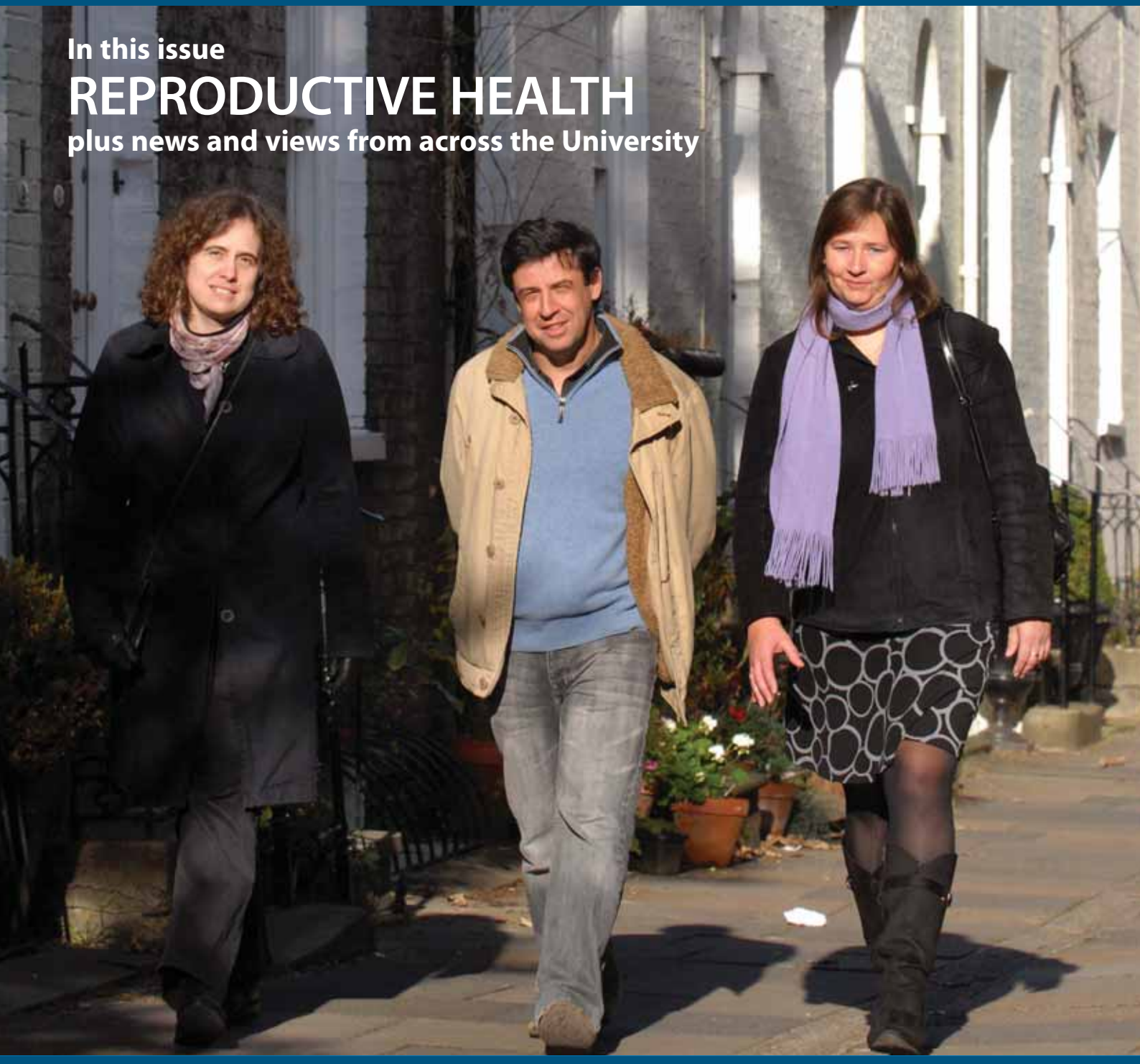
RESEARCH HORIZONS



In this issue

REPRODUCTIVE HEALTH

plus news and views from across the University

UNIVERSITY OF CAMBRIDGE
800 YEARS
1209 ~ 2009

University of Cambridge research magazine
www.research-horizons.cam.ac.uk

Issue 8 | Spring 2009

Welcome to the spring issue of Research Horizons at the start of a very special year for the University. From its early beginnings in 1209, when a small group of scholars settled in the city, to its current standing as one of the world's leading universities, the University of Cambridge celebrates 800 years of outstanding research and scholarship this year.

It's a celebratory time too for Research Horizons magazine, as we branch out from print to web. Research Horizons Online will continue to bring you the latest in research, discoveries and innovations but now in a fully searchable format, with links to related research activities and resources across the University. Why not take a moment to visit the website at www.research-horizons.cam.ac.uk and let us know what you think?

And in a year when we look back to the birth of the University and ahead to a healthy future, what better focus for our Spotlight section than Reproductive Health? Tying in with the Horizon Seminar on 1 April, this focus gives us the chance to find out about research in and around this most fascinating of biological processes.

Three contributors to the Spotlight section are shown on our front cover: Professor Anne Ferguson-Smith (left), Dr Miguel Constância and Dr Sue Ozanne. Their research exemplifies how fundamental studies at the molecular level are linking to physiological and metabolic outcomes with important clinical implications. At the heart of their work is a phenomenon known as epigenetics. The way that our DNA is packaged is inherited from our parents and their research is showing that this has implications for development *in utero* and beyond.

I hope that you find much to interest and entertain you throughout this issue. Many thanks go to all our contributors.

Louise Walsh

Dr Louise Walsh
Editor

KRISTIN GIUSSANI

Prenatal origins of heart disease

SCOTT POLAR RESEARCH INSTITUTE

Freeze Frame: through the eyes of the polar explorers

Contents

Cover photograph of Professor Anne Ferguson-Smith (left), Dr Miguel Constância and Dr Sue Ozanne (Photographer: Keith Heppell).
Edited by Louise Walsh.
Designed by Cambridge Design Studio (www.cambridgedesignstudio.org).
Printed by Cambridge University Press (www.cambridge.org).

Transforming Tomorrow: 800th Anniversary of the University of Cambridge

This year the University celebrates a remarkable history of research and scholarship that began in 1209.

The University of Cambridge has embarked on a year-long programme of celebratory events to mark 800 years as a seat of learning and academic research. The activities aim to strike a balance between commemorating the world-changing discoveries of the past, celebrating the achievements of the present and leaving a legacy for the future.

A striking example of Cambridge's academic achievements is the 83 Nobel prizes awarded to affiliates of the University for significant advances in physics, medicine, chemistry, economics, literature and peace. Cambridge ideas have shaped thinking across all the disciplines; Cambridge discoveries have changed our understanding of life, matter and the universe.

Highlighting the University's transformative research, a series of podcasts, vodcasts and films – 'Cambridge Ideas'– will showcase Cambridge academics nominated for their ability to inspire, innovate, discover, engage and achieve. Visit the 800th Anniversary website for more details.

An important component of the anniversary has been securing the future of education and research at the collegiate University. In 2005, Cambridge announced the public phase of the 800th Anniversary Campaign with the ambitious goal of raising £1 billion towards this future. Over £800 million has now been raised, funding new buildings, posts, programmes and Cambridge's collections and architectural heritage, as well as enhancing the financial support available for students, both at undergraduate and postgraduate level.

Examples of important new facilities that will enhance Cambridge's contributions in research and teaching include the Centre for the Physics of Medicine (see page 20), purpose-built facilities for the Institute for Manufacturing, the Hauser Forum (future home to Cambridge Enterprise Ltd and associated activities) and the new Sainsbury Laboratory for the study of plant development (see right). A series of prestigious professorships has also been endowed across a wide range of subjects including the Joseph Needham Professorship of Chinese History, Science and Civilization, the A G Leventis Professorship of Greek Culture and the Tata Steel Professorship of Metallurgy.

'Cambridge has never stood still and for almost 800 years has shown a remarkable ability to evolve to meet the challenges and grasp the opportunities that the future presents. Cambridge-educated graduates and Cambridge research have frequently transformed the world we live in,' said Professor Alison Richard, Vice-Chancellor of the University. 'The legacy of the 800th Campaign will be that Cambridge can make the investments that will ensure that a hundred years from now our successors will be able to celebrate Cambridge's achievements with the same pride we feel today.'

For more information, please visit the 800th Anniversary website (www.800.cam.ac.uk) and the 800th Anniversary Campaign website (www.foundation.cam.ac.uk/800-home.php).

Exceptional gift for plant science research centre

Cambridge will be home to a new research laboratory for the study of plant development.

The Gatsby Charitable Foundation has provided £82 million – the largest single gift received by the University since the launch of the 800th Anniversary Campaign – for a new building with state-of-the-art laboratory facilities situated in the Cambridge University Botanic Garden (CUBG).

Due for completion in late 2010, the Sainsbury Laboratory will house 120 scientists, and 30 additional staff, to study plant development. The Gatsby Charitable Foundation has given a further £2 million to support research fellowships in the Department of Plant Sciences and £2 million to fund the research of David Baulcombe, Professor of Botany, who was recently awarded America's highest research honour, the Lasker Prize.

The building will also provide a home for the University Herbarium, which contains over a million pressed and dried plant specimens from all over the world, including those collected by Charles Darwin on the *Beagle* voyage. This collection is a key resource in our understanding of plant evolution and biodiversity.

'This is one of the most exciting projects with which my Charitable Foundation has been involved,' said Lord Sainsbury. 'I believe it will soon become a world-class centre of excellent plant science.'

Professor John Parker, Director of the CUBG, added: 'The Garden looks forward in the 21st century to maintaining its position with the study of plant diversity in the most modern way. The laboratory will be dedicated to the advancement of curiosity-driven research.'

For more information, please visit www.botanic.cam.ac.uk

What do we think we are?

Would you like to hear the sounds deep within the body, consider the similarities between a funeral sculpture and the structure of DNA, or explore the classical idea of beauty?

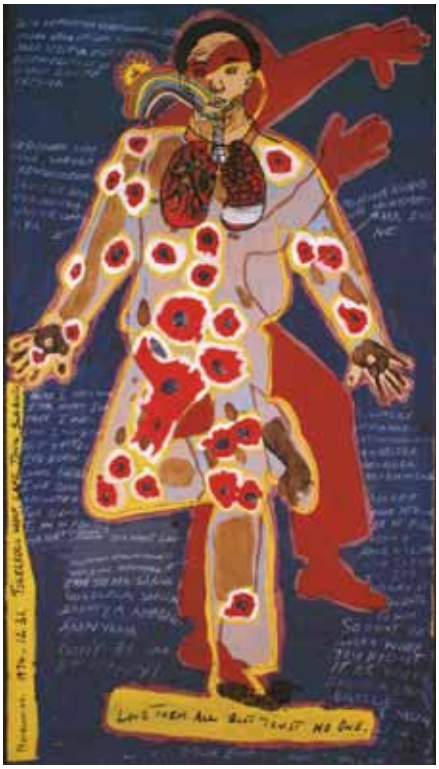
'Assembling Bodies', a major new exhibition opening in March at the Museum of Archaeology and Anthropology, challenges us to think in different ways about the human body. The exhibition explores how bodies have been considered in different time periods, cultural contexts and disciplinary perspectives, as well as the technologies through which bodies are made visible.

The exhibition is part of a five-year, cross-disciplinary research project – 'Changing Beliefs of the Human Body' – involving 15 researchers spread across the Faculty of Archaeology and Anthropology, the Faculty of Classics, and the Museum of Archaeology and Anthropology. This ambitious programme is a comparative history, spanning 10,000 years, of how and why humans change what they believe about the human body. Both the wider project and the exhibition have been funded by the Leverhulme Trust, with additional support for the exhibition provided by the Arts Council England (East) and the Wellcome Trust.

'The exhibition incorporates findings generated by the larger project but is also developing its own independent research,' explained Curator Anita Herle. 'The intention is to build bridges between disciplines that will lead to further study, as well as to provide a springboard for outreach events and artist workshops.'

One goal has been to showcase the extraordinarily rich and diverse collections within the Museum, the University and the Colleges. Alongside these fabulous artefacts will be commissioned artworks, including a unique collection of body maps painted by the Bambanani Women's Group in Cape Town, South Africa, documenting the lives of women with HIV/AIDS, and a soundscape of recordings from deep within the body.

'One of the fun things about this exhibition is that when you put very different objects together you provoke new kinds of ideas,' said Anita Herle. 'There is an intellectual challenge implicit in the contrast for instance between a Malanggan mortuary effigy and Watson and Crick's structure of DNA. Unexpected juxtapositions stimulate us to think about the body in new ways.'



MUSEUM OF ARCHAEOLOGY AND ANTHROPOLOGY

Body map created for the exhibition; these maps are life-sized images that trace the contours of the painter's body, articulating how they have been affected by HIV; the shadowy form of the person who has supported the painter hovers behind the image, indicating the crucial support needed from others (painted by Nondumiso Hlwele, Bambanani Women's Group, South Africa, MAA 2008.20)

'Assembling Bodies' opens in March 2009 and will run until November 2010 at the Museum of Archaeology and Anthropology (http://maa.cam.ac.uk). The exhibition is curated by Anita Herle with Mark Elliott and Rebecca Empson.

Research collaboration for mental health

A new £23 million partnership brings together the National Health Service (NHS) with four University departments to improve mental healthcare.

A partnership between the University, the County Council and a range of Cambridgeshire and East Anglian NHS healthcare commissioners and providers has been awarded funding for a Collaboration for Leadership in Applied Health Research and Care (CLAHRC). Hosted by the Cambridgeshire and Peterborough NHS Foundation Trust (CPFT), the CLAHRC is one of nine in the UK, and the only one to focus on mental health.

The funding comprises an award of £9.5 million by the NHS National Institute for Health Research (NIHR) to match £13.5 million of aligned funding from the NHS and County Council. It was made following open competition throughout England and Wales and review by an international panel.

CLAHRCs are collaborative partnerships between a university and the surrounding NHS organisations focused on improving patient outcomes through the conduct and application of applied health research. The Cambridge centre aims to test new ways of working in mental health to see if they are effective and appropriate for everyday use in the health service.

'This will be a true collaborative effort that efficiently and effectively harnesses research findings to clinical practice,' said Professor Peter Jones, Head of the Department of Psychiatry and Director of the centre. Alongside the Department of Psychiatry, the partnership involves the Department of Public Health and Primary Care, the Engineering Design Centre in the Department of Engineering and Judge Business School. A physical base is being established at Douglas House, Trumpington Road, Cambridge, where both University and NHS staff will work together. The CLAHRC Board, chaired by Karen Bell, Chief Executive Officer of CPFT, involves all the partners in this innovative venture.

For more information, please email CLAHRCoffice@cpft.nhs.uk

Funding for frontier research

Five Cambridge scientists have won funding from the European Research Council (ERC) that encourages applicants 'to go beyond established frontiers of knowledge'.

The ERC recently announced the results of its first pan-European Advanced Grants scheme, which has a total budget of €542 million. With the maxim 'Bringing great ideas to life', the ERC encouraged researchers to aim high, be adventurous and take risks in their proposals. The sole selection criterion was scientific excellence: applicants were expected to be the very best scientists, scholars and engineers, with a track record of significant research achievements.

Over 270 grants were awarded: 41.5% in Physical Sciences and Engineering, 30.5% in Life Sciences, 17.5% in Social Sciences and Humanities and 10.5% in Interdisciplinary Research. The UK won 59 grants, the highest number to be awarded across 23 countries.

In Cambridge, the five Principal Investigators who have won grants worth a total of approximately £8 million over five years are:

- Professor Graeme Barker (Department of Archaeology)
- Professor David Baulcombe (Department of Plant Sciences)
- Professor Tony Cheetham (Department of Materials Science and Metallurgy)
- Professor Daan Frenkel (Department of Chemistry)
- Dr Alan Tunnacliffe (Department of Chemical Engineering and Biotechnology)

Professor Ian Leslie, Pro-Vice-Chancellor for Research, said: 'This is a tremendous success – not only can the Principal Investigators now embark on ambitious research of the highest quality but they have been given due recognition as leading scientists in their fields.'

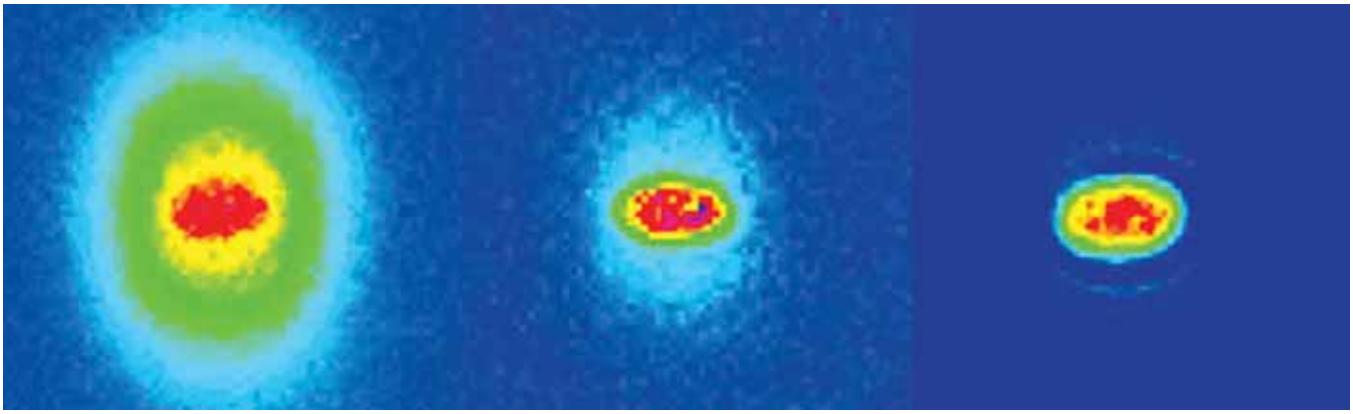
The ERC was established in 2007 by the European Commission and is funded through the 7th Framework Research Programme. In addition to the Advanced Grants, the ERC also awards Starting Grants to support the next generation of research leaders; this year eight were awarded to Cambridge researchers.

By challenging Europe's brightest minds, the ERC 'expects that its grants will help to bring about new and unpredictable scientific and technological discoveries – the kind that can form the basis of new industries, markets, and broader social innovations of the future.'

For more information regarding the ERC, please visit http://erc.europa.eu

Cool machines

At about a billionth of a degree above absolute zero, a machine built by the Cold Atoms Group at the Cavendish Laboratory is one of the coolest places on Earth.



DR MICHAEL KÖHL

Atoms collapsing into the quantum state known as the Bose–Einstein condensate

According to the laws of thermodynamics, absolute zero (–273.15°C) cannot be reached. However, Dr Michael Köhl's group in the Department of Physics has developed a laser-based method of cooling that has achieved almost absolute zero. At these ultracool temperatures, atoms trapped in the machine come to a standstill, allowing researchers to study their quantum nature.

'The ability to control and cool atoms by laser light has given a completely new twist to the traditional field of atomic physics in recent years,' explained Dr Köhl. 'Experimentally, it only became achievable a decade ago, but it has initiated a wave of research based on access to a microscopic understanding of quantum degenerate gases.'

The Cold Atoms Group has built a machine in which six interfering laser beams are directed via a small army of lenses through rubidium gas. The laser light slows down the gas atoms, which are then subjected to evaporative cooling in a magnetic trap. For the first time ever in Cambridge, the group has recently demonstrated a Bose–Einstein condensate – essentially, atoms at close to absolute zero that have collapsed into the lowest quantum state.

'The ultimate controllability of atoms in these states makes us optimistic about studying a whole range of phenomena linked to solid-state physics,' said Dr Köhl. 'Such research might provide solutions to unanswered questions in condensed matter physics and high-temperature superconductivity, as well as pave the way for quantum computers of the future.'

For more information, please contact Dr Michael Köhl (mk540@cam.ac.uk).

Останні новини!* Ukrainian Studies launched in Cambridge

A new initiative, the first of its kind in Europe, aims to deepen understanding of the language, literature and culture of Ukraine by advancing fresh and innovative approaches to research.

Its territorial borders define the eastern boundaries of the European Union, and its state language is spoken by over 40 million people worldwide. Yet Ukraine, Europe's second-largest country, remains a relatively unknown quantity in British universities. Now, thanks to a generous donation from Mr Dmitry Firtash, Ukrainian Studies has been launched in the Faculty of Modern and Medieval Languages under the leadership of Rory Finnin, newly arrived from Columbia University, New York. Trained in comparative literature, Finnin centres his research on the interplay of literature and national identity in Ukraine.

'Ukraine is in an important geopolitical position at the crossroads between East and West,' said Finnin. 'It has a vibrant literary tradition and a lively culture which, since its independence in 1991, has really begun to explore new directions. This is a very exciting time for scholars of Ukrainian literature and culture, and it's an excellent time for Cambridge to be formulating a programme to study this remarkable country.'

Although the initiative focuses on Ukraine's language, literature and culture, Finnin aims to foster a broader exchange with researchers from various disciplines that will enrich the study of Slavic and Turkic cultures, as well as nationalism and post-colonialism. 'The historic permeability of Ukraine's territorial, linguistic and ethnic borders provides an opportunity for us to explore the interdependency of the cultures of Eastern Europe and the Black Sea region,' explained Finnin. 'An interdisciplinary approach is being true to the region itself, whose historical reality is largely one of tolerance and cross-cultural penetration.'

Rory Finnin will work closely with CamCREES, the Cambridge Committee for Russian and East-European Studies, which facilitates interdisciplinary collaboration among scholars of the region, as well as the Centre for Research in the Arts, Social Sciences and Humanities (CRASSH).

'I am delighted that this initiative has given Cambridge an opportunity to explore such a complex and fascinating country,' said Simon Franklin, Professor of Slavonic Studies in the Faculty of Modern and Medieval Languages. 'Not only will it benefit Cambridge but it will undoubtedly promote the study of Ukraine further afield, in the UK and beyond.'

Rory Finnin

For more information, please contact Rory Finnin (ref35@cam.ac.uk) or visit www.cambridgeukrainianstudies.org.uk

***'News flash!'**

'Life Race' (etching based on scientific images) by Stefanie Reichelt, Cancer Research UK – Cancer Research Institute

A boost for family research

A team studying the psychological well-being of children created by assisted reproduction has been awarded a prize for their work.

A report on work carried out by the Centre for Family Research (CFR) was awarded the Fertility Society of Australia (FSA) Exchange prize at the European Society for Human Reproduction and Embryology conference in Barcelona.

The research is being carried out by Polly Casey, Lucy Blake, Jennifer Readings and Dr Vasanti Jadva, and is led by Professor Susan Golombok. With funding from the US National Institutes for Health (NIH), the longitudinal study is looking at parent–child relationships and the psychological well-being of children in families created by surrogacy, egg donation and donor insemination. The study is also examining whether and when parents decide to tell their children about their origins.

The CFR is based in the Faculty of Social and Political Sciences. 'To be awarded a prize for the best presentation at an international conference is a remarkable achievement for the Centre for Family Research given that the competitors were largely from the biological and biomedical sciences,' said Professor Golombok, Director of the CFR. 'The award enabled the researchers to travel to Brisbane to present a paper at the recent FSA conference.'

For more information, please contact Polly Casey (pc371@cam.ac.uk).

A full-length article on this study has been published in Research Horizons Online (www.research-horizons.cam.ac.uk).

Solar Decathlon Europe 2010

An interdisciplinary team has won the chance to participate in an international competition to design and build the best solar-powered home.

A team of undergraduate and graduate students led by Michael Ramage, University Lecturer in the Department of Architecture, and Dr Allan McRobie, Reader in the Department of Engineering, has started the countdown to unveiling a solar-powered home in Madrid in 2010.

Cambridge is one of 20 teams chosen to compete in this international competition, winning €100,000 towards the project from the sponsors, the Spanish government. Although this is the first competition of its kind in Europe, it builds on almost a decade of competitions in the US sponsored by the US Department of Energy.

The team's innovative proposal is the Integrated Design for Engineered Architecture (IDEA) Home – a modular system that can adapt to changing needs and climates. The prefabricated design can be assembled in different permutations and number, horizontally and vertically, giving maximum versatility. Modularity permeates the entire design, requiring the team to develop modular systems of energy production and consumption.

The project is being supported by ongoing research in the Departments of Architecture and Engineering, and will use innovative approaches developed across the University, such as photovoltaic cells, natural ventilation, energy-efficient design and computer-based monitoring. 'The truly excellent designs are those that combine cutting-edge technology with first-rate architecture,' explained Michael Ramage. 'Our ambition is to create a home with outstanding performance on energy efficiency, architectural and engineering design, sustainability and marketability.'

In June 2010, the team will take the IDEA Home to Madrid, where it will be judged by international experts and visited by tens of thousands of visitors. 'This is a remarkable opportunity to combine teaching with hands-on learning, basic research with applied practice, and novel insight with experience,' said Dr McRobie. 'Following the competition we will set up the home in Cambridge to monitor its performance over three years so that it can continue to serve educational and research purposes.'

For more information, please contact Michael Ramage (mhr29@cam.ac.uk). Additional funding is being sought for this project.

Building Physics and the Sustainable City

A conference in March will examine the contribution that building physics, engineering, science and architecture can make to the sustainable city.

By the middle of the century, it is expected that two-thirds of the world's population will live in urban areas. A two-day conference 'Building Physics and the Sustainable City', which takes place on 17–18 March 2009 at the Department of Engineering in Cambridge, aims to examine how engineering can shape the architectural and urban forms of the future.

'In aspiring to a sustainable world we need to aspire to sustainable cities,' said Randall Thomas, Visiting Professor for Building Engineering Physics. 'The field of building physics covers a spectrum of activities in the man-made and natural environments that can provide information on how best to design sustainable cities that are comfortable to live in.'

The conference is sponsored by the Royal Academy of Engineering, the Departments of Engineering and Architecture, and the BP Institute, and brings together leading academic specialists and renowned experts from industry. 'Building physics and energy-efficient cities is a growth area for the University,' said Professor Thomas. 'Through this conference, our intention is to encourage the research-active community to develop a long-range, holistic approach for building physics and sustainable cities.'

For more information, please visit www.rsd.cam.ac.uk/events/buildingphysics or email rsdevents@rsd.cam.ac.uk

More News stories published online…

Magnetic secrets of the Perseus Cluster: Top 100 Science Story

Unravelling a 100-million-year-old mystery about a giant galaxy deep in space has been listed one of *Discover* magazine's Top 100 Science Stories of 2008.

New Programme to facilitate Arctic geopolitics

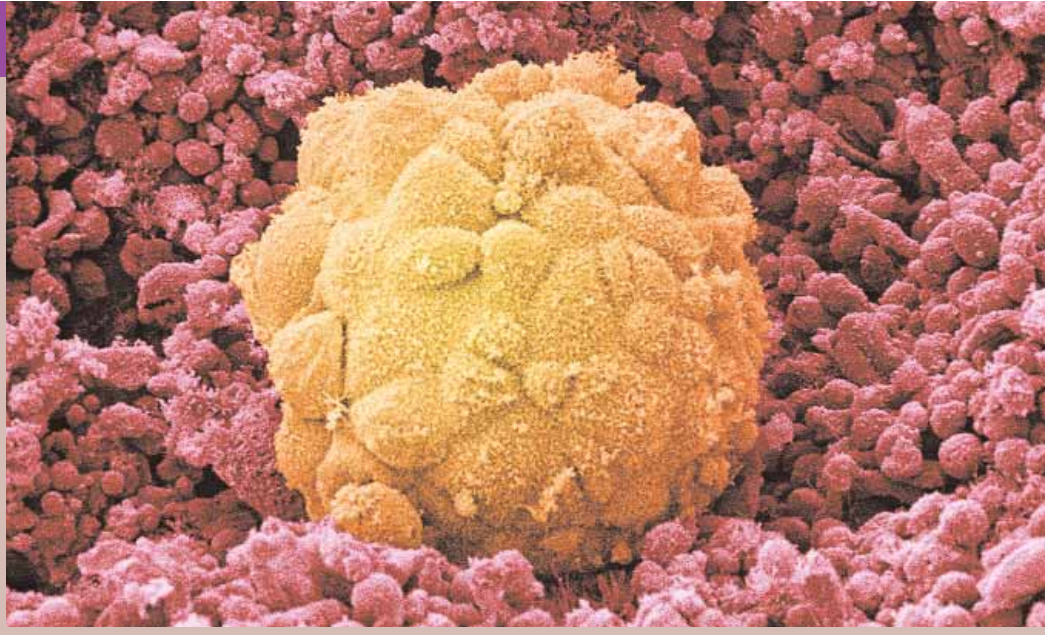
After millennia of sea-ice in the Arctic Ocean, the region is becoming increasingly ice-free during the summer. A new Programme aims to consider how an international decision-making framework might operate for the Arctic.

Innovation nation

What is the relationship between innovation and business performance, and how does this affect the national economy? The new UK Innovation Research Centre at Judge Business School will study how innovation can make businesses more competitive.

Please visit www.research-horizons.cam.ac.uk to view these stories and much more.

Reproductive Health



The Horizon Seminar 'Reproductive Health' takes place on 1 April 2009. In this introduction, Professors Gordon Smith and Graham Burton reflect on how this field encompasses some of the most fascinating of biological processes.

The past 50 years have seen many societal and technological changes in reproductive health. The ready availability of hormonal contraception has dramatically altered reproductive behaviour; the normal place of birth has moved from the home to hospital; Caesarean section, once the mode of delivery for a small proportion of women, is the method of birth for approximately a quarter of the current generation; and the management of infertility has been transformed by *in vitro* fertilisation, with more than 10,000 children a year now being born in the UK as a result of this process.

Our understanding of the physiological, pathological and clinical processes relating to reproductive health has also flourished. We now know that certain genes we inherit from each parent undergo complex reprogramming during formation of the eggs and sperm, and play key roles in regulating feto-placental growth. We have a deeper understanding of the immunological interactions that take place at the materno–fetal interface in the womb, and how these are vital for supporting the growth of the fetus. We also know that growth conditions in the womb can have long-term health effects, such as a higher risk for diabetes, obesity and cardiovascular disease.

Many research departments across Cambridge have been instrumental in unravelling these complex events. The Horizon event on 1 April aims to bring together representatives to showcase the advances Cambridge is making, as well as to strengthen the links that are providing successful translation between fundamental research and clinical outcomes. One such initiative that is fostering research collaborations across the University is the recently launched Centre for Trophoblast Research, which aims to promote the study of placental biology.

Reproductive disorders and unsuccessful pregnancies cause great distress to families. The societal and health economic burdens are also substantial, ranging from the costs associated with preterm births (estimated at $26 billion for a single year of preterm births in the USA) through to the costs of diseases later in life as a result of intrauterine complications. Improving our fundamental understanding of reproductive health, and translating these basic insights into clinical intervention, clearly has enormous potential to impact positively on the rest of society.

Professors Gordon Smith (left) and Graham Burton

Professor Gordon Smith is at the Department of Obstetrics and Gynaecology; Professor Graham Burton is at the Department of Physiology, Development and Neuroscience, and is Director of the Centre for Trophoblast Research. The Horizon Seminar takes place at the Centre for Mathematical Sciences, Cambridge, on 1 April 2009. For more information and to book online, please visit www.rsd.cam.ac.uk/events/reproductivehealth

Participating speakers

Professor Graham Burton, Dept of Physiology, Development and Neuroscience
Dr Stephen Charnock-Jones, Dept of Obstetrics and Gynaecology
Dr Miguel Constância, Dept of Obstetrics and Gynaecology
Professor Doug Easton, Cancer Research UK Genetic Epidemiology Unit, Strangeways Research Laboratory
Professor Anne Ferguson-Smith, Dept of Physiology, Development and Neuroscience
Dr Dino Giussani, Dept of Physiology, Development and Neuroscience
Professor Ashley Moffett, Dept of Pathology
Dr Sue Ozanne, Metabolic Research Laboratories, Institute of Metabolic Science
Professor Gordon Smith, Dept of Obstetrics and Gynaecology
Professor Azim Surani (tbc), The Wellcome Trust/Cancer Research UK Gurdon Institute

Germ cells: the route to immortality

How do cells become equipped to generate a whole new organism?

PROFESSOR AZIM SURANI. REPRODUCED WITH PERMISSION FROM *NATURE* (2005) 436, 207–213

Primordial germ cells (in red) just after specification

A fertilised egg is potentially immortal since it develops into a new organism that, in turn, can give rise to an endless series of generations. The precursors of sperm and eggs, known as germ cells, provide this enduring link between generations because they transmit the parents' genetic information to the offspring. Precisely how these cells become equipped to reproduce a new organism – and the remarkable erasing and reprogramming steps that happen during this process – is being studied by Professor Azim Surani's research group in the Wellcome Trust/Cancer Research UK Gurdon Institute, with funding from the Wellcome Trust and the Biotechnology and Biological Sciences Research Council (BBSRC).

Backing-up the blueprint

Even as the embryo implants in the lining of the womb during pregnancy, a founding population of germ cells is already being set aside within the embryo for the next generation. It's very important that these cells maintain the ability to form every cell type within the organism – an attribute known as pluripotency and one that is quickly lost from those cells that develop into the rest of the body (skin, neurones, muscle and so on). Studies in Professor Surani's group have discovered that these primordial germ cells develop in response to a 'master regulator' of germ cell fate called Blimp1. This initiates a special germ cell programme that at the same time represses all the other potential cell fates in these cells, leaving intact the blueprint for creating any cell in the body.

Wiping the disc clean

After Blimp1 has halted the march towards development into body cells, the germ cells then proliferate and migrate into fetal gonads, which develop independently at another site in the embryo to form either testes or ovaries. Here, one of the most extraordinary of events occurs that is rather like wiping a hard disc clean and then reloading it with either a maternal or a paternal operating system.

The critical 're-setting' event wipes out all the pre-existing information and 'imprints' that are normally associated with the genetic blueprint that carries the instructions necessary to form the whole organism. This associated information, known as epigenetic modification, is usually required to interpret the genetic information appropriately so that the right genes are selected for expression at the right time during critical cell fate decisions. The modifications are 'imprinted' and heritable, to denote their maternal or paternal origin.

What the researchers at the Gurdon Institute have discovered is precisely how the erasure process wipes out all the pre-existing epigenetic information and imprints. This leaves the genetic information intact in preparation for new instructions and imprints to be laid down on top of the genetic information – a process that occurs during development of the eggs and sperm in the growing fetus.

How to make eggs and sperm

Our understanding of these processes has now reached such a level that it is possible to make germ cells directly from pluripotent embryonic stem cells, or even from body cells such as skin cells. This naturally raises the prospect that sperm and eggs could be developed directly from body cells in a culture dish. Such innovations might provide new opportunities for applications in reproductive medicine, including exploration of the basis for certain forms of infertility or the underlying causes of cancers such as testicular tumours. But they also raise important ethical issues that will need to be addressed hand-in-hand with progress in the field.

Professor Azim Surani

For more information, please contact the author Professor Azim Surani (a.surani@gurdon.cam.ac.uk) at the Wellcome Trust/Cancer Research UK Gurdon Institute. **This research was published in *Nature* (2008) 452, 877–881 and (2005) 436, 207–213.**

Rethinking the secrets of life: a code upon a code

Epigenetics is taking the biomedical research world by storm; three Cambridge scientists use examples from their own research to explain why.

'Large Chromosomes' (etching based on scientific images) by Stefanie Reichelt, Cancer Research UK – Cancer Research Institute

Cracking the DNA structure in the early 1950s revolutionised the study of genetics in providing key information on how cells transmit information to the next generation. Five decades later, upon the publication of the draft human genome sequence, we entered the so-called post-genomic era. The ability to interrogate our complete DNA sequence has allowed a field of genomic medicine to emerge that has had profound promise for our understanding of genetic disease.

But our genomes constitute more than just the linear DNA blueprint. DNA is bundled into three-dimensional chromosome structures. This packaging is influenced by molecular flags known as epigenetic modifications that are attached to the DNA and to the proteins that organise it into chromosomes. These chemical modifications (including methylation and acetylation) determine whether parts of chromosomes are tightly or loosely packaged, which in turn influences whether a gene has the potential to be switched on or off.

Remarkably, during cell division, cells acquire the same epigenetic modifications as their parent cell, resulting in the heritable transmission of these epigenetic states and a 'memory' of a cell's identity. Epigenetic states, however, have inherent flexibility because they can undergo normal regulated change in response to particular stimuli, to modulate gene expression as the need arises; for example, during the development of stem cells into particular organ systems. If these natural epigenetic processes occur improperly, major adverse health and behaviours can ensue. Epigenetic modifications therefore render our genomes functionally flexible, adaptable and vulnerable.

The study of the epigenetic control of genome function has led to the dawn of a new revolution that some have coined the 'epigenomic era'. Professor Anne Ferguson-Smith (Department of Physiology, Development and Neuroscience), Dr Miguel Constância (Department of Obstetrics and Gynaecology) and Dr Sue Ozanne (Metabolic Research Laboratories at the Institute of Metabolic Science) are studying epigenetic processes that confer long-term memory to genes under the influence of the cellular environment, with far-reaching implications for human reproduction and health.

An epigenetic voyage in space and time

Epigenetic mechanisms of gene regulation are important throughout development, from when the sperm first meets the egg (fertilisation), through early lineage decisions, to fetal development and postnatal life. Somatic epigenetic modifications need to be 'reprogrammed' in germ cells and also in early embryos so as to achieve developmental pluripotency, whereby cells can give rise to all the cells needed in the developing fetus. This normally results in epigenetic marks that are different in some locations on chromosomes inherited from eggs compared with those inherited from sperm.

For 99% of genes inherited by the embryo, gene expression can occur from both the maternally and paternally inherited versions. But the remaining 1% are 'imprinted', which means that only one of the two gene copies is expressed

after fertilisation. The teams of Professor Ferguson-Smith and Dr Constância use imprinted genes as tractable experimental systems for studying the epigenetic control of genome function and its role in mammalian development. Recently, Professor Ferguson-Smith's team showed that a DNA-binding protein plays a key role in the programming of imprints, providing a link between the underlying DNA sequence and the regulation of epigenetic marks.

Parent power

Why do we need imprinting and what are its evolutionary consequences? The Cambridge researchers have discovered that the functional epigenetic asymmetry that exists between the genomes of the parents has important influences during pregnancy and throughout life. These effects include contributions to the allocation of maternal resources – especially to the control of key aspects of mammalian physiology related to growth and adaptations to feeding and metabolism.

Dr Constância's group has recently described the effects of one gene that is expressed only from the copy inherited from the father. The gene for insulin-like growth factor 2 (Igf2) operates in a vital area of the placenta where maternal and fetal blood mix and nutrients are exchanged, controlling the influx of nutrients to the fetus. Igf2 also operates in fetal tissues to control the level of demand for nutrients. These studies raise the novel concept that imprinted genes are key genetic regulators of the supply of, and genetic demand for, maternal nutrients to the mammalian fetus. This may have implications for our understanding of the selective forces that led to the evolution of the process of imprinting.

The control of nutritional resources is now known to apply to many other epigenetically regulated imprinted genes controlling growth in the mother's womb and also after birth. Work by Professor Ferguson-Smith's group has looked in further detail at such genes and has shown that imprinted genes can also influence normal metabolism.

We are what we eat

The diet of an individual has important health issues at any stage of life – 'we are what we eat' after all. There is growing evidence from studies both in humans and in animal models that maternal diet during pregnancy is particularly important as it has major long-term health consequences, including risk of developing type 2 diabetes, heart disease and obesity – so in some ways 'we are also what our mothers ate'. This has been termed the developmental origins of health and disease hypothesis. It suggests that subtle differences in nutrition or other early environmental factors during fetal or early postnatal life lead to permanent alterations in the structure and function of important organs, leaving a legacy of disease susceptibility in later life.

Dr Ozanne's group has shown that reducing the protein intake of pregnant rodents leads to type 2 diabetes, obesity and premature death in the offspring. This is accompanied by permanent changes in the expression of genes regulating insulin production and action. All three research teams are currently investigating what the molecular mechanisms could be that connect the effects of maternal diet during pregnancy with gene expression in the offspring many years later (i.e. after many rounds of cell division). Not surprisingly, permanent changes in the epigenetic marks on DNA, and therefore effects on gene programmes throughout development and into adult life, are emerging as a major player. For example, Dr Ozanne and Dr Constância have recently discovered that a reduction in protein intake during pregnancy alters the epigenetic marks on the regulatory regions of important genes in the pancreas, leading to differences in their expression.

DNA wears Prada

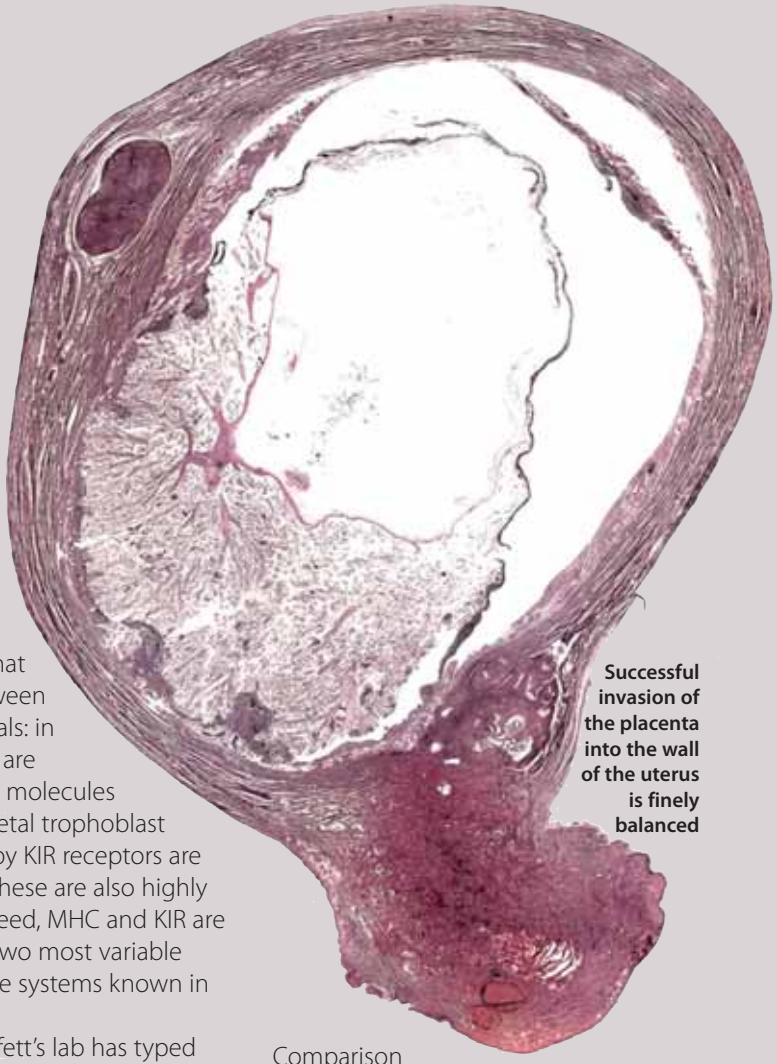
Epigenetic processes are not confined to nutrition and growth – many other systems under epigenetic influence are also now coming to light. These include the ability of plants to respond to seasons, the capacity of chromosomes to segregate properly during cell division, and many of the key changes that occur in cancer and neurological disorders. It seems that our genetic future lies not only in studying the skeleton that is our DNA, but also in understanding the epigenetic modifications that clothe it.

Professor Anne Ferguson-Smith (left), Dr Miguel Constância and Dr Sue Ozanne

For more information, please contact the authors Professor Anne Ferguson-Smith (afsmith@mole.bio.cam.ac.uk; Department of Physiology, Development and Neuroscience), Dr Miguel Constância (jmasmc2@cam.ac.uk; Department of Obstetrics and Gynaecology) and Dr Sue Ozanne (seo10@cam.ac.uk; Metabolic Research Laboratories, Institute of Metabolic Science).

The balance between mother and fetus in 'no-man's-land'

New insights into pregnancy are resulting from research on the interaction between mother and fetus at the placental interface.



PROFESSOR ASHLEY MOFFETT

Successful invasion of the placenta into the wall of the uterus is finely balanced

Professor Ashley Moffett's research group in the Department of Pathology studies how the immune system acts during pregnancy to establish and maintain a balance between the different needs of the mother and her baby as it develops. If this is defective, major problems of pregnancy arise, including recurrent miscarriage, low birth weight, stillbirth and pre-eclampsia.

Degrees of invasion

As many as 3–10% of births worldwide are affected by pre-eclampsia, a complication that is particularly common in first pregnancies. Pre-eclampsia develops suddenly towards the end of pregnancy and progresses rapidly, causing death of the mother and her baby unless there is delivery by emergency Caesarean section. The condition arises when the placenta (which is derived from the fetus) fails to invade deeply into the uterus, so that the proper connections with the uterine arteries that provide essential oxygen and nutrients to the fetus are not established. A fine balance exists in this 'no-man's-land' – too little invasion means the fetus will be starved, too much invasion is detrimental to the mother.

Placental trophoblast cells are at the interface between the placenta and uterus; as they migrate through the uterine wall they come into contact with cells of the maternal immune system. The maternal cells that appear to be especially important in regulating the degree of invasion are uterine natural killer (uNK) cells. Work in Professor Moffett's lab has been looking at what determines which way the balance tips and how uNK cells might both assist and hinder placentation.

Mix and match

The group's focus has been on the receptors on uNK cells that recognise fetal trophoblast cells. These receptors, known as KIR, are inherited as a family of genes that differ widely between different individuals: in other words they are polymorphic. The molecules on the invading fetal trophoblast cells recognised by KIR receptors are called MHC and these are also highly polymorphic. Indeed, MHC and KIR are encoded by the two most variable polymorphic gene systems known in humans.

Professor Moffett's lab has typed the KIR genes in women with pre-eclampsia and compared them with those of mothers with normal pregnancies. Results show that particular combinations of maternal KIR genes and fetal MHC genes are associated with pre-eclamptic pregnancies. Similar findings were found in women with repeated early miscarriages where the placenta fails to establish proper connections with the uterine arteries early in gestation. How these genetic findings translate into a biological understanding of placentation is now under active investigation.

Brainy humans walk upright

Curiously, pre-eclampsia is unique to humans and is absent even in the great apes; is this related to the particular type of placenta that humans have evolved? There are selective pressures associated with both the constraints imposed on the pelvis by walking upright and the acquisition of large brains, which requires a longer period of development in the uterus. These specifically human attributes have placed unique demands on the system that regulates the balance *in utero* between the mother and her fetus.

Comparison with their primate relatives indicates that the human KIR and MHC gene families have changed and expanded since humans evolved. Part of this rapid change may have been dictated by the potential dangers of human reproduction – fine-tuning is needed to achieve a birth weight not too large to prevent delivery through the female pelvic outlet and yet large enough for the baby to survive once born.

Professor Ashley Moffett

For more information, please contact Professor Ashley Moffett (am485@cam.ac.uk) at the Department of Pathology. **This research is funded by the Wellcome Trust and the Centre for Trophoblast Research.**

Obesity and diabetes in pregnancy: a vicious circle?

A complex interplay of prenatal and postnatal factors determines the risk of childhood obesity and diabetes during later life.

Intrauterine exposure to diabetes during pregnancy – either because the mother already has diabetes or because gestational diabetes is triggered by the pregnancy – increases the risk that the baby will develop weight gain and insulin-resistant (known as type 2) diabetes later in life. Because these babies are themselves likely to be at increased risk of gestational diabetes, the population risk for type 2 diabetes could accelerate in just a few generations. The problem is compounded by maternal obesity and there is evidence from some high-risk populations that only modest increases in maternal obesity may be enough to precipitate gestational diabetes.

High BMI

Recent research in the Department of Paediatrics and Medical Research Council (MRC) Epidemiology Unit led by Professor David Dunger and Dr Ken Ong has shown that high maternal body mass index (BMI) increases the risk of obesity in offspring. In collaboration with colleagues in Uppsala, Sweden, the group is looking at variations in maternal glucose and lipid metabolism during pregnancy using state-of-the-art cold-isotope techniques. These complex physiological studies are being carried out at the Wellcome Trust Clinical Research Facility on the Cambridge Biomedical Campus at Addenbrooke's Hospital.

The findings show that maternal obesity and insulin resistance are determinants of fetal and newborn body fat, even where glucose levels are normal. Futhermore, although maternal glucose levels in late pregnancy are an important determinant of body fat at birth, over the first two years of life this relationship tends to decline and, by the age of two years, the pre-pregnancy BMI of the mother is the more important determinant of offspring weight.

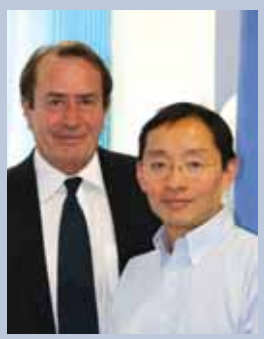
Feeding on demand

Maternal weight gain and genes predisposing to type 2 diabetes may not be the only factors determining gestational diabetes risk in mothers. Professor Dunger and Dr Clive Petry, with support from an MRC project grant, have also found evidence that fetal genotypes associated with increased fetal growth may modify the metabolism of the mother. It seems likely that these effects are a result of the fetus trying to boost its own growth by increasing nutritional demand through the secretion of placental hormones into the maternal circulation. The important inference here is that if some fetal genotypes influence the risk of maternal gestational diabetes then, in combination with increased rates of maternal obesity, this could contribute to the current worldwide epidemic of diabetes.

Baby growth

The group has also identified rapid postnatal weight gain as a major risk factor for adult obesity and risk of type 2 diabetes. To explore this further, the investigators are using the Cambridge Baby Growth Study of over 1000 infants, originally established with European Union funding by Professor Ieuan Hughes in the Department of Paediatrics and now funded by the MRC. The group is looking at the effects of feeding regimes, including breast, bottle and early introduction of solids and cows' milk, as well as measures of satiety, to determine hormonal markers of differential weight and height gain.

The aim over the next five years is to arrive at a full evaluation of these complex prenatal and postnatal determinants of obesity risk in childhood and type 2 diabetes risk in later life. The accurate prediction of risk might lead to the development of new intervention strategies that will reduce the vicious circle of maternal obesity and diabetes risk in future generations.



Professor David Dunger (left) and Dr Ken Ong

For more information, please contact the authors Professor David Dunger (dbd25@cam.ac.uk) and Dr Ken Ong (ken.ong@mrc-epid.cam.ac.uk) at the Department of Paediatrics. Dr Ong is also at the MRC Epidemiology Unit, Institute of Metabolic Science.

Prenatal origins of heart disease

Studies in La Paz, the highest city in the world, are helping to uncover a link between prenatal conditions and heart disease in later life.

Heart disease is the greatest killer in the UK today, accounting for four in every 10 deaths and imposing a substantial burden on the nation's health and wealth. The concept is familiar to us all that traditional risk factors, such as smoking and obesity, and genetic makeup increase the risk of heart disease. However, it is now becoming apparent that a third factor is at play – a developmental programming that is predetermined before birth, not only by our genes but also by their interaction with the quality of our prenatal environment.

A biological trade-off

Pregnancies that are complicated by adverse conditions in the womb, such as happens during pre-eclampsia or placental insufficiency, enforce physiological adaptations in the unborn child and placenta. While these adaptations are necessary to maintain viable pregnancy and sustain life before birth, the adaptations come at a cost, claiming reduced growth as a biological trade-off. In fact it's more than just growth that is affected – we now know that the trade-off extends to the development of key organs and systems such as the heart and circulation, which increases the risk of cardiovascular disease in adult life. Overwhelming evidence in more than a dozen countries has linked development under sub-optimal intrauterine conditions leading to low birth weight with increased rates in adulthood of coronary heart disease and its major risk factors – hypertension, atherosclerosis and diabetes.

The idea that a fetus' susceptibility to disease in later life could be programmed by the conditions in the womb has been taken up vigorously by the international research community, with considerable efforts focusing on nutrient supply across the placenta as a risk factor. But nutrient supply is just part of the story. How much oxygen is available to the fetus is also a determinant of growth and the risk of adult disease. Dr Dino Giussani's research group in the Department of Physiology, Development and Neuroscience is asking what effect reduced oxygen has on fetal development by studying populations at high altitude.

Lessons from high altitude

Bolivia lies at the heart of South America, split by the Andean Cordillera into areas of very high altitude to the west and areas at sea-level to the east, as the country extends into the Amazon Basin. At 400 m and almost 4000 m above sea-level, respectively, the Bolivian cities of Santa Cruz and La Paz are striking examples of this difference.

Pregnancies at high altitude are subjected to a lower partial pressure of oxygen in the atmosphere compared with those at sea-level. Women living at high altitude in La Paz are more likely to give birth to underweight babies than women living in Santa Cruz. But is this a result of reduced oxygen in the womb or poorer nutritional status?

The research team studied birth weight records from healthy term pregnancies in La Paz and Santa Cruz, especially from obstetric hospitals and clinics selectively attended by women from either high- or low-income backgrounds. High-altitude babies showed a pronounced reduction in birth weight compared with low-altitude babies, even in cases of high maternal nutritional status. Babies born to low-income mothers at sea-level also showed a reduction in birth weight, but the effect of undernutrition was not as pronounced as the effect of high altitude on birth weight; clearly, fetal

KRISTIN GIUSSANI

oxygenation was a more important determinant of fetal growth within these communities

Remarkably, although one might assume that babies born to low-income mothers at high altitude would show the greatest reduction in birth weight, these babies were actually heavier than babies born to high-income mothers at high altitude. It turns out that the difference lies in ancestry. The lower socio-economic groups of La Paz are almost entirely made up of Aymara Indians, an ancient ethnic group with a history in the Bolivian highlands spanning two millennia. On the other hand, individuals of higher socio-economic status in Bolivia represent a largely European and North American admixture, relative newcomers to high altitude. It seems therefore that an ancestry linked to prolonged high-altitude residence confers protection against reduced atmospheric oxygen.

Do these early influences of oxygenation feed through to increased risk of cardiovascular disease? A large-scale, five-year study to determine this has been initiated in the two cities that will link birth weight data with measurements of cardiovascular health and disease in Bolivian high- and lowlanders. But an early indication has been supplied by a somewhat unlikely source: Bolivian hen eggs.

Mountain chicks

Dr Giussani's group has discovered that they can replicate the results found in Andean pregnancies in eggs: fertilised eggs from Bolivian hens native to sea-level show growth restriction when incubated at high altitude, whereas eggs from hens that are native to high altitude show a smaller growth restriction. Using hen eggs has allowed the researchers to accomplish something that would take generations of migration in human populations to demonstrate: moving fertilised eggs from hens native to high altitude down to sea-level. This not only restored growth, but the embryos were actually larger than sea-level embryos incubated at sea-level. And, importantly, when looking for early markers of cardiovascular disease, it was discovered that growth restriction at high altitude was indeed linked with cardiovascular defects – shown by an increase in the thickness of the walls of the chick heart and aorta.

Lower levels of oxygen in the womb – whether caused by conditions like pre-eclampsia or simply by living at high altitude as for these Bolivians – enforce physiological adaptations in the unborn child and placenta

Bringing the Andes to Cambridge

To have hopes of clinical intervention, we need to understand why reduced oxygen should be a trigger for a prenatal origin of heart disease. Towards this goal, the group's most recent data studying rat pregnancy complicated with reduced fetal oxygenation have indicated that the adverse effects on cardiovascular development may be secondary to a disturbance known as oxidative stress. The body normally produces by-products of oxygen called free radicals and, unless these are neutralised by antioxidants, they cause damage to cells. If oxidative stress is the underlying cause of cardiovascular defects, this offers the highly interesting possibility of using antioxidants to treat pregnancies complicated by reduced oxygen delivery to the fetus, be it at sea-level or high altitude. This may halt the development of heart disease at its very origin, bringing preventive medicine back into the womb.

Dr Dino Giussani

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Research described here was sponsored by the British Heart Foundation, Biotechnology and Biological Sciences Research Council (BBSRC), Lister Institute of Preventive Medicine, Royal Society and Wellcome Trust. Dr Giussani is a member of the Centre for Trophoblast Research.

Doctor's orders, Roman style

Rebecca Flemming from the Faculty of Classics works with ancient texts on health and reproduction.

Roman votive offering

Investigating the reproductive health of people who lived 2000 years ago is not an easy task; but it is an important one. Rome under the Empire was the first mega-city, reaching around a million inhabitants at its height. Gaining insight into issues such as just how risky pregnancy and childbirth were for women in Imperial Rome, and the chances of any child surviving a year, let alone five, is crucial to understanding both the structure and the texture of Roman society. The extent to which the city's population was sustained only through very high levels of immigration rather than by being able to reproduce itself must have had very considerable social and cultural consequences. The rates of infant mortality, on the other hand, will have impacted heavily on the practicalities and meanings of family life.

What the ancients knew

Ancient medical texts offer one avenue for research into these key issues. The most detailed discussion of reproduction and female health to survive from the Roman Empire belongs to the physician Soranus of Ephesus, who practised at Rome in the late 1st and early 2nd century AD.

Though scornful of anatomy (he considered it 'useless'), Soranus shares the general classical view that the fetus is nourished through the vessels of the umbilical cord, and supports those who argue for the existence of two embryonic membranes, attacking those who contend there is just one. Nor is this the only ancient medical dispute he becomes involved in – his treatise is highly polemical throughout.

Soranus also offers advice (and criticism) on everything from the best time for intercourse if the aim is conception, to infant weaning and teething, covering topics like the (exacting) care to be given during pregnancy and birth, the best swaddling techniques, and how to choose and manage a wet-nurse.

A fresh dialogue

As the last point suggests, this is a work aimed at the elite of Rome; the bulk of the urban poor would not have been able to afford the time or expense required to pursue Soranus' instructions on the diet, exercise, bathing and massage regime to be followed by a pregnant woman. And perhaps they even followed the prescriptions of his rivals. Can we move from advice to what actually happened, from ancient treatises to demographic patterns on the ground? This is beginning to happen, as new scientific techniques aimed at extracting a range of data about diet, lifestyle, disease and well-being from ancient skeletal remains are developed, the results of which can be compared with the teachings of ancient physicians. Data recently derived from isotopic and dental analysis of skeletal remains from ancient Rome, for example, have proved consistent with the written advice of the Roman doctors that encouraged mothers to introduce solid foods after six months and complete weaning soon after two years.

This kind of dialogue between ancient materials and modern techniques and models needs to be developed and expanded. Research into ancient reproductive health requires an interdisciplinary approach, a bringing together of scholars in the fields of ancient medicine and historical demography, as well as experts working with the new scientific analyses. Dr Flemming is currently helping to build up such a broad and collaborative approach in Cambridge – an approach that promises further progress in these crucial areas of understanding.

Dr Rebecca Flemming

For more information, please contact the author Dr Rebecca Flemming (ref33@cam.ac.uk) at the Faculty of Classics.

DEUTSCHES HYGIENE-MUSEUM, DRESDEN

Head modeller Ella Lippmann making model embryos at the German Hygiene Museum for education in public health some time before 1945

Making visible embryos

A new online exhibition explores the visual culture of embryology as part of a research initiative on the history of reproduction.

Reflection on generation goes back to antiquity, but the term 'reproduction' gained wide currency only during the age of revolutions around 1800. 'Generation' was the all-encompassing process by which new creatures came into being and in which the human acquisition of a rational soul was the crucial event. 'Reproduction' was more narrowly framed, and soon became a topic of scientific research, a target of medical and agricultural intervention, and a project for pressure groups and states seeking to improve the quantity and quality of populations. In the modern era, reproduction has been made increasingly independent of sex.

A group of medical historians in the Department of History and Philosophy of Science (HPS) is studying these changes. Under the theme 'From Generation to Reproduction', and funded by a Wellcome Trust Enhancement Award, Drs Nick Hopwood and Lauren Kassell and Professors John Forrester, Jim Secord and Nick Jardine are investigating how our world of reproductive practices, controversies and, not least, images was made.

From generation to reproduction

Since 2004, the Enhancement Award has enabled the researchers to build strength in the history of reproduction through studentships, research leave and events. Seminars, workshops and conferences have generated lively local, national and international conversations, and created new cross-disciplinary initiatives such as the Cambridge Interdisciplinary Reproduction Forum, a graduate/faculty research group at the Centre for Research in the Arts, Social Sciences and Humanities (CRASSH).

Current work covers topics as diverse as consultations about childbearing in astrological casebooks, controversies over Darwinism, the hospitalisation of childbirth in the 20th century and the advent of *in vitro* fertilisation. The history of embryo and fetus, and especially their visualisation, is a major focus and the subject of the main outreach activity of the award – 'Making Visible Embryos', an online exhibition by Drs Tatjana Buklijas and Nick Hopwood.

An online exhibition

Images of human embryos are everywhere today: in newspapers, clinics, classrooms, laboratories, baby albums and on the internet. Debates about abortion, evolution, assisted conception and stem cells have made these representations controversial, but they are also fairly routine, and we tend to take them for granted. Yet as recently as 250 years ago human development was nowhere to be seen. How were embryo images made to represent some of the most potent biomedical objects, and subjects, of our time?

The story begins with a sketch of the variety of views of pregnancy and the unborn before developing embryos were first drawn at the end of the 18th century. We then see how, during the 1800s, medicine and biology exploited technical innovations to produce pictures and models that communicated new attitudes to childbirth, evolution and reproduction. In the 20th century, these became the dominant representations of pregnancy and prominent symbols of biomedical hope and fear.

The exhibition contextualises such icons as the German Darwinist Ernst Haeckel's allegedly forged illustrations and the Swedish photographer Lennart Nilsson's 'Drama of Life Before Birth' on a 1965 cover of *Life* magazine. It also interprets over 120 now little-known drawings, engravings, woodcuts, oil paintings, frescos, wax models, X-rays and ultrasound scans. By depicting imaging technologies and people engaged in image production (see picture), the web pages emphasise the work of making visible embryos. Wherever we stand in today's debates, it should enrich our understanding of embryos, and of reproduction more generally, to explore how these icons have been made.

Dr Nick Hopwood

For more information, please contact the author Dr Nick Hopwood (ndh12@cam.ac.uk) at HPS. 'Making Visible Embryos' is at www.hps.cam.ac.uk/visibleembryos and the HPS History of Medicine programme is at www.hps.cam.ac.uk/medicine

FASHIONING THE VALUE CHAIN

Changes in the clothing industry have fashioned a new look for how manufacturing and retail is managed globally.

Twenty-five years ago, the clothing industry in the UK, the USA and other western countries was very different to the industry we see today. Production was organised almost entirely within the respective country and companies employed a very large, semi-skilled labour force. The 'value chain' – the activities from conception of the product, through its production, to its final sale that add value at each stage of the chain – was overseen by skilled managers, technical experts and designers. Today, outsourcing and offshoring have reshaped the industry, just as they have reshaped many other industries worldwide. Depending on the management strategy adopted, many companies have relocated several steps in the chain to low-wage countries around the globe, and today only 10–20% of clothing is manufactured in western countries.

How are companies responding to the pressures associated with globalisation and particularly how are they managing the fragmented value chain? To research this question, a collaborative project 'Globalising Behaviour of UK Firms in a Comparative Context' has been undertaken jointly by a team in the Cambridge Centre for Business Research, based at Judge Business School, and the Industrial Performance Center at Massachusetts Institute of Technology (MIT). Financed by the Cambridge-MIT Institute (CMI), the project focused on pharmaceuticals, publishing and – the focus of our book – textiles and clothing.

Fashioned by nations

Much of our research was conducted in the 'field' – in Britain, the USA and Germany – carrying out in-depth, qualitative interviews with top managers/owners of clothing, textile and retail companies, as well as industry experts. We spoke to suppliers to our western firms in three very important (in terms of import volume) sourcing countries: China, Turkey and Romania. We explored the geographical and organisational aspects of the clothing value chain. And we asked how managers configure the value chain and whether relations with contractors in different parts of the globe are organised in nationally distinctive ways.

Even within such a highly globalised industry as clothing, we discovered that the configuration of the value chain is still influenced by the social institutional context of our firms' home country. Highly distinctive product paradigms were retained by companies from Germany, the UK and the USA, determined by the material and the human resources that firms can access; by the capabilities developed as a result; by the regulatory climate; and by the nature of consumer demand.

German clothing firms produce mainly branded clothing for the

upper-middle market, destined for older and more conservative consumers both at home and in Europe. UK companies concentrate more on middle and lower-middle market private-label fashion clothing for the younger consumer and they mainly service the domestic market. US clothing firms pursue yet another strategy, combining the production/in-licensing of branded and private-label clothing. They serve a diversified mainly middle to lower-middle market, with more classical fashion and fashion basic garments. The export performance of US firms is not as good as German firms' but is better than that of UK firms.

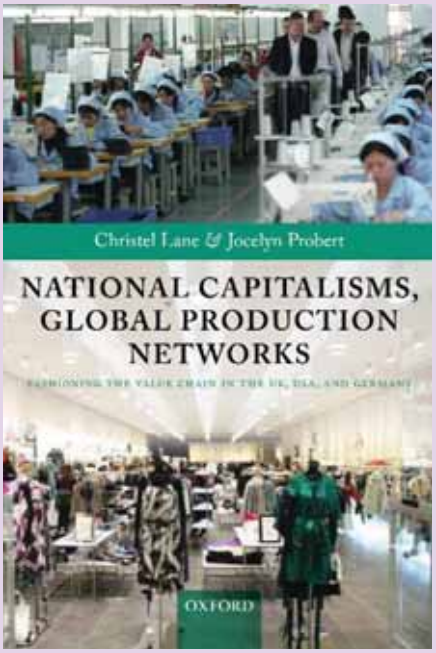
These diverse strategies, in turn, affect the divergent relations established with suppliers in low-wage countries. In order to achieve control, buyer firms seek to integrate their suppliers to differing degrees. This is expressed through more relational contracting by German firms, market-type arms' length relations by US firms, and by British firms taking a position between these two extremes. One notable exception to national influence is evident in the management of labour, where low costs and a low incidence of unionisation in supplier countries provided the impetus for outsourcing in the first place.

Protection versus competition

Our book was conceived as a multi-level study, encompassing various geographical and political-regulatory levels, and designed to capture the complexity of this globalised industry.

The global production networks of western buyer firms are highly dynamic and have been influenced, though not always in the intended direction, by frameworks seeking to protect the US and European industries, such as the 1995 Agreement on Textiles and Clothing. Following the end of this agreement and consequent abolition of export quotas for developing countries on 31 December 2004, the networks have become increasingly influenced by the competitiveness of their suppliers.

We enquired how national, institutional and political contexts have shaped competitiveness, as well as explored how contractors view the relationships with their various national buyer firms. We found that regulatory frameworks channelled the activities of



National Capitalisms, Global Production Networks: Fashioning the Value Chain in the UK, USA, and Germany **by Professor Christel Lane and Dr Jocelyn Probert will be published in spring 2009 by Oxford University Press**

companies to a very significant degree and partly explained their relatively high mobility between sourcing countries and contractors. They have not, however, afforded the western clothing industries the protection they were intended to provide. Instead, they have drawn more and more developing countries into the industry, greatly intensifying global competition and its harmful effects on labour.

Retail dominance

According to our research, the dominant position in the value chain has been assumed by the fashion retailers, owing to the high levels of capital concentration in retail and because of their greater closeness to final consumers. Electronic point-of-sale technology provides retailers with superior knowledge of the quantity and, particularly, the quality of demand. This dominance expresses itself in the retailers' ability to determine pricing, lead times and the modalities of clothing delivery, as well as production quality. Their much increased influence over western middleman 'manufacturers' is passed on by the latter to contractors in developing countries who, in turn, pass on competitive pressures to labour, the relatively defenceless social group at the end of the chain. Again, national differences prevail. In the less highly concentrated German retail sector, 'manufacturers' still retain some influence and relations are more cooperative. These divergent power relations, in turn, determine the degree of adversarialism present in global networks.

A much-copied pattern

In the context of a globalising economy, research into the clothing industry has granted us many valuable insights, from the dynamics of global production to the changing geo-political and regulatory frameworks that shape the globalisation process and entrench polarisation between developed and developing countries. The clothing industry was the first to engage in large-scale outsourcing and as such provided a template that many other industries have since copied. Ironically perhaps, the fashion industry is sometimes regarded as an 'unfashionable' industry to study, yet it retains an enduring fascination for scholars of value chain dynamics and comparative capitalisms.

Professor Christel Lane (left) and Dr Jocelyn Probert

For more information, please contact the book's first author Professor Christel Lane (col21@cam.ac.uk) at the Department of Sociology. Dr Jocelyn Probert is at the Centre for Business Research, based at Judge Business School.

Physics of Medicine

The Grand Opening of the Centre for the Physics of Medicine in December 2008 marked a major development in bringing together researchers working at the interface of physical sciences, life sciences and clinical sciences.

Centre for the Physics of Medicine; the sculpture on the top floor celebrates the discovery of the structure of DNA by physicists at Cambridge's Cavendish Laboratory in 1953

Medicine and biology have long benefited from fundamental advances in physics. Whether it's the tools of diagnosis and treatment (from X-rays to lasers), or understanding the structure and organisation of biological systems, the association between the disciplines has broken new ground time and again. For Cambridge, this interaction holds a special, historical significance: the momentous discovery of the double helical structure of DNA by physicists at Cambridge's Cavendish Laboratory in 1953 transformed our understanding of the building blocks of life. The breakthrough gave birth to the entirely new discipline of molecular biology and, in effect, the founding in 1962 of the Laboratory for Molecular Biology on what is now the Cambridge Biomedical Campus. In 2009, we stand once more at the dawn of a new era and witness the founding of a new laboratory, one that will give structure and direction to the interaction between physicists, biologists and clinicians.

Building a future

Over the past decade, an increasing crossover in goals, philosophy and techniques has been emerging between researchers in the Department of Physics and those in the many biomedical departments and research institutes across the University. Building on this, the vision of the Physics of Medicine initiative has been to draw physics more deeply into the life sciences by creating an environment where researchers from these different fields can work together.

The first step of the University's investment in Physics of Medicine has just been completed with the building of a new research centre on the West Cambridge Site, adjacent to the Cavendish, and the appointment of four lecturers in experimental biomedical physics, Drs Jochen Guck, Pietro Cicuta, Ullrich Keyser and Julian Huppert. The new building, comprising state-of-the-art laboratory space and core facilities, was opened on 16 December 2008 and will house researchers from different disciplines alongside a core from the Department of Physics.

Diversity of science is expected to be associated with the enterprise. To underpin this, and to ensure representation from the different academic communities, the initiative is overseen by a steering committee comprising the School Chairs of Physical Sciences, Clinical Medicine, Biological Sciences and Technology.

Construction of a second phase of the building is planned. Currently awaiting funding, this will provide office and teaching space, as well as additional areas where researchers can meet, discuss and develop common terms of reference. An important dimension will be the training of a new generation of young researchers to be familiar with a broad range of approaches and capable of working at the interface of disciplines. As research groups develop within the Centre, and collaborations reach out across the University, a host of exciting new opportunities will be nurtured that will push boundaries in the physics of medicine as never before.

Professor Athene Donald

For more information, please contact the author Professor Athene Donald (amd3@cam.ac.uk), Director of the Physics of Medicine Initiative, or visit the Physics of Medicine website (www.pom.cam.ac.uk). Professor Donald has recently won the prestigious 2009 L'Oreal UNESCO Women in Science Award for Europe.

Research at the interface

Although the Centre for the Physics of Medicine is still in its infancy, it is already creating new collaborations between researchers across the University. Projects are under way in the fields of stem cell research and pathogenic infection, and additional collaborations are constantly being instigated.

Stem cells

Dr Jochen Guck (Department of Physics) is developing optical tools based on the use of laser beams that cause cells of any kind to deform. Different cells respond in different ways – it's even possible to distinguish cancerous cells from healthy cells as they pass through the beam. Optical deformation is opening up an alternative solution to conventional methods of cancer diagnosis, and holds promise as a means of sorting stem cells using physical information derived at the single-cell level.

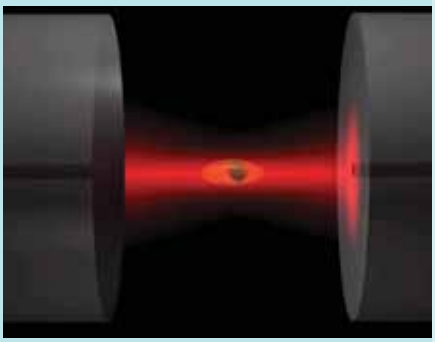
Professor Ben Simons (Department of Physics) and **Dr Phil Jones** (Hutchison/MRC Research Centre) are applying approaches in theoretical physics to analyse experiments studying stem cell fate during the maintenance of the epidermal skin layer. The modelling work has shown that the standard dogma about epidermal maintenance (involving the existence of so-called transit amplifying cells) is false, and provides an alternative framework that no longer requires ongoing stem cell proliferation.

The process by which a 'pluripotent' stem cell commits to becoming a particular type of cell depends on the stiffness and three-dimensional structure of the substrate (or scaffold) to which it is attached. Several collaborating groups are working on the design of tissue scaffolds and the nature of cell–scaffold interactions: **Dr Serena Best** and **Dr Ruth Cameron** (Cambridge Centre for Medical Materials), **Professor Wilhelm Huck** and **Dr Melinda Duer** (Department of Chemistry), and **Professor Eugene Terentjev** and **Professor Athene Donald** (Department of Physics). Through collaboration with researchers within the Stem Cell Initiative, including **Professor Fiona Watt** and **Professor Roger Pedersen**, the possibility of control over the stem cell differentiation process using appropriately designed scaffolds can be explored.

Pathogenic infection

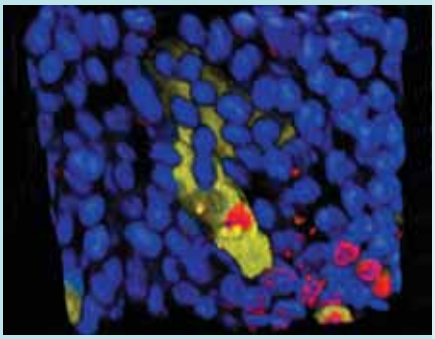
Bacterial interactions between cells and respiratory tissues are being studied by **Dr Pietro Cicuta** (Department of Physics) and **Dr Clare Bryant** (Department of Veterinary Medicine), and **Dr Julia Gog** and **Professor Ray Goldstein** (Department of Applied Mathematics and Theoretical Physics), using a combination of mathematical modelling, optical tweezers and real-time imaging. Optical tweezers are used to manipulate beads coated with a variety of biologically relevant materials. By directly visualising how the cell engulfs the beads and how this process is affected by the nature of the coating, researchers hope to gain new insight about the infection process. Mathematical modelling is directed towards understanding fluid dynamics in the respiratory tract in the vicinity of the tiny 'hairs' that clear bacteria during infection.

Professor Athene Donald is collaborating with **Professor Duncan Maskell** (Department of Veterinary Medicine) to pioneer novel methods of imaging bacterial pathogens. Bacteria are being imaged using the new technique of environmental scanning electron microscopy, which permits imaging while the bacteria are still viable. The aim is to obtain higher resolution images of a living pathogen than is currently possible with conventional light microscopy and to analyse how bacterial shape may change during the life cycle.



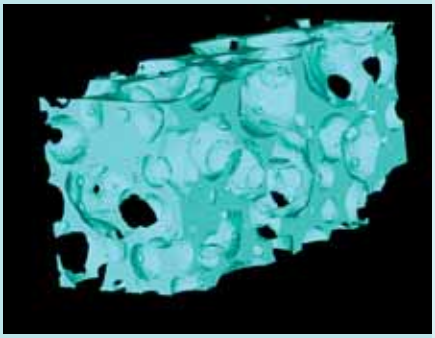
JOCHEN GUCK

Cell sorting by optical deformation



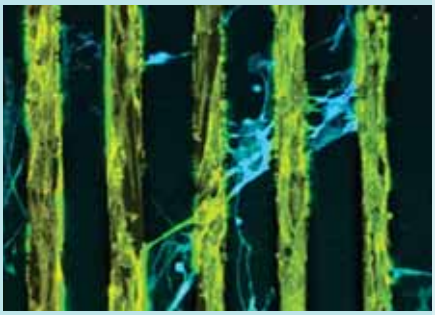
PHIL JONES

Skin cell clones for studying stem cell fate



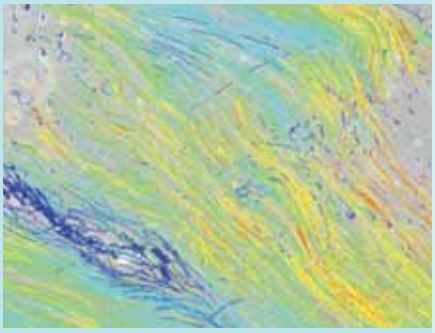
SERENA BEST AND RUTH CAMERON

Ceramic scaffold for orthopaedic applications



PETER STEVENSON AND ATHENE DONALD

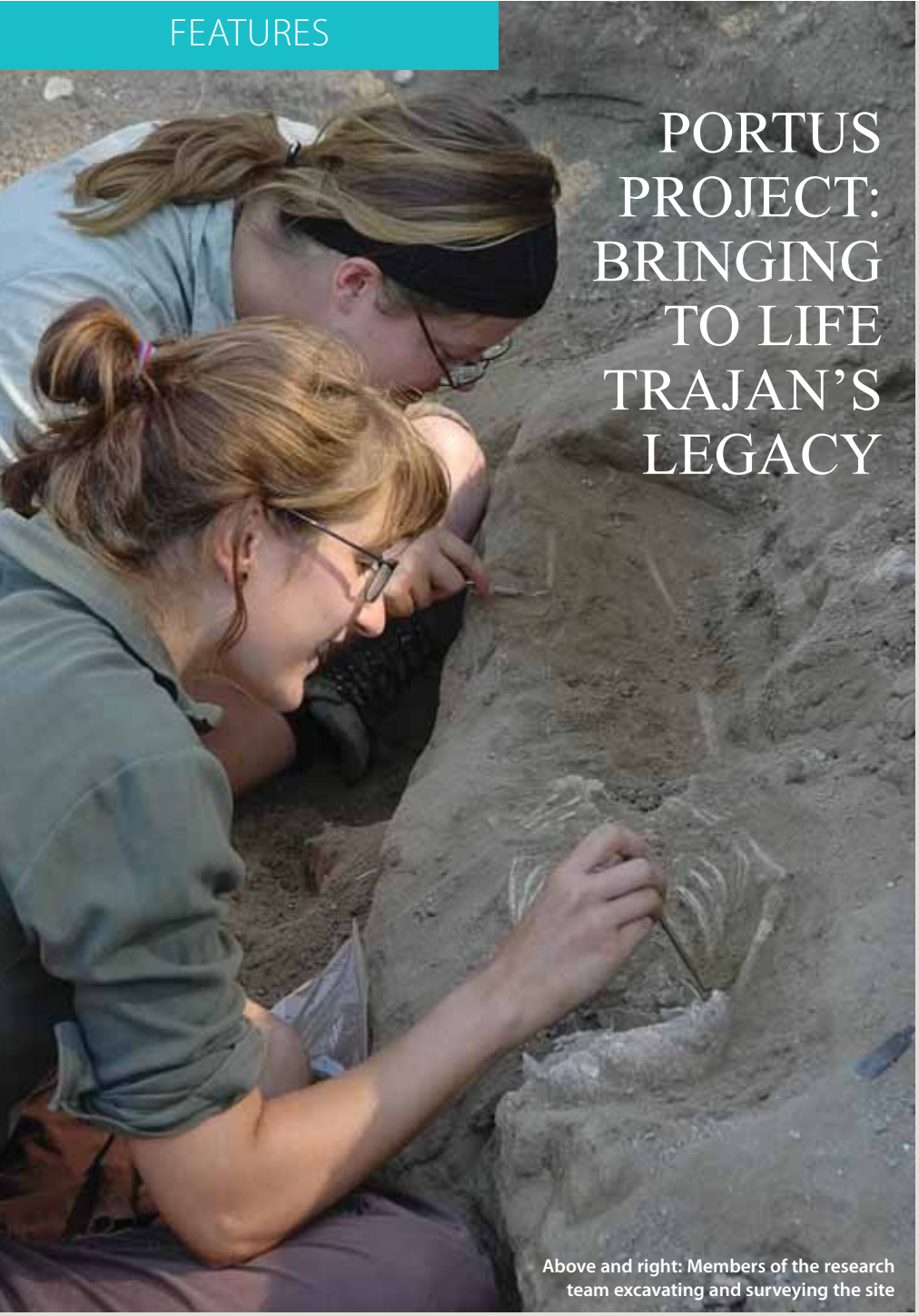
Cells spreading on a topographically patterned substrate



PIETRO CICUTA

Trajectories of tracers on beating cilia

PORTUS PROJECT: BRINGING TO LIFE TRAJAN'S LEGACY



Above and right: Members of the research team excavating and surveying the site

ALL IMAGES BY HEMBO PAG/PORTUS PROJECT

Excavation and geophysical survey are uncovering the secrets of an exceptionally diverse Imperial Roman landscape.

Portus, the great sea-port of Imperial Rome, is regarded as one of the most significant civil engineering works of the ancient world and yet, through a combination of historical circumstances, it has been the subject of surprisingly little archaeological research. The port area spans more than 2 km by 1 km and features a unique hexagonal harbour basin covering more than 32 hectares, itself equivalent in size to a middle-ranking Roman city. And stretching out from Portus lies an even larger area of archaeological interest – Isola Sacra – an artificial island created by Emperor Trajan on which is sited one of Italy's best preserved Imperial Roman cemeteries.

For the past decade, a project aimed at answering many of the key questions surrounding this important site has been carried out by a collaboration between the Universities of Cambridge and Southampton, and the British School at Rome, in collaboration with the Soprintendenza per i Beni Archeologici di Ostia and the Duke Sforza Cesarini. The latest stage of the project began in 2007 with funding from the Arts and Humanities Research Council (AHRC), and combines a new survey using geophysical techniques with excavation of the core of the complex. Through this, the project aims to gain a fuller understanding of the historical and topographical development of this immense site, as well as to provide information that will help the Italian authorities manage it effectively.

Gateway to Rome

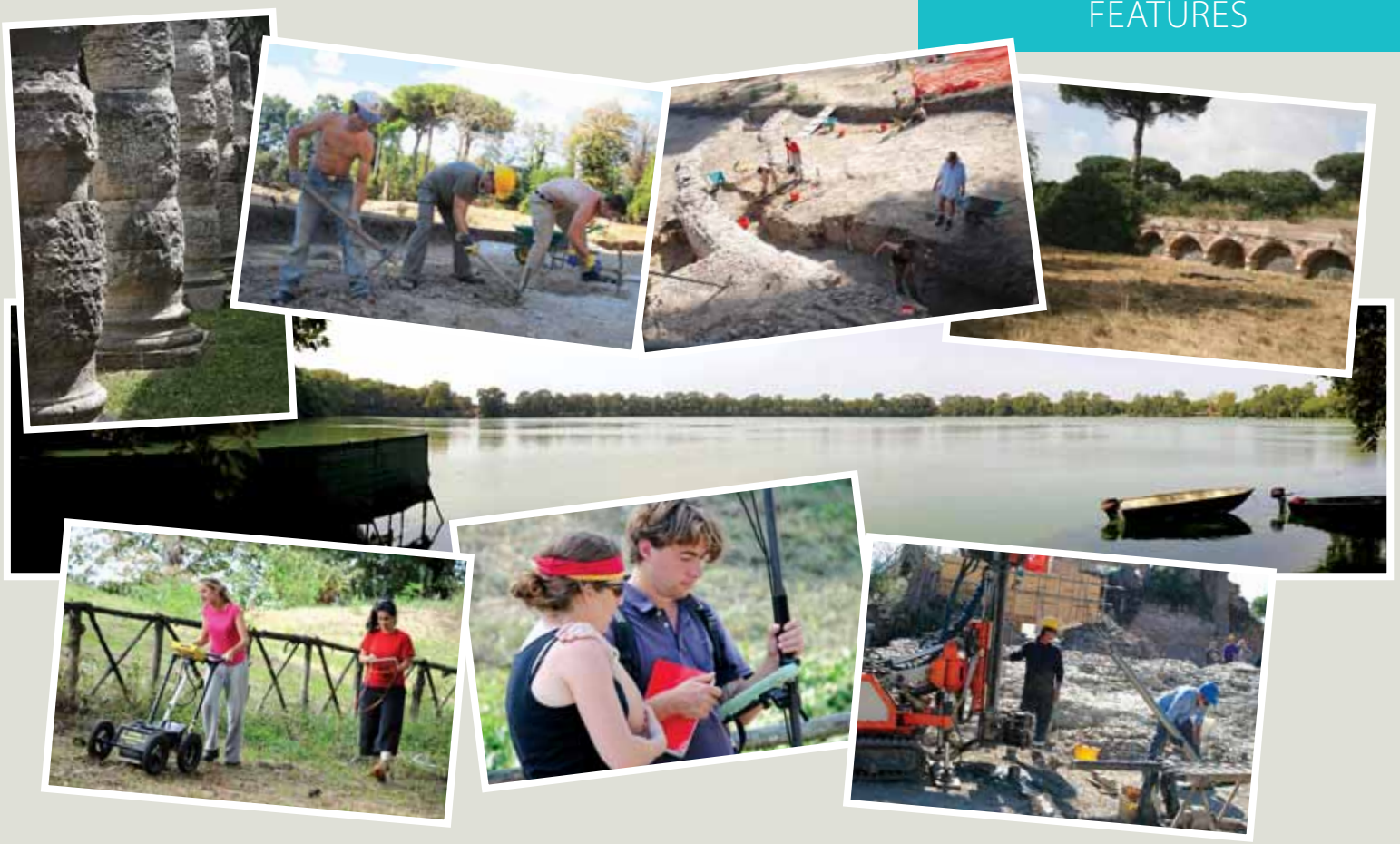
According to ancient texts, the construction of Portus was initiated by the Emperor Claudius, inaugurated by the Emperor Nero and enlarged by the Emperor Trajan. In the 1st century AD, Claudius ordered the construction of a great harbour and the digging of canals to drain the land at the mouth of the River Tiber. But it wasn't until the early 2nd century, when Trajan constructed a hexagonal harbour basin and huge warehouses a little inland, that Portus became the main thoroughfare of imports from the Empire. Marble, glass, metalwork and foodstuffs arrived on ships from Egypt, Africa and the Mediterranean provinces bound for the Imperial city.

Under Trajan's rule, the area due south of Portus in the Tiber delta was transformed into an artificial island defined to the east and south by the River Tiber, to the west by the Tyrrhenian Sea and to the north by a canal. A road traversed Isola Sacra, linking Portus with the adjacent city of Ostia, and along the road grew a major cemetery.

By the 6th century, however, the once bustling, cosmopolitan Portus had had its day, as Rome and her Mediterranean trade declined. Gradually, the mausolea, paintings, inscriptions, sculptures and mosaics of the necropolis were buried by sand dunes.

A hidden gem

Although records show that antiquarians and archaeologists have studied the ruins of Portus since the 16th century, and a substantial part of the Isola Sacra necropolis was excavated in the 1930s, the site has been effectively closed to study through most of the 20th century. A major issue for the Italian antiquities agency has been how to manage and preserve this monumental landscape, which sits within an area of intensive modern development immediately adjacent to Rome's main airport at Fiumicino. In the 1990s, they acquired much of the site to develop it as an archaeological park, opening up the area to new research such as the Portus Project.



Excavation and survey

The excavation led by Professor Simon Keay and Dr Graeme Earl from the University of Southampton is applying an integrated suite of techniques not widely used on complex Mediterranean sites, including digital recording and visualisation. A particular focus has been an area between the Claudian and Trajanic harbour basins that is helping to disentangle the structural sequence that runs from the 1st to the 6th century AD. It has already revealed unexpected details about the Claudian harbour, as well as information concerning the system for providing fresh water for ships to use at sea. The excavated finds (including marble and pottery) hold great potential for writing the economic and social history of the port, thereby making an important contribution to our understanding of its role in relation to Ostia, Rome and the Roman Mediterranean.

Professor Martin Millett from Cambridge's Faculty of Classics and Kris Strutt from the University of Southampton are directing the geophysical component of the project. The new survey is attempting to cover all the areas of the Roman landscape on Isola Sacra that have not been built over. The first results from 2008 (covering about a third of the island) are already proving their worth. They show a sequence of relict pre-Roman coastlines left behind as the Tiber delta expanded westwards. Importantly, these join with those previously discovered in the survey of Portus to the north, demonstrating conclusively that no former east–west river channel existed in this area before the canals were dug in the 1st century.

Overlying this sequence of geological deposits are three different Roman landscapes. First, a settlement and buildings appear to be limited to the north margin of the island, along the course of the canal, and include marble wharves and a bridgehead settlement opposite Portus. Second, there is a series of land boundaries which imply that much of the island was given over to agricultural exploration, presumably to provide foodstuffs to the populations of Ostia and Portus. Finally, there are the funerary landscapes. These include both the dense concentration of tombs beside the road across the island as well as a smaller number of monuments overlooking the Tiber. The latter continue the pattern observed in the survey further north, and reflect the use of the Tiber as an artery for communication – the Roman dead were buried in tombs that were designed to be seen by travellers, whether travelling by road or by river.

Future fieldwork

Both the excavation and the survey are in their early stages and further discoveries are sure to follow over the next two seasons of fieldwork. However, it is already apparent that the integrated methodology being used – the geophysical survey to enhance understanding of the area's layout together with the excavation of individual buildings and material culture – is yielding a breadth and depth of knowledge not previously available. In the process, this exceptionally rich and challenging site is also providing young academics and students from a range of countries with experience and training in site and survey techniques, electronic data capture and the identification and analysis of artefacts, fauna and botanical remains.

Professor Martin Millett

For more information, please contact the author Professor Martin Millett (mjm62@cam.ac.uk) at the Faculty of Classics or visit the Portus Project website (www.portusproject.org).

New hopes for the nervous system

Cambridge neurologists have shown that an antibody used to treat leukaemia also limits and repairs the damage in multiple sclerosis.

Multiple sclerosis (MS) affects almost 100,000 people in the UK and several million worldwide, many of whom develop the illness between the ages of 20 and 40. Individuals at first experience episodes that transiently disturb functions that healthy people take for granted: seeing, walking, feeling, thinking and emptying the bladder. Later, the episodes are replaced by secondary progression and, as the disabilities mount up, the illness begins to threaten many aspects of daily living.

MS results when the body mounts an autoimmune attack on nerve fibres, particularly targeting the myelin sheath that envelops them and interfering with the passage of the nerve impulse through the spinal cord and brain. The prime orchestrator of this damage has been identified – a type of white blood cell known as the T cell – but exactly how tissue injury occurs, why there is a characteristic relapsing–remitting pattern followed by secondary progressive disease, and how to treat the illness effectively, have remained elusive.

Made in Cambridge

The results of a recent study raise new hopes for patients with MS. A three-year, Phase 2 clinical trial with Alemtuzumab (also known as Campath), in which over 300 patients were treated, showed that not only was the advance of disease halted but, remarkably, many patients started to get better – perhaps due to brain repair. Professor Alastair Compston and Dr Alasdair Coles in the Department of Clinical Neurosciences found that the drug reduced the relapse rate by an additional 74% compared with the standard treatment, and the risk of accumulating fixed disability also fell by 71%.

These results provide a new installment in what has been a fascinating history for an antibody made in Cambridge in 1979 by Professor Herman Waldmann in the Department of Pathology. Campath was the first antibody to be 'humanised' – a technique pioneered by Dr Greg Winter at the Medical Research Council Laboratory of Molecular Biology that minimises the risk of the drug being rejected as foreign when given to patients. Because the drug destroys white blood cells, it has been principally used to treat adult leukaemia, a disease in which abnormal white blood cells build up and fatally 'crowd out' normal, healthy blood cells. This lymphocyte-destroying ability is now being exploited to destroy the perpetrators of havoc in MS.

Surprisingly, given that the drug is known to destroy white blood cells, infections were only slightly more common after treatment with Campath. Instead, the development of another autoimmune disease – usually affecting the thyroid gland – proved to be the major, and unexpected, complication.

All in the timing

Although Campath's potential as a treatment for MS was first considered 18 years ago in Cambridge, early attempts to treat patients who had already reached the secondary progressive stage failed to improve their worsening disabilities. It seems that it's all in the timing. The results of this latest study have shown that the drug must be given early, before the destruction of the myelin sheath has advanced to the point that secondary damage to the underlying nerves continues unabated. Not only does this strategy head off sustained accumulation of disability but it also allows some existing damage to get better, a factor not seen in any previous clinical trials. Expectations are high that the Phase 3 trials, now in progress, will lead to drug registration within a few years.

Professor Alastair Compston

For more information, please contact the author Professor Alastair Compston (alastair.compston@medschl.cam.ac.uk) at the Department of Clinical Neurosciences. **This research was published in *New England Journal of Medicine* (2008) 359, 1786–1801 and was funded by Genzyme and Bayer Schering Pharma AG.**

Damage to the nervous system lies at the root of the devastation caused by multiple sclerosis and Parkinson's disease

DR JON HERAS, EQUINOX GRAPHICS (WWW.E-NOX.NET)

The way a common virus hijacks the cell it infects could hold the clue to combating Parkinson's disease.

Parkinson's disease (PD) is one of the most common neurodegenerative diseases in the elderly population. Usually diagnosed after the age of 50, PD has a prevalence that is rising as the average population age increases, with about 120,000 people currently affected in the UK. The disease results from loss of the cells that produce dopamine, a chemical that relays signals from one neuron to another in the brain. Without this neurotransmitter, debilitating neurological symptoms ensue, including impaired walking, talking, swallowing and speech.

Although the processes leading to neuronal death in PD are not fully understood, indications from experiments with neurotoxins point towards a role for mitochondria, the energy-producing powerhouses of cells. It seems likely that the neuronal cell death and degeneration of neurological functions are a result of impaired mitochondrial function, particularly of an enzyme known as Complex I that provides the first step in the chain that coverts food energy into chemical energy.

Protecting the powerhouse

Cell death isn't always a bad thing. Timely and regulated cell death is crucial for the correct development of some tissues and is also an important defence mechanism against invading pathogens. For this reason, many viruses have evolved ways to keep cells alive until the viral replication cycle is completed. Human cytomegalovirus (HCMV), a type of herpesvirus, is an expert at this. Because HCMV needs 4–5 days to complete its replication cycle, it encodes several pro-life genes that hijack cellular functions to keep the cell alive throughout the stresses of the infection cycle.

Molecular virologists in Professor John Sinclair's group in the Department of Medicine have long been interested in the machinations of this virus. Recent research took a surprising turn when they discovered that one product of HCMV – a piece of ribonucleic acid (RNA) that doesn't even encode a protein – targets mitochondria and protects Complex I from stress-induced dysfunction. Could this viral RNA protect neuronal cells from the type of neurodegeneration observed in PD?

Pro-life therapeutic

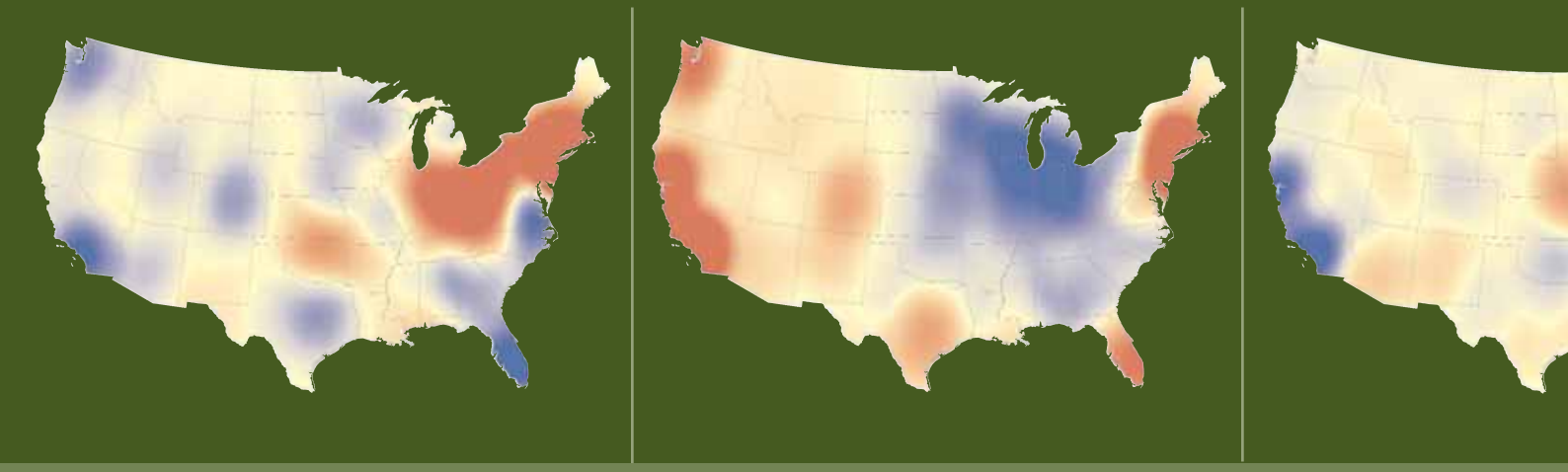
With recent funding from the Michael J Fox Foundation for Parkinson's Research, Professor Sinclair's group is now investigating how to translate the basic virological function discovered in HCMV into a novel therapeutic.

Experiments are being designed in collaboration with Dr Roger Barker and Professor Maria Grazia Spillantini at the Cambridge Centre for Brain Repair, part of the Department of Clinical Neurosciences, with the aim of preventing neurodegeneration in models of PD by delivering the viral RNA directly to the brain. Such approaches are difficult as the brain is protected by the blood–brain barrier, which restricts the passage of various chemicals and microscopic objects (such as bacteria) from the blood to the brain. However, some viruses such as rabies are not only able to overcome this barrier but can also specifically target neuronal cells by expressing a protein that binds to them; even a small polypeptide fragment of this protein is sufficient.

The researchers have generated a complex comprising the HCMV RNA and the rabies polypeptide, and results are already indicating that it protects neuronal cells in the Petri dish from cell death. By engineering this polypeptide to bind RNA even more tightly, the hope is that it might deliver its RNA cargo to the brain after injection into the bloodstream. This would be a fascinating example of translational biology – taking observations of the basic molecular analysis of virus infection and extending them to therapeutic solutions for neurodegeneration.

Professor John Sinclair

For more information, please contact the author Professor John Sinclair (js@mole.bio.cam.ac.uk) at the Department of Medicine. Part of this research was published in *Science* (2007) 316, 1345–1348.



The new geography of personality

Jason Rentfrow explains how analysis of over three-quarters of a million online surveys has been used to build a 'personality map' of the USA.

The study of personality can be traced back over two millennia but it wasn't until the early 1990s that an empirically derived framework for studying personality became widely accepted in the scientific community. Decades of research involving hundreds of thousands of individuals revealed five broad dimensions of personality. These so-called Big Five dimensions – Extraversion, Agreeableness, Conscientiousness, Neuroticism and Intellect – provided a basic model for conceptualising and measuring personality.

We know a fair amount about the antecedents and consequences of the five dimensions. Evidence from studies of identical twins suggests that the Big Five have a substantial genetic basis. There is evidence that the dimensions exist in different parts of the world. And numerous studies have shown that differences between individuals are associated with important life outcomes, from academic and occupational success, to marital stability and physical health.

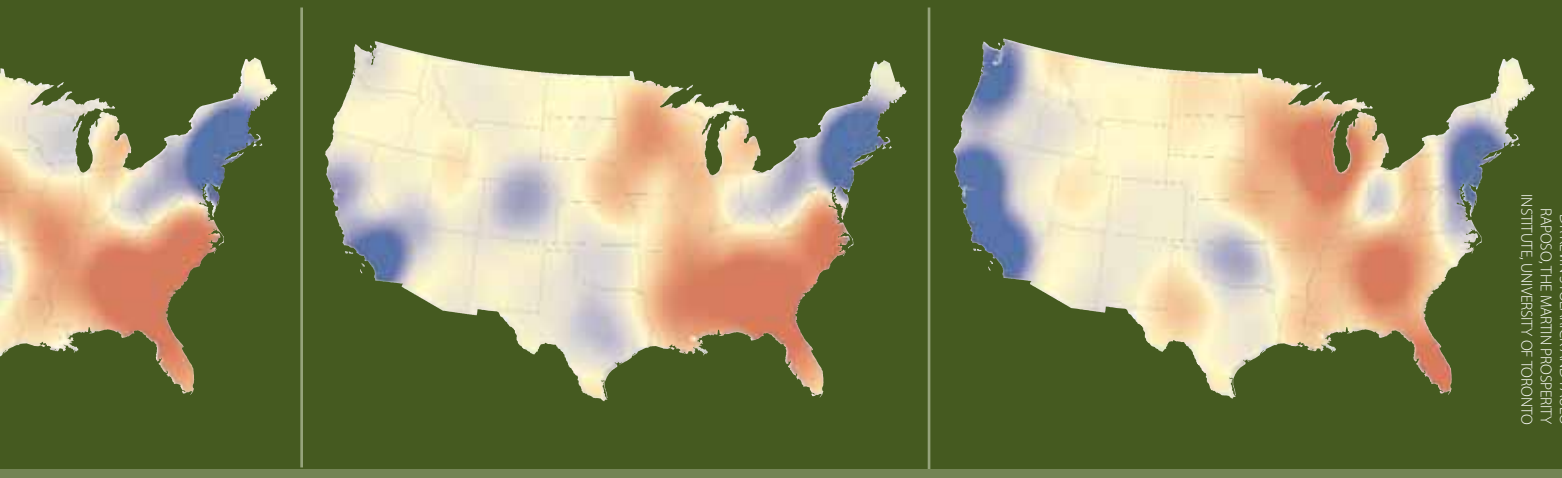
One question that we know less about concerns the geographic distribution of personality. Are the Big Five personality dimensions evenly distributed across the globe, or are they geographically clustered? National and regional stereotypes would have us think that there are important geographic personality differences. But do such stereotypes have any basis in reality?

Mapping personality

Ongoing research by Dr Jason Rentfrow, at the Department of Social and Developmental Psychology, and Dr Sam Gosling, at the University of Texas, aims to examine geographic variation in personality. In a large-scale project partially funded by the US National Science Foundation (NSF), data collected by online survey from over three-quarters of a million individuals in the USA revealed that personalities are not randomly distributed but are clustered into distinct geographic patterns.

It seems that residents of the Mid-Atlantic and New England states are relatively stressed, irritable and depressed, whereas West Coast residents are more emotionally stable, relaxed and calm than the rest of the country. The two coasts are quite similar on other traits, though. Traits associated with intellect, such as creativity, imagination, and openness, are higher in the Northeast and West Coast than in the Central and Southern states, where people are more pragmatic, straightforward and traditional. Compared with the rest of the country, residents of the Central and Southern states are also more neighbourly, friendly and generous.

One particularly important discovery is that the prevalence of certain personality traits is associated with a range of important geographic indicators. In states where rates of neuroticism are high, life expectancies are short and rates of cancer, heart disease, stroke and diabetes are high. In such places, residents are also less socially connected than in regions where people are more emotionally stable. In regions where intellect is high, more patents are produced per capita and more people work in the arts, technology and R&D than in places



DR KEVIN STOLARICK AND PAULO RAPOSO, THE MARTIN PROSPERITY INSTITUTE, UNIVERSITY OF TORONTO

Personality heat maps showing the geographic distributions of the Big Five dimensions: left to right, Neuroticism, Intellect, Conscientiousness, Agreeableness and Extraversion; areas in red have high concentrations of each trait and areas in blue have low concentrations

where intellect is low. The prevalence of traits associated with agreeableness, such as warmth, generosity and friendliness, is linked to lower crime rates – people are more trusting in safe places.

Do birds of a feather flock together?

One explanation for the geographic clustering of personality traits is selective migration – the idea that people choose to live in places that meet their needs. Concerns about safety, job opportunities and the quality of schools factor into some people's decisions about where to live. So it's reasonable to expect that aspects of personality also filter into the decision. Consider, for instance, the finding that large cosmopolitan cities have disproportionately large numbers of people who are open, creative and intellectual. It's likely that such people migrate to cosmopolitan cities precisely because those cities afford a multiplicity of choices with which to satisfy their needs for stimulation and diversity.

Another explanation is social influence. There's a wealth of empirical evidence that attitudes, opinions and emotions are contagious. So it is conceivable that the clustering of neuroticism, for instance, is a result of emotional contagion. In places with disproportionately large numbers of people who are anxious, irritable and tense, others 'catch' some of that negative affect simply through regular contact.

A third explanation is environmental influence. As in the case of social influence, features of the physical environment could affect the personalities of individuals within a given region. Climate, for instance, has a significant effect on the types of activities in which people within a region can engage. In warm climates people spend more time outside and have more contact with larger varieties of people than those in colder climates. Research on seasonal affective disorder indicates that in regions that receive little direct sunlight during certain parts of the year residents are prone to depression and anxiety. Aspects of a region's physical environment might not only shape the psychological characteristics of the residents, but might also provide incentives for settling or migrating.

Magnet or melting pot?

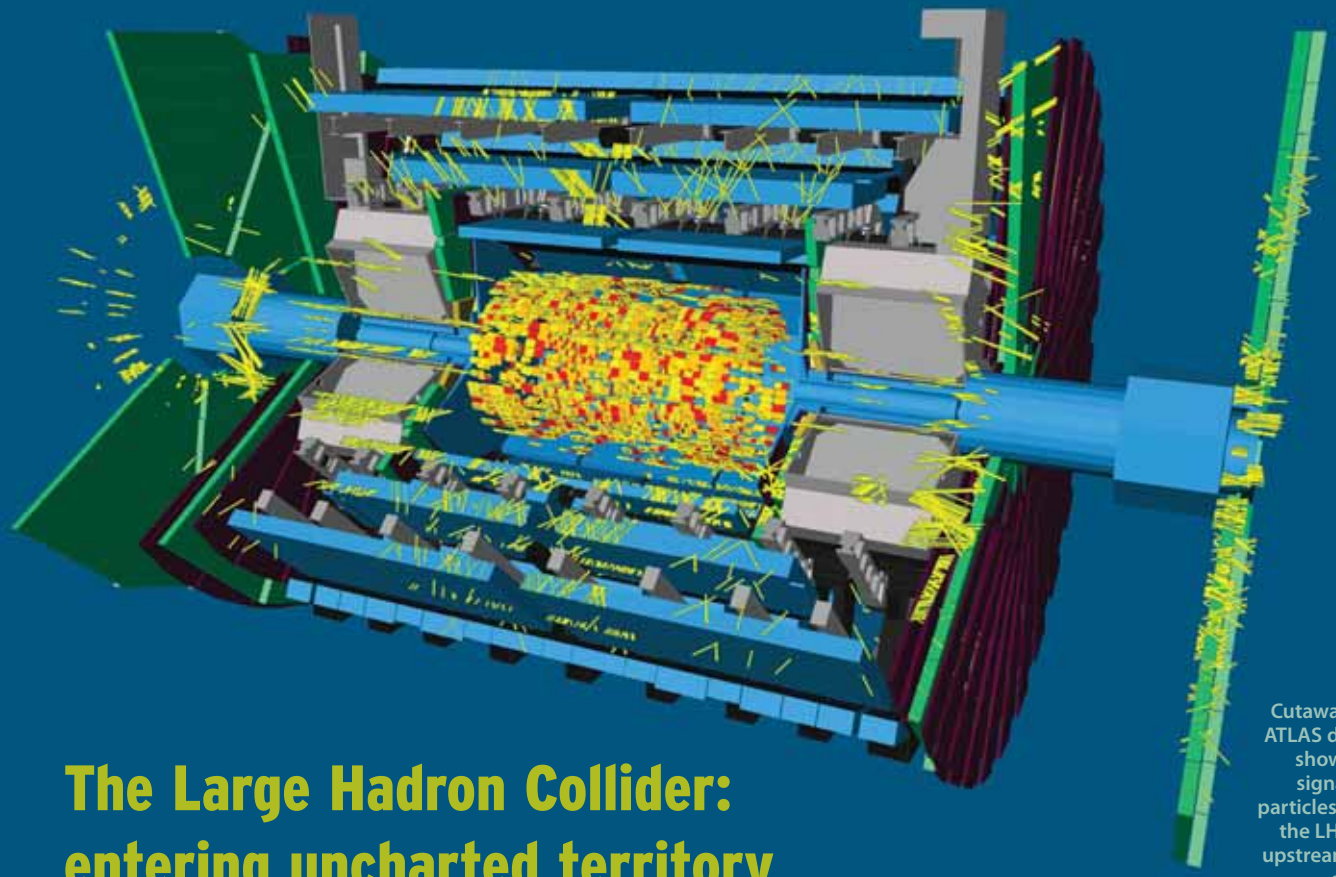
Understanding regional personality differences can inform our knowledge of what makes regional development tick – why it is that some regions prosper while others struggle. Social scientists have argued that technology, human capital and community are essential ingredients for economic and social prosperity. But it now appears that we have another set of useful ingredients with which to work. It will be informative to examine how the Big Five are distributed in other countries and whether the processes connecting traits and geographic indicators are similar.

Personality captures an individual's behavioural tendencies, emotionality and capacity to acquire new information. It has been shown to predict important life outcomes, such as occupational success, longevity and social connectedness. So it's not too far fetched for the aggregate personalities of thousands of individuals to play a significant role on a geographic scale. Indeed, it makes sense that more innovation and discovery occurs in places with high concentrations of intellectual people because pushing knowledge to the limit requires curiosity and imagination. It also makes sense that rates of disease and mortality are lower in places where people are emotionally stable because psychological health is a key determinant of physical health. But which came first?

This research, like most, raises more questions than it answers. Are regions like magnets, attracting certain people and repelling others? Or, are they like melting pots, infusing the beliefs, values and customs of their inhabitants? We don't yet know the answers to these questions, but the new geography of personality provides a map that may direct us to the answers.

Dr Jason Rentfrow

For more information, please contact Dr Jason Rentfrow (pjr39@cam.ac.uk) at the Department of Social and Developmental Psychology. Dr Rentfrow is also a member of the University's Psychometrics Centre.



THE ATLAS EXPERIMENT AT CERN HTTP://ATLAS.CH

Cutaway of the ATLAS detector, showing the signals from particles leaving the LHC beam upstream of the detector

The Large Hadron Collider: entering uncharted territory

The world's most expensive scientific instrument will be ready for full experiments in 2009; Andy Parker describes Cambridge's role in constructing and using the machine that hopes to understand the universe.

The Large Hadron Collider (LHC) is becoming a rare example of a scientific project that needs no introduction – the recent publicity when the machine was turned on has ensured a celebrity rating as high as the Hubble Space Telescope, perhaps even rivalling the latest reality TV show winners! But few perhaps understand the scale of the challenges posed by the project. Accelerating beams of protons to within a whisker of the speed of light, around a tunnel the size of London Underground's Circle Line, in a vacuum as empty as intergalactic space and colliding them together every 25 nanoseconds to re-create the conditions just after the universe was formed is just the start…

Hunting for Higgs

The scientific goals of the LHC are extremely ambitious – no less than the untangling of some of the longest standing mysteries of physics relating to the innermost structure of matter. One of the key endpoints is to determine, finally, whether the mass of fundamental particles is due to the long-sought-after Higgs mechanism. According to the Standard Model of particle physics, the Higgs mechanism explains how mass-less particles acquire mass and, for the theory to be correct, the hypothetical Higgs boson particle must be shown to exist.

The aim also is to search for phenomena beyond the Standard Model: seeking to explain why the universe contains so little antimatter; searching for supersymmetric particles, which may be a source of dark matter; and even exploring whether we live in a universe with hidden dimensions. With these advances, it may even be possible to create and study tiny black holes within the laboratory.

An extraordinary collaboration

The figures associated with the design, build and implementation of the LHC are truly spectacular: involving an estimated 3000 research scientists, at 300 universities, spread across 111 nations and with an approximate budget of £2.6 billion, it is officially the world's largest experiment.

Cambridge has been involved from the beginning, when Professor Andy Parker, now head of the High Energy Physics Group at the Cavendish Laboratory, attended the first meeting in 1989. Since then, with funding from the Science and Technology Facilities Council (STFC), a technical team has had responsibility for designing the silicon sensors used to measure particles emerging from the collisions. The team, led by Professor Janet Carter until September 2008 and now led by Professor Parker, also designed and built some of the complex electronics needed to read out the detectors, and is responsible for the software used to get the data safely recorded.

Data deluge

On 10 September 2008, the Cambridge physicists, along with a huge global audience, awaited the switching on of the particle beams at CERN (the European research laboratory in Switzerland) and the first successful

attempt to bring protons around the full circumference. Within a few days, the first collisions had been successfully recorded; however, a faulty electrical connection between two of the accelerator's magnets then temporarily halted further beams. The accelerator will be restarted in 2009 and Cambridge has been preparing for the deluge of data expected to flow out from the LHC.

Current estimates rate the data flow as fast enough to fill a DVD every 2.5 seconds. To absorb this tsunami of bytes, computers around the world have been linked into a 'Grid' of over 100,000 processors to crunch the data into meaningful information for the scientists to inspect. Data will cascade from the 'Tier 0' centre at CERN to 11 'Tier 1' centres based at national supercomputer institutes, and from there to 140 'Tier 2' centres, grouped into 38 federations covering 32 countries and hosted by universities like Cambridge. Users can submit their jobs to analyse the data to their local computers and the Grid software will automatically send the work to a computer anywhere in the world that can access the data needed and return the results. The user has seamless access to all the processors and a distributed datastore capable of holding 15 million gigabytes each year for the 15-year lifetime of the project. The Grid facility in Cambridge, known as CamGrid, is providing a powerful computational tool for university members not just in high-energy physics but also in many other departments.

To infinity and beyond

It is difficult to predict what will be discovered when the protons start colliding again at the LHC. But what is certain is that the results will transform our fundamental understanding of the universe. Hypotheses will be confirmed or dashed, exotic new particles and dimensions may be found; and, if we're lucky, we may discover something that not even the theorists have predicted.

Professor Andy Parker

For more information, please contact the author Professor Andy Parker (parker@hep.phy.cam.ac.uk) at the Cavendish Laboratory, Department of Physics.

Centre for Scientific Computing

High-level computing of the sort required to analyse data created by the LHC is embedded in many research activities in the physical and biomedical sciences. It might be driven by the ability to collect enormous datasets, such as for the LHC, or by a requirement to analyse huge gene banks or medical records as quickly as possible, or to process data delivered from satellites or environmental sensors.

In Cambridge, high-level computing resources have been brought together under the Centre for Scientific Computing (CSC) with the goals of linking research projects in diverse disciplines, encouraging the sharing of resources, consolidating intellectual activities and transferring skills.

CSC is a federated initiative that encompasses the **High-Performance Computing Service (HPCS)**, which is one of the largest academic supercomputers in the UK; the **eScience Centre**, which supports eScience projects involving scientists and industry using Grid-enabled applications (e.g. **CamGrid**) in the Cambridge region; and teaching at the MPhil level.

For more information, please contact CSC Director Professor Mike Payne (mcp1@cam.ac.uk).
Coming soon in Research Horizons: 'Supercomputing at the HPCS'.

CamGrid

CamGrid is a distributed computing resource in which the processing capacity of desktops or dedicated machines across the University is put to use at times when the machines lie idle. In operation since 2005, CamGrid now links spare capacity equivalent to approximately 1000 machines in 12 different departments.

As well as ramping up for the LHC, the data-sharing and massive processing capability of CamGrid has been used in multiple ways in Cambridge: by the Unilever Centre to explore the structure of molecules; by the Department of Earth Sciences to determine the properties of materials under the enormous pressures and temperatures at the Earth's core; and by the Department of Pathology for phylogenetic analyses to address how eukaryotic cells evolved from their prokaryotic ancestors.

For more information, please contact eScience Centre Director Mark Hayes (mah1002@cam.ac.uk).

SCOTT POLAR RESEARCH INSTITUTE

Freeze Frame: through the eyes of the polar explorers

Dr Wilson at the sunshine recorder; one of Herbert Ponting's photographs from Scott's British Antarctic Expedition, 1910–1913

An ambitious project is making accessible some of the most important visual resources for research into international polar exploration.

The Scott Polar Research Institute (SPRI) holds a unique photographic collection that documents over a century of journeys to the Arctic and Antarctica – two of the last great wildernesses on Earth. The archive is among the richest in the world for the study of polar environments but is extremely fragile, and for the past two years a team at SPRI have been working to capture and preserve over 20,000 of their photographic negatives. Now nearing completion, the JISC-funded project will be available online as Freeze Frame, opening up this unparalleled resource to those wishing to discover the history of polar exploration for themselves.

The heroic age

Spanning 1845–1982, the images represent the great wealth of history of exploration and embrace some of the most iconic photographs of their time: the men, their ships, sledges and skidoos; tents, huts and rations; equipment for survival and for scientific investigation; as well as stunning images of the Arctic and Antarctic landscapes.

The collection includes photographer Herbert Ponting's entire visual archive (some 1700 glass plates) taken on Captain Robert Falcon Scott's Expedition (1910–1913) to reach the South Pole. Also featured are images from Ernest Shackleton's valiant attempt in 1915 to achieve the first land-crossing of the Antarctic, and the only known daguerreotypes of Sir John Franklin and his crew, taken in 1845 prior to their fateful voyage in search of the Northwest Passage.

Promoting research

The collection provides a record of the living conditions and the scientific efforts of the men involved in polar exploration. This is an invaluable resource to researchers who are interested in exploring the history of extreme physiology and human endurance, such as Dr Vanessa Heggie from the Department of History and Philosophy of Science. Dr Heggie will be using the Freeze Frame materials as she starts work on a project examining the experiments and observations that were undertaken on various trips to the poles, since these were central to some of the earliest understandings of how the human body reacts to low temperatures. This type of research has diverse applications, from improving the provision of emergency medical aid during natural disasters to designing medical supervision for ultra-endurance sports.

Freeze Frame

Growing public interest in changes to the polar ice caps, as well as the forthcoming centenaries of the 'Heroic Age' expeditions, have provided the impetus for SPRI to promote research into its collections. In so doing, this visual archive will be accessible to a global audience, from schoolchildren in Nunavut and northern Greenland investigating their polar heritage, to university researchers with an interest in the development of polar technologies, physiology at low temperatures or the changing shape of the cryosphere.

Digitisation of related documents – personal journals and official expedition reports – will provide historical and cultural context. Many of the images are unpublished, having been rediscovered within private albums and personal collections. A series of interpretative web pages and e-learning resources will provide access to these hidden collections for all educational levels. The hope is that Freeze Frame will encourage users to discover polar environments through the eyes of those who dared to venture there.

MARTIN HARTLEY

Heather Lane

For further information, please contact the author Heather Lane (freezeframe@spri.cam.ac.uk), Librarian and Keeper of Collections, Scott Polar Research Institute. Freeze Frame (www.freezeframe.ac.uk) was funded by the Joint Information Systems Committee (JISC) and will be launched on 1 March 2009.

Dr Barbara Bodenhorn

At first glance, reasons for researching locations as different as the Arctic and Mexico are not self-evident. But comparison is at the core of Social Anthropology and, for Dr Barbara Bodenhorn, a dual focus on these remarkably different environments is shaping a cross-cultural exchange programme between young members of three indigenous communities.

Dr Barbara Bodenhorn, Newton Trust Lecturer in the Department of Social Anthropology, has an association with the Inupiat (Inuit) communities of the Alaskan Arctic that stretches back almost 30 years. Having lived and worked there, she returns often to learn how the Inupiat engage successfully with their environment – social, political and physical. Her current interests lie in how these communities perceive and adapt to environmental changes as they continue to work towards shaping their own futures.

Exploring these 'roots of success' extended to Mexico in 2004. A six-year interdisciplinary project was launched to explore environmental knowledge in forest communities with Dr Laura Barraza, a specialist in environmental education from the Universidad Nacional Autónoma de México, which funded the project. The researchers particularly focused on adolescents: their knowledge of the environment, their appreciation of community membership, and their sense of the future.

Since 2006 this project has expanded to include an innovative exchange programme, funded by the US National Science Foundation, between students from the North Slope of Alaska and two forest communities of Mexico. Recently back from taking the Alaskan students to Mexico for a month, Dr Bodenhorn is delighted with the foundational and transformative potential of the interchange: 'Through hands-on work with scientists and community elders, these young people gain new understanding of global processes, enrich their appreciation of their own local communities, and establish enduring bonds with young people whose worlds are very different from their own.' As well as providing students with unique learning opportunities, these 'temporary communities of knowledge' underpin an anthropological examination of how scientific research is simultaneously understood by scientists, local experts, teachers and students.

Have you ever had a Eureka moment?
Occasionally people make throwaway comments that stop you dead in your tracks (in fact these frequently become titles of my papers!). My first 'Aha!' moment happened in 1979 when an Inupiat whaler said that the whale 'gives itself up to the whaling Captain's wife'. The major stereotype of Eskimos is that they are the most male-dominated of hunter-gatherer groups and, yet, Inupiat whalers regard the whale as giving itself as a gift to the community via the Captain's wife. With this one comment, everything fell out of place and I realised my assumptions about hunting as well as gender had been wrong. As an anthropologist this is what I look for – what surprises me, what doesn't fit, what challenges received wisdom.

What's the best piece of advice you've ever been given?
That you have to be realistic about what it is you can know based on what you've learned. This was advice I was given by an Inupiat woman when I was writing a report and feeling the pressure to generalise. She brought me down to Earth by telling me not to get fussed about discovering the nature of the world, but instead to stay focused on being true to the information I had gathered.

If you could wake up tomorrow with a new skill, what would it be?
Recently I've thought that perhaps I'd like to be a volcanologist. All the regions I study are profoundly affected by seismic activity and I'm fascinated by volcanoes, in terms of what they can do and how people think about them.

What motivates you to go to work each day?
It's the thought that I am doing something in which it makes a difference that I'm the one who's doing it. I don't mean that to sound megalomaniac but to emphasise that I want my work to require something of who I am. You spend most of your life working, so it's vital that there's a real 'so what?' element to what you do. It's important to me that my relationships make a difference to what I'm doing. People in the Arctic communities know me as Barbara, who happens to be an anthropologist, and I think this must help my credibility when I talk to them. My research has always included local collaboration, with a specific goal that there is a local end benefit – whether it's facilitating environmental education classes taught by local folks, or promoting recognition of local expertise. The 'so what?' of it all is as much about what happens locally as whether I'll get a publication out of it.

What is your favourite research tool?
Mainly, it's being able to talk to people. But I think any kind of social science depends on the dedication to use as many tools as possible – combining personal in-depth interviews with listening to people, taking part in what they do, analysing census data and going into the archives to find letters written 100 years ago. What anthropology has to offer is the possibility of working in the same communities for years – as well as having the chance to work in a different part of the world altogether. With any luck, that means your initial impressions and assumptions will get dashed to bits!

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

The Economic and Social Research Council (ESRC) supports research from across the social sciences, from sociology to anthropology, through to statistics, methods and computing.

The ESRC's aim is to equip the UK with the knowledge and evidence needed to prosper in a demanding and unpredictable world: whether it's tackling economic and social problems, making the most of business opportunities, improving the impact of education strategies, or understanding global uncertainties.

A third of the ESRC budget (£56 million in 2007/2008) is allocated to postgraduate studentships, to strengthen future research by training the next generation of social scientists, and nearly two-thirds (£105 million in 2007/2008) is allocated to research.

Cambridge benefits from ESRC support across many departments. The two projects highlighted here are the Electricity Policy Research Group (EPRG) and the Gender Equality Network (GeNet). Other examples of some of the larger ESRC-funded projects in Cambridge include:

- A three-year, £1.1 million project is exploring the potential of emerging semantic web technologies to support teaching and learning. Jointly funded by the ESRC and the Engineering and Physical Sciences Research Council (EPSRC) under the Technology Enhanced Learning Programme, the 'Ensemble' project is led by Dr Patrick Carmichael in the **Centre for Applied Research in Educational Technologies (CARET)**.
- Issues of international collaboration, knowledge transfer and capacity building in biomedical science and bioethics are being addressed by a three-year study in the **Department of Social Anthropology** led by Professor Marilyn Strathern and Dr Monica Konrad. The ESRC has contributed £1.2 million to support the study.
- The Peterborough Adolescent and Young Adult Development Study, led by Professor Per-Olof Wikström in the **Institute of Criminology**, has been awarded £2.6 million over five years to contribute to a better understanding of the causes of young people's involvement in crime.
- A £2.5 million, five-year grant 'Conflict in Cities' led by Dr Wendy Pullan in the **Department of Architecture** is investigating how cities that have been torn apart by ethnic unrest or war may regenerate.
- The **Centre for Public Health Research Excellence in Diet and Physical Activity** at the Institute of Public Health is providing the evidence base for improving diet and physical activity across the population. Funding was provided under the umbrella of the UK Clinical Research Collaboration (UKCRC), a partnership of funders administered by the ESRC, which together have invested £20 million over five years to establish five Centres of Excellence in the UK.
- The **UK Innovation Research Centre (UK IRC)** is a recently announced collaborative venture between the Centre for Business Research at Judge Business School and Imperial College Business School to research into how innovation can make businesses more competitive. The Centre is part of a wider initiative that will receive £5 million over the next five years from its partner funders, which includes the ESRC.

For more information on these and other ESRC-funded projects, please visit www.esrcsocietytoday.ac.uk

Electricity Policy Research Group

Towards a sustainable energy economy

Research in the Electricity Policy Research Group (EPRG) is providing world-class analysis for an industry faced with major changes in the years ahead.

As global energy resources decline and concerns over climate change increase, how the UK and other countries produce and supply electricity has become of critical importance. In Cambridge, the EPRG is a focus for applied interdisciplinary research into the electricity supply industry.

The EPRG was launched in 2005 with £2.38 million funding under the joint UK Research Council initiative 'Towards a Sustainable Energy Economy (TSEC)', which is supported by the Economic and Social Research Council (ESRC), the

GeNet

Gender equality in modern times

The largest multidisciplinary research network of its kind in the UK is investigating why gender equality is still a pressing social issue in the 21st century.

The Gender Equality Network (GeNet) links academics from eight UK institutions who are conducting empirical research on gender equality. Funded since 2004 with £3 million from the Economic and Social Research Council (ESRC), the Network is coordinated by Professor Jackie Scott, from Cambridge's

Engineering and Physical Sciences Research Council (EPSRC) and the Natural Environment Research Council (NERC). The remit of this initiative is to find reliable, affordable, safe and low-carbon ways to supply the growing demand for energy.

Electricity policy research in Cambridge in fact stretches back to 1990, at the very start of the liberalised UK electricity industry. Since then, Cambridge researchers have benefited from almost two decades of support from the ESRC and, with the launch of the EPRG, have formed one of only three energy research groups in the UK to be awarded ESRC Research Group status, giving them the stability of five years of funding.

Professor David Newbery, Director of the EPRG, leads a core research team of 12 from the Department of Economics and Judge Business School. Together with PhD students and Associates from departments across Cambridge and other universities, the Group numbers in excess of 30.

The Group's contribution to the TSEC initiative addresses three key themes: delivering reliable and safe energy in a liberalised market (Professor Newbery and Dr Michael Pollitt); investigating the benefits of strategically deploying new low-carbon energy technologies and the economic impact of carbon emission policies (Dr Karsten Neuhoff); and researching social and political attitudes to energy policy, as well as governance processes (Drs William Nuttall and David Reiner).

A key component of the Group's research – the 'feet-on-the-ground' aspect as Professor Newbery puts it – is engagement with stakeholders through the Energy Policy Forum, directed by Dr Pierre Noël. By bringing together academics with leaders in the electricity industry, regulators and policy makers, the Forum encourages the identification of real-world problems and plausible solutions.

Commenting on the EPRG, Professor Newbery said: 'We are delighted to have been given this extraordinary opportunity to contribute to a major UK initiative. It allows us to engage in and influence an energy policy debate that will have impact for the next 50 years.'

Professor David Newbery

For more information, please contact Professor David Newbery (david.newbery@econ.cam.ac.uk; www.eprg.group.cam.ac.uk).

Department of Sociology in the Faculty of Social and Political Sciences.

'Society today is witnessing an ongoing paradigm shift in gender relations,' said Professor Scott. 'We have gone beyond the male breadwinner/female homemaker post-war family. Dramatic changes have taken place in the workforce and enormous progress has been made in policy, but a gap remains in women's attainment in the world of paid work, and this relates to the unequal division of unpaid work in the home.'

Nine projects funded through the Network ask questions such as why has the gender wage gap proved so difficult to overcome? Do women who play an equal role in the workforce do so at the expense of family life? How have career paths for men and women changed across the generations? What are young people's aspirations for gender equality? How do families trade off conflicts between time and money? What steps have corporations taken to support equity goals?

In Cambridge, Professor Simon Deakin, Programme Director in the Centre for Business Research at Judge Business School, is addressing gender inequality through progressive human resource management in the workplace. And Professor Scott is examining shifts in public opinion about women's work–family balance.

'I'm a tremendous fan of Network grants,' said Professor Scott. 'From the very start, all members bought into the goal of talking to each other, informing each other's work and contributing to joint outputs. The Network has given us the critical mass and diverse expertise needed to create a really strong factual understanding of gender equalities, what choices we make as adults, and how we might shape our children's lives at the start of the 21st century.'

Professor Jackie Scott

For more information, please contact Professor Jackie Scott (jls1004@cam.ac.uk; www.genet.ac.uk).

NEWS FROM RESEARCH SERVICES DIVISION

Research Horizons is now online!

An online version of Research Horizons went live last month – providing you with a fully searchable archive of the material we've published during the past two years. With links between articles and external resources, Research Horizons Online is a rapid and user-friendly means of accessing information about research across the University of Cambridge.

Professor Ian Leslie, Pro-Vice-Chancellor for Research, commented: 'The University recognises how important it is to provide an accessible and lively means of promoting the breadth and depth of its research to our many sponsors, industry, government, other academics and the general public. By launching the magazine online, we can bring the latest research to a global audience and provide a resource for those interested in discovering what cutting-edge research at Cambridge has to offer.'

Martin Reavley, Director of RSD, added: 'We view showcasing the excellence of the University's research capabilities to an external audience as an important component of our activities in RSD. It's a natural extension of our role in helping academics to find, secure and manage research funding and form partnerships with industry.'

Please visit Research Horizons Online at www.research-horizons.cam.ac.uk and let us know what you think.

New Director of RSD

Martin Reavley became Director of RSD on 1 October 2008. Prior to this appointment he had been the First Bursar of King's College. Since graduating in Modern Languages from King's in 1976, he has held several financial posts in commerce, including a position as Finance Director with Kesa Electricals plc. Edna Murphy, who served as Acting Director for the past two years, is now Deputy Director.

NEWS FROM CAMBRIDGE ENTERPRISE LTD

A novel way to model endometriosis

A recently patented invention holds promise for understanding a debilitating disease that affects two million women in the UK.

Modern women will on average experience a total of 400 menstrual cycles. This is an unnatural state for women, as Dr Stephen Charnock-Jones, from the Department of Obstetrics and Gynaecology, explained: 'The natural state for woman during the child-bearing years is either pregnant or lactating. It is only with the introduction of birth control and a decrease in infant mortality that a modern woman can control her fertility and also expect to see her children reach adulthood.'

For many women, this increase in menstrual cycles is associated with additional distress due to endometriosis, a disease in which endometrial tissue – the lining of the uterus – also occurs outside the uterine cavity, most commonly within the pelvis. Endometriosis is found at a higher frequency in patients presenting with infertility.

The wide range of symptoms make it difficult either to define the underlying cause or to identify a model that drug companies could use to develop drugs. Ethical considerations limit research in humans and primates; although some mouse models exist, each has significant limitations and, as a result, disease studies are difficult to undertake and results are hard to interpret.

Dr Charnock-Jones and colleagues have generated a novel endometriosis allograft mouse model, recently patented through Cambridge Enterprise Ltd, in which cells are sourced from a genetically modified mouse and transplanted into another mouse. After implantation, the hormone-treated endometrial tissue grows and the recipient mouse develops characteristic endometriosis lesions and associated blood vessels.

For the first time, this model of endometriosis reproduces the mechanism that is thought to underlie the human disease, allowing scientists to investigate the cellular and molecular mechanisms responsible. This is a significant step forward as the model will help in the screening and development of new therapeutics.

A solution will not be found overnight. The condition imposes a significant burden on the sufferer because surgical and medical treatments are only moderately effective. However, for the millions of women who suffer worldwide, there is now a glimmer of hope.

If you are an employee of the University and would like advice on the patentability and commercial opportunities for your invention, please contact Cambridge Enterprise (Tel: +44 (0)1223 760330; email: enquiries@enterprise.cam.ac.uk; www.enterprise.cam.ac.uk).

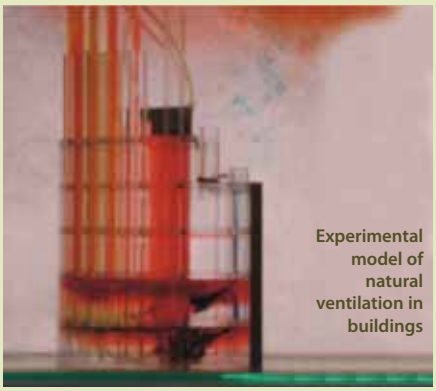
FORTHCOMING EVENTS: SAVE THE DATES!

9–22 March 2009

'Centuries of Science'
Cambridge Science Festival

The Cambridge Science Festival 2009 celebrates centuries of Cambridge science as part of the University's 800th Anniversary year. A series of free events will encompass science and technology past, present and future, including hands-on family fun and a lecture series for adults. Family events include the ever popular 'Crash, Bang Squelch' in which students from CHaOS demonstrate over 50 experiments. The Festival also hosts a 'Superheroes of Science' musical lecture with the Intercontinental Music Lab singing songs about scientists with lots of surprises. Festival speakers include David MacKay, Ben Goldacre and David Spiegelhalter.

The full programme will be available at www.cambridgescience.org from January 2009, or please email csf@admin.cam.ac.uk to request a printed programme.



Experimental model of natural ventilation in buildings

PROFESSOR ANDY WOODS, BP INSTITUTE

17–18 March 2009

'Building Physics and the Sustainable City'
Department of Engineering, Cambridge

By the middle of the century, it is expected that two-thirds of the world's population will live in urban areas. What are the implications of this rapid urbanisation? How can urban planners cope with this growth? What environmental, institutional, social and cultural issues need to be addressed to ensure that we create truly sustainable cities? A two-day conference at the Department of Engineering in Cambridge aims to examine how engineering can shape the architectural and urban forms of the future.

Please visit www.rsd.cam.ac.uk/events/buildingphysics or email rsdevents@rsd.cam.ac.uk for further information.

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1 April 2009

Horizon Seminar 'Reproductive Health'
Centre for Mathematical Sciences, Cambridge

Improving our fundamental understanding of reproductive health, and translating these basic insights into clinical intervention, has enormous potential to impact positively on the rest of society. The past 50 years have seen many societal and technological changes in this field. This Horizon Seminar will showcase the latest University research on epigenetics, the fetal origins of disease, placental biology and reproductive medicine. By exploring factors that influence the growth and development of the fetus, the Seminar will examine how what happens before birth can continue to affect our health and well-being throughout adult life.

Please visit www.rsd.cam.ac.uk/events/reproductivehealth or email horizon@rsd.cam.ac.uk for further information.

5–10 July 2009

The Darwin 2009 Festival

This year is the bicentenary of Charles Darwin's birth and the 150th anniversary of the publication of his seminal work *On the Origin of Species*. This Festival is a tribute to one of the world's most influential scientists: it will be a celebration of the science, society, literature, history, philosophy, theology, art and music arising from the writings, life and times of Charles Darwin. Talks, exhibitions and workshops will explore the past, present and future of the natural world in the light of evolutionary understanding. Festival speakers include Sir David Attenborough, Richard Dawkins, Ian McEwan and Dame Gillian Beer.

Please visit www.darwin2009.cam.ac.uk for full details of events and to book tickets.

Your way into Cambridge

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Research Horizons Online: www.research-horizons.cam.ac.uk

Are there areas of research that you would like to see covered in Research Horizons? We welcome suggestions, feedback and comments: please send ideas to the Editor at research.horizons@rsd.cam.ac.uk