Research

The University's research activity tackles 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 institute addresses global uncertainty

Some of the most pressing environmental issues facing the modern world are to be addressed by the University's Cabot Institute, which was launched in November 2010 and brings together world-leading researchers in science, engineering, social sciences and law.

A discussion panel event marking the launch featured speakers including Sir Crispin Tickell, Director of Policy Foresight Programme; the Hon Sir Jonathon Porritt, Founder Director of Forum for the Future; Julie Hill of the Green Alliance; Brendon Gormley, Chief Executive of the Disasters Emergency Committee; and Professor Ric Parker, Rolls-Royce Director of Research and Technology. The first director of the Cabot Institute is Professor Paul Bates from the School of Geographical Sciences.

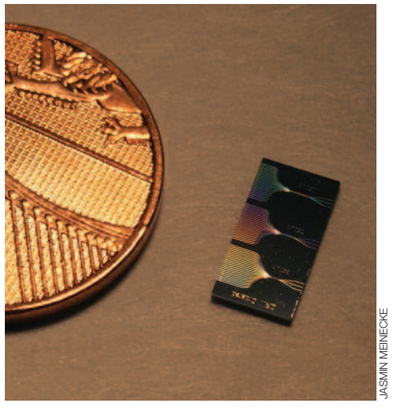
Historic China explored

The history of modern China before the Cultural Revolution is being pieced together by researchers including Professor Robert Bickers from the Department of Historical Studies, whose new book *The Scramble for China: Foreign Devils in the Qing Empire, 1832-1914* tells the epic story of foreign impact on China from the early 19th century to the start of the First World War. *The Sunday Times* praised the book as 'compelling, erudite and clear-sighted'. Professor Bickers is also the Director of the Historical Photographs of China (HPC) project, which after several years of collecting and digitising images has developed into the JISC-funded Visualising China, an online resource that offers access

PETER HIBBARD

Above: Young man on a 'motorbike' in a photographer's studio, probably in Shanghai, c1950. Print purchased in a junk shop, Jing'an district, Shanghai, 2010.

Research continued



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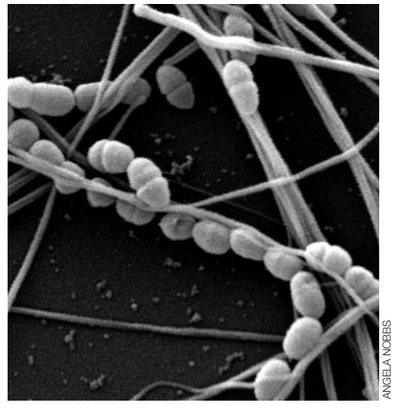

ANGELA NOBBS

Far left: A photonic chip next to a UK penny. The chip contains micrometer and sub-micrometer features and guides light using a network of waveguides.

Left: Streptococcal cells attached to collagen fibrils, illustrating another mechanism by which they may promote disease after entering the bloodstream – by binding to, for example, heart valves and causing blood clots.

to major collections such as HPC, the Sir Robert Hart Collection (Queen's University, Belfast) and Joseph Needham's Photographs of Wartime China (Needham Research Institute, Cambridge). Also featured are previously unseen and private collections and a Google Books library of China-related publications. Visualising China, a collaboration with the University's Institute for Learning and Research Technology, was launched in July.

Optical chip enables new approach to quantum computing

An international group led by Bristol's Centre for Quantum Photonics has developed a new approach to quantum computing that could represent a faster route to a quantum computer – a powerful type of computer that uses quantum bits (qubits) rather than the conventional bits used in today's computers, and can therefore hold and process a much larger amount of information at a greater rate. The group includes researchers from Tohoku University, Japan, the Weizmann Institute in Israel and the University of Twente in the Netherlands.

The technique developed in Bristol uses two identical particles of light (photons) moving along a network of circuits in a silicon chip to perform an experiment known as a quantum walk. A quantum computer based on a multi-photon quantum walk could be used to simulate processes governed by quantum mechanics, such as superconductivity and photosynthesis. Other possible applications include designing high-tech materials, new pharmaceuticals, and more efficient solar cells.

'The move to a multi-photon device is relatively straightforward, but the results will be just as exciting,' said Professor Jeremy O'Brien, Director of the Centre for Quantum Photonics. 'This is very much the beginning of a new field in quantum information science, and will pave the way to quantum computers that will help us understand the most complex scientific problems.'

Novel approach to chronic pain relief

A collaboration involving the universities of Bristol, Toronto and Seoul has found the basis for a novel approach to more effective, targeted relief of chronic pain caused by nerve injuries.

A protein molecule known as PKM zeta is required to store memories, and chronic pain involves a malfunctioning in this neural process, causing an individual to re-experience pain as the memory of it persists. The new research, having detected the cause of this malfunction, has identified a target for the treatment of neuropathic pain. By inhibiting PKM zeta in a part of the brain involved in the perception of pain in a mouse model, the international team has been able to eliminate the painful memory responsible for chronic pain.

Professor Graham Collingridge, from the University's MRC Centre for Synaptic Plasticity, and part of the Bristol Neuroscience network, said: 'It may be possible one day to treat some forms of chronic pain by inhibiting PKM zeta or other molecules involved in the storage of the painful memory. The challenge will be to target the drug so that it inhibits painful memories but not other forms of memory.'

'Jailbreak' bacteria can trigger heart disease

Bacteria that cause dental plaque can move from the mouth into the bloodstream and increase the risk of heart attack, according to research by the School of Oral and Dental Sciences and the Royal College of Surgeons in Ireland (RCSI).

'Poor dental hygiene can lead to bleeding gums, providing *Streptococcus* bacteria with an escape route into the bloodstream,' said Professor Howard Jenkinson. 'These bacteria use a protein on their surface, called PadA, as a weapon to force platelets in the blood to bind together and form clots. These completely encase the bacteria, providing a protective cover not only from the immune system, but also from antibiotics that might be used to treat infection. As well as helping out the bacteria, platelet clumping can cause small blood clots, growths on the heart valves (endocarditis) or inflammation of blood vessels that can block the blood supply to the heart and brain.'

The team is using a new blood-flow model, developed by Dr Steve Kerrigan at the RCSI, that mimics conditions in the human circulatory system, to investigate how the platelet-activating function of PadA can be blocked. This could lead to new treatments for cardiovascular disease, the biggest killer in the developed world.

UK researchers release draft sequence coverage of wheat genome

The first sequence coverage of the wheat genome has been released by a team of UK researchers, including Professor Keith Edwards and Dr Gary Barker at the School of Biological Sciences. This major step towards a fully annotated genome is a significant contribution to efforts to support global food security and to increase the competitiveness of UK farming. The work was funded by the Biotechnology and Biological Sciences Research Council (BBSRC).

The wheat genome is five times larger than the human genome and presents a huge challenge for scientists. These 'raw' draft sequences give scientists access to 95 per cent of all wheat genes (a complete copy of the genome requires further revisions, annotations and the assembly of the data into chromosomes). Understanding the genetic differences between varieties will enable development of new types of wheat better able to cope with drought or salinity, and to deliver higher yields.

This is one of the largest genome projects undertaken to date, and the rapid public release of the data (a condition of the original BBSRC support for this project) is expected to accelerate the use of the information by wheat breeding companies. The team also included researchers from the University of Liverpool and the John Innes Centre, a BBSRC-funded institute.

'Honour-based' violence study makes international impact

Research by Professor Gill Hague and Dr Nazand Begikhani from the School for Policy Studies into 'honour-based' violence and honour killings in Iraqi Kurdistan and the UK has earned plaudits from the Foreign and Commonwealth Office and the UN.

The study, conducted with colleagues from the University of Roehampton, assessed the nature and extent of such violence (which is carried out against family members, most often women, by other family members, most often men), and evaluated the impact of these practices on women's experiences in Kurdish communities. Attention was paid to cultural and family traditions, and to media representations of Kurdish ideas concerning gender relations and family honour.

The study was described by Alistair Burt, former Minister for the Middle East, as offering 'a roadmap to combating honour-based violence in Iraqi Kurdistan'. The Kurdistan Regional Government supported the study in order to get a better understanding of the nature and consequences of this violence and abuse, and the findings have already led to legislation to reduce violence against women and crimes in the name of honour.

Bristol New Enterprise Competition

The winner of the University's 2011 New Enterprise Competition (organised by Research and Enterprise Development to inspire new business ideas and entrepreneurial talent among students, staff and recent graduates) was Avishek Banerjee, a teaching assistant in the Department of Mechanical Engineering, for SunHub, which aims to provide sustainable lighting to the poorest communities in rural India. Small solar panel charging stations can provide enough electricity to charge low-power LED lanterns, giving customers a higher quality lighting service at a lower price than the existing kerosene lamps.

Above: An ear of wheat being prepared for pollination and crossing in the glasshouse, School of Biological Sciences.

The second-place winners were Spyglass Technologies (Engineering Mathematics PhD student Oliver Payton, and Dr Loren Picco and Professor Mervyn Miles from the School of Physics), for a novel Atomic Force Microscope, considerably cheaper than the nearest competitor, which requires no special training to operate.

In joint third place were William Goodwin, a final-year civil engineer, for EventBand, which uses Radio Frequency Identification wristbands to provide proof-of-identity and cashless payment systems for festivals; and Mark Caldwell, a final-year computer scientist, for ChirpID, a smartphone application that identifies bird species from audible birdsong.

This year's competition entries were judged by a panel of industry experts from sponsoring organisations including Bristol City Council, Deloitte, EADS, Jones Lang LaSalle, IP Group, Motorola, Osborne Clarke, Santander, SETsquared Business Acceleration Centre (Bristol) and Wyvern Seed Fund.

Research continued

Grants

The University attracted a total of £105 million in grants during 2010/11. This included the following:

Over **£2 million** from the European Research Council to Professor Nigel Smart in the Department of Computer Science for an examination of the various methods designed to ensure that cryptographic protocols are secure. Cryptography is widely used to hide information and applications include cash machines, computer passwords and internet communications. The project will focus on advanced cryptographic protocols, which enable various security-related functions, such as identifying who you are, securing data, or performing a given operation securely. The protocols to be examined include those currently underlying mobile phone and internet communications, as well as in emerging areas such as electronic voting.

Over **£1 million** to Dr Morag McDermont at the Law School by the European Research Council for a four-year investigation into how UK advice agencies (principally Citizens Advice) mediate between citizens and the practices of law, in order to understand how people experience law in their everyday lives.

£800,000 to Professor Derek Offord in the Department of Russian from the Arts and Humanities Research Council to conduct the first large-scale history of the French language in Russia, from the early 18th century, through its rise as the language of the political and social elite, to its decline following the October Revolution of 1917.

Over **£2 million** from the Medical Research Council for a project in the School of Physiology and Pharmacology looking into the neural network basis of learning, memory and decision-making in health and disease. The majority of the grant will fund Dr Matt Jones' research into the use of electrical stimulation techniques to control the brain's electrical signalling and improve cognitive performance in patients with schizophrenia and other disorders.

£6 million over six years from the Engineering and Physical Sciences Research Council to a team from the University's Advanced Composites Centre for Innovation and Science (led by Professor Michael Wisnom) and the Composites Centre at Imperial College London (led by Professor Alexander Bismarck) to develop a new generation of high-performance, fibre-reinforced polymer composites. Current materials, though strong and stiff, are inherently brittle, and failure can be sudden and catastrophic. More robust materials will provide greater reliability and safety, reduced design and maintenance requirements, and longer service life.

£1.2 million from the National Institute for Health Research for a survey of the types of treatment available for pre-school children with speech and language difficulties. The study – the first of its kind in the country – will be led by Professor Sue Roulstone (Research Fellow in the School of Clinical Sciences and Clinical Research Director at the Speech and Language Therapy Research Unit at Frenchay Hospital) and carried out by North Bristol NHS Trust in partnership with the universities of Bristol and the West of England and Manchester Metropolitan University. Barnardo's and Afasic England are also supporting the project.

Almost **£0.5 million** to a team led by Professor Mark Duffield from the University's Global Insecurities Centre in the School of Sociology, Politics and International Studies and Dr Sarah Collinson of the Humanitarian Policy Group, Overseas Development Institute, London, for a project on risk management in conflict-affected states. The two-year project, which began in October 2010, is funded by the Department for International Development and the Economic and Social Research Council as part of its Security, Conflict and Development theme.