



UNIVERSITY OF
Southampton

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New Boundaries | Issue 13 | December 2011

Super-fast DNA testing

Speeding up medical diagnosis and crime scene investigation

Carbon-rich oceans

The effects of CO₂ on marine life

Helping people recover from stroke

New techniques for restoring touch and movement

Miracle metal

Copper takes on the superbugs

In this issue

Welcome to *New Boundaries*, the University of Southampton research magazine. In this issue, you will discover how our multidisciplinary collaborations are addressing some of the most challenging issues facing society today.

Southampton researchers from Chemistry and Medicine have created new super-fast DNA tests, with applications for both medical diagnosis and crime scene investigation. Find out more on page 4. As well as new diagnostic tools, our researchers from Health Sciences and Electronics and Computer Sciences are pioneering novel therapies to help people rehabilitate themselves after a stroke. Read more on page 16.

Superbugs are a major threat to public health: hospital-acquired infections alone affect seven million people each year worldwide. Southampton microbiologists, engineers and clinicians have discovered that copper surfaces could keep infection rates down and save thousands of lives every year. Find out more on page 22.

Moving from human health to the health of our oceans, this year a team of Southampton oceanographers, marine biologists and chemists led the largest ever experiment at sea to find out how increasing CO₂ levels in the atmosphere are affecting marine life. Find out more on page 10.

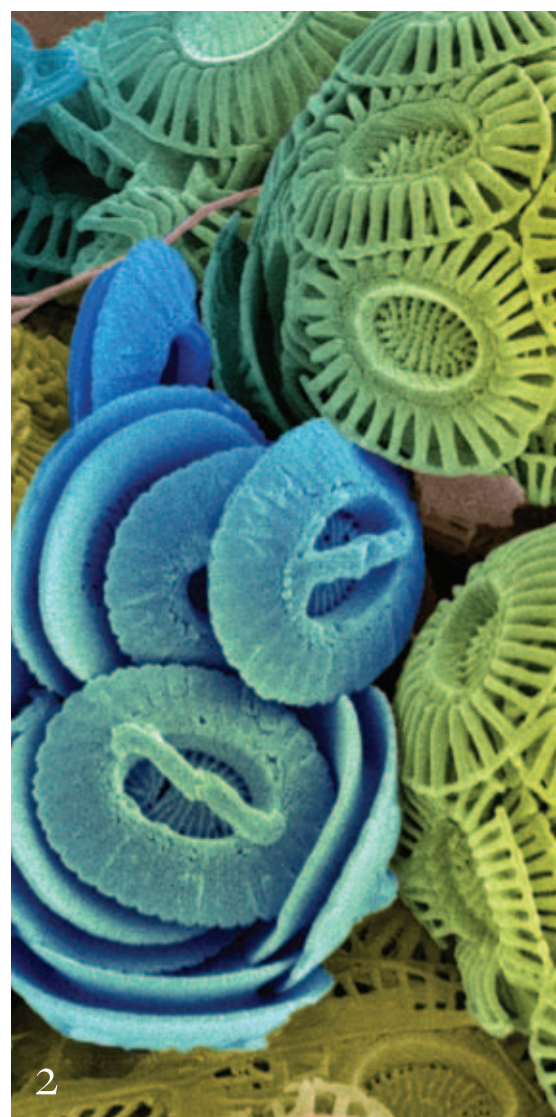
Intrinsically linked to environmental change is our growing population, and this year the number of people on Earth reached seven billion. Migration is one of the main drivers of population change and at Southampton our researchers are investigating its impacts to enable more informed policy making. Read more on page 26.

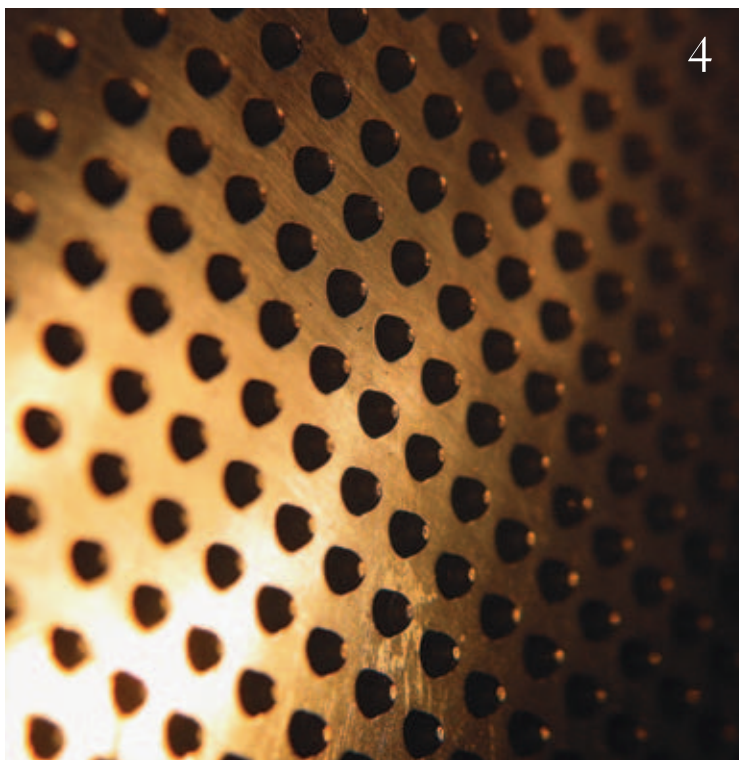
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Claire Macdonald
Editor, *New Boundaries*

Please send us your feedback

We are keen to receive any feedback you have about *New Boundaries*. If you have any comments or suggestions, please do send them to **newboundaries@southampton.ac.uk**





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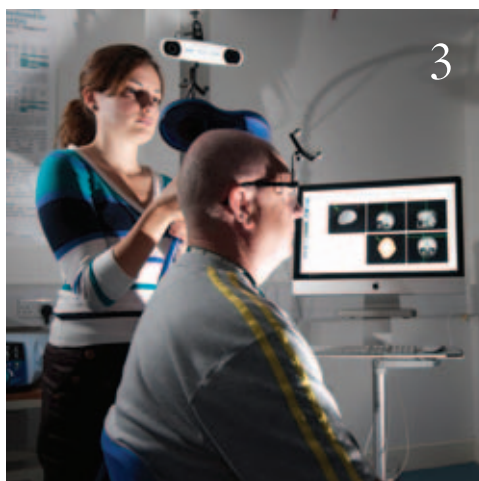
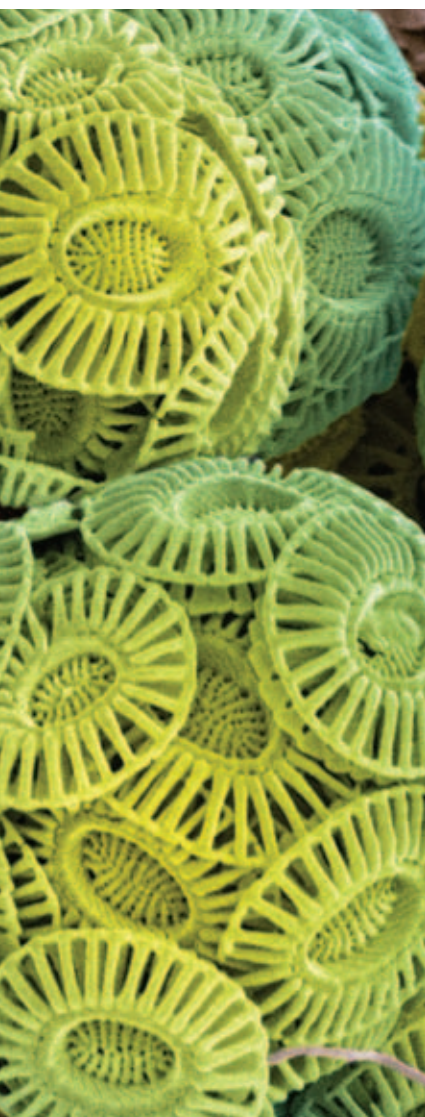
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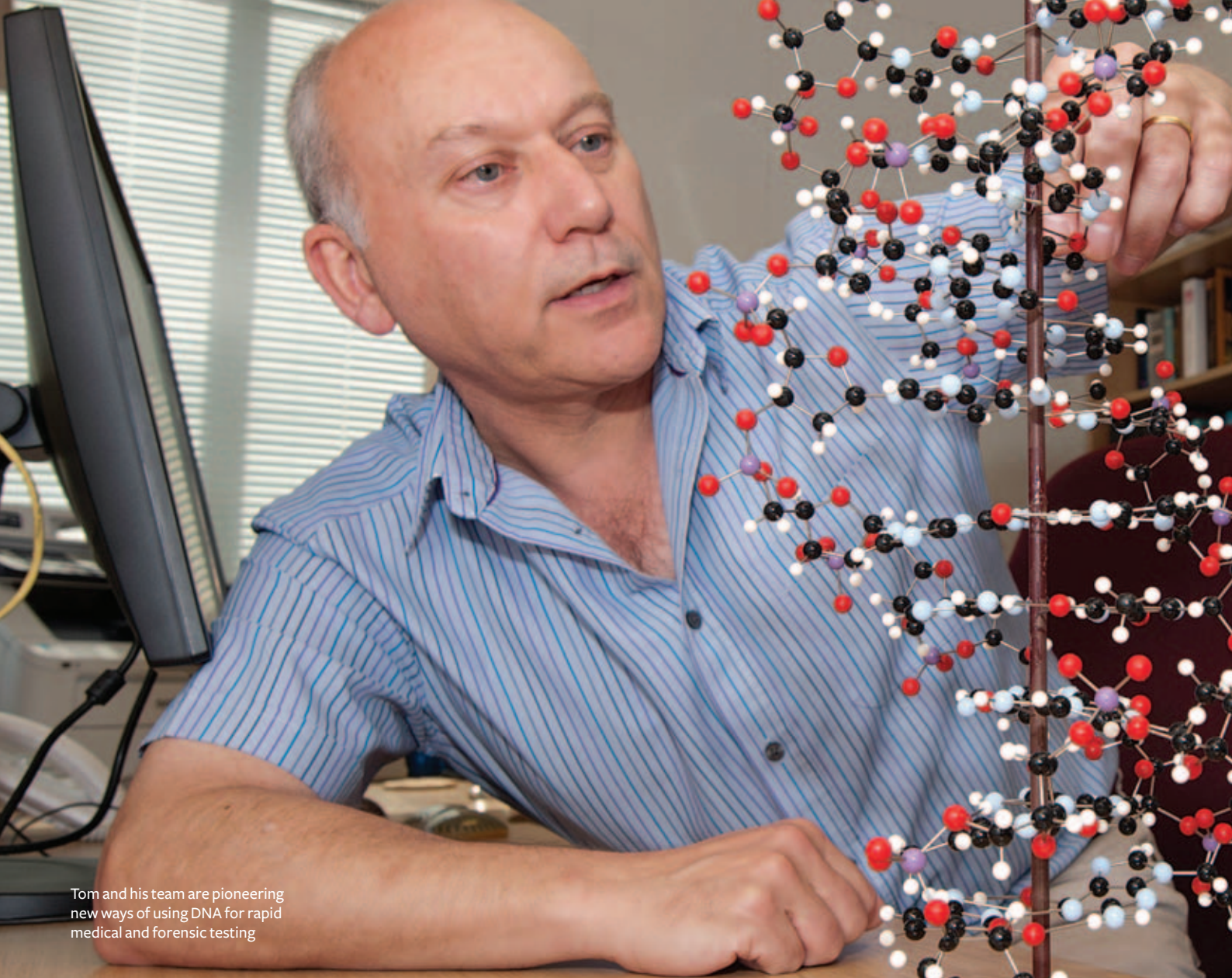


Super-fast DNA testing

Southampton researchers are developing an innovative technique for DNA testing that is paving the way to point-of-care tests for medical conditions and faster crime scene analysis.

“Previous studies have shown that up to 40 per cent of people diagnosed with chlamydia did not return for treatment, so it would be far better for diagnosis and treatment to occur at the same visit to a clinic.”

Ian Clarke,
Professor of Molecular Microbiology



Tom and his team are pioneering new ways of using DNA for rapid medical and forensic testing

“In theory you could diagnose any infectious or genetic disease by using HyBeacons on the DNA sequence of bacteria, viruses or people.”

Tom Brown,
Professor of Chemical Biology

The ability to diagnose disease and identify people from the DNA sequence of their genome has revolutionised medicine and forensic science. However, the time-consuming nature of this type of test causes problems when the results are needed quickly. Southampton researchers are leading the way in developing super-fast DNA tests.

In partnership with international analytical science company LGC, Southampton researchers have developed a new way of fluorescently labelling DNA with special probes, known as HyBeacons. “HyBeacons are like little balls of loosely screwed up string that uncoil easily and find their targets,” says project leader Tom Brown, Professor of Chemical Biology. The HyBeacons light up when they attach to a specific target sequence of DNA. Their advantage over existing systems is their very simple structure, which makes them more predictable: they bind faster to their targets and always work. “In theory you could diagnose any infectious

or genetic disease by using HyBeacons on the DNA sequence of bacteria, viruses or people,” says Tom.

Towards faster diagnosis

Tom’s team is currently developing a fast test for chlamydia, a common sexually transmitted infection (STI) that is becoming a big problem, particularly in the western world. Chlamydia can usually be treated with antibiotics – but only a quarter of women and half of men with the condition show any symptoms, so most people are unaware that they have the infection and so continue to spread it. If left untreated, chlamydia can lead to long-term painful infections in women that result in infertility. Ectopic pregnancy is a life-threatening condition that has also been linked to prior chlamydial infection.

Despite these serious complications, many patients who have tested positive for chlamydia don’t return for their results. “Previous studies have shown that up to 40



per cent of people diagnosed with chlamydia did not return for treatment,” says Ian Clarke, Professor of Molecular Microbiology at the University of Southampton. “This obviously increases the risk of passing on this infection, so it would be far better for diagnosis and treatment to occur at the same visit to a clinic.”

To address this issue, Southampton researchers led by Ian, in partnership with LGC and Optigene – a company that manufactures systems for analysing DNA – are designing a chlamydia test that aims to produce results within 15 minutes. Having secured £480,000 of funding from the Engineering and Physical Sciences Research Council (EPSRC) and the UK’s Technology Strategy Board, they are developing the new test using HyBeacons to detect the presence of the *Chlamydia* bacterium in urine samples. In the future doctors could use this type of test to diagnose several different bacterial infections from

one sample, which would be particularly useful for diagnosing STIs, as they often occur at the same time.

Personalised medicine

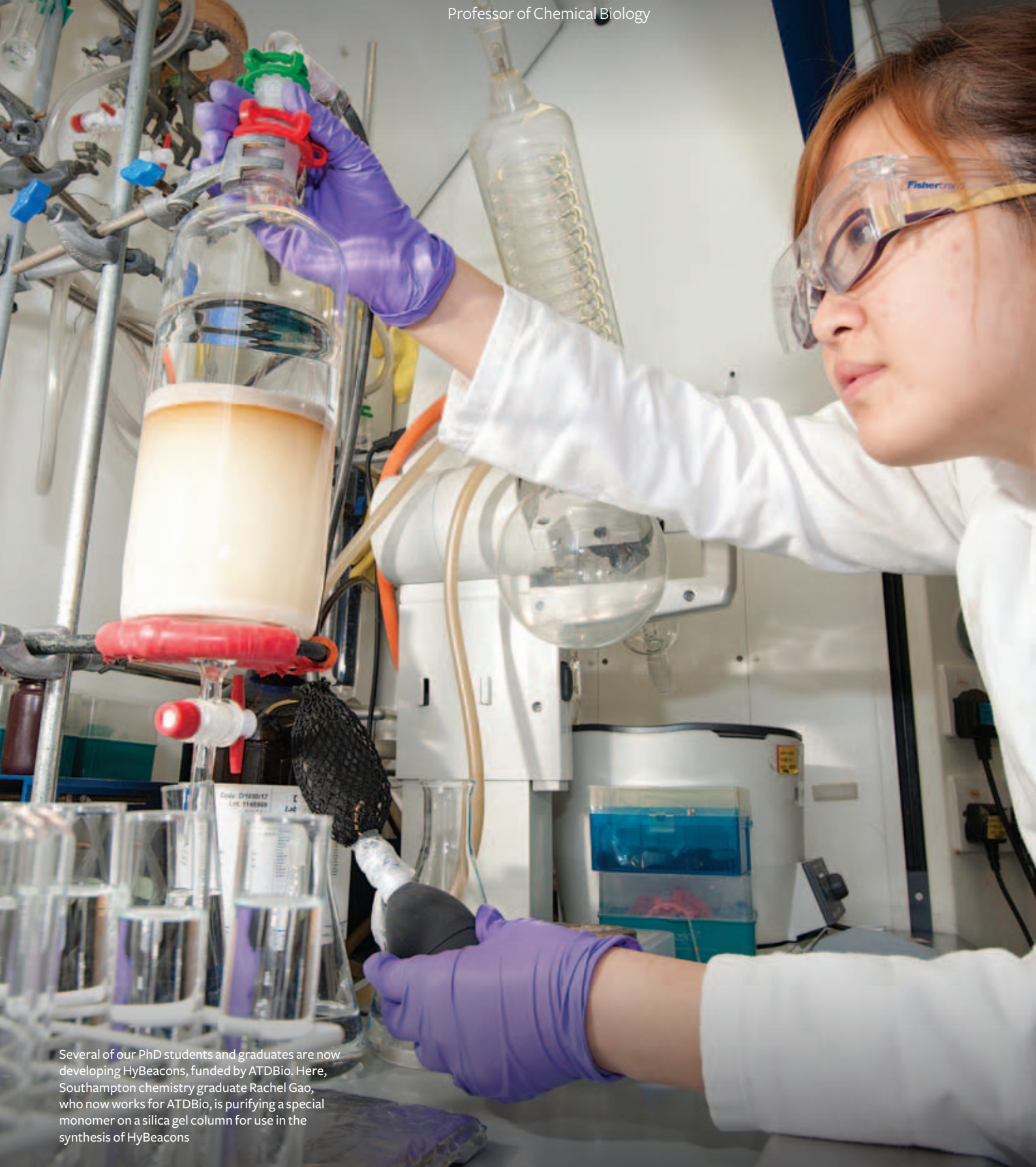
HyBeacons could also be valuable for accurately prescribing medicines. Many people who are susceptible to deep vein thrombosis (DVT) take warfarin to prevent their blood from clotting. The dosage of this drug needs to be tailored for each person; however, HyBeacons could make this process easier in the future. Using HyBeacons, doctors could use a person’s individual genetic make-up as part of the calculation and work out the dosage much more easily. HyBeacons could also have a role for testing a patient’s susceptibility to the side-effects of certain medicines, such as statins, the cholesterol-lowering drugs that are taken by around seven million people in England alone. Side effects of statins can be anything from cramp to kidney failure. If statins became available over the counter,

a 15-minute test that tells people whether they are likely to get any side effects would be crucial to helping them make an informed choice.

The University’s Nucleic Acid Research Group, led by Tom, made a groundbreaking advance in personalised medicine in the 1990s. In collaboration with AstraZeneca, they invented a novel real-time polymerase chain reaction (PCR) method, which copies a DNA sequence millions of times for rapid analysis. The method, known as Scorpion Technology, helps researchers identify mutations in a person’s genome. “Scorpion Primers enable treatment to be tailored to the genetic nature of the disease to ensure that the correct therapy is given,” says Tom. “If you can understand which drugs are going to work for which people, you can avoid unnecessary expense and stress, and if there is more than one possible drug, you can give them the right one. This could have a huge impact – prolonging life and saving money.” ▶

“One of the great things for me about doing research at Southampton is that we have such fantastic facilities. We have great students and a lot of collaborations across the University.”

Tom Brown,
Professor of Chemical Biology



Several of our PhD students and graduates are now developing HyBeacons, funded by ATDBio. Here, Southampton chemistry graduate Rachel Gao, who now works for ATDBio, is purifying a special monomer on a silica gel column for use in the synthesis of HyBeacons

Rapid crime scene analysis

We all have our own unique genetic ‘barcode,’ which is what forensic scientists use to identify people from traces left at a crime scene by comparing DNA samples with, for example, the UK’s National DNA Database. However, finding a ‘match’ from a DNA sample is a lengthy process and suspects often need to be released from custody before the results are ready. Now Southampton scientists and LGC are developing an ultra-rapid portable test that could be carried out by non-experts.

As a species we share more than 99 per cent of our DNA; some of the differences between us lie in the length of the DNA sequence between certain sections of our genome known as short tandem repeats (STRs). To create a genetic profile, forensic scientists take a sample of hair or saliva, extract the DNA and make multiple copies of the STRs at 11 key points in the human genome. To measure the length between the STRs, forensic scientists currently need to run the DNA strands through a polymer gel at a high voltage, which takes about a day and needs specialist equipment and expertise. HyBeacons could be the key to much faster tests. In the same way as for diagnostic tests, they bind to the DNA taken from a crime scene, producing a fluorescent glow. When the mixture is heated gradually, it stops glowing at a certain temperature, proportional to the length of the DNA strands. This so-called ‘melting temperature’ shows the type of STRs present and the exact length of the DNA strands between them, which can be compared to the DNA database in order to identify a suspect.

“This is particularly valuable if you want to very quickly determine if someone was present or absent at the scene of a crime,” says Tom. “If you have someone in a custody suite and you can only keep them for a certain length of time, you need a fast test to enable you to retain them for longer. If you combine this with the portable equipment, you can do this at the scene of the crime,” he explains.

This research is now in the commercial arena: LGC are hoping to commercialise the technique and they are working with ATDBio, a company based at the University of Southampton and co-founded by Tom, to make the probes. There are also several of our PhD students further developing HyBeacons at the University, funded by ATDBio.

The applications of HyBeacons don’t stop there; they could be used for a whole host of other areas, including paternity testing, making sure rare parrots have been bred legally in captivity rather than illegally imported from the wild, testing sheep for the prion disease scrapie and also for foot and mouth disease. “A portable test for scrapie and foot and mouth could become important at any time,” says Tom. “HyBeacons make it possible to test for these out in the field rather than taking samples back to the lab, which minimises the risk of spreading the infection,” he adds.

Building on strong foundations

Southampton’s Nucleic Acid Research Group has an impressive history of innovation, multidisciplinary working and enterprise. Tom founded the company Oswel Research Products, which synthesises chemically modified molecules such as DNA, and co-founded two spin-out companies, ATDBio and PrimerDesign. In 2008, in collaboration with PrimerDesign, Tom’s team produced the first H1N1 swine flu test kit, which was used in Mexico at the early stages of infection. The team has recently developed a novel technique for linking DNA strands together using chemical methods. Still in its early stages, this could eventually have implications in molecular biology and biotechnology. The team’s future plans include developing small molecules that interact with nucleic acids to switch off disease-causing genes – a big challenge because the human body is extremely adept at finding ways of adjusting to change.

“One of the great things for me about doing research at Southampton is that we have such fantastic facilities,” says Tom. “We have great students and a lot of collaborations across the University. With the development of the new Institute for Life Sciences, we are looking forward to being able to collaborate more and more across the disciplines.”

For more information, visit www.southampton.ac.uk/research

Key facts

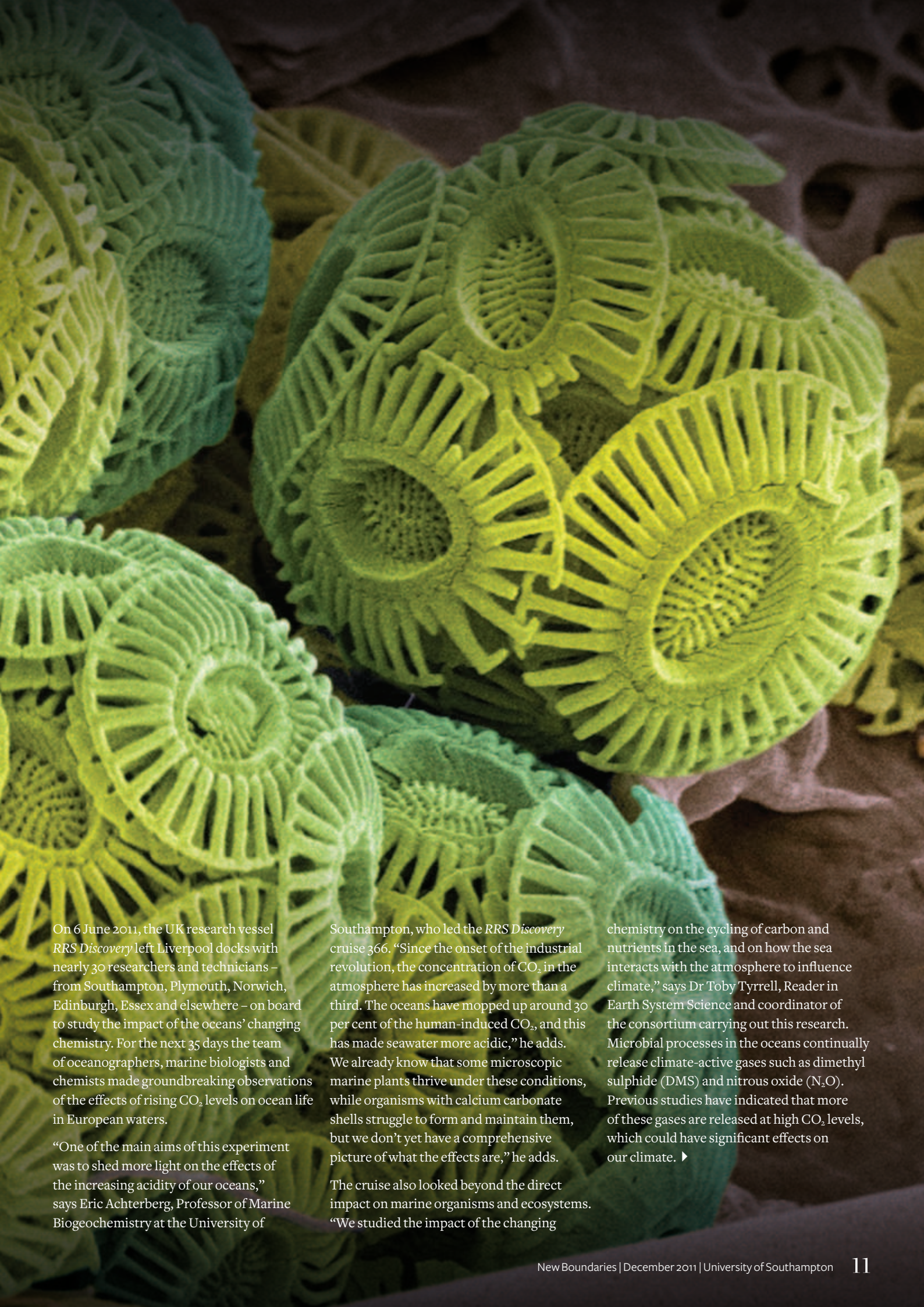
- As a species we share more than 99 per cent of our DNA.
- The Human Genome Project, completed in 2003, revealed that there are approximately 25,000 genes in our DNA. This is far fewer than was anticipated.
- Using forensic STR analysis, sections of the human genome can be converted into a ‘barcode’ that is unique for every individual.
- In theory clinicians could use HyBeacons to test for multiple infections, such as STIs, in one go.

A detailed scanning electron micrograph (SEM) of coccolithophores, which are tiny marine organisms. The image shows numerous circular, disc-like structures with intricate, radial patterns of calcification. Some structures are in sharp focus in the foreground, while others are blurred in the background, creating a sense of depth. The colors are a mix of blue, green, and yellow, likely due to the scanning process.

Carbon-rich oceans

The oceans absorb vast quantities of carbon dioxide (CO_2) every day, yet the effects on marine life are still poorly understood. This summer, a Southampton-led research team embarked on the largest ever experiment at sea to investigate how increasing CO_2 levels are affecting ocean life.

Coccolithophores (pictured) are tiny marine organisms that are widespread in European waters. Researchers led by the University of Southampton are investigating the effects of increasing CO_2 levels on these and other marine creatures



On 6 June 2011, the UK research vessel *RRS Discovery* left Liverpool docks with nearly 30 researchers and technicians – from Southampton, Plymouth, Norwich, Edinburgh, Essex and elsewhere – on board to study the impact of the oceans’ changing chemistry. For the next 35 days the team of oceanographers, marine biologists and chemists made groundbreaking observations of the effects of rising CO₂ levels on ocean life in European waters.

“One of the main aims of this experiment was to shed more light on the effects of the increasing acidity of our oceans,” says Eric Achterberg, Professor of Marine Biogeochemistry at the University of

Southampton, who led the *RRS Discovery* cruise 366. “Since the onset of the industrial revolution, the concentration of CO₂ in the atmosphere has increased by more than a third. The oceans have mopped up around 30 per cent of the human-induced CO₂, and this has made seawater more acidic,” he adds. We already know that some microscopic marine plants thrive under these conditions, while organisms with calcium carbonate shells struggle to form and maintain them, but we don’t yet have a comprehensive picture of what the effects are,” he adds.

The cruise also looked beyond the direct impact on marine organisms and ecosystems. “We studied the impact of the changing

chemistry on the cycling of carbon and nutrients in the sea, and on how the sea interacts with the atmosphere to influence climate,” says Dr Toby Tyrrell, Reader in Earth System Science and coordinator of the consortium carrying out this research. Microbial processes in the oceans continually release climate-active gases such as dimethyl sulphide (DMS) and nitrous oxide (N₂O). Previous studies have indicated that more of these gases are released at high CO₂ levels, which could have significant effects on our climate. ►



To find out how ecosystems vary between naturally more acidic and alkaline seawater, the researchers collected samples from different depths to analyse on deck

“Through this project, we are leading vital research at the forefront of international efforts to understand the effects of emitting enormous quantities of carbon dioxide.”

Dr Toby Tyrrell,
Reader in Earth System Science

Floating laboratory

The RRS *Discovery* is an on-water laboratory that takes measurements in often very challenging conditions. “The main difference to working on land is that the laboratory moves constantly,” says Eric. “Activities that would be trivial on land suddenly become a lot harder with waves at four to six metres high and the wind blowing at six to seven on the Beaufort scale.”

The researchers made their observations in several different ways. One key method was to take water samples from different depths and locations and look at how ecosystems vary between naturally more acidic or alkaline seawater. The team made observations at specific points in the ocean using a ‘CTD’ (CTD literally means ‘conductivity-temperature-depth’) – a metal frame that holds a rack of sampling bottles and an array of instruments, that is lowered down as far as several kilometres below the ocean surface. The instruments measured properties such as the temperature and salinity of the water, while water samples were collected in 20-litre bottles for analysis on deck. This enabled the team to measure the concentrations of gases, such as DMS and N_2O , dissolved in the water, as well as to look at different properties of

phytoplankton – the tiny marine organisms that form the base of the food chain – such as the relative abundance of different species.

As well as the CTD points, the team also used the ‘underway supply’: a pipe that collects water continuously as the ship is moving, enabling them to measure the local seawater without stopping the ship. By collecting such samples, the team could employ a technique called flow cytometry to find out how numerous viruses, bacteria, protists and smaller phytoplankton were in small samples of water.

Another approach was experimentation on natural seawater. The team collected seawater from the surface of the sea, put it into separate bottles where the CO_2 level was changed, and placed the bottles in a controlled laboratory on deck. “We subjected the natural seawater to the levels of CO_2 that could occur in the future to give us a glimpse of what may happen to the marine ecosystem as atmospheric CO_2 continues to rise,” says Eric. The team carried out these bioassay experiments to measure how efficiently minute organisms converted higher levels of CO_2 into energy through photosynthesis, or into a calcium carbonate shell. They also measured the gene and protein expression

“We urgently need to consider the use of the oceans by future generations, as well as tackling issues such as rising atmospheric CO₂ levels, fisheries and wind farm developments in coastal zones.”

Eric Achterberg,
Professor of Marine Biogeochemistry

of microbial communities exposed to experimentally high CO₂ levels to find out how capable microbes were at adapting to climate change.

The next challenge is to analyse and interpret the findings, which will be used by modellers to inform, for example, the Intergovernmental Panel on Climate Change (IPCC) on the effects of different future CO₂ emissions scenarios on the marine system.

Protecting our oceans for the future

Rising CO₂ levels are already affecting our oceans. “The warming of the surface layer of the ocean is decreasing its density, resulting in a more stratified, or layered, water column. This is reducing the supply of nutrient-rich deep waters to the productive sunlit surface ocean,” says Eric. This decrease in nutrients will mean that in the future, the oceans will be unable to support the abundance and diversity of marine life they can today, as well as having a knock-on effect on our food supply. “The decline in primary productivity of the ocean plants and microorganisms that form the base of the food chains in ocean ecosystems will also ultimately impact on fisheries, which are a vital protein source for large parts of the world’s population,” Eric adds.

Rising CO₂ levels aren’t the only threats to our oceans. In the coastal zones, we are still discharging waste into our seas, causing low-oxygen regions to form, which create a hostile environment. “This situation is worst in rapidly industrialising countries like China, but also noticeable in European waters,” says Eric. “There are also regular reports on overfishing, and we collectively have to tackle this issue and move rapidly to a sustainable fishing industry. We need to view the oceans as an asset, and protect them. We urgently need to consider the use of the oceans by future generations, as well as tackling issues such as rising atmospheric CO₂ levels, fisheries and wind farm developments in coastal zones.”

Oceanographers in Southampton are investigating the impacts ongoing global changes have on the oceans, and also the

feasibility of some geoengineering options to mitigate global change.

The RRS *Discovery* cruise 366 is part of the £12m UK Ocean Acidification Programme, funded by the Natural Environment Research Council and two government departments: the Department of Environment, Food and Rural Affairs and the Department of Energy and Climate Change. The team is now planning two more cruises as part of the ocean acidification project: the next one will be in the Arctic Ocean in July 2012, and the final expedition will be in the Antarctic region in January 2013. These research cruises build on a strong history of oceanography expertise at the University of Southampton. “The National Oceanography Centre Southampton (NOCS) is one of the leading centres in the world, and our work on ocean acidification and ocean productivity is widely recognised,” says Eric.

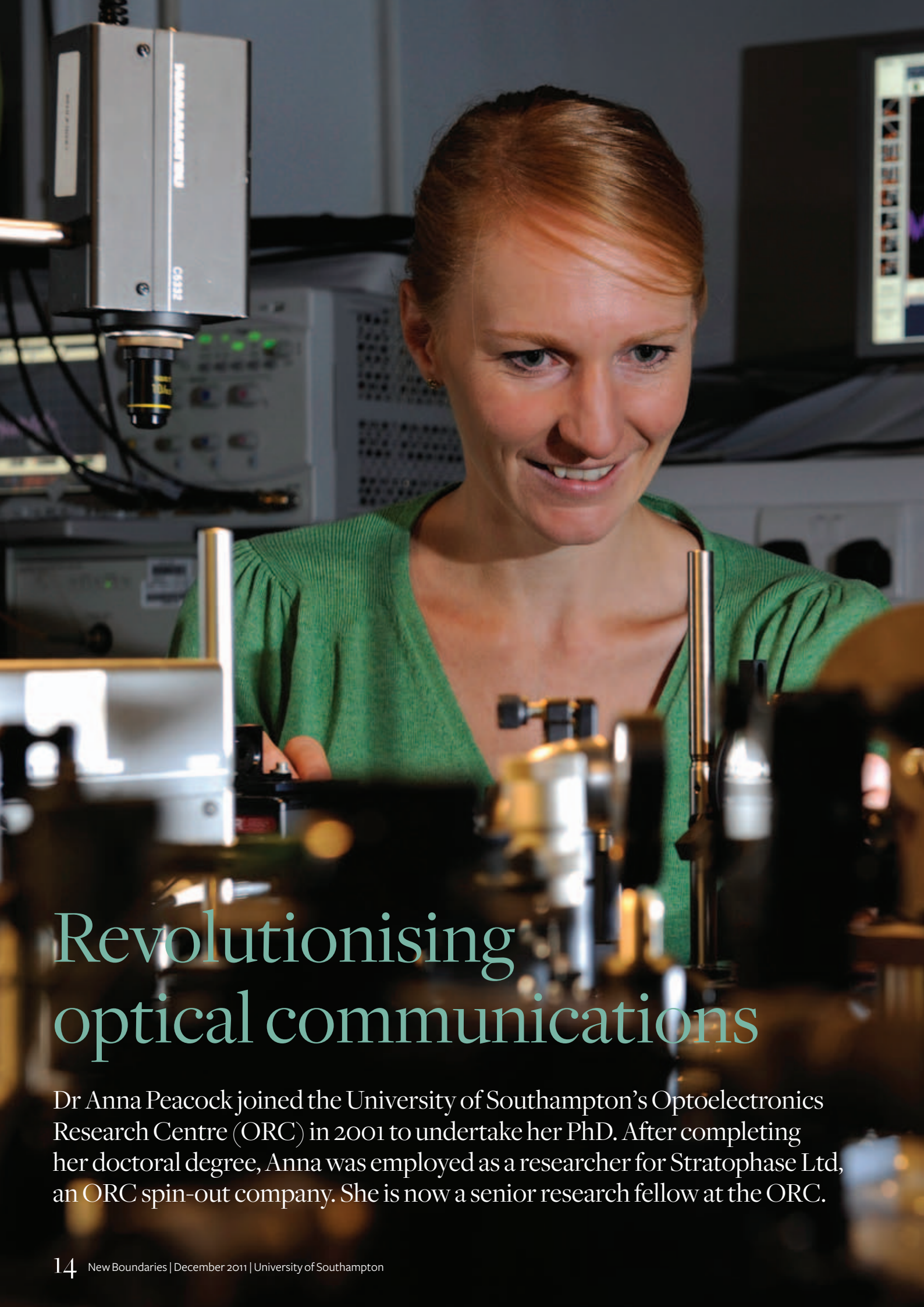
Training the next generation of oceanographers is a key component of these projects, and a significant part of the work is done by PhD students and early career scientists. Dr Sophie Richier, an early career researcher at NOCS who was a member of the RRS *Discovery* cruise 366, says: “Taking part in this research was a once-in-a-lifetime experience for me; it was fantastic to be surrounded by so many experienced scientists with different areas of expertise, all working together as a cohesive team and a close community. I learned so much during the five weeks at sea.”

Together these expeditions add up to an exciting new venture in multidisciplinary research, led by the University of Southampton. Toby explains: “Through this project, we are leading vital research at the forefront of international efforts to understand the effects of emitting enormous quantities of carbon dioxide. The knowledge gained on these research cruises will inform us in our quest to be intelligent stewards of our changing planet.”

For more information, visit
www.noc.ac.uk/news/rrs-discovery-cruise-366

Key facts

- The top 3.3m of the oceans hold as much heat as our entire atmosphere.
- The oceans provide 99 per cent of the Earth’s living space – the largest space in our universe known to be inhabited by living organisms.
- More than 3.5 billion people depend on the oceans for their primary source of food. In 20 years, this number could double to 7 billion.



Revolutionising optical communications

Dr Anna Peacock joined the University of Southampton's Optoelectronics Research Centre (ORC) in 2001 to undertake her PhD. After completing her doctoral degree, Anna was employed as a researcher for Stratophase Ltd, an ORC spin-out company. She is now a senior research fellow at the ORC.

Q *What are the main aims of your research?*

The age of optical communications has been enabled by two key technological breakthroughs: semiconductor-based chips, used to process optical data, and low-loss silica optical fibres, used to transport this data. The aim of my research is to combine these two technologies by incorporating semiconductor materials inside the fibre geometry. This will enable the fibres to act as processors as well as transmitters of light, transforming the way information is distributed. Ultimately, the combination of these capabilities into a single device presents enormous potential to make communications faster, cheaper and more efficient.

Q *What impact will your research have on society?*

The rate of data traffic is increasing every year, placing a huge stress on existing communication infrastructures. The ability to develop semiconductor fibres that will increase the speed and capacity of these systems, while at the same time offering reduced energy consumption, could be a key development in preventing an eventual bottleneck, as well as maintaining the sustainability of the digital economy. The broad wavelength range that these fibres can transmit light over means that their applications also extend beyond communications and into areas such as medicine, sensing, imaging and security monitoring. For example, compact mid-infrared laser sources could be used in tissue imaging and drug analysis.

Q *What sparked your interest in this topic?*

Throughout my research career I have worked on a diverse range of novel optical fibres including fibre amplifiers (devices that power today's internet) and microstructured fibres (a new type of fibre that can be used for a range of applications, including telecoms, sensing, medicine, aerospace and defence). Both these types of fibre were invented at the ORC here at Southampton. What really attracted me to this project was the unique opportunity to combine the flexible light-guiding capabilities of fibres with the rich optoelectronic functionality of semiconductors, which opens the door to many new and exciting research opportunities.

Q *What do you enjoy most about your work?*

I enjoy the challenge of working on a cutting-edge technology that has the potential to shape the future of telecommunications networks. We are one of only a few research teams in the world that have the capability to work in this area, and it is highly rewarding to take conceptual ideas and transform them into real-world devices.

Q *What do you see as your biggest challenge?*

The biggest challenge has been to convince well-established industries to adopt our new technology. This can only be achieved by demonstrating the huge potential of semiconductor fibres, which continually drives us to improve the fabrication and device performance, as well as to search for new capabilities unique to the fibres we develop here.

Q *Why is Southampton a good place to do this type of research?*

The ORC is one of the world's leading institutes for photonics research, with numerous state-of-the-art laboratories and in-house facilities for fabricating, characterising and developing a wide range of fibre and planar devices of different materials. This is an excellent time to be conducting photonics research at Southampton; opportunities are continually arising to establish new collaborations and exploit the wider range of available resources within the University's extensive Mountbatten clean room complex.

Q *How important is multidisciplinary collaboration to your research?*

The University's multidisciplinary approach is very important because our semiconductor fibre work includes aspects of optical physics, materials development and computational modelling. I have been able to use many of the facilities, including those in Chemistry, Electronics and Computer Science (ECS), Physics and Astronomy, as well as the *Iridis* supercomputing service, which is one of the largest university-owned computers in the UK.

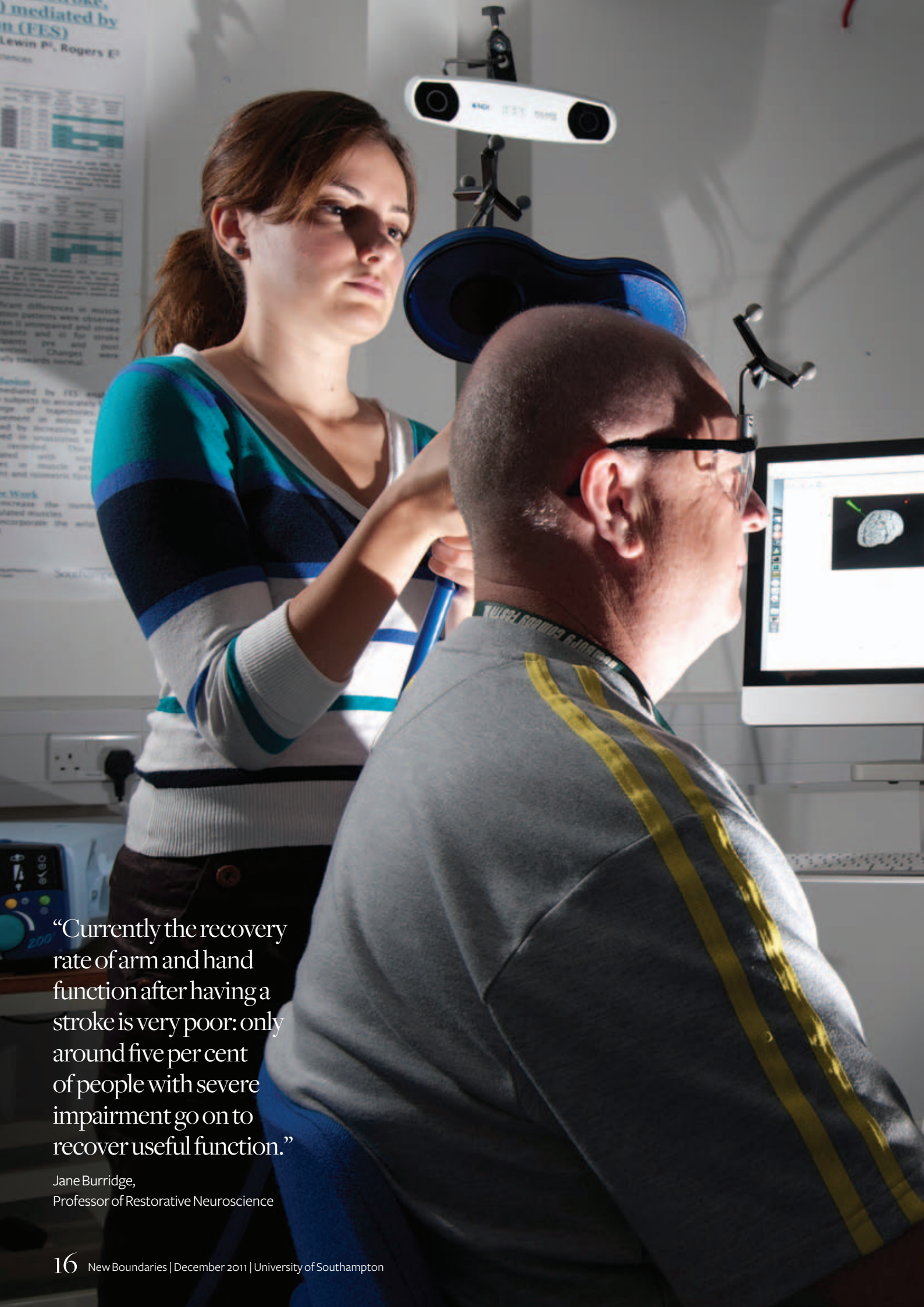
Q *How would you rate Southampton for early career research opportunities?*

Southampton has been an excellent place for my early career development, both in terms of its top-class facilities, as well as supporting me through my funding applications and providing me with opportunities to grow my research area. The strong and competitive research environment is immensely stimulating and motivates a high level of research output.

Q *What have been your biggest achievements since joining the University?*

Winning the support of the Royal Academy of Engineering and Engineering and Physical Sciences Research Council through a fellowship and a first grant was a big achievement. This confirmation of the importance and timeliness of the semiconductor fibre technology has enabled me to establish independent research activities in this exciting new area. It has been highly rewarding to publish our first papers as a new research team, and to receive recognition in the form of invited talks and feature articles in some of the leading photonics journals.

For more information about research at the ORC, visit www.southampton.ac.uk/orc



“Currently the recovery rate of arm and hand function after having a stroke is very poor: only around five per cent of people with severe impairment go on to recover useful function.”

Jane Burridge,
Professor of Restorative Neuroscience

Helping people recover from stroke

Every year around 15 million people globally have a stroke; it's the third most common cause of death in the UK and the leading cause of severe disability. Now pioneering Southampton research could help people regain movement and feeling in their arms and hands much more effectively after having a stroke.

A stroke happens when the blood supply to part of the brain is cut off. This causes some of the brain cells (neurones) to become damaged or die, breaking the connections between the brain and the muscles and often preventing the person from moving their limbs. Southampton researchers are carrying out groundbreaking research using rehabilitation robots and functional electrical stimulation to enable people who have had a stroke to move their arms and hands again. They are also developing novel tactile devices that stimulate the sense of touch to help people regain lost sensation.


A novel combination

"Currently the recovery rate of arm and hand function after having a stroke is very poor: only around five per cent of people with severe impairment go on to recover useful function," says Jane Burridge, Professor of Restorative Neuroscience. "This is largely because after a stroke many people have reduced movement so don't get the opportunity to practise exercises," she adds. Jane is leading the Southampton team conducting the first randomised controlled trial in the world to study the combination of electrical brain stimulation – known as trans-cranial direct current stimulation, or tDCS – and rehabilitation robots.

The rehabilitation robot supports the arm and helps it to move, enabling patients to regain movement and coordination. While practising in the robot, tDCS, a low-level continuous electrical current, is passed across the brain through electrodes on the head. It raises the electrical excitability of the neurones, helping them to send signals to make the muscles move. As well as helping patients practise a motor skill, tDCS may also stimulate recovery of damaged neurones so that new connections can be made.

The researchers are able to monitor the activity of the neurones using trans-cranial magnetic stimulation (TMS) pulses, which stimulate the brain with a weak magnetic field causing small muscle contractions. The relationship between the strength of the TMS pulses and the muscle contraction provides information about the connections between the neurones and the muscles. In this way, the researchers are able to not only see if someone is getting better, but also understand why. The team is conducting a preliminary trial with five participants using tDCS and rehabilitation robots, to test the technique. With funding from the UK's Wessex Medical Trust, they will be expanding this into a larger trial with 40 participants who have recently returned home after a stroke.

As well as using tDCS to stimulate neurones in the brain, Jane's team is also studying the effect of using functional electrical stimulation (FES) to activate the muscles of the arm directly while participants are exercising in the robot. FES assists them to perform simple tasks repeatedly and so recover useful movement. In one trial, for example, participants played a computer game that involved moving a ball along a tube. The researchers looked at the difference, or error, between how they performed at this task and a perfect score, and stimulated the muscle by a controlled amount to correct for the error. "When you're practising a skill like tennis, you learn and refine your performance by adjusting to whether you have hit the ball inside or outside of the court," says Jane. "If you have had a stroke and can't move, then you can't get that practice and correction. The electrical stimulation enables people to move their arm and helps them to correct the error and improve at the task." ▶



Southampton researchers are conducting the first randomised controlled trial in the world to study the combination of electrical brain stimulation and rehabilitation robots. The robot (pictured here) supports the patient's arm to help improve movement and coordination

“The multidisciplinary collaboration and state-of-the-art facilities at the University of Southampton have been crucial to the success of this project.”

Dr Geoff Merrett,
Lecturer in Electronics and Computer Science

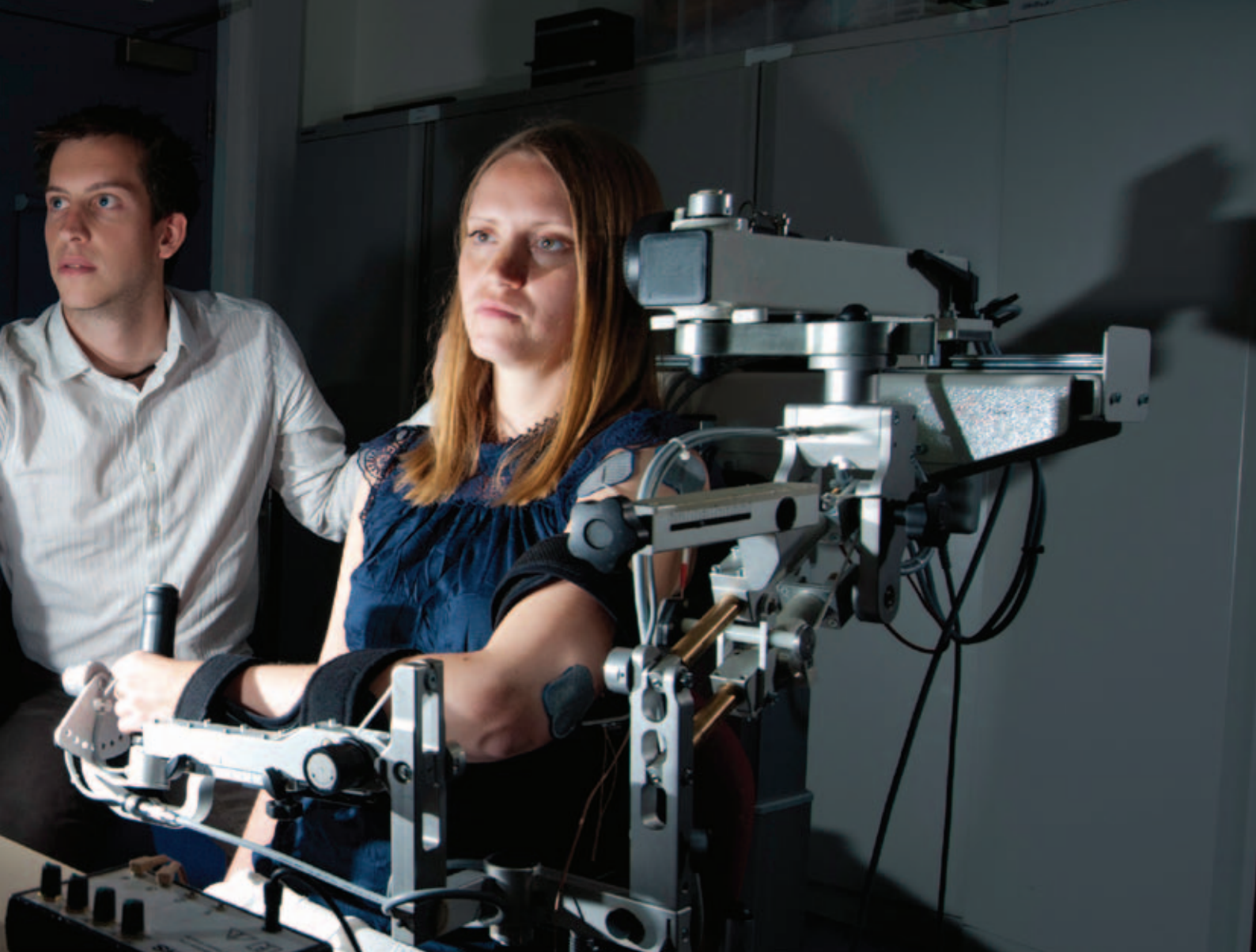
This study, funded by the Engineering and Physical Sciences Research Council (EPSRC), is based on an approach known as iterative learning control: the participants repeat the task, see how they have performed and then, through practice, they continually improve. These preliminary trials have shown that the technique is very promising and the team is now working towards designing systems that patients can use at home, improving their recovery and bringing significant cost savings for the NHS. “The long-term aim of this research is to give physiotherapists practical and smart tools to help stroke patients take responsibility for their own rehabilitation. The techniques we are using tap into the way people normally learn a new skill, and our overall aim is to give them the support that enables them to practise,” says Jane.

Sensory aspect

Southampton researchers are also developing novel devices that help stroke patients regain the sense of touch in their arms and hands. Dr Geoff Merrett, who is leading the

project, says: “The sensory aspect of stroke rehabilitation hasn’t had much attention so far, but it is vital. It’s all very well being able to move your hand to pick up an object, but when you can’t feel that object, you don’t know whether it’s slipping out of your hand or whether it’s hot or cold. The devices we’re designing will reinforce those perceptions.”

The team has now developed three different devices that provide a sensation by stimulating the receptors in the fingers. These include a ‘vibration’ tactile device; a motor-driven squeezer device; and a ‘shape memory alloy’ device that, between them, can apply a range of sensations including temperature, pressure and vibration. A group of stroke patients and healthy participants gave detailed feedback on how they felt the devices had performed. “Most stroke rehabilitation systems ignore the role of sensation and they only allow people repetitive movement,” says Dr Sara Demain, a physiotherapist at the University of Southampton, who works with people



who have experienced a stroke. “Our aim is to develop a technology that provides people with a sense of holding something or of feeling something, like, for example, holding a hot cup of tea, and we want to integrate this with improving motor function.”

The results showed that participants with the most severe impairments reacted best to the vibration and the least impaired reacted best to the shape memory alloy devices, so it’s likely that the final version of the device will include a combination of different modalities. The testing also revealed that the devices need to be small, light and not obstruct movement so that they don’t impede the normal function. “It’s incredibly important to take on board the views of the user from day one if you want to create an effective new technology that people will actually use. We have taken this feedback, as well as feedback from clinicians and carers, into consideration to design new, improved versions of the devices,” says Dr Cheryl Metcalf, a lecturer in biomechanics whose

research spans the fields of both health science and electronics. “By considering all these perspectives, especially in an economic climate like this, we hope to come up with a device that will be accepted not only by the patient community, but also by funding bodies like the NHS,” Cheryl adds.

The project received initial funding from the University of Southampton’s Adventures in Research fund, and the team has just secured further funding from the UK’s Technology Strategy Board to continue this research towards a workable prototype in a few years’ time, which will then be ready to go through clinical trials. The ultimate goal is to translate the device out of the clinical setting and into people’s homes, so it can be part of a toolkit to be used alongside other technologies such as tDCS, rehabilitation robots and conventional therapies.

“The multidisciplinary collaboration and state-of-the-art facilities at the University of Southampton have been crucial to the success of this project,” Geoff says.

“We have a team of physiotherapists, electronic engineers, biomechanists, psychologists, and a mechanical engineer all bringing their insights. And with our new equipment, we have been able to print out the 3D plastic devices directly.”

This research looks set to have a major impact on stroke rehabilitation research. As Jane says: “Anyone who has had to endure the debilitating effects of a stroke, either themselves or in helping a loved one in that situation, will know just how difficult it can be. Through our research across the different disciplines, and with the help of people who have had a stroke, we are really hoping to transform the recovery process and make life more manageable for those who find themselves in that situation in the future.”

For more information, visit www.southampton.ac.uk/research



Aerospace innovations

Andy Keane, Professor of Computational Engineering, is the Director of the Rolls-Royce University Technology Centre for Computational Engineering and is distinguished for his research in aerospace design. Andy, who was elected as a Fellow of the Royal Academy of Engineering this year, tells *New Boundaries* about his research.

Q *What are the main aims of your current research?*

My current research focuses on two main areas: making the best use of large computer simulations and models during the aerospace design process, and the impact of latest-generation manufacturing methods on design. Computer simulation and manufacturing technology are rapidly moving fields and designers need to refine their approaches to take advantage of these developments if their products are to remain competitive. The tools we research assist in this work and sit alongside the more traditional design packages such as computer-aided design (CAD) packages and finite element analysis (FEA). They address areas such as design optimisation and robustness in the face of uncertainties, such as inaccuracies in manufacturing, how the product is used, and wear and tear during service. They also enable groups of methods to be linked and used by teams with reduced human intervention.

Q *Could you tell us more about one of your team's recent successes?*

Recently we brought together our ideas in rapid design and advanced manufacture by designing the world's first three-dimensional printed aircraft. We went from initial idea through the full design cycle to flight trials in four weeks and built an aircraft that contained no conventional fasteners or fixings such as nuts, bolts and screws. The aircraft was printed in four large pieces, complete with all hinged control surfaces pre-assembled and then the parts were simply snapped together to make the complete airframe. All the on-board avionics, control systems, power plant and batteries simply snapped into clip fittings, pre-designed into the airframe. The resulting aircraft met all the specifications on its first flight and is capable of speeds of over 90mph.

Q *What are the potential impacts of your research on industry?*

The printed aircraft demonstrates what advanced approaches to design can achieve. It also showed how highly capable unmanned aerial vehicles (UAVs) can be designed to meet specific needs and be flown at a much lower cost than is usually the case in the defence and aerospace sectors. The aircraft we flew, including all on-board avionics and the autonomous controller, cost less than £6,000.

Q *Why is UAV development important?*

UAVs have traditionally been seen as military assets, but they have many civilian uses. They can be used for coastal surveillance to support air-sea rescue teams. They can be used by farmers to monitor their fields or conservationists to study forests, and the owners of transmission lines can use them for inspection purposes. They can be used for scientific missions – for example UAVs can be used to study volcanic ash clouds without endangering humans so that the safety of an airspace can be established. The only thing holding back a revolution in the use of our skies is the regulatory framework and it's anticipated that this will change in the next decade to free up a massive growth in the use of civilian UAVs.

Q *What opportunities are there for early career researchers and students in this area?*

We have a new advanced MSc course in autonomous systems that started in October. This course is the first of its kind, and will allow young engineers to learn about the whole range of exciting technologies required to realise our vision for the UAV sector. Students will build and operate their own UAVs in small teams using our range of advanced design tools and manufacturing facilities.

Q *How important is multidisciplinary collaboration to your research?*

All the work we do is multidisciplinary because all aspects of a design need to be considered together to establish the true value of a new concept. This includes traditional areas such as aerodynamic and stress analysis, along with costing and manufacturing schemes, right through to simulating the aircraft's performance throughout its life and its benefit to the final end-user. The team at Southampton has expertise in all these areas. The University is also linked to most of the major aerospace companies in the UK, who support the research in a range of ways from financial support through to helping us jointly develop platforms for our research.

Q *What successes have you had in commercialising your research?*

We have produced two spin-out companies: Plexus Planning, a supply chain management company, and Dezineforce, a design optimisation service, which was recently bought by Microsoft.

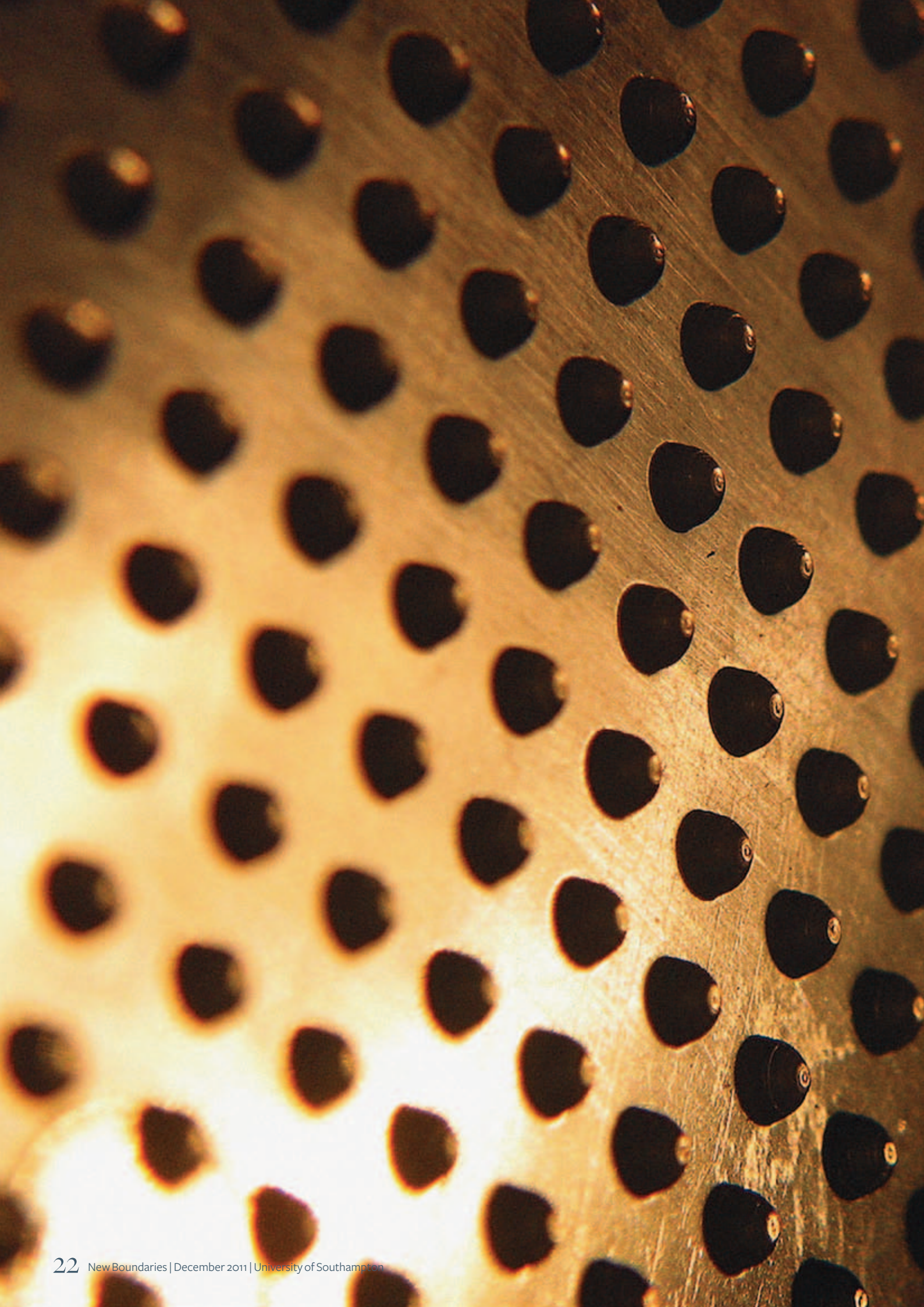
Q *Are there any other exciting developments coming up?*

The University designed and built the world's first human-powered aircraft around 50 years ago, and we are currently trialling another human-powered aircraft that is aiming to take one of the last remaining prizes in the field of human-powered flight.

Q *What is your impression of Southampton as a place to do research?*

The University of Southampton is an exciting and fun place to work. It allows people to develop their ideas and grow their research. It enables people to work in new areas that lie outside the traditional discipline boundaries and the University's aerospace activity is one of the strongest in the world.

For more information, visit
www.southampton.ac.uk/research



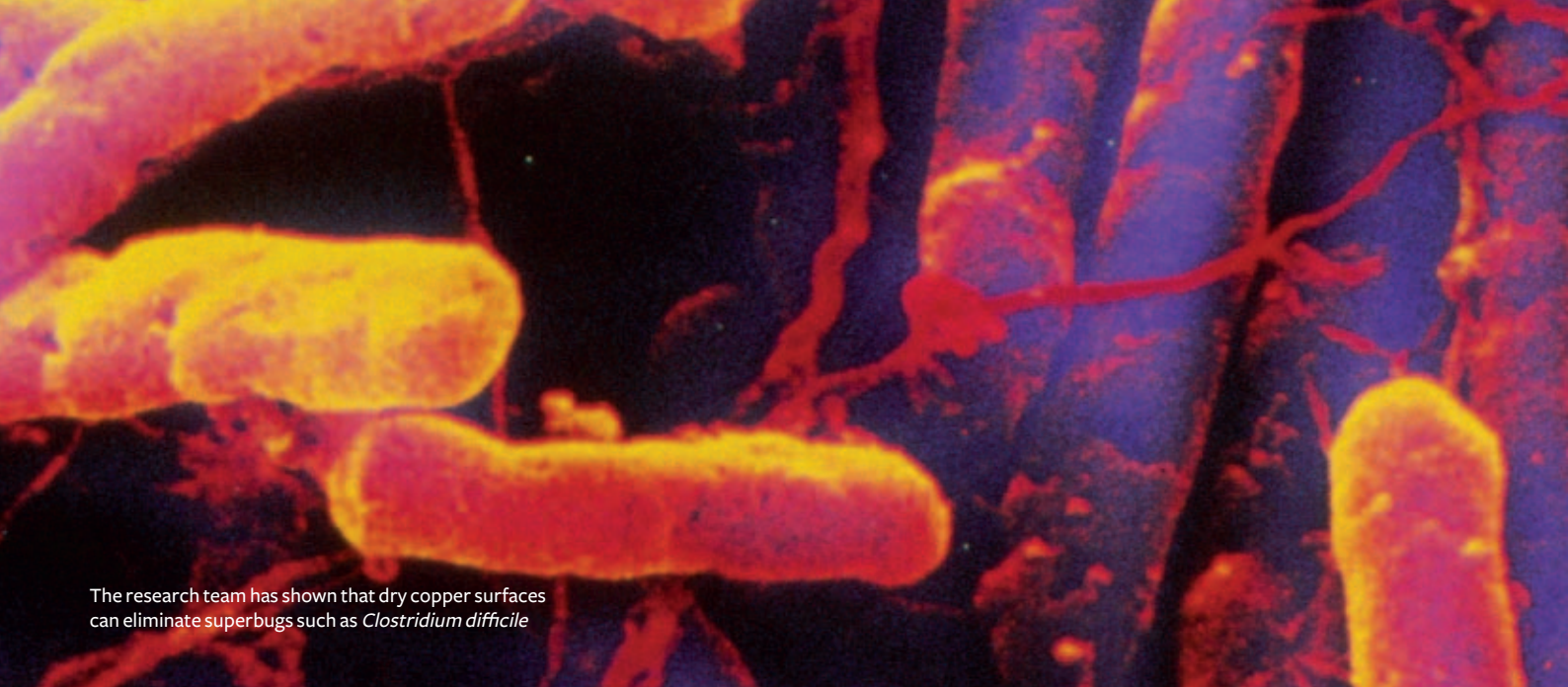
Miracle metal

Seven million people around the globe contract a healthcare-associated infection each year. According to the World Health Organization, the annual cost is over \$80bn. Southampton researchers have discovered that copper may help to eliminate this threat.

Healthcare-associated infections (HAIs) cause a range of symptoms, from minor discomfort to serious disability, and even death. High standards of infection control are crucial for containing the spread of these infections. But despite widespread hand washing campaigns and improvements in cleaning, infection rates remain unacceptably high. As new strains of bacteria and viruses emerge and spread from hospitals to schools, homes and public transport, or vice versa, researchers face a constant 'arms race' to find new solutions.

Professor Bill Keevil, Head of the Microbiology Group and Director of the Environmental Healthcare Unit at the

University of Southampton, has been researching HAIs for several years. His team has discovered that the natural antimicrobial properties of copper and copper alloys dramatically reduce the presence of methicillin-resistant *Staphylococcus aureus* (MRSA) compared with stainless steel, which is commonly used on surfaces in hospitals. "Although stainless steel looks like a mirror surface to the naked eye, under the microscope it's full of scratch marks and bacteria are able to hide in the grooves," says Bill. "The reason it's used is that it's deemed to be easy to clean and disinfect, but if you look at a magnified image of the surface, you can see that this is not the case." ►



The research team has shown that dry copper surfaces can eliminate superbugs such as *Clostridium difficile*

“We have developed very sensitive assays showing that copper completely destroys the bacteria’s DNA in minutes so they can’t go on to become resistant.”

Professor Bill Keevil,
Head of the Microbiology Group
and Director of the Environmental
Healthcare Unit

In a recent trial, the researchers found that MRSA bacteria remain fully active for days on stainless steel surfaces, whereas on brass (an alloy of copper and zinc), they die in less than five hours on a moist surface and on pure copper they are eliminated in under 30 minutes. On a dry surface this happens in just a few minutes.

Earlier this year, the researchers also completed a study of copper’s efficacy against new strains of *Escherichia coli* (*E. coli*), the pathogen that caused the recent health crisis in Germany, and found they were eliminated from a dry surface in 10 minutes. “We tested *E. coli* O157, which has caused several past outbreaks of severe gastrointestinal illness, as well as several other strains, all of which were killed rapidly on copper,” says Bill. “The crisis in Germany was caused by a new strain of *E. coli* O104, which had never been seen before in an outbreak. Although this wasn’t included in our tests, it’s interesting to speculate that the outbreak could have been reduced if copper alloys had been used either in the food producing facility or in restaurants and shops where contaminated food may have been,” he adds.

How copper kills

There are many examples in antiquity showing that copper is beneficial to health. “The ancient Egyptians used it to sterilise drinking water and treat wounds; Hippocrates in Greece used it to treat leg ulcers and varicose veins; and the Aztecs used copper oxide and malachite, which is copper carbonate, for skin conditions,” says Bill. However, until recently, there have been no laboratory tests to measure its effectiveness.

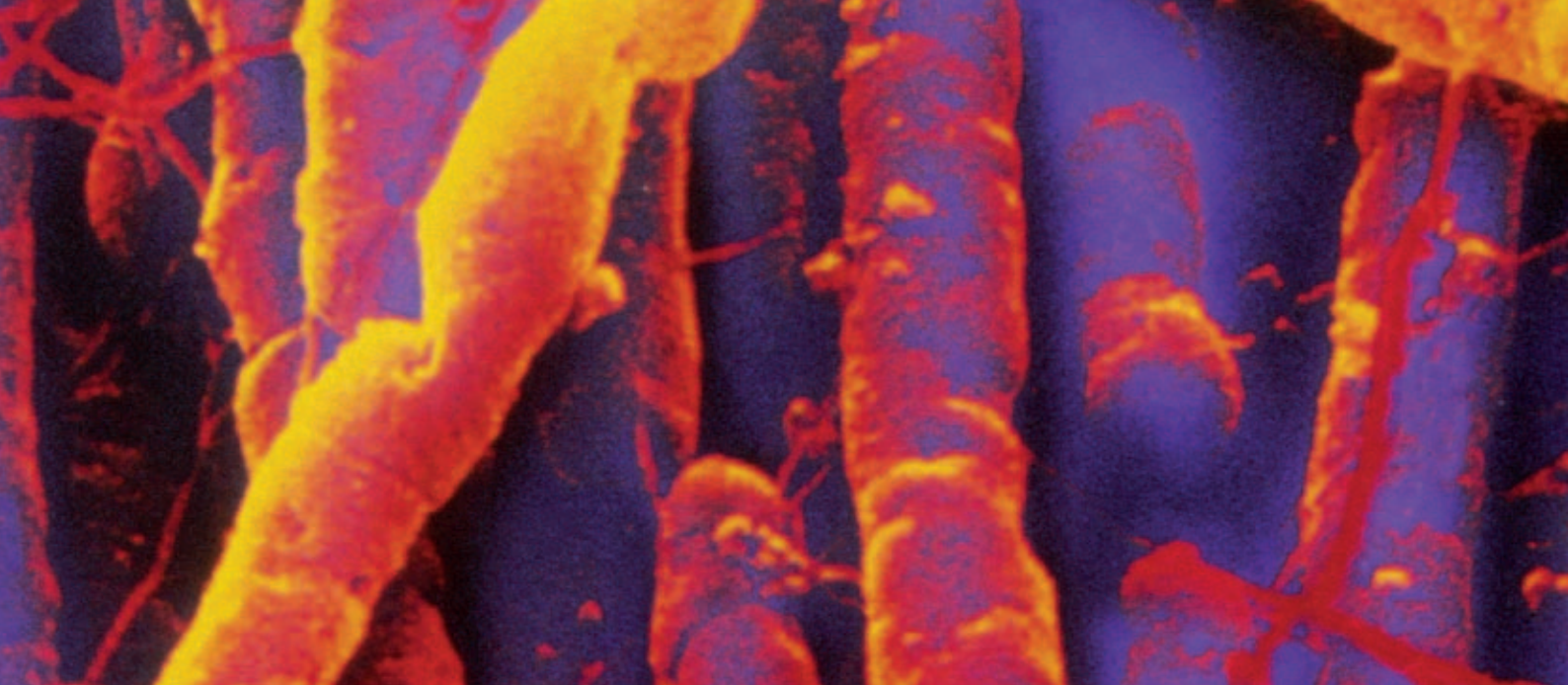
The Southampton research team has shown that copper works in several different ways to shut down bacterial cells’ chemistry and physiology. Using ‘quenching agents’ to inhibit the action of copper, the team worked out that the metal releases positively charged ions and reactive oxygen species, which quickly kill any bacterial cells that touch it.

“We have developed very sensitive assays showing that copper completely destroys the bacteria’s DNA in minutes so they can’t go on to become resistant,” says Bill. Copper destroys not only chromosomal DNA, but also plasmids, which are circular pieces of DNA that confer antibiotic resistance. These plasmids can move between bacteria, passing on the antibiotic resistance to different bacterial species. So copper not only kills these agents but also prevents mutation and resistance transfer to other potential superbugs.

Microscopic scale

Detecting signs of life in bacteria requires precision equipment, and Southampton researchers have developed a unique microscope for this purpose. The Episcopic Differential Interference Contrast (EDIC) microscope can look directly at the organisms on a surface and, using simple fluorescent stains, can tell whether they are alive. “We have also developed new methods to look at membrane integrity, respiration and DNA integrity of bacteria, as well as showing the generation of reactive oxygen species from a copper surface in real time,” says Bill.

Currently there isn’t a single approved test for antimicrobial touch surfaces, so Bill’s team has also developed a new test, which he



hopes will become the international standard. The test involves incubating the organisms (bacteria, viruses or fungi) on a surface for up to two hours, and using EDIC to look for signs of life. “There is a real need for a new test for antimicrobial surfaces, as there are some spurious tests out there at the moment that aren’t relevant for a ward environment,” says Bill.

Taking on the superbugs

The Southampton team has been investigating the antimicrobial properties of copper for over 10 years, and the University is the leading centre for this research in the UK. “Over the years this work has developed into a multidisciplinary activity,” says Bill. “The initial research was done by microbiologists, and we now work with engineers for advice on the metallurgy, as well as clinicians and infection control nurses.”

In early laboratory trials, the team showed that copper killed 10 million MRSA, *Clostridium difficile* and *Acinetobacter baumannii* bacteria in 45 minutes to two hours. When they adjusted their assays to the low concentrations of MRSA reported in hospital environments, they found that the copper killed all the bacteria much faster – in just 10 to 15 minutes. “Once we saw how effective copper could be, we started talking to the Department of Health in the UK and the National Institutes of Health in the USA about doing ward trials to find out whether our results in the lab would translate into real benefits in hospitals,” says Bill.

In 2009, the researchers conducted a trial at Selly Oak Hospital in Birmingham, UK, in which all the fixtures and fittings – such as

door handles and light switches – in one ward were replaced with copper. The trial, funded by the UK’s Copper Development Agency, showed that the copper fittings reduced the numbers of viable organisms on the copper surfaces by more than 90 per cent. This trial has now been repeated in the USA, South Africa, Japan, Germany and Chile, with similar results. “Our colleagues in the USA recently reported that copper alloy touch surfaces caused a 40 per cent reduction in infection rates in a new hospital trial. This is very exciting because it means that, as a research community, we have now shown in several separate studies that copper is effective at reducing microbial contamination and infection,” says Bill, who also presented his team’s results on the antimicrobial mechanisms of copper at the same conference – the first International Conference on Infection and Prevention Control, in Geneva, earlier this year.

The team’s research is already having an impact: some hospitals around the world are already starting to incorporate copper alloys into their wards. With new superbugs emerging all the time, Southampton researchers are at the forefront of finding new ways to tackle them.

For more information, visit www.southampton.ac.uk/research

Key facts

- 20-30 per cent of us are unknowingly carrying *Staphylococcus aureus* at all times.
- 51 per cent of patients in intensive care units worldwide have infections.
- 80 per cent of infectious diseases are transferred by touch.
- There are 300 different antimicrobial copper alloys.



Crossing the borders

This year the world's population reached seven billion, and with more and more people seeking opportunities abroad, international migration is affecting societies across the globe. Southampton researchers are leading two European studies to investigate the effects of migration and help governments develop informed immigration policies.

“Migration is the main driver of population change in Europe and this affects the distribution of resources. Good statistics are needed to study the impacts of these population changes.”

Dr James Raymer,
Reader in Social Sciences

Along with births and deaths, migration is one of the three drivers of population change. People migrate for a whole host of reasons – to join family, study abroad, find a better quality of life, or as refugees or asylum seekers. Although migration is thought to increase diversity, innovation and economic prosperity for destination countries, currently there is a lack of data on both its extent and effects.

Dr Jackline Wahba and Dr James Raymer, both based at the University of Southampton's Economic and Social Research Council Centre for Population Change (CPC), are addressing just this issue. They are leading two projects within the prestigious €22m NORFACE (New Opportunities for Research Funding Co-operation Agency in Europe) migration research programme. Their work will help governments more accurately keep track of migration across their borders, as well as understand the challenges faced by migrants to help them safeguard their human rights.

Measuring migration

Governments need robust information on migration to develop informed policies.

“Migration is the main driver of population change in Europe and this affects the distribution of resources. Good statistics are needed to study the impacts of these population changes,” says James. However, he adds: “Unlike statistics for births and deaths, there are no legal requirements for collecting migration statistics.” This results in a variety of data sources and measures used to track population movements, causing an incomplete understanding of these movements.

James's team has already produced the first set of consistent and complete estimates of migration flows among countries in the EU. Now they are building a statistical model that incorporates expert judgements and uncertainty. Once completed, the model will enable national statistical offices and other organisations, such as Eurostat and the United Nations, to see where there are gaps in existing information so that they may start to fill them.

“Governments are under a lot of pressure right now to make the best use of the data they already have rather than generate new data. So the possibilities of combining information from a number of different



sources, such as passenger surveys and population registers, collected by both sending and receiving countries, offers a relatively cheap and efficient way to improve our knowledge of migration patterns and processes,” says James.

Earlier this year, the UK government placed an annual limit on the number of immigrants allowed into the UK from outside the European Union. Imposing limits in this way could cause unintended consequences, says James. “There are a lot of industries that depend on migrants,” he explains. “Just to give one example, a lot of people want to purchase British-grown fruit, but they also want the prices to remain competitive with food obtained from other countries. Migrants are brought in to meet this need. Without migrants, there would be a labour gap, which could have a detrimental effect on the economy.”

Choices and challenges

Another team of researchers, led by Jackline, is investigating the socio-economic aspects of migration. They are looking at the choices faced by the migrants themselves and how they integrate into their host country. Many people are worried that swathes of migrants

are coming into their country, dominating the local jobs market and abusing the welfare system, but the team’s research has shown that this stereotypical view doesn’t stand up to scrutiny. They analysed data on more than 94,000 labour immigrants to the Netherlands between 1999 and 2007 and found that unemployment was more likely to result in people returning to their home country than staying on to find new employment or claim benefits.

“Our work has shown that people who come into the country don’t harm the ‘natives’ and they themselves also benefit, so migration can work to help balance out global inequality. The findings from our study in the Netherlands are important because they indicate that, contrary to popular belief, the migrants are not trying to benefit from the welfare state.” The team is also looking at the impacts of migration in Germany, and from February next year, they will also be looking at developing countries, particularly in North Africa.

“Southampton is a great place to do this type of research because we have the leading centre for understanding population change in the UK, with economists, sociologists,

geographers and social statisticians all working together to tackle some of today’s most pressing challenges,” says Jackline.

A growing issue

Migration is on the increase, and Southampton researchers are at the cutting edge of research to find sustainable, workable solutions. “Ninety-eight per cent of the growth from six billion to seven billion has occurred in developing countries, and this increase in population will lead to more people migrating to Europe,” says Jackline. “Migration is one way in which food, energy and healthcare provision around the world can be balanced out to reduce global inequalities. If well managed, migration will help our growing population to make best use of the planet’s resources.”

For more information, visit www.southampton.ac.uk/research

In brief



Faster file sharing

Sending large electronic files faster than by email for free is now a reality thanks to scientists from the University of Southampton. The system allows users to send files within and beyond their organisations from their own servers with no size restriction.

Julian Field, Postmaster for Electronics and Computer Science at the University, developed ZendTo – a free and secure web-based system. ZendTo is particularly useful in a customer service environment as when it sends files, it incorporates customer service ticketing references, so that all the references are kept intact.

Julian is no stranger to innovative web-based tools. In 2000, he began developing MailScanner, which is now a world-leading email security and anti-spam system. It has been downloaded over 1.5 million times and is used in 226 countries by organisations such as the US Space and Naval Warfare Systems Command, Vodafone Europe, Amnesty International and the British Antarctic Survey.

“Ironically, the success of MailScanner and its strict security protocol means that it imposes limits on files being sent by email, which led to the development of ZendTo, which has no size or type restrictions,” says Julian.



Nanoscale materials

Faster computers, smarter sensors and more energy-efficient mobile phones could be a reality now Southampton scientists have secured £5m of funding for advanced nanotechnology research.

Hi-tech materials underpin a wide variety of photonic and electronic devices, but how these materials are layered and patterned determines properties like data storage, speed and power. Electrodeposition is used in the microelectronics industry to make the minute wires that connect different components inside the latest computer chips. Copper is deposited from solution in water within pores in the insulating material that encapsulates the wires. However, depositing materials from liquids becomes impractical for pores smaller than a few tens of atoms, because the liquid will not go into the holes.

Professor Phil Bartlett and his team of researchers from Southampton, Nottingham and Warwick, are going to be using supercritical fluid electrodeposition to make and enhance materials at the smallest scale possible. “Supercritical fluids completely fill a space, like a gas, but can dissolve things, like a liquid, and their properties can be adjusted by changing the temperature and pressure. Their extreme penetrating powers will enable electrodeposition to be used for structures far smaller than anything achieved to date,” says Phil.

The five-year programme funded by the Engineering and Physical Sciences Research Council could revolutionise nanomaterial design and make technological devices faster, smaller and smarter.



Image: Havant Borough Council

Newspapers help understand floods

Local newspaper archives have helped University of Southampton researchers to understand the relationship between high sea levels and coastal flooding in the Solent region along the south coast of England. Coastal flooding in the Solent has been common over the last 70 years and a significant number of these events have caused repeated damage and disruption.

To highlight the most flood-vulnerable areas, Robert Nicholls, Professor of Coastal Engineering, and colleagues, have used digitised sea-level data for the ports of Southampton (1935-2005) and Portsmouth (1961-2005) to identify extreme sea level events. They then examined the daily newspapers *The Southern Daily Echo* and *The News* along with a range of other local publications to see how many of these reported floods.

The team has found that parts of Portsmouth, Southampton, Hayling Island, Fareham and Cowes are vulnerable areas with floods happening on multiple occasions – the most severe flooding was in December 1989.

“While the occurrence of extreme sea levels has increased throughout the data, the number of damaging floods has remained roughly constant and fewer areas have flooded,” says Robert. “A combination of new and improved coastal defences in high-risk areas and less stormy periods since the 1990s are the main reason for this decline,” he adds.



Languages at war

A major factor in the success of military intervention in foreign lands is the ability to understand and interact with the people you meet. Researchers are now studying the way war is 'spoken' by focusing on the people who give a voice to the military.

British forces in Afghanistan currently employ a total of 650 local interpreters, and the Americans employ 9,000 in Iraq. It is a dangerous job in which hundreds have died

since 2003. The University of Southampton has been involved in a study that showed that good language provision can have a major effect on the success of a military operation.

Using Bosnia as a case study, Southampton researchers have concluded that the military increasingly depend on locally employed linguists, who may not be professionals with the necessary skills and knowledge and are often treated with suspicion by both sides.

The University of Southampton's Professor Mike Kelly led the research into language encounters during the peacekeeping mission in Bosnia-Herzegovina. "There is still no alternative to training troops in how to communicate with people from other languages and cultures," says Mike. "You don't have to be fluent, but you need to make an effort to communicate. And you really do need someone on your side who can speak the language."

In brief

Threat of asteroid collision

Southampton scientists have developed a new software tool that could help governments decide how to respond to the threat of an asteroid or comet hitting Earth.

The chances of a Near Earth Object (NEO) impact are very small, but just one impact could be devastating to the human race and the planet. Many NEOs that pass close to Earth have been identified, including the 400m asteroid 2005 YU55 that approached to within 325,000km of the Earth in November 2011. But if an impact was predicted, procedures would need to be in place in order to save lives.

The Near Earth Object Mitigation Support System (NEOMiSS), designed by PhD student Charlotte Norlund and supervisors Professor Peter Atkinson and Dr Hugh Lewis, provides information about the ability to evacuate a threatened region before an impact. By combining models of the physical effects of an impact with historical knowledge of hurricanes, volcanic eruptions and tsunamis, the system predicts the vulnerability of the region.

“The early results show that some regions of the world would require a considerable amount of time to get their population out of

harm’s way,” says Hugh. “A key thing about this system is that it will allow decision-makers to adjust their information sets as the uncertainty around the predicted location of an impact diminishes,” adds Peter.

“The question then is when to take action to alter the asteroid’s path or to evacuate a city in the face of diminishing uncertainty.”



Saving lives

The United Nations Population Fund (UNFPA) in partnership with the University of Southampton and 28 other organisations worldwide reports that 3.6 million lives could be saved by upgrading midwifery services in developing countries.

Each year 358,000 women die while pregnant or during childbirth, some two million babies die within 24 hours of being born and 2.6 million stillbirths occur, all because of inadequate healthcare.

The State of the World's Midwifery 2011 report, launched at the Triennial Congress of the International Confederation of Midwives in Durban, South Africa, in June, confirms that there is a significant gap between the number of practising midwives and the number needed to save lives.

Southampton statistician and demographer Professor Zoë Matthews was instrumental in analysing the data and writing parts of the report. "We collected completely new data on the midwifery workforces in 58 'resource poor' countries where nearly 60 per cent of the world's babies are born," she says.

The report highlights that unless the competencies of the existing midwives are addressed and an additional 112,000 midwives are trained, deployed and retained, many of the countries surveyed will not achieve the internationally agreed goal that all pregnant women should have a skilled health worker to assist in childbirth.



Joy of music for all

There is music to cater for all types of tastes, but getting enjoyment out of music for a deaf person is nearly impossible. Now, Southampton researchers are investigating how patients with a cochlear implant can 'hear' music.

Cochlear implants can enable people with severe to profound hearing loss to perceive and understand speech. However, current technology doesn't allow the same with music due to the complexity of the sound produced.

Music professor David Nicholls, project composer Dr Ben Oliver and Dr Rachel van Besouw from the University's Institute of Sound and Vibration Research (ISVR), with the help of a £109,000 grant from the Arts and Humanities Research Council, are looking at ways to help patients from the South of England Cochlear Implant Centre, based at the University.

Through innovative music workshops in conjunction with the Southampton Community (SoCo) Music Project, the team will explore the aspects of music that can be appreciated by patients through listening, computer-based and practical activities.

"We want to build a computer tool kit of listening exercises that people can listen to at home, which will help them to distinguish, recognise and appreciate different musical sounds," says David.



Tackling identity-related crime

Counterfeit identification documents represent an increased threat to national security. Southampton researchers are now embarking on a £1.85m project to tackle identity-related crime.

A recent assessment by the National Fraud Authority estimates that identity fraud costs the UK over £2.7bn a year. The Super-Identity (SID) project, led by psychologist Dr Sarah Stevenage, examines a range of physical and behavioural cues to predict other unknown information about us, in order to build an accurate identity.

"The ways in which we reveal our identity are rapidly changing. We signal who we are through our physical presence, and through the way that we behave, but now this can occur both in a real-world context and a cyber context," says Sarah. The team hopes to identify cues in a cyber environment such as use of social networking sites and browsing patterns which might indicate identity and give valuable cues to signal changes in behaviour or intention.

The system works by building a network of information up about a person. It can also quantify the certainty associated with the information, so the end user can have a level of confidence in the accuracy of the data. This will offer significant value to security and intelligence services.

For more information on these stories, visit www.southampton.ac.uk/research

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