

# Research

The University's research is world renowned for its quality and impact and covers a broad spectrum of disciplines. We tackle the world's most urgent issues head-on; issues such as health and disease, climate change, food security, energy, and social justice. Our academics are also engaged with the cultural life and history of nations, communities and individuals across the world; with the future of technology, science and medicine and the development of innovations in every field; and with the rich cross-pollination made possible by interdisciplinary fields such as nanotechnology, quantum cryptography, composite materials, stem-cell engineering, and complexity science.

## The University's priorities in this area are to:

- be recognised globally for the quality of our research;
- create a positive research environment and infrastructure that will attract and retain the highest quality researchers and postgraduate students worldwide;
- develop our portfolio of flagship and high-impact research, working across and between disciplines to answer important societal questions and contribute to the social, political, environmental and economic well-being of the region, the UK and the wider world;
- seek, manage and provide professional support for strategic relationships and alliances with key national and international partners – business and industry, the public sector, user communities, sponsors of research and policy-makers;
- play a leading intellectual role in enterprise, knowledge exchange and economic and social impact agendas, and continue to be a beacon of good practice and leader of innovation in the city and region;
- develop a sustainable portfolio of research informed by evidence-based leadership, management and administration and supported by high standards of governance.

## New centre for composite materials

A major new centre for innovation in composite materials, hosted and owned by the University of Bristol, is open for business. The National Composites Centre (NCC), a £25-million investment supported by the Department for Business, Innovation and Skills, the South West Regional Development Agency and the European Regional Development Fund, was formally opened by the Business Secretary, Dr Vince Cable, in November 2011.

Composite technology is transforming a wide range of industries, with applications to the manufacture of electric cars, tidal turbine blades, aircraft wings, medical equipment, and much more. The NCC will bring together dynamic companies and enterprising academics to develop new technologies for the design and rapid manufacture of high-quality composite products. It is also part of the High Value Manufacturing (HVM) Technology and Innovation Centre initiative, a network of world-leading technology and innovation centres that aim to transform the UK's capability for innovation.

The Centre has powerful support from industry members: AgustaWestland, Airbus, Rolls-Royce, GKN, Umeco and Vestas have already committed almost £5.5 million of work over three years. It is located at the new Bristol and Bath Science Park, in which the University is a key stakeholder, and which serves as a hub for many of the region's science and technology businesses.

## University Research Institutes

The academic year 2011/12 saw the formal approval by Senate and the University Planning and Resource Committee for the first two University Research Institutes (URIs), which serve as focal points for the wide-ranging research conducted at Bristol to tackle key global issues. The Cabot Institute, having been founded in 2010 to bring together research groups and individuals working on themes connected with global uncertainty and the environment, became the first URI; the second draws together the many strands of health research at the University and is a key player in Bristol Health Partners, a major new partnership (with the local NHS Trusts, Bristol City Council and the University of the West of England) that aims to improve healthcare services in Bristol by integrating, promoting and developing the city's strengths in clinical services, research, innovation and education. URI Health was launched in August 2012.

## Funding boost for creative industries

The University is a key partner in a new Knowledge Exchange Hub for the region. The Research and Enterprise in Arts and Creative Technologies Hub (REACT) for Bristol, the South West of England and South Wales is one of four funded by the Arts and Humanities Research Council (AHRC) to boost their respective regions' creative economy. Other partners in REACT are the Universities of Bath, Cardiff, Exeter and the West of England and the Watershed Arts Trust (and iShed). REACT will invest £3 million in up to 70 themed projects over four years.

## Research continued



The Business Secretary, Dr Vince Cable, opens the National Composites Centre.



A racehorse is put through its paces at the School of Veterinary Sciences in Langford.

### Cord blood could mend hearts

Stem cells from umbilical cord blood could help repair damaged heart muscle, according to a study led by Professor Raimondo Ascione (ChM 2007), Chair of Cardiac Surgery and Translational Research in the School of Clinical Sciences. The research, funded by the British Heart Foundation and the National Institute for Health Research, found that it is possible to expand up to seven-fold, *in vitro*, a rare variety of stem cells (called CD133+) from human cord blood and then grow them into cardiac muscle cells. The findings, published online in *Stem Cell Reviews & Reports*, could have major implications for future treatment following a heart attack.

### Partner abuse is 'normal' say disadvantaged youth

The levels of violence girls and boys from disadvantaged backgrounds experience in their partner relationships is revealed in research funded by the NSPCC and led by Christine Barter, Senior Research Fellow in the School for Policy Studies. The report, 'Standing on my own two feet', is the first in-depth look at violence in the intimate relationships of disadvantaged teenagers not in mainstream education. The researchers interviewed 82 boys and girls aged 13-18, some of whom had been

permanently excluded from school, or were young offenders or teenage mothers. Over half of the girls reported that they had been a victim of physical violence in at least one intimate relationship, and a quarter of boys said they had dated physically aggressive partners. Many appeared to accept violence as a normal, although unwanted, aspect of being in a relationship. The problem was highlighted in a Home Office teen violence campaign launched the same month.

### Archaeology + geology + biology = ant nests in four dimensions

A novel application of CT scanning technology has allowed an interdisciplinary team to create a four-dimensional picture of how ants build their nests – some of the most remarkable structures in nature. Nests are built collectively, through self-organisation and local interactions of ants with one another and their environment, but previous studies used plaster casts that destroy the nests.

Geologist Dr Nicholas Minter (BSc 2003, PhD 2008), archaeologist Dr Kate Robson Brown (BSc 2003, PhD 2008), and biologist Professor Nigel Franks used high-resolution CT scanning as a non-destructive way of imaging ant nests throughout the process

of their excavation. The resulting dataset – the first of its kind – showed that nest architecture is influenced by factors both social (the density of ants) and environmental (the structure of the sediment through which they tunnel).

### Jetlagged racehorses see the light

A study led by Dr Domingo Tortorese in the School of Veterinary Sciences has shown that racehorses can adapt very quickly to sudden shifts in the 24-hour light-dark cycle, such as those resulting from a transmeridian flight, with unexpected benefits to their physical performance.

In the first study of its kind, thoroughbred horses were housed in light-controlled rooms and put through a daily fitness programme for three months. They then experienced a shift in the 24-hour light-dark cycle that mimicked an easterly flight across seven time zones. The results showed that they adapted rapidly to changes in light, with no increase in their level of stress; instead, there were alterations in their endocrine systems favouring enhanced physical capacity. Consequently, the horses were able to run at full gallop for an additional 25 seconds before reaching fatigue. Since racehorses can be subjected to changes in daily light without travel being involved, these findings could help to reduce the level of injury in competitions. The research, in collaboration with the universities of Melbourne and Cambridge, was supported by a research grant from the Horserace Betting Levy Board and by a Wellcome Trust Equipment Grant.

### One step closer to a quantum computer

Researchers from the Centre for Quantum Photonics have developed a multi-purpose optical chip that represents an important step forward in the race to develop a quantum computer. The chip generates, manipulates and measures entanglement and mixture – two quantum phenomena which are essential driving forces for quantum computation.

The Bristol researchers, led by Peter Shadbolt, have shown for the first time that entanglement (a connection between two

distant particles) can be generated, manipulated and measured entirely on a tiny silica chip. They have also used this chip to measure mixture – an often unwanted effect, which can now be controlled and used to characterise quantum circuits. The 70mm x 3mm chip performs several experiments that would ordinarily need a large optical bench. It consists of a network of tiny channels which guide and manipulate single photons. Using eight reconfigurable electrodes embedded in the circuit, photon pairs can be manipulated and entangled, producing any possible entangled state of two photons or any mixed state of one photon. The researchers are now working on scaling up the complexity of this device.

#### 'Royal' coffin found in seaside museum

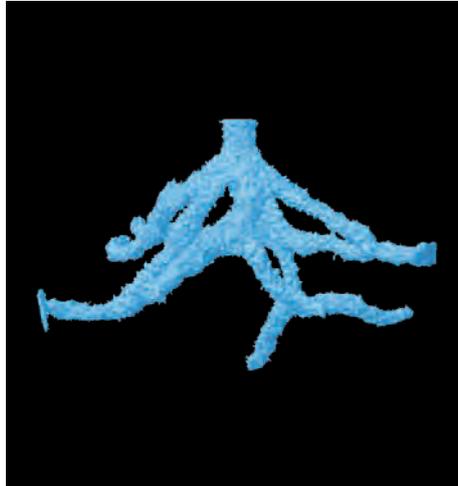
Dr Aidan Dodson, a senior research fellow in Bristol's Department of Archaeology and Anthropology, discovered an extremely rare Egyptian coffin at Torquay Museum while undertaking a long-term project to catalogue Egyptian coffins in English and Welsh provincial museums.

The child's coffin was cut from a single log of cedar wood and is exquisitely carved, inlaid and painted. Its present occupant is in fact nearly 1,000 years younger than the coffin itself, which may originally have been made for a junior member of royalty somewhere between 1525 BC and 1470 BC.

#### Bristol spin-out company AIMS high

Revolmer, the British polymer company co-founded by Professor Terence Cosgrove (DSc 1991) based on technology he developed at Bristol, was listed on AIM, the London Stock Exchange's international market for smaller growing companies. Revolmer conditionally placed a total of 25,000,000 Placing Shares with institutional investors at a price of 100 pence per Placing Share ("Placing Price") to raise gross proceeds of £25 million.

Its entire issued share capital (including the Placing Shares) was issued to trading on the AIM market of the London Stock Exchange in July 2012. Revolmer will use



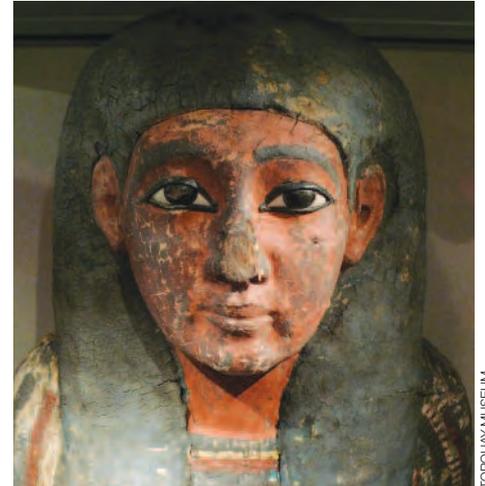
A CT scan of an ant nest.

the net proceeds of the Placing primarily to expand the distribution of its confectionery gum products in the USA and into Europe, to fund additional regulatory dossiers in connection with its nicotine gum commercialisation, and to fund the development of its consumer specialties products.

#### Bristol New Enterprise Competition

The winner of the University's 2011 New Enterprise Competition (organised to inspire new business ideas and entrepreneurial talent among students, staff and recent graduates) was Rusty Squid Ltd, whose team of roboticists, puppeteers and model makers design and build 'corporeal' creatures which can interact with people. Their 'soft robotics' creations have already proved popular with theatres and museums, and with marketing companies. Final-year Physics PhD student Brendan Arnold put Rusty Squid's business plan together and works alongside company directors David McGoran, Roseanne Wakely and Paul O'Dowd.

Second place went to students Sam Harris and Nishil Raichura for Pedal Power Transport, a courier and taxi business powered by people rather than petrol. They have specialised rickshaws which



The head of the coffin discovered at Torquay Museum.

allow them to make deliveries of people and parcels around the city, offering a high-quality, competitive and eco-friendly service.

Two teams of Engineering students shared third place: Cleatfit (Sam Barrett (MEng 2012), Madeline Burke (MEng 2012), Leo Morgan (MEng 2012), James Gray (MEng 2012) and Odysseas Pappas (MEng 2012)), a mechanical solution for cyclists to accurately replace the cleats that fasten their cycling shoes to their pedals; and Flare (Tim Ankers (MEng 2012), Laura Clare (MEng 2012), Will Tiley (MEng 2012), George Cusworth (MEng 2012), Dave Green (MEng 2012) and Claire Tobin (MEng 2012)), which designs organic cotton bags that use colour-changing technology to indicate when UV radiation from the sun has reached specific intensities.

This year's competition entries were judged by a panel of industry experts from sponsoring organisations including Deloitte, EADS, IP Group, Motorola, Santander, SETsquared Business Acceleration Centre (Bristol), Veale Wasbrough Vizards, and Wyvern Seed Fund.

## Research continued

### Grants

The University attracted a total of £126.4 million in grants during 2011/12. This included the following:

**£1.3 million** from the European Research Council (ERC) to Dr Paul Curnow (PhD 2003) in the School of Biochemistry for a study of minuscule algae cells that are able to produce silica – the fundamental constituent of glass – in the hope that his findings could lead to a new generation of medical imaging tools.

**£960,000** from the ERC to Professor Samir Okasha and Professor Ken Binmore in the Department of Philosophy for their project ‘Darwinism and the Theory of Rational Choice’.

Over **€3 million** (€2 million from the European Commission plus a €1.1 million CHIST-ERA award from European funding agencies including the EPSRC) to Dr Ruth Oulton and Professor John Rarity at the Centre for Quantum Photonics to address the problem of sending information in single quantum particles over global distances by using semiconductor devices on the nanoscale.

**£900,000** from the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC) as part of a larger grant for a collaborative study (with the universities of East Anglia, Oxford and Leeds, the British Geological Survey and the Overseas Development Institute, plus overseas partners) exploring better ways to forecast and cope with future volcanic eruptions.

**£2.7 million** from the Biotechnology and Biological Sciences Research Council (BBSRC), the State of São Paulo Research Foundation (FAPESP, Brazil) and the British Heart Foundation to a research team comprising members of the University of Bristol, the Bristol Heart Institute and the University of São Paulo, to explore possible new blood pressure treatments that target the nervous system.

**€500,000** to Dr Simon O’Doherty (MSc 1988, PhD 1991) in the School of Chemistry as part of InGOS (Integrated non-CO<sub>2</sub> Greenhouse gas Observing System), an EU-funded project to monitor emissions of methane, nitrous oxide and other non-CO<sub>2</sub> greenhouse gases and improve the observational infrastructure.

A total of over **£1 million** from Action Medical Research and the Medical Research Council to Bristol neuroscientists led by Dr Nadia Cerminara, Professor Richard Apps and Dr Richard Edwards to target childhood cancer, explore how the brain controls movement, and tackle the high-risk surgery involved in treating brain tumours in children.

**£246,000** from the Leverhulme Trust to Professor Sarah Street in the Department of Drama: Theatre, Film, Television for her project ‘Colour in the 1920s: Cinema and its Intermedial Contexts’.

**£200,000** from the Leverhulme Trust to Dr Jonathan Rossiter (BEng 1992, MSc 1996, PhD 2000) in the Department of Engineering Mathematics for his project ‘A robot that

decomposes: towards biodegradable robotic organisms’.

**£297,000** from the British Heart Foundation to the Bristol Heart Institute for a project led by Gavin Murphy, Reader in Cardiac Surgery, to develop blood transfusion methods that reduce the risk of organ injury during cardiac surgery.

**£750,000** from the UK Medical Research Council (MRC) for research led by Dr Ariel Blocker from the School of Cellular and Molecular Medicine (in collaboration with Dr Luca Giuggioli at the Centre for Complexity Sciences and Professor Keiichi Namba at the University of Osaka, Japan) into the mechanisms behind infectious diseases, focusing on how a dysentery-causing bacterium infects its human host.

Over **£640,000** from the EPSRC to Dr Martin Cryan in the Department of Electrical and Electronic Engineering (in collaboration with Dr Geoff Nash from the University of Exeter) to develop a new type of nanoscale lens technology that it is hoped will revolutionise the semiconductor laser (which powers the internet, laser machining, the defence industry and scientific research).