

**SPECIAL** Invisible cloaks and the perfect lens // **BUZZ** : How to grow 10,000 mosquitoes

Keeping classic cars on the road → TUNNELLING UNDER CAMPUS → Voice of engineering in government

# IMPERIAL

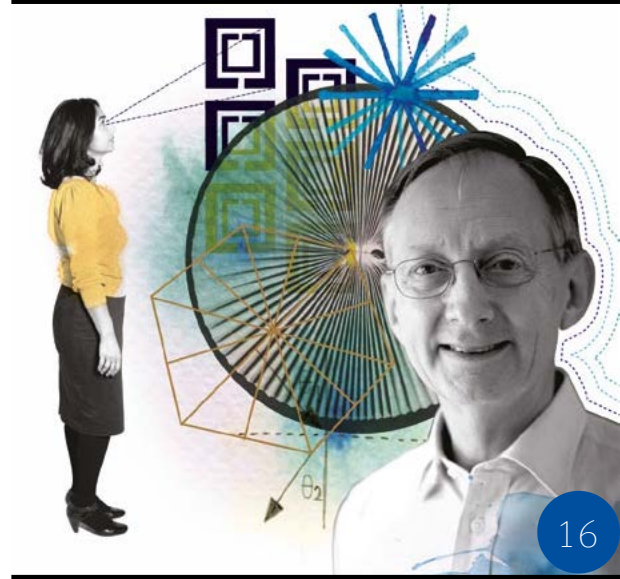
THE MAGAZINE OF IMPERIAL COLLEGE LONDON

Spring 2012



## POP-UP SURGERY

Medical drama in the  
inflatable operating theatre



16

### 3 Rector's welcome

### 4 Inbox

Editorial, letters and contributors

### 7 In brief

Spotlight on recent events and discoveries

### 12 Product pipeline

#### HELP AT HAND

Hospital equipment designed to wipe out infections

### 13 Question time

Has the human genome project lived up to its promise?

### 14 Career ahead

#### MAGNIFICENT MOTORS

Alumnus Will Fiennes gets under the bonnet of vintage car restoration

### 15 Campus life

#### STORMY CROSSING

Master's student Kelly Oakes writes about riding today's jobs market

### 16 Feature

#### LEADING LIGHT

Inside the mind of theoretical physicist Sir John Pendry

### 20 Picture this

#### THE IMPERIAL UNDERWORLD

Photographer Dave Guttridge fine tunes his tunnel vision

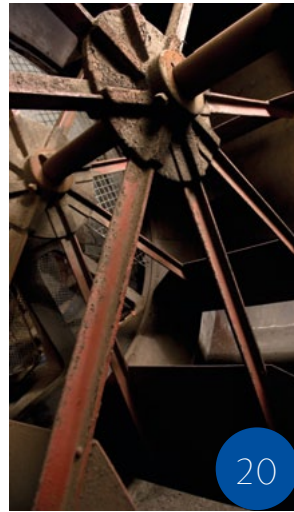
### 22 Feature

#### GETTING THINGS DONE

An inside view on the role of engineering in government from David Fisk



34



20

### 26 Behind the scenes

#### BITING BACK

Lifting the lid on the life scientists who are fighting malaria

### 28 Going public

#### CUTTING EDGE

Operating dramas and surgical surprises – not for the squeamish

### 31 Alter ego

#### CHORD CHEMIST

Lecturer and musician Michael Bearpark connects teaching and performing

### 32 Good reception

Alumni, friends, supporters and staff at College events around the world

### 34 Travel

#### SAND TRAP

Geologist Cedric John looks for an answer to global warming in the Omani desert

### 35 Obituaries

### 36 In memoriam

### 38 Alumni dispatches

### 39 Calendar

#### ON THE COVER

Illustration by Matt Owens/  
Volumeone.com

## IMPERIAL

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Imperial College  
London

ILLUSTRATION: (PENDRY) VICTORIA TOPPING. PHOTOS: (ROCK) CEDRIC JOHN; (BLADES) DAVE GUTTRIDGE/THE PHOTOGRAPHIC UNIT



## FROM THE RECTOR

Excellence is a healthy preoccupation for the Rector

Many of you have shared that same message with me over the past year at events in London and across the globe. You wish to see Imperial continually flourish because you, like me, believe that **what we do here makes a real difference to society.**

The translation of our research can transform lives. To give an example, a new collaboration with the Royal British Legion will find novel ways to protect service men and women from injuries caused by explosive devices (see page 8).

Through the educational experience we provide, we give students academic expertise, broaden their horizons and equip them with skills for their future careers. The impact can be seen through the success of our alumni, who contribute to a wide variety of fields and endeavours, extending Imperial's reach far and wide. As Hang Cheong Tan, President of the Imperial College Alumni Association of Singapore, said at a reception last summer: "The mark of a truly world class institution is measured by what its graduates do after leaving."



PHOTOS: (RECTOR) MIKE FINN-KELCEY; (BLAST RIG) MARTIN BEDDALL; (TELETHON) MIKE FINN-KELCEY

### RING RING

The autumn telethon raised £381,000 for the Rector's Scholarship Fund thanks to pledges from 1,344 alumni.



**COMBAT WOUNDS**  
Lab equipment replicating the impact of explosions aims to help researchers improve treatment of bomb injuries.

To continue making a real difference in this way, we need the right route map and, critically, the right fuel. With radical changes to the way higher education is funded in the UK, reducing the amount universities receive from the government, it is **essential that we seek out and explore new sources of funding.**

Many of you have already stepped forward to help – nearly 4,000 of you understood the urgent need I highlighted last summer for scholarships to support the brightest students who may struggle with the cost. **Thanks to your contributions** we were able to spend £624,000 on Rector's Scholarships in 2011–12, awarding many more than ever before. Imperial is far behind its global competitors in the size of the endowment funds it can call upon, so I am hugely grateful to all of you who have supported us. Your contribution helps to ensure that we continue to achieve the excellence in education, research and translation that is core to our mission.

The articles in this issue of *Imperial* bear testament to some of the **big ideas and creative approaches** to education currently emerging from the College. The new field of metamaterials championed by physicist John Pendry (see page 16), or the astounding and realistic surgical simulations developed by Roger Kneebone and his colleagues to train surgeons and immerse public audiences in the surgical experience (see page 28) are cases in point. It is world-changing innovations and advances like these that we need to find new ways to sustain in the future.

I hope to welcome many of you to the inaugural **Imperial Festival**, which includes the **Alumni Reunion** on Saturday 12 May, and to meet many more of you further afield, during my visits to countries across the world. I look forward to receiving your guidance on the College's future path.

Best wishes,

*Keith O'Nions*

SIR KEITH O'NIONS FRS is Rector of Imperial College London. He is a geologist who has worked at Oxford, Cambridge and Columbia Universities, and has served the UK government as Chief Scientific Advisor to the Ministry of Defence, and as former Director-General of the Research Councils.





FROM THE EDITOR

# Imperial measure

Everyone remembers a good teacher. At your most receptive, their very words can lodge in your ears for a lifetime.

Among Biology favourites, I remember Professor Charles Godfray's line on evolution: "The name of the game is to get as many of your genes into the next generation as possible."

Whilst I was learning about relatedness, I heard of chemical engineers receiving profound insight into whether hell was exothermic or endothermic, and for medics a vivid lesson on why there's no such thing as 'normal anatomy'.

Moments like these are gifts from truly outstanding teachers, and we're blessed at Imperial to have so many around us.

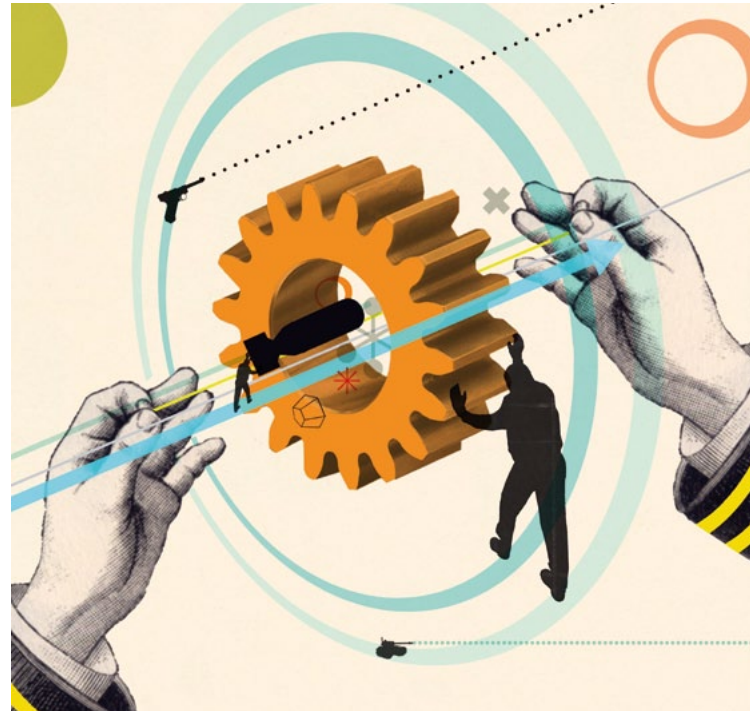
One who knows more than most about wielding such inspiration is Dr Lorraine Craig of Earth Science and Engineering. Thanks to her and her colleagues' efforts, the Department regularly tops the tables of our most satisfied students.

So it's fitting that Lorraine chairs Exploration Board, operational since 1955, and responsible for sending adventurous students to the furthest flung and most demanding parts of the world, such as the Odra Valley in the Himalayas, pictured below during a recent student trip.

This summer the Board is looking to approve a full slate of overseas expeditions, and to preserve its ability (almost unique in the UK) to do so well into the future by seeking support from sponsors and alumni. If you think you might share the vision to preserve this ultimate student experience then please consider contacting Lorraine directly at [L.craig@imperial.ac.uk](mailto:L.craig@imperial.ac.uk)

I hope you like this new issue of *Imperial*, will keep your letters coming and, if you're tickled by what you see in these pages, then please think about joining us for the 'live version' – the inaugural Imperial Festival on 11–12 May. Thank you.

TOM MILLER *Biology 1995*



## the INBOX

### LEAVE SCHOOL IMMEDIATELY!

Our Spring/Summer 2011 issue featured Professor David Edgerton musing on the relationship between war and innovation, and the role that Imperial played in the Second World War.

Congratulations on an excellent new-look *Imperial* magazine!

I was particularly interested in David Edgerton's article, and in particular his mention of "the great railway engineer Sir William Stanier".

Sometime in 1947–48, I was in a group of boys from my school taken by our maths master to hear a talk by Sir William on careers in engineering, during which he extolled the benefits of a full seven-year apprenticeship as being the only practical means of becoming a successful engineer. At the end of the talk, those in the audience were asked if there were any questions. One boy bravely stood up and said "Yes, Sir.

You have advocated us taking an apprenticeship. Are you aware, Sir, that all the boys in this audience are planning to go to university. What would you recommend that we do?"

Without hesitation, Sir William answered in three words: "Leave school immediately!"

In the coach on the way back, our crestfallen maths teacher pointed out that, famous as Sir William was, his was but one opinion. I am glad that I, for one, chose to opt for the maths teacher's recommendation to stay on at school. I spent a happy three years (1949–52) doing the Mining Engineering course at the RSM.

Sir William, great man that he was, did not always have the right ideas!

A.C. (TONY) BREWIS  
*Geology 1952, DIC Mining and Mineral Technology 1961*

### WE'RE TWEETING!



@ImperialSpark Documentary researcher asked if we have a perpetual motion machine. Unfortunately we require all our academics to obey the laws of thermodynamics.

→ Doing something brilliant? Tell us about it at @ImperialCollege or @ImperialSpark

PHOTOGRAPHY: (TOM MILLER) MARTIN BEDDALL; (OBRA VALLEY) JONATHAN PHILLIPS; ILLUSTRATION: (GEAR) MARK ALLEN MILLER

### TIME AND TIDE

Dear Sir, I read with interest the obituary of Dr David Warren in the Spring/Summer 2011 issue of *Imperial* magazine. My grandfather, Benjamin W. Warwick, was one of T.H. Huxley's boys reading physics at the Royal College of Science, having previously trained as an escapement maker and clockmaker. In about 1890, he made a clockwork-powered ship's magnetic heading recorder which recorded on paper tape. He patented it and the prototype worked on several voyages to Portugal. Unfortunately, it was not a commercial success, evidently being far ahead of the available technology. Dr Warren's successful device has manifestly filled a real need.

JUSTIN WARWICK  
*Mechanical Engineering 1957, MSc 1960, MSc History of Science, Technology and Medicine 2005*

RECENT TWEET

“Enjoying the Rector’s talk at the alumni dinner, I suggest you reach out to lost alumni via Facebook.” – @ANTHONYHSIAO

“Glad you’re enjoying Mumbai reception & hearing what #ImpCol’s up to at the moment. Will be sure to pass on FB suggestion.” – @IMPERIALCOLLEGE

### WELL... WE DID ASK

Dear Friends, I have received the first copy of your new magazine *Imperial* in which you ask for comments. I must say that I find it very superficial and not as good as *Imperial Matters*, which at least had some in-depth articles of interest. I sincerely hope that *Imperial Engineer* will continue to publish the very good contributions that it has in the past. Your magazine may serve some general public interest, but seems to have nothing worthy of the high standing that the College represents. Sorry to be so negative – but you did ask!

EDGAR MOSS  
*Chemical Engineering and Applied Chemistry 1945, PhD 1947*



### MORE PLEASE

Hello Tom, What's happened to your magazine! I opened it up on my iPad and immediately found three stories I want to read. It looks fantastic. Graphics and style look like they're heading towards *Wired* magazine, which has to be a good thing. The closer people associate the cutting edge work coming out of Imperial with popular culture, the more it'll have impact.

After graduating in Aeronautical Engineering in the 90s, I went on to study, teach, and research at the Royal College of Art. I'm particularly interested in how new technology is embedded in everyday life (along with its social, cultural and ethical implications). I'm very pleased your magazine's taking this new approach. I imagine there might be some old reactionaries who prefer to return to a trade or professional journal style magazine. Don't listen to them. I love this new direction, and I plan to forward the PDF to other colleagues in the creative industries.

Congratulations. More along these lines please.

BRENDAN WALKER  
*Aeronautics 1993, DIC Mechanical Engineering 1996*



### MOULD FRIEND, NEW IDENTITY

From the moment that a spore of fungus fell onto Sir Alexander Fleming's culture plate in 1928, killing the surrounding bacteria, it was destined to become one of the most studied organisms on the planet. But despite eight decades of attention from scientists, it seems there may have been a case of mistaken identity. The fungus that contaminated Fleming's bacterial culture in his messy laboratory in St Mary's Hospital Medical School (which merged with Imperial in 1988) was later ascribed to the species *Penicillium chrysogenum*. Now Imperial scientists have subjected preserved specimens of Fleming's fungus to modern genetic analysis, and discovered that it's actually a closely-related species, which has yet to be named.

### from the ARCHIVE

**FLEMING'S MAGIC BULLET:** Alexander Fleming's discovery of penicillin might never have happened had it not been for his shooting prowess. He had the option of becoming a surgeon but the captain of St Mary's rifle club, apparently reluctant to lose Fleming as a member, suggested that Fleming join St Mary's research department. There, he became assistant bacteriologist to Sir Almoth Wright.

### WHAT YOU WROTE TO US ABOUT



### MOST UNUSUAL PLACE TO FIND THE MAGAZINE

Dear Sir, My full name is Le Trinh Quan Hien. You can call me Joseph (my Christian name). I am Vietnamese.

Last week I went to the Singapore General Hospital and saw your magazine. I learnt some new things which I had not known before. Even though I am not an alumnus of the College, I would love to receive it.

JOSEPH HIEN

Editor's response → – Your copy's in the post!

### SHARE YOUR THOUGHTS

By post to • Imperial Magazine, SALC Mezzanine, Level 5 Sheffield Building, South Kensington Campus, London SW7 2AZ, UK

By email • [imperialmagazine@imperial.ac.uk](mailto:imperialmagazine@imperial.ac.uk)  
By online comment • [www.imperial.ac.uk/imperialmagazine](http://www.imperial.ac.uk/imperialmagazine)



**AND NOW A FEW WORDS FROM OUR CONTRIBUTORS**

“Facially, he’s brilliant” says photographer **TIM WALLACE (1)** who took pictures of Will Fiennes (PhD Mechanical Engineering 1970) and his classic cars for *Careering ahead* (page 14). “Will looks like he’s been an engineer since he was five years old!” Tim’s own chosen craft was also clear from a young age: he first picked up a camera at the age of seven and is now a specialist in automotive photography, with a clientele including some of the most prestigious car manufacturers in the world. Double alumnus **ANJANA AHUJA (2)** (Physics 1990, PhD 1993) experiences a bout of nostalgia as she reconnects with the Department of Physics to

interview theoretical physicist John Pendry (page 16). “John enjoys a formidable reputation among students and staff, and I initially worried that he would be a completely impenetrable interviewee. In fact, it is rare to meet a scientist who is so clear about what they do and why they do it.” Anjana is a freelance science writer and columnist for *Prospect* magazine. Previously, she worked at *The Times* as a feature writer and science columnist.

“Not only hot but steamy, too,” is how photographer **DAVE GUTTRIDGE (3)** described his experience of shooting Imperial’s network of underground tunnels for *Picture this* (page 20). We also enlisted Dave’s expert eye for a number of other unusual photoshoots for issue 37 of *Imperial* (pages 28 and 31). When not behind the camera, Dave does a fine



line as pre-vinyl disc jockey DJ78, using two 1930s wind-up gramophones and his vast collection of rare shellac records. Illustrator **VINCENT RHAFANEL ASEO (4)** is based in the Philippines, where he generates his art using a mix of computer programmes, a good eye and lots of hard work. His depiction of David Fisk for *Getting things done* (page 22) draws on portrait

photography and is inspired by David’s work in making sure the voice of engineering is heard in government: “It took a while and I had to do a few studies – it’s important to find a reference photograph with good composition.”

Science reporter **JESSICA HAMZELOU (5)** (MSc Science Communication 2009) had to hold on to her nerves and her breakfast to cover the simulated surgery

event presented in glorious detail on page 28. Jessica, who has peered inside cadavers and held a human brain as part of her biomedical sciences degree, found the experience a unique one. “The simulation appealed to people’s fascination with medical drama – it was certainly a novel way to spend my Saturday morning,” says Jessica, who can more often be found writing for *New Scientist*.



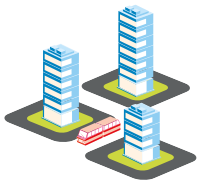
Imperial scientists are planning to take physics to new limits with two missions recently given the green light by the European Space Agency, which are due to launch by 2019. Solar Orbiter will travel closer to the Sun than any other mission, measuring the star’s magnetic field and improving our understanding of how solar activity and the harsh solar wind affect the Earth. The Euclid mission will address key questions about dark energy and dark matter, which are fundamental to physics and cosmology, and search for clues to the early expansion of the universe. Through a massive ‘near-infrared digital camera’, Euclid will survey far distant parts of space using faint light that started its journey shortly after the Big Bang.

**/in brief**

EVENTS + DISCOVERIES

**CITIES SLICKER**

Researchers from Imperial are embarking on a programme to improve the quality of life in cities, by making them more pleasant and efficient places in which to live, work and travel.



Most cities have grown without strategic planning, meaning Victorian sewers service state-of-the-art hospitals and intelligent cars use roads with limited capabilities. Problems with transport, energy, water and waste tend to be considered on their own, rather than jointly.

The £5.9 million Digital City Exchange programme, funded by Research Councils UK, aims to create a more integrated approach. It is hoped this will enable city leaders to better manage peak demand across sectors, conserve resources, stabilise prices and create capacity for businesses to grow.

**Tap into IMPERIAL’S BIG IDEAS**

Stay up to speed on the latest thinking and research with Imperial’s inaugural and special lectures online.

[www.imperial.ac.uk/events/catchup](http://www.imperial.ac.uk/events/catchup)



**36**

**PERCENTAGE REDUCTION IN DEATHS FROM INFECTION AND RESPIRATORY ILLNESS AMONG PATIENTS PRESCRIBED A STATIN**

The benefits of being prescribed statins are still being felt by participants following a major trial that ended in 2003. Imperial researchers have found that the death rate among those prescribed a statin is still lower than in those given a placebo, even though most participants in both groups have been taking statins ever since.

**IN HIS OWN WORDS:** Felix Editor, Pallab Ghosh (Physics 1983)

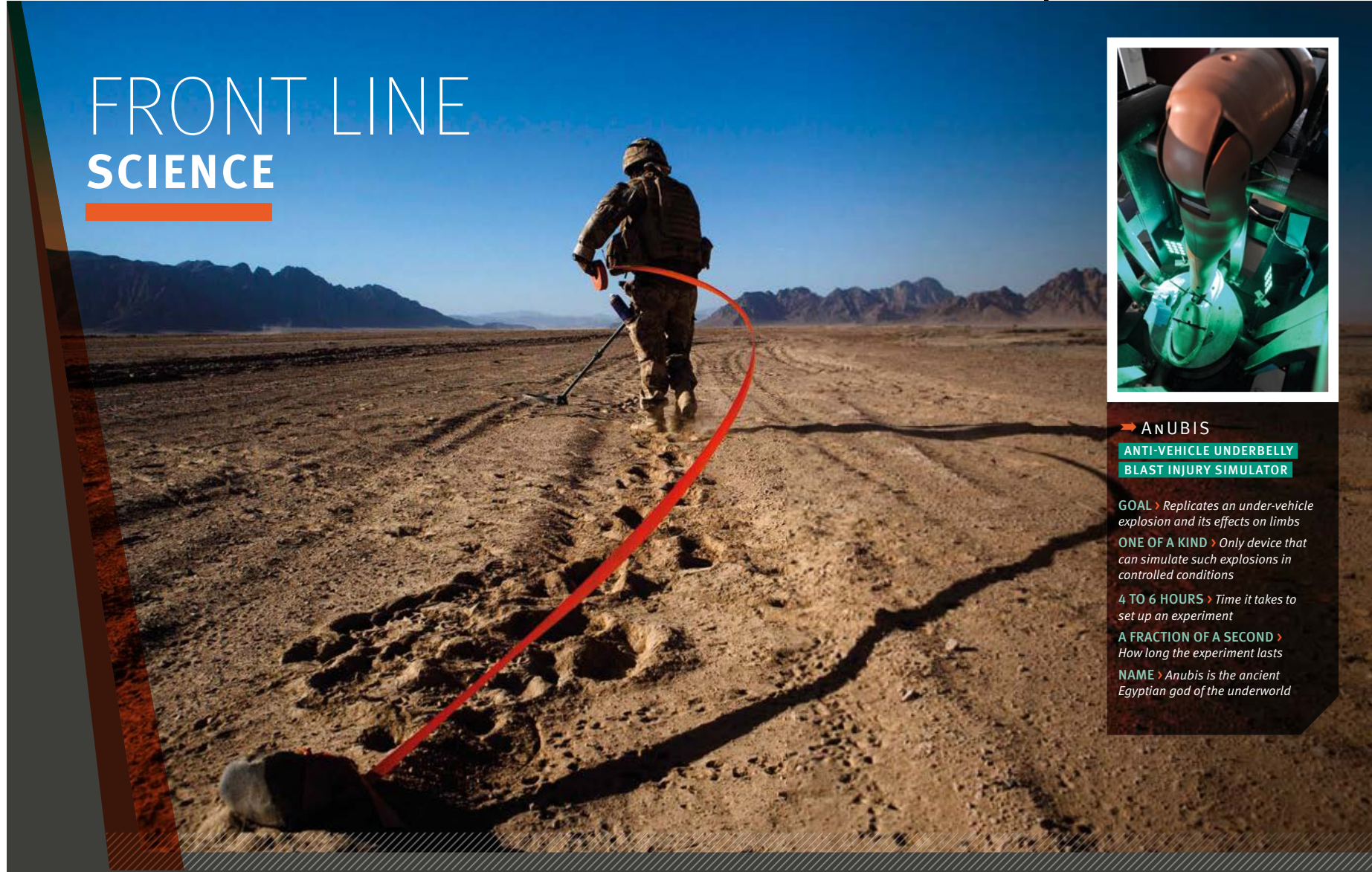
“I even managed to annoy the then Rector to the point that he arranged for a rival one-off newspaper to be produced, called Fido, full of gossip about me.”

*Felix*, Imperial’s student newspaper, published its 1,500th issue in November 2011. The newspaper began in 1949 and is still keeping students up-to-date and entertained today, breaking stories, unveiling scandals, and – in the tradition of all great newspapers – keeping the authorities on their toes. You can browse the *Felix* archive, including the very first edition, at [www.felixonline.co.uk/issuearchive](http://www.felixonline.co.uk/issuearchive)





# FRONT LINE SCIENCE



➔ **ANUBIS**  
**ANTI-VEHICLE UNDERBELLY BLAST INJURY SIMULATOR**

**GOAL** › Replicates an under-vehicle explosion and its effects on limbs

**ONE OF A KIND** › Only device that can simulate such explosions in controlled conditions

**4 TO 6 HOURS** › Time it takes to set up an experiment

**A FRACTION OF A SECOND** › How long the experiment lasts

**NAME** › Anubis is the ancient Egyptian god of the underworld



**THE APP: A SPOT-ON IDEA**

Students from Imperial and UCL have won £10,000 for developing a digital aid to fight acne in the Startup Summer entrepreneurial competition. Spotless is a phone application and web platform that allows users to take a photograph of their skin and then track the spread or retreat of their acne, providing them and their doctors with a record of how the acne is responding to different treatments over time. The money will support developing the idea as a product and registering Spotless as a company.



**SOLAR CHARGING: A BRIGHT PLAN**

A strategy to enable retailers in the developing world to generate income by offering a solar mobile phone charging service has won £10,000 in the Business School's latest Business Plan competition. The MBA students plan to put most of their prize money towards developing the phone charger prototype, known as Solaris, and moving it towards manufacture. Solaris was created by Siten Mandalia (MEng Mechanical Engineering 2009) and it can charge several mobile phones at the same time.



**Lost and found**  
**Scientists race against time to save the last 'Flying Pencil' from being erased**

At midday on 26 August 1940, at the height of the Battle of Britain, a German bomber was intercepted by RAF aircraft, sustaining heavy damage. It crash-landed in the shallows off the Kentish coast by the Goodwin Sands, killing two of its four crew members. The wreck of the Dornier 17 plane, also known as the 'Flying Pencil', sank some 50 feet to the bottom and was covered in sand.

By 2010, the sands had shifted enough to uncover what is believed to be the last 'Flying Pencil' in existence. Now, Imperial researchers are in a race against time to defend the plane against the corrosive effects of seawater, so that it can be conserved and exhibited. The Royal Air Force Museum is planning to lift the plane out of the sea later in 2012. They ultimately want to unveil it in a new gallery in tribute to those who lost their lives during the Battle of Britain

The recovery and conservation of this bomber will greatly enhance the RAF Museum's ability to tell the wider story of the Battle of Britain, particularly the sacrifices made on both sides during the conflict.

Dr Mary Ryan, from Imperial's Department of Materials, is one of those trying to save the plane. She said: "We have been analysing fragments already brought to the surface and it is absolutely fascinating to see how this bomber, which crash landed more than 70 years ago, has been so well preserved by the layers of sand. We are relishing the challenge of finding a way to help save this historical treasure, so that it can be raised and put on display for future generations." She and her colleagues are developing a liquid solution to clean the Flying Pencil's aluminium fuselage and remove corroded layers from it. The hope is that this solution, based on citric acid, will be powerful enough to clean the bomber and prevent further attacks of corrosion, but not so powerful that it damages any remaining paint and markings on the plane.

“I very nearly lost my life for my country, so of course I absolutely welcome any research to better understand blast injuries and to treat and equip injured service personnel in the future.”

TRIPLE AMPUTEE AND FORMER ROYAL MARINE COMMANDO MARK ORMROD, 28

The team is also aiming to develop a test that can detect the early onset of blast lung – the most common cause of death among people who initially survive an explosion. Shockwaves from bomb blasts can cause internal trauma that can damage whole organs, as well as disrupting cellular and molecular processes. These injuries may not show for days, making it difficult for medical teams initially to detect and gauge the severity of blast trauma.

➔ **VIDEO EXTRA** : Using real footage and sounds from the blast lab, a team of MSc Science Communication students, working on a project called *Inside Knowledge*, have reconstructed *Seven Nation Army*, a song by the *White Stripes*, from scratch: <http://bit.ly/xv07xp>

Roadside bombs are the leading cause of death and injury for armed service personnel on operations in Afghanistan and Iraq. Advances in medicine and protective gear mean that soldiers have a greater chance of surviving a bomb blast than ever before, but those who are injured can face amputations, long-term disability and dependency. Now, a new £8 million centre has launched at Imperial that aims to enable researchers to gain a better understanding of the injuries caused by roadside bombs, improve how such injuries are treated, and create

better means of protecting people from bomb blasts. Centre Director Professor Anthony Bull (Mechanical Engineering 1992, PhD 1995), from the Department of Bioengineering, said: "We urgently need to know more, so that we can protect and treat people more effectively. This centre can make a real difference to the survival and quality of life of those serving in conflicts." Civilian engineers, scientists and military doctors at the Royal British Legion Centre for Blast Injury Studies at Imperial are already working on a number of projects, including developing an 'intelligent' combat boot. Insulated with putty, this would absorb and then deflect the impact of an anti-vehicle mine blast.

PHOTOGRAPHS: (SOLDIER) SEAN POWER FOR THE ROYAL BRITISH LEGION; (LEG) JOHN STILLWELL/PA WIRE



A  
**CHEEP**  
DATE

Wildlife enthusiasts across south-east England are volunteering their time to carry out a regular census of rose-ringed parakeets – small, noisy green birds that have settled in England over the last 50 years. These relatives of the parrot and budgerigar first came to the UK from Africa and Asia as exotic pets, but many have now escaped and settled in parks and gardens. Researchers from Imperial’s Project Parakeet are using the survey data to assess how these birds could affect our native British bird populations, as well as their potential effect on agriculture. More information about how to take part is at [www.projectparakeet.co.uk](http://www.projectparakeet.co.uk).



**RUMOUR HAS IT** the parakeets descend from a pair freed by Jimmy Hendrix in the 1960s.



**EYE OPENER**  
**Gene therapy to save sight**

The first patients to receive gene therapy for an incurable type of blindness are being treated in a new trial. If successful, the advance could lead to the first-ever treatment for choroideraemia, a progressive form of genetic blindness that arises in childhood and affects over 100,000 people worldwide.

The novel gene treatment was developed by Professor Miguel Seabra at Imperial’s National Heart and Lung Institute in collaboration with Professor Robert MacLaren at Oxford University, who is leading the trial. It replaces the

gene that is faulty in people with choroideraemia, aiming to halt the deterioration that gradually leads to blindness.

Twelve patients in the trial are undergoing surgery to have the gene therapy injected into one eye. The therapy uses a virus as a delivery vehicle to transport DNA, including the missing gene, into the light-sensitive cells in the retina. Once there, the gene is switched on and becomes active. With this particular gene therapy, the treatment could provide a one-off permanent correction of the disease, since the gene is thought to remain in the retinal cells indefinitely.

“The ability to offer a gene replacement treatment for these patients was the final objective

“The ability to offer a gene replacement treatment was the final objective of 20 years of intense research in my laboratory. This is a moment of fulfilment for us and a dream come true for all choroideraemia patients.”

— Professor Miguel Seabra

**OLYMPICS 2012**  
Watch out for these Imperial hopefuls



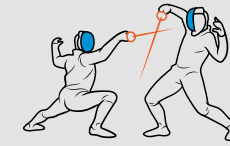
**ROWING** Melanie Wilson, a graduate entry Medical student and rowing scholar, won a place in the GB rowing team in 2009.




**WATERPOLO** Adam Scholefield is Vice-Captain of the GB team and an Electrical and Electronic Engineering PhD student.



**SAILING** Alumna Alexandra Rickham (Environmental Policy 2006) is hoping for a sailing gold in the Paralympics. She competes in a two-person keelboat (SKUD 18) as half of Team Birrell Rickham.



**FENCING** Fourth year medical student Maiyuran Ratneswaran is on the GB senior fencing team while fifth year Hannah Bryars, another medic, is on the women’s fencing team.



**£624k**  
=  
**61**  
UNDERGRADUATE  
**20**  
MASTER'S STUDENTS  
**4**  
PHD STUDENTS

Generous donations from alumni and supporters to the Rector’s Scholarship Fund allowed 85 Rector’s Scholarships to be awarded to students beginning their studies in the 2011–12 academic year, more than three times as many as the previous year.

ILLUSTRATION: (OLYMPICS) JAMES PROVOST

**NEW BUZZ ON CAMPUS**

Like hall wardens looking out for the students in their care, members of the Imperial College Environmental Society are watching over 3,000 housemates in the South Kensington Campus’s first beehive. The bees moved into the society’s garden, behind the *Ethos* sports centre, last summer. Sadly they had not produced much honey by the time winter set in, so their guardians have been feeding them sugar syrup to try to help them bolster food supplies. The budding beekeepers have been getting tips from colleagues on the Silwood Park Campus, which has seven active hives. In August, Silwood’s annual honey harvest produced several jars of honey, which was shared between those who have been working with the bees.



**less than**  
0.0000000  
00000000  
00000000  
0001 **cm**

The amount the electron differs from being perfectly round, as recently discovered by Imperial physicists.

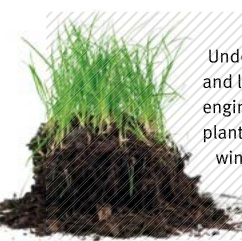


If the electron was magnified to the size of the solar system, it would still appear spherical to within the width of a human hair.

**Turbocharging the roots**

STUDENTS ENGINEER BACTERIA TO FIGHT SOIL EROSION

PHOTOGRAPHY: (HONEY HARVEST) DANIELLA MCMANAMON



Undergraduate bioengineers and life scientists have engineered bacteria to help plants to combat soil erosion, winning them top prizes in the 2011 International Genetically

Engineered Machine World Championship at MIT. In the lab, the team altered *E.coli* bacteria, so that they could seek out seedling plants and enable these to survive better in poor-quality eroded soil by encouraging the plants’ roots to grow faster and longer than normal.

→ Soil erosion worldwide prevents stops crops growing on land the equivalent of half the size of the UK each year.



**The Designing Out Medical Error** project brought together hospital staff, safety experts and process analysts from Imperial College London and St Mary's Hospital with designers at the Royal College of Art to conceive hospital products that minimise the occurrence of mistakes that endanger the patient.

This storage unit helps hospital staff prevent infections and save time by ensuring that the equipment they need is conveniently accessible at the end of every bed. The CareCentre™ is now being trialled on hospital wards.

**1. GEL RAISING**

Hand hygiene is regarded as the most important factor in preventing hospital-acquired infection, but compliance is poor. The CareCentre puts alcohol hand gel at the end of every bed, helping staff remember to wash their hands before and after visiting each patient.

**2. CONTACT PRECAUTIONS**

Gloves and aprons are kept in the CareCentre, ensuring that it is easy for staff to follow hygiene protocol.

**3. WRITE STUFF**

During their observations of hospital wards, the team noticed that drugs trolleys had no surface to write on, making it inconvenient for staff to put down their folders and wash their hands. The CareCentre has a flat top for writing...

**4. SAFE STORAGE**

...with drugs kept in a locked cabinet beneath

**5. CLEAN DESIGN**

Wipes are on hand to keep surfaces clean.

**6. THROWAWAY SUGGESTION**

Gloves, aprons and wipes can go straight into a clinical waste bin that opens automatically.

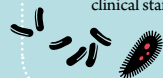


**SMART DESIGN**  
Infection prevention

# HELP at HAND

**NEW DESIGNS FOR HOSPITAL EQUIPMENT AIM TO WIPE OUT HOSPITAL INFECTIONS**

**BUG BRIEFING**  
Healthcare-associated infections (HCAIs) are preventable using simple, low-cost measures, but innovation is required to change the behaviour of clinical staff.



Each year in Europe, there are:

**4.5 MILLION** episodes of HCAIs

**16 MILLION** extra days in hospital as a result

**37,000** deaths attributable to HCAIs



**110,000** additional deaths in which HCAIs contribute

**€7 billion**



resulting cost to healthcare providers — a significant financial burden

Source: European Centre for Disease Prevention and Control (ECDC)

PHOTOGRAPHY: BRISTOL MAID

# Has the Human Genome Project lived up to its promise?

**1**  
THE RESEARCH FUNDER

“The human genome project has exceeded our expectations and has transformed the science of genetics by decoding the DNA within each of our cells. Many thousands of scientists worldwide now use the genome sequence in their day-to-day research. International collaborations are exploring genetic variation among thousands of human genomes, as well as improving our understanding of the biology of other species, including microorganisms that cause infectious diseases.

The result is a constant stream of discoveries about how genetic variation influences our health. For example, 10 years ago, we did not know the mutations that cause malignant melanoma. As a result of the project, we have now found a mutation that occurs in more than half of all melanomas, which has led to the development of the new drug vemurafenib.

We have new approaches to everything from diagnostics to drug design because of the Human Genome Project. It has more than lived up to its promise: it is shaping the future of medicine.”



**PROFESSOR SIR MARK WALPORT** is Director of the Wellcome Trust, and was previously Professor of Medicine and Head of the Division of Medicine at Imperial

**2**  
THE GENETICIST

“When the first human genome was sequenced in 2001 no-one anticipated such a massive rate of change. The race between public and private funding for the first sequence set the scene for rapid technological development. Sequencing costs have gone from \$3 billion to less than \$5,000 per genome in just 10 years – now it’s data analysis and storage that eat resources.

The project has caused a complete culture change in how we research links between genes and disease, and has provided some patients with diagnoses where this previously wouldn’t have been feasible. For people with some single gene and common disorders, more precise diagnosis and targeted treatment have become possible.

I’ve worked on finding genes for insulin resistance and kidney disease. Being involved in such significant advance has been extraordinary. It’s also important for us to help people understand and adapt to the challenges and changes presented by this new era of research.”



**PROFESSOR TIM AITMAN** is Head of the Physiological Genomics and Medicine Group in the MRC Clinical Sciences Centre at Imperial. He is a Trustee of the Public Health Genomics Foundation, and was a special advisor to the 2008 House of Lords Inquiry on Genomic Medicine

**3**  
THE POLICY SPECIALIST

“The project has completely changed the way that people talk about genetics and disease. The research is just the beginning of a big conversation we need to have about how we use the data.

It has also raised important questions about how genetic information from this research should be shared. People are generally disposed to want their data to be used to help others, as long as it is done securely and they retain some control. But how do we ensure this information is used safely, and that discoveries can be shared for everyone’s benefit?

At medical research charities, we have links to patients, clinicians, researchers and funders and well-known public faces, and we are working on finding answers to these questions. We get better policy if people engage directly, so we need everyone to get involved in discussing these issues – from patients to politicians, and children to grandparents.”

**BECKY PURVIS** is Head of Policy at the Association of Medical Research Charities (MSc Science Communication 2003)

**4**  
THE GP AND ETHICIST

“The project was introduced with great fanfare and high expectations, but two decades later, it has to be said that its impact on primary care is muted. As a GP, I have only occasionally experienced patients requesting non-routine genetic tests, such as the antenatal test for cystic fibrosis or for the BRCA mutations in relation to breast cancer.

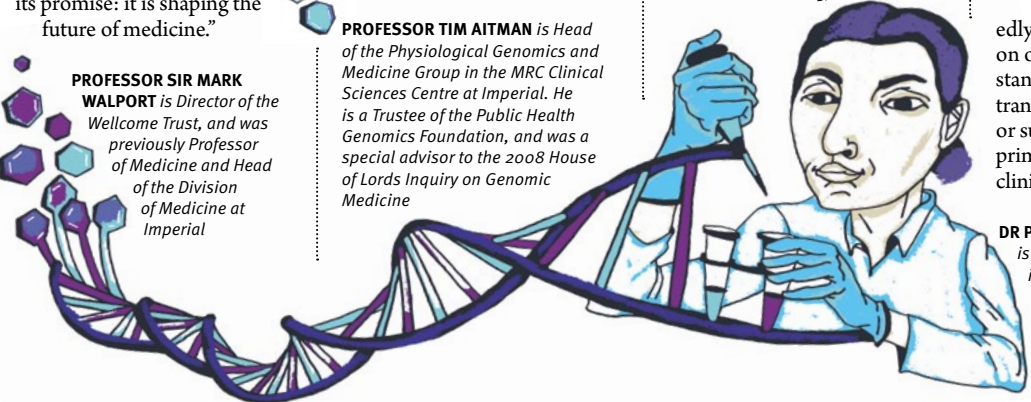
Before widespread genetic testing is offered, adequate guidance, education and training of GPs will have to be expanded, so that we are confident in discussing with our patients the ethical implications of sharing or withholding information with or from family members.

Outcomes from the project have also raised resource issues in the broader healthcare sector. Provision of the new monoclonal antibody drugs against cancer has led to strident discussion about the ethics of rationing, the so-called postcode lottery, the extent of patient autonomy and the role of organisations such as NICE (the National Institute of Clinical Excellence).

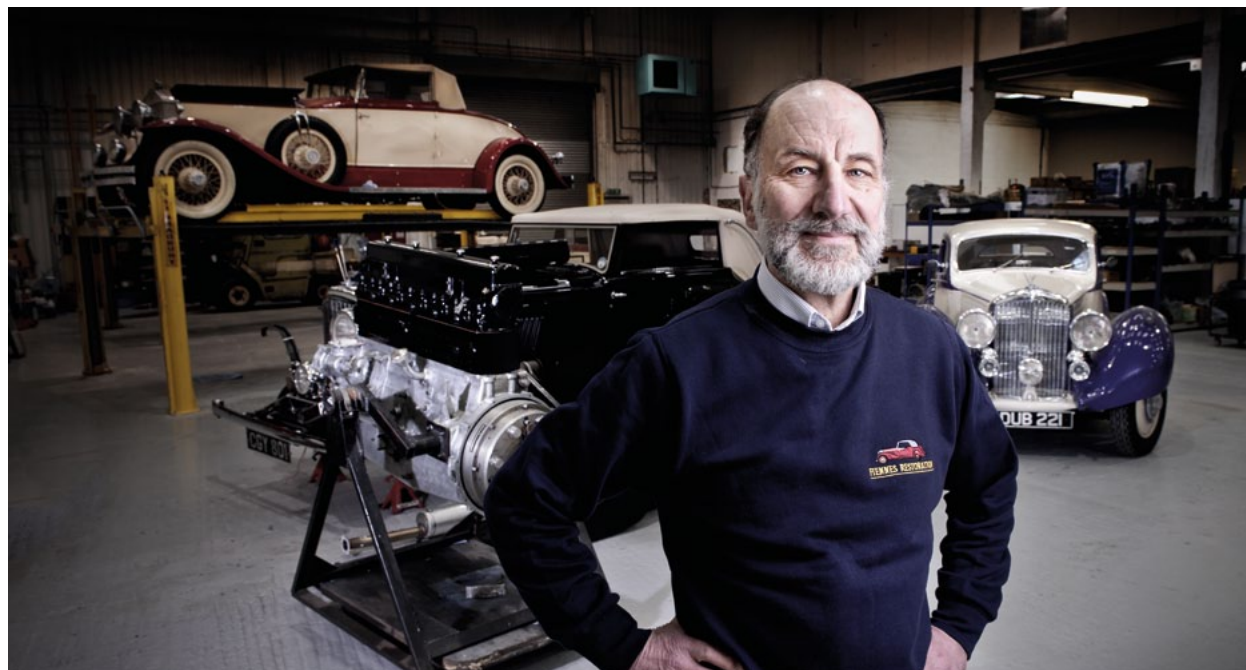
The project has undoubtedly had a significant impact on our scientific understanding, but this has yet to translate into meaningful or substantial changes in primary care or everyday clinical practice.”

**DR PAQUITA DE ZULUETA** is a GP and honorary lecturer in the School of Public Health at Imperial, where she is Programme Director for the Applied Clinical Ethics Course.

ILLUSTRATION: KIM ROSEN







## MAGNIFICENT MOTORS

➔ No U turn: restoration in progress

### LOGBOOK

#### OCCUPATION:

Managing Director of  
Fiennes Restoration

#### BUSINESS:

Restoration of  
pre-war Bentleys and  
Rolls-Royces

#### LOCATION:

Filkins, Oxfordshire

#### RECOMMENDED DRIVE:

Peking to Paris  
rally

#### FIRST CAR:

1936 Riley

#### MOST DECORATED CAR:

Pebble Beach  
Concours d'Elegance  
winning Rolls-Royce  
20/25

After finishing my PhD,  
I realised that industrial  
research wasn't really  
for me, and so decided to  
do my own thing.

In restoration projects that may last years, if not decades, Will Fiennes (PhD Mechanical Engineering 1970) takes the unrecognisable shell of what may, in its heyday, have been a supercar and painstakingly returns it to its former glory.

**IMPERIAL:** You've made a career out of something you love: what advice would you give to today's students?  
**FIENNES:** If you have an ambition or a dream, it will always be an unanswered question unless you have a go at achieving it. There's that nagging "what if" and, for me, that question would bug me for the rest of my life. When something is your heart and soul, you'll put up with difficulties that people in a regular job just wouldn't.  
**IMPERIAL:** Would you change anything about your career?  
**FIENNES:** I don't have any formal business training and I started out very naive – I remember trying to

summon up the courage to send out my first invoice. I used to wonder if I would have done things differently if I'd had any formal business training but came to the conclusion that I'd probably never have started the business in the first place.  
**IMPERIAL:** What's been your favourite car to restore and why?  
**FIENNES:** Of all the cars we've had through the workshop, the one that gave me a real thrill was a 1938 Bentley known as the Embricos Bentley, commissioned and built to test the theory of aerodynamics. We had it here about 25 years ago and it was the most wonderful car to drive: even with all the windows down there was no change in air pressure inside the car – which was tricky in hot weather.  
**IMPERIAL:** What's the closest you've come to disaster?  
**FIENNES:** I was taking the first car we'd ever restored back to its owner in London: our former premises were down a single track lane with

a sharp blind bend and I met the Post Office van coming in the opposite direction – we stopped about six inches apart.  
**IMPERIAL:** Why should classic cars be driven?  
**FIENNES:** Cars need exercise. I remember one customer coming to collect their car: we took it for a test drive on a local route with lots of sweeping bends and they turned to me and said, "I've never driven it at more than 40," and I thought to myself: shame on you! Some of these cars may be over 50 years old but they still more than hold their own against modern traffic.  
**IMPERIAL:** Why is there such an enduring love and fascination for these cars?  
**FIENNES:** There's a sense of satisfaction from repairing something and making it work. People who buy these cars often have that sort of interest. These days, if you take something apart, you'll probably have to throw it away because it won't survive the process of disassembly.

It's a shame that there are kids who haven't had the opportunity to really get involved in the mechanics of an object.  
**IMPERIAL:** Tell me more about the 1932 Rolls-Royce 20/25  
**FIENNES:** Originally shipped to Switzerland with a formal saloon body, the original owner later rebodied it with open coachwork. After his death, the car was sold to an Afghan prince who, in 1939, accidentally drove it into Lake Geneva returning from a party (it was retrieved the next day). The daughter of its 1950s owner tracked the car down to Seattle: she bought it, shipped it to the UK and we got involved in the late 1990s, completing the restoration last year. We were invited to attend the Pebble Beach Concours d'Elegance, where the car won second in Rolls-Royce class, as well as the Lucius Beebe Trophy.  
**+ ONLINE EXTRA:** See more photographs from the workshop and find out about the Rolls Royce 20/25 at [www.imperial.ac.uk/imperialmagazine](http://www.imperial.ac.uk/imperialmagazine)

PHOTOGRAPHY: TIM WALLACE

# Stormy crossing

Journeying from College to career is no easy ride, says Kelly Oakes



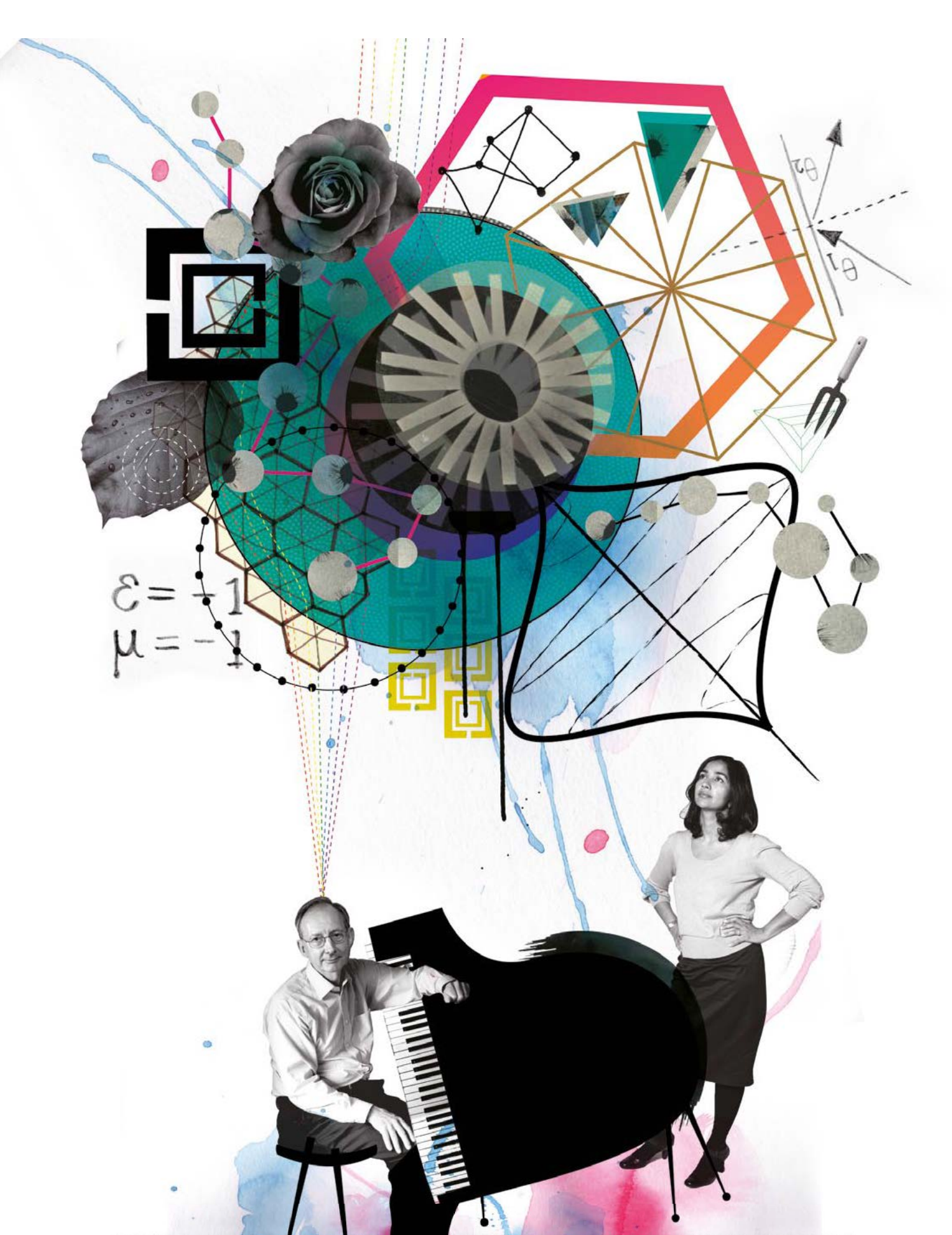
“I'm afraid we don't have any umbrellas left, would you like a free pen instead?”

As rain hammers on the roof of the crowded careers fair marquee on the Queen's Lawn, a pen from a prospective employer promises to do little to shelter me from the down-pour. But should it give me hope for when I leave Imperial? If they're handing out free pens, might that mean they have jobs to give out too?  
At the end of my undergraduate studies, the Rector told us in the Royal Albert Hall that our newly conferred Imperial degrees would open many doors for us. Despite impressive statistics – 89 per cent of Imperial graduates find graduate-level jobs six months after completing their studies – my classmates and I are finding those doors rather stiff.  
Faced with a stormy jobs market, and no umbrella to protect me from the worst of it, I opted to shelter inside academia for

one more year while studying for a Master's degree. I'm gaining skills that I hope will help me into a job when I leave Imperial.  
At a recent Royal College of Science Union dinner, I spoke to an alumnus who graduated a generation before me. In her final year she received not one, or even two, but three job offers. In similar tales, alumni described the 'milk round', when companies would visit campus and encourage students to sign up to interviews for any positions that interested them.  
Current students talk about the old-style 'milk round' as if it were a myth or legend. Though it still exists, these days it is the employers who have their pick of the students, not the other way around.  
Today, most students frequenting Imperial's careers fairs will say they're 'networking' with the people manning the

stalls. The marquee is awash with students who would claim that it's just a coincidence that they happen to be wearing a suit and carrying a stack of freshly printed CVs on the day of a fair. You will often see these same people trying to strike up a casual conversation with a potential employer which, in reality, looks anything but casual. Alongside seasoned careers fair patrons are the more sceptical punters, unconvinced that the event supports their cause, who are using it to gather enough free stationery to see them through revision instead.  
Regardless of the approach taken at a careers fair, getting an interview is a marathon affair. Meeting the challenge requires hours of online assessments, application form filling and CV tweaking, not forgetting all those extra curricular activities you should be doing too. A degree is no longer enough.  
Interview days can provide some light relief, especially if they involve The Apprentice-style tasks, as many now do. They are nonetheless hard work. Employers want perfection – in a whole day spent analysing case studies, working in small groups and enduring one-to-one interviews, just one slip-up and you've blown it.  
In our final year, instead of rumours of job offers spreading through lecture theatres, those who had received good news made announcements on Facebook. Congratulations were offered in the same way, giving others yet to taste success a computer screen behind which they could hide their jealousy.  
Those who went on from Imperial straight into jobs or PhD study were the ones who had numerous internships under their belt, or had spent sweltering summers working in the lab.  
As for the rest of us, some rays of sunshine are beginning to peek through the clouds. Some of my classmates are back with their parents for now, but as the interviews trickle in they are inching closer to their first, proper job.  
Those of us who chose to stay in academia just a little longer will have to leave its warm embrace eventually. Though it didn't protect me from the rain, that free pen will come in handy when I start filling in job applications of my own.  
KELLY OAKES (MSci Physics 2011) is studying for a Master's in Science Communication. She edits the science pages of Felix, the Imperial student newspaper, and blogs for Scientific American.





# LEADING LIGHT

Theoretical physicist John Pendry reveals what gets him thinking and the inspirations behind his new ideas.

WORDS BY ANJANA AHUJA // ILLUSTRATION BY VICTORIA TOPPING

**I have just disembarked at** a train station outside London, when I spot the tall, thin, bespectacled man in a woollen jumper smiling at me from the opposite platform. We shake hands and climb into his polished black Lexus, me anxiously trying not to muddy the plush cream mats while the driver, one of the world's leading theoretical physicists, chats about property prices in this well-heeled part of the world.

Professor Sir John Pendry speeds me to an immaculately kept bungalow; the sitting room and study are decorated not with equations but with framed photographs that he himself has taken, courtesy of the digital camera that he carries everywhere in his briefcase. The scenes – Isles of Scilly landscapes and sunlit doorways in South Kensington – reveal a decent eye. “It’s all about the geometry, the visuals,” he explains of his photography. Only later, when transcribing our interview, do I realise how similar his response is when I ask him to describe his approach to theoretical physics: “I think in geometry; I always like to have pictures in my mind.” This unique clarity of vision has enabled John, 68, to ‘see’ and solve mathematical challenges in physics across a staggering breadth of subject areas, from surface science to optics to the completely new discipline of metamaterials, which he largely invented.

During the next two hours, he sheds his initial formality, turning into a gracious,

candid and amusing interviewee. Of his 2004 knighthood, the first bestowed on a serving Imperial physics professor since Sir George Thomson received one in 1943, he says: “I regard it as a great honour but I never have it on my badge at scientific meetings. You have to be careful not to ponce around calling yourself Sir John all over the place.” The breadth of his work was also memorably celebrated in 2008 during a three-day ‘Pendryfest’ at Imperial, where he has worked since 1981 as Professor of Theoretical Solid State Physics, following stints at Bell Labs in the US and Daresbury Laboratory in Cheshire.

The metamaterials for which he has become so well-known are artificial materials whose effects derive from their physical structure, not their chemical make-up. In brief, they are engineered from collections of microscopic structures that, at a larger scale, do unexpected things to electromagnetic waves, such as deflecting them. Such materials can theoretically be used to bend light around an object, rendering the object invisible – a 2006 finding that led to him being lauded in the international press as the inventor of a Harry Potter-style invisibility cloak. His achievements have attracted attention from many quarters: a presentation on the cloak to the American military research agency Darpa resulted in a job offer – rejected, of course – paying considerably more than a professorial stipend, and certainly enough for several

more luxury cars. He has also been a consultant for Marconi; the filing cabinet in his fastidiously tidy study, where we are shuttered away for the interview, is stuffed full of old patents he wrote while consulting for industry.

Not that his other major pieces of work have been dull. In 2000, he published a short but explosive paper in *Physical Review Letters* explaining the theoretical possibility of a perfect lens. It built upon work done nearly 40 years earlier by the forgotten Russian scientist Victor Veselago, who suggested that a material with a negative refractive index – something never seen in nature – could produce an almost magical lens capable of creating images at a resolution finer than the wavelength of light being used.

He recalls: “One day I decided to do the job properly, and found something that Veselago hadn’t noticed: that you could arrange things so that the focus was theoretically perfect. It turns out that the lens was so simple that anyone from Maxwell’s time onwards could have solved it quite easily, even a third year undergraduate.”

Really? “Yes!” And it only took him a day? “One morning!” he chuckles, leaning back in his chair. “It’s just that nobody asked the question – amazing, isn’t it? That’s why people thought I’d got it wrong.” That day, John emerged from his study to tell his wife Pat, a Cambridge-educated mathematician and now retired Inland Revenue adminis-



trator, that he had just done something that would either make or break his reputation.

Publishing his solution – it took him a month to work up the nerve – was the most gut-wrenching moment of his professional life: “I knew it would press some buttons but I also knew the consequences if it was wrong. Scientists are awfully competitive, and if there’s one way for a young scientist to make his reputation it’s as Jack the Giant Killer. So some senior scientist comes out with something that makes a damn fool of himself, and pointing it out is a route to fame and fortune. Quite a few young men and some older ones tried to take that route when I published.”

The brevity of the lens paper only fuelled the unbelievers: “I was head of department at the time. I was doing my science at weekends, and I couldn’t take a month out of my life to write a huge review. So when people didn’t see a long paper emerge, every man and his dog came forward. Some letters were really quite nasty. These things make you angry and upset but then I realised: if these people, who aren’t fools, were misunderstanding things, this must be something more profound than I originally thought.”

John still regards it as one of his most spectacular achievements, exemplifying his philosophy of diligently following where the numbers lead: “When you see something anomalous, it may be as small as a speck of dust on this table but it’s a gift, because either it will improve your understanding or will lead to something new.” Google records more than 5,000 citations for the paper. While John will not comment on the possibility, it is likely that he will also match

## I THINK IN GEOMETRY; I ALWAYS LIKE TO HAVE PICTURES IN MY MIND.



George Thomson’s achievement of a Nobel Prize for Physics. According to impeccable sources, he has certainly been nominated.

**In an alternate universe, John might well** have been an experimental scientist. Even as a grammar school boy growing up near Manchester – living with his oil rep father, secretary mother and younger sister above his grandmother’s sweet shop – he had a practical bent. “My uncle was an engineer and he put magazines like *Wireless World* my way – that’s where spotty kids went in my day. Today, I suppose, they go to the internet. But I take pride in being able to fix things and love knowing how things work.”

The decision to abandon experimental work, taken while he was reading natural sciences at the University of Cambridge (where he met his wife), was a pragmatic one: “The problem with being an experimentalist is that you’re shackled to your kit. As a theorist you travel much more lightly, so you can hop about.” This is especially important given his belief that scientists should change field every 10 years or so, because “your PhD problem will only last so long. Most ideas, with a few exceptions, are worked out in 10 years.”

He can still enjoy, vicariously, the thrill of experimentation by collaborating with experimenters like Professor David Smith at Duke University, who, to the delight of many, including journalists, turned John’s elegant equations into reality by building a cloaking device at radio frequencies. And,

he says, he loves proposing experiments for others to try. Sometimes, experimenters merely point him to papers they’ve written as a result, or consult him for more hands-on advice. “That I really, really enjoy. I love going into a lab and asking questions about the kit. For someone who’s not a full-time experimentalist, I have a good understanding of what’s likely to work. It’s a bit like being a composer – you can’t play all the instruments but you have to know what they do. That’s the difference between mathematics and theoretical physics – in mathematics you’re often generating results for their own beauty, but for me, the crucial thing is whether someone can do an experiment. If they can’t, then the idea is dead.”

Despite being two years away from his 70th birthday, his ability to generate novel ideas is still very much alive. Recently, John and Professor Stefan Maier, a renowned experimentalist also based at Imperial, won a £4.9 million grant from the Leverhulme Trust to properly establish the field of metamaterials with Southampton University, and, crucially, move it into optical wavelengths. Optical wavelengths, in the range of a few hundred nanometres, are orders of magnitude smaller than radiofrequency wavelengths. The metamaterials needed to manipulate optical light therefore need to be correspondingly Lilliputian, presenting a nanoengineering challenge.

While they are working towards constructing the perfect lens out of metamaterials –

which could revolutionise the storage of data on optical disks – they are also pioneering a specialist field called plasmonics, which is the control and manipulation of light down to the nanometre scale. Their first challenge is to build a crude precursor to the perfect lens, known as a light harvester. The harvester does not create an image, but instead gathers all the light falling on it and sends it to a single point. Being able to concentrate light in this way is, John thinks, a critical step in the process of getting light beams to interact. Such photon-photon interactions could, he says, drive a new industry.

When I met John at the train station, I had only vaguely recognised his face from my student days at Imperial, which I joined in 1987 as a physics undergraduate. My lack of familiarity might be because he cut a deal early on with his colleagues to do more administration and less teaching. Today, John does not lecture to undergraduates but continues to recruit research students. Given that I stayed on to do a PhD, our paths might well have crossed in the Blackett Laboratory’s eighth floor postgraduate coffee room but, since it is also the place where I met my husband, I can fairly claim distraction.

**I return occasionally to Imperial, either to see** old colleagues or to chat to the press office. For me, the addition of the glassy, colour-blocked Faculty Building, and the revamped Main Entrance on Exhibition Road, lend the College a more corporate, professional feel. John, who remembers being horrified at the unpainted, tobacco-stained office he was allocated on arrival, is largely approving: “College is much better organised, even just the simple things like getting the bloody place painted. Plus, there used to be very few formal ways of looking after people’s careers. So if your colleagues were collegiate and responsible you were fine, but there were horrible instances where it went wrong. On the other hand, when I joined there were only 5,000 students and maybe 100 professors [compared with today’s figures of nearer 14,000 and over 400, respectively], and the Rector knew every professor personally.”

“Also, the way research studentships are

handled has become much more formal, with more form-filling and lecturing involved. In my day, if PhD students needed to know something they looked it up. I accept that’s a very old fashioned attitude and I’m happy to go along with the new system but I would have hated it. I still remember attending my last lecture at Cambridge. At the end of it I put my pen down and thought: ‘That’s the last bloody lecture I will ever go to in my life.’”

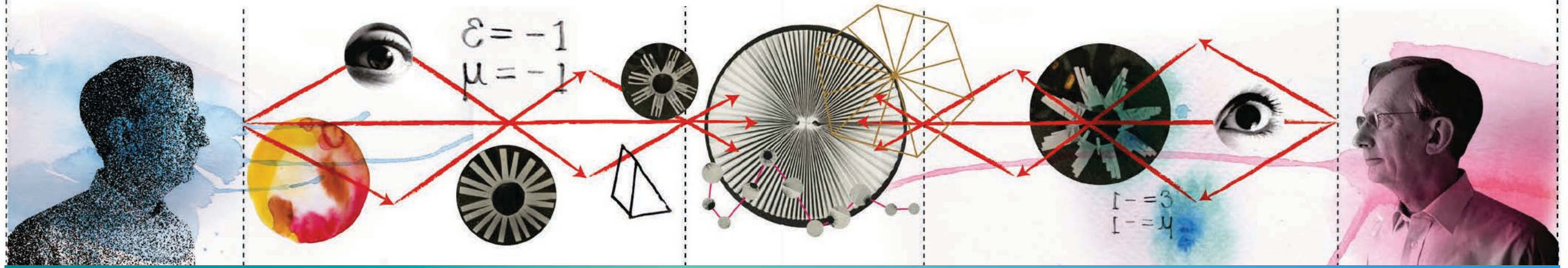
“But overall the College has provided a good environment for my work, particularly in terms of colleagues. Standards are high and the reputation is high, which is hugely important to how your research progresses.” The formidable combination of John and Imperial’s reputations has attracted not just large grants in hard economic times, but also some of the brightest talents in optical science, including Maier, who has just picked up a prestigious Wolfson merit award from the Royal Society, and Professor Ortwin Hess, who holds the Leverhulme Chair in Metamaterials.

This, plus the campus’s position near Hyde Park, has made John reluctant to move elsewhere, despite his general dislike of London. He gets into his car at 5.30, heads to his *pied à terre* in Battersea and plays piano for an hour, before coming to work. He is an accomplished pianist; he owns three, including a grand piano bought by his wife Pat as a gift for his 60th birthday. He would love to have been a concert pianist, he confesses, but shies away from playing in public, although he does demonstrate his talents to me by playing a Bach prelude just before we sit down to a pasta lunch.

*It’s a bit like being a composer – you can’t play all the instruments but you have to know what they do. That’s the difference between mathematics and theoretical physics – in mathematics you’re often generating results for their own beauty, but for me, the crucial thing is whether someone can do an experiment. If they can’t, then the idea is dead.”*

He pays his dues to society in the currency of outreach, revelling in giving public talks and lectures all over the world. He confesses to feeling slightly nervous about a forthcoming talk to a secondary school – he and Pat don’t have children, he explains, so he feels a little out of his depth with younger pupils – but, admirably, he’s going to feel the fear and do it anyway. Just mention Harry Potter, I advise. My nine-year-old daughter, I tell him, is terribly excited that I am meeting the real-life inventor of an invisibility cloak.

And no, he does not begrudge being mentioned in the same breath as the bespectacled boy wizard. “What constitutes success for an idea?” he muses, reclining his long frame in perhaps the same way he did 11 years ago, when he discovered that he had seen what Veselago had not. “It’s other people picking it up and running with it. So, by going around and getting publicity – and it’s been my good fortune to ride on the coat-tails of these wonderful Harry Potter stories – you encourage other scientists to work in the area and do something with your ideas. Ultimately, if you’re going to pay your debt to society for having all this fun with science, somebody has to make something with it.”





# THE IMPERIAL UNDERWORLD

Staff and students go about their daily business oblivious to the world beneath their feet: a network of tunnels under the South Kensington Campus that is shrouded in mystery. One winter afternoon, *Imperial* shimmied down a hole and became lost for time in this subterranean land.

The purpose – to investigate the myths that have become campus legend. Rumours range from the discovery of a mummified body to tunnellers being stopped by military police with machine guns. As we descend deeper, the temperature rises noticeably. “That’s hell down there,” says our guide, Chas Guirey, Head of Maintenance, pointing to one particularly blistering tunnel.

Constructed after the Great Exhibition of 1851 for the Imperial Institute’s heating systems, the tunnel network criss-crosses campus, running beneath Exhibition Road to reach Southside and Prince’s Gardens. In days gone by they’ve played host to drinking parties in the foundations of the Queen’s Tower, secret trysts (a love nest complete with a bed, a light and an empty bottle of wine was once discovered) and kidnapped constituent college mascots held captive, awaiting ransom payment. Today, they house the College’s network of cables, wires and heating ducts. Essential stuff, but a lot less exciting than imagining what went before.

Adam Wielowieyski-Ipnarski (Computing 2001), describes his time traversing the maze as: “The thrill of the unexplored”. And indeed it is.

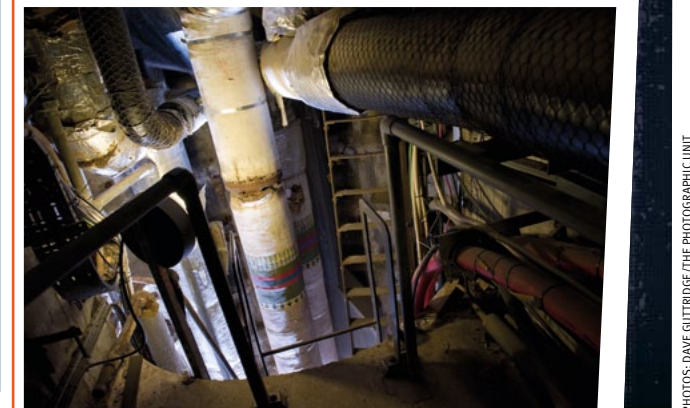
→ Share your tales of the tunnels: [www.imperial.ac.uk/tunnels](http://www.imperial.ac.uk/tunnels)



“I was shocked in my first year, coming out of a tutorial, to be told to follow my tutor down a service duct. He showed me how to get from the Computing Department to the Union Bar without getting wet one day when it was tipping it down.” CHRIS EVANS (COMPUTING 1988)

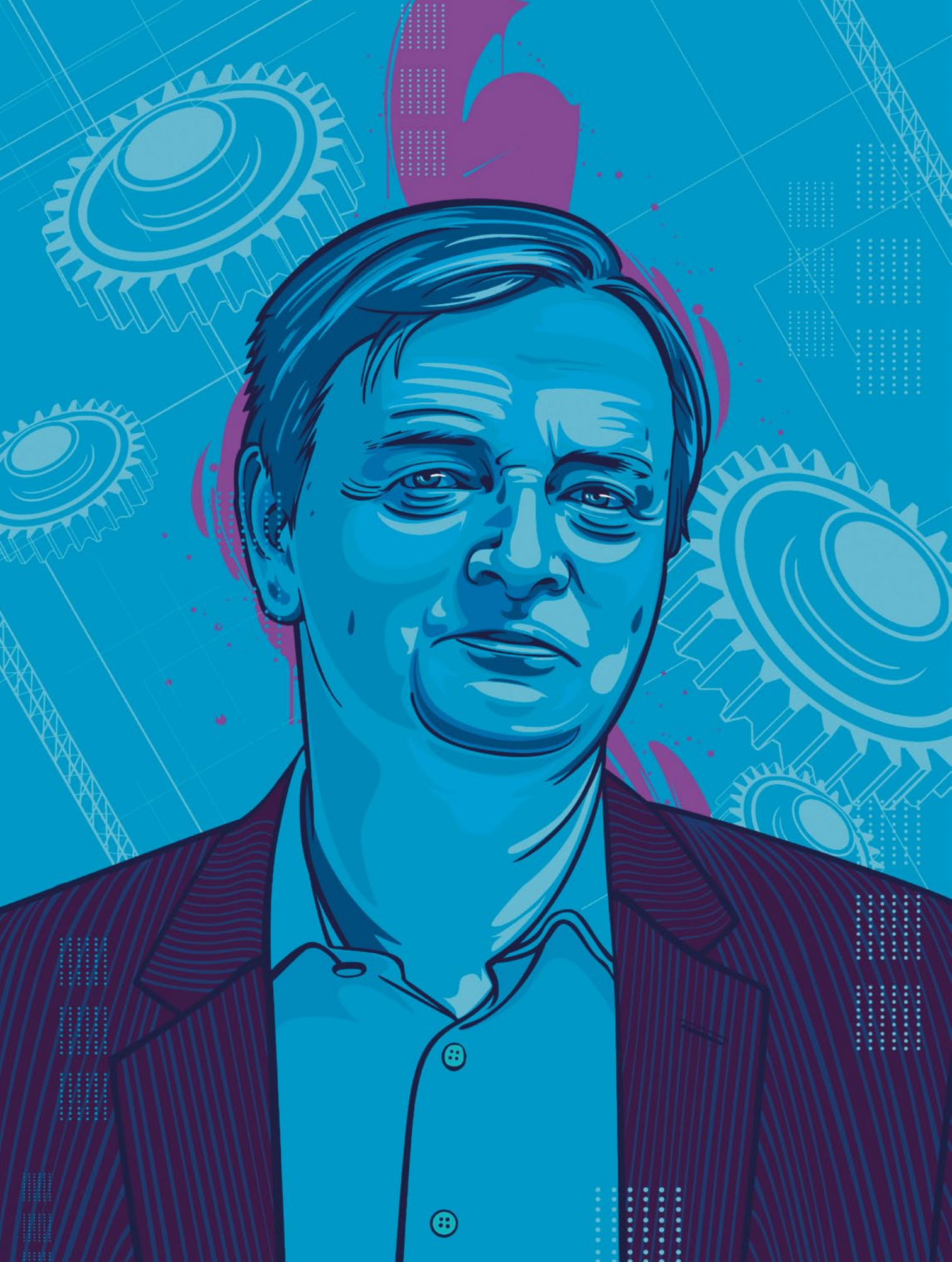


“There were rumours of nuclear waste being stored in the tunnels. Being the idiot I am, I went down. We do not talk of that day or how I glow in the dark” JULIE HARRIS (IMPERIAL SCIENCE FICTION SOCIETY MEMBER, 1992)



PHOTOS: DAVE GUTTRIDGE / THE PHOTOGRAPHIC UNIT





# GETTING THINGS DONE

AN INSIDE VIEW ON THE ROLE OF ENGINEERING IN GOVERNMENT

As a House of Commons select committee considers how government uses engineering advice and expertise, systems engineer David Fisk reflects on his experiences in strengthening relations between government and engineering to show why this relationship matters, how it has evolved, and how Imperial alumni might strengthen it.

'Engineering' to most people means getting things done. Technology – 'the knowledge of things' – plays its part, but engineering is more than 'things'. Stripped to its essentials, to engineer an outcome takes someone to be persuaded to make something, and others to want to use it when it is made. If that something has never been made before, then it follows that there are judgments to be made and risks to be taken. Governments are also supposed to be about getting things done. So what should citizens expect from their governments when they need something engineered?

#### KEEPING UP WITH INDUSTRIALISATION

For several thousand years governments have required access to an engineering capability to arm their nations. But it was not until the nineteenth century that engineering issues began to appear in UK civilian legislation. Industrialisation was taking place at speed and government needed a way of engineering factories to be cleaner and safer, as an alternative to forcing them out of business through prohibitions.

The pragmatic Victorian solution was for parliament to appoint a person with formidable technical knowledge as Chief Inspector to regulate industry. Regulation was designed to encourage incremental improvements in innovation and therefore keep pace with the rate

BY  
DAVID  
FISK

of industrialisation. This approach provided a strong incentive for manufacturers to secure competitive advantage by devising new technologies that exceeded the current standard. The Chief Inspector needed to be alert to false claims, but the incentive system made the job technically plausible.

The Chief Inspector oversaw the industry, but did not need to run it. This approach was certainly effective. It is essentially how vehicle emissions, once the bane of urban life, have been regulated through continued technical improvement to levels where eating at a pavement café in central London is now a pleasure.

#### FROM SOLUTIONS TO OUTCOMES

By the 1970s, this approach to regulating technology was becoming a little ragged where issues of scaling and complexity were involved. For example, oil refineries presented a bespoke legacy of systems stitched together over decades rather than a discrete technical solution to a single problem. The energy performance of the interconnected systems of a modern commercial building or hospital was far too complex to be regulated by the simple rules that applied to a domestic house.

Attention thus started to move from specific best practice solutions towards performance targets such as maximum rate of pollutant emis-

Illustration by VINCENT RHAFAEL ASEO



sions. This permitted different engineering solutions with the same outcome, without the need to identify which one was best. The government's requirement for in-house technical skills moved from the engineering expertise of Chief Inspectors towards specialists in measuring performance. The US was probably the first to push this logic further and set as the target the state of the environment itself. If the environmental standard was met, then surely firms could decide how to achieve it amongst themselves by reconfiguring their technologies and emissions?

#### THE ECONOMICS OF INNOVATION

This line of reasoning soon led to the birth of air pollutant emissions trading in the early 1990s. But it was also accompanied by something of a paradox: if the environmental standard was a sharp universally agreed level, then the conceptual economic model worked fine; but if the standard were to be a trade-off, the regulatory body would be hard pushed to know the true cost of an innovative measure without the engineering expertise to know 'how the widget works'. Unfortunately, by focusing on outcomes, this knowledge had been lost from inside government agencies. Asking the industry to come up with a number would be like asking a turkey to pick the date of Christmas. This was brought home to me during the negotiation of one EU directive where 'cost per unit' emission differed by at least a factor of 10 between member states for the same technology, even when some of those states were being briefed by different parts of the same company.

The difference in intellectual spaces inhabited by the economics of innovation and the economics of the public sector means that government measures aimed at improving the economy can have a rather poor net effect on the national balance sheet. 'Market-based' regulatory instruments are a case in point: they might offer a theoretical economist some satisfaction, but if the starting point is a poorly structured engineering regulation, the outcome cannot *per se* count as a triumph

of public policy.

The lack of direct experience and true understanding of the parameters that govern engineering innovation have often led to the opposite of the intended effect when it comes to public policy. For example, the European Trading Schemes (ETS) for greenhouse gas emissions promised to open the market to innovative solutions for a low carbon economy. But brave new expensive green technologies that relied on high ETS prices have been bankrupted, and smoke stack industries that kept their nerve have survived the crash in market prices for carbon units. Somewhat belatedly, governments are realising that they cannot avoid employing engineering knowledge and judgment after all. But how should they do so in today's complex world so different from that of the Victorian Chief Inspector?

#### ACADEMICS AS GOVERNMENT ADVISORS

In search of an answer, we might first look to a model that was originally developed to help government better assess technology for military procurement which has always set a particular challenge and requires immense amounts of good judgment. As government is frequently seeking to buy what has never been made before, discovering that it does not work as intended in a real conflict can be disastrous.

The problem of finding a better way to assess military technology became more pressing once the concept of a technology arms race really caught on after the First World War. By the 1950s it had become sufficiently perplexing for the Ministry of Defence (MoD) to institute a new role of Chief Scientific Advisor (CSA). In the MoD this was and remains a senior post recruited from academia, closely linked to the procurement process, and with an internal analytical capability to challenge technical assertions from equipment providers and internal advocates.

The CSA model is now widely replicated across government departments, demonstrating a spread of concern about things technical that spreads far beyond

military procurement. I myself performed this role for the then Department of the Environment from 1988. As my colleague, David Edgerton (PhD Social and Economic Studies 1984) described in issue 36 of this publication, Imperial has contributed a full-house of such advisers across different departments, including the current Chief Scientific Advisor to the government, Professor Sir John Beddington.

CSAs have 'access to ministers', meaning that they often join meetings where technical substance underpins the political decision. They are not intended to be a walking Wikipedia, but are well-positioned to draw heavily on external peer networks, such as Fellows of the Royal Society and the Royal Academy of Engineering.

The CSA model forms part of a wider check and balance system to ensure that technical expertise is available to those who need it. But while it seems to work for big issues, it is less good for some of the other levels at which government is engineering things. Some of these never drop into a CSA's inbox at all, or if they do, it is at a stage when the only intervention left is to halt gross errors in official process. So the problem of sourcing good day-to-day engineering judgment remains. Very large problems can start from very small errors.

#### OTHER OUTSOURCING OF ENGINEERING EXPERTISE

Rethinking how government's engineering competence could be improved cannot be just a matter of going into reverse gear to a golden age. First, the move to focus on specifying outcomes has meant that engineering expertise has long since left central government. The state industries and laboratories have gone to the private sector and with them their engineering knowledge. This makes plausible engineering careers in government a little hard to identify: you will find fewer chartered engineers in most central civil departments than you would in a typical town hall (or indeed the state council of the People's Republic of China).

What has emerged to fill this space has been the engineering consultant. Imperial academics, through Imperial Consultants, have frequently played this role of analysing the engineering implications of policy, under contract to a department. In one sense the new world order is good business for independent consultants: no-one in govern-

## STOPPRESS

### STRENGTHENING THE VOICE OF SCIENCE AND ENGINEERING IN GOVERNMENT

As we went to press, the House of Lords Science and Technology Committee published its report on the role and functions of departmental CSAs. The report sets out a range of recommendations to strengthen CSAs' access to the expertise, independence and resources they need to do their job effectively by challenging ministers and continuing to play a crucial role in informing government policy.

## Turning ideas into reality

When the House of Commons select committee published its 2009 report of the enquiry into how government uses engineering, it drew on a piece of career advice from Lord Mandelson that would warm the hearts of many of our staff and students: "If you really want to change the world, choose a career in engineering".

At the time, Lord Mandelson was Secretary of State for Business, Enterprise and Regulatory Reform, and his comment encapsulated the spirit of the committee's report, which observed that the recent economic crisis has presented government with a "once-in-a-generation opportunity to restructure the economy by building on the existing substantial strengths of UK engineering".

The report recognised that engineering underpins the work of many government departments and has a major role to play in addressing global challenges such as climate change, food and water supplies, energy sources and economic stability. After reviewing key themes via case studies on nuclear engineering, plastic electronics and geo-engineering, the report went on to make a number of recommendations about the specific role of engineering in government, which were broadly welcomed in the government's subsequent response. These include:

- » Government should know what expertise it has in the civil service, and might look towards establishing greater levels in the generalist civil service as well as recruiting more engineering policy specialists, for example, via the science and engineering fast stream;
- » The policy process should recognise that engineering and scientific advice have different things to offer, for example by seeking engineering advice earlier in the process of policy formation, and ensuring that government has enough in-house engineering expertise to act as an intelligent customer;
- » Government should adopt a practice of developing roadmaps for major engineering programmes, coordinating between them, and providing more strategic support for emerging industries and policy areas such as geoengineering;
- » A reorganisation of the high-level advisory structures in government could provide better overall transdepartmental management of engineering policy.

ment would believe industry, even if government were equipped to understand fully what they were saying. The critical point arises when a government department no longer has the internal knowledge to match the consultancy contract it is managing, at which point it fails to understand the limitations of any advice it has commissioned – the 'unknown knows'.

The imperative to recover engineering competence in modern government is as strong as ever. Regulators like Ofcom are facing formidable technical opponents in the form of the world's monopoly-minded IT industry. Regulators like Ofgem and Ofwat are signing off billions of pounds of novel green infrastructure proposals that will end up on our utility bills, even if the widgets do not work as intended. Only the European Commission, with the collective strength of member states behind it, succeeded in taking on the power of Microsoft to unbundle the internet services from the Windows platform. But even the well-endowed Commission had to rely on a valiant consultant to make the case. The National Audit Office (itself with no internal engineering expertise) meticulously records progress on vast IT engineering procurements, such as the communications system for the Fire Service, that subsequently collapse in disarray, without even appearing to ask why such ambitious projects are being scoped by non-engineers in the first place.

#### RECENT PROGRESS

The good news is that this problem has not gone unnoticed. In 2009, the UK Commons Select Committee on Science and Technology published the report of its enquiry into how government uses engineering advice and expertise in policy, *Engineering: turning ideas into reality*. I, with other colleagues like Professor Julia King (then Principal of Imperial's Faculty of Engineering), gave oral evidence.

Since then there has been some noticeable progress. In December 2011, and after many months of indecision

in Brussels, the President of the Commission appointed the EU's first Chief Scientific Advisor, Professor Anne Glover. Considering that so much of the UK's technical legislation arises from implementing EU directives, it must be with some relief that the UK CSA system has at last a point of contact in Brussels. Nearer to home, the UK's Department for Energy and Climate Change has been the first central department to advertise for a Head of Engineering.

At the time of writing, the Committee on Science and Technology has also launched a short follow-up investigation to its original enquiry. Imperial's Faculty of Engineering has made a submission in which we recognise the top-level improvements that have taken place. We suggest that a wider use of short-term expert secondments, especially from academia, could provide a possible solution to enriching the back-room processes where key detailed decisions get made. UK universities potentially have much to offer.

These concerns may all sound rather geeky in a world of sound-bite politics, but the problem threatens to harm the heart of

a participatory democracy. It is hardly plausible to envisage a parliament able to assess engineering issues on its own. It relies on the knowledge of the executive. But if the executive no longer fully understands its engineering, the only certainties are the policy's cost, and that someone will benefit directly from charging for it. The outcome, for which the hapless taxpayer yearned, risks becoming totally indeterminate. This is not just a local British problem. Technical complexity is engulfing the participatory democracy the world over. Institutions like Imperial with its vast cohort of professional engineering alumni could prove an invaluable resource in preventing this from happening.

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## ➔ BITING BACK

Imperial's laboratories are home to tens of thousands of mosquitoes that are specially bred to help researchers understand and prevent the spread of devastating diseases.

**01 ❁ TAMING THE BEASTS** With over 300 million people affected by malaria every year and no immediate prospects of a vaccine, scientists keenly seek new ways to tackle this disease, which is transmitted by the bites of the female *Anopheles* mosquito. Around 50 Department of Life Sciences staff are dedicated to breeding mosquitoes and analysing their interactions with the malaria parasite *Plasmodium* in labs in the Sir Alexander Fleming Building. Mosquitoes are kept at a tropical 80 per cent humidity and 28°C, similar to conditions in their natural habitats in Africa, India and Asia.

**02 ❁ LIFE IN THE LAB** Mosquito eggs hatch in their hundreds in large white trays partially filled with salted water. Just one millimetre long, the swimming larvae feed on algae and bacteria, growing to eight millimetres in one week before forming a chrysalis and emerging as adults after another week. The flying insects are then transferred to meshed cages, like the one held here by Dr Dina Vlachou and Professor George Christophides, where they feed on infected animal or human blood sucked through a membrane that mimics real skin. Imperial's researchers are particularly interested in adult mosquitoes; research indicates the spread of malaria can be halted most effectively at this stage.

**03 ❁ FIGHTING FEVER** Imperial has long been at the forefront of efforts to halt malaria. Over a decade ago Professor Andrea Crisanti bred the first transgenic *Anopheles* mosquitoes. Now researchers aim to stop the disease by creating mosquitoes genetically immune to *Plasmodium*, blocking its transmission to humans, or suppressing the insect populations by creating sterile males. Their work is funded by the Wellcome Trust and Bill and Melinda Gates Foundation, among others. Professor Christophides coordinates a European Union-backed study in sub-Saharan Africa, where scientists are testing how malaria parasites and their mosquito carriers react to potential vaccines and drugs.



# CUTTING EDGE

**“AAAAH!”**  
 THE MAN LYING ON  
 THE TROLLEY BEFORE ME  
 MOANS AND WRITHES IN AGONY.

Technologies for training surgeons double up as essential props in public events that make a drama out of an operating theatre crisis.

WORDS BY  
**JESSICA HAMZELOU**

PHOTOGRAPHY BY  
**DAVE GUTTRIDGE**

He’s been rushed to hospital after being stabbed in the side, explains the surgeon, who lifts the man’s shirt to show me, along with a group of other curious individuals, the bleeding wound. There’s a thud as the woman standing beside me falls to the floor in a faint.

The man, we’re told, urgently needs surgery. He needs to be opened up so that doctors can check whether there’s been any damage to his internal organs, particularly his spleen. We’re warned that should the spleen detach, the blood vessel supporting it will be free to “hose around”.

Moments later, we’re asked to put on gowns and hats and we shuffle over to the operating table, where the patient’s insides are on display. The surgeon probes the slimy large intestine and invites us spectators to join him in having a poke around. As my finger slides up underneath the man’s liver, the peckish feeling I had earlier evaporates.

Welcome to the world of simulated surgery. Thankfully, the man is an actor and his convincing injury is merely an artistic prosthetic. The surgeons are real, as is the fainting member of the audience, but the injuries and internal organs subject to our prodding are not.

Roger Kneebone, new Professor of Surgical Education at Imperial, has developed these simulations to improve the training provided for surgeons. Now he is also using them to give members of the public, like myself, a flavour of what really goes on inside an operating theatre.

It certainly feels like a real operating theatre. Inside an igloo-like inflatable half-shell of a room, the dummy patient lies on a hospital bed, hooked up to a blood bag and an anaesthesia machine while his heart monitor continually beeps. Most of the body is covered by a blue sheet, but the bloody face and matted hair are so lifelike that they momentarily distract me from the surgeon’s description of his innards.

The prosthetic organs have been developed in collaboration with Max Campbell, the artist behind many of the medical models seen on hospital television drama *Holby City*. Creating fake organs for surgeons is more of a challenge though, as it’s vital that they feel as lifelike as they look.

The models also provide an opportunity for Roger’s team to engage public audiences with surgery more generally. “We want to raise public awareness of surgical training,” says Roger. “The truth is that people tend to have mixed feelings about surgery. It’s scary but it’s of great interest – people are repelled by it but they’re also fascinated.”



**1 / SURGEON OMAR FAIZ (L)** explains to the audience what he needs to do to treat the ‘stab victim’ who’s just been wheeled in.



**2 / VISITORS LEAN FORWARD TO SEE THE LIVER AND gall bladder that Professor Roger Kneebone bought from the butcher to show the similarity between some human and pig organs.**



**3 / THE PORTABLE INFLATABLE OPERATING THEATRE — affectionately known as the igloo — lends itself to both surgical training sessions and public events.**



**4 / WRITER JESSICA HAMZELOU DONS SCRUBS** for a hands-on encounter with a full set of vital organs in the abdomen of the dummy patient.





Surgical demonstrations can help clear up any questions that people might have about surgery. "It's important for a lot of young people who might be thinking of going into medical careers, and for people who hear about surgical procedures but don't know what they are. The events are also a great opportunity for us to learn from our potential patients, and refine our work accordingly."

“The gory nature of the events rules them out for the faint-hearted. We have processes in place to look after people who feel squeamish. At the same time, the occasional pair of weak knees helps confirm that things are genuinely convincing.”

Training with models and actors gives everyone a much better idea of what a real operation is like. "When I came to Imperial 10 years ago, surgical skills were taught with an emphasis on the technical," says Roger. He recalls that while students were honing their stitching skills, it was only on pieces of latex. "It doesn't give you an idea of what it's like to treat someone who has been stabbed, had a few drinks, or just come off their bicycle," he says.

This is where the actors come in. "Having a real person there gives the clinician a sense of urgency," Roger says. "You need to be able to respond to people who are very anxious and very sick."

The 'theatre' has been put together by a team of surgeons, psychologists, designers and industrial engineers Matt Harrison (MEng Mechanical Engineering 2002) and Cian Plumbe (DIC Mechanical Engineering 2004). While the overall impression is that of being at the heart of a surgical procedure, a second glance at the backdrop reveals that the trolley of surgical equipment is actually a poster, and that the heart monitor consists of two iPads mounted on a wheeled cabinet. The fact is that when your nose is centimetres away from a bleeding spleen, the background details lurking in your peripheral vision don't have to be quite as realistic.

As a result, the entire set-up can be put together quickly and cheaply, and can even be carried around in a few backpacks. Members of Roger's team have just started taking their portable simulation set-up to hospitals around London to train surgeons from other places as well as Imperial, by giving them the chance to experience a simulation.

Installing the surgical set-up at public venues is a more recent line of work for Roger and his team. At one event, the group put together a simulation at Imperial's Reach Out Lab, for London schoolchildren who had been affected by knife crime. "All the children knew someone who had been involved in a knife attack, but they had no idea of what happened once the injured person had been taken off in an ambulance," says Roger. "It was the perfect way for them to find out."

So far, Roger's team has put on simulations for young and adult audiences at London venues including the Wellcome Collection, the Natural History Museum and the Science Museum, as well as the Cheltenham Science Festival.

It must be stressed, though, that the gory nature of the events rules them out for the faint-hearted. "We have processes in place to look after people who feel squeamish," says Roger. "At the same time, the occasional pair of weak knees helps confirm that things are genuinely convincing."

Even the surgeons can get caught up in the realistic situations. When the group ran a simulation of a trauma scenario in which a man had been hit by a lorry, the clinician got so carried away that he pulled out his scissors and cut off the actor's trousers, T-shirt and even his underpants, much to the actor's surprise.

Roger and his colleagues are now turning their attention to finding realistic ways of simulating other medical procedures for trainee doctors, such as mimicking the feeling of internal assessments by using haptic technology to develop devices that give the user tactile feedback.

Internal assessments, of the vagina or rectum, for example, are tricky to teach. "The student can't see what they're doing and neither can the teacher," says Roger. With the device he's currently working on, the student would be faced with an actor lying on a bed but, instead of sticking their finger in the actor's bottom, they would place it in a cradle connected to a computer. "When you put your finger into the 'anus', it feels realistic and, while you're doing that, you still have to respond to a real, wincing person," says Roger.

Meanwhile, there are plenty of real, wincing members of the public recovering from their close-up encounters with the medical drama they have just witnessed. When the actor comes back on stage at the end of the performance, I am impressed with the long, red signature of his 'emergency surgery' that's been artfully painted down his belly in place of the original bleeding wound. While the surgeons remove their masks to take questions from the audience, the rest of the team roll up their sleeves to clear away the splattered blood in time for the next performance.

JESSICA HAMZELOU was taking part in the Pop-up Anatomy Lesson, produced at Wellcome Collection by the Clod Ensemble as part of their Performing Medicine Anatomy Session. You can hear more about Professor Kneebone's work at his inaugural lecture on 23 May 2012 at Imperial's South Kensington Campus, and on iTunesU shortly after.



PHOTOGRAPHY: DAVE GUTTRIDGE/THE PHOTOGRAPHIC UNIT

**HUNCHED INTENTLY OVER A LAPTOP IN THE LIBRARY,** Dr Michael Bearpark might be shuffling his lecture slide set, determining the structure of biomolecules or laying down a new track for his electronic duo to perform at the weekend. "Musical harmony is a type of chemistry and lecturing is more of a performance than a lesson," comments Mike, a Reader in the Department of Chemistry, referring to his work teaching first and third year undergraduates about computational chemistry.

Darkroom was formed in 1996, and is Mike on guitar and Andrew Ostler on synthesiser and laptop. "We take conventional band elements like my guitar playing and put them together in an unusual way," he says, describing their sound. "We treat each instrument like a sample; we loop it, then overlay it with improvisation." The duo has released eight albums with science-inspired names such as *Some Of These Numbers Mean Something*. Their improvised gigs attract anything from one to 100 people. Mike says he'll never get tired of the feeling when a gig or a lecture goes well. "When all the ingredients come together and you get a good reaction from the crowd, there's a real sense that you have discovered something," he says. "In both situations there is always the hope that you are inspiring people."





ALUMNI RECEPTIONS

1 / Val Nagle, Dr C. Farmer and Victor Nagle (Chemical Engineering 1963) mingle with more than 90 of Imperial's 1,000 Canadian alumni at a drinks reception in Toronto.

2 / The Rector, Sir Keith O'Nions and his wife, Lady Rita, meet Chandra Gupta and Professor Syamal Gupta FIC (Mechanical Engineering 1963, MPhil 1986) at the alumni reception in Mumbai.

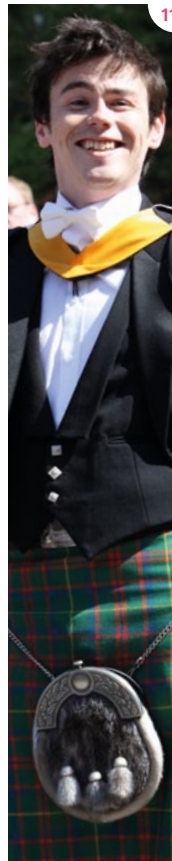
3 / The first class buffet dinner on the menu at the alumni reception in Kolkata in the garden of Rajive Kaul (Metallurgy 1971), President of the Imperial College Alumni Association of India.

4 / Ivy Pan (Mathematics 1989), and Dr Shir-Ming Shen (MSc Mathematics 1979) join over 130 other guests at the alumni reception in Hong Kong.

5 / Dr Daniel Friess (Agricultural Science 2004), Jennifer Morris (Earth Science and Engineering 2001) and Carolina Lee enjoy a drink with the Rector at a reception in Singapore attended by alumni with graduation dates spanning more than half a century.

6 / Victoria Monjo and Wilfried Laufs (Civil Engineering 1994) attend the New York alumni reception at the British Consulate-General with over 100 other guests, making it the largest ever Imperial alumni event held in the region.

7 / Datin Siew Ka Mun, Alicia Chong and Mrs Al-Manaf (Aeronautics 1994) join over 170 alumni and guests at a reception at the British High Commissioner's Residence in Kuala Lumpur.



11 / A kilted MSc science graduate at the 2011 Postgraduate Awards Ceremonies.

12 / Master's graduates from the Business School celebrate their graduation in front of the Royal Albert Hall.

13 / A PhD graduate takes a ride on Imperial College Union's vintage fire engine, Jezebel, after the Postgraduate Awards Ceremonies.



8 / The Secretary of State for Culture, Olympics, Media and Sport, Jeremy Hunt, tours the Business School with Professor David Gann to announce the government's £362 million investment to roll out superfast broadband across the UK, focusing on the challenge of creating ultrafast mobile networks.



9 / The Rector shares a joke at the Natural History Museum as Imperial researchers take part in the Science Uncovered event.

10 / A future scientist plays with BioBricks on top of the giant *E. coli* from the 2011 iGEM team of student synthetic biologists.



14 / A group of Chemistry students, part of the graduating class of 1961, dressed for the outdoors on a geology field trip to Dartmoor.

15 / Fifty years later, donning lab coats again, they returned to the lecture theatre to celebrate their anniversary reunion. Some had travelled back to South Kensington from the USA, Canada and Israel to reunite with their old colleagues and tour the Department.



16 / Debbie and Graham Perry (Aeronautics 1965) join over 200 donors, alumni and friends, at a 2011 reception to thank those whose support has enabled Imperial to provide more philanthropically-funded scholarships than ever before.

17 / The Rector joins some of the 85 new Imperial scholars who have received scholarships funded by donations to the Rector's Scholarship Fund 2011-12.





# SAND TRAP

AN ANSWER TO GLOBAL WARMING MIGHT LIE IN THE ROCKY OUTCROPS OF THE DESERT IN OMAN. IMPERIAL MAGAZINE INTERVIEWS DR CEDRIC JOHN.



Cedric and his team from the Department of Earth Science and Engineering take frequent trips to the Middle East to investigate how depleted oil and gas reservoirs in the rock could be exploited for storing carbon dioxide underground. Their research is part of a 10-year collaboration with Qatar Petroleum and Shell.

➔ I'M A GEOLOGIST. I'M INTERESTED IN ROCKS, SO I TEND TO GO WHERE THE ROCKS ARE.

I go on about 10 trips a year, often to the Middle East as a large part of my activity is on Middle Eastern rocks that act as reservoirs for oil and gas.

We're trying to understand how carbonate rocks, like those that store oil and gas, were formed, so that we can predict their characteristics under the surface. These rocks are deep underground in Qatar, but in Oman they're at the surface where we can see them. They have tiny spaces inside, like a sponge, which can hold oil or gas. If you inject liquid carbon dioxide into them, that can also be trapped under the surface. We go to **field locations, we measure things, we collect rock samples**, [1] we bring those samples back to London and we look at them in thin sections under a microscope. The composition of the rocks tells us something about their history.

The most remote places take three or four hours of off-tarmac driving to get to. To reach some of the outcrops you have to walk for several hours, so they can be quite

long hikes but we always have GPS; we always tell the base team where we go and we never work alone, so we do take precautions.

Safety is obviously always important but when you work with an oil and gas company, they take that a step further. A logistics company provides 4x4s and they take care of everything. Their drivers are **very experienced at driving in the desert**. [2] We always have spare cars in case something happens. We have a lot of water. We have satellite phones so we're always in touch with the base. It's actually quite luxurious in one sense.

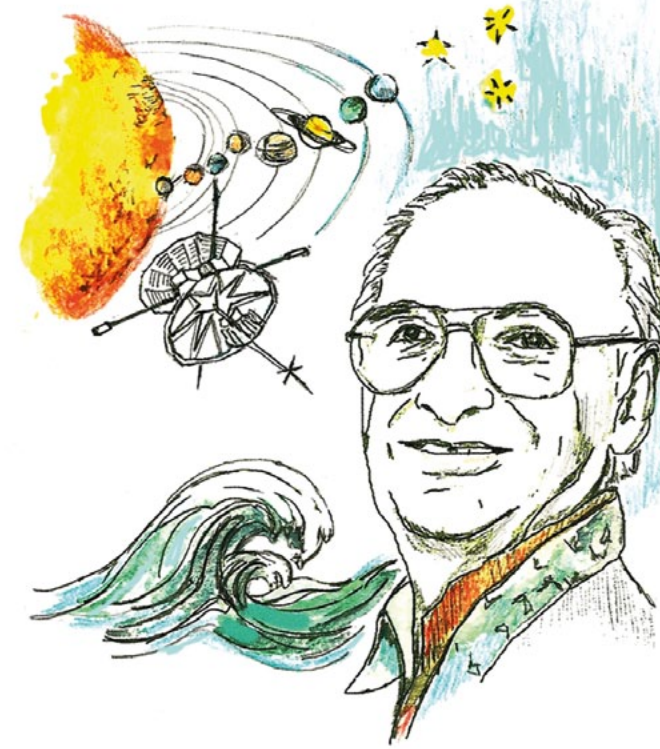
Camping is one of the pleasures of doing fieldwork. It can get very cold at night. In some locations we've had frost at night. Then you go to 40 degrees during the day so it can be quite uncomfortable, but in general it's not too bad. I go for a week or two weeks maximum but some of my PhD students have stayed for a month on location.

The food when we're camping is fantastic. We tend to put on weight rather than lose it while we're away. We have a lot of Indian food because the cooks are all from India, and also Middle Eastern

food. If there's one thing we're not lacking, it's food.

The only thing that's gone wrong was when we used to work in a wildlife reserve for **oryxes — Middle Eastern antelopes**. [3] We had permission to work there but the government of Oman decided to close the reserve while one of my students was there, so she had to stay with the logistics team. Luckily we were able to find a different region to focus on at short notice.

I think the Qatar Carbonates and Carbon Storage project will have a serious impact. First, it's a long-term effort, instead of being a piecemeal approach like some projects are, and it's integrating disciplines across engineering and geology. The other reason is because the state of Qatar is serious about doing carbon capture and storage. You can really tell that it's something that they have planned. They want to reduce the carbon footprint of Qatar and the biggest carbon footprint comes from the oil and gas industry. If they can actually capture carbon dioxide at the gas or oil well and reinject it, then they will manage to reduce that footprint.



## outwardBOUND

Earth's boundaries were no constraint for one Imperial alumnus. Escaping revolutionary turmoil and war in his early life, rocket engineer Robert Benzwi (DIC Mechanical Engineering 1945) worked on the first NASA missions to reveal the characteristics of other planets in the solar system.

Bob Benzwi, who died on 3 May 2011 aged 92, had a tasted for adventure even into his nineties. Wearing two or sometimes three swimming caps to keep warm, he liked a winter dip in the Pacific Ocean, especially in rough seas. As the oldest member of La Jolla Cove Swimming Club in California, Bob spent his autumn years swimming in chilly open waters. As a younger man space was the territory he explored, working on pioneering missions that went further from Earth than ever before.

Robert Benzwi was born Reuven Kossoy in Ukraine in 1919. The country was still in the grip of chaos following the Russian revolution and, when he was three weeks old, his family fled to Istanbul. There Bob grew into a talented student, picking up mathematics and languages with particular ease. He continued his studies in Haifa in the Middle East, where he was inspired by the activist

Yitzhak Ben-Zvi, another Jewish émigré from the fallen Russian Empire who went on to become the second leader of Israel. Bob adopted a form of his surname.

Pursuing his flair for mathematics Bob studied civil engineering in France, but his time there was interrupted dramatically by the outbreak of the Second World War and the subsequent Nazi invasion. He fled from mainland Europe aboard a Dutch ship bound for the United Kingdom, becoming once again a refugee.

Initially he focused on using his engineering expertise on the war effort, repairing equipment damaged by bombs. He later took a postgraduate degree in aeronautics at Imperial, joining other academic refugees from across Europe for whom the College provided a safe haven during the war.

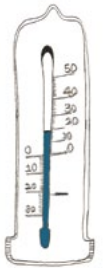
On graduating in 1945, Bob designed aircraft parts for the Bristol Aeroplane Company before moving to the United States in 1948. After his marriage he became a US citizen, able to follow career paths previously closed to him. He joined the General Dynamics Corporation, a specialist in the aerospace industry based in San Diego, working closely with the newly formed National Aeronautics and Space Administration (NASA).

Bob Benzwi's engineering skills helped unmanned missions to break new ground. As a member of the teams working on the Mariner and Pioneer missions, he designed crucial parts of the space vehicles that revealed craters on Mars, took measurements on Jupiter and made the first direct observations of Saturn. Emeritus Professor Andre Balogh (MSc Physics 1966) from Imperial's Department of Physics described the 1960s as an era that produced groundbreaking space missions in an amazingly short time. "Those were years when everything was still there to be discovered from space; they were exciting and fast-moving," he said.

Bob later led the Helios programme of the 1970s and 1980s, sending probes close to the sun, which, according to Balogh, provided observations so unique that our knowledge of how the Sun shapes the interplanetary medium still depends on the data gathered. "Robert Benzwi and his generation of space scientists and engineers have left a very solid inheritance," he said.

In retirement Bob frequently visited family in Asia and Europe, but was always pulled towards home and the delicious La Jolla Cove where he learnt to swim. He took up painting and in a spree lasting several years produced landscapes that covered his front room. "He would get excited about things and just take off," said his friend, Bob West. Bob's eagerness to gain new knowledge and skills was a lifelong trait that earned him a place in the history of space discovery and a firm fan base among La Jolla swimmers.

FACTOIDS



11°–22° C

Range of temperature of the Pacific Ocean at La Jolla Cove, California, where Bob swam daily.

"In the winter, it feels like it's full of ice cubes."

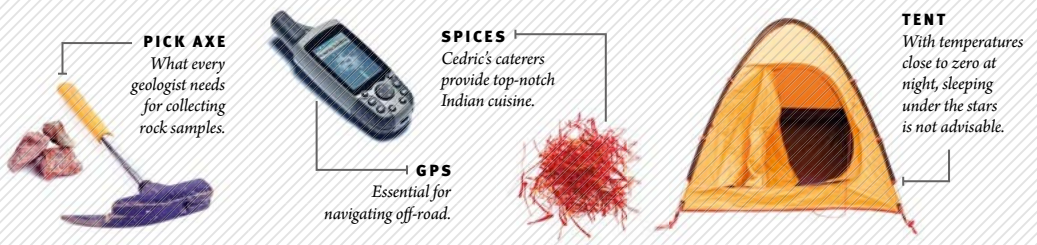


Ukraine → Turkey → Palestine → France → England → USA

Bob's émigré path began at three weeks old with an escape from Ukraine.

WHAT'S PACKED?

2 WEEKS. 7,000 MILES. NECESSITIES FOR LIFE IN THE DESERT.



PHOTOGRAPHY: (ROCKS) CLAIRE NUJMES HARRINGTON SEMA ILLUSTRATIONS: DONNA MCKENZIE





## Breaking the mould

In science the dead-end finding can be as important as the ‘Eureka!’ moment, as penicillin pioneer Ronald Bentley (PhD Chemistry 1945) found during his early studies of the drug.

Dr Ronald Bentley, who died on 6 June 2011 aged 89, was equally at home in the kitchen as he was in the lab. Away from research, he foraged for his favourite cooking ingredient – mushrooms – in nearby woods or on the local golf course. His baking was renowned, not only for the results from the oven, but also for the biochemistry lessons that he gave his family as the yeast got to work.

Ronald’s fascination with fungi arose when pursuing a doctorate at Imperial. Ineligible on health grounds for military conscription during the Second World War, he served the war effort by researching the production of penicillin.

After studies at Derby Technical College, he joined Imperial’s Department of Chemistry in 1943, 15 years after Alexander Fleming’s discovery of penicillin in a laboratory in St Mary’s Hospital. Progress in applying it to kill pathogenic bacteria in the human body had stalled in subsequent years.

As Ronald began his investigations, war had made research efforts in the field more urgent. Contributing to a project involving 1,000 scientists in the United Kingdom and the United

States, he looked for a way to chemically synthesise the new antibiotic, a method that was then assumed necessary for mass production. However, all attempts to chemically engineer penicillin failed.

This defeat marked a turning point in drug discovery history. Scientists had revealed that the microorganisms present in mould were essential to the

production of penicillin and that chemistry principles could not recreate this natural process. As Ronald himself observed on a blog in 2008, the early 1940s marked the start of the antibiotic revolution leading to the successful control of many previously intractable infectious diseases.

Doc B, as Ronald was known to colleagues and students, devoted his career to deciphering how bacteria and fungi biosynthesise natural products, publishing over 200 papers in research roles at Colombia University and the University of Pittsburgh in the United States. He was proud of the education he had received at Imperial and remained a generous donor to the College 60 years after his own graduation.

THIS DEFEAT MARKED A TURNING POINT IN DRUG DISCOVERY HISTORY... THE EARLY 1940S MARKED THE START OF THE ANTIBIOTIC REVOLUTION.

## In memoriam

Imperial College London regrets to announce the deaths of the following alumni, students, staff and former staff, who were members of the College, the constituent medical schools or Wye College.

The list has been compiled from information received since issue 36 of *Imperial* went to press in May 2011. Alumni are listed according to their year of graduation. Where an alumnus has obtained more than one degree from the College, they are listed according to the graduation year of their first degree.

An asterisk (\*) indicates that an obituary is available online at [www.imperial.ac.uk/alumni/obituaries](http://www.imperial.ac.uk/alumni/obituaries). To share news of a death, please email [alumni@imperial.ac.uk](mailto:alumni@imperial.ac.uk).

### 1940s

#### Mr Montague Alfred (Mathematics and Mechanics 1944)\*

From his role as head of the economics department at Courtauld’s, Monty joined the British Printing Corporation, where he was instrumental in the founding of Usborne Books. He went on to work for the civil service, first as chief executive of the Property Services Agency, and then as second permanent secretary at the Department of the Environment. Active in the community, he chaired both the south London and Kingston synagogues.



- Mr David W.T. Angwin (Mechanical Engineering and Motive Power 1948)
- Mr Robert Benzwi (Mechanical Engineering and Motive Power 1945)\*
- Professor Ronald Bentley (Chemistry 1945)\*
- Mr Ronald S. Bradshaw (Electrical Engineering 1948)
- Dr Derek H. Isaac (St Mary’s Hospital Medical School 1946)
- Mr Kenneth W.G. Clack (Mechanical Engineering and Motive Power 1947)
- Dr John (Jack) C. Chapman (Civil and Environmental Engineering 1942, PhD 1948)\*
- Dr James A.W. Dalziel (Chemistry 1949, PhD 1957)
- Dr John N. Carlyle Cooke OBE (St Mary’s Hospital Medical School 1945)
- Dr Roger D. De Vere (Charing Cross and Westminster Medical School 1945)
- Dr H.J. Groves (St Mary’s Hospital Medical School 1947)
- Mr Brian E. Hopkinson (Electrical Engineering 1940)
- Mr Leonard L. Martin (Mechanical Engineering 1948)
- Dr G.D.W. Mckendrick (St Mary’s Hospital Medical School 1943)
- Dr Gareth Mitford-Barberton (St Mary’s Hospital Medical School 1949)
- Mr William Page (Botany 1949)

- Dr Robert J. Rabett (St Mary’s Hospital Medical School 1945)
- Mr Richard J. Syrett (Mechanical Engineering and Motive Power 1946, DIC 1947)
- Mr Herbert J.R. Thorne (Chemical Engineering and applied Chemistry 1946)
- Mr William H. Tinker (Mining 1947)
- Mr John W. Vernon (Chemistry 1944)
- Mrs Netta Waller (Wye College 1940)
- Dr Alan A. Ware (Physics 1944, PhD 1949)
- Dr David J. Weeks (Mechanical Engineering and Motive Power 1946, PhD 1954)
- Dr Eugene Wolf (Charing Cross and Westminster Medical School 1943)

### 1950s

- Mr James Armstrong (Civil Engineering 1957)

#### Mr George Band OBE (Geology DIC 1958)\*

The youngest member of the 1953 British Everest expedition which put Hillary and Tenzing on the summit, George was responsible for the radio equipment and food, and helped establish the route through the Khumbu Icefall and up the 3,700-foot Lhotse Face. He was the first to ascend Kanchenjunga, the third highest peak, and climbed all over the world through his work in oil exploration.



- Dr Colin R. Bayley (Chemistry 1955)
- Mr Ian C. Bell (Mechanical Engineering 1956)
- Dr Leslie Crystal (Charing Cross and Westminster Medical School 1950)
- Mr John H. Chapman (Wye College 1954)
- Dr David Eddie (Charing Cross and Westminster Medical School 1955)
- Professor James Lawrence Livesey (Mechanical Engineering DIC 1952)
- Dr John S. Bennett (St Mary’s Hospital Medical School 1953)
- Mr William B. Boland (Mathematics 1955)
- Mr Peter G. Davies (Electrical Engineering 1957)
- Mr Charles D. Easteal (Metallurgy 1952)
- Dr David A.S. Eddie (Westminster Hospital Medical School 1955)
- Mr Paul Chipman Farish (Mechanical Engineering 1950)
- Professor David Grahame-Smith (St Mary’s Hospital Medical School 1956)
- Mr Michael C. Hall (Civil Engineering 1959)
- Mr Norman A. Hancock (Botany 1952)
- Dr George C.B. Hawes (St Mary’s Hospital Medical School 1955)
- Mr Anthony D. Hoadley (Civil Engineering 1956)
- Mr Anthony C. Holder (Chemistry 1952)
- Mr Lancelot Laycock (Mining 1955)
- Mr Brendan G. McKeown OBE (Geology 1956)

- Mr David H. Richardson (Chemical Engineering 1958)
- Dr Leslie Richards (St Mary’s Hospital Medical School 1945)
- Dr Cyril J. Stephens (Charing Cross and Westminster Medical School 1953)
- Dato Foo Sun Lau (Civil Engineering 1952)
- Dr Denis Charles Mayr (Charing Cross Hospital Medical School 1952)
- Mr Harry Rook (Civil Engineering 1957)

#### Count Andrzej (Andrew) Skarbek (St Mary’s Hospital Medical School 1954)\*

Following a complicated escape from Russian-occupied Poland, Andrzej arrived in England on a troop train in 1946. Wartime trauma, coupled with work alongside renowned psychoanalyst Donald Winnicott, led him to specialise in psychiatry and he is credited with helping to develop NHS psychotherapy services. His work included applied psycholinguistics, the effect of drugs on speech, and speech therapy for children with language difficulties.



- Mr Peter M. Turner (Civil Engineering and Surveying 1950)
- Dr Basil J. Wakefield (Chemistry 1955, PhD 1958)
- Mr John A. Wheatcroft (Mechanical Engineering 1958)

### 1960s

- Mr Richard C. Beckwith (Electrical Engineering 1968)
- Mr Ivan Burgess (Electrical Engineering 1967)
- Mr Brian R.M. Collins (Mining 1960)
- Mr Anthony J. Fairweather (Aeronautics 1961)
- Mr Milon Ghose (Civil Engineering 1967)
- Professor Gordon W. Kirby (Chemistry PhD 1960)
- Dr Victor J.M. Hickman (St Mary’s Hospital Medical School 1961)
- Dr Edward H Penry (St Mary’s Hospital Medical School 1967)
- Mr John A. Reason (Electrical Engineering 1961)\*
- Dr John Klaschka (Chemical Engineering 1962, PhD 1966)
- The Hon. Neil Turner OBE (Wye College 1967)
- Dr Anthony K. Waters (St Mary’s Hospital Medical School 1968)
- Mr John G. Wilkinson (Physics 1960)
- Mr John Williams (Mechanical Engineering 1962)
- Mr George Wray (Chemical Engineering 1964)

### 1970s

- Mr Roger S. Barnett (Mathematics 1970)
- Dr Juliusz Borysowski (Chemical Engineering 1972)

- Dr John Ferguson (Geology 1970)
- Dr Gertrude L. Blamires (St Mary’s Hospital Medical School 1975)
- Dr Peta D. Buchanan (History of Science and Technology 1970, PhD 1977)
- Mr Christopher G. Cadwell (Physics 1972, DIC 1973)
- Mr Alan Harwood (Mathematics 1970)
- Dr Warren H. Redding (Charing Cross and Westminster Medical School 1976)\*

### 1980s

- Dr Nigel Peter Botting (Chemistry 1983, PhD 1986)
- Dr Sigrun Tollerton, née Eriksen (Chemistry 1984, PhD 1987)

### 1990s

- Mr Peter Calderbank (Mineral Resources Engineering 1990, DIC 1994)
- Mr Robert C.W. Cheung (Biochemistry 1993)
- Dr Milton H. Ward (Mineral Resources Engineering 1995)\*

### Students

- Mr Mir Balach (Environmental Policy)
- Mr Diego Garcia Florez (Physics)
- Mr David Williams (Medicine)

### Staff

- Miss Lorna Bottomley (Medicine)
- Professor Sasha Gogolin (Mathematics)
- Mr Peter Seal (Facilities Management and Property Services)

#### Professor Peter Richards (Medicine)



Medical scientist Peter Richards combined his expertise in neurosurgery and leprosy with a passion for training future doctors. As Dean of St Mary’s Hospital Medical School, Peter led the School into the 1988 merger with Imperial, becoming Pro Rector (Medicine) and bringing medics to work alongside engineers and scientists there for the first time. He went on to be President of Hughes Hall, Cambridge.

- Professor Chris Wastell (Medicine)

➔ To enquire about leaving a legacy to Imperial in your will, please contact Clare Dodds on +44 (0)20 7594 6132 or email [c.dodds@imperial.ac.uk](mailto:c.dodds@imperial.ac.uk)



# ALUMNI DISPATCHES

Lost the rhythm in Rio? Failing to savour every bite of the Big Apple? Imperial's international alumni associations will help you find our community wherever in the world you might be – get in touch and they'll be pleased to welcome you.

## 01/ Relive your student days with a night out

**HONG KONG:** *Lan Kwai Fong* is not to be missed when it comes to nightlife. Don't be surprised if you find yourself in the middle of a street festival!

**SINGAPORE:** For the best view of sunset and aerial views of the city, head to the *Roof Garden at the Marina Bay Sands*. It's free admission if you're going up for a drink, but \$20 if you just want to admire the view (although apparently if you're persuasive enough, the guard will let you up for free...).

**BANGALORE:** It's unlikely that you'll meet a Bangalorean who doesn't recognise the name *Koshy's*. It's a rendezvous for people of all ages and walks of life engaged in debates, nostalgia and gossip – a great place to get a feel of Bangalore society.

**KAZAKHSTAN:** Try the national beverage, kumys, in *Almaty*, the former Kazakh capital located in the foothills of the Alatau mountains.

**RIO DE JANIERO:** During the day, *Agua de Coco* is delicious at any kiosk along the beaches of Copacabana, Ipanema, or Leblon. At night there are many activities in Lapa – musical programmes for lovers of samba, bossa nova or chorinho, as well as jazz and other types of music.

**NEW YORK:** The *20th floor penthouse at 230 Fifth Avenue* is an excellent place to have a cocktail or even a cuppa. It has no sign outside – very discreet. It's fairly pricey but the view of the Empire State Building is excellent. Alternatively, to be seen and to spot celebs, head to the meat packing district and hang at the bar at Pastis.

## 02/ Recover the next day with a bite to eat

**HONG KONG:** **DIM SUM** It's definitely worth a visit to the world's cheapest Michelin starred restaurant: Tim Ho Wan Dim Sum Specialist has turned from a small restaurant with no fame to a 'must-eat'. Choose a weekday afternoon to avoid the crowds. Also try Lin Heung Tea House, one of the oldest restaurants in Hong Kong: like many traditional restaurants, they only serve dim sum during the day. The decor may be simple, but the place is always packed.

**SINGAPORE:** **CHILLI CRAB** Try the seafood restaurants at the East Coast Seafood Centre: the more popular ones are Red House, Jumbo and Palm Beach. Order both a portion of chilli crab and black pepper crab and, of course, all crab is best digested with a cold Tiger beer.

**BANGALORE:** **DOSA** A popular eatery is MTR. Since 1924, this small restaurant has been making hot dosas for Bangaloreans. Everything is old world here: dhoti-clad waiters, the furniture and even the photographs.

**KAZAKHSTAN:** **BESHBARMUK** Too many to recommend but, wherever you go, do call in advance to request your preferred meat as beshbarmuk can be cooked with mutton, beef or horse.

**RIO DE JANIERO:** **FEIJOADA** Experts claim that the best is served on weekends at the Jockey Club in Gavea.

**NEW YORK:** **BURGER AND FRIES** Pete's Tavern – which claims to be the oldest tavern in New York established in 1864 – does a wonderful Kobe beef burger for \$18.

## 03/ The top insider tip from those in the know

**HONG KONG:** The *synchronised light show* held every night by skyscrapers on both sides of Victoria Harbour – best viewed from The Peak.

**SINGAPORE:** Explore the *Arab Street area* and try Peranakan food, a fusion of Chinese and Malay, which uses lots of fragrant spices and is found only in Singapore, Malacca and Penang.

**BANGALORE:** **Gangarams** on MG Road. This bookstore caters to all genres and licensing agreements ensure that almost all books cost a fraction

of western prices. Stop in and pick up a phrasebook in the local language of Kannada and learn to say "Namaskara". **KAZAKHSTAN:** Kazakhstan is vast and difficult to experience all at once. Take a dip into the country and visit *Astana* with its breathtaking architecture. Climatologically, Astana is the second coldest capital in the world, but the locals will welcome you warmly.

**RIO DE JANIERO:** More adventurous visitors should try climbing the *Pico de Tijuca*, the highest point in Rio: it's a 50-minute hike from the foot of the mountain. Another adventure would be to go up the *Complexo de Alemão*, one of the famous Favelas, by cable car. The view from the top is absolutely breathtaking.

**NEW YORK:** A visit to the *Highline* is a must: this one-mile (1.6 km) park in the clouds is on the old rail tracks and has exhibitions, performances, and video programmes by artists who live in NYC.

**WITH THANKS** for contributions from alumni associations in Brazil, Hong Kong, India (Bangalore chapter), Kazakhstan, New York and Singapore.

→ Find out more about alumni groups at Imperial: [www.imperial.ac.uk/alumni/alumni/groups/atozofallgroups](http://www.imperial.ac.uk/alumni/alumni/groups/atozofallgroups)  
→ Contact us if you'd like to be profiled in the next issue: [imperialmagazine@imperial.ac.uk](mailto:imperialmagazine@imperial.ac.uk)



**QUESTIONS?** Alumni membership is free. Contact us for help with issues concerning membership or services.

Email: [alumni@imperial.ac.uk](mailto:alumni@imperial.ac.uk)

Phone: +44 (0)20 7594 6138

Post: Alumni Office, Imperial College London, SALC Mezzanine, Level 5 Sheffield Building, South Kensington Campus, London SW7 2AZ, UK

Web: [www.imperial.ac.uk/alumni](http://www.imperial.ac.uk/alumni)

# calendar

EVENTS + MEETINGS + OCCASIONS

1 MAY →

## PETER LINDSAY MEMORIAL LECTURE Exploring physics moments after the Big Bang

Join Imperial professor and CERN physicist Jim Virdee in the hunt for the elusive Higgs boson.  
[bit.ly/2012PeterLindsay](http://bit.ly/2012PeterLindsay)  
South Kensington Campus, London



3 MAY →

## PUBLIC LECTURE Athena Lecture

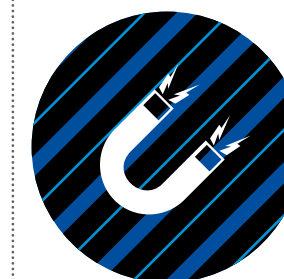
Manchester Vice-Chancellor Professor Dame Nancy Rothwell offers insights into her career as a neuroscientist.  
[bit.ly/2012Athena](http://bit.ly/2012Athena)  
South Kensington Campus, London



← 9 MAY

## GRADUATION Postgraduate Graduation Ceremonies

Postgraduates celebrate their achievements and make their way into the world as Imperial alumni.  
[www.imperial.ac.uk/graduation](http://www.imperial.ac.uk/graduation)  
Royal Albert Hall, London



← 11-12 MAY

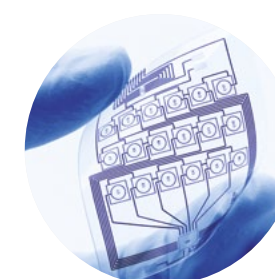
## COME AND VISIT Imperial Festival

Two-day College celebration open to students, staff and members of the public, incorporating the alumni reunion.  
[www.imperial.ac.uk/festival](http://www.imperial.ac.uk/festival)  
South Kensington Campus, London

15 MAY →

## FRIENDS OF IMPERIAL LECTURE Plastic electronics: the coming revolution

Monthly Friends of Imperial Lecture to be given by the Pro-Rector (Research), Professor Donal Bradley.  
[www.friendsofimperial.org.uk](http://www.friendsofimperial.org.uk)  
South Kensington Campus, London



23 MAY →

## INAUGURAL LECTURE Meet our new professors

Professor Roger Kneebone explains how surgical simulation can show doctors how it feels to be the patient.  
[www.imperial.ac.uk/events/inaugurals](http://www.imperial.ac.uk/events/inaugurals)  
South Kensington Campus, London



← 13 JUNE

## SUPPORT THE COLLEGE Legacy Lunch

Alumni considering leaving a donation to Imperial in their will are invited to come and find out more.  
[www.imperial.ac.uk/events/legacylunch](http://www.imperial.ac.uk/events/legacylunch)  
South Kensington Campus, London



← 21-23 JUNE

## MUSIC FESTIVAL Supersonix

Exhibition Road's institutions host a conference on the art and science of sound, culminating in Music Day.  
[www.exhibitionroad.com/supersonix](http://www.exhibitionroad.com/supersonix)  
South Kensington, London

28 JUNE →

## COME AND VISIT Open Day

Prospective undergraduates and their parents are invited to visit Imperial and discover what it's really like to study here.  
[www.imperial.ac.uk/visit](http://www.imperial.ac.uk/visit)  
South Kensington Campus, London



6 JULY →

## ON THE ROAD Hong Kong alumni dinner

Alumni in Hong Kong celebrate the 30th anniversary of their association.  
[www.imperial.ac.uk/alumni/hongkong](http://www.imperial.ac.uk/alumni/hongkong)  
Hong Kong



PHOTOGRAPHY: (CERN) STFC/IMPERIAL COLLEGE LONDON; GRADUATION: JODY KINGZETT

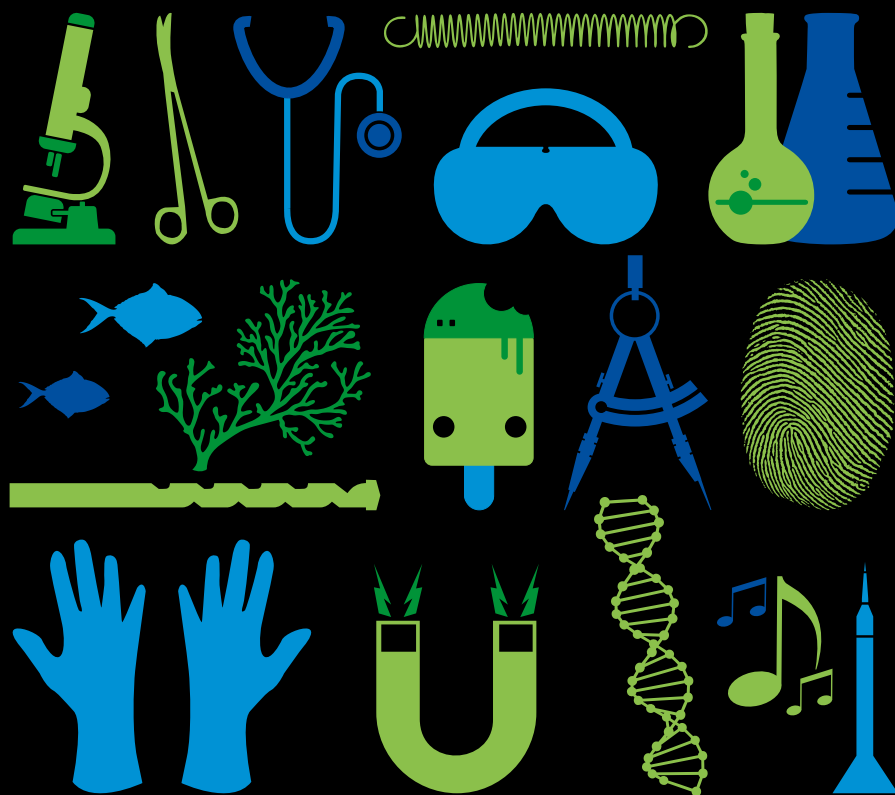
For more details on Imperial College events, visit: [www.imperial.ac.uk/events](http://www.imperial.ac.uk/events)

Sign up and receive the e-Bulletin every fortnight by emailing: [imperial-events-join@imperial.ac.uk](mailto:imperial-events-join@imperial.ac.uk)



# IMPERIAL FESTIVAL

11  
MAY  
+  
12  
MAY



**Spark something different** → From forensics to robots, artwork to enterprise, come and explore the best on offer from Imperial staff and students today. Meet soapbox scientists, analyse your fingerprints, listen to the Imperial College Symphony Orchestra or try your hand at surgery.

**Saturday 12 May**

**10.30–19.00**

A special programme of events and networking opportunities for everyone who has ever studied at Imperial will be taking place alongside the Festival programme. Details and tickets:

[www.imperial.ac.uk/alumni/reunion](http://www.imperial.ac.uk/alumni/reunion)

**Alumni  
Reunion**

IMPERIAL COLLEGE LONDON • FREE + OPEN TO THE PUBLIC  SOUTH KENSINGTON

[www.imperial.ac.uk/festival](http://www.imperial.ac.uk/festival)