

bioscience: biomillions

Delivering impact from research

May 2008

BIOSCIENCE: Delivering
Impact
BIOMILLIONS From
Research

bbsrc
biotechnology and biological
sciences research council

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about us

The Biotechnology and Biological Sciences Research Council (BBSRC) is the leading UK funding agency for research across the biosciences. Funded through the Government's Science Budget, BBSRC annually invests over £400M in a wide range of research that makes a significant impact on the UK economy and wider society, as this brochure illustrates.

BBSRC works collaboratively with its sister Research Councils through Research Councils UK (www.rcuk.ac.uk). We carry out many activities in support of knowledge transfer and research commercialisation in this way, for example through the RCUK Economic Impact Group, and through schemes such as the RCUK Business Plan Competition. In addition, BBSRC works with individual Research Council partners and others, for example, in Follow-on Funding, and Enterprise Fellowships.





welcome

Defining the economic and societal value of the outputs and outcomes of scientific research is rarely straightforward. At one extreme, hindsight might suggest that most technological and societal advances in a field may be attributed to a particular 'breakthrough' or paradigm shift – in which case the figures are so all-encompassing as to be largely meaningless. At the other extreme, assessment of 'hard cash' attracted in the short-term by a new avenue of research may seriously underestimate ultimate value that in some cases may be being realised in tangential applications.

Nonetheless it is important that we measure the impact of our research as sensibly as we can; not least because this helps to focus academic scientists on the broader context of their research and to harness the scientific benefits that can arise, for example, by collaborative working with industrial R&D and the business community. The analysis importantly helps in identifying and sharing best practice. Moreover, being open about our achievements, and their current and likely applications and implications, is an important part of how we account as a whole for public investment in bioscience research.



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In BIOSCIENCE:BIOMILLIONS we celebrate the success of close to 50 researchers who, with funding from BBSRC and others, are translating the UK's world-leading bioscience research into real outcomes. We present two types of 'exhibits': the big picture and the perspective from the lab bench. We have invited the researchers to estimate the value of impacts and outcomes. These total many millions of pounds and represent a substantial contribution to the UK economy.

One of the most encouraging features of this work is how, within a generation, leading researchers have engaged with the knowledge translation and commercialisation agenda. A focus on scientific excellence in UK bioscience would bring together virtually the same people as BIOSCIENCE:BIOMILLIONS. There is still more work to be done to get the message across that research of the highest quality is the driver, not an alternative, to an effective knowledge and technology-based society. This is something that UK bio-industries rely upon, and is a cornerstone of the 'excellence with impact' approach we are taking through the BBSRC.

Dr Peter Ringrose, BBSRC Chairman

May 2008

“We have invited the researchers to estimate the value of impacts and outcomes. These total many millions of pounds and represent a substantial contribution to the UK economy.”



BBSRC strives to encourage innovation, inventiveness and entrepreneurship among early career researchers and to foster talent.

the next generation

Amy Openshaw **Biotechnology YES**

Amy, from Newcastle University, together with her team from the 2006 Biotechnology Young Entrepreneurs Scheme competition patented a filter that removes viral infections from a mother's breast milk.

In 2007 what began as their hypothetical business idea became their real company. Osiris Biotechnology Ltd won the 'Science and Technology Achievement Award' giving them start-up funds.

Martin Wickham **Enterprise Fellowship**

Martin was awarded Follow-on Funding and an Enterprise Fellowship in 2006 to help him commercialise his research on human gut physiology and develop the Model Gut Technology. This 'state of the art' system enables the food and pharmaceutical industries to predict and test behaviour of real foods and medicines during digestion.

taking part

Bioscience: Biomillions draws together nearly 50 top academic researchers whose work has had an impact of the UK's economy and society.

Key

- Pharmaceuticals
- Healthcare
- Food
- Agriculture/Horticulture
- Regulations/Policy
- Chemical/Biological processing



● **Dr Riccardo Bennett-Lovsey**
Imperial College London

Equinox Pharma has developed a cost-effective machine learning system that rapidly screens potential new drugs, so that only the most promising go forward for testing. Equinox's rate of success is higher than that of any other drug screening methodology.



● **Prof Jim Beynon**
Warwick HRI

Why can some plants resist disease better than others? Jim is helping to answer this question by combining plant genomics with a systems biology approach. This is providing an holistic understanding of plant defences, which will help identify options to produce crop varieties that are less reliant on pesticides.



● **Prof Mervyn Bibb**
John Innes Centre

Antibiotics are essential in modern medicine. Not only has Mervyn developed technology now being applied by pharmaceutical companies to improve production and development of antibiotics, he also helped to found two spin-outs, Novacta Biosystems and Procarta Biosystems, to develop novel antibiotics to combat bacteria resistant to conventional antibiotics.



● ● **Prof Sir Tom Blundell**
University of Cambridge

Co-founded by Tom Blundell, Chris Abell and Harren Jhoti in 1999, Astex Therapeutics applies an innovative approach drug discovery. By 2003 Astex had raised US\$88M and forged partnerships with Astra Zeneca, Novartis and other big pharma. Astex has four molecules in clinical trials and promising cancer targets in its pipeline.



●
Prof Simon Bright
Warwick HRI

UK horticulture is worth £9Bn a year. Warwick HRI, and Director Simon Bright, have commercialised innovations ranging from tackling pest and disease attack on crops to peat substitution and waste recycling. These have helped to drive new markets and reduce the input costs and impact of intensive greenhouse production systems.



●
Prof Neil Bruce
University of York

Solvents used in chemical engineering are often both environmentally damaging and unsuitable for bio-based processing. Neil helped to found Bioniqs, which has developed novel ways of designing and optimising novel 'green' solvents to meet the needs of individual manufacturers. Bioniqs also supports IP licensing, scale-up and solvent supply.



●●●●●
Dr Jan Chojecki
Plant Bioscience Ltd

Plant Bioscience Limited's Managing Director, Jan Chojecki, has overseen the establishment of six spin-out companies and has a portfolio of over 80 innovations, many from research at BBSRC institutes. These include: cancer-fighting broccoli, drought tolerant crops, pharmaceutical screens and therapeutic compounds.



●●●
Dr Sam Deacon
Cardiff University

How therapeutics are 'packaged and delivered' to their site of action in the body is critical for their effectiveness. Sam and colleague Ruth Duncan have developed the first clinical trials of polymer-based therapeutics as anti-cancer agents, and are designing polymer-based systems that promote tissue repair and combat infection.



●●
Dr Suzanne Dilly
University of Warwick

Medicines can have unexpected and positive side effects. Suzanne's company a2sp Limited developed technology to exploit these side effects by screening current drugs against a huge library of potential targets. This re-profiling helps provide a source of low-risk, clinic-ready therapeutics.



●●
Prof Athene Donald
University of Cambridge

The micro-structure of food critically affects how the food can be processed and how it feels in the mouth. Athene is using innovative characterisation methods to reveal food microstructure and its effects. This will help manufacturers to optimise processing and develop healthier foods using novel textural replacement for fats.

tackling 'Super-bugs'

Each year in England and Wales around 5,000 people die from 'hospital acquired infections'. The two most prominent causes are methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile*, which are estimated to cost the NHS over £1Bn a year.

Research funded by BBSRC has helped underpin the establishment of several companies that are working on new antibacterial therapies and approaches.

ABsynth Biologics

Research by Professor Simon Foster and colleagues at the University of Sheffield has helped to identify a unique group of surface-exposed proteins of *S. aureus* that are essential for the bacterium's survival, and are very similar in all strains, including MRSA.

These proteins are good novel targets for a vaccine and for prophylactic or therapeutic antibodies to control infections. The combined market value of such treatments is estimated to reach around \$5Bn by 2020.

Prolysis

This antibacterial drug discovery and development company builds on research by Professor Jeff

Errington and colleagues at the University of Oxford, which identified proteins used uniquely by bacteria for cell division. These proteins are attractive targets for attack by novel therapeutics.

Proprietary whole-cell assays and state-of-the-art microscopy, as well as traditional antibacterial technologies, are used to test the effectiveness of compounds against new targets.

Novacta Biosystems Ltd

Spun-out from research led by Professor Mervyn Bibb and colleagues at the John Innes Centre, Novacta deploys a range of specialised approaches to rationally manipulate biosynthetic pathways in microbes so that they produce new bioactive products, for example against new targets in pathogens. The company has several programmes based around its proprietary lantibiotic derivatives.

Inspiralis Ltd

Researchers at the John Innes Centre have launched a new company, Inspiralis Ltd, based around their expertise in DNA topoisomerases. Inspiralis makes a range of topoisomerase products targeted to the pharmaceutical industry to enable drug discovery. Professor Tony Maxwell and his team have developed a new technique for rapidly screening the effectiveness of potential drugs in inhibiting topoisomerases.

Procarta Biosystems Ltd

Procarta aims to develop novel proprietary therapeutics against drug-resistant pathogens. It draws upon the expertise of scientists within the *Streptomyces* group at the John Innes Centre. Dr Michael McArthur and Professor Mervyn Bibb have developed a novel way of characterising the molecular 'switches' that turn *Streptomyces* and other bacterial genes on and off. This opens up the potential for targeting the switches that turn on the genes that make pathogens resistant to antibiotics.

DAVID SCHARF/SCIENCE PHOTO LIBRARY





●
Prof Jeff Errington
University of Newcastle

Jeff discovered a new class of proteins that only bacteria use for self-replication, and realised their potential as targets for novel antibiotics. He established a company, Prolysis, that has developed innovative screening technology to identify promising new antibiotics for use against bacteria resistant to conventional treatments.



● ●
Dr Richard Faragher
University of Brighton

It's well known that as people age they become more susceptible to diseases; just a very modest reduction in this susceptibility could save billions of pounds. Richard is identifying fundamental mechanisms underlying human ageing, with the ultimate aim of increasing the 'healthspan'.



● ● ●
Dr Steven Fish
**Institute of Biological,
 Environmental and Rural Sciences**

Evidence-based advice for policymaking to manage the efflux of greenhouse gases and water-polluting nitrates, improved silage inoculants and new oat varieties worth an estimated £40M annually are among the outputs from the former IGER (now the Institute of Biological, Environmental and Rural Sciences at Aberystwyth University).



● ● ●
Prof Sabine Flitsch
University of Manchester

The relatively unexplored medical field of glycotherapeutics has potential in diverse applications including cancer, infectious diseases, inflammation and neurodegeneration. Sabine has developed a screening technology that can help understand the role of carbohydrate-protein interactions in health and disease.



●
Prof Russell Foster
University of Oxford

The body's natural clock, our circadian rhythm, controls when we feel sleepy or alert. Russell's research into the processes that regulate sleep cycles has revealed important safety and efficiency implications for shift workers, students, and long haul passengers. This understanding could help to boost productivity and workplace safety.



● ● ●
Prof Robert Freedman
University of Warwick

Many new-generation pharmaceuticals are made in 'cell factories' – bacteria or yeast – that produce human proteins on a large scale. These proteins need to be folded correctly in the bacteria or yeast. Robert's work has increased our ability to make sure that this happens, potentially saving time, energy and resources.



Prof Peter Fryer
University of Birmingham

Peter applies chemical engineering principles to solve problems in food manufacture. This generates opportunities for low-fat foods with good texture, and for optimising processing parameters to minimise production 'downtime'. He is leading a £3.6M academic-industry consortium funded by the Technology Strategy Board to reduce the environmental impact of consumer goods manufacture.



Professor Don Grierson
University of Nottingham

Don identified genes that influence important quality attributes in fruits, and pioneered the use of 'gene silencing' to manipulate those involved in ripening. This provided new opportunities for growers and processors to improve product shelf life, reduce waste and ensure good eating quality for consumers.



Dr Robert Hancock
SCRI

The UK has a globally competitive blackcurrant industry. Robert has investigated how blackcurrants accumulate vitamin C. He has developed molecular markers that enable plant breeders to select rapidly for varieties that develop high vitamin C fruits. This will help UK growers maintain their competitiveness against competition from eastern Europe.



Dr David Hardman
Babraham Institute

Babraham Bioscience Technologies delivers Babraham's knowledge transfer remit through developing a campus with world class research and facilities that foster and stimulate commercialisation and knowledge transfer. Over 30 biotech companies that develop technology platforms, products and services now employ over 200 staff.

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**Prof Phil Haygarth
North Wyke Research**

Phil's research on diffuse pollution of water by agricultural activities helps to inform policy to meet regulatory requirements and mitigate pollution levels. It improves the quality of land and waterways. This benefits the farming and other land-use sectors as well as the quality of life for society in general.



**Prof Rod Hubbard
University of York**

For nearly 30 years Rod has been developing methods for visualising and exploiting the structure of protein molecules. His work has been pivotal in inter-disciplinary research that underpins research into new pharmaceuticals. This includes understanding the function of therapeutically important proteins and using this knowledge in structure-based drug discovery.



**Prof Doug Kell
University of Manchester**

The brewing, biotechnology and fermentation industries need to monitor the levels of yeast and other microorganisms in these harsh environments. Aber instruments, founded by Doug, produces a suite of patented biomass probes, and won the Queen's Award for Export achievement in 1998.



**Prof Tom Kirkwood
Newcastle University**

Increased life expectancy is one of the great achievements of modern society. However, along with this the elderly tend to spend more of their old-age in ill health. Tom's research explores the complex factors that underpin the ageing process with the aim of ensuring lifelong health for us all.



**Prof David Klenerman
University of Cambridge**

Inspired from basic research funded by BBSRC in the 1990s, David and colleagues at the University of Cambridge set up a single molecule high-speed DNA sequencing company, Solexa. First patents were filed in 1998, and just nine years later, in 2007, the company was purchased by Illumina for \$600M.



**Prof Jeremy Lakey
Newcastle University**

Orla, founded by Jeremy, develops diagnostic molecular components for use in disease diagnosis and in applications such as stem cell research. Based on BBSRC-funded science and supported through various BBSRC schemes, Orla now employs five people and has recently announced the joint development of new groundbreaking devices with Japan Radio Co Ltd.



Prof Peter Leadlay
University of Cambridge

Natural antibiotics from soil bacteria are potentially a huge source of novel antibiotics. Peter co-founded Biotica Technology to exploit a BBSRC-funded breakthrough in understanding how soil bacteria synthesise antibiotics. Biotica Technology's leading product is now in pre-clinical development.



Prof Lynne Macaskie
University of Birmingham

Lynne has developed a bacterial fermentation technology that converts sugary wastes from food manufacturing into hydrogen to power fuel cells. The bacteria also convert precious metals recycled from spent automobile catalysts into the expensive catalysts needed to drive the fuel cells. So, two wastes are converted into zero-carbon electricity.



Prof Anthony Maxwell
John Innes Centre

Founded on BBSRC-funded basic research, Tony's spin-out company, Inspiralis, provides drug-discovery reagents and screening services to the pharmaceutical industry. In partnership with Plant Bioscience Ltd, Inspiralis uses a new patented screening technique, which various companies exploit through non-exclusive licences.



Dr Richard Mithen
Institute of Food Research

Richard's research seeks to understand how naturally occurring phytochemicals found in fruits and vegetables can reduce the risk of cancer and heart disease. It has led to the development of new cultivars of broccoli with enhanced levels of specific phytochemicals, which are being taken forward for commercialisation by PBL and Seminis Inc.



Dr Gladys Pearson
Manchester Metropolitan University

In 1999 falls cost the United Kingdom Exchequer £981 million in NHS and Social Service costs. These were not only direct costs of treatment and care, but also indirect costs of lost productivity from carers. Gladys' research is geared at reversing disuse atrophy and thus improve independent mobility and prevent falls.



Prof Mike Peck
Institute of Food Research

Safe cooked chilled foods are expected and essential for many modern shoppers. By working with individual food companies, the industry as a whole and regulatory bodies, Mike's work has made a substantial contribution to this field.

Bioscience making a real difference...

Apart from its industrial and commercial potential, UK bioscience underpins a wide range of policy areas and wider social benefits.

to an ageing population

Research to understand natural ageing processes suggests new strategies for healthier old age. These include potential opportunities to:

- reduce falls in the elderly – by using routine exercise to slow down, and even reverse, some age-related changes in muscle function
(Manchester Metropolitan University)
- modulate levels of stress hormones to boost immune defence in the elderly and so reduce susceptibility to 'flu, pneumonia and other infections
(University of Birmingham)

to changing climate and landscapes

Research data underpin development of decision support systems that help farmers to optimise crop yields and reduce both input costs and impact on the environment under changing climate.

SIRIUS is a crop model that simulates wheat yields in response to climatic variations. It predicts, for example, that yield losses due to water stress decrease in future,

because wheat matures earlier in warmer climate avoiding summer drought.

(Rothamsted Research, with Crop and Food Research, New Zealand)

Predictive models indicate where, when and under what climatic conditions Bluetongue disease is likely to attack UK sheep and cattle. This enables surveillance and defensive action to be targeted to where it is most needed.

(Institute for Animal Health)

to developing countries

Applying knowledge about natural chemical signalling between plants and insects has helped farmers in East Africa use companion planting to reduce pest and weed attack on maize – increasing yields and providing fodder for livestock.

(Rothamsted Research & The International Centre of Insect Physiology and Ecology)

Cattle plague (Rinderpest) has been virtually eliminated in Africa thanks to technologies developed at the Institute for Animal Health. The net benefit to Africa is a least £1Bn per annum.



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Dr Martino Picardo University of Manchester Incubator Company

Martino, Manager of UMIC, has overseen the successful establishment of a number of spin-outs that have benefited from BBSRC funding, including Renovo, Gentronix and F2G. Martino has also been instrumental in setting-up BBSRC's North West Biotechnology Young Entrepreneurs Scheme.



Dr Stefan Przyborski Durham University

Stefan is founder and chief scientific advisor of Reinnervate Ltd. Basic bioscience research led to the development of a new technology to control the growth and function of cultured cells, particularly stem cells. Reinnervate exploits this technology and is working with major multi-nationals to market its products.



Professor David Rice University of Sheffield

Non-selective herbicides remain important, especially in water-conserving low tillage systems in countries facing drought as a result of global warming. David leads a project with an industrial partner that combines academic expertise in structural biology with the company's R&D on novel herbicides to control weeds resistant to existing products.



Prof Kevin Shakesheff University of Nottingham

Novel scaffold matrix technologies that aid the regeneration of tissues and organs, developed by Kevin and colleagues, led to the birth of the spin out company RegenTec Ltd. The company has since gone on to secure a host of grants and awards, developing a range of scientific and clinical products.



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Prof Martin Shirley
Institute for Animal Health

Globally, around one billion poultry a year are protected against the parasitic disease, coccidiosis, by a vaccine developed by Martin and colleagues at the Institute for Animal Health. Launched in 1989, Paracox became the biggest selling live attenuated vaccine against protozoan parasites.



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Prof Toni Slabas
Durham University

Raw materials from plants offer sustainable alternatives to some industrial oils. Toni's work is focused on generating such alternatives with the potential to supply raw material for the lubricant and polymer industry. Such alternatives would mean huge savings in carbon dioxide emissions.



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Prof Nigel Slater
University of Cambridge

Nigel is Director and co-founder of Cobra Bio-Manufacturing plc, which designs solutions for the production of preclinical and clinical proteins, viruses, DNA and cell products. Employing over 120 staff in Oxford and Keele, Cobra has completed contracts on 96 biopharmaceutical products for 36 global companies.



●

Prof Katherine Smart
University of Nottingham

The UK's only female Professor of Brewing, Katherine is key to a MSc level modular training for industry programme (supported by BBSRC and EPSRC). Her research includes the study of bioethanol fermentations with a view to generating model systems for strain screening and selection.



● ●

Prof Jenny Southgate
University of York

Based on understanding the basic biology of bladder cells, Jenny's research has led to the development of *in vitro* systems that mimic the human bladder's lining. This work has contributed to pre-clinical evaluation of drugs and the identification of diagnostic and prognostic markers for bladder cancer.



●

Prof Andy Taylor
University of Nottingham

Andy's research has led to technologies for measuring flavour release in foods. The food industry's application of these *in vivo* techniques has led to the reformulation of flavours in health foods. Andy's spin-out, Flavometrix, also provides short-term contract research to the food industry.



●
Dr Daniel Thorogood
**Institute of Biological,
 Environmental and Rural Sciences**

Studies into the genetic basis of the breakdown of the green pigment chlorophyll in leaves as they age, led Danny and colleagues to quantify a genetic trait that keeps grass green. Working with plant breeders this discovery has resulted in the commercial turf ryegrass, AberNile, incorporating the Staygreen[®] trait.



●
Prof Mick Tuite
University of Kent

The research of Mick and his collaborators led to a patented, and successfully licensed, generic technology for production of biopharmaceuticals. Applications have included: recombinant human albumin and albumin fusion proteins used to produce artificial human serum.



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Prof Richard Walmsley
University of Manchester

Richard's company, Gentrionix, has developed an innovative toxicity screening method for potential cancer hazards in early stage drug discovery and household product development. This helps reduce the number of compounds that require animal testing, in recognition of this Gentrionix won the 2007 Reduction Prize of the UK NC3Rs.



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Prof Christine Williams
University of Reading

Policymakers concerned with tackling heart disease, which remains a major cause of premature death in the UK, and the food manufacturing industry draw upon Christine's research. Her findings have revealed how different dietary fats raise blood lipid levels, and the knock-on effects for vascular health.



● ●
Prof Roland Wolf
University of Dundee

Research on pathways that define the sensitivity and efficacy of therapeutic drugs has resulted in extensive patenting, licensing and two spin-out companies. Roland helped start the Wyeth Translational Medicine Research Initiative. His research has led to new paradigms in drug development and contributed significantly to the concept of personalised medicine.



● ●
Prof Mike Young
Aberystwyth University

Basic microbiology from Mike's lab has led to innovations, awards and sale of marketing rights in areas as diverse as industrial enzyme production, fermentation with applications in renewable biofuels and potential targets for novel vaccines against TB, where the organism's dormancy and growing resistance are major problems.

BBSRC-sponsored research institutes

Sustainable Agriculture and Land Use

- John Innes Centre www.jic.ac.uk
- Rothamsted Research www.rothamsted.ac.uk

Animal Health and Welfare

- Institute for Animal Health www.iah.ac.uk

Biomedical and Food Sciences

- Babraham Institute www.babraham.ac.uk
- Institute of Food Research www.ifr.ac.uk

Systems Biology centres

- Centre for Integrated Systems Biology of Ageing and Nutrition (CISBAN) (University of Newcastle)
- Centre for Integrative Systems Biology at Imperial College (CISBIC) (Imperial College London)
- Manchester Centre for Integrative Systems Biology (MCISB) (University of Manchester)
- Centre for Systems Biology at Edinburgh (CSBE) (University of Edinburgh)
- Centre for Plant Integrative Biology (CPIB) (University of Nottingham)
- Oxford Centre for Integrative Systems Biology (OCISB) (University of Oxford)

BIOSCIENCE: Delivering
BIOMILLIONS Impact
From
Research

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