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Regulars

04 FROM THE PRESIDENT

An update from Professor Alice Gast.

06 IMPERIAL INNOVATES

Arjun Panesar of Diabetes Digital Media.

09 EDUCATION

Professor Emma McCoy on Imperial’s multi-mode digital education programme.

10 ADVENTURES IN ... POETRY

Imperial’s Poet in Residence Dan Simpson.

38 IMPERATIVE

Professor Maggie Dallman.

39 A WORKING LIFE

Yvette Stevens – from Imperial to the UN.

40 ADVENTURES IN ... POETRY

Imperial’s Poet in Residence Dan Simpson.

43 A WORKING LIFE

Yvette Stevens – from Imperial to the UN.

44 RESEARCH

Professor Pier Luigi Dragotti.

45 PUZZLES

The ultimate prize puzzle challenge.

46 POLICY AGENDA

Dr Nejra van Zalk.

48 ALUMNI LIFE

Featuring the wide range of online events.

Features

12 WE CAN DO MORE

... and we will. Discrimination and inequality must be challenged at all levels, and Imperial is playing its part.

18 EXTINCTION DAY

After the heat; after the dark; after the cold. New research is revealing exactly what happened the day the dinosaurs died.

22 FLIGHTS OF FANTASY

Imperial’s Science Fiction Library is a unique window on our world – past, present and future.

28 DIAGNOSIS AT ANOTHER LEVEL

Using nanomaterials and biosensors, Imperial is transforming the way diagnoses are made.

28 SAFE AND SOUND

Data, Infrastructure, Borders. Imperial specialists are leading the effort to keep the nation safe.

34 ISSUE 49 - WINTER 2020/21
As the COVID-19 crisis has shown, building resilience to react to rapid and sudden change is a crucial part of Imperial’s contribution to society – which is why it’s a core strand of the College’s new Academic Strategy.

Alongside the development of a sustainable, healthy and smart society, the new strategy will help Imperial continue to push the frontiers of research, life-changing education and transformative innovation. It represents the College’s mission to discover new knowledge and use Imperial’s deep understanding of the world to address some of its most pressing challenges – and identify new opportunities to improve it.

“The frontiers of knowledge are expanding,” says Imperial’s Provost, Professor Ian Walmsley. “We are sending missions to Mars, building artificial cells that mimic nature and gathering data at a new scale. New opportunities arise every day as technology advances. But we also must think about resilience – how we can react to rapid change and ensure high-quality delivery of services in the long term.”

Professor Walmsley

As one of the proposers of the Cluster mission (Next stop: Jupiter, Imperial 48), space plasma physics continues to be my field of research. The facts about the aurora are even more interesting – the aurora is produced by electrons of much higher energy than those of the solar wind. They are scattered from the magnetosphere into the atmosphere where they produce ionisation, excitation and light. Those that create the brightest and most colourful types of aurora, the iconic curtains and rays, are accelerated during precipitation by a mechanism that appears to be similar to the plasma-wave surfing employed to accelerate electrons in tokamaks used for research into nuclear fusion. The power involved in an auroral display is at times comparable to that of the UK’s national grid.

Duncan Bryant

(Physics 1955, PhD 1958)
In challenging times we remain leaders in the battle – adapting, creating and advancing

It has been a challenging year for everyone around the world. Nobody has been spared from the disruption and sadness accompanying the global COVID-19 pandemic. Yet amid this distress we see the absolute best coming from members of our Imperial community. We see their compassion as they work to help one another. We see their ability to adapt to new ways of teaching and learning. We see their resolve to keep moving forward during a period when time seems to have stopped.

In my annual Autumn message to the College, I drew on my experience of a ride on the Ultimate, said to be Europe’s longest rollercoaster, as a metaphor for what we have experienced this year. The ride begins quite innocently: a lift hill followed by long smooth hills and some friendly bunny-hops. Then there is a second lift hill and a turn to the left toward the woods. Warning signs soon appear: “Hang On.” Hang on, indeed! Then it’s chaos. Rapid turns jolt you left and right. You want to close your eyes to lessen the terror, but you left and right. You want to close your eyes to lessen the terror, but you need to see which direction you will be thrown in in order to brace yourself. This is what 2020 feels like to me. A benign beginning that turned into a nightmare ride, one that is lasting longer than any of us anticipated or wanted.

The moment when I realised we were on a ride we never chose to ride was when I saw the Coronavirus pandemic. We were all in this together; all of us, university in emergency preparedness? He was right. We began using our university’s greatest resource, our experts, and their scientific evidence, to guide our planning and decision-making. We prepared for the worst, and our community pulled together to deal with the rapid changes and shutdown. The pandemic brought us closer together. As we learned more about the virus, we also learned more about ourselves at the same time. We learned that in adapting to the constraints of the pandemic world, we are creating new ways of moving forward. Our multi mode teaching is one example. It combines the best of remote learning with valuable time in person, talking to peers and professors, experimenting in laboratories, practising in studios and gaining practical training. The pandemic accelerated these changes and provided more focus on how best to use our precious in-person time.

We know we are not doing enough to address racial inequality and injustice. Recently and in person we are responding to this call. We can, and will, do more to improve the College to make it an equitable and welcoming place for all. You will see in these pages some of what we are doing to show that Black lives matter at Imperial. We continue to be inspired every day by the ways our colleagues are mitigating the impacts of COVID-19 through advances in modelling, testing, treating and vaccinating. The breakthroughs by Professor Molly Stevens and her colleagues in ultrasensitive medical diagnostics will help us, not only in this pandemic, but also in early stage diagnosis of cancer, HIV and other diseases. Other articles capture the inspiring work going on daily across the College. From the dramatic story of the asteroid that killed off the dinosaurs to uncovering the sketches hidden beneath a famous painting, the work of Imperial staff and students is enthralling.

We must all hang on during the rollercoaster we never chose to ride. Our community is part of the solution.

Professor Alice Gast is President of Imperial College London and is an internationally renowned academic leader and researcher.

OUTREACH

New maths school launched

Imperial has announced its launching a new specialist school for sixth-form maths students in 2023, and will specifically target underrepresented groups such as female students, students from BAME groups and disadvantaged communities.

The new Imperial College London Mathematics School, developed in partnership with London’s Woodhouse College, will become a beacon for high attainment in maths, part of a growing national network of maths schools aimed at increasing STEM graduates generally.

The Hitchhiker’s Guide to the Galaxy says 42 is the answer. But what is the question? For Dr Marc Stettler it’s how to alter the course of climate change.

Could a small tweak to flight paths significantly reduce global warming? Dr Marc Stettler, Senior Lecturer in the Department of Civil and Environmental Engineering, believes so. Along with his colleagues in Imperial’s Transport and Environment Laboratory, he’s working on what he calls “the fastest way for aviation to reduce its overall climate impact.”

His focus is contrails, the white streaks that form in an aeroplane’s wake when water vapour condenses on to soot particles and freezes as ice crystals. While the majority evaporate, some linger and form a barrier that traps heat that would otherwise escape the Earth’s atmosphere.

Existing efforts to curb aircraft-related climate change focus on reducing or offsetting carbon-dioxide emissions, but Stettler says these will take decades to implement, may work less well than expected and could be expensive. His research, based on in-depth analysis of flight data from Japanese airline, weather and flight trajectories, breaks new ground in the finding that one small change could have huge impact.

“We found that two per cent of flights contribute 10 per cent of the warming effect related to contrails,” he says. “The research suggests that making a minor change to these flight trajectories could be transformative, as it is possible to avoid the thin layers of the atmosphere where the (cold and humid) weather conditions are just right for contrails to persist.”

The next step is getting the aviation industry on board. However Stettler points out that if just one forward-thinking airline started considering contrails at the flight-planning stages, it would set a trend. “It’s a small change that could have a big effect and very quickly – within five years, if there is an appetite to do it.”

Mitigating the Climate Forcing of Aircraft Contrails by Small-Scale Diversions and Technology Adoption by Roger Teoh, Ulrich Schumann, Arnab Majumdar, and Marc E.J. Stettler was published in February 2020 in Environmental Science and Technology.

The lectures will be filmed in December 2020 and broadcast on BBC Four between Christmas and New Year.
Until recently, type 2 diabetes was considered to be a chronic, progressive disease that would eventually require medication. Thanks to my grandfather, though, I knew that didn’t have to be the case.

In my first year at Imperial, he had an emergency quadruple heart bypass and was subsequently diagnosed with type 2 diabetes, which came as a huge shock. One day, he asked me what he should eat, and I had no idea. The lack of information online led me to start diabetes.co.uk, a digital community that now has 1.8 million active members. My grandfather used the forum, and within four years had put his diabetes into remission by lowering his carbohydrate intake. Many other members had similar stories so, in 2012, I founded a company, Diabetes Digital Media, and we self-funded studies into the effectiveness of using a digital therapy to place type 2 diabetes into remission.

In 2015, we launched our first medical device, the Low Carb Program app. It guides people through reducing carbs in their diet and has been proven to place type 2 diabetes into remission – something no drug can do. In the general population, one in a thousand people is able to achieve type 2 diabetes remission through diet, but of the 440,000 people who’ve used our app, around 100,000 achieved remission within a year. We now have 13 NHS clinical commissioning groups using it, and our economic analysis shows that for every 3,000 people that go through the programme, we save the health service £956,000.

Imperial played a big part in our success. At first, I wasn’t sure I could cut it, because you’re sitting next to some of the greatest minds on the planet. But being in a high-pressure environment surrounded by exceptional students encourages you to be better, and fosters resilience and adaptability, which are essential in challenging times. When you tell people you learned your trade at Imperial, it’s met with a lot of respect and I was particularly proud to win Imperial’s Emerging Alumni Leaders Award in February.

Our next medical device is the Gro Health app, which goes beyond nutrition, adding sleep, activity and wellbeing. We’ve just launched in India, and we’re also running studies in the UK and Europe. The plan is to become leaders in the field of personalised medicine, which is exciting. Things are going well for my grandfather, too. At 87, he’s as fit as a fiddle – and I think he is proud of what he’s inspired.
Darker nights? No problem.

"For reading, this light is better than daylight.

Mrs Watkins London

We have all been spending more time indoors with our heads in a book or absorbed in our favourite hobbies. The light we live under has far reaching effects. At this time of year as darkness takes over, it becomes even more obvious just how important light is to us. Poor quality light causes eyestrain and can affect our ability to read and concentrate.

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INTERIM VICE-PROVOST (EDUCATION AND STUDENT EXPERIENCE)

Multi-mode programme will take the Imperial experience to yet another level

Students on a virtual trip to the Pyrenees used panoramas to observe more detail than they could have done in person

Operations Group, which comes together to work collaboratively, share best practice and discuss progress. Already this is enabling departments to communicate with each other in new ways. In addition, the Team is a newly established group made up of our EdTech leads across the College, our education leads, and representatives from ICT and our Digital Learning Hub who come together to share good practice. We cannot pretend that this coming year is going to be what any of us expected it to be, but what we can do is be confident that we’re offering a safe – and intellectually rewarding – experience.

> Professor Emma McCoy is a member of the Royal Statistical Society council.

the multi-mode approach that allow us to deliver lectures, communicate through online discussion, set and mark assignments, and track student progress. We know already that this method gives us the opportunity to provide more instant feedback than we used to. And we have broad representation from across the College in our Education and Strategy
Poet and spoken-word artist Dan Simpson isn’t scared of looking silly. Indeed, he’s equally at home wearing a sandwich board – which he did at an Imperial Lates event just before lockdown – as he is performing and writing. “I’ve always loved maths and science,” he says, “and I have a natural curiosity. I’m all about starting conversations about science with lots of different people in a way that is inclusive and allows for two-way dialogue.”

As Imperial’s Poet in Residence, Simpson has been collaborating with researchers and the public to experiment with words. A recent speed-writing challenge saw him write haiku over Twitter (@ImperialSpark) in response to whatever science topic academics, students and the public sent his way – from synthetic chemistry to static electricity. Here’s one on scientific theories: “Sometimes physicists/ Make quantumly complex jokes/ They then must disprove.”

An experienced and engaging performer – he’s a Glastonbury veteran – Simpson hosted a recent live-streamed Poetry Slam featuring an impressive line-up of spoken word performers as part of Imperial Lates Online. But, for him, it’s as much about getting everyone else to take part as it is about making his own work. In fact, his latest spoken word composition for Imperial – *Back to Nature* – was entirely crowdsourced and inspired by conversations with Dr Ans Vercammen at the Centre for Environmental Policy. The public were asked to respond to prompts from those conversations, and Dan crafted the contributions into a poetic meditation on our place in the natural world. He then went on to collaborate with Vercammen on an original poem. “I challenged her to jot down her feelings. Her interests are in mental health, scuba diving and blue space, and it followed from there. It was a lovely collaboration.”

“People are often nervous about poetry but in the original oral, campfire tradition it was just a way of telling people things. It was only when we started writing it down that it became thought of as a textual medium, rather than a spoken one – but there is a lot of overlap between the two.”

Inspiration has come from Imperial researchers’ liveliness and creativity. “Science itself is a creative act. You reinterpret, question and challenge. You expect that from both artists and scientists. We are all human, trying to understand the world and communicate it; there’s an overlap.”

Following residencies at Waterloo Station and the National Trust, alongside his ongoing work with primary schools, Simpson says coming to Imperial feels timely. “Science is dominating the headlines. For tragic reasons, we have become more engaged, but I hope our interest grows around a wide range of areas of science. We’re interested in climate change, in our mental health, in how cities are organised. The more we can talk about research in lots of different ways, the more everyone can connect with research and researchers.”

“A man with a way with words
Imperial’s Poet in Residence Dan Simpson brings the worlds of art and science together.

Words: Megan Welford / Photography: Angela Moore
As the world watched the shocking footage of the killing of George Floyd – reigniting global attention on the Black Lives Matter movement – Imperial’s President, Professor Alice Gast, knew that the university had a duty to respond quickly, and thoroughly. “I felt a deep anger and despair at such a senseless death,” she says. “It brought to the surface my shock and disappointment that racism, and the violence that it breeds, continue in the United States. I am also saddened by persistent racial inequality and injustice here in Britain and around the world. “Racism and violence have no place in society. Our spirit of common purpose must prevail, and we must pull together and collaborate as a community to support those who are afraid and mourning. We are a university committed to equality, diversity and inclusion. I am determined to not just talk about solidarity, but to listen to all members of our community, so that we are better placed to enact change. We all have the responsibility and opportunity to contribute our excellence toward addressing racial inequality and injustice. We can all do more – and we will.”

“I wanted to create something that changed misconceptions”

Kitan Oyeleke

“It’s important that our voices are being heard and we’re part of the solution”

Sean Bazanye-Lutu

Left: Kitan Oyeleke (Chemical Engineering, Third Year) is Vice-President of the African Caribbean Society and the driving force behind the Black People of Imperial project, inspired by the earlier 56 Black Men campaign, designed to address stereotypes.

Words: Lucy Jolin / Photography: Sophia Spring
Immediate steps taken by Imperial included: working with the College’s BAME staff network, Imperial at One, to develop a concrete action plan to make a tangible difference in the College’s community and wider society; rolling out new advice and support to equip staff and students to be better allies; driving forward a new outreach programme targeting Black students in London with the aim of doubling the number coming to Imperial by 2024-25; establishing a new scholarship fund to support Black students; ending the use of the historic Latin motto in any new materials, in order to better reflect the College’s culture, values and commitment to diversity and commissioning a working group to examine the College’s history and legacy.

But the work had already started, says Professor Stephen Curry, Assistant Provost for Equality, Diversity and Inclusion, pointing out that #BlackLivesMatter has enabled it to reach a much wider audience—and, hopefully, encourage more people to take part. But there is a lot of work to do, he acknowledges, and no single solution or one-size-fits-all policy: tackling diversity means properly reaching into every aspect of Imperial’s operation, from admissions and research to student and staff wellbeing.

He hopes that Imperial’s 2018 Equality, Diversity and Inclusion Strategy will provide the information and inspiration to improve. “For example, the data shows that we admit as many British-Asian students to medicine at Imperial as we do white students,” he says. “But our numbers of African and Black-Caribbean medical students are very low, so we need to seriously do something about that. We are committed to doubling the number of Black students we admit within the next five years.”

Faculty-led, top-down programmes—such as Athena SWAN, a charter that recognises gender-equality work in higher education, and its equivalent, the Race Equality Charter—are, of course, just one part of the plan, and Curry is eager to bring in those at Imperial who have recognised the importance of this work. Dr Sarah Essilfie-Quaye, Project Manager in Research Strategy, Faculty of Medicine, is co-chair of Imperial As One and a member of the Race Equality Charter Self Assessment Team. Essilfie-Quaye first started working at Imperial in 2002.

“I always knew making it to the top in academia was difficult for anyone,” she says. “I watched as people around me progressed, and observed who was supported and retained—the majority were male and white. One day, I looked up the number of Black female professors at Imperial. It was zero. Since then I have found out that the number I was looking at wasn’t even professors—it was academics. No lecturers, no readers. But it’s not just Imperial that’s at fault because, right now, there are only 35 Black female professors in the whole of the UK.

“There is a lot of work still to be done but there are positives coming out,” she says. “We recently hosted the 4th BME Early Career Researcher conference, an entire day tailored to helping Black and minority-ethnic researchers stay in academia. Imperial is working on tackling some of the barriers underrepresented people can face, looking at our recruitment processes, and making scholarships available. People are starting to listen, and one of the biggest things you can do is listen when people tell you about their experiences of racism. When you dismiss them, or try to debate, you are not debating something in a bubble, you’re debating people’s existence and their lived experiences, and that takes up a lot of energy. A series of candid interviews called ‘Belonging’ started at the beginning of lockdown, is growing in popularity, with students, academics and professionals sharing their experiences and insights in finding their sense of belonging.”

Last year, Kitan Oyeleke (Chemical Engineering, Third Year), Vice-President of the African Caribbean Society (ACS), was awarded...
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EQUALITY AND DIVERSITY

Equality and Diversity seed funding for the ACS Outreach Programme. She has also had personal experience of Imperial’s reputation as overwhelmingly white and male.

“When I was applying, my maths tutor asked me about my first-choice university, I told her it was Imperial, and she said: ‘Okay! There are no Black people, there are no women!’ So, I expected to feel othered,” she says. “But when I got here, I realized that it wasn’t that bad! Although there is a diversity problem, the Black community is very close-knit. I wanted to create something that changed misconceptions about the Black community within Imperial. I feel that the ACS could be doing a lot more, and that we have a huge responsibility to the wider community regarding how Imperial is seen.”

The resulting ACS Outreach Programme is designed to provide pastoral and welfare support, mentorship and advice to high-achieving Year 12s and 13s from minority-ethnic backgrounds. Applying for the funding was easy, says Oyeleke. “All we had to do was prepare a plan of what we hoped to achieve, and our ESUs. Initially, it will run at the London Academy of Excellence in Stratford, as members of the committee attended the school and have a relationship with it already. However, Oyeleke hopes to open it up to wider application in the future.

She’s also responsible for the Black People of Imperial Instagram project. Based on the much-shared 56 Black Men social media initiative, which shares personal stories and images to highlight and challenge stereotypes, the project seeks to capture experiences of Black people at Imperial across the board, from students to support staff to academic staff. “We want to show all those people without whom Imperial wouldn’t run,” says Oyeleke.

Debbie Adegoke (Molecular Bioengineering, Second Year) is BME Officer at the Student Union. Coming from a predominantly white area of the UK, in north west England, she thought Imperial would be far more multicultural and reflective of its London base. “I was shocked to see that it wasn’t as diverse as expected,” she says. “I decided that I wanted to try to do something to make a difference.”

The role doesn’t have defined responsibilities, and Adegoke says part of the challenge is working out exactly what needs to be done, and the best way to do it. To that end, she spends a lot of time talking to different student communities and communicating their needs and expectations back to the Union council. She is also a member of the Race Equality Charter Self-Assessment Team, and has worked with outreach organisation the Blueprint Project on Bridging the Gap 2020, the UK’s first graduate-led conference for Black and mixed-race A-level and International Baccalaureate students.

Outreach is crucial if we’re going to understand and address the barriers,” adds Amr AlWishah, (MSc Sustainable Energy Futures 2020). Now an energy consultant, Amr helped establish a steering group to identify barriers to application and what could be done to address them.

“Just because we are a science university, it doesn’t mean we shouldn’t be diverse”
Amr AlWishah

17
EXTINCTION DAY
NEW RESEARCH IS REVEALING EXACTLY WHAT HAPPENED THE DAY THE DINOSAURS DIED.

Words: Helena Pozniak / Illustration: Stuart Patience

For life on Earth, the day began like any other. Twenty-four hours later, dinosaurs – along with three-quarters of all other species – would be set on a path to extinction, smashed out of existence by an asteroid the size of a city travelling at speeds of up to 72,000km an hour. And, for the Earth itself, it was the end of the beginning.

“It was an unlucky day,” says Dr Matthew Genge (Geology 1989) in the Department of Earth Science and Engineering, in a masterpiece of understatement. “The dinosaurs would barely have seen it coming, but the asteroid would have a catastrophic impact on the evolution of the planet.”

Given that these events occurred 66 million years ago, understanding the scale of the mayhem is a feat of the imagination – and a triumph of science. The escaped piece of space rock, from the solar system’s asteroid belt, smashed into what is now the Gulf of Mexico at the worst possible angle. And, as a result of Imperial research, we now know – in unprecedented detail – what happened next.

By raking over physical evidence extracted by drilling hundreds of metres into the ocean-covered crash site, and feeding on-the-ground measurements from the crater into a supercomputer, Imperial scientists within Earth Science and Engineering are painstakingly creating 3D simulations of the moment of impact and generation of a fast-moving dust cloud that circled the Earth in a few hours, initiating an impact winter that ended the reign of the dinosaurs.

After the initial flash, seismic waves would have travelled around the planet many times. Anything within about 1,000km would have been burned to a crisp, says Professor Gareth Collins (PhD Environment and Earth Science 2001) of the Department of Earth Science and Engineering, who has analysed numerical models of the impact run by colleague Dr Thomas Davison (MSci Earth Science 1989).

As water rushed back into the crater, explosive steam jets shot into the sky. A molten curtain of debris – known as ejecta – carried above the Earth’s atmosphere and travelled around the world in a dust cloud blocking out sunlight.

1) The asteroid was the size of a city travelling at supersonic speeds of up to 72,000km an hour. Researchers estimate the asteroid hit with the equivalent power of 10 million megaton nuclear bombs.

2) Surrounding rock melted to form a lake of superheated melt 70km across and 3km deep. Further rock, temporarily liquefied, was also ejected.

19
and Engineering 2016, PhD 2011). Dinosaurs living thousands of kilometres away from the impact would have broken bones after being smacked down by the hurricane-force winds. Surrounding rock would have been liquified to form a pool of superheated melt 710km across and 3km deep. Further out, rock temporarily behaved like a fluid for about 10 minutes during crater formation. As water rushed into the crater, explosive steam jets would have shot into the sky. A molten curtain of debris – known as ejecta – would have cascaded above the Earth’s atmosphere and travelled around the world in a dust cloud, blocking out sunlight. It would have felt like the end of the world. And while it wasn’t quite the end, the mystery of what happened on that day has fascinated scientists for decades. The asteroid theory was first suggested as the cause of the end of the dinosaurs back in 1980, but it wasn’t until 1991 that a 200km-wide crater was discovered beneath Mexico’s Yucatán peninsula and the Gulf of Mexico – it was named the Chicxulub crater, after a nearby town.

Four years ago, an international team, co-led by Imperial’s Professor Joanna Morgan in the Department of Earth Science and Engineering, began drilling deep into the crater site to extract samples of rock buried for millions of years – the first direct evidence to reveal how the inner ring was formed, but, to Morgan’s delight, what they found proved beyond doubt what had happened. The granite-like rock they extracted was from the mid-crust, 10km deep, which was highly fractured and shocked by the impact. It proved what’s known as the ‘dynamic collapse theory’, suggesting a deep rebound and outwards collapse. “It’s a very dramatic model,” says Morgan. “Rocks moved tens of kilometres in the first ten minutes.”

Initially the impact gouged a hole 30km deep and 100km wide, ripping fault lines into the Earth’s mantle and liberating billions of tonnes of chemicals. “The Earth’s crust isn’t strong enough to keep the hole there – the walls collapse inwards and the bottom of the hole collapses – so that a huge volume of rock with a vast amount of energy shoots upwards,” says Collins. In a matter of minutes this rebound – briefly – formed a mountain on the scale of Mount Everest, but as the unstable mound collapsed back down, it created a flat, shallow crater, as well as the peak ring that stands above 500 metres above the crater floor.

Imperial’s physicists fed the newly discovered evidence into a high-performance computer to model the impact and its aftermath in three dimensions. When an asteroid strikes, the shape and geology of the crater depends on the angle of impact, and the team was able to deduce that the asteroid struck at around 60 degrees – the most damaging incline possible for life on Earth. But they were also able to calculate that, within 35,000 years of impact, Mexico’s Chicxulub crater fostered a thriving ecosystem – a much faster recovery than many sites around the world.

The team also fed information into the model that included the whereabouts of the centres of the crater and peak ring, and the location beneath the surface where dense rock from the Earth’s mantle has been uplifted. By aligning these points along an axis, the team could work out the direction of travel. “It was good to come out with such a clear vision of what it would have looked like,” says Davison. “We think the asteroid travelled from the north-east. It was so big that the atmosphere wouldn’t have slowed it. The ring of peaks is offset to the south-west.” Simulations of a 60-degree strike from the north-east reproduced observations from the centre almost exactly.

And it was this devastating angle that caused such large amounts of climatic-active gases, dust and burned carbon to be ejected at high velocity above the atmosphere and travel around the world, leading to cold and dark conditions for years after the impact. For Earth, it was life-altering. The asteroid struck rocks that were rich in sulphur, carbon and organic matter, says Morgan. Unable to photosynthesise, forests, land and ocean plants died, and wildlife were ignites around the world. Life higher up in the food chain froze or starved to death, Evolution, says Morgan, was altered forever.

Scientists at that time were considering two different theories as to how the inner ring was formed, but, to Morgan’s delight, what they found proved beyond doubt what had happened. The granite-like rock they extracted was from the mid-crust, 10km deep, which was highly fractured and shocked by the impact. It proved what’s known as the ‘dynamic collapse theory’, suggesting a deep rebound and outwards collapse. “It’s a very dramatic model,” says Morgan. “Rocks moved tens of kilometres in the first ten minutes.”

Initially the impact gouged a hole 30km deep and 100km wide, ripping fault lines into the Earth’s mantle and liberating billions of tonnes of chemicals. “The Earth’s crust isn’t strong enough to keep the hole there – the walls collapse inwards and the bottom of the hole collapses – so that a huge volume of rock with a vast amount of energy shoots upwards,” says Collins. In a matter of minutes this rebound – briefly – formed a mountain on the scale of Mount Everest, but as the unstable mound collapsed back down, it created a flat, shallow crater, as well as the peak ring that stands above 500 metres above the crater floor.

Imperial’s physicists fed the newly discovered evidence into a high-performance computer to model the impact and its aftermath in three dimensions. When an asteroid strikes, the shape and geology of the crater depends on the angle of impact, and the team was able to deduce that the asteroid struck at around 60 degrees – the most damaging incline possible for life on Earth. But they were also able to calculate that, within 35,000 years of impact, Mexico’s Chicxulub crater fostered a thriving ecosystem – a much faster recovery than many sites around the world.

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As any science-fiction aficionado knows, things that appear modest — say, the TARDIS, or the monolith at the finale of 2001: A Space Odyssey — may reveal unexpected dimensions. Such is the case of Imperial’s Science Fiction Library which, over the course of five decades, has expanded from a handful of books in a padlocked cupboard to 10,000 volumes, plus 2,000 DVDs and 600 comics, containing an infinity of universes.

“When I was a student, the library was a few shelves of books on the ground floor of the Physics building in Prince Consort Road,” recalls Diana Ayres (Mathematics 1971), who loved to “drop in to browse or borrow a book.”

By the time Simon Bradshaw, Tom Yates and Dave Clements arrived at Imperial in the mid-1980s, the collection “lived in some grey metal cabinets up on the top floor of the Union building,” says Bradshaw (MEng Electrical Engineering 1990). But ambitious plans were afoot. A bequest from the then-warden of Beit Hall, Professor John Finlay, added some rare editions of early British sci-fi, including an 1895 edition of HG Wells’s The War of the Worlds, and doubled the number of books.

And with the grant of a basement in Beit Hall to house the enlarged collection, the library achieved its current form — “a space down tortuous-when-rainy stairs in a dark corner of Beit Quad, with a sign on the door saying ‘Beware of the Leopard’,” recalls Yates (Physics 1988). “We now had a library!” says Bradshaw. “More importantly, we now had what was effectively a clubroom.” The library became the heart of the Imperial College Science Fiction, Fantasy and Gothic Horror Society (ICSF), which went from a meeting held once or twice a week to a place where people would hang out in their spare time. “It helped that it was just across the quad from the bar,” adds Bradshaw.

“At the time, ICSF was the biggest club at Imperial because we were the only club showing films, so we had a lot of money to spend,” recalls former chair Clements (Physics 1986), now a Reader in Astrophysics and the published author of science-fiction short stories. The team went to the celebrated specialty store Forbidden Planet with a copy of the library catalogue. “Tom was counting the money, I started dashing around getting books I thought it would be good to have, while the rest started at A and bought everything on the shelves the library didn’t have. They got to ‘M’ before we had to stop.”

Flights of Fantasy

Imperial’s Science Fiction Library is a unique window on our world — past, present and future.

Words: Victoria James
Illustration: Matt Murphy
I don’t think it’s any coincidence that many of the world’s leading STEM universities have long-running science-fiction societies

TREASURES OF IMPERIAL’S SCI-FI LIBRARY

Foundation series Isaac Asimov
One of the most scientifically significant book in the library as many of the theories contained in Asimov’s 1950s trilogies have proved influential in real-world social science, including the main character’s uncertainty or incompleteness principle: if a population gains knowledge of its predicted behaviour, its self-aware collective actions become unpredictable.

Dune Frank Herbert
The most borrowed book in the library, the 1965 classic is regularly cited as being the greatest science-fiction novel ever having sold around 20 million copies worldwide. The ‘Duniverse’ has expanded to include prequels, sequels, films, TV mini-series and video games, and it’s argued that without it, Star Wars would never have been made.

The War of the Worlds HG Wells
Some of the oldest books in the library are by HG Wells. The War of the Worlds, perhaps his best-known title, was first serialised in Pearson’s Magazine in the UK in 1897, and is reportedly based on a discussion between the author and his brother Frank about the catastrophic effect of the British on indigenous Tasmanians. The book was most memorably dramatised in a 1938 radio programme directed by and starring Orson Welles, that allegedly caused public panic. Many listeners who did not know the Martian invasion was fiction.

years, this carried in its own museum of commerce. But beyond them both lay the clouded area, the Great Unseen where all the universe seemed embroiled.

The differences in the ways he comprehended the universe haunted him—security matched with insecurity. He saw it in life. Yes, when it was born, when it came into the pressures of reality, the new had its own life and grows with its own subtle differences. Terrible purpose remained. Race consciousness remained. And over all loomed the Judd, bloody and wild.

Chani joined him beside the men, hanging her elbows, looking up at him from the corners of her eyes the way she did when she studied his mood.

"Tell me again about the waters of thy birdfeeder." He asked. He was growing lighter, and he noted that some of his friends would never read this thing. "I'll neither you nor the other what the world is your mother in his path?"

"It's Aila he holds as his," she said. "My sister."

"What's it like in the sickness?" he asked.

"Why will you ever find the water? I wish to see it first through your eyes."

"Yes, that's very lovely, she said.

"How are the refreshments for you not right on the bench?"

"I have a few. The sickness. It is nothing."

The children are pleasant. If any one of us may come north to the white."

"Is there a thing to be desired for you in this world?"

"I was asked to speak in her. The unknown."

"The unknown."

Presently a woman, wearing a red dress, entered in her voice. "The unknown."

"There is trouble," Chani looked toward the glassed-in observation area. "Reverend Mother. They demanded that the demon in her daughter suffer not a witch to live among us."

"And what did my mother say to them?"

She recited the law and sent the woman away ashamed. She looked up. "There is trouble too. It is the fault of authority for not foreseeing and preventing the most foolish."

"I'll explain how the
Dr Hadi Alagha says he can’t begin to describe how the generosity of Imperial alumni has impacted his life. Today, Hadi is an aspiring orthopaedic surgeon who specialises in the use of big data and AI to optimise patient safety.

In 2012, Hadi, then an undergraduate, was forced to leave behind his home, friends and family in Syria to continue his medical studies in Europe. “I fled a war zone,” he says. “Without the generosity of the Imperial community, achieving my ambitions would have been very challenging. This opportunity gave me the peace of mind and freedom to focus on excelling in my development, and allowed me to undertake the research which I hope, one day, will influence the surgical management of orthopaedics and trauma patients worldwide.”

Hadi received the President’s Scholarship which ensures extraordinary students are free to excel. No one knows the value of an Imperial education – and of Imperial research – better than our alumni community, and it is your support that helps to ensure that financial barriers do not stand in the way of a talented student and their dreams.

With your help, we can continue to provide essential aid to disadvantaged and deserving students through the Imperial Bursary, attract the best and brightest applicants with the President’s Scholarship, and meet the needs of those facing sudden financial hardship which casts their future at Imperial into doubt.

Your support can transform the life of an individual student. But because they are Imperial students, many of those you support now will go on to change the world. So if you would like to support students such as Hadi, whether through regular giving or with a bequest in your will, please turn to the donation form enclosed or visit: www.imperial.ac.uk/giving/autumn-magazine-20

Your support means that financial worries won’t stand in the way of our students’ ambitions.

A gift that can help change the world.

Dr Hadi Alagha

Without the generosity of the Imperial community, achieving my ambitions would have been very challenging.

Dr Hadi Alagha

A lot of good science fiction is not just about the future, it’s about the present as well.

The War of the Worlds by HG Wells

A lot of good science fiction is not just about the future, it’s about the present as well. One of the authors of the recent paper on possible evidence for life in the clouds of Venus. In addition to inspiration, he sees the library as offering interaction – between Imperial’s students, the faculty and the wider community. “The library is a great place for students from different departments to meet and share ideas,” he says. Trevorrow agrees. “It allows students and lecturers not only to have something in common and debate over, but also to explore other scientific areas that they may not have otherwise thought about,” she says. “And it helps both to connect with people who don’t necessarily have a science background. Academics and researchers often struggle with putting concepts into words, while science fiction offers ways to do that.”

ICSF offers all that, plus – as Yates gleefully recalls – the opportunity to “get inside a genuine, working BBC Dalek”. It’s no wonder the Beit Quad basement and the myriad of worlds it contains are as popular as ever.
DIAGNOSIS AT ANOTHER (MICRO) LEVEL

Using nanomaterials and biosensors, Imperial is transforming the way diagnoses are made.

Words: Megan Welford / Photography: David Vintiner
Early, and accurate, diagnosis is key to better patient outcomes. We know this to be true for treatment and, as the global pandemic has highlighted, for controlling the spread of infectious diseases. But it is incredibly difficult to achieve. Blood tests lack the required sensitivity, rare diseases may not be immediately recognised, and access to healthcare is not universal.

At Imperial, Molly Stevens, Professor of Biomedical Materials and Regenerative Medicine and recently elected Fellow of the Royal Society, and her team are making groundbreaking advances in the field of diagnosis. Using their unique position at the interface of chemistry, engineering and medicine, they are working to develop new biomaterials. In the process, they hope to democratise access to healthcare across the globe.

“We want to highlight the opportunity not only to make sensitive diagnostics but to combine them with mobile technologies,” Stevens says. “To have this connected approach that can feed into online healthcare pathways, and hopefully transform the way that we can treat people within their community – both in early detection, but also in treatment and disease surveillance.”

It all starts with diagnosis.

Point-of-care, equipment-free tests – to detect disease at a molecular level – are already in use, but, as Stevens points out, they are simply not sensitive enough. So, she and her team want to go further. Not only are they developing ultra-sensitive nanomaterials for biosensing, but they are also manipulating what those materials can do. In the case of HIV, “we wanted to develop a test that could detect the virus itself, in particular some proteins on the surface of the virus called p24. That meant we needed new types of technology to give us really sensitive results.

“We work with nanoparticles: if you shrink the Sun down to the size of a football, then shrink it down by the same amount again, that’s the size we’re talking about. These particles can be made of different materials, but we are interested in creating materials that generate colour changes. Then you can take those particles and decorate the surface of them with molecules that bind to the virus, and you’ll be able to know if the virus is present.”

The tests look like a standard pregnancy test and work in a similar way, using biological material such as blood or urine to produce a colour change in the presence of disease-indicating markers. Stevens’ lab also works with state-of-the-art microscopy, some of which, such as SPARTA, her team developed. “You know you have a high-quality product if you can visualise it,” she explains, “so we use electron microscopy and chemical imagery. It’s not just about making something, it’s about making the right thing!”

Elsewhere, in pre-clinical work involving animals, Stevens is using that same principle – manipulating molecular behaviour – but inside the body for non-communicable diseases. “We are developing powerful biosensing particles that tell us about diseases inside the body,” she says, “such as cancer but also malaria, for example. It works by detecting enzymes – we know about enzymes for digesting, but they also have lots of different functions. If you have cancer, you have a different level of certain enzymes from the normal baseline level in a healthy person.

“Along with MIT in the United States, we have developed tiny gold particles that are held together in clusters, but when they come into contact with these cancer-indicating enzymes they break apart. Those particles then disperse and become small enough to be filtered through the kidney and passed out in your urine. Once in the urine, we can add simple chemicals and the urine will turn blue. We don’t need complicated equipment to read it; it can be seen by the eye, and the urine will turn blue less than an hour after you’ve done the test.”

It is a marker of Stevens’ work that this test is not only scientifically sophisticated, but is also easy to use, even in a remote healthcare setting. “You can elegantly design materials that will be written about in scientific journals,” she reflects, “but what will you do with them? How will you make them useful to society? That’s always in my mind.”

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As she told the World Economic Forum at Davos: “Infectious diseases disproportionately affect low-income countries. HIV, AIDS, malaria and Ebola all have a devastating effect on these countries. We need to come up with diagnostics that can be cheaper, simpler, more effective and globally accessible, which can help with democratising access to healthcare.”

The Stevens Group’s point-of-care tests, such as the one for HIV, are designed to cost less than a dollar, and work in conjunction with mobile phones. “We are used to using mobile phones for web searches and social media,” she says, “but they can have really important applications when we use them connected to lab tests and as diagnostic tools; when we think of them as portable mini-computers.”

Stevens cites the eight billion mobile phone subscriptions worldwide—a number that is growing by the minute, even in places like sub-Saharan Africa. In Uganda, for example, she says, 20 per cent of people live more than 5km from a healthcare centre, but many of them still have access to a phone signal, despite persisting inequalities of access to phones, such as in age and gender.

“We’re interested in the camera capabilities of the phone,” she says, “so you can read the test result with a mobile phone and transfer the data through wireless connectivity. We have developed ‘i-Sense’ machine-learning algorithms that integrate within an app to analyse test results, so that we know it is robust. We can then work with healthcare professionals to place that patient into a healthcare pathway. In South Africa, for example, it can take a year after a test to get into a treatment programme. So, we’ve been working with our partners at the Africa Health Research Institute, and they’ve trained community field workers to carry out tests and get the patients into care—it’s a nice continuation in treatment.”

Being able to build a very large dataset of people is also incredibly important for monitoring the way a disease spreads. “In Uganda, we are looking at serological surveillance, at people who have had Ebola and survived, and detecting between three different species of the Ebola virus. This is important in understanding how the disease is spreading. We have developed a multi-marker test and an app that can generate geotag maps of spread. There are challenges around data and privacy, but we are engaged with ethicists and others in the community to get this right. It means we can then understand how to control the disease.”

During the COVID-19 lockdown, Stevens assembled a crack team of volunteers from all over the world to work on a portable, point-of-care test called QwikZyme. It is designed to detect coronaviruses very early, even in asymptomatic people, and to allow ongoing immune-response monitoring. “This work is in its very early stages,” she says, “but we have had an incredible response. We had a core team of 25 based at Imperial and we collaborate with different groups all over the world.”

COVID-19 may have brought home the importance of infectious-disease control to countries that are not used to having to worry about it too much, but Stevens’ approach is always global. “There are many diseases that are not as prevalent in the developed world and it’s important to achieve control of these,” she says. “It’s also important to prevent their spread, as has come to the attention of the developed world during COVID-19. Enabling all sectors of society to have access to early disease diagnosis, from cancer to cardiovascular disease to infectious diseases, is of massive societal importance.”

This is a motivation she has transmitted to her passionate and committed team at Imperial. “I did a PhD in fundamental biophysics, about how molecules interact with each other, and I loved it,” she says. “But, actually, being able to take the joy of science, and the interest of it, and make technology that really helps people, is something else. I travelled a lot in countries in the developing world before and after my PhD, and I saw a lot of inequality. I think technology is amazing, and, if you design it right, it can make a real difference.”
Safe and sound

Data. Infrastructure. Borders. Imperial specialists are leading the effort to keep the nation secure.

Words Lucy Jolin / Illustration: The Project Twins
Grunman, and we previously hosted a NATO group of 30 people from 16 different countries. They chose to come to White City having seen the ecosystem that we’re building over there. Innovation flourishes through collaboration and a wide range of voices and perspectives, agrees Friend. “It’s important that we challenge the status quo and that we have a mature and broad level of thinking throughout our organisation. This melting pot of skills and experience is essential to enable innovation.”

And that’s vital because unpredictable threats to vast, complex systems often require fresh, counterintuitive solutions, says Tarter. “It’s next to impossible to remove all vulnerabilities in systems, as they involve hundreds of millions of lines of code,” he points out. “If we can’t design out all the vulnerabilities, if the threat changes too quickly for us to adequately deploy resources against it, then the only thing left is how to minimise the impact.”

Netflix, for example, might seem like an unlikely pioneer of such solutions. But its engineers use what’s known as ‘chaos engineering’ to protect their systems. “Netflix realised that, at some point, one of their engineers was inevitably going to misconfigure something and cause a system to crash,” says Tarter. “So, they send out a programme that randomly picks a server and intentionally turns it off – they call them ‘chaos monkeys’. The engineers don’t get to decide when that happens. The system is now designed to take account of someone randomly pulling the plug – and, over time, that’s become phenomenally reliable.

It also means that any attacks attempting to do something similar are also not so much of an issue, as the impact they will cause is minimal.

Chaos engineering is just one example of a security solution that isn’t sector-specific. “That’s the approach that we want to go towards in the future – looking at all of these problems as an abstraction and not worrying about the specific industry too much,” says Chana. “You realise that many industries are doing the same thing. For example, I recently worked on a digital money index project funded by Citibank at the Centre for Financial Technology, where I’m the co-director. “We are trying to take in data feeds about different countries that tell us which country is ready to have a digital banking infrastructure and transform into a purely digital banking entity. That involves us taking structured and unstructured data from multiple sources running algorithms, coming up with a mathematical way of actually analysing that data and then writing that up in an algorithm. That’s not necessarily a direct security issue. But once we are able to generate these indexes and measures, we could also look at infrastructure resilience, for example, or cyber-security readiness.”

Another project developed a two-stage machine-learning algorithm to detect network traffic in a cyber-physical system – a factory, for example, with a mixture of computing and physical systems. The aim was to monitor the network traffic between the various components and detect bits of information that could be potentially dangerous, a method that’s easily applicable to other situations.

He has also worked on CrowdVision, a crowd analysis technology startup originally designed to monitor the movement of pilgrims at Mecca. Pivoted to the transport sector, it has also been used at London City Airport to monitor how quickly people were being processed through the security checkpoint. This helps avoid overcrowding and can also check to see if the security value of those checks is being undermined because people are being rushed through.

Whatever the threat to a nation, Chana believes the solution is the same: convergence of domains and disciplines, diversity of thought, and an end to silos. “We’re looking to create a new way of driving innovation in security and defence that cuts across infrastructure resilience, fromcyber security to physical security,” he says. “If you’ve got new problems, and the current global COVID-19 crisis is a prime example, then you need to look for solutions in new areas.”

It’s difficult to cause anything to go bang, but surprisingly simple to make things trip
Ahead of the curve: how Imperial is driving diversity in innovation and entrepreneurship

T
oday I spend my time working out how to support entrepreneurs – but, back in the late 1990s, I was on the other side of the table, as the co-founder of what would become a successful biotech startup. Back then, although we had lots of great ideas, there was very little actual support. Nobody advised us on what our involvement should be, how to pitch to venture capitalists, how to manage our IP etc. or in what direction we should take the company. It was a fantastic experience and I learned a lot. But perhaps if we had had a little more support, we could have ended up in a different place.

Today, of course, Imperial is ahead of the curve in terms of entrepreneurship and innovation. Not everyone wants to be an entrepreneur – and that’s fine: it’s just one of the many ways in which we, as a university, contribute to society. Our job is to encourage everyone who has a brilliant idea to put it out there, bring it to life and see where it takes them. We also want to increase the diversity of our entrepreneurs. Throughout the entrepreneurial world, fewer women lead companies than men – but there are statistics to show that the female-led companies are often more successful. That’s why we’ve created a range of support for female entrepreneurs, and we are seeing some incredible results.

WE Innovate, for example, is a competition for women who are developing an early-stage business idea. It offers masterclasses, pitching advice and one-to-one support, with teams competing for £80,000 in prizes every year. Entrepreneurs receive a huge amount of support and mentoring throughout the whole process, and we’ve found some extraordinary students who are somehow managing to fit in these enormous projects alongside their study.

It’s been astonishing – and incredibly gratifying for me personally – to see how diversity in the projects coming forward has increased since we started offering specially tailored support for women. If we want to be innovators, we must recognise the importance of diversity. People with different lives have different needs. That means that someone else will come up with ideas that you wouldn’t have come up with, because you don’t have that particular need.

Olivia Abu, CMO (MBBS Medicine 2011; Biomedical Engineering 2015, MSc Innovation Design Engineering 2017), wanted to tackle the 200,000 tonnes of sanitary-product landfill waste every year in the UK. Their idea, the Polipimp – the world’s first biodegradable, flushable sanitary pad – won the WE Innovate first prize in 2017 to tackle the issue.

Whether you have expertise, ideas or financial support to offer, everyone has a part to play...
From the local pub to the bright lights of University Challenge, Imperial quizzers show some impressive feats of knowledge.

Society

Imperial College Quiz Society

Starter for ten

Words: Helena Poznani / Photography: Hannah Maule-ffinch

When Jeremy Paxman declared Imperial the champions of University Challenge last April, there was one audience member who was particularly satisfied—and relieved. As outgoing chair of the Imperial Quiz Society, Susan Rutter (MSci Mathematics, Third Year) had a personal interest in the team’s success—which is why, when it came to it, she could barely watch. “I’d run a mile rather than actually compete on air,” she says. “At the last recording, I just sat in the audience squeezing my neighbour’s arm too tightly.”

University quiz teams are famous for their geekery and their oatmeal jumpers. Team members—usually male—display weird depths of knowledge, impressively swift recall, and are occasionally floored by popular culture. The odd fist pump after a correct answer is as racy as it gets. Add cameras, bright lights and Paxman, and you’ve got an adrenaline rush like no other.

But it’s not all glamour. Imperial College’s Quiz Society offers contests for every taste, from arcane academic knowledge to popular culture, and revels in the traditional pub-quiz challenge as much as the high-profile events. “We tell newcomers that it really doesn’t matter if you get questions wrong now and again,” says Rutter, who joined the society keen to try her hand at inter-university competitions and to sharpen her reactions.

“Pub quizzes are more about random knowledge—what we call ‘old men’s knowledge’. We go along for the social. But, underneath it all, students at Imperial care a lot about being smart, and being perceived as knowing things. That’s the premise of this hobby.”

There are different approaches to absorbing facts. “Personally, I like finding out what I know and whether I can apply my knowledge in different ways,” says Rutter, a mathematician with an in-depth knowledge of late nineteenth-century Impressionism. She’ll browse Wikipedia and even BBC Bitesize, following her own interests. “Some people are naturally just good and fast and know things. Some like to systematically look things up. I know someone who spends two hours a day memorising facts from flashcards so he can improve.”

But when it comes to the biggest quizzes, everyone gets stage fright. Imperial doesn’t necessarily outperform on science questions at university level, says Rutter. “Sometimes the hardest questions to answer can be on your own subject. Everyone is staring at you and you just have no idea. I’m a mathematician but I had to get a chemist to sit next to me to answer the most simple maths question.”

Quiz teams are often mainly male, which is why Rutter was keen to take the chair this year. “I hate to recognise that an aspect of knowledge is ‘gendered’. You get a question on feminist literature and you see three male teammates turn to their one female member. I hope we can change that.”

People quiz because “learning new stuff is fun”, she says. “I think everyone at Imperial genuinely enjoys finding out new things. It is nerdy. But, in a sense, everyone at Imperial is nerdy.”

Oscar O’Flanagan answers... A. Translational degrees of freedom (though we’d accept centre of mass motion).
Beneath Da Vinci’s The Virgin of the Rocks

Context
Art lovers have always been fascinated by the creative process behind a masterpiece, including the practice of painting on top of previously used canvases. While X-ray imaging has been around for half a century, it’s only recently that non-destructive, non-invasive techniques have been able to break down the layers of an artwork into its individual chemical elements. However, art historians have had to rely on manual, time-consuming methods to understand the layers of an artwork. The new algorithm developed by Dragotti and his team separates all elements in all layers, taking all the specific data from the painting to visualise hidden drawings, to reveal hidden chemical elements of the painting to enhance the experience of looking at and understanding how great works of art came into being,” says Dragotti. “We see earlier versions, finished sketches and abandoned sketches. But this can also help art curators and historians contextualise the work, understanding which artists used which materials when and in which regions – and how these might reveal relationships between artists – which is of enormous benefit to the understanding of art. We’ve always known canvass were scarce and artists often created new works over existing paintings, but this helps us reveal those layers. “We are looking to apply this to other masterpieces – we’re currently looking at works by Titian, and we are also working to develop AI, where the algorithm keeps learning to become more and more detailed. “And this may not be restricted to paintings, but may give us insights into how other objects were created too.”

Methodology
The new algorithm was combined with macro-X-ray fluorescence (MA-XRF) screening, a non-invasive scanning process that maps chemical elements within paintings. While MA-XRF is widely used, previous analyses relied on manual selections of various elements and expert user-interpretation. The Finite Rate of Innovation theory algorithm developed by Dragotti and his team separates all elements in all layers automatically to an unprecedented level of precision. “We analysed each pixel individually to break each pigment down to a minimum degree,” says Dragotti, “and then put them all together to make up a truer map of all the chemical elements in the painting.”

Outcomes
“By revealing Da Vinci’s creative process, we can enhance the experience of looking at and understanding how great works of art came into being,” says Dragotti. “We see earlier versions, finished sketches and abandoned sketches. But this can also help art curators and historians contextualise the work, understanding which artists used which materials when and in which regions – and how these might reveal relationships between artists – which is of enormous benefit to the understanding of art. We’ve always known canvass were scarce and artists often created new works over existing paintings, but this helps us reveal those layers. “We are looking to apply this to other masterpieces – we’re currently looking at works by Titian, and we are also working to develop AI, where the algorithm keeps learning to become more and more detailed. “And this may not be restricted to paintings, but may give us insights into how other objects were created too.”

1: HARD
Milly Miffen made muffins more than Molly’s mother made, and Milly Miller’s mother made a muffin more than Molly made and Milly’s mother made muffins but Milly and Molly’s mother made four muffins more than Milly and Molly’s mother made so murmur now how many muffins Milly made. JAH Hunter in Fun with Figures, submitted by Robb Gasien, postgraduate student.

2: VERY HARD
Is it possible to find five points in an equilateral triangle of side 10cm so that each pair of points is more than 5cm apart?

3: FIENDISH
My maths teacher drew three arbitrary circles on the whiteboard. She then drew the common external tangents to a pair of the circles, which, of course, intersected. She challenged me to demonstrate that the intersection points of the three tangent pairs were collinear. Professor Myron L. Good, submitted by David Lloyd Owen (BSc Physics 1972).

PUZZLE
Test your brain power
Ready to test your little grey cells? Imperial’s best minds set the ultimate puzzle challenge.

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HOW TO ENTER:
Senders of correct solutions for two or more of the puzzles will be entered into a prize draw to win a copy of Superhuman Innovation: Transforming business with Artificial Intelligence by Chris Dufey. Winners’ names will be in Imperial 50 in May 2021, and solutions published at www.imperial.ac.uk/be-inspired/magazine/issue-48/brain-power. Entries close 31 January 2021. To enter, please email imperialmagazine@imperial.ac.uk.

FOR ISSUE 48 SOLUTIONS:
www.imperial.ac.uk/be-inspired/magazine/issue-48/brain-power

ISSUE 48 WINNERS: Congratulations to:

Robert Maciejczek (BEng Electrical Engineering 1984) and

Kathryn Sayer (BSc Chemistry 1984), Caroline Barnes (BEng Mechanical Engineering 1979), Kathryn Sayer (BSc Chemistry 1979) and Martin Haynes (BSc Chemistry 1979), Pete Chapp (BEng Electrical Engineering 1984) and Robert Maciejczak (BSc Physics 1993).

SOLUTION TO THE PUZZLE IN THE DEFENCE FEATURE FROM PAGE 37
The transmitter is found at a distance of (a+b+c+d+e)/10 miles (~19.4 miles) from the first town along the road. Let the distances of the four towns along the road to the first fixed point, be a, b, c, and d in the order they are named in the message. The first instruction takes C to a point at a distance (a+b)/2 from the fixed point. The second instruction takes C to (a+b+c+d)/2 from the fixed point. Similarly the final instruction takes C to (a+b+c+d+e)/3 from the fixed point. This is symmetric in the four distances and we can calculate it without knowing which town is which as it gives their centre of gravity.
Q. Did you always plan to become a GP?

It is a tough old slog to get through your training in medicine, and this felt personal for me. I left Imperial disillusioned with the medical profession and the system of healthcare, but I had gained at Imperial alongside the soft skills I had learned at university—problem solving in challenging environments, resilience and supportive communication, all directly relevant to my clinical work in the UK during the COVID-19 pandemic. The most important thing is to be humble and understand that local people and healthcare workers will know far more about their context than you will. As such, it is important to listen and to go without preconceived notions. This will also help build a rapport and a relationship with the people you will be working with, and this is key to building trust and supporting cross-learning. I am always clear I have learned far more from my experiences than I could teach.

Q. What prompted you to volunteer to work with MSF?

My thesis was on micro-surgical procedures used in reconstructive surgery for breast cancer. These can involve a team of up to ten working in the operating theatre for 12 hours, so they require a great amount of skill and resources. I was writing up my thesis at the height of the refugee crisis in Europe and this felt personal for me. I left Imperial disillusioned with the contrast between the high level of technical care and expertise available to some in a world where others did not even have access to paracetamol. People were drowning in my homeland of Greece and I felt I had to do something.

Q. What was your first experience of medicine in a conflict zone?

In my third year as a student I went to Bosnia with ICAB (Imperial College Aid to the Balkans). There was real desperation among the people we were treating and some of their stories were heartbreaking. I still have the letters and drawings from the children. I had stepped outside the Imperial bubble and my first thought was, ‘That could have been me’. I knew then that I had to use the skills I had been lucky enough to be taught to help others who were simply victims of circumstance.

Q. What lessons from Imperial have stayed with you in your relief work?

It is a lesson I try to apply to all my work. Recently, I was in the Rohingya camps in Bangladesh, where some of their stories were heartrending. I still have the letters and drawings from the children. I had stepped outside the Imperial bubble and my first thought was, ‘That could have been me’. I knew then that I had to use the skills I had been lucky enough to be taught to help others who were simply victims of circumstance.

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Q. What is the most important lesson you pass on to your students?

Q. How has your work in refugee zones fed into your career?

Dr Tsallas put his career in plastic surgery on hold to volunteer for MSF in Lebanon to Syria during an escalation of violence.

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Next-generation privacy: why we need to do more to avoid mass datafication

THE SITUATION
What does sharing our — and especially our children’s — personal information mean for wider society? This is the key question that policy makers should be asking themselves, says Dr Nejra van Zalk, Lecturer and Researcher in Psychology and Human Factors at the Dyson School of Design Engineering. “While older generations may see the world as online and offline, for the younger generation there is no such dichotomy,” she says, pointing out that, across the world, 70 per cent of those aged 15-24 have access to the internet. “Their world is online, of those aged 15-24 have access to the internet. “Their world is online, and they are far less concerned about the implications for privacy – and manipulation.”

THE ISSUE
Face-to-face social interaction is multifaceted, but social media was not designed to foster deep relationships and few foresee the extent to which the emotional privacy of our young people is being invaded. We need to educate our children rather than lock them up in a digital shed. Transparency is key but it is doable. Another part of the answer may lie in introducing more paid-for services. “If I pay for a service then I have more rights as a consumer and the company is not so desperate for my attention. We must find a way to make companies accountable for the way in which they use our data.”

THE OPPORTUNITY
Van Zalk’s colleagues at the Dyson School of Design Engineering produced research on how much data is being collected through everyday items, and she is working with the Information Commissioner to design age-appropriate guidelines for privacy and security. “We are seeking to make policy makers aware of the mass datafication of our children. Concerns about the impact on democracy are pushing the issue to the fore of governments’ minds. But there is far less awareness of the extent to which the emotional privacy of our young people is being invaded. We need to educate our children rather than lock them up in a digital shed. Transparency is key but it is doable.”

THE CHALLENGE FOR POLICY MAKERS
Van Zalk points out that currently there is no legislation for information protection on the most basic household items. “Awareness needs to move hand in hand with greater legislation on a global scale. It may be too late to change the way the tech giants such as Facebook are designed, but their usage is slowly changing and even dying out among the young. The challenge is to ensure the next generation of social media takes privacy concerns into account.”

We need to educate our children rather than lock them up in a digital shed. Transparency is key, but it is doable.

Our alumni programme is now fully digital

Imperial’s events are now online, with more opportunities than ever to join our global alumni community.

Illustration: Andrea Manzati

The Imperial world of events may have had to adapt, but the result is that we’re able to offer even more opportunities for our global community to connect and learn. Our new online events programme offers expertise and insight, focusing on sharing knowledge, supporting each other and celebrating the success of our alumni and the College’s work. We hope to see many of you in person again soon but, in the meantime, here’s just a taste of the wide range of events open to our alumni community:

MEET THE EXPERTS
Our world-class Imperial academics and alumni leaders share their opinions on current policy, industry and research issues.

EVEN FOR RECENT GRADUATES
A series of events such as webinars and masterclasses designed for alumni who graduated within the last ten years, to support your professional development, help you make professional contacts and give you an exclusive insight into different industries.

CONNECTING REGIONAL NETWORKS
Local alumni groups – from London and Bristol to Singapore and New York – have been hosting events featuring alumni and Imperial speakers, or tapping into their own professional networks to share industry knowledge and support each other.

COLLEGE ONLINE LECTURES AND EVENTS
Take advantage of our new events series showcasing the very best of Imperial’s teaching expertise, such as: the Science Breaks series demonstrating the impact and relevance of Imperial’s research and work taking place at the College, and covering topics such as reinventing capitalism, when art meets science, from the Big Bang to AI; and Imperial Lates Online, free after-hours events exploring cutting-edge science and engineering at Imperial in creative ways.

ALUMNI SPOTLIGHT
Shining a light on talented and passionate alumni from our global community, each event features an Imperial alumnus who shares their career journey, expertise in their sector and thoughts on leadership and making an impact.

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A walk in Kensington Gardens
David Tyoember (Chemistry, Third Year) finds the perfect getaway.

A s founder of Imperial's first Rap Society, you might think the peace and quiet of the flower walk in Kensington Gardens is the last place I'd like to be. But the solitude is often just what I need, and often I'll sit on a bench and listen to audiobooks for hours — it's a place that helps me think. You won't ever find me here with chemistry books; it's not somewhere I come to study. Chemistry is an intense degree, so this is the perfect chance to get away and clear my head.

Kensington Gardens is also a good place to plan all the extracurricular stuff I'm involved in. Imperial has provided so many opportunities. I've been president of the Investment Society and now I'm focusing on music and leading the Rap Society. And I'm also recording a series of podcasts — interviews with Black men who are pursuing a career in financial services. My aim is to help dispel "impostor syndrome" through increasing visibility, giving students an insight into various roles, and inspiring people who might feel too intimidated to enter the sector. After all, I'm the guy who stood outside a tube station with a sign reading: "Seeking work in finance". I learned many things about the finance sector from colleagues during my resulting year of internships and leading the Rap Society. And I'm also recording a series of podcasts — interviews with Black men who are pursuing a career in financial services. My aim is to help dispel "impostor syndrome" through increasing visibility, giving students an insight into various roles, and inspiring people who might feel too intimidated to enter the sector. After all, I'm the guy who stood outside a tube station with a sign reading: "Seeking work in finance".

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