

RESEARCH

Research at Bristol includes much that is of public benefit. The University's activity is engaged in the fullest sense: engaged with urgent issues such as disease, climate change, energy, social justice, natural resources and the welfare of the individual; engaged with the cultural life and history of nations and communities across the world; engaged with the future of technology and science and the development of innovations in medicine, nanotechnology, quantum cryptography, composite materials, stem-cell engineering and other emerging fields.

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.

Strong showing for Bristol in Research Assessment Exercise

The results of the 2008 Research Assessment Exercise (RAE), an independent assessment of the quality of research in UK universities, confirmed the University of Bristol as a world leader in research.

The RAE, a rigorous exercise carried out on behalf of the higher education funding bodies, helped the Higher Education Funding Council for England to determine how more than £1.5 billion in research funding would be allocated annually. Over 90 per cent of eligible staff at Bristol were included in the University's RAE submission – thought to be one of the highest percentages in the sector.

Over 61 per cent of the research work assessed in 48 research fields at Bristol was awarded either the top 4* rating, defined as 'world leading', or the 3* rating, classed as 'internationally excellent'. The quality of Bristol's research in geography emerged as first equal with Cambridge in the UK.

Epidemiology and public health, health services research, chemistry, mathematics, drama, mechanical engineering, economics, accounting and finance, aeronautical engineering and sports-related studies are among other research areas in which the University achieved particular distinction.

Bristol's faculties of Science and Engineering performed exceptionally well, but there were areas of outstanding research performance across all six faculties.

Taking into account the 2* rating – defined as 'recognised internationally' – as well as the 3* and 4* ones, nearly 93 per cent of research at Bristol was deemed to be of international standard.

Adult stem-cell breakthrough

Academics from Bristol played a key role in a breakthrough in stem-cell research that was announced in November 2008. Professor Anthony Hollander from the Department of Cellular and Molecular Medicine and Professor Martin Birchall from Clinical Science at South Bristol were part of a pan-European team that achieved a breakthrough in tissue engineering using adult stem cells, leading to a life-saving transplant operation. A young woman's diseased trachea was replaced by a length of cartilage grown from the patient's own stem cells in Professor Birchall's lab, and matured into cartilage cells using an adapted method originally devised by Professor Hollander for treating osteoarthritis. The operation was performed in June 2008 in Barcelona by Professor Paolo Macchiarini of the University of Barcelona.

The breakthrough gained global media coverage, and by April 2009 Professor Hollander had raised over £1.6 million to fund trials, including the first human study, of the pioneering 'cell bandage' technology, which aims to save thousands of patients from the type of knee surgery that currently leads to premature osteoarthritis. The trials will be conducted by the spin-out company he co-founded, Azellon Cell Therapeutics.

Found: world's earliest nuclear family

An international team including Dr Alistair Pike, Head of Archaeology at Bristol, and PhD student Hylke de Jong, has uncovered the earliest evidence of a nuclear family, dating back to the Stone Age. A 4,600-year-old grave excavated at Eulau in Germany contained a female, a male and two children, buried facing each other – an unusual practice in Neolithic culture.

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Using state-of-the-art genetics and isotope techniques, the researchers established that the group consisted of a mother, father and their two sons. This provides the oldest molecular genetic evidence in the world of a nuclear family and fills in an important gap in our knowledge of human social evolution.

Quantum cryptography sets new standard in 'unbreakable' encryption

A Bristol team led by John Rarity, Professor of Optical Communication Systems in the Department of Electrical and Electronic Engineering, is one of the partners in a Europe-wide project to establish a secure communications network using quantum cryptography. The network was demonstrated for the first time in October 2008 in Vienna.

The encryption process uses quantum cryptography to generate and distribute 'keys' that encrypt confidential communications with the highest level of security ever achieved. Potential users of this network include government agencies, financial institutions or companies with distributed subsidiaries.

Work transformed: new study earns plaudits

An acclaimed new book by Kevin Doogan, Jean Monnet Professor in the School for Policy Studies, examines the undercurrents of the new global economy and challenges conventional thinking about the causes of the current economic crisis. *New Capitalism? The Transformation of Work* looks at the modern economic landscape through the lens of the labour market, examining themes such as globalisation, technological change, and the pension and demographic time-bombs.

Professor Doogan takes issue with the prevailing view that the more precarious world of so-called 'new capitalism' is the result of rapid technological change, the mobility of multinational capital and the privatisation of the welfare state. His book includes a comprehensive analysis of developments in Europe and North America,

and concludes that the precariousness of employment is not a natural consequence of the new global economy but is manufactured, emanating from neoliberal policy that advocated greater exposure of the economy to market forces and encouraged extraordinary levels of financial speculation, consumer debt and over-production.

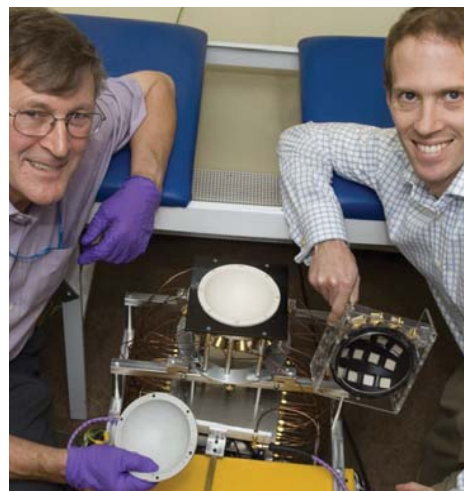
Professor Doogan explains that the book, which has received huge critical acclaim around the world, 'aims both to counter despair and to contribute to the restoration of rationality in the management of economic affairs'.

Breast cancer screening transformed by radio waves

A revolutionary new technique for breast cancer screening, which has been in development at the University for several years, began trials at North Bristol NHS Trust in November 2008.

Alan Preece, Emeritus Professor in Medical Physics at Clinical Science at South Bristol, has been collaborating with Professor Ian Craddock from the Department of Electrical and Electronic Engineering to develop a breast-imaging machine that uses radar. Their prototype adapts the pioneering work of Bristol's Professor Ralph Benjamin on landmine detection. It produces a detailed, 3D image of the breast in less time – and with much greater comfort for the patient – than either a mammogram or an MRI scan.

It is hoped that the new technique, developed with funding from the Engineering and Physical Sciences Research Council and the trustees of University Hospitals Bristol, will prove successful enough to be commercialised via Micrima Ltd, a University spin-out company.



Top: A still from the Chamber of Demonstrations (see p11)
Bottom: Professors Alan Preece (left) and Ian Craddock with their breast cancer screening prototype

Bristol chemists make liquid protein

Chemists at Bristol have created the first known example of a liquid protein, opening up the possibility of a number of medical and industrial applications.

Professor Stephen Mann and Dr Adam Perriman, along with Helmut Cölfen of the Max Planck Institute for Colloid and Interface Research in Germany, made a liquid form of the iron-storage protein, ferritin, by modifying its surface. The resulting highly concentrated protein could pave the way for a new generation of protein-based pharmaceuticals, sensors, coolants and lubricants.

DVD sheds new, detailed light on Jacobean theatre

Professor Martin White and colleagues in the Department of Drama: Theatre, Film, Television have made a major contribution to our understanding of theatre history, with a DVD reconstruction of a candlelit Jacobean playhouse. The Chamber of Demonstrations (an outcome of a project funded by the Arts and Humanities Research Council) features high-definition (HD), multi-angle footage of scenes from *The Duchess of Malfi*, *The Changeling* and other works, performed by classical actors in costumes from Shakespeare's Globe. The DVD, produced by Ignition Films, includes a wealth of supporting material on 17th-century English drama practice and is one of the first HD DVDs to be created specifically as an academic research and teaching tool.

Virtual chemical labs bring safety to school science

Learning Science Ltd, a start-up company based in the University's SETSquared Business Acceleration Centre, has launched a groundbreaking chemistry e-learning tool developed at Bristol. The LabSkills Schools Dynamic Lab Manual (www.labskills.co.uk), the result of a collaboration between Bristol ChemLabS and teachers from Southampton, Bristol, Leicester and Sheffield, allows trainee chemistry teachers and their pupils to watch or carry out 'virtual'

experiments, practise the techniques and make mistakes – all before they tackle the real thing.

Interdisciplinary work

Interdisciplinarity, currently a buzzword in academia, has for some time been a major component of the University's research strategy, with many instances of collaboration across disciplines that have already yielded concrete, highly beneficial outcomes (see, for example, the work on breast cancer screening, p10). At the organisational level, the University has invested heavily in establishing a number of new centres and networks to make the walls between disciplines more permeable, and to create opportunities for imaginative collaboration between disparate researchers. Here are just a couple of examples.

Institute for Advanced Studies

The University's Institute for Advanced Studies (IAS) promotes and encourages interdisciplinary research at Bristol, facilitates visits by distinguished international scholars and creates conditions for collaboration and the generation of ideas that otherwise might not see the light of day. Its programme of fellowships, Benjamin Meaker Visiting Professorships, workshops and other events forms the framework for a vigorous and lively culture of discussion and exchange between individuals, disciplines and institutions.

A notable instance of the work of the IAS is its hosting of the Water and Health Research Centre (WHRC), an interdisciplinary partnership between all six University faculties that provides a research focus for over 30 academic staff in 13 different departments. The largest WHRC project is AQUATEST, an international programme (funded by the Bill & Melinda Gates Foundation) to develop and distribute an easy-to-use, low-cost device for testing water quality in developing countries. In 2008/09, other WHRC projects making significant headway included a collaboration between Bronwen Morgan, Professor of

Socio-legal Studies in the School of Law, and FRANK Water, a locally based social-enterprise company, to study and improve the delivery of FRANK's support of community-run clean water projects in India and Africa.

Bristol Neuroscience

Bristol Neuroscience (BN) is a focal point for the University's neuroscience community. It enables neuroscientists working at separate sites to make full use of the expertise and facilities within the University and its partner hospitals and to create opportunities for collaboration across disciplines. BN's co-ordinator, Dr Anne Cooke, also organises public lectures and other events.

BN is affiliated to the Institute for Advanced Studies, has close links with the local NHS Trusts and works in partnership with the Cardiff Neurosciences Centre via the Bristol-Cardiff Neuroscience Collaboration. This latter initiative has established Young Neuroscientists' Day, a highly successful networking event for early-career UK neuroscientists. Autumn 2008 saw the second of these annual events, hosted by Cardiff University and featuring workshops, mini-symposia and a plenary lecture by Dr Sarah-Jayne Blakemore from University College London.

Among many illustrations of the fertile environment fostered by BN is a recent discovery by three scientists from different departments that suggests a new approach to the treatment of multiple sclerosis (MS). Professor David Wynick in the Henry Wellcome Laboratories for Integrative Neuroscience and Endocrinology, who works on the function of a neuropeptide called galanin in the relief of neuropathic pain, wanted to investigate whether galanin might play a role in the treatment of MS. A BN symposium provided the opportunity to discuss his ideas and propose a collaboration with David Wraith, Professor of Experimental Pathology in the Department of Cellular and Molecular Medicine, and Neil Scolding, Burden Professor of Clinical Neurosciences in Clinical Science at North



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Bristol. Their tests showed that mice bred to produce high levels of galanin were completely resistant to an MS-like disease called experimental autoimmune encephalomyelitis. This and other results provide powerful insights into how MS might be treated in humans.

AN EYE TO BRITAIN'S FUTURE

The University recognises its responsibility to help improve the future of the UK population – our health, our infrastructures, our preparedness for new challenges. In December 2008, as part of a £250-million initiative to create 44 training centres across the UK, the Engineering and Physical Sciences Research Council announced funding of over £24 million for four new centres at Bristol that will train the scientists and engineers needed for Britain's future:

The Advanced Composites Centre for Innovation and Science

(based in the Department of Aerospace Engineering)

The Doctoral Training Centre in Functional Nanomaterials

(based in the new Centre for Nanoscience and Quantum Information)

The Holistic Doctoral Training Centre for Chemical Synthesis

(based in the School of Chemistry)

The Industrial Doctorate Centre in Systems

(based in the Faculty of Engineering)

Supporting research

Staff in Research and Enterprise Development (RED) work with University colleagues, students and external partners to support world-class research and enterprise, and to develop a sustainable portfolio of activities that strengthen and underpin the University's research base. The RED team provides training and advice on entrepreneurship, knowledge transfer and the exploitation of research and expertise. RED also holds the annual New Enterprise Competition, which is judged and sponsored by local government and national businesses.

SETsquared

RED manages the University's SETsquared Business Acceleration Centre, part of the SETsquared Partnership, which also includes the universities of Bath, Southampton and Surrey and is now the UK's largest enterprise collective, with some 6,500 researchers. The Centre draws on in-house expertise and a wide network of seasoned entrepreneurs, investment advisers, professional services firms and academics to provide support for emerging technology companies, accelerate growth and pre-empt the common pitfalls of technology businesses. The Centre was named 'Established Business Incubator of the Year 2008' by the UKBI, the professional body for the business incubation industry.

It was reported late in 2008 that 12 of the companies in the University's SETsquared Business Incubator had between them raised over £23 million in the Centre's busiest year since its inception in 2002. The Centre's 37 early-stage, high-tech, high-growth businesses together increased turnover by 20 per cent to over £6 million and increased headcount by 66 per cent to 175 people.



Top: Professor David Wynick (see p11)
Bottom: The first cohort of students in the Holistic Doctoral Training Centre for Chemical Synthesis

Left: Professor Bronwen Morgan (left) and PhD student Sarika Seshadri, who are helping FRANK Water to develop its support of clean water projects in India and Africa (see p11)

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New Enterprise Competition

The winner of the 2009 New Enterprise Competition was Jennifer Griffiths, a fourth-year student in the Department of Computer Science, for Snap-Fashion, a new website that uses a number of image processing techniques to provide a 'pictorial search engine' for fashion items. The prize included £15,000 plus six months' managed office space at the Bristol SETsquared Business Acceleration Centre and free legal advice from Bristol law firm Osborne Clarke.

The joint runners-up were:

- Srilakshmi Sharma, a member of staff in the Department of Ophthalmology, for Selo, a low-cost device that increases the efficiency of eye injections to treat macular degeneration, a major cause of blindness, potentially saving the NHS some £50 million per year;
- Engineering Mathematics undergraduate Edward Matos for Shamba Technologies, a social enterprise that will distribute biodigester technology among the rural poor of developing countries, introducing a fuel source derived from livestock excrement – a cleaner alternative to the firewood that causes disease and death for thousands every year through smoke inhalation.

The 2009 competition entries were judged by a panel of experts from the sponsoring organisations, including Bristol City Council, Business Link, Deloitte, EADS, Edwards, Ginko Investments, IP Group, North Bristol NHS Trust, Osborne Clarke, Santander and Wyvern Seed Fund.

GRANTS

The University attracted a total of £102 million in grants during 2008/09. This included the following:

£1.5 million in Doctoral Training Grants from the Biotechnology and Biological Sciences Research Council to the Faculty of Medical and Veterinary Sciences for the training of postgraduates.

A European Research Council Advanced Grant of **€2.4 million** over five years to Professor Steve Sparks in the Department of Earth Sciences for a study of volcanoes and their environmental and social impact.

£1.1 million from the Medical Research Council for a study led by Chris Salisbury, Professor of Primary Health Care, to improve access to physiotherapy in the NHS.

Over **€2 million** in the form of a five-year European Research Council Advanced Grant to Jeremy Henley, Professor of Molecular Neuroscience in the Department of Anatomy, for a study of brain proteins entitled 'Mechanisms and consequences of synaptic SUMOylation in health and disease'.

£1.2 million over three years from the Biotechnology and Biological Sciences Research Council to David Murphy, Professor of Experimental Medicine in the Henry Wellcome Laboratories for Integrative Neuroscience and Endocrinology, and Professor Julian Paton in the Department of Physiology and Pharmacology, for studies of gene expression and hypothalamic plasticity in response to dehydration.

An EC grant of nearly **€11 million** to an international consortium, including Paolo Madeddu, Professor of Experimental Cardiovascular Medicine at the Bristol Heart Institute, that seeks to understand the molecular mechanisms that impair wound-healing and organ repair in ageing

or ill patients. The ultimate aim is to find ways of enhancing the body's healing capacity and reducing chronic inflammation.

€1 million from the European Space Agency to a team including members of the Department of Aerospace Engineering working on the design of a reusable space plane, the SKYLON, that can take off from a conventional aircraft runway, carry over 12 tonnes into orbit and return to land on the same runway.

£0.6 million from the Economic and Social Research Council to Dr Maurizio Marinelli (Centre for East Asian Studies), Professor Robert Bickers (Department of Historical Studies) and Professor Nikki Cooper (a former Bristol academic now at Swansea University) for a three-year research project on colonial Chinese history, focusing on the northern Chinese port city of Tianjin.

£1.7 million from the Biotechnology and Biological Sciences Research Council to a team including Keith Edwards, Professor of Cereal Functional Genomics and Dr Gary Barker, Research Fellow in the School of Biological Sciences (along with researchers at the University of Liverpool and the John Innes Centre) to carry out an extensive genetic analysis of the wheat genome, with a view to increasing disease resistance, quality and yield.

Funding of **€1.0 million** from the energy company E.ON to Dr Neil Fox from the School of Chemistry and the Department of Physics for a project to exploit solar heat to produce electricity using devices called thermionic energy converters. Dr Fox is developing special electrodes for these converters using nanoparticles of industrial diamond powder, which is low-cost and readily available.