UNIVERSITY OF Southampton

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New Boundaries | Issue 11 | November 2010

# Food for the future.

## Using insect pheromones and natural predators to tackle pests

**Pioneering energy solutions**
Research into sustainable biofuels

**Harnessing echolocation**
Nature-inspired solutions for improving sonar and medical imaging

**Bringing an ancient civilisation to life**
Using technology of the future to visualise the past

# In this issue

Welcome to *New Boundaries*, the University of Southampton research magazine. This issue has an 'inspired by nature' theme, focusing on some of our research projects that are guided by natural processes.

Feeding the growing population is one of today's complex global challenges. On page 4, we feature our multidisciplinary approach to providing solutions to food security, from enhancing food production using insect pheromones for pest control to improving food diversity and local markets.

With fossil fuels diminishing, biofuels could be the answer to meeting our future energy needs. On page 14 we explore how our researchers are pioneering sustainable biofuels using algae, coppiced trees and grass, as well as engaging the public in this new technology.

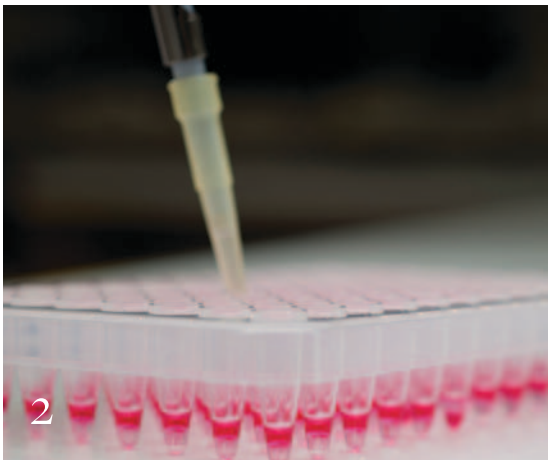
Learning how animals such as bats 'see' the world through sound using echolocation could lead to breakthroughs in sonar and medical imaging. A research team from the Institute of Sound and Vibration Research is pushing the boundaries to improve our knowledge base on how it works (see page 18).

This year is the 10th anniversary of the draft sequence of the human genome. In a timely piece of research, Michael Zev Gordon, senior lecturer at Southampton, has composed a unique piece of music based on the human genetic code (see page 26).

*New Boundaries* gives just a flavour of the world-leading research taking place here at the University of Southampton. For more research stories, visit our website **www.southampton.ac.uk/research**

If you have any comments or suggestions about the magazine, please send them to me at newboundaries@southampton.ac.uk

Claire Macdonald
Editor, *New Boundaries*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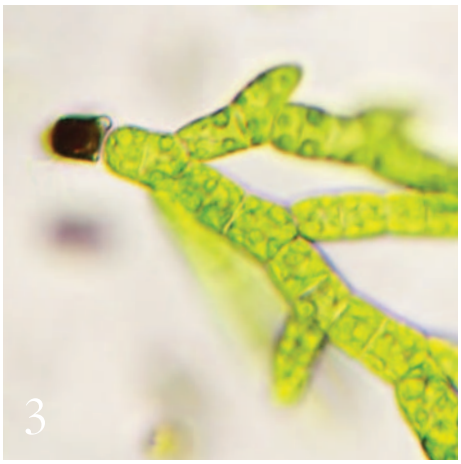




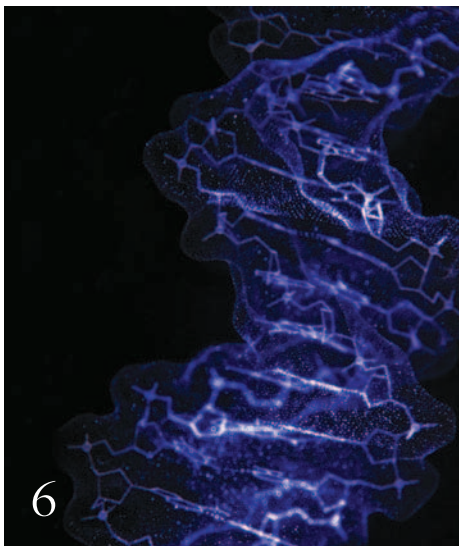



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# Food for the future

In the next 20 years, we will need 50 per cent more food and energy and a third more water, according to Professor Guy Poppy, Head of Biological Sciences at Southampton, who has advised UK, Indian and Chinese policy makers on food security.

"Modelling ecosystem services is a new and growing area of research; we are recruiting and training research students and staff to strengthen our expertise in this area."

Professor Terry Dawson,
Professor of Remote Sensing

'Food security' is everyone in the world having access to enough safe and nutritious food for a healthy and active life (Food and Agriculture Organization of the United Nations, FAO). It's an issue at the top of the UK government's agenda: last year the Chief Scientific Adviser, Professor Sir John Beddington, warned that the rising demand for food, water and energy will result in a 'perfect storm' of shortages, leading to cross-border conflict and mass migration by 2030.

At Southampton we are researching innovative ways to meet this growing demand, bringing experts together on a range of collaborative projects to both understand the issues behind the demand and offer real solutions to ease the burden.

**Healthy ecosystems**

Ecosystems provide us with clean air, water, food and materials that are vital for our health and wellbeing. Forests, for example, act as a crucial safety net for rural communities in developing countries by providing wild food during crisis events such as droughts.

"But there are difficult decisions about the trade-offs between keeping forests and clearing them for agriculture," says Professor Terry Dawson, Professor of Remote Sensing at Southampton.

Communities face a difficult question of how such an ecosystem can best serve their needs. Terry is investigating this conflict and aims to find a way to quantify the value of forests for food, economic security and health. Outcomes of pilot studies in Colombia and Malawi will include new modelling tools to show the real consequences of clearing forests, as well as the effects of climate change on this resource.

Southampton researchers are also investigating how different ways of managing ecosystems can enhance their productivity. Traditionally, national parks are fenced off from local people to preserve wildlife; however, our researchers are analysing a new approach to conservation management which engages with, rather than alienates, local communities.

The rangeland conservancy approach used by the Northern Rangelands Trust in northern Kenya allows local people to engage in sustainable management of their land. Semi-nomadic pastoralists are able to plan their grazing activity across the land, giving them the security to produce their food in traditional ways while the wildlife is protected in special set-aside zones. Preliminary results show this system benefits both the local people and wildlife.

**Enhanced food production**

More than a third of food around the world is lost to pests and the viruses they transmit. Aphids, for example, cause £100m of damage each year to food crops in England and Wales alone. As the pressure on food supply increases, we need to maximise yields.

Pests are becoming increasingly resistant to chemical pesticides and the public's concern about the effects of such chemicals on our health is growing in parallel. Innovative pest control techniques are urgently needed; Southampton researchers are responding by investigating sustainable, chemical-free methods of pest control.

Using insect predators – for example wasp species that predate aphids – is one way of controlling pests and Mandela Fernandez-Grandon, researcher in biological sciences, is looking at how this type of 'biological control' can be honed.

"Scientists realised a while ago that wasps can locate their aphid prey by detecting the pheromones they release to communicate with each other," Mandela explains. He is investigating how aphid pheromones might be harnessed to help the natural predators 'eavesdrop' on their insect prey and therefore increase their efficiency for controlling these pests.

However, as well as a practical solution Mandela stresses that education is needed to sway people from relying on chemicals to protect their crops: "Many pests show a high level of resistance to pesticides but it's a difficult step to stop spraying the chemicals, especially in developing countries that have relied on them for so long."

## Improving food diversity and local markets

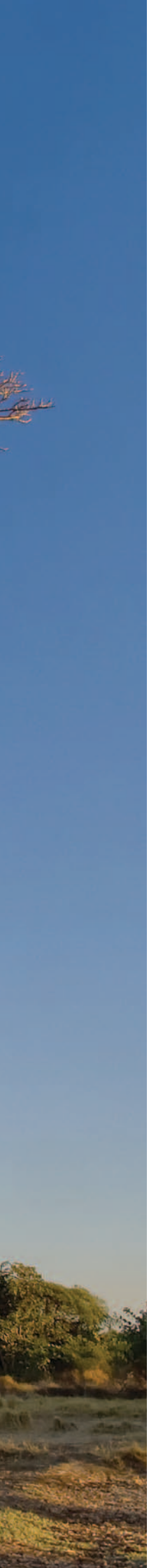
There are more than 13,000 food plants in the world, yet just 20 of these provide the bulk of our food supply. And with pressure from environmental change, pests and land-use conflict, it's a risky strategy to rely so heavily on so few crops.

Southampton's Centre for Underutilised Crops aims to improve food security, nutrition and economic welfare through the development and sustainable use of locally useful plants. ▸

"Cultivating these new species will help improve the diversity of our food crops and protect us from risks such as climate change and pests."

Dr Kate Schreckenberg,
Coordinator of the Centre
for Underutilised Crops

Baobab trees are at risk from changes in climate and land use.



Centre Coordinator, Dr Kate Schreckenberg, believes the research will provide people with the information and skills to get greater value from indigenous crops, which have often been ignored by conventional agronomic science.

The Centre's research has helped to increase the genetic diversity and resilience of newly domesticated species such as tamarind and baobab, which are widely used throughout dry-land Africa but are at risk from climate and land-use changes. Other recent successes include the development of new technologies for processing a wide range of tropical fruit.

Giving people in developing countries more control of their food supply is another key area of research. 'Food sovereignty' is a development paradigm that aims to give local people the power to manage their own food systems. A recent project at the Centre analysed the effects of the Food Acquisition Programme (FAP), which was set up by the Brazilian government to help poor farmers by providing a market for their agricultural products. Results of the project show that having access to a guaranteed market that pays fair prices leads to increased food production while improving the wellbeing, quality of life, health and income of farmers.

## Influencing policy

According to the United Nations' annual report on global food security, more than a billion people – one sixth of the world's population – are undernourished. And 1.7 billion more people will be at risk from undernourishment by 2050, according to a recent study from Southampton researchers in partnership with the University of Reading. Southampton is at the forefront of changing policy to tackle this vast problem.

The University's GeoData Institute, which specialises in environmental data management and analysis, is working with the FAO on projects that have a direct input into the international development of policy on food security in sub-Saharan Africa and Libya. With colleagues in Social Sciences, GeoData researchers have recently contributed a chapter to the *State of Land & Water*, the FAO's first publication on the global status of land and water resources, food security and child health.

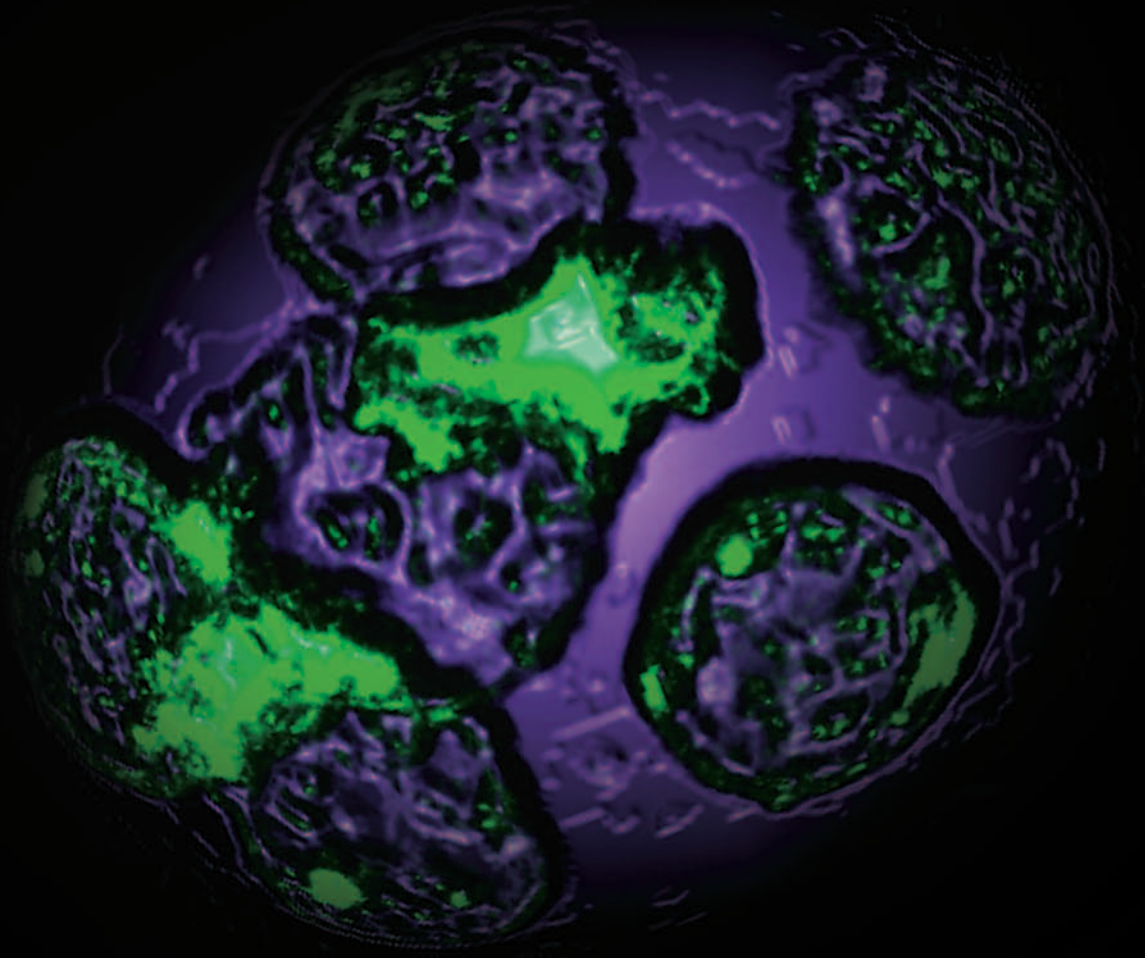
Dr Craig Hutton, at the GeoData Institute, comments: "Food security is a broad-ranging issue that is a reflection of land, water, socio-economic and policy-based management, from the sub-national to international level. It needs a multidisciplinary and strategic perspective."

Southampton offers the integrated approach that is needed to rise to the challenge of providing enough food for our growing population. Professor Guy Poppy says: "It's important to realise that it's not just about increasing food production. With a complex problem like food security it's essential that we take a broad approach, right across the social and natural sciences.

"It would be naïve and arrogant for scientists to think they can solve the problem by themselves, but foolish and dangerous for governments to think they can solve the problem without science. At Southampton we are working with both scientists and policymakers to tackle food security from all sides."

For more information about food security research at Southampton, see **www.southampton.ac.uk/research**

Our Living with Environmental Change multidisciplinary research theme focuses on how the global community can anticipate environmental change over the coming years and take appropriate action. Several key areas, such as adaptation, resilience and ecosystem services, will be crucial for developing plans for food security management. For more information about our research themes, see **www.southampton.ac.uk/research/themes** ■



# Using antibodies to kill cancer

Despite recent advances, there are still many patients who don't respond to current treatments for common blood cancers such as lymphoma. Southampton researchers have made a discovery that could lead to more effective treatments.

The current 'gold standard' treatment for lymphoma is a monoclonal antibody drug called Rituximab, which has been used to treat over a million patients. Despite its success, Rituximab doesn't work for all patients and some develop resistance to it. Researchers at Southampton have been pioneering new types of antibody treatments to find an alternative.

Monoclonal antibody treatments such as Rituximab harness a natural process to kill cancer: antibodies are produced naturally by the body to attack foreign substances, or pathogens, such as invading bacteria and viruses. Monoclonal antibodies are made in the lab from one 'parent' B-cell – a type of white blood cell – so that they are all identical and can be tested for different properties.

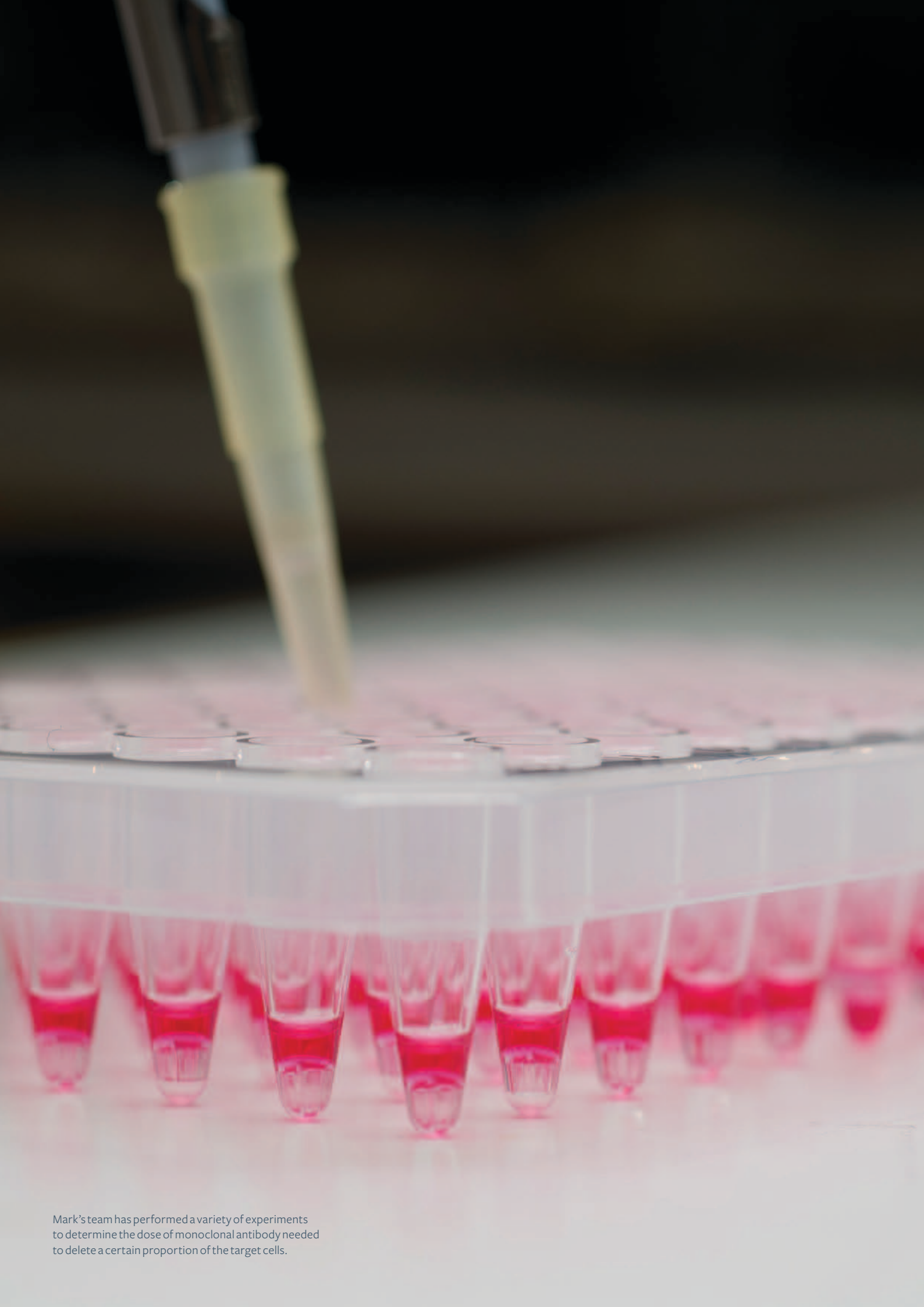
The Southampton team has discovered that new 'type II' monoclonal antibodies are five times more effective at killing lymphoma cells than current 'type I' drugs, such as Rituximab. The research is led by Professor Mark Cragg and Professor Martin Glennie from the Cancer Sciences Division, with funding from Leukaemia & Lymphoma Research, Tenovus, Cancer Research UK and the Medical Research Council. Mark, who was recently awarded a Chair in Experimental Cancer Biology at Southampton, says: "Everyone has antibodies in their circulation and we are using these antibodies to target cancer cells. Although this idea has been around for over 30 years, it is only now that we are learning how to target the antibodies much more efficiently and discovering new and interesting ways to use the antibodies to kill cancer cells.

"Chemotherapy has a lot of toxic side-effects, whereas by using antibodies we can attack tumour cells in ways that are much less toxic to the other cells in the body. Blood tumour cells develop resistance to chemotherapy but they still seem to be sensitive to antibodies, which is one of the reasons we are so interested in using them."

The Southampton researchers were the first in the world to classify monoclonal antibodies that target a specific molecule known as CD20 into two types: I and II; the findings have been published in several high-profile journals, including *The Journal of Clinical Investigation* and *Blood*. They discovered that although type I monoclonal antibodies bind to more receptors and can 'hack into' cancer cells by causing calcium signalling to trigger cellular processes in the target cells, they are also removed from the cell surface soon after binding to it. In contrast, type II monoclonal antibodies do none of these things but are better at triggering cell death and staying attached to the target cells after binding. ▸

"Everyone has antibodies in their circulation and we are using these antibodies to target cancer cells."

Professor Mark Cragg,
Chair in Experimental Cancer Biology



Mark's team has performed a variety of experiments to determine the dose of monoclonal antibody needed to delete a certain proportion of the target cells.

"Blood tumour cells develop resistance to chemotherapy but they still seem to be sensitive to antibodies."

Professor Mark Cragg,
Chair in Experimental Cancer Biology

The team has performed a variety of experiments in transgenic mice that express the human CD20 molecule, looking at the dose of monoclonal antibody that would delete a certain proportion of the target cells. They found that they needed only a fifth of type II monoclonal antibody to get the same effect as a type I treatment.

Mark comments: "The biggest challenge in carrying out this research was trying to find out why type II monoclonal antibodies work better. Existing dogma says that CD20 antibodies do not get removed from the cell surface, but this was purely based on studies on cell lines that have been cultured in vitro for decades.

"It was only when we examined fresh primary cells straight from cancer patients and looked in vivo with the transgenic mice that we realised that cells can remove type I but not type II monoclonal antibodies from their surface – and that this is the reason why type II treatments work better: they stay attached to the target cells and so are more effective at killing them."

The Southampton team brings together clinical, scientific and technical expertise, and includes scientists, research assistants, clinicians, clinician scientists, PhD students, medical students and core support staff from the biomedical imaging unit. The team is also working in partnership with Leiden University in Holland and the University of Manchester.

Mark, who completed his PhD at the University of Southampton, says: "I chose Southampton for its history, expertise and the facilities that are in place for developing antibody therapy. Southampton is a fantastic place for taking basic science and putting it into practice.

"With a Cancer Research UK clinical centre, several centres of excellence sponsored by other cancer charities and international experts in different aspects of immunology, we have the ability and resources to translate findings into clinical practice. Southampton is unusual in having all of these different elements in place."

One of the type II monoclonal antibodies the team studied, known as GA101, is currently in phase I/II clinical trials in 20 centres worldwide, including Southampton. If this treatment is proven to be successful, GA101 could be available within a few years. Mark hopes that more trials like this will follow and he and his team are considering developing their own treatment for clinical use.

Over the next five years, the team aims to develop a new range of antibodies that are even more effective than Rituximab to improve survival rates of people with lymphoma. ■

# Pioneering energy solutions

Southampton research teams are investigating exciting new ways of producing biofuels and engaging the public in this emerging technology.

### Algal biofuels

This year two Southampton research teams were selected by the Carbon Trust to join a UK 'dream team' of top scientists to find a world-beating formula for algal biofuels. By 2020 the Carbon Trust's Algal Biofuels Challenge aims to achieve a five- to 10-fold reduction in algae production costs to enable algae biofuels to be sold as a premium fuel blend.

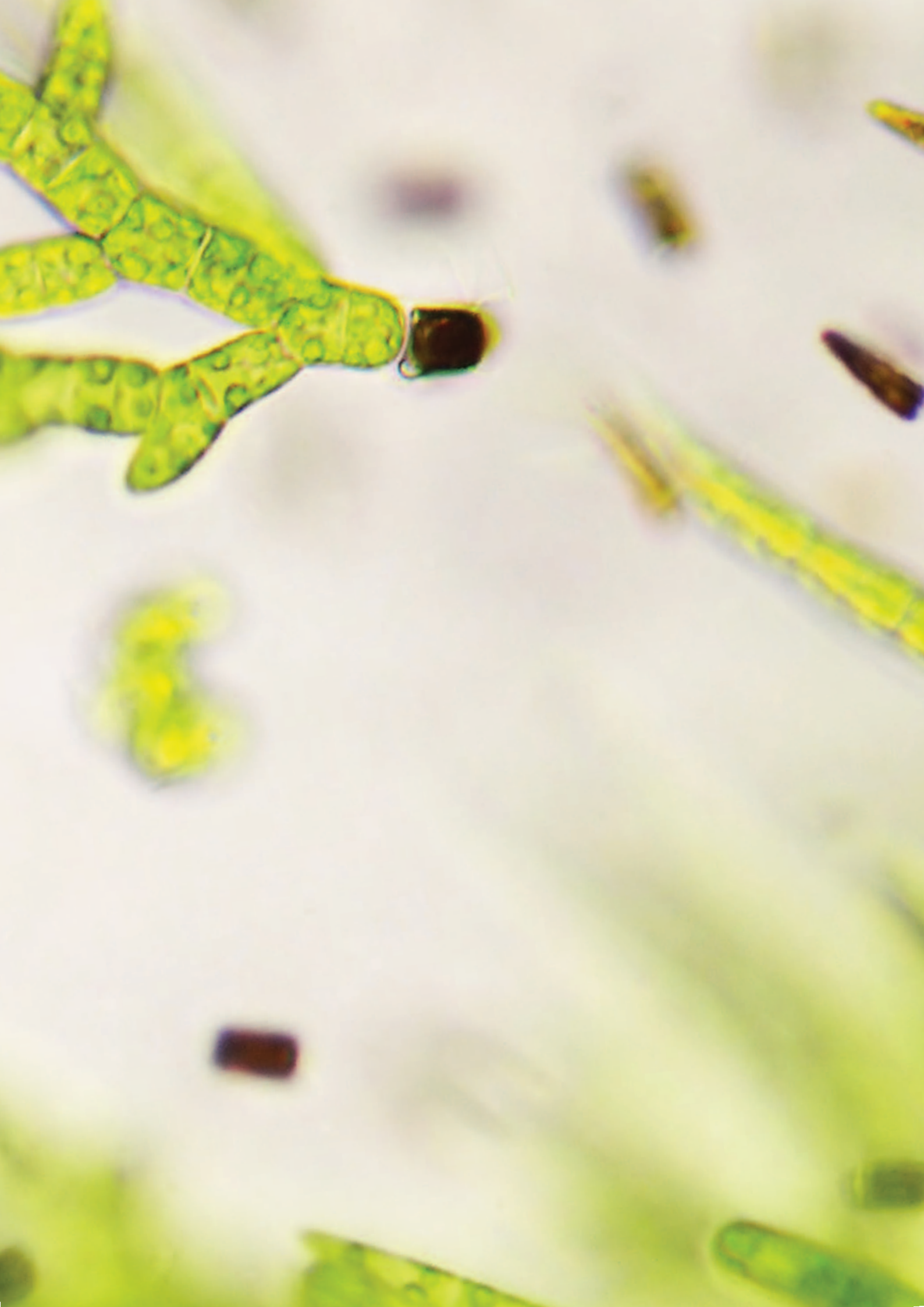
### Increasing algal efficiency

Researchers based at the National Oceanography Centre, Southampton (NOCS) are working on improving the ability of algae to convert sunlight into energy – and biofuel – by photosynthesis.

Dr Tom Bibby, lecturer in biological oceanography, says: "The Carbon Trust has targeted algal biofuel as a future economy for the UK and has identified the University of Southampton as a research centre that provides the expertise in biology, oceanography and engineering to realise this potential."

Algae are photosynthetic organisms, similar to plants; they use light and carbon dioxide to produce their food source. When enough light and carbon dioxide are available, the algae will grow quickly, maximising their ability to produce oil that can be used to make biodiesel. However, certain evolutionary traits of algae can cause problems; for example, algae do not naturally grow to high enough densities to make algal biofuel efficient. Postdoctoral researcher Dr Patrick Stephenson explains: "Algae growing at the surface of a culture can shade the cells growing below, which limits productivity."

The team is addressing this problem by identifying algae that need less light to grow, making more light available for the culture as a whole and maximising overall productivity. "Increasing light-usage efficiency has the potential to triple the productivity of algae," explains Patrick. ▸



"Our research has already shown that bioenergy crops such as trees and grasses could potentially reduce carbon emissions by several million tonnes in the UK over the next decade."

Professor Gail Taylor, plant biology expert

### Engineering solutions

Southampton engineers are investigating how to cultivate algae so that they produce biodiesel from the minimum cost and energy inputs. This research is also part of the Carbon Trust's Algal Biofuels Challenge.

"A large proportion of the cost and energy needs of the large-scale production of algae come from the supply of carbon dioxide and mixing the algae so they are all exposed to sunlight. Without these essentials, the process becomes too costly and production of biofuels is not economically or energetically viable, no matter how photosynthetically effective the algae are," explains postdoctoral researcher Dr Mark Walker.

Research is taking place in the Bioenergy and Organic Resources Research Centre, which is internationally recognised for its work on renewable energy. "The combination of a strong knowledge base in biotechnology and hydraulics from world-leading experts, excellent indoor and outdoor laboratory facilities and specialist technical support make Southampton the ideal place to carry out this research," says Centre Director Professor Charles Banks.

One thing we don't have in Southampton is the ideal climate for cultivating algae. The research team will be designing and building pilot-scale ponds on a site at the University of Almeria in Southern Spain to find out the carbon dioxide and mixing requirements of large algal cultures. These pilot-scale ponds will enable other partners in the Carbon Trust's Algal Biofuels Challenge to transfer science from the lab to a realistic outdoor environment.

Once the Southampton team has determined the best methods of mixing and introducing carbon dioxide, they will design engineering systems to supply these requirements to future full-scale algal biofuel facilities in the most energy- and cost-effective way possible.

### Energy from trees and grass

Professor Gail Taylor has been researching the potential of fast-growing trees as a source of sustainable energy for the past 15 years.

Gail's work has identified the molecular basis of the fast growth and cell wall breakdown in poplar trees and her team is investigating the genes for these processes. One current EU-funded project aims to enable woody plant material to be used more efficiently for heat, electricity and liquid fuels, with less cost to the environment.

Gail is leading a national team tracking the path of carbon that is captured by trees and grasses through the process of photosynthesis. They will also look at how trees and grasses can trap carbon in the soil over the long term.

Gail explains: "Using trees and grasses is an efficient and cost-effective way of providing a source of energy and offsetting $CO_2$ emissions from equivalent fossil fuels. Our research has already shown that bioenergy crops such as trees and grasses could potentially reduce carbon emissions by several million tonnes in the UK over the next decade.

"In the future, bioenergy crops could be turned into liquid fuels such as bioethanol, avoiding the conflict between food and fuel when grain crops are used for these purposes."

The unique £1.1m project is funded by the Natural Environment Research Council (NERC) as part of its Living with Environmental Change research programme. The research team comprises scientists from the University of Southampton, University of Warwick, Rothamsted Research Centre for Bioenergy and Climate Change, the Centre for Ecology and Hydrology, the University of East Anglia, the University of Edinburgh and the Aberystwyth University.

### Public engagement

Engaging the public in new technologies is crucial if biofuels are to be accepted as a major energy source to replace fossil fuels. As part of her PhD, Elizabeth Shepherd is investigating public concern and the scientific issues of biofuels. Her findings will help inform policy on how to best engage with the public and help prevent the public mistrust that emerged from GM foods.

Elizabeth is devising a questionnaire – based on the responses of a series of focus groups – that will be sent to 3,000 people in the Southampton area to ascertain their views on biofuels and the types of information they trust.

"It's an inherently multidisciplinary project," says Elizabeth. "I'm working with researchers across the University in geography, politics, environmental science, ocean and earth science, and biology.

"The best thing about doing this type of research at Southampton is the links; this project is part-funded by the plant science company Syngenta and came about from an existing link at the University. The interdisciplinary aspect of the project is crucial." ■

Our Living with Environmental Change multidisciplinary research theme focuses on how individuals, societies, nations and the global community can anticipate environmental change over the coming years and decades, and take appropriate action.

For more information about our research themes, see **www.southampton.ac.uk/research/themes**

# Harnessing echolocation

Understanding how animals use echolocation has huge potential for improving our sonar systems, medical imaging and hearing aids. Southampton researchers have had a leading role in a national project to improve our knowledge base.

"We can apply our findings to improving hearing aids and cochlear implants, helping people with hearing impairments to hear in 'stereo' rather than from just one ear."

Professor Robert Allen,
Institute of Sound and Vibration Research

Professor Robert Allen from the University of Southampton's Institute of Sound and Vibration Research (ISVR) is the scientific co-ordinator of the Biologically Inspired Acoustic Systems (BIAS) project. BIAS brings together biologists, medical physicists, petrochemical scientists and signal processing experts to inspire breakthroughs in engineering and medicine based on echolocation.

Bats and dolphins use echolocation to orientate, navigate and hunt for prey in complex environments. Although echolocation has been fine-tuned by evolution over millions of years, we still have a great deal to learn about how animals 'see' the world through sound. Compared with bats, our sonar systems and medical ultrasound are extremely basic: they consist of simple sounds, a single transmitter and single receiver. Learning how bats emit, receive and interpret complex waveforms will help us improve the quality of the images we can produce from sound.

Robert comments: "Southampton is the ideal place to study echolocation because of the unique facilities and expertise here at ISVR. We have acoustic experts, signal processors and clinical staff. It's unusual to have such a range of facilities all at one institution.

"Being co-located with the new Institute for Life Sciences is also a benefit; we have already started working on further interdisciplinary projects on bio-inspired engineering."

Funded by Research Councils UK, the BIAS project brings together researchers from the universities of Southampton, Leeds, Leicester, Edinburgh and Strathclyde, and the British Geological Survey and start-up company Fortkey.

The Southampton team has conducted fundamental studies on echolocation using a life-sized model of a fruit bat head set in an experimental 'air rig' to investigate the sounds the bat would emit and receive.

The experiments were set up in our state-of-the-art anechoic chambers, an ideal environment for testing the sounds without interference from ambient echoes.

The team has also been studying how people can use echolocation, a technique that could be very useful for people who are blind. In a series of experiments involving 50 participants, PhD student David Edwards has been looking at how effectively people can tell if an object is on the left or the right using sound cues alone.

David explains: "People have a very different mechanism of echolocation to bats. Bats are effectively 'deaf' to the sound they transmit so that they can concentrate on hearing the echoes. Humans do the opposite: focusing on the sound they send out and instinctively blocking echoes. This is known as the 'precedence effect'."

To be good at echolocation, people need to learn to ignore this precedence effect so they can hear and make sense of the echoes. The team's preliminary results suggest that this is possible.

The applications for echolocation are diverse; Robert's team is also looking at how it could be used for remote-controlled robots to orientate themselves in hazardous environments, such as inside nuclear reactors during routine inspections. Project partners have also looked at how it could be harnessed for finding oil and other mineral deposits in the ground by determining the signals that bounce back from different types of geological materials.

Dr Dragana Nikolic, a postdoctoral research fellow at ISVR, is looking at how to translate the findings into practical tools for identifying the direction of a sound and the objects that have caused the echoes. "This research could have significant implications for medical ultrasound imaging," says Dragana.

Robert adds: "Multidisciplinary working is a key part of our research at Southampton. As well as working with biologists to unravel secrets of the animal world such as in communication and locomotion, our engineers can adapt the principles to create new and exciting technologies for the future."

The results of the BIAS project will be published this year in the international journal *Bioinspiration and Biomimetics*, of which Robert is the founding editor-in-chief. ■

# Bringing an ancient civilisation to life

Çatalhöyük in Turkey has attracted international scientific interest since its discovery in the 1950s. Southampton archaeologists are helping to bring its wonders to a wider audience while enhancing scientific knowledge.

"We are pioneering new research strategies to engage with a wide variety of audiences, both specialist and general public, bringing important aspects of this incredible monument to life."

Professor Stephanie Moser, project leader

Çatalhöyük is one of the world's most important archaeological sites. Dating from around 9,000 years ago when people were beginning to live in large urban settlements, it has some of the best preserved examples of dwellings of the period, giving us a unique insight into Neolithic life.

Professor Stephanie Moser and her archaeological visualisation team from the University of Southampton have been conducting investigations at Çatalhöyük since 2009, working in collaboration with Professor Ian Hodder's team at Stanford University. By creating exciting new visualisations of the site and new interpretations of the wealth of data unearthed by past generations of archaeologists, Stephanie and her team are bringing Çatalhöyük back to life.

Southampton's pioneering project is the first of its kind to analyse the long-term graphic archive of an archaeological excavation, and to develop and systematically evaluate the impact of new visual outputs on everything from media coverage of the site to audience response at Çatalhöyük's Visitor Centre.

**A unique archaeological record**

Following its discovery by a British-led team, excavation at Çatalhöyük began in 1961. With its remarkable age, size and wealth of discoveries that shed light on what daily life there was like, it soon gained fame as a site of immense scientific and cultural importance. Çatalhöyük offers one of the greatest concentrations of Neolithic art and symbolism anywhere on earth, with some of the world's earliest wall paintings and murals. At its height, it was home to up to 8,000 people who lived in what appear to be multi-storey homes. These dwellings were used for both living and ceremonial purposes and were even home to the dead, who were buried beneath the plaster floors. Once each home had seen out its useful lifespan of 70 to 100 years, it was carefully collapsed and used as the foundation for a new home. The remarkably well-preserved archaeological record that resulted from this process provides a unique account of an ancient civilization and offers an exciting opportunity to reconstruct life in a town built at least 4,000 years before Stonehenge.

With only 170 houses unearthed so far and thousands potentially remaining to be investigated, Çatalhöyük continues to tantalise us with untold stories of the past. Once unearthed, however, the ancient mud-brick buildings deteriorate rapidly, making the work of the Southampton team vital for preserving the record of this key stage in human history. Through insights into the religion, art and economy of one of humanity's earliest towns, they are bringing a new understanding of the past and of society today to local Turkish citizens and visitors to the site. This research is also engaging a global audience of public and professionals. ▸

A computer graphic model of one of the houses at Çatalhöyük, courtesy of Grant Cox.

Archaeologists drawing and surveying in the south area shelter at Çatalhöyük, which was also recently laser scanned.

"Southampton is one of the world's leading centres in the historical and conceptual analysis of archaeological imagery."

Professor Stephanie Moser, project leader

### Creating a 'window' to the past

As the understanding of archaeology lends itself to the use of imagery, the Southampton team is generating and testing new interpretations of Çatalhöyük using many visualisation technologies, including museum installations, three-dimensional computer models, graphic designs, drawings, life-sized reconstructions of the houses, photographs and maps. These tools provide different ways to bring an excavation site to life, to help us appreciate what it would have been like and how people would have lived in the past.

Visual representations can shape archaeological thinking and transform our understanding of human behaviour at the site. Illustrative forms have varying functions and effects – and a range of visuals are needed to cater for the diverse audiences. By generating a variety of new images, the team at Southampton will test how different visualisations produce a range of understandings of the past and how they create new knowledge.

"The wealth of material accumulated from Çatalhöyük is overwhelming. It's a fundamental responsibility of us as professionals to communicate the ever-evolving ideas about the site in clear and meaningful ways.

"The study of the history of representation of the site and its political implications is vital to understanding the interpretations that have built up about Çatalhöyük. Using a range of visual technologies and contemporary artistic styles, we aim to engage a broad set of communities in the process of generating new visions of antiquity," says Stephanie.

### World-leading expertise and facilities

The multidisciplinary Southampton team, led by Stephanie, brings together world-leading expertise from archaeology, art, design, museum studies, history, geophysics, engineering, chemistry and computer science. For example, the team is using some innovative computer imaging tools for recording wall paintings on site, funded by the Arts and Humanities

Research Council's Digital Equipment and Database Enhancement for Impact (DEDEFI) scheme.

"Using the University's new supercomputer – Europe's fastest Windows computer – and detailed information gathered on site, we can create digital simulations of the site that are as close to physical accuracy as possible. In turn, this allows interpretations to be built from the simulations that reflect on physical experience of the real world," says Dr Graeme Earl from the Archaeological Computing Research Group.

As the project progresses, more and more data gathered on site in Turkey and from previous work will be incorporated into the visualisations, enabling a representation of Çatalhöyük that is designed to stimulate new archaeological interpretations and enhance the public presentation of the site to communities in Turkey and across the world. Most recently this has included a three-dimensional geophysical survey conducted by University of Southampton archaeologists.

Southampton postgraduate and undergraduate students are gaining field experience at Çatalhöyük. Researcher Sara Perry is one of a series of archaeological visualisation specialists trained by the University in recent years. Sara says: "This project gives me the ideal opportunity to experiment with a variety of innovative visual technologies and concepts in an environment with a deep archaeological legacy. Here at Çatalhöyük I can contribute to research that has the potential to fundamentally alter how we make and understand imagery in archaeology."

"Southampton is one of the world's leading centres in historical and conceptual work on archaeological imagery," says Stephanie. "Drawing on this expertise, we are pioneering new research strategies on visualisation to engage with a wide variety of audiences, both specialist and public, bringing important aspects of this incredible monument to life." ■

**Did you know**

- Over 9,000 years ago, up to 8,000 people lived in an ancient farming community at Çatalhöyük.
- The site, spread over 13.5 hectares, was occupied for 1,400 years.
- Remains of thousands of ancient homes are buried underneath a single mound that is 21m in height.

# Linking music and science

This year marks the tenth anniversary of the draft sequence of the human genome, and as part of a timely piece of research, Michael Zev Gordon has created a unique piece of choral music based on the genetic code.

Michael, a leading composer and senior lecturer in music at Southampton, composed the inspiring piece of music, entitled *Allele*, as part of a piece of scientific research to investigate a genetic basis for musical ability. The 'Music from the Genome' project was funded by the Wellcome Trust and led by Dr Andrew Morley, consultant anaesthetist at St Thomas' Hospital in London.

Andrew comments: "Genes have many negative connotations, and it's easy to see how this has arisen. Genes 'for' common diseases like diabetes and for breast cancer feature regularly in the lay media. Retention of genetic information by the police raises questions of civil liberty. The aim of this project was to reinforce to the public and the scientific community alike the fact that genes have positive associations."

"I hope that *Allele* will help others to contemplate the wonder and beauty of the genetic code," says Michael.

Although we all share more than 99 per cent of our genetic material, small differences in our genes at certain points cause variations such as our eye colour, blood type, and possibly even abilities such as musical creativity. The different forms of the gene are known as alleles, giving the composition its name.

Music from the Genome involved comparing DNA samples from 250 choral singers with samples from 250 non-musicians. Using particular alleles from the genetic sequences from 40 members of the New London Chamber Choir, Michael composed the piece so that each singer could perform music from his or her own genetic code. Poet Ruth Padel wrote the text to accompany the music.

"The core of this research is the individual variance of alleles. The genetic code – made up of the four base pairs adenine, thymine, guanine and cytosine (ATGC) – looked to me like musical notes, so I could translate them and map them to music," says Michael.

"Anyone can mechanically convert those letters into notes, but it was essential for me to turn it into an actual piece of music: something that makes artistic and aesthetic sense. I wanted to stick to the code as strictly as I could but at the same time produce something that speaks as music."

"The emphasis Southampton places on multidisciplinary research means that I feel fully supported in my composition work, both in terms of time and the resources I might need. This research will be part of my submission to the next Research Excellence Framework," he adds.

*Allele* was premiered at Oxford Contemporary Music this summer and performed at the Royal Society of Medicine in London, at an evening of discussion about the links between the arts and science. ■

"I hope that *Allele* will help others to contemplate the wonder and beauty of the genetic code."

Michael Zev Gordon, composer and senior lecturer

**Linking music and science is a key part of our multidisciplinary approach to research.**

- Researchers in the Institute of Sound and Vibration Research (ISVR) and Music are running composition workshops to help people with cochlear implants to hear and enjoy music. The results will guide the development of music rehabilitation materials for cochlear implant users.
- Our researchers, in collaboration with a postdoctoral composer, will create practical compositional tools for people with hearing impairments; these tools will be made freely available on the web.
- Music and Electronics and Computer Science researchers are working together on the musicSpace and MusicNet projects to improve access to online music resources.

# In brief

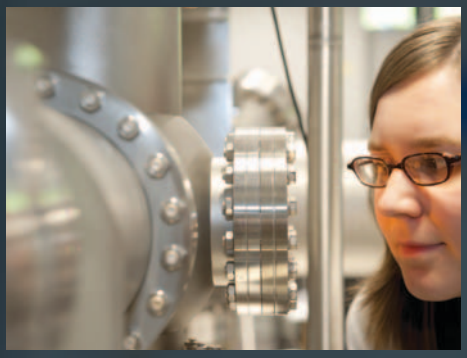
## Key gene linked to blood disorders

Researchers from the University of Southampton have identified a key gene, which, if mutated, can cause serious blood disorders. The findings, published in the journal *Nature Genetics*, shed light on how these disorders develop and could lead to the design of new treatments.

Using new genome scanning technology, the scientists examined the DNA of individuals with different types of blood disorders, including leukaemia. They found that up to 12 per cent of patients with particular subtypes had tiny mutations in one important gene, called EZH2.

The study was funded by the blood cancer charity Leukaemia & Lymphoma Research, which earlier this year named the University as a centre of excellence for cancer research.

Professor Nick Cross, a professor of human genetics, who led the research team, says: "The identification of this key genetic mutation gives us new and unexpected insights into the development of blood disorders. This information could be used to guide future treatments and to design new drugs that target the mutant cells."



## Ilika floats on London stock market

University of Southampton spin-out company, Ilika, has floated on the Alternative Investment Market (AIM) of the London Stock Exchange at a market capitalisation of £18.7m.

Ilika has established a strong client base of multinational companies such as Toyota, Shell, Asahi Kasei and NXP, and is one of 12 successful companies that have been spun out from Southampton since 2000.

Since spinning out from the School of Chemistry in 2004, Ilika has become a global leader in the discovery of new materials. It has developed many products that impact on broad and diverse markets, including the energy and healthcare sectors – for example the company has developed lithium ion batteries for use in electric and hybrid vehicles.

Professor Don Nutbeam, Vice-Chancellor of the University of Southampton, says: "In a tough economic climate, innovation companies of high quality generate real value and stimulate the economy. The University of Southampton has a global reputation for its spin-out creation and direct economic impact. The listing of Ilika shows that universities are contributing directly to growth in the economy with globally competitive companies born from international research excellence."

## Helping save lives at sea

Southampton management scientists and engineers have joined forces with the Royal National Lifeboat Institution (RNLI) to reduce the operational costs of its fleet. Through a Knowledge Transfer Partnership (KTP), Southampton researchers will help vital donations to save more lives.

The RNLI, which is dependent on charitable giving, currently supports 300 lifeboats based at 235 lifeboat stations around the UK and Ireland. Equipping and maintaining the fleet can be expensive: a Tamar-class lifeboat costs £2.7m to buy and equip, and has a working life of 30 years.

Professor Douglas Macbeth, Director of Supply Chain Research at Southampton, says: "By analysing the supply chain, equipment design and the logistics of maintaining the lifeboat fleet, this KTP will define how the RNLI can reduce costs and safely extend the life of its fleet. We are confident this joined-up approach across disciplines will produce useful results."

Two graduates will work as associates on the two-year project at RNLI headquarters in Poole, UK.

## New X-ray Crystallography Service

The University is hosting a new National X-ray Crystallography Service to support and develop research excellence in chemistry, biochemistry and the physical sciences. The Engineering and Physical Sciences Research Council (EPSRC) is providing £3.57m in funding to deliver the service over the next five years.

The facility will include new state-of-the-art laboratory equipment and considerable expertise to enable academics from across the UK to study chemical structures at the scale of electrons, atoms and molecules. It will have the best single crystal X-ray diffraction facility in the world for small molecules.

Professor Phil Gale, new Head of the National Crystallography Service, says: "I'm delighted that the EPSRC National Crystallography Service will remain at Southampton for the foreseeable future – it demonstrates the confidence that the UK crystallographic community has in Southampton.

"The new facility draws on the expertise of the University's crystallography group. As well as providing a service to the UK science community, it will be available to Southampton students and staff to use for their research."

# In brief

## People power

Southampton social science researchers, in partnership with the University of Manchester, have shown it is possible to get citizens to do more to create a 'big society' in which people feel empowered and willing to make a difference.

The results show that, if approached in the right way, people are keen to take a positive role in their community, such as giving to charities, recycling, volunteering and discussing controversial topics that affect the community. The research team found that talking to people face-to-face was the best way to engage them in positive community action.

Professor Gerry Stoker from the University of Southampton comments: "We show citizens are willing to change their behaviour and do more to help themselves and others. But to make this happen, the government needs to be less paternalistic, more challenging to residents, and have higher expectations and a clearer understanding of what motivates citizens to take action."

The three-year project was funded by the Economic and Social Research Council and the Department of Communities and Local Government. The UK government is using this research to help develop policy in this area.

## Partnership to secure future maritime success

The University of Southampton will be leading research into ships of the future, thanks to a new partnership with BAE Systems Surface Ships.

New projects are expected to focus on improving and enhancing the design and construction of ships, including the next generation of warships. Southampton researchers and engineering students will be working on projects to ensure that ships are safer, more economical and more sustainable.

The partnership, announced in July this year, builds on existing links between BAE Systems Surface Ships and the University. It will involve reciprocal secondments between the company and University staff, industrial placements for master's students and long-term collaborative research.

Vice-Chancellor, Professor Don Nutbeam, says: "This formal partnership marks the culmination of an existing relationship between the University and BAE Systems, which combines excellence in education, research and business.

"We are delighted to have the opportunity to develop our long-established links in exciting new ways, enhancing Southampton's reputation in world-leading engineering and creating an environment for cooperative research and education in the long-term."

## Changing atmosphere is increasing space junk

Scientists from the University of Southampton have confirmed a long-term change in the Earth's upper atmosphere – possibly caused by the build-up of greenhouse gases. This is causing satellites and space 'junk', to remain in orbit for longer than expected.

Using data from 30 satellites from the past 40 years, Southampton postgraduate student Arrun Saunders has found that atmospheric density in the thermosphere has been decreasing at a rate of five per cent per decade at an altitude of 300km. The effect is even greater at higher altitudes.

Southampton researchers led by Dr Hugh Lewis and Dr Graham Swinerd have previously shown that this decreased atmospheric density can lead to more collisions between satellites and orbital debris. They suggest that international proposals to remove large items of junk may be much less effective if these atmospheric changes continue.

Hugh comments: "We rely on the atmosphere to provide us with a natural mechanism for removing debris so it's important to understand how changes in the atmosphere will impact on these proposed solutions."

## Geologists uncover clues on tsunamis

Scientists at the National Oceanography Centre, Southampton have uncovered clues showing why some undersea earthquakes generate huge tsunamis. In partnership with researchers from the US and Indonesia, the team's findings may help explain why the 2004 Sumatra Boxing Day tsunami was so devastating.

Four months after the Boxing Day tsunami, another strong earthquake occurred immediately to the south, but triggered only a relatively small tsunami that claimed far fewer lives.

Dr Simon Dean and his colleagues identified key differences between the earthquakes that could account for the occurrence of tsunamis. They found some unusual features that could have resulted in the 2004 earthquake rupture continuing much closer to the seabed, making a tsunami more likely.

"More work is needed, but our results could help develop new ways of assessing the risk of a tsunami in the future," says Simon.

The results are published in the journal *Science*.

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

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