uk/giving*

WORDS: LUCY JOLIN. ILLUSTRATION: EVA BEE

MY IMPERIAL

Ribbon rhythm

Zhengli Lim
(Research Postgraduate, Mechanical Engineering).

Words: **Jo Caird** / Photography: **Emli Bendixen**

People tell me my ribbon dancing looks very graceful from a distance. From my perspective, though, it's complete chaos. I have no formal dance or gymnastics training. I like just feeling the music.

When I was 18 I discovered that I liked to dance at nightclubs. Years later, I thought, 'This is fun, but what if I spice it up?' I tried different things – a pilates bar, a gymnastics ball – and eventually ended up with this ribbon on a stick and it felt like it was meant for me. Now I don't need to go clubbing – the Dangoor Plaza at Imperial is perfect.

Because of the chaos, it's the ideal spot for my practice – it's open with plenty of space, so there's less chance of hitting anyone. I hope that nowadays I have enough control to avoid that, but it hasn't always been the case. When I was first starting, the balance between my power and precision was a bit off. The stick can fly up to 30m away if you lose your grip, and although I've never injured anyone, I once knocked a seagull out of the sky. That was in Hyde Park. I heard a squawk then looked down and saw a seagull splashing into the pond outside Kensington Palace. I was relieved it didn't die, it was just a bit dazed.

Fortunately there aren't many seagulls around Imperial, but there are plenty of people. The lawn can get busy, depending on the weather, and if it's crowded, I won't practise at full strength. Or I go elsewhere. Every time I exercise, a child or dog will show up and want to play with it. I'm used to it, so I always carry extra ribbons so that they can.

Although, if someone is watching, I don't really notice. I just pick a patch of grass, stick in my earbuds and dance. I reach my top level of performance when I'm completely unaware of anyone else around me and it's just for myself: when I'm in a flow state. I don't reach that state very often but when I do, it feels great.

My PhD setup doesn't require me to be on campus at all, but I go anyway because I like the ambience – I'll either head straight to the lawn or the library. And I always have my ribbons with me; I never know when I might want to use them. On a good day I can be out for six hours. When I first started it was very exhausting, but you get used to it. And I need the practice: even now my skill is not at the level I want to be at, and there is so much more I can do. ◆

Above
Zhengli performing on Dangoor Plaza during his lunch break.